Using the Apama Studio Development Environment

5.3.0

May 2015

This document applies to Apama 5.3.0 and to all subsequent releases.

Specifications contained herein are subject to change and these changes will be reported in subsequent release notes or new editions.

Document ID: PAM-Using_the_Apama_Studio_Development_Environment-5.3.0-20150518@254863

Table of Contents

Preface

Apama Studio is an integrated environment for developing Apama applications. The process of developing an Apama application is centered around an Apama *project*. This manual describes how to create projects and add the various Apama resources that make up an application. The information in this book is organized as follows:

- "Overview of Developing Apama Applications" on page 11 describes Apama Studio's integrated environment for developing Apama applications.
- "Working with Projects" on page 27 describes how to create and configure projects, add resources to them, and launch applications from them.
- "Using Query Designer" on page 83 provides information about implementing Apama query applications.
- "Launching Projects" on page 104 describes how to create launch configurations projects.
- "Debugging EPL Applications" on page 127 describes how to use Apama Studio to debug applications written in the Apama Event Processing Language (EPL). Beginning with Release 4.3, Event Processing Language is the new name for MonitorScript.
- "Debugging JMon Applications" on page 136 describes how to use Apama Studio to debug Apama applications written in JMon.
- "Profiling EPL Applications" on page 148 describes how to use Apama Studio to collect profiling data for applications written in EPL.
- "Using the Data Player" on page 160 describes how to play back previously saved event data as you develop your application.

Documentation roadmap

On Windows platforms, the specific set of documentation provided with Apama depends on whether you choose the Developer, Server, or User installation option. On UNIX platforms, only the Server option is available.

Apama provides documentation in three formats:

- HTML viewable in a Web browser
- PDF
- Eclipse Help (if you select the Apama Developer installation option)

On Windows, to access the documentation, select Start > All Programs > Software AG > Apama 5.3 > Apama Documentation . On UNIX, display the `index.html` file, which is in the `doc` directory of your Apama installation directory.

The following table describes the PDF documents that are available when you install the Apama Developer option. A subset of these documents is provided with the Server and User options.

Title	Description
Release Notes	Describes new features and changes since the previous release.
Installing Apama	Instructions for installing the Developer, Server, or User Apama installation options.
Introduction to Apama	Introduction to developing Apama applications, discussions of Apama architecture and concepts, and pointers to sources of information outside the documentation set.
Using the Apama Studio Development Environment	Instructions for using Apama Studio to create and test Apama projects, develop EPL programs, define Apama queries, develop JMon programs, and store, retrieve and play back data.
Developing Apama Applications	Describes the different technologies for developing applications: EPL monitors, Apama queries, Event Modeler, and Java. You can use one or several of these technologies to implement a single Apama application. In addition, there are C++, C, and Java APIs for developing components that plug-in to a correlator. You can use these components from EPL.
Connecting Apama Applications to External Components	Describes how to connect Apama applications to any event data source, database, messaging infrastructure, or application. The general alternatives for doing this are as follows: • Implement standard Apama Integration Adapter Framework (IAF) adapters. • Create applications that use correlator-integrated messaging for JMS or Software AG's Universal Messaging • Develop adapters with Apama APIs for Java and C++. • Develop client applications with Apama APIs for Java, .NET, and C++.
Building and Using Dashboards	Describes how to build and use an Apama dashboard, which provides the ability to view and interact with scenarios and DataViews. An Apama project typically uses one or more dashboards, which are created in the Dashboard Builder. The Dashboard Viewer provides the ability to use dashboards created in Dashboard Builder. Dashboards can also be deployed as simple Web pages, applets, or WebStart applications. Deployed dashboards connect to one or more correlators by means of a Dashboard Data Server or Display Server.
Deploying and Managing Apama Applications	Describes how to use the Management & Monitoring console to configure, start, stop, and monitor the correlator and adapters across multiple hosts. Also provides information for:

Title	Description
	• Improving Apama application performance by using multiple correlators and saving and reusing a snapshot of a correlator's state. • Managing and monitoring over REST (REpresentational State Transfer). • Using correlator utilities.
Using the Dashboard Viewer	In a User installation of Apama, this document describes how to view and interact with dashboards that are receiving run-time data from the correlator. In the Developer and Server installations, this information is included in *Building and Using Dashboards*.

Preface

Contacting customer support

You may open Apama Support Incidents online via the eService section of Empower at http://empower.softwareag.com. If you are new to Empower, send an email to `empower@softwareag.com` with your name, company, and company email address to request an account.

If you have any questions, you can find a local or toll-free number for your country in our Global Support Directory at https://empower.softwareag.com/public_directory.asp and give us a call.

Preface

Chapter 1: Overview of Developing Apama Applications

Apama Studio is an integrated environment for developing Apama applications. The process of developing an Apama application is centered around an Apama *project*. In Apama Studio you create a project and then use Apama Studio to:

- Create new Apama resources for the application
- Include standard, pre-packaged Apama resources
- Include existing Apama resources from other projects or applications
- Specify configuration properties necessary for launching the application
- Run and monitor the application
- Export the initialization information necessary for deploying the application

When you add resources to your application, Apama Studio creates the resource’s metadata and launches the appropriate editor where you add the code to implement its behavior. As you create the resource’s application code, Apama Studio automatically validates it. Where necessary, Apama Studio launches the Apama tool such as Query Designer, Event Modeler or Dashboard Builder that is appropriate to the specific resource being added.

Samples and tutorials

Apama Studio is packaged with several sample programs and tutorials. These are available from the Apama Welcome screen, which is displayed when you start Apama Studio for the first time and which is always available by selecting Help > Welcome from the Apama Studio menu. From the Welcome screen click Samples or Tutorials and then click Apama Samples or Apama Tutorials.

The Apama samples are demonstration applications that illustrate some of the features and capabilities of the Apama platform; they include dashboards in which you can interact with the application and readme files that describe what the application does, what files make up the project, and how you might modify the application. Use the demonstration applications to gain an overview of what goes into an Apama project and what some common Apama applications can do.

The tutorials are interactive instructions that get you quickly up to speed writing Event Processing Language programs, creating scenarios, defining reusable blocks for use in scenarios, and creating dashboards that provide the user interface to scenarios. Each tutorial provides a skeleton project and a completed project. At the end of the tutorial instructions, you run the project.

When you open a sample or a tutorial for the first time, it is *copied* into the Eclipse workspace. You can revert to the original sample or tutorial without any changes you've made at any time by deleting the project as follows:

1. Right-click the project.

2. Click Delete.

3. Select Also delete contents in the confirmation dialog and click Yes.

Then open the project again from the Tutorials or SamplesWelcome page.

Overview of Developing Apama Applications

The Apama interface

Apama Studio is an Eclipse plug-in and using it is similar to working in other Eclipse development perspectives.

Apama Studio provides the following distinct perspectives for working with projects:

- "The Apama Workbench perspective" on page 13
- "The Apama Developer perspective" on page 15
- "The Apama Runtime perspective" on page 16

In each of the perspectives, you can create projects, add Apama resources, and launch your application. While developing your application, you can switch from one perspective to the other.

When you debug an Apama application, by default Apama Studio switches to the Eclipse **Debug** perspective. See

When profiling an Apama application written in the Apama Event Processing Language (EPL), Apama Studio uses the **Apama Profiler** perspective. See "The Apama Profiler perspective" on page 151. (Beginning with Apama 4.3, "Apama Event Processing Language" is the new name for MonitorScript.)

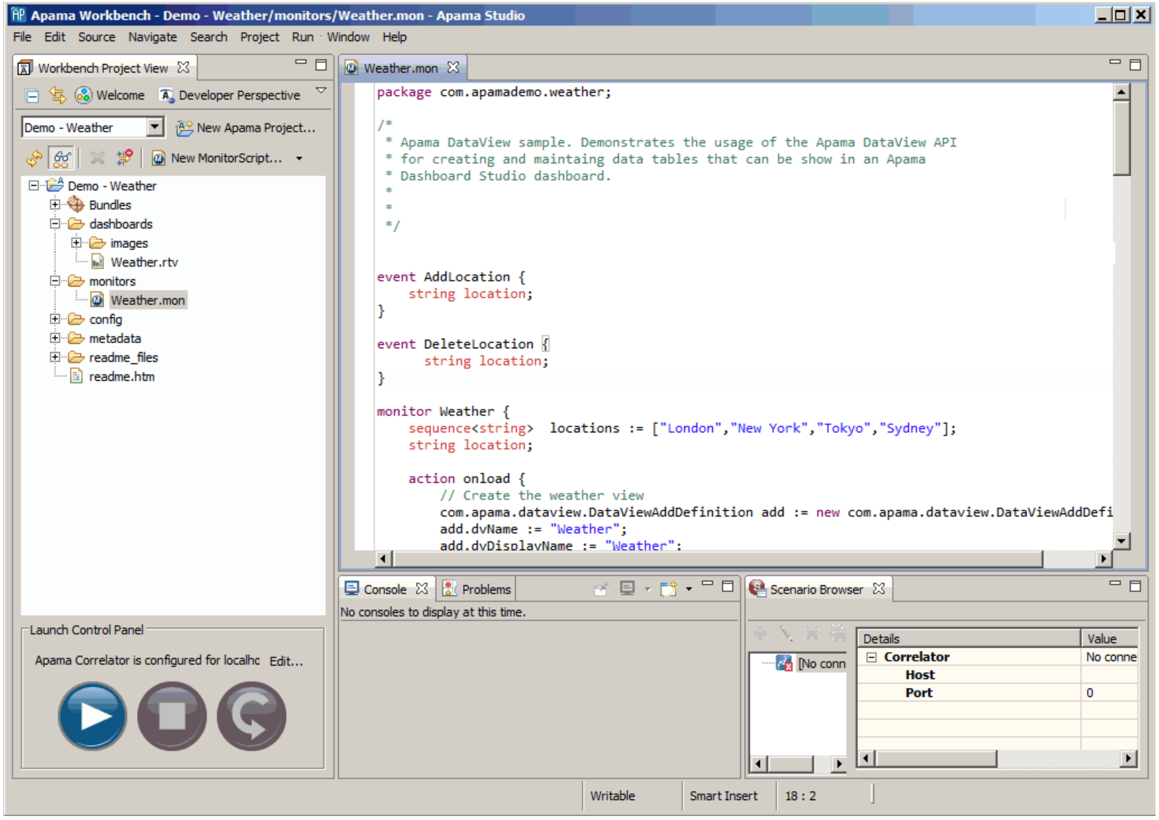
Note: When using any of the Apama perspectives, you can redisplay the default perspective layout by selecting Window > Reset Perspective from the Apama Studio menu.

Caution: The recommended installation folder is `Program Files`, which is a protected location on recent Microsoft Windows operating systems. These include the client operating systems Windows 7 and Windows 8.1, and the server operating systems Windows Server 2008 R2 and Windows 2012 R2. To write to the `Program Files` folder, you must run the Apama installer with Administrative privileges. After Apama installation, if you want to add additional plug-ins to Eclipse, you can run the Eclipse plug-in installer or use the Eclipse Check for Updates facility but you must have Administrative privileges when you install the Eclipse plug-in. Lack of Administrative privileges might cause the plug-in installation to fail or become corrupt. Adiministrative privileges are required because Eclipse also installs its plug-ins in the protected `Program Files`s folder. Alternatively, you can choose to install Apama in a non-recommended location outside the `Program Files` folder.

Overview of Developing Apama Applications

The Apama Workbench perspective

The **Workbench** perspective presents a more streamlined view of a single Apama project. It shows only the resources related to that project and provides a simplified way of launching an Apama application.



```
package com.apamademo.weather;

/*
 * Apama DataView sample. Demonstrates the usage of the Apama DataView API
 * for creating and maintaing data tables that can be show in an Apama
 * Dashboard Studio dashboard.
 *
 *
 */


event AddLocation {
    string location;
}

event DeleteLocation {
      string location;
}

monitor Weather {
    sequence<string>  locations := ["London","New York","Tokyo","Sydney"];
    string location;

    action onload {
        // Create the weather view
        com.apama.dataview.DataViewAddDefinition add := new com.apama.dataview.DataViewAddDefi
        add.dvName := "Weather";
        add.dvDisplayName := "Weather";
```

No consoles to display at this time.

Details	Value
Correlator	No conne
Host	
Port	0

The important interface components of the **Apama Workbench** perspective are:

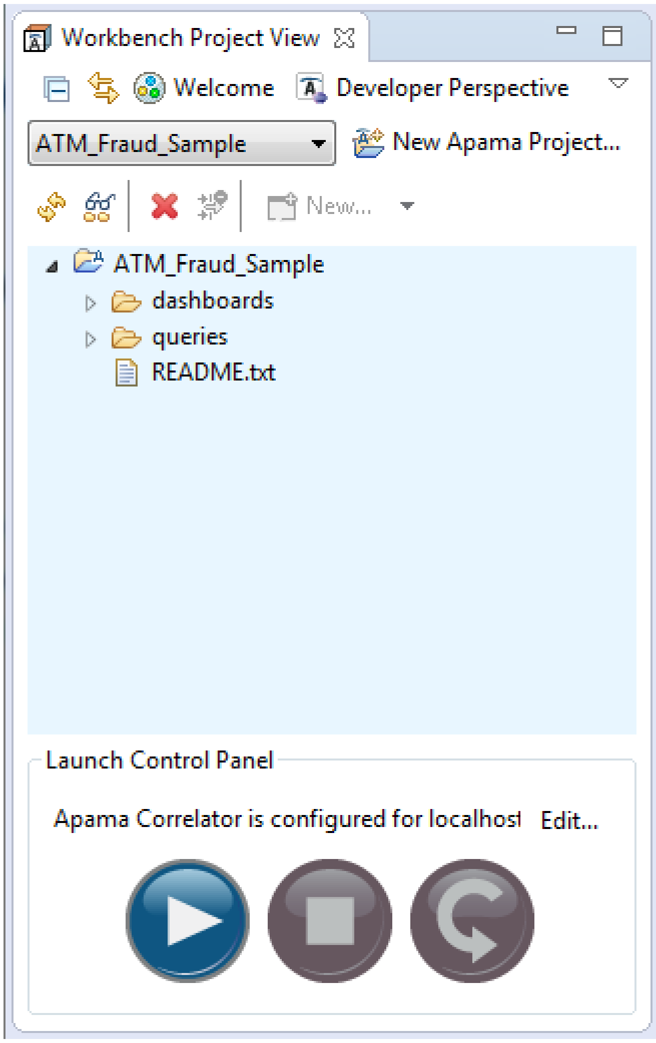
- "Workbench Project view" on page 13
- "Editors" on page 19
- "Scenario Browser view" on page 20
- "Console view" on page 23
- "Problems view" on page 24

Overview of Developing Apama Applications

Workbench Project view

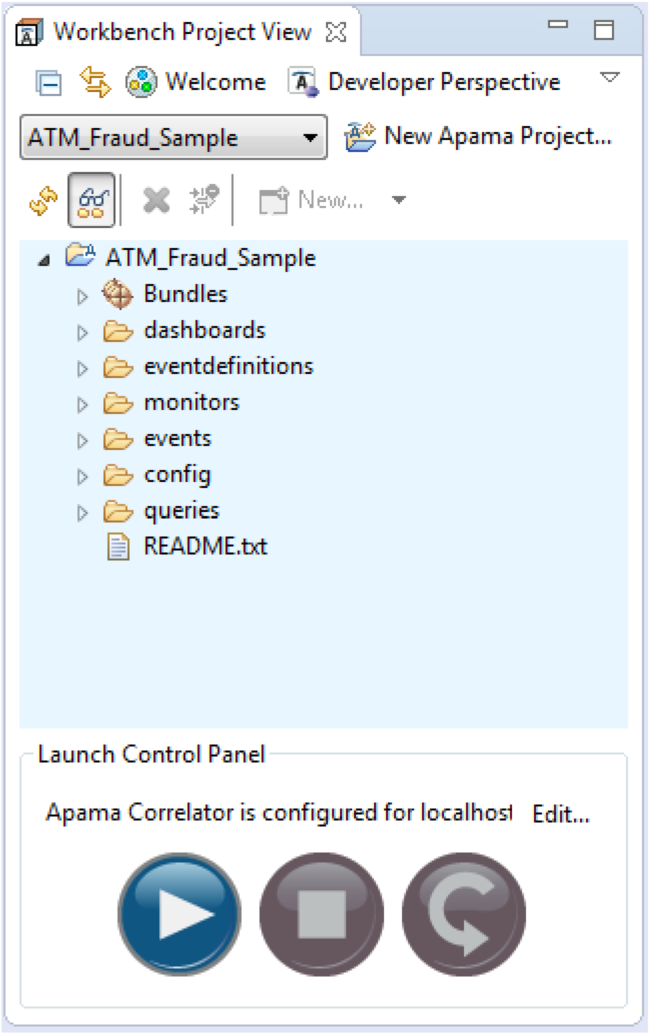
When you develop an application in the **Apama Workbench** perspective, you work on a single project at a time. The project is displayed in the **Workbench Project** view. This is where you add the various Apama resources that are necessary for the application. This is also where you run the application that is represented by the project.

When viewing a project in the **Workbench** perspective you can use the Show All Folders icon to toggle between a displaying a limited view of the project's resources and displaying all of the project's resources. In the limited view, below, Apama Studio displays any dashboard, event files, query, and scenario resources:



Apama Correlator is configured for localhost

Clicking the Show All Folders icon displays an expanded view that lists the Event Processing Language (EPL) files and other file types, such as Bundles, block files, and function files used in the project as shown below.

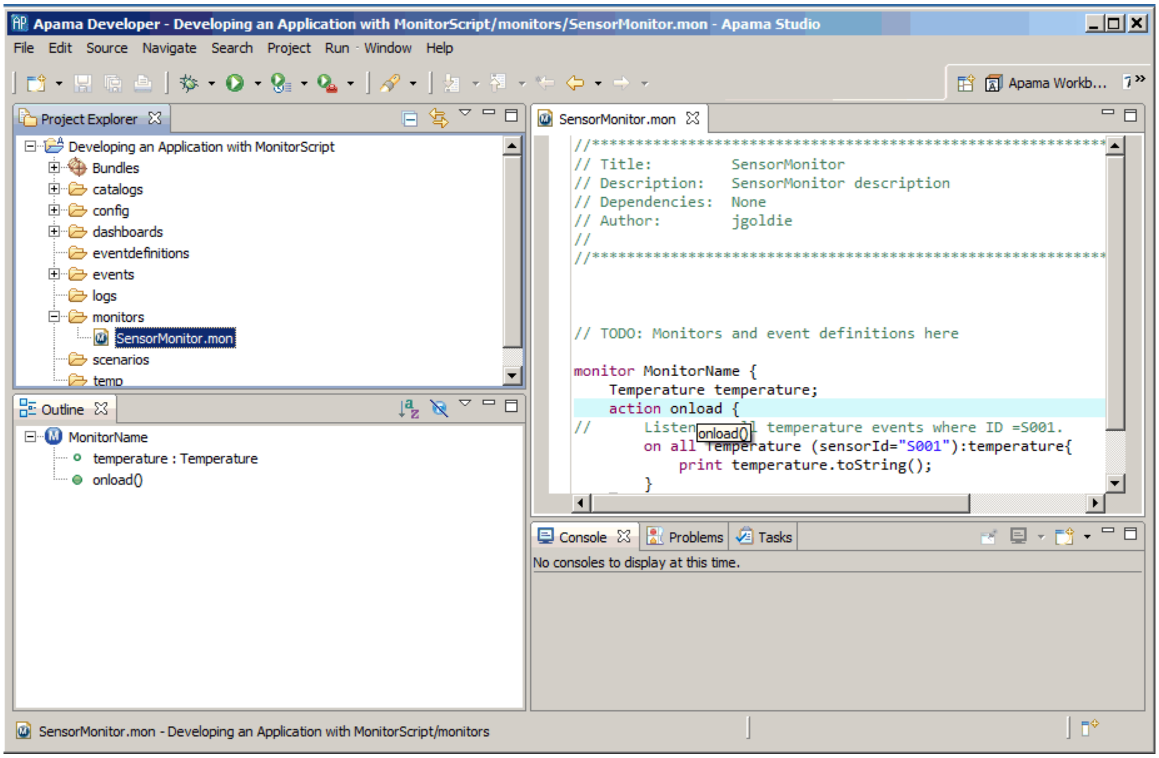


Apama Correlator is configured for localhost

The Apama Workbench perspective

The Apama Developer perspective

The **Apama Developer** perspective uses the full Eclipse interface and displays all the Apama projects in the user's workspace. It is designed for experienced developers and assumes that you are familiar with standard Eclipse features.


Apama Developer - Developing an Application with MonitorScript/monitors/SensorMonitor.mon - Apama Studio
File Edit Source Navigate Search Project Run Window Help
Apama Workb...
Project Explorer
Developing an Application with MonitorScript
Bundles
catalogs
config
dashboards
eventdefinitions
events
logs
monitors
SensorMonitor.mon
scenarios
temp
Outline
MonitorName
temperature : Temperature
onload()
SensorMonitor.mon
Console
Problems
Tasks
SensorMonitor.mon - Developing an Application with MonitorScript/monitors

```
//*************************************************************
// Title:         SensorMonitor
// Description:   SensorMonitor description
// Dependencies:  None
// Author:        jgoldie
//
//*************************************************************



// TODO: Monitors and event definitions here

monitor MonitorName {
    Temperature temperature;
    action onload {
//      Listen onload() l temperature events where ID =S001.
        on all Temperature (sensorId="S001"):temperature{
            print temperature.toString();
        }
```

No consoles to display at this time.

The important interface components of the Developer perspective are:

- "Project Explorer view" on page 16
- "Console view" on page 23
- "Outline view" on page 20
- "Problems view" on page 24
- "Editors" on page 19

Overview of Developing Apama Applications

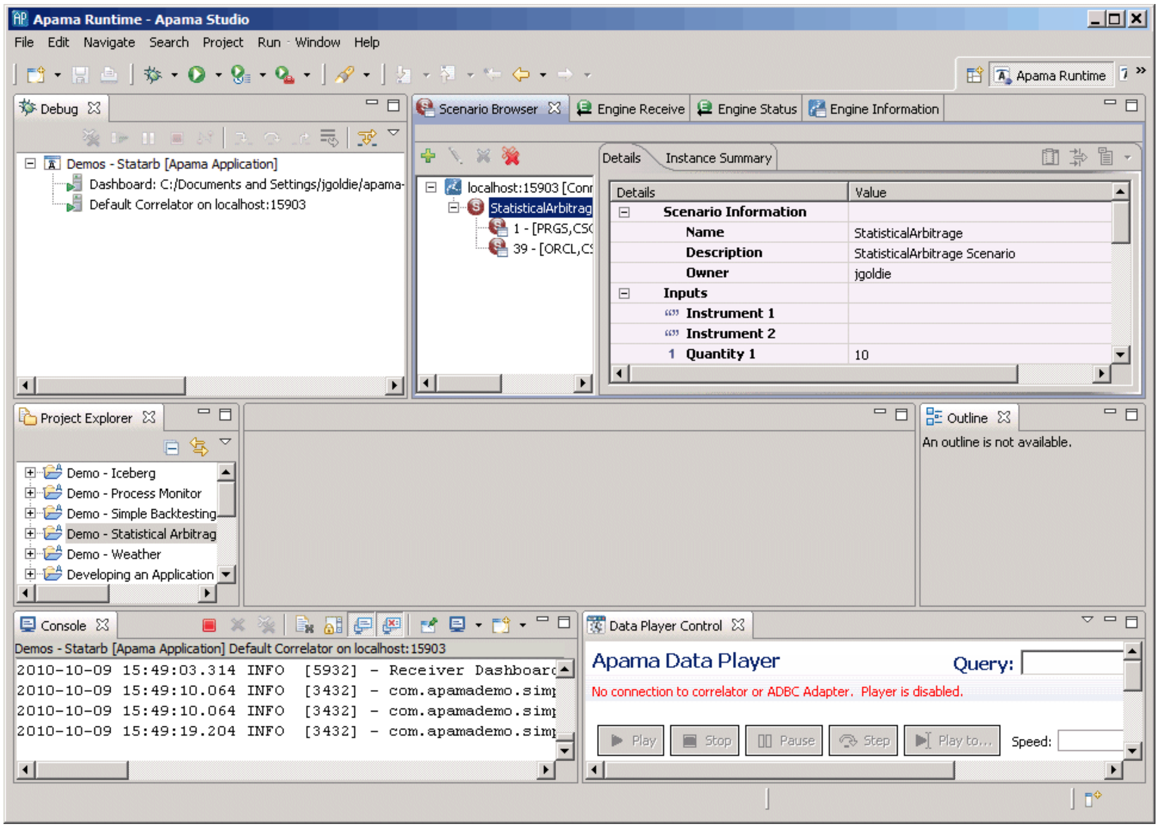
Project Explorer view

The **Apama Developer** perspective uses the standard Eclipse **Project Explorer** view. This view is at the center of the process of developing an application in Apama Studio. This is where you add and manage all the Apama resources that are necessary for the application. The **Project Explorer** view is where you build and launch your projects.

The Apama Developer perspective

The Apama Runtime perspective

The **Apama Runtime** perspective is similar to the **Apama Developer** perspective but is designed for inspecting and interacting with a running Apama application. This perspective is designed for experienced developers and assumes that you are familiar with standard Eclipse features.


Apama Runtime - Apama Studio
File Edit Navigate Search Project Run Window Help
Apama Runtime
Debug
Demos - Statarb [Apama Application]
Dashboard: C:/Documents and Settings/jgoldie/apama-
Default Correlator on localhost:15903
Scenario Browser
Engine Receive
Engine Status
Engine Information
localhost:15903 [Conr
StatisticalArbitrag
1 - [PRGS,CSC
39 - [ORCL,CS
Details
Instance Summary
Project Explorer
Demo - Iceberg
Demo - Process Monitor
Demo - Simple Backtesting
Demo - Statistical Arbitrag
Demo - Weather
Developing an Application
Outline
Console
Demos - Statarb [Apama Application] Default Correlator on localhost:15903
Data Player Control
Apama Data Player
Query:
Play
Stop
Pause
Step
Play to...
Speed:

Details	Value
Scenario Information	
Name	StatisticalArbitrage
Description	StatisticalArbitrage Scenario
Owner	jgoldie
Inputs	
Instrument 1	
Instrument 2	
Quantity 1	10

An outline is not available.

```
2010-10-09 15:49:03.314 INFO  [5932] - Receiver Dashboarc
2010-10-09 15:49:10.064 INFO  [3432] - com.apamademo.simp
2010-10-09 15:49:10.064 INFO  [3432] - com.apamademo.simp
2010-10-09 15:49:19.204 INFO  [3432] - com.apamademo.simp
```

No connection to correlator or ADBC Adapter. Player is disabled.

To use the **Apama Runtime** perspective:

1. Select Window > Open Perspective > Other from the Apama Studio menu.
2. Select Apama Runtime from the **Open Perspective** dialog.
3. Click OK.

The Apama Runtime perspective is made up of these views:

- "Project Explorer view" on page 16
- "Scenario Browser view" on page 20
- "Engine Receive view" on page 21
- "Engine Status view" on page 22
- "Engine Information view" on page 23
- "Outline view" on page 20
- "Console view" on page 23
- "Problems view" on page 24
- "Data Player Control view" on page 24

Overview of Developing Apama Applications

About Apama projects

An Apama project typically manages a single Apama application. A project provides a means of keeping the application's resources organized. In the process of developing an application with Apama Studio, you add the various resources that make up the application to the project. For example, you can include:

- EPL files — These files define *monitors* and associated *event types* that are used by your application. EPL files have a `.mon` extension.
- Query files — These files define Apama *queries*. Queries process only the event types that you specify. Query files have a `.qry` extension.
- JMon Monitor files — These Java source files define *monitors* for Apama applications written in Java.
- JMon Event files — These Java source files define *event types* for Apama applications written in Java.
- Scenario definition files — If your application uses scenarios, you specify the new scenario in Apama Studio. This adds a *scenario definition file* to your project and opens the new scenario in Apama Studio's Event Modeler editor where you specify its behavior. Scenario definition files have a `.sdf` extension.
- Dashboard definition files — If your application uses dashboards, you specify the new dashboard in Apama Studio. This adds a *dashboard definition file* to your project and opens the new dashboard in Apama's Dashboard Builder. Dashboard definition files have an `.rtv` extension.
- Bundles — These are pre-packaged collections of Apama objects.
- Event files — Event files have an `.evt` extension.
- Block definition files — If your application uses scenarios and, in addition to the standard blocks packaged with Apama, you need to create customized blocks, you create the block in Apama Studio. This adds a *block definition file* to your project. Block definition files have a `.bdf` extension.
- Function definition files — If your application uses scenarios and, in addition to the standard functions packaged with Apama, you need to create customized functions, you create the function in Apama Studio. This adds a *function definition file* to your project. Function definition files have a `.fdf` extension

Apama Studio provides a variety of ways to manage and interact with the resources in your application's project.

This section briefly describes these Apama Studio features. For more information on how to use them, see "Working with Projects" on page 27 and "Launching Projects" on page 104.

Overview of Developing Apama Applications

Managing project hierarchies

Apama Studio organizes your project into a hierarchy that is displayed in the **Project Explorer** view (if you are using the Developer perspective) or the **Workbench Project** view (if you are using the Workbench perspective). The hierarchy is made up of folders that group Apama resource files by type. The **Project Explorer** view lists all your Apama projects, while the Workbench Project view lists just the current project. Apama Studio displays a different icon for each type of resource file:

- indicates an Apama project.
- indicates a bundle.
- indicates an EPL (`.mon`) file.
- indicates an Apama project.
- indicates an Apama query (`.qry`) file.
- indicates an EPL plug-in written in Java (`.java`) file.
- indicates an event (`.evt`) file.
- indicates a scenario (`.sdf`) file.
- indicates a scenario block (`.bdf`) file.
- indicates a scenario function (`.fdf`) file
- indicates a dashboard (`.rtv`) file.
- indicates a correlator deployment package (`.cdp`) file.

If a monitor, query or scenario file contains an error, Apama Studio displays an error icon over the file name, over the folder that contains the file that has the error, and over the project folder. For example, a scenario file that contains an error would look like this: count-days-example.sdf .

About Apama projects

Editors

Apama Studio provides wizards and editors to create and modify the resource files that define the following:

- Monitors
- Queries
- Events
- Blocks
- Functions
- Scenarios
- Dashboards

When you add a resource, Apama Studio generates the definition file and opens it in the appropriate Apama editor.

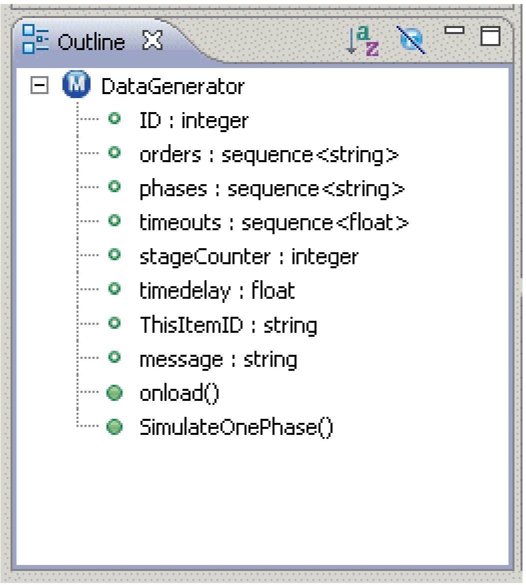
Note: When you add or edit a dashboard, Apama Studio creates the dashboard's definition file and opens the Apama Dashboard Builder in a separate window.

As you edit resource files, you can take advantage of the Apama Studio editing features, including content assistance, auto-bracketing, templates for frequently entered constructs, and problem detection. After you build an Apama project, Apama Studio flags each line that contains an error.

About Apama projects

Outline view

The **Outline** view shows the structure of the EPL or block file that is open in an Apama editor. The following illustration displays an **Outline** view of an EPL file.

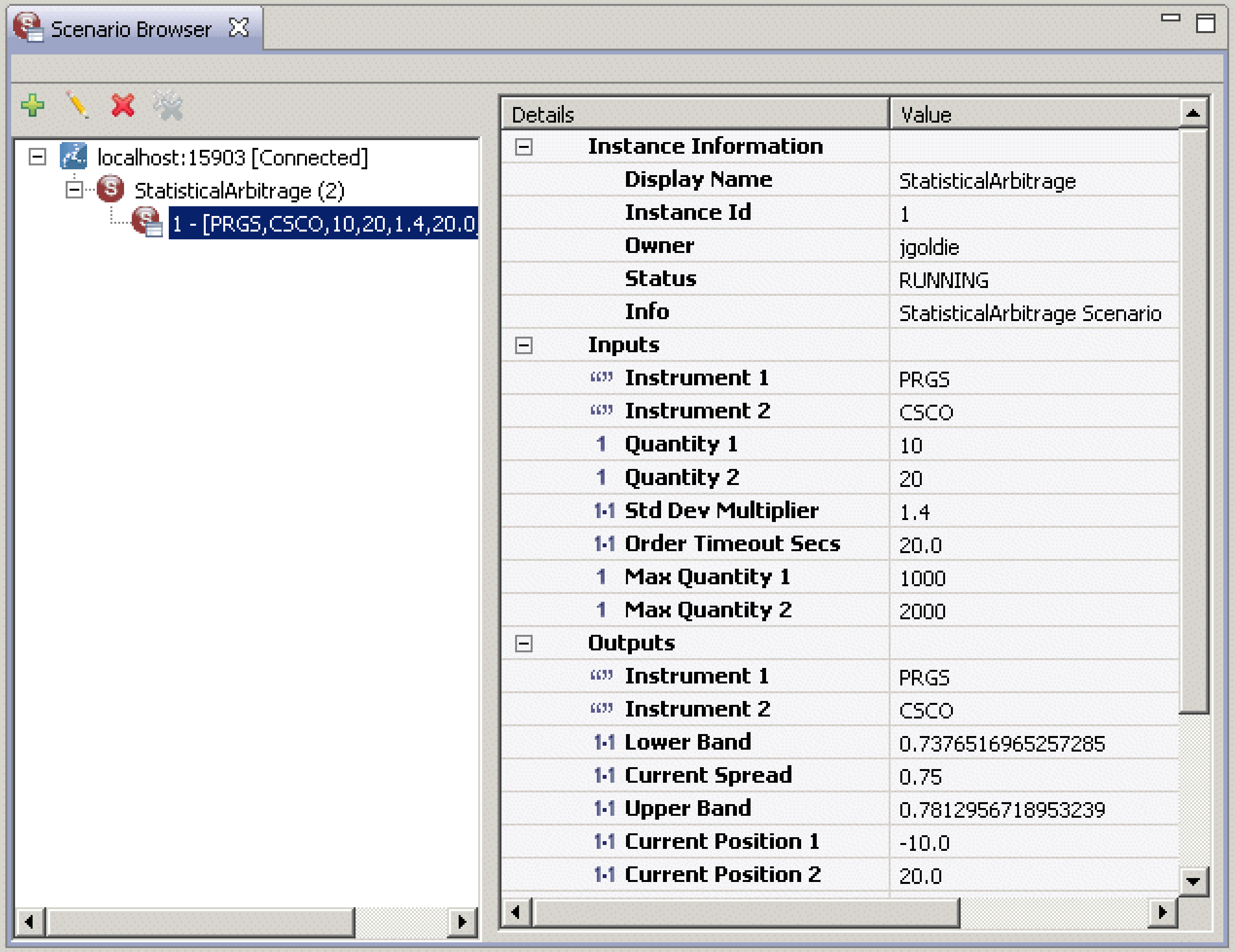


When you click on an event type or action in the outline, the editor pane highlights and displays the line of code that defines that item in the file.

About Apama projects

Scenario Browser view

The **Scenario Browser** view displays scenario and query definitions that are loaded in the correlator and any scenario and query instances that are running. When an application is running in Apama Studio, you can add, edit, and delete scenario and query instances.



Details	Value
Instance Information	
Display Name	StatisticalArbitrage
Instance Id	1
Owner	jgoldie
Status	RUNNING
Info	StatisticalArbitrage Scenario
Inputs	
Instrument 1	PRGS
Instrument 2	CSCO
Quantity 1	10
Quantity 2	20
Std Dev Multiplier	1.4
Order Timeout Secs	20.0
Max Quantity 1	1000
Max Quantity 2	2000
Outputs	
Instrument 1	PRGS
Instrument 2	CSCO
Lower Band	0.7376516965257285
Current Spread	0.75
Upper Band	0.7812956718953239
Current Position 1	-10.0
Current Position 2	20.0

For more information on using the view, see "Using the Scenario Browser view" on page 120.

About Apama projects

Engine Receive view

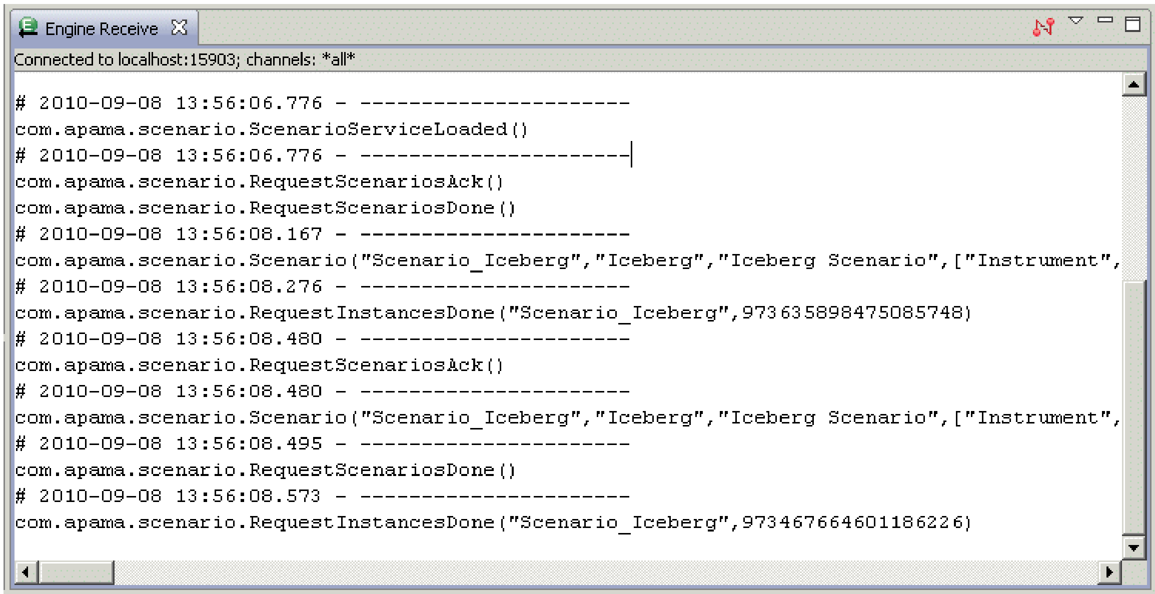
The Engine Receive view shows all events generated from the connected correlator.

The Toggle Connection button to temporarily disconnect the EngineReceive view from the correlator.

When the Toggle Connection button is pressed, the console will not update any further events from correlator. The background of the console will be changed to indicate the temporary disconnect mode. The Select All, Clear, and Copy actions will still work in this mode.

To resume from the temporary disconnect mode, simply click on the Toggle Connection button again to resume the connection. The console will be cleared and new events will be shown in the console again.

For more information on the Engine Receive view, see "Using the Engine Receive view" on page 118.



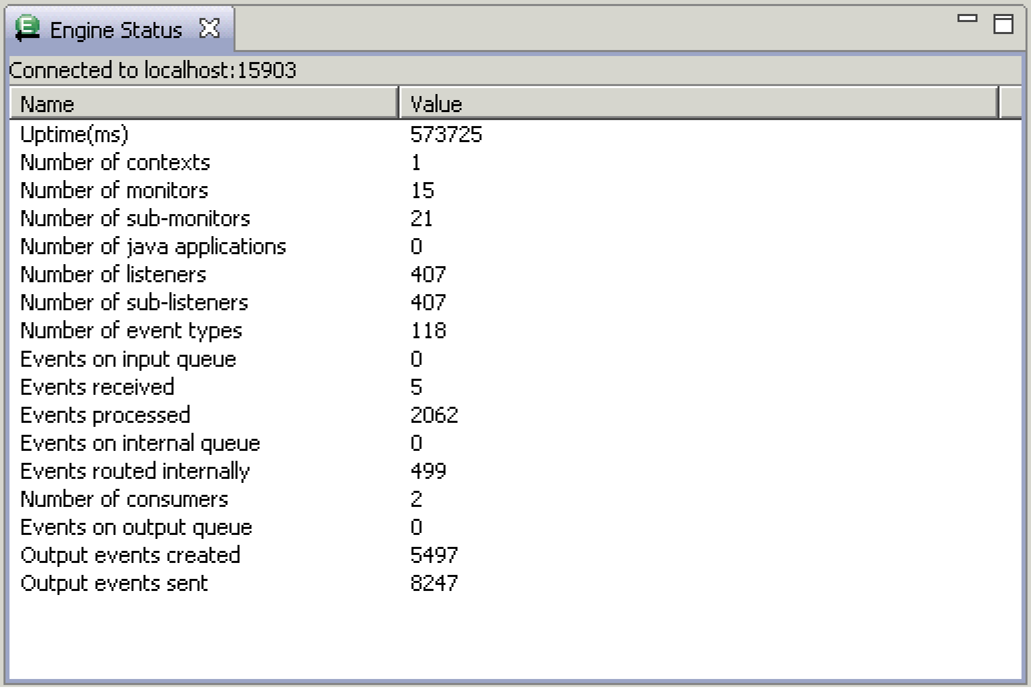
Connected to localhost:15903; channels: *all*

```
# 2010-09-08 13:56:06.776 - ----------------------
com.apama.scenario.ScenarioServiceLoaded()
# 2010-09-08 13:56:06.776 - ----------------------
com.apama.scenario.RequestScenariosAck()
com.apama.scenario.RequestScenariosDone()
# 2010-09-08 13:56:08.167 - ----------------------
com.apama.scenario.Scenario("Scenario_Iceberg","Iceberg","Iceberg Scenario",["Instrument",
# 2010-09-08 13:56:08.276 - ----------------------
com.apama.scenario.RequestInstancesDone("Scenario_Iceberg",973635898475085748)
# 2010-09-08 13:56:08.480 - ----------------------
com.apama.scenario.RequestScenariosAck()
# 2010-09-08 13:56:08.480 - ----------------------
com.apama.scenario.Scenario("Scenario_Iceberg","Iceberg","Iceberg Scenario",["Instrument",
# 2010-09-08 13:56:08.495 - ----------------------
com.apama.scenario.RequestScenariosDone()
# 2010-09-08 13:56:08.573 - ----------------------
com.apama.scenario.RequestInstancesDone("Scenario_Iceberg",973467664601186226)
```

About Apama projects

Engine Status view

The Engine Status view displays the information about the correlator status. The information is the same as the output of Apama command line tool `engine_watch`.



Connected to localhost:15903

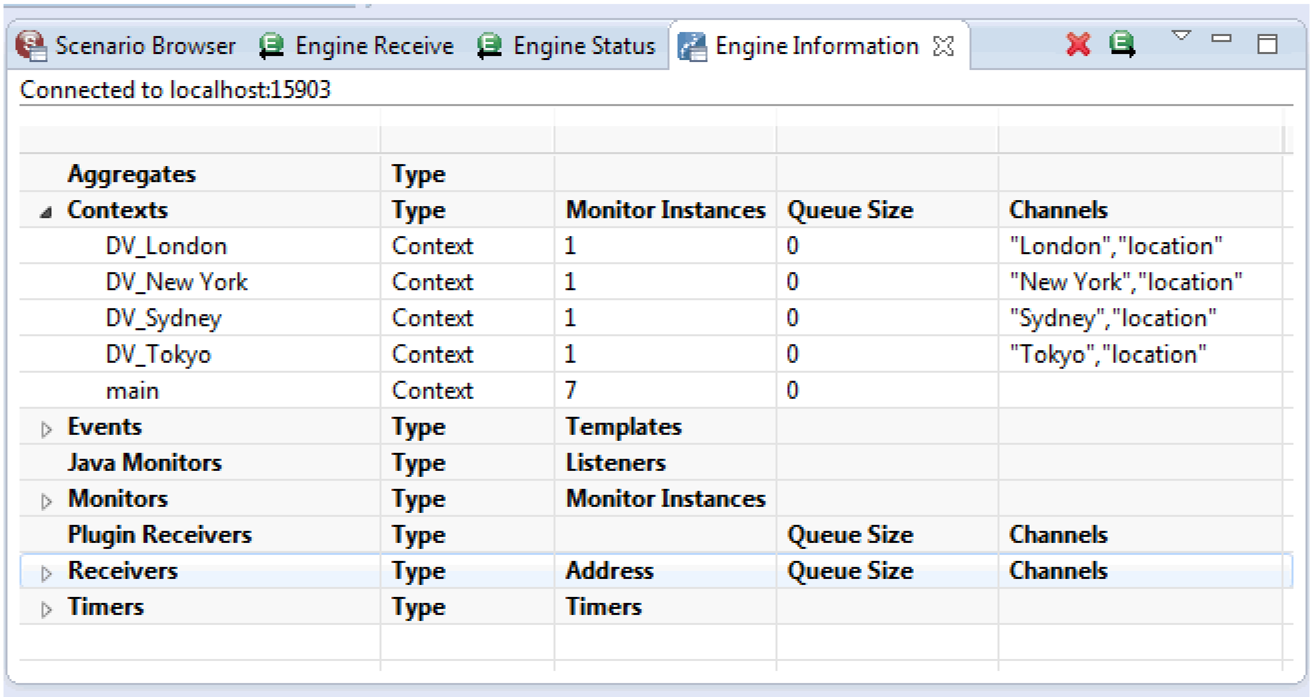
Name	Value
Uptime(ms)	573725
Number of contexts	1
Number of monitors	15
Number of sub-monitors	21
Number of java applications	0
Number of listeners	407
Number of sub-listeners	407
Number of event types	118
Events on input queue	0
Events received	5
Events processed	2062
Events on internal queue	0
Events routed internally	499
Number of consumers	2
Events on output queue	0
Output events created	5497
Output events sent	8247

For more information on Studio's Engine Status view, see "Using the Engine Status view" on page 119.

About Apama projects

Engine Information view

The **Engine Information** view inspects a running correlator and displays defined contents of the correlator. It shows the same information as the Apama command line tool `engine_inspect`. For example:



Connected to localhost:15903

Aggregates	Type			
Contexts	Type	Monitor Instances	Queue Size	Channels
DV_London	Context	1	0	"London","location"
DV_New York	Context	1	0	"New York","location"
DV_Sydney	Context	1	0	"Sydney","location"
DV_Tokyo	Context	1	0	"Tokyo","location"
main	Context	7	0	
Events	Type	Templates		
Java Monitors	Type	Listeners		
Monitors	Type	Monitor Instances		
Plugin Receivers	Type		Queue Size	Channels
Receivers	Type	Address	Queue Size	Channels
Timers	Type	Timers		

The following actions are available:

- Delete button — Direct deletion of the defined named entities. You can also delete the entity by right clicking the entity and selecting Delete from the drop down menu. A confirmation message is displayed after you click Delete. If the entity has dependencies on it, a confirmation message is displayed asking if you want allow a forced deletion.

- Send button — Send an event from this view. You can also send an event by right clicking it and selecting Send from the drop down menu.

For more information on Studio's **Engine Information** view, see "Using the Engine Information view" on page 117.

About Apama projects

Console view

The **Console** view displays information concerning a running Apama application. An application can have several consoles:

- Correlator — Displays output from the correlator.

- Engine Inject —Displays initialization information injected to the correlator.
- Engine Send — Displays information from Apama components such as dashboards that stream data to the correlator.
- Correlator Initialization — Displays information about the correlator initialization including the Java files, `.mon` files (monitors), and `.sdf` files (scenarios) that have been injected and the `.evt` files (events) that have been sent and whether the actions succeeded or failed.

To view one of these consoles, click the drop down arrow of the Display Selected Console button and select the console you want.

About Apama projects

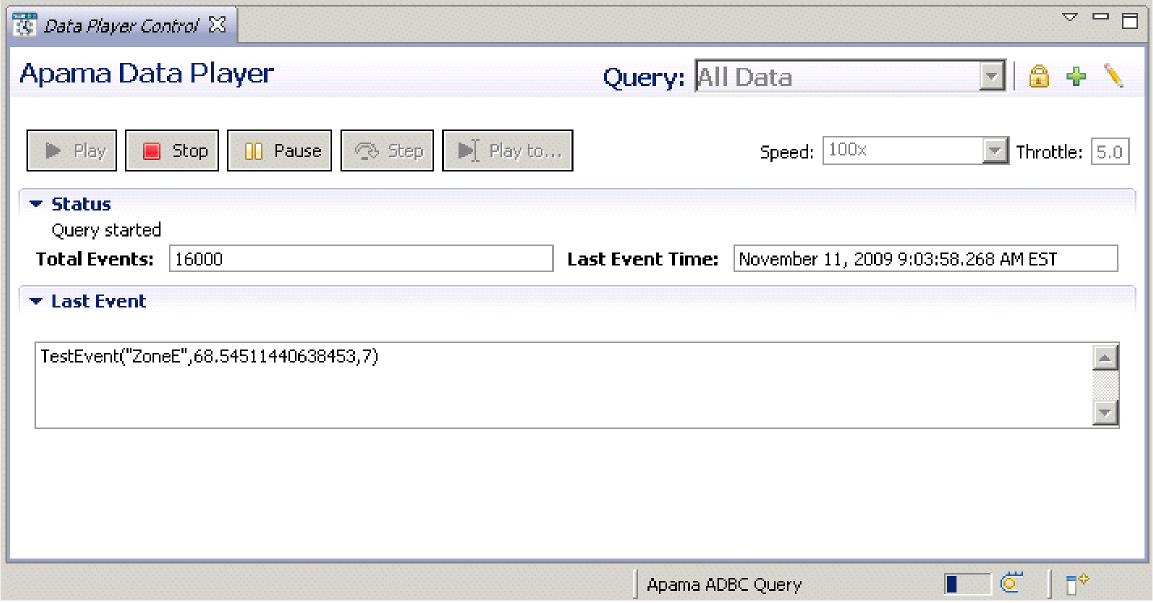
Problems view

The **Problems** view is a standard Eclipse **Problems** view that lets you view a list of any errors in your EPL, query and scenario files, and ODBC-ADBC and JDBC-ABDC adapter instances. When you build an Apama project, if Apama Studio detects errors in your project's files, or file dependency errors, it lists them here. The **Problems** view is displayed when you run an application.

About Apama projects

Data Player Control view

The **Data Player Control** view allows you to control how Apama data is played back in an application running in a project. For example, you can specify how fast to play back the event data, step through events one at a time, or specify a Data Player query to filter what events are played back.



Query: All Data

Speed: 100x

Throttle: 5.0

Query started

Total Events: 16000

Last Event Time: November 11, 2009 9:03:58.268 AM EST

TestEvent("ZoneE",68.54511440638453,7)

For more information on the Data Player Control, see "Using the Data Player" on page 160.

About Apama projects

Building Apama projects

Apama Studio validates Apama projects, in a process known as “building” the project. During validation, Apama Studio

- Checks the syntax to ensure that it is valid EPL or Java code.
- Checks that only valid values have been specified. For example, if you specify integer as the type of a field, it ensures that you specify an integer as the value of the field.
- Ensures that the dependencies are valid throughout the project.

In summary, Apama Studio validates that its launcher can inject the project’s EPL files into the correlator.

For more information, see "Building Apama projects" on page 63.

Overview of Developing Apama Applications

Launching Apama projects

Apama Studio can launch an Apama project in a test environment. When Apama Studio launches a project, the default is that it starts an instance of the correlator and injects all the resources that are included in the project. You can change the default launch behavior by editing the launch configuration for the project.

You can specify multiple launch configurations for each Apama project, including configurations for debugging and profiling applications. For each launch configuration, you can:

- Add correlator arguments.
- Specify event files that should be sent to initialize/start the application.
- Specify what adapters to use.
- Define environment variables, for example, appending directories to the `PATH` used to start the correlator and any IAF processes.
- Indicate whether the configuration can be shared among Apama Studio installations.

For more information on creating launch configurations and launching Apama projects, see "Launching Projects" on page 104.

Overview of Developing Apama Applications

Specifying the location of the license file

When Apama Studio launches an application configured to start a correlator Apama Studio looks for the Apama license file in the default location, which is `APAMA_WORK\license\license.txt`. This is automatically taken care of when the correlator is started by Apama Studio.

If your Apama license file is not located in the default location you can specify the location before launching your application. If you do not then the correlator will be started in an evaluation mode. This means it can communicate only with processes on the same machine and it will automatically exit after 30 minutes of operation. Check the correlator console output on startup to see if the correlator is running in evaluation mode. If it is put a license into the default location or provide the location of the license file if it is somewhere non-standard.

In Apama Studio, to specify the location of the Apama license file:

- In the Apama Studio menu bar, choose Window > Preferences.
- In the Preferences dialog that appears, click Apama.
- In the License file field, specify or navigate to the path of the Apama license file. The default path is `APAMA_WORK\license\license.txt`.
- Click Apply and then OK.

Overview of Developing Apama Applications

Chapter 2: Working with Projects

This section describes how to use Apama Studio to develop applications.

You can use Apama Studio to write Apama applications in the Apama Event Processing Language (EPL) and in the Apama in-process API for Java (JMon).

As you develop your application to a stage where you want to run it for testing purposes, you can launch it directly from Apama Studio. For more information on launching Apama projects, see "Launching Projects" on page 104.

Note: When using any of the Apama perspectives, you can redisplay the default perspective layout by selecting Window > Reset Perspective from the Apama Studio menu.

Creating Apama projects

To create an Apama project:

1. From the Apama Studio menu, select File > New > Apama Project to display the **New Project** dialog. If you are using the **Apama Workbench** perspective, you can also click the New Project button in top right of the **Workbench Project** view.
2. In the **New Apama Project** dialog, specify information for the following fields:

   a. In the Project Name field, enter the name of your new project. Project names typically use titlecase capitalization and may contain spaces, for example. “My Project”.

   b. If you want to store the project in a directory other than the default location, clear the Use default location checkbox, click Browse, and navigate to and select the location for storing your new project.

3. If you do not need to change the bundles that will be included in the project, click Finish which takes you to Step 6.

   Bundles are packages of Apama objects such as EPL files, event definition files, and event files that are required for specific types of applications. Adapter bundles contain the configuration files, service monitors, and other files associated with the standard Apama adapters.

   When you create a new project the settings for selected bundles remain the same as they were for the last time you created a new project. If you want to change these settings and specify other bundles for your application, click Next.

4. On the Configure new project page, add checkmarks to the bundles that are appropriate to the type of application you are developing. For example if your application is a dataview application, select the DataView Service bundle.

   If you are creating a project for an EPL application, click Finish.

   If you are creating a project for a JMon application, add a check to the Add Java support to this project checkbox and click Next.

5. If you are creating a JMon application, in the **Configure the new Apama Java application** dialog, fill in the fields as desired. Click Finish.

6. If you are not currently in an Apama perspective, the **Open Associated Perspective?** dialog appears; it is up to you whether to select Remember my decision. Click Yes or No.

If you are in the **Apama Developer** perspective, Apama Studio displays the name of your new project in the **Project Explorer** view pane on the left of the perspective. If this is your first project, the other panes are blank.

Working with Projects

Adding resources to Apama projects

You specify the Apama resources that make up your application by adding them to the Apama project. Apama Studio recognizes and provides editing features for the following files:

- EPL files (`.mon`)
- Apama query files (`.qry`)
- Block definition files (`.bdf`)
- Function definition files (`.fdf`)
- Event files (`.evt`)
- JMon monitor and event files (`.java`)
- Scenario definition files (`.sdf`)
- Dashboard definition files (`.rtv`) — opens in Dashboard Builder

However, you can add any type of file to an Apama project and Eclipse uses the correct editor to open it.

When adding new blocks and functions to a project, you should create the definition files using Apama Studio.

Working with Projects

Creating new monitor files for EPL applications

EPL files define monitors and/or event types or they define Apama queries.

> **Note:** EPL monitors and EPL queries (also referred to as Apama queries) provide two different approaches to implementing an Apama application. This topic provides instructions for adding files that will define monitors and/or events. To add a file that will define a query, see "Creating new query files" on page 30. See also: "Comparison of queries and monitors" in *Introduction to Apama*.

Monitor definitions and event type definitions are in `.mon` files. To add a new `.mon` file to an Apama project:

1. If you are in the **Apama Workbench** perspective, click the Show All Folders icon if necessary to display the enhanced view that shows all the project's resources.
2. In the **Project Explorer** view or the **Workbench Project** view, right click the `monitors` folder of the project where you want to add the EPL file and select New > MonitorScript File. In the **Workbench Project** view you can also select the `monitors` folder and click the New MonitorScript File button

3. In the **New MonitorScript File** wizard, enter information in the following fields:
   a. The Containing Folder field is the folder where the file will be saved; by default this is the folder of the currently selected project, but you can select another folder using the Browse button.
   b. In the File name field, specify the name of the new file. Specifying the `.mon` extension is optional as Apama Studio will add the `.mon` file extension. Apama Studio will not let you specify anything except `.mon` as a file extension.
   c. The Package field is optional; information in this field is an EPL package name.
4. Click Finish. The name of the new file now appears in the **Project Explorer** viewor the **Workbench Project** view under the project that contains it and the EPL file opens in the EPL editor.
5. In the EPL editor, add the desired EPL code and save the file.

For more information about EPL, see "Getting Started with Apama EPL" in *Developing Apama Applications*. For more information on the editing features available when writing EPL code, see "Editing Apama files" on page 55.

Adding resources to Apama projects

Creating new query files

Apama queries are useful when you want to monitor incoming events that provide information updates about a very large set of real-world entities such as credit cards, bank accounts, cell phones. Typically, you want to independently examine the set of events associated with each entity, that is, all events related to a particular credit card account, bank account, or cell phone. A query application operates on a huge number of independent sets with a relatively small number of events in each set.

To add a query file to a project:

1. In **Project Explorer**, right-click the project you want to add a query to and select New > Query File.
2. In the New Query File dialog, the Containing folder field shows the name of the project you selected. Accept this or enter the name of the project you want to add the query to.
3. In the File name field, enter a name for the query file.
4. In the Package field, you can optionally specify the EPL package that contains this query. If you do not specify a package then the query file is in the default package, which contains EPL files that do not specify a package name.

Apama Studio adds the new query file to the project's queries folder and opens the new query in the Design tab of the Query Designer. See "Using Query Designer" on page 83.

Adding resources to Apama projects

Creating new event definition files for EPL applications

You can add new event definitions to an Apama Studio project. There are several ways to create event definitions:

- "Creating event definitions by adding EPL code" on page 30
- "Creating event definitions from XML files" on page 31
- "Creating event definitions from XSD files" on page 32

Creating event definitions by adding EPL code

To create an event definition by adding EPL code:

1. In the **Project Explorer** view, right-click the project’s `eventdefinitions` folder and select New > Event Definition from the pop-up menu. The **New Event Definition** dialog is displayed.
2. In the **New Event Definition** dialog, in the Generate Event Definition using field, select EPL Editor and click Next. The **Choose output location for Event Definition** dialog is displayed.
3. In the **Choose output location for Event Definition** dialog, enter information in the following fields:
   a. The Containing Folder field is the folder where the file will be saved; by default this is the currently selected folder of the current project, but you can select another folder or project using the Browse button.

  b. In the File name field, specify the name of the new file. Specifying the .mon extension is optional as Apama Studio will add the .mon file extension. Apama Studio will not let you specify anything except .mon as a file extension.

  c. The Package field is optional; information in this field is an EPL package name.

4. Click Finish. The new event definition file is added to the specified folder in the project and the EPL file opens in the EPL editor.

5. In the EPL editor, add the desired EPL code and save the file.

Note, you can also create these types of event definitions by using the New > MonitorScript menu item; for details, see "Creating new monitor files for EPL applications" on page 29.

Creating event definitions from XML files

You can create an event definition that is based on the structure of an XML document. The generated event definition is based on the following:

- All fields are treated as string.
- All prefixes are ignored, in other words, event definitions will be generated even if inner elements have different namespaces.
- Namespace attributes (attributes having an xmlns prefix) are ignored.
- All inner event names are prepended with Element_.
- Generated event definitions will have an xmlTextNode field if the XML element contains a text value and also contains an attribute.

To create an event definition from an XML file:

1. In the **Project Explorer** view, right-click the project's eventdefinitions folder and select New > Event Definition from the pop-up menu. The **New Event Definition** dialog is displayed.

2. In the **New Event Definition** dialog, in the Generate Event Definition using field, select XML File and click Next. The **Choose output location for Event Definition** dialog is displayed.

3. In the **Choose output location for Event Definition** dialog, enter information in the following fields:

   a. The Containing Folder field is the folder where the file will be saved; by default this is the currently selected folder of the current project, but you can select another folder or project using the Browse button.

   b. In the File name field, specify the name of the new file. Specifying the .mon extension is optional as Apama Studio will add the .mon file extension. Apama Studio will not let you specify anything except .mon as a file extension.

   c. The Package field is optional; information in this field is an EPL package name.

4. Click Next. This displays the **Select XML File** dialog.

5. In the **Select XML File** dialog, in the XML File field, specify the name of the XML file on which you want to base the event. You can use the Browse button to navigate to the desired file. The Down Arrow button switches the scope between Workplace and FileSystem.

6. In the **Select XML File** dialog, in the Event Name field, specify the name you want to assign to the root level event.

7. Click Finish. Apama Studio creates an EPL file that defines the root level event along with associated nested events.

Creating event definitions from XSD files

You can create event definitions that are based on the structures of elements defined in XSD schema files.

To create an event definition from an XSD file:

1. In the **Project Explorer** view, right-click the project's `eventdefinitions` folder and select New > Event Definition from the pop-up menu. The **New Event Definition** dialog is displayed.
2. In the **New Event Definition** dialog, in the Generate Event Definition using field, select XSD File and click Next. The **Choose output location for Event Definition** dialog is displayed.
3. In the **Choose output location for Event Definition** dialog, enter information in the following fields:
    a. The Containing Folder field is the folder where the file will be saved; by default this is the currently selected folder of the current project, but you can select another folder or project using the Browse button.

    b. In the File name field, specify the name of the new file. Specifying the `.mon` extension is optional as Apama Studio will add the `.mon` file extension. Apama Studio will not let you specify anything except `.mon` as a file extension.

    c. The Package field is optional; information in this field is an EPL package name.
4. Click Next. This displays the **Select XSD File** dialog.
5. In the **Select XSD File** dialog, click the Browse button to the right of the Schema Element/Type field. This displays the **Type Chooser** dialog.
6. In the **Type Chooser** dialog, specify the file that contains schema's global element that you want to use as the root element on which to base the event definition. Click the Browse button to navigate to the file. The Drop-down arrow allow you to change scope among Recent files, Local file system, Workspace, Remote URL, and XML Schema. After selecting a file, click OK. This returns to the **Select XSD File** dialog with the root element you selected displayed in the Schema Element/Type field.
7. In the **Select XSD File** dialog, in the Event Name field, specify the name you want to assign to the root level event.
8. Click Finish. Apama Studio creates an EPL file that defines the root level event along with associated nested events.

Creating new files for JMon applications

For Apama projects that use JMon applications, you can add new JMon applications, JMon monitors, and JMon events. In Apama applications written in Java, monitors and event types are implemented as Java classes.

Adding resources to Apama projects

Adding a new JMon application

To add a new JMon application to an Apama project:

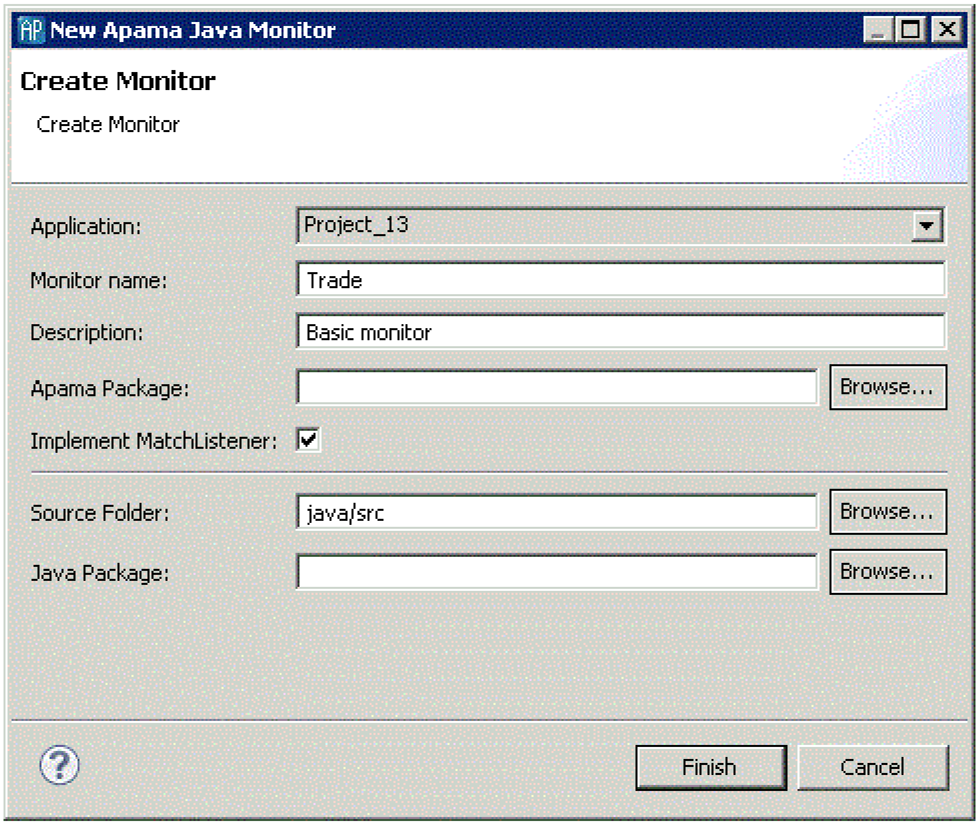
1. If you are in the **Apama Workbench** perspective, click the Show All Folders icon if necessary to display the enhanced view that shows all the project's resources.
2. In the **Project Explorer** view or the **Workbench Project** view, right click the name of the project where you want to add the monitor and select New > Java Application. The **New Java Application** wizard is displayed.
3. In the **New Java Application** wizard, in the Configuration field specify the name of the application and click Finish. The application is added to the project and its configuration opens in the Apama Java configuration editor.
4. In the Apama Java configuration editor, specify the application's meta-data and add classes and contents as required. For more information on editing the configuration, see "Adding resources to JMon projects" on page 45.

Creating new files for JMon applications

Adding a JMon monitor

To add a new JMon monitor to an Apama project:

1. If you are in the **Apama Workbench** perspective, click the Show All Folders icon if necessary to display the enhanced view that shows all the project's resources.
2. In the **Project Explorer** view or the **Workbench Project** view, right click the name of the project where you want to add the monitor and select New > Java Monitor. You can also select File > New > Other from the Apama Studio menu and then select Apama > Java Monitor from the **Select a wizard** dialog. The **New Apama Java Monitor** wizard is displayed.



Application: Project_13

Monitor name: Trade

Description: Basic monitor

Apama Package:

Implement MatchListener: ☑

Source Folder: java/src

Java Package:

3. In the **New Apama Java Monitor** wizard, enter information in the following fields:

   a. The Application field is the application to which you are adding the monitor.

   b. In the Monitor name field, specify the name of the new monitor. This will become the name of the class and the Java file.

   c. The Description field is optional.

   d. The Apama Package field is optional; this is the package of the monitor inside the correlator.

   e. Add a check to the Implement MatchListener check box if you want Apama Studio to generate the skeleton code for the class's `MatchListener` interface.

   f. The Source Folder field specifies the folder in the project to contain the file; by default this is `java/src`.

   g. The Java Package field is optional; this is the package of the created Java class.

4. Click Finish. The name of the new class file now appears in the **Project Explorer** viewor the **Workbench Project** view under the project that contains it and the `.java` file opens in the editor.

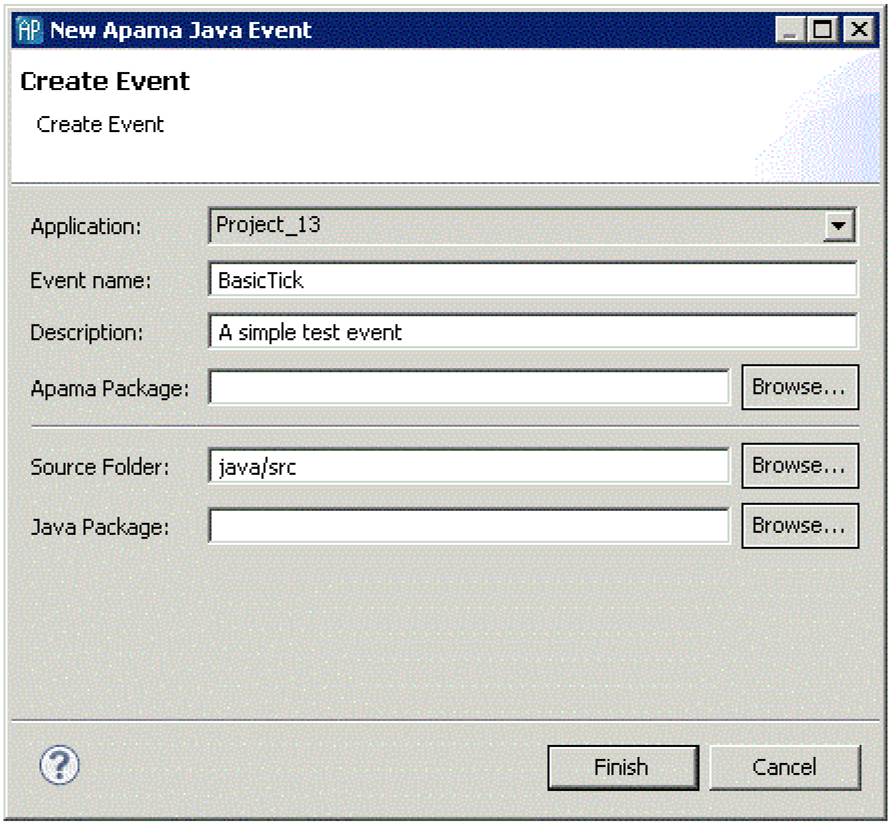
For more information about JMon applications, see "Overview of JMon Applications" in *Developing Apama Applications*.

Creating new files for JMon applications

Adding a JMon event

To add a new JMon event to an Apama project:

1. If you are in the **Apama Workbench** perspective, click the Show All Folders icon if necessary to display the enhanced view that shows all the project's resources.
2. In the **Project Explorer** view or the **Workbench Project** view, right click the name of the project where you want to add the monitor and select New > Java Event > Other. You can also select File > New from the Apama Studio menu and then select Apama > Java Event from the **Select a wizard** dialog. The **New Apama Java Event** wizard is displayed.



Create Event

Create Event

Application: Project_13

Event name: BasicTick

Description: A simple test event

Apama Package:

Source Folder: java/src

Java Package:

3. In the **New Apama Java Event** wizard, enter information in the following fields:
   a. The Application field is the application to which you are adding the event.
   b. In the Monitor name field, specify the name of the new event. This will become the name of the class and the Java file.
   c. The Description field is optional.
   d. The Apama Package field is optional; this is the package of the event inside the correlator.
   e. The Source Folder field specifies the folder in the project to contain the file; by default this is `java/src`.
   f. The Java Package field is optional; this is the package of the created Java class.
4. Click Finish. The name of the new class file now appears in the **Project Explorer** viewor the **Workbench Project** view under the project that contains it and the `.java` file opens in the editor.

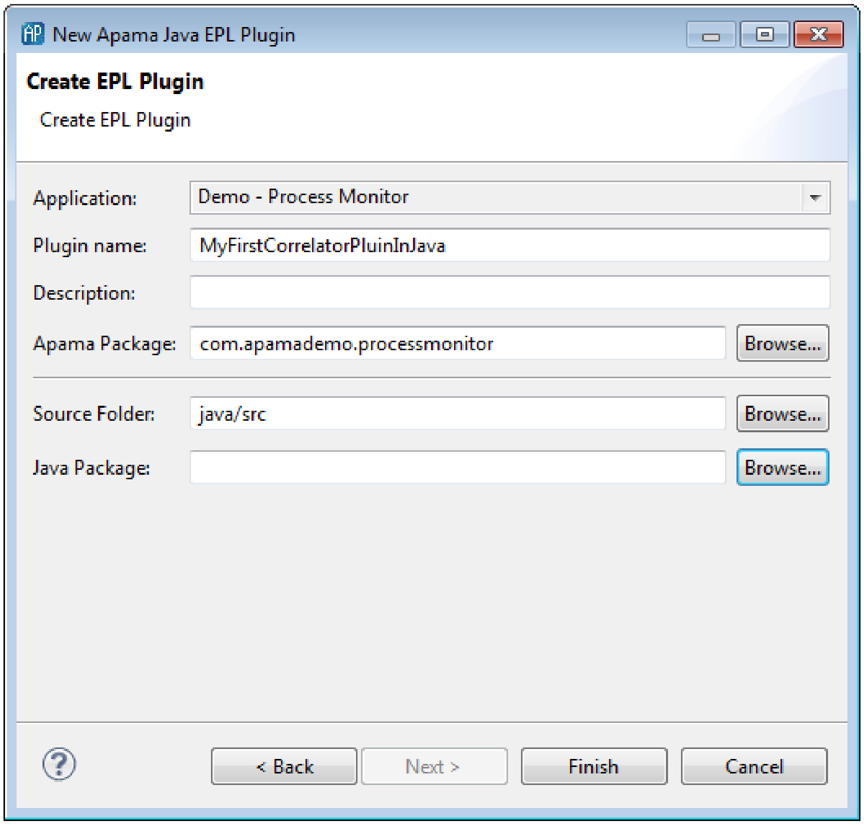
For more information about JMon applications, see "Overview of JMon Applications" in *Developing Apama Applications*.

Creating new files for JMon applications

Adding an EPL Plug-in written in Java

To add a new correlator plug-in written in Java to an Apama project:

1. If you are in the **Apama Workbench** perspective, click the Show All Folders icon if necessary to display the enhanced view that shows all the project's resources.
2. In the **Project Explorer** view or the **Workbench Project** view, right click the name of the project where you want to add the correlator plug-in and select New > Java EPL Plugin. You can also select File > New > Other from the Apama Studio menu and then select Apama > Java EPL Plugin from the **Select a wizard** dialog. The **New Apama Java EPL Plugin** wizard appears.



New Apama Java EPL Plugin

Create EPL Plugin

Create EPL Plugin

Application: Demo - Process Monitor

Plugin name: MyFirstCorrelatorPluinInJava

Description:

Apama Package: com.apamademo.processmonitor

Source Folder: java/src

Java Package:

3. In the **New Apama Java EPL plug-in** wizard, enter information in the following fields:
   a. The Application field is the application to which you are adding the plug-in.
   b. In the Plugin name field, specify the name of the new plug-in. This will become the name of the class and the Java file.
   c. The Description field is optional.
   d. The Apama Package field is optional; this is the package of the plug-in inside the correlator.
   e. The Source Folder field specifies the folder in the project to contain the file; by default this is `java/src`.
   f. The Java Package field is optional; this is the package of the created Java class.
4. Click Finish. The name of the new class file now appears in the **Project Explorer** view or the **Workbench Project** view under the project that contains it and the `.java` file opens in the editor. In **Project Explorer**, the icon indicates a Java plug-in to the correlator.

5. Select the Show All Folders icon in the Project View pane. You will find the source file for your Java class in the `java/src` package in your project. You can now add functionality to the class as required for your application. This can be called from EPL using the mechanism described in "Using Java plug-ins" in the "Developing Correlator Plug-ins" part of *Developing Apama Applications*.

For applications that you plan to inject into a correlator, the recommendation is to create separate jar files for:

- EPL plug-ins written in Java
- JMon applications

Although the mechanism for creating these jars and describing their meta-data is similar, the interactions of these two different uses of injected jars mean that they will often need to be injected into the correlator separately. The creation of separate jar files ensures that you can inject your application components in the correct order, which is typically:

1. EPL plug-ins written in Java
2. EPL monitors and events
3. JMon applications

For more information, see "Overview of JMon Applications" as well as "Developing Correlator Plug-ins" in *Developing Apama Applications*.

Creating new files for JMon applications

Creating new scenarios

Scenarios define templates that, when instantiated with a set of parameters supplied by the user, implement an application's strategy. To add a new scenario to an Apama project:

1. In the **Project Explorer** view or the **Workbench Project** view, right click the `scenarios` folder of the project where you want to add the scenario and select New > Scenario. In the **Workbench Project** view you can also select the `scenarios` folder and click the New Scenario button New Scenario...
2. In the **New Scenario** wizard, enter information in the following fields:
   a. The Containing Folder field is the folder where the definition file will be saved; by default this is the folder of the currently selected project, but you can select another folder using the Browse button.
   b. In the File name field, specify the name of the new file. Specifying the `.sdf` extension is optional as Apama Studio will add the `.sdf` file extension. Apama Studio will not let you specify anything except `.sdf` as a file extension.
3. Click Finish. Apama Studio adds the name of the new scenario definition file to project and opens the new scenario in the Apama Event Modeler.

Using Event Modeler, you complete the scenario by adding state and rules and specify the blocks and functions necessary to implement the desired strategy. For more details on developing scenarios, see "Overview of Using Event Modeler" in *Developing Apama Applications*.

Adding resources to Apama projects

Creating new blocks

This section is a brief description of how to create a new block in Apama Studio. For more details on this process, see "Creating Blocks" in the Event Modeler part of *Developing Apama Applications*. You can create a block in Apama Studio either from scratch or from an existing event definition.

For information on creating new blocks, see the following topics:

- "Creating a block with the block editor" on page 38
- "Creating a block from an EPL event definition" on page 39
- "Adding EPL code to a block" on page 40

Note: When you create a new block, you should place it in the project's default `blocks` directory. This directory is found in the project's `catalogs` directory. The `blocks` directory has a name in the form *`project_name`* `blocks`. So, for example, the default block directory of a project named `My_Project` will be `catalogs\My_Project blocks`. If you place the block in the default block directory, scenarios created in the project will automatically find them and make them available in Event Modeler when you are displaying the scenario.

Creating a block with the block editor

Creating a block in Apama Studio consists of two main steps. In the first step you create the block metadata and specify its interface. In the second step you add the EPL code that implements the block's behavior.

To add a new block to an Apama project using the block editor:

1. In the **Project Explorer** or **Workbench Project** view, right-click the default block folder (typically `catalogs\`*`project_name`* `blocks`) and select New > Block button from the pop-up context menu. The **New Event Modeler Block** dialog is displayed.
2. In the **New Event Modeler Block** dialog, specify the name of the project in the Containing folder field if you want to create the block in a different project; you can also click Browse to select the project from a list of projects in the workspace.
3. Also in the **New Event Modeler Block** dialog, select Block Editor in the Generate block using field and click Next. The **Create a new Apama Block** dialog is displayed.
4. In the **Create a new Apama Block** dialog, fill in the various fields or accept the default values. The most important fields to set at this point are the block name and version. The Type field specifies what type of code will be generated for the block. The choices are:
   - Callback — Implements the block as an event type; this is the default. Generates EPL code to which you can add custom code.
   - Callback (DEBUG) — Implements the block as an event type. Generates EPL code to which you can add custom code. Also generates statements that can help you debug the EPL you are adding. You can easily switch your block between Callback and Callback (DEBUG).
5. Click Finish. The block definition file for the new block is added to the project and the block's metadata is displayed in the Builder tab of the block editor.

6. The left side of the Builder tab displays the parameters, input feeds, output feeds, and operations that make up the block; a new block will not contain any entries here. To add one of these elements:

   a. Right click the element you want to add and select Add Parameter, Add Input Feed, Add Output Feed, or Add Operation. The right side of the Builder tab displays the item's properties.

   b. Fill in the values for the properties.

7. For input feeds and output feeds, right click the element and select Add Field.

8. In the Properties panel for the field you added in the previous step fill in the values for the properties and field validation specifications. Repeat for each field you want to add to an input or output feed.

9. When you finish specifying the block's metadata, save the file.

For details about adding EPL code to a block, see "Adding EPL code to a block" on page 40.

Creating a block from an EPL event definition

In cases where you want to create an event from a scenario or to update the scenario types from an Apama event, you should create a block based on the event type.

Creating a block from an existing EPL event definition consists of selecting the event definition from which you want to create the block, specifying whether you want to create an input block or an output block, and specifying what fields in the event are to be used when the block is generated. For input blocks, the specified fields are used to construct listeners; for output blocks, the specified fields are used to set the values of output parameters.

To add a new block to an Apama project from an existing EPL event definition:

1. In the **Project Explorer** or **Workbench Project** view, right-click the default block folder (typically `catalogs\`*`project_name`*`\blocks`) and select New > Block from the pop-up context menu. The **New Event Modeler Block** dialog is displayed.

2. In the **New Event Modeler Block** dialog, specify the name of the project in the Containing folder field if you want to use an event definition in a different project; you can also click Browse to select the project from a list of projects in the workspace.

3. Also in the **New Event Modeler Block** dialog, select EPL event definition in the Generate block using field and click Next. The **Select the Block type and Event type** dialog is displayed.

4. In the **Select the Block type and Event type** dialog, click Browse to display the **Event Type Selection** dialog. Note, that events with field types chunk, listener, or stream are not listed because they cannot be emitted, routed, or enqueued.

   a. In the **Event Type Selection** dialog's Choose an Event Type field, enter the name of the event. As you type, event types that match what you enter are shown in the Matching Events list.

   b. In the Matching Events list, select the name of the event type you want to use to generate the block. The name of the EPL file that defines the selected event is displayed in the status area at the bottom of the dialog.

   c. Click OK.

5. In the **Select the Block type and EPL typ**e dialog, specify whether you want to generate an input block or an output block. Also, in the Include comments field, add a check if you want to include ApamaDoc comments from the event definition in the generated block code and click Next. The **Create New Apama Block** dialog is displayed.

6. In the **Create a New Apama Block** dialog, specify the name, version, type and description of the new block. By default, Apama Studio uses the name of the event as the basis for the name of the block. The Type field specifies what type of code will be generated for the block. The choices are:

   - Callback — Implements the block as an event type; this is the default. Generates EPL code to which you can add custom code.
   - Callback (DEBUG) — Implements the block as an event type. Generates EPL code to which you can add custom code. Also generates statements that can help you debug the EPL you are adding. You can easily switch your block between Callback and Callback (DEBUG).

   When you finish entering information, click Next. The **Select Block Parameters from Event Fields** dialog is displayed.

7. In the **Select Block Parameters from Event Fields** dialog, in the Event Fields field, specify the fields to be used to create the block.

   Note, for input blocks, fields with inner event fields, and fields of `dictionary` or `sequence` types are not displayed. Also, for both input and output blocks, `constant`, `action`, and `context` fields are not displayed.

   - When you create a new input block, code is generated for a block parameter and listener for a specified field. If you select more than one field, block parameters and listeners are created for all combinations of all the selected fields. The maximun number of fields you can select is ten.

     For input blocks, code is also generated for an output feed that includes all the fields in the specified event, as well as `start` and `stop` actions that activate and deactivate the listeners.

   - When you create a new output block, code is generated for parameters for the event fields you specify. This means that values for those fields can be specified when the block is used.

8. Click Finish.

Apama Studio creates the block's `.bdf` file (the block definition file) and opens it in the block editor. The left side of the Builder tab displays the parameters, input feeds, output feeds, and operations that are automatically generated from the information you specified for the block. For details about adding EPL code to a block, see "Adding EPL code to a block" on page 40.

Adding EPL code to a block

When you save a block, Apama Studio generates the underlying code that defines the block's interface and saves it as a *block definition file* with a `.bdf` extension. To this file, you then add EPL code to implement the necessary behavior. To add code to the block:

1. If necessary, double-click the block in the **Project Explorer** to open it in the block editor. In the block editor display the Source tab.

2. On the Source tab, code is displayed either with a gray background or a white background. Code with a gray background is maintained by Apama Studio and is not editable. The sections of code with a white background are the areas where you add your custom EPL code.

For details, see "Adding EPL code to the block definition" in the Event Modeler part of *Developing Apama Applications*. Also, for background information on the elements that make up the actual code of a block's definition file, see "File Definition Formats", also in the Event Modeler part of *Developing Apama Applications*.

Creating new scenario functions

Many Apama applications are implemented partially or entirely as scenarios. Apama Studio supplies many pre-packaged scenario functions that can be used in conditions or actions when defining rules for scenarios. In addition, you can define your own scenario functions within Apama Studio.

Note: When you create a new function, you should place it in the project's default functions directory. This directory is found in the project's `catalogs` directory. The function directory has a name in the form *`project_name`* `functions`. So, for example, the default `functions` directory of a project named `My_Project` will be `catalogs\My_Project functions`. If you place the function in the default function directory, scenarios created in the project will automatically find them and they will be available in Event Modeler when you are displaying the scenario.

To define a new scenario function:

1. If you are in the **Apama Workbench** perspective, click the Show All Folders icon if necessary to display the enhanced view that shows all the project's resources.
2. In the Project Explorer view or the **Workbench Project** view, open the `catalogs` folder of the project where you want to add the EPL file.
3. Right click the functions folder within the `catalogs` folder. It will have a name such as `MyProject functions`. Select New > Scenario Function.

   In the **Workbench Project** view you can also select the functions folder and click the New Scenario Function button New Scenario Function....
4. In the **New Scenario Function** wizard, specify information for the following fields:
   a. The Containing Folder field is the folder where the function definition file will be saved; by default this is the functions folder you selected in Step 4, but you can select another folder using the Browse button.
   b. In the Function Name field enter a unique name for the function. By convention, this should be in uppercase.
   c. In the Display Name field enter the name that will be displayed in the Apama Event Modeler tool. By default this the same as the Function Name but you can change it if you like; it does not need to be unique.
   d. In the Return type field specify the type for the value returned by the function.
   e. In the Description field specify the descriptive text that will accompany the function in the Apama Event Modeler tool.
5. Click Finish. This generates the definition file for the function and opens the file in the Apama editor.
6. The function definition file is an XML file. To implement the behavior of the function you need add the EPL code to the `action` statement in the file's `<code>` element. In the `.fdf` file, this section is labeled:

   ```
   // TODO: put MonitorScript code to implement the function here
   ```

After you have added a new scenario function to a project, when you look at a scenario in the project with the Apama Event Modeler, the new function will be included in the Event Modeler's function catalog associated with the project.

For more information on using functions in scenarios, see "Using functions in Event Modeler" in *Developing Apama Applications*. For more information on the XML format of the function definition file, see "File Definition Formats" also in *Developing Apama Applications*.

Adding resources to Apama projects

Creating new dashboards

Dashboards provide the ability to view and interact with scenarios and DataViews. They contain charts and other objects that dynamically visualize the values of scenario variables and DataView fields. Dashboards can also contain control objects for creating, editing, and deleting scenario instances and DataView items. Normally, you add new dashboards after you have substantially developed and tested your application.

You can create dashboards with either the **Dashboard Generation** wizard or the Dashboard Builder. The wizard allows you to generate simple, default dashboards, customized with your choices regarding basic layout and visualization objects to use. The Builder is a graphical composition tool that gives you fine-grained control over a dashboard's appearance and behavior.

The following sections describe how to create dashboards to your project:

- "Creating dashboards with the Dashboard Generation wizard" on page 42
- "Creating dashboards with the Dashboard Builder" on page 43

Adding resources to Apama projects

Creating dashboards with the Dashboard Generation wizard

To create dashboards that are generated by the **Dashboard Generation** wizard, follow these steps:

1. If you are using the **Project Explorer** view, ensure that a project is selected.
2. In either the **Project Explorer** view or the **Workbench Project** view, select New > Dashboard from the File menu. (You can also right-click in the navigation pane and select Dashboard from the popup menu. In the **Workbench Project** view, you can also click the New button that is above the navigation pane and select Dashboard from the Apama folder, or click the down arrow that is next to the New button, and select Dashboard from the popup menu.)
3. In the **New Dashboard** dialog, click the **Dashboard Generation** wizard radio button, and enter a name in the Configuration name field. The **Dashboard Generation** wizard uses this as the name of the new configuration that will be used to generate your Dashboards. When you use the Wizard, you can accept a default configuration or specify a custom configuration.
4. Click Finish.The Dashboard Generation Wizard appears, and displays the new dashboard-generation configuration. In addition, a new dashboard-generation configuration file (`dashboard_generation.xml`) appears under the current project's config folder, if one wasn't already present.

For information on using the **Dashboard Generation** wizard, see "Generating dashboards" in *Building and Using Dashboards*.

Adding resources to Apama projects

Creating dashboards with the Dashboard Builder

To create a dashboard and develop it with the Dashboard Builder, follow these steps:

1. If you are using the **Project Explorer** view, ensure that a project is selected.
2. In either the **Project Explorer** view or the **Workbench Project** view, select New > Dashboard from the File menu. (You can also right-click in the navigation pane and select Dashboard from the popup menu. In the **Workbench Project** view, you can also click the New button and select Dashboard from the Apama folder, or click the down arrow next to the New button, and select Dashboard from the popup menu.)
3. In the **New Dashboard** dialog, click the Dashboard Builder radio button, and enter information in the following fields:
   a. Containing Folder is the folder where the dashboard definition file will be saved; by default this is the dashboards folder of the current project, but you can select another folder using the Browse button.
   b. File name specifies the name of the new definition file. Specifying the `.rtv` extension is optional as Apama Studio will add the `.rtv` file extension. Apama Studio will not let you specify anything except `.rtv` as a file extension.
4. Click Finish. The name of the new dashboard definition file appears under the current project's dashboards folder. Additionally, in a separate window Apama Studio opens the Apama Dashboard Builder tool showing the new dashboard.

Using Dashboard Builder, you complete the dashboard by adding visualizing and control objects and connecting them to live correlator data. For more information on completing dashboards, see "Introduction" in *Building and Using Dashboards*.

Adding resources to Apama projects

Creating new dashboard-deployment configurations

Dashboard-deployment configurations contain the information necessary for the generation of deployment packages for a project's dashboards. Follow these steps to create a deployment configuration:

1. If you are using the **Project Explorer** view, ensure that a project is selected.
2. In either the **Project Explorer** view or the **Workbench Project** view, select New > Dashboard Deployment from the File menu. (You can also right-click in the navigation pane and select Dashboard Deployment from the popup menu. In the **Workbench Project** view, you can also click the New button that is above the navigation pane and select Dashboard Deployment from the Apama folder, or click the down arrow that is next to the New button, and select Dashboard Deployment from the popup menu.)
3. In the **New Dashboard Deployment Configuration** dialog, enter a name in the Configuration field. The Dashboard Deployment Configuration Editor uses this as the name of the new configuration.

4. Click Finish.The Dashboard Deployment Configuration Editor appears, and displays the new dashboard configuration. In addition, a new dashboard-deployment configuration file (`dashboard_deploy.xml`) appears under the current project's config folder, if one wasn't already present.

For information on using the Dashboard Configuration Deployment Editor, see in .

Adding resources to Apama projects

Creating new event files

To add a new event file to an Apama project:

Event files are used to supply events of a specific type. For example in applications written in EPL, you should usually send in an event to tell the monitors making up the application to start listening for events once everything has been injected.

1. If you are in the **Apama Workbench** perspective, click the Show All Folders icon if necessary to display the enhanced view that shows all the project's resources.
2. In the **Project Explorer** view or the **Workbench Project** view, right click the `events` folder of the project where you want to add the event file and select NewFile > Event. In the **Workbench Project** view you can also select the `events` folder and click the New Event File button New Event File... .
3. In the **New Event File** wizard, enter information in the following fields:
   a. The Containing Folder field is the folder where the file will be saved; by default this is the folder of the currently selected project, but you can select another folder using the Browse button.
   b. In the File name field, specify the name of the new file. Specifying the `.evt` extension is optional as Apama Studio will add the `.evt` file extension. Apama Studio will not let you specify anything except `.evt` as a file extension.
4. Click Finish. The name of the new file now appears in the **Project Explorer** viewor the **Workbench Project** view under the project that contains it and the event file opens in the Apama Studio event editor.

Adding resources to Apama projects

Adding resources to EPL projects

To add an existing EPL file that defines a monitor to an Apama project, you add the file as an External Dependency. You can also add EPL files that are contained in an Apama Correlator Deployment Package file. To add a file to an active project as an external dependancy:

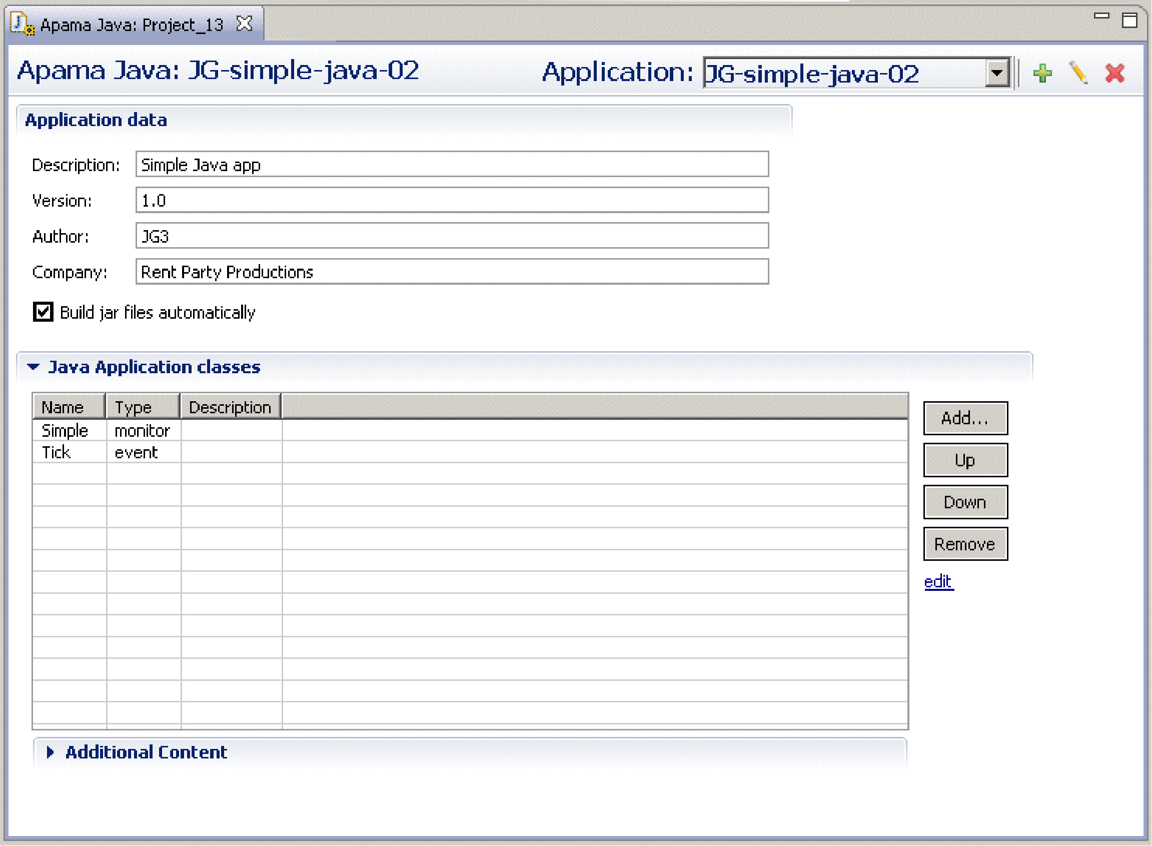
1. Select Project > Properties from the Apama Studio menu.
2. In the **Properties** dialog, select MonitorScript Build Path from the left hand pane and select the External Dependencies tab in the right pane.
3. Click Add External button and navigate to the files you want to add. You can select EPL (`.mon`) files or Correlator Deployment Package (`.cdp`) files.
4. When finished, click OK at the **Properties** dialog.

Adding resources to Apama projects

Adding resources to JMon projects

To add existing resources to a JMon project, you modify the project's configuration. The configuration information is stored in the project's `config/apama_java.xml` file.

To add resources to a JMon project, double click the project's `config/apama_java.xml` file. The Apama Java configuration editor opens.



Apama Java: JG-simple-java-02

Application: JG-simple-java-02

Application data

Description: Simple Java app

Version: 1.0

Author: JG3

Company: Rent Party Productions

☑ Build jar files automatically

Java Application classes

Name	Type	Description
Simple	monitor	
Tick	event	

The Application drop-down list on the right of the editor's title bar shows the application you are editing. You can select any JMon application currently included in the project and you can add JMon applications from other projects to your current project.

You can add other JMon classes (JMon events and JMon monitors) and non-JMon Java files to a project.

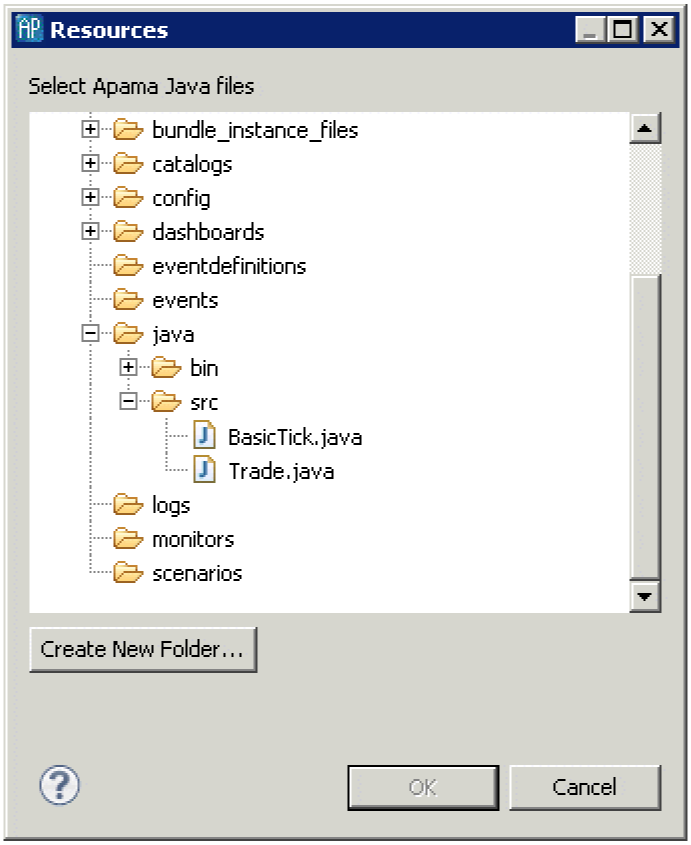
Adding resources to Apama projects

Adding JMon applications

To add a JMon application from another Apama project:

1. Click the Add application button (✚). The **New Application Name** dialog is displayed.

2. Specify a name for the new application and click OK. The editor will display the settings for this new application and the name will be added to the editor's drop down list.
3. In the Apama Java configuration editor, expand the Java Application Classes heading. This displays the current list of the Java classes included in the project. Click Add; this displays the **Select Java Apama Files** dialog showing the available JMon Application projects.



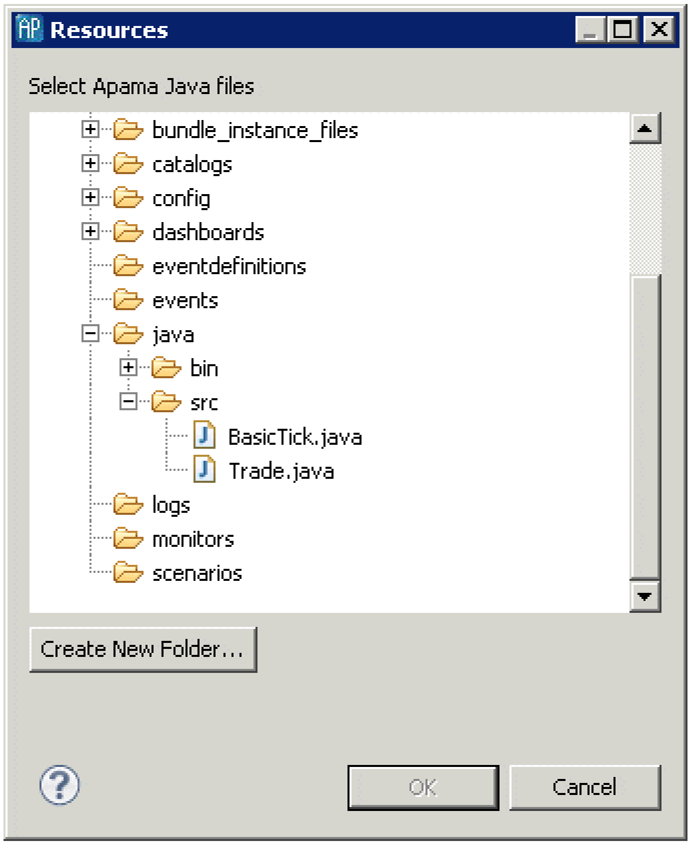
4. Select the JMon application file you want and click OK.
5. When you save the configuration information, Apama Studio generates a .jar file and puts it in a new folder in the current project.

Adding resources to JMon projects

Adding JMon classes

In order to add a JMon monitor or event from another Apama project:

1. In the Apama Java configuration editor, expand the Java Application Classes heading. This displays the current list of the Java classes included in the project. Click Add; this displays the **Select Java Apama Files** dialog showing the available JMon application projects.



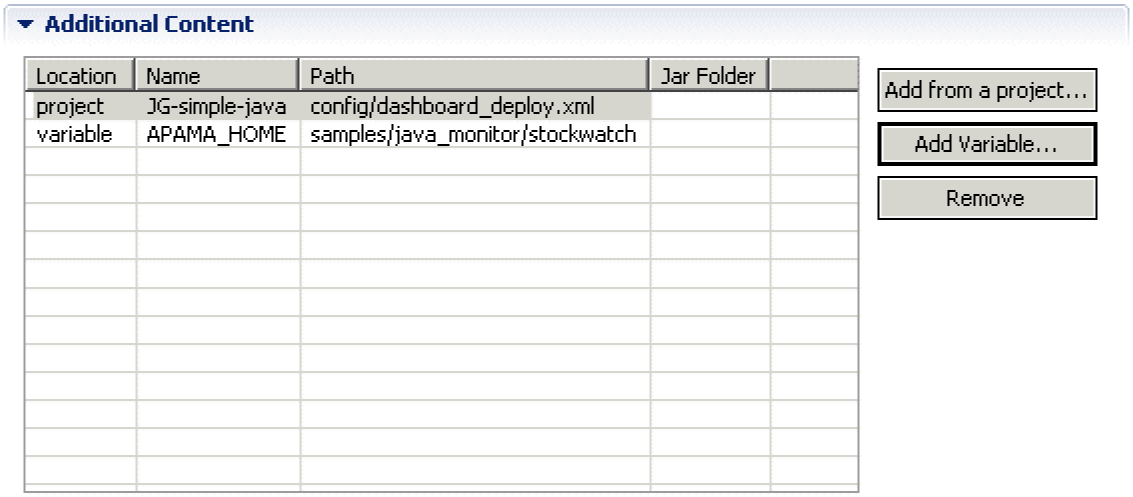
2. In the **Select Java Apama Files** dialog navigate to the class you want to add, select it, and click OK.
3. In the Apama Java configuration editor, you can also change the order in which the JMon classes are listed with the Up and Down buttons. This affects the way the files are ordered in the manifest file and the order in which they are injected in the correlator. Events are injected first, followed by monitors; in both cases, they are injected in the order they are listed here.

Adding resources to JMon projects

Adding non-JMon Java files

To add non-JMon Java files:

1. In the Apama Java configuration editor, expand the Additional Content heading. This displays the current list of non-JMon Java files included in the project.

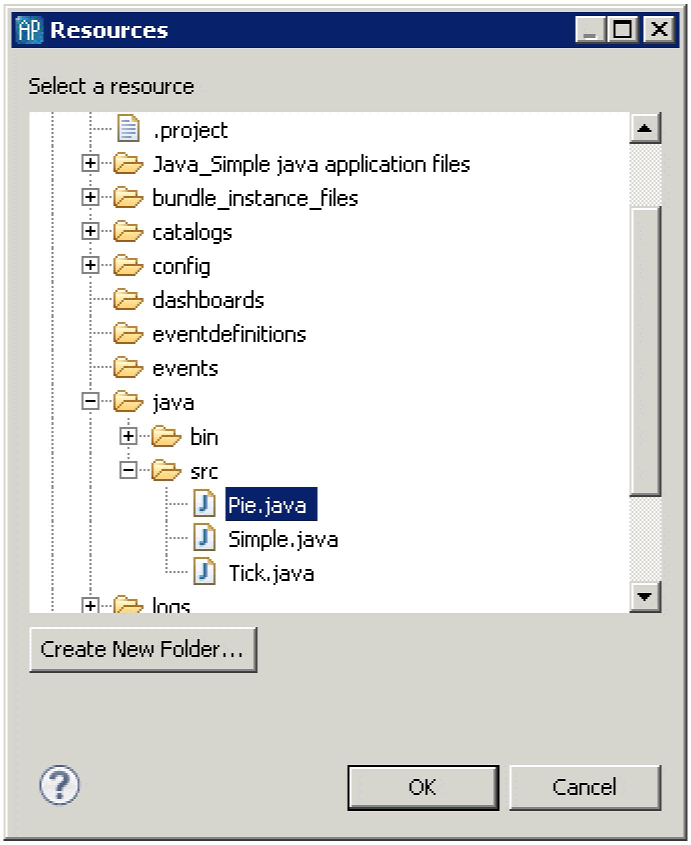


Location	Name	Path	Jar Folder	
project	JG-simple-java	config/dashboard_deploy.xml		
variable	APAMA_HOME	samples/java_monitor/stockwatch		

You can add files from other Apama projects and you can add non-project files from outside the Apama Studio workplace.

2. To add a file from an existing Apama project:

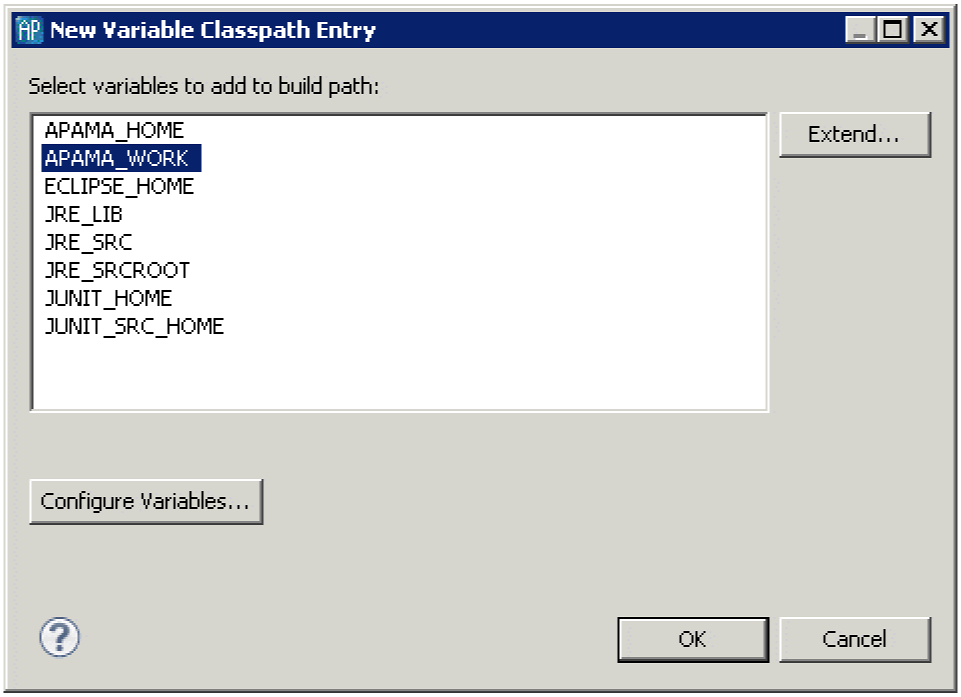
   a. Click Add from a project. This displays the **Select a Resource** dialog.



   b. Navigate to the file you want to add, select it, and click OK.

3. To add a file from outside Apama Studio:

   a. Click Add a Variable. The **Select variables to add to build path** dialog is displayed



.

b. Select a variable and, if necessary, click Extend to identify specific folders on the path. Click OK.

Adding resources to JMon projects

Adding bundles to projects

Bundles are named collections that group the Apama objects that are necessary for different types of applications. *Standard Bundles* contain service monitors and event definitions that are specific to the type of application you are building. For example, applications that include scenarios need the Scenario Service bundle, while applications that use data views need the DataView bundle. *Adapter Bundles* contain adapter configuration files, monitors, and other files needed by the Integration Adapter Framework (IAF). For information on adding adapters, see "Adding adapters to projects" on page 52.

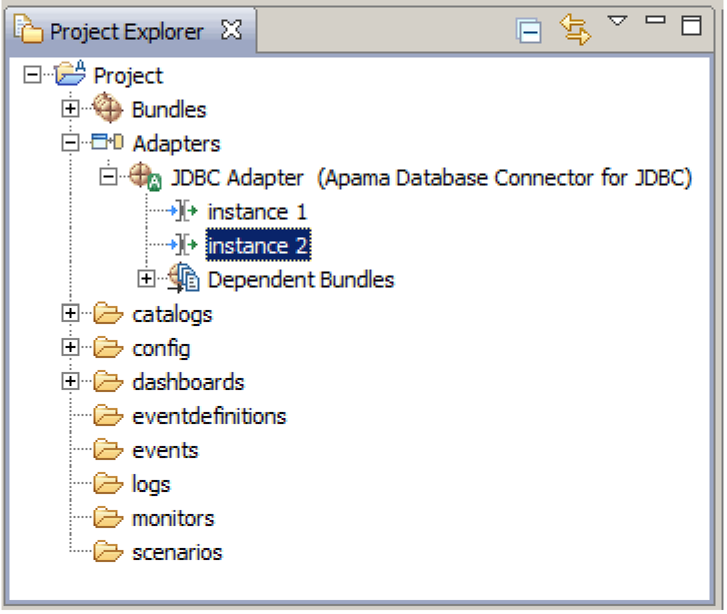
Adding resources to Apama projects

Bundle instances

Many bundles and adapters contain only EPL or Java files; adding these bundles means that references to the bundle files will be added to the project build path, but does not involve copying any files into the project. However, when you add a bundle that contains customizable files such as `.evt` or adapter configuration files, Apama Studio physically copies these files into the project, in addition to the changes made to the project build path.

If you add more than one instance of a particular bundle or adapter to the project, Apama Studio creates separate copies of these files for each instance (except for bundles where it only makes sense to have one copy of the instance files per project). If a bundle contains instance files, you can change and customize those files in any manner. It is possible to add multiple instances of such bundles to a given project, to allow different customizations of the same instance files, for example if your application needs to run with two instances of a particular adapter, each connected to a different data provider.

If a bundle contains instance files, the **Add Bundle Instance** dialog will prompt for a unique *bundle instance name* to identify the instance, to distinguish it from any other instances of the same bundle. This instance name will be included in the filename of the bundle instance files when they are copied into the project. If only one instance of a given bundle will be required, it is fine to use the default bundle instance name. Each bundle or adapter instance is represented in the **Project Explorer**.



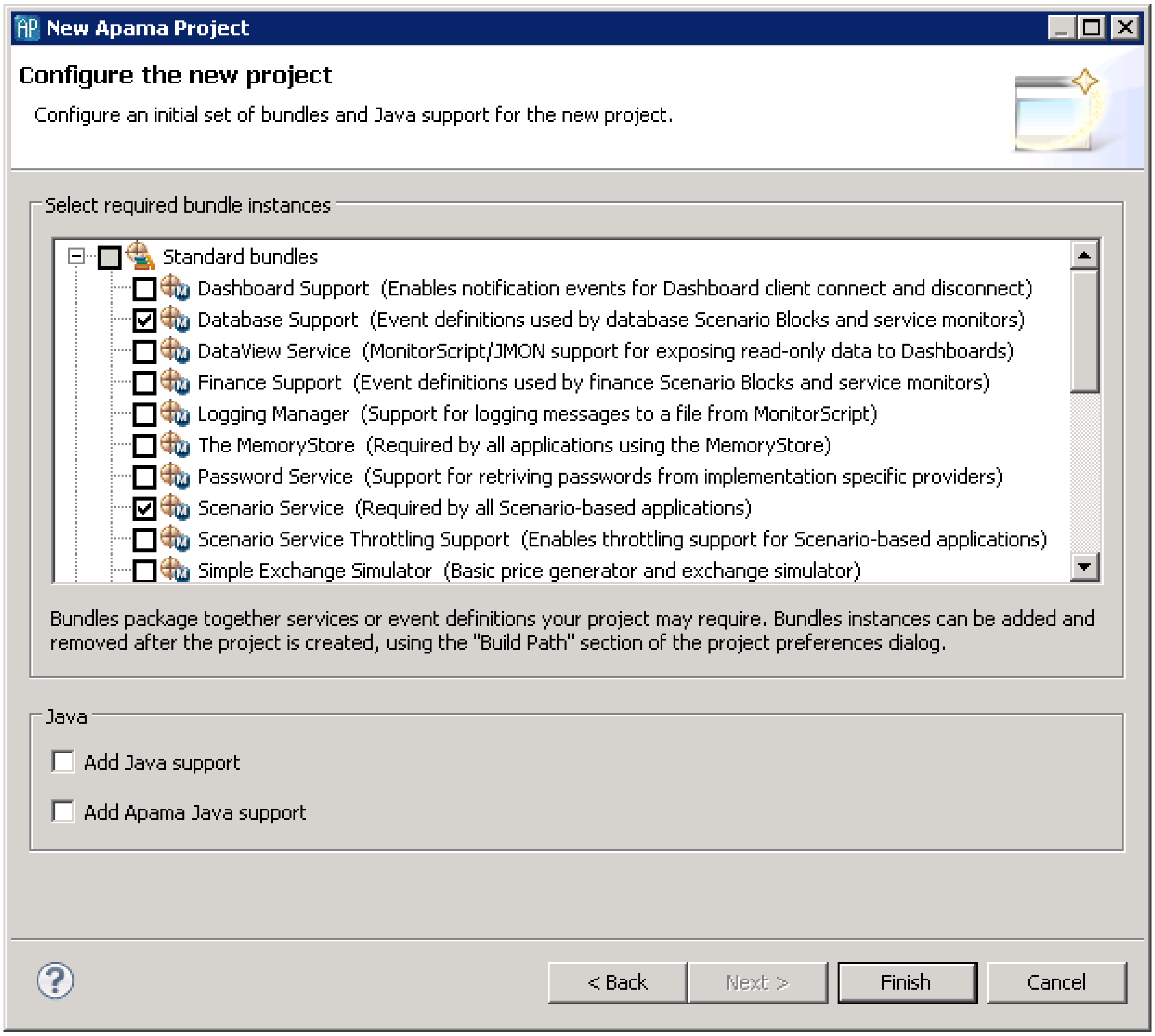
After adding a bundle that contains instance files, the instances can be removed or updated independently (right-click the instance name and select Remove Instance from the pop-up menu). After a bundle with instance files is removed, a dialog will appear to confirm whether you also wish to delete the instance files that were copied to the project. Usually you will want to delete these files at the same time as removing the bundle, as long as backup copies of any important customizations have been made.

It is never necessary to have more than one instance of a bundle that does not contain any instance files, so this option is disabled in the **Add Bundle Instance** dialog.

To add a bundle to an Apama project:

1. There are two ways of adding a bundle to a project.

   - *If you are creating a new Apama project*, select File Project > New > Apama , give it a name, and click Next. The New Apama Project dialog opens.



Configure the new project

Configure an initial set of bundles and Java support for the new project.

Select required bundle instances

- □ Standard bundles
  - □ Dashboard Support (Enables notification events for Dashboard client connect and disconnect)
  - ☑ Database Support (Event definitions used by database Scenario Blocks and service monitors)
  - □ DataView Service (MonitorScript/JMON support for exposing read-only data to Dashboards)
  - □ Finance Support (Event definitions used by finance Scenario Blocks and service monitors)
  - □ Logging Manager (Support for logging messages to a file from MonitorScript)
  - □ The MemoryStore (Required by all applications using the MemoryStore)
  - □ Password Service (Support for retriving passwords from implementation specific providers)
  - ☑ Scenario Service (Required by all Scenario-based applications)
  - □ Scenario Service Throttling Support (Enables throttling support for Scenario-based applications)
  - □ Simple Exchange Simulator (Basic price generator and exchange simulator)

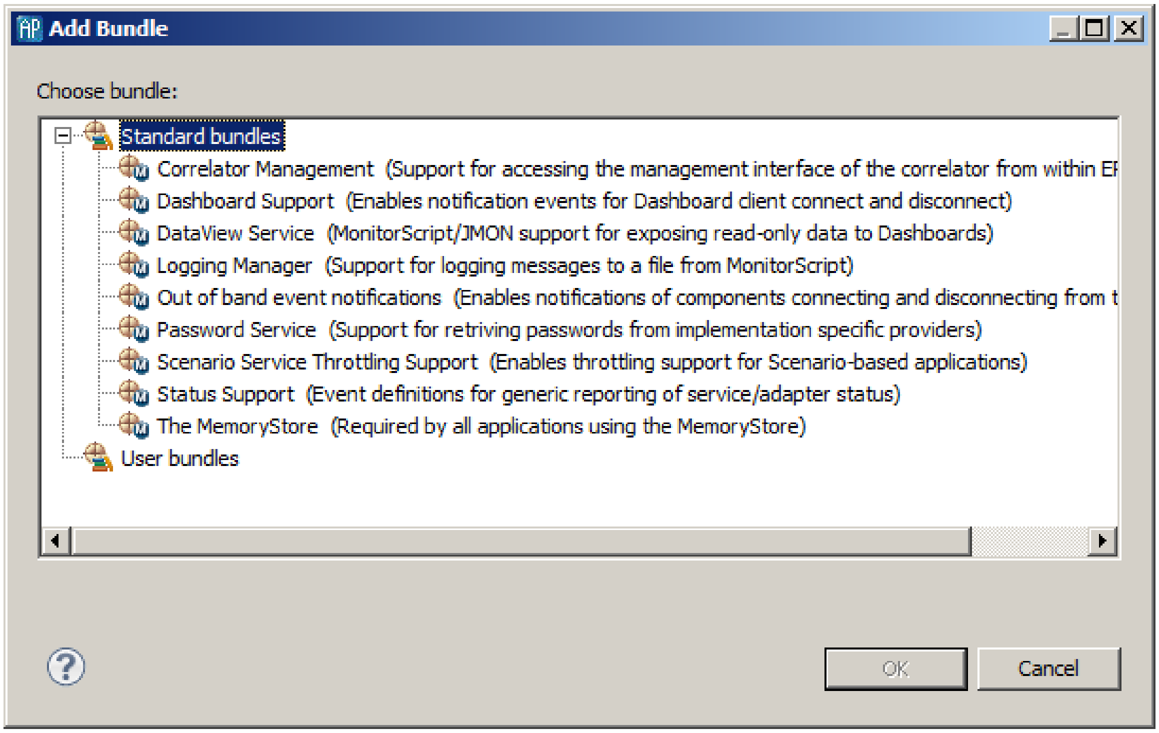
Bundles package together services or event definitions your project may require. Bundles instances can be added and removed after the project is created, using the "Build Path" section of the project preferences dialog.

Java

□ Add Java support

□ Add Apama Java support

- *If you are adding a bundle to an existing project,* in the Project Explorer right-click the project and select Apama > Add Bundle. The **Add Bundle** dialog opens.



Add Bundle

Choose bundle:

- Standard bundles
  - Correlator Management (Support for accessing the management interface of the correlator from within EI
  - Dashboard Support (Enables notification events for Dashboard client connect and disconnect)
  - DataView Service (MonitorScript/JMON support for exposing read-only data to Dashboards)
  - Logging Manager (Support for logging messages to a file from MonitorScript)
  - Out of band event notifications (Enables notifications of components connecting and disconnecting from t
  - Password Service (Support for retriving passwords from implementation specific providers)
  - Scenario Service Throttling Support (Enables throttling support for Scenario-based applications)
  - Status Support (Event definitions for generic reporting of service/adapter status)
  - The MemoryStore (Required by all applications using the MemoryStore)
- User bundles

2. Select the bundle that is appropriate for your application. Click Finish or OK.

Apama Studio adds the bundle to the `Bundles` folder in your project along with the supporting monitors such as `DatabaseSupport.mon`. If a bundle contains a Correlator Deployment Package you can see this in the bundle's hierarchy in the project's `Bundles` folder in Project Explorer.

Adding bundles to projects

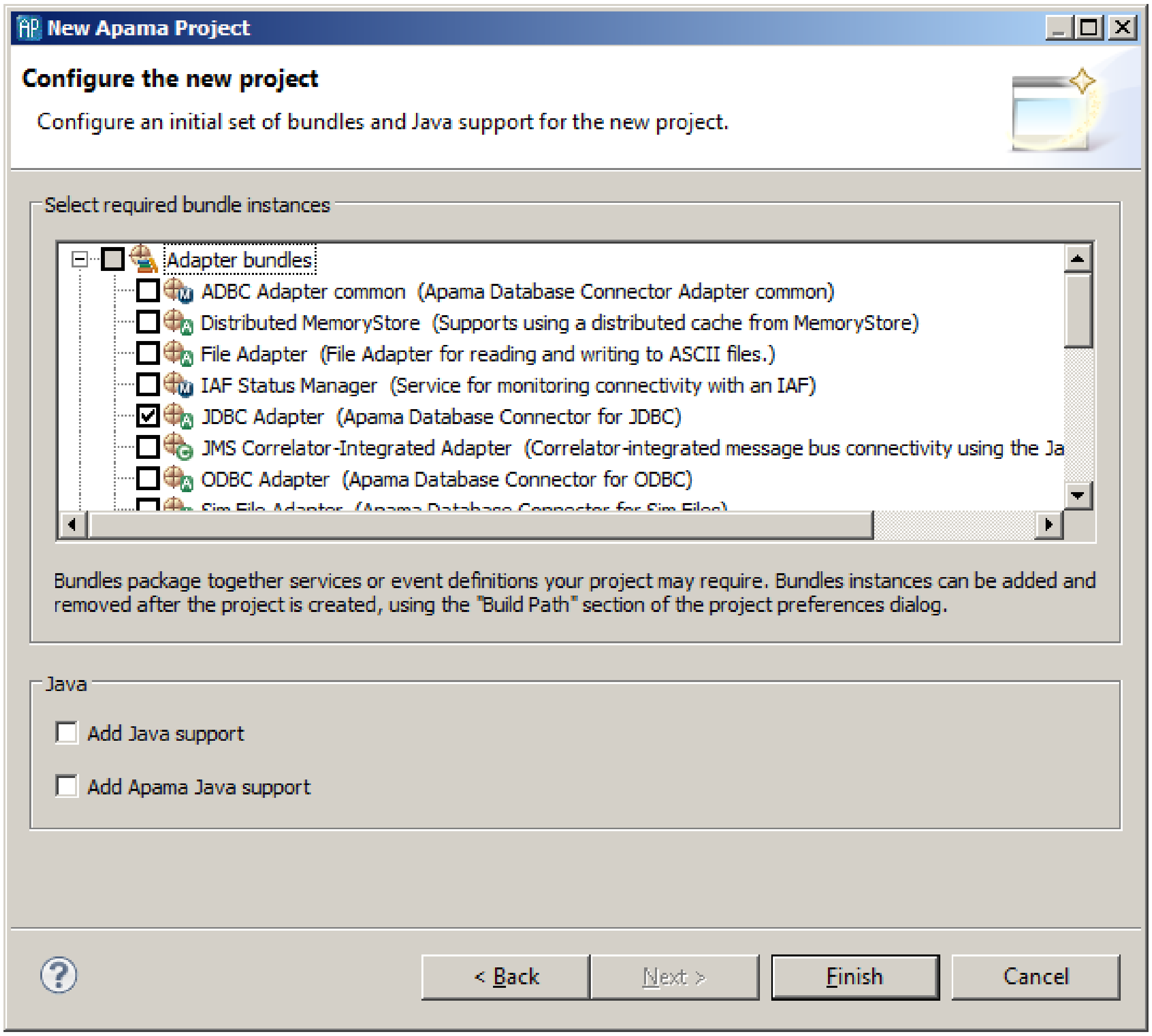
Adding adapters to projects

Apama provides standard adapters that communicate with third-party messaging systems, transforming incoming messages into Apama events and, in the opposite direction, transforming Apama events into the proprietary representations required by third-party messaging systems. In addition, the adapter for the Apama Database Connector (ADBC) allows an application to connect to standard ODBC and JDBC data sources as well as Apama Sim data sources. You can add these adapters to an Apama Studio project by the adding the corresponding adapter bundle to the project.

To add an adapter to a project:

1. There are several ways of adding an adapter to a project.

   - *If you are creating a new Apama project*, select File > Project > New > Apama , give it a name, and click Next. New Apama Project dialog opens.



New Apama Project

Configure the new project

Configure an initial set of bundles and Java support for the new project.

Select required bundle instances

- □ Adapter bundles
  - □ ADBC Adapter common (Apama Database Connector Adapter common)
  - □ Distributed MemoryStore (Supports using a distributed cache from MemoryStore)
  - □ File Adapter (File Adapter for reading and writing to ASCII files.)
  - □ IAF Status Manager (Service for monitoring connectivity with an IAF)
  - ☑ JDBC Adapter (Apama Database Connector for JDBC)
  - □ JMS Correlator-Integrated Adapter (Correlator-integrated message bus connectivity using the Ja
  - □ ODBC Adapter (Apama Database Connector for ODBC)
  - □ Sim File Adapter (Apama Database Connector for Sim Files)

Bundles package together services or event definitions your project may require. Bundles instances can be added and removed after the project is created, using the "Build Path" section of the project preferences dialog.

Java

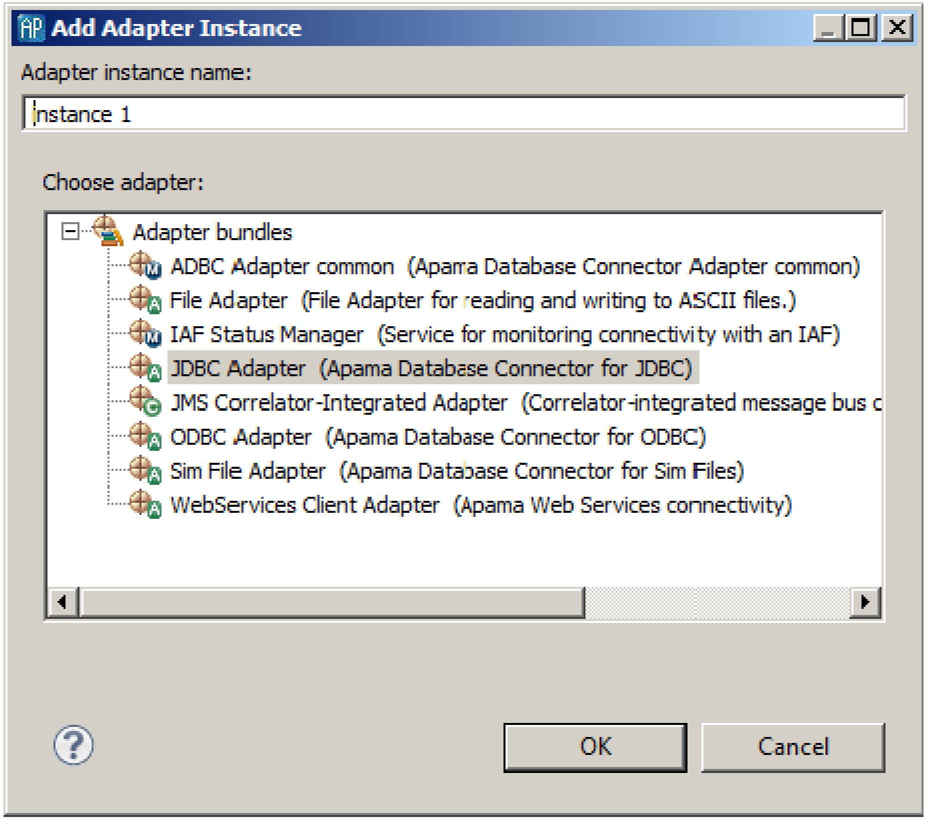
□ Add Java support

□ Add Apama Java support

- *If you are adding an adapter to an existing project*:

a. In the Project Explorer right-click the project and select Apama > Add Adapter. The **Add Adapter Instance** dialog opens.

b. If desired, in the **Add Adapter Instance** dialog, create a new name for the adapter instance or accept the default instance name. Apama Studio prevents you from using a name that is already in use.



Add Adapter Instance

Adapter instance name: Instance 1

Choose adapter:

- Adapter bundles
  - ADBC Adapter common (Apama Database Connector Adapter common)
  - File Adapter (File Adapter for reading and writing to ASCII files.)
  - IAF Status Manager (Service for monitoring connectivity with an IAF)
  - JDBC Adapter (Apama Database Connector for JDBC)
  - JMS Correlator-Integrated Adapter (Correlator-integrated message bus c
  - ODBC Adapter (Apama Database Connector for ODBC)
  - Sim File Adapter (Apama Database Connector for Sim Files)
  - WebServices Client Adapter (Apama Web Services connectivity)

2. Select the adapter bundle that is appropriate for your application. Click Finish or OK.

Apama Studio adds an instance of the adapter to the `Adapters` folder in your project along with the supporting monitors such as `IAFStatusManager.mon` and the associated service monitors. Reference to bundled files associated with the adapters, such as IAF Status Manager and Status Support are listed in the adapter's `Dependent Bundles` folder

You can add multiple instances of a given adapter to a project. This allows you create different configurations of the adapter, for example if your application needs to run with different data providers.

For more information on configuring Apama standard adapters, see "Using Standards Adapters" and "Using the Apama Database Connector" in *Connecting Apama Applications to External Components*.

Adding resources to Apama projects

Adding Universal Messaging configuration to projects

Universal Messaging (UM) is Software AG's middleware service that delivers data across different networks. It provides messaging functionality without the use of a web server or modifications to firewall policy. In Apama applications, you can configure and use the connectivity provided by UM.

Apama provides the `UM-config.properties` template file in the `etc` folder of your Apama installation directory. The template is for a standard Java properties file. When you add UM configuration to a project, Apama Studio copies the `UM-config.properties` file to the `config` folder in your project.

To add UM configuration information to a project:

1. Right-click the project you want to add UM configuration properties to.
2. Select Apama > Add UM Configuration.

   A project can contain only one UM configuration properties file. If a `UM-config.properties` file is already in the `config` folder of your project then this option is not available.
3. Right-click the `UM-config.properties` file that is now in the `config` folder of your project. Select Open With > Apama UM Configuration Editor.

   For details about the content of this file, see "Defining UM properties for Apama applications" in *Connecting Apama Applications to External Components*.

For information about using UM in an Apama application, see "Using Universal Messaging" in *Connecting Apama Applications to External Components*.

Adding resources to Apama projects

Editing Apama files

Apama Studio provides many features to help you write application code for monitor files (`.mon`), query files (`.qry`), block definition files (`.bdf`), event files (`.evt`), and JMon monitor and JMon event files. The following topics provide instructions for using these features:

- "Obtaining content assistance" on page 55
- "Using auto-completion" on page 56
- "Displaying information for events and actions" on page 56
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Working with Projects

Obtaining content assistance

To obtain content assistance, enter Ctrl+space in a blank line, or after one or more words in a line.

Apama Studio displays a list of keywords or names that are valid in that location. For example, it might display a list of event types, standard functions, or actions. Double click the one you want or select with the arrow keys and press Enter.

To ensure that content assistance is always as up-to-date as possible, turn on automatic builds. Automatic builds ensure that when you add, delete, or change a project resource, Apama Studio immediately builds the project. Building a project after a resource change ensures that content assistance has access to the most current resources. See "Build automatically when a resource changes" on page 64.

Using auto-completion

To have Apama Studio automatically complete the word you are typing, enter Ctrl+space.

If you have entered enough characters so that there is only one possible completion, Apama Studio inserts the rest of the word. If there are two or more possible completions, Apama Studio displays a list of the completion candidates. Double-click the correct completion or select with the arrow keys and press Enter.

Apama Studio displays only those completion candidates that are valid in the current context and scope.

To ensure that auto-completion is always as up-to-date as possible, turn on automatic builds. Automatic builds ensure that when you add, delete, or change a project resource, Apama Studio immediately builds the project. Building a project after a resource change ensures that auto-completion has access to the most current resources. See "Build automatically when a resource changes" on page 64.

Displaying information for events and actions

When you position the mouse cursor to hover over an event declaration or action, Apama Studio pops up a box that displays the event type definition or the signature for the action.

Specifying comments

To toggle comment notation, click in a line or select one or more lines, and press Ctrl+/.

Alternatively, you can adjust comment notation as follows:

1. Click in a line or select one or more lines.
2. Right-click anywhere in the code editor.
3. In the menu that appears, select Source and then one of the following:
   - Toggle comment — Inserts `//` comment notation if the selected line or lines is not a comment. Removes `//` comment notation if the selection is already a comment.
   - Add block comment — Inserts `/*` at the beginning of the section, and `*/` at the end of the selection.
   - Remove block comment — Removes the `/*` and `*/` notation.

Using auto-Indent

To indent one or more lines relative to the entire EPL file:

1. Click in a line or select one or more lines.
2. Press Ctrl+i.

   Alternative: Right-click in the code editor and select Source > Correct Indentation .

Using auto-bracketing

Auto-bracketing is turned on by default.

When auto-bracketing is turned on, and you enter an open bracket ({) or open quotation marks, Apama Studio automatically inserts the closing bracket or closing quotation marks.

To toggle auto-bracketing:

1. In the Apama Studio menu bar, choose Window > Preferences.
2. Expand Apama.
3. Click MonitorScript.
4. Select or clear the Auto Close Brackets checkbox.
5. Click OK.

Using tabs

Apama Studio inserts tabs instead of spaces by default. Each tab is four spaces.

To toggle whether Apama Studio uses tabs or spaces:

1. In the Apama Studio menu bar, choose Window > Preferences.
2. Expand Apama.
3. Expand MonitorScript.
4. Click Editor Formatting.
5. Select or clear the Insert tabs instead of spaces checkbox.
6. If you want, adjust the number of spaces in each tab.
7. Click OK.

Defining shorthand (templates) for frequently used EPL code

EPL templates provide a way for you to define a short name for a longer pattern that you often specify in an EPL file. For example, Apama Studio provides the `dict` template. When you enter `dict` followed by a space, Apama Studio automatically inserts `dictionary<>`.

Apama Studio provides some templates and you can define additional templates. Each Apama project can use all EPL templates.

Apama Studio provides the following EPL templates. To use one, type its name followed by a space.

Name	Description	Pattern
`dict`	`dictionary<>`	`dictionary<%\c>`
`ona`	`on all`	`on all %\c`
`onall`	`on all`	`on al %\c`
`seq`	`sequence<>`	`sequence<%\c>`

In the pattern, `%\c` indicates the location of the cursor after you type the template name.

To define an EPL template:

1. In the Apama Studio menu bar, choose Window > Preferences.
2. Expand Apama.
3. Expand MonitorScript.
4. Click Editor Templates.
5. Click New.
6. In the Name field, specify what you want to enter to insert an instance of the template.
7. In the Description field, specify what Apama Studio should display in the EPL file.
8. In the Pattern field, duplicate what you specified in the Description field and insert `%\c` to indicate the location of the cursor after Apama Studio inserts the value.
9. Click OK twice. All Apama projects can now use this template.

Sharing templates among Apama Studio installations

You can define templates in one Apama Studio installation, and export them for use in another Apama Studio installation.

To export templates:

1. In the source Apama project, define the templates you want to share. See "Defining shorthand (templates) for frequently used EPL code" on page 57.
2. In the **Editor Templates** dialog, click Export All.

3. In the **Export Abbreviations** dialog, specify a text file to contain the templates you are exporting. The default file name is `Abbreviations.txt`. If you can, specify a path that is reachable from Apama Studio installations that will import the templates.
4. Click Save.
5. Click OK.

In some other Apama Studio installation, import the templates as follows:

1. Open the project into which you want to import templates.
2. In the Apama Studio menu bar, choose Window > Preferences .
3. Expand Apama.
4. Expand MonitorScript.
5. Click Editor Templates
6. Click Import.
7. In the **Import Abbreviations** dialog, navigate to a file that contains template definitions.
8. Double-click it.
9. Click OK

Specifying colors to distinguish EPL elements

In EPL files, Apama Studio uses the following colors to indicate the various parts of EPL code:

- Keywords are dark magenta.
- Types are red.
- Comments are green.
- Literal values are blue.
- Operators (+, –, =, and so on) are black.
- All other text is black.

To change one or more colors:

1. In the Apama Studio menu bar, choose Window > Preferences.
2. Expand Apama.
3. Expand MonitorScript.
4. Click Editor Colors.
5. Click the current color of the item whose color you want to change.
6. In the color palette that appears, click the new color.
7. Click OK twice.

Shortcuts when editing Apama files

Apama Studio provides the following shortcuts, in addition to the usual Eclipse shortcuts:

Action	Key	Description
Auto-completion and content assistance	Ctrl+space	If the text you entered has only one possible completion, Apama Studio inserts the completion. If you did not enter any text, or if there are two or more completion candidates, Apama Studio displays candidates for you to choose from.
Toggle comment line notation	Ctrl+/	Toggles comment notation for selected lines. That is, this action inserts or removes // from the beginning of each line.
Insert block comment	Ctrl+Shift+/	Makes the selected text a block comment. That is, this action inserts / * at the beginning of the selected text, and */ at the end of the selected text.
Remove block comment notation	Ctrl+Shift+\	Removes block comment notation from the selected text. That is, this action removes /* from the beginning of the selected text, and */ from the end of the selected text.
Auto-indent	Ctrl+i	Inserts appropriate indents in selected lines relative to the entire file.
Move line (s) up	Alt+up arrow	Move the selected line or lines to be before the previous line.
Move line(s) down	Alt+down arrow	Move the selected line or lines to be after the subsequent line.
Shorthand for any EPL	Templates	Templates let you define short names for patterns you frequently specify in EPL files. See "Defining shorthand (templates) for frequently used EPL code" on page 57.

Navigating in Apama files

In addition to the usual Eclipse navigation tools, Apama Studio lets you quickly jump to particular parts of an EPL file by

- "Using the Outline view to navigate" on page 61
- "Using the Quick Outline to navigate" on page 61
- "Jumping to an event or action definition or variable declaration" on page 61"Adding JMon classes" on page 46
- "Searching in EPL files" on page 61

You can use these features to navigate the code of EPL files (`.mon`), and block definition files (`.bdf`).

Working with Projects

Using the Outline view to navigate

In an Apama Studio perspective, the Outline view displays the event types and monitors in the currently open `.mon` or `.bdf` file, showing event parameters and actions and monitor fields, actions, and listeners within actions. When you click an entry in the Outline view, the focus in the editor view jumps to the code that defines the item you clicked.

Apama Studio updates the Outline view each time it saves your EPL file. If you add a resource to your EPL file but you do not save your file, the new resource does not appear in the Outline view until you save your file.

Using the Quick Outline to navigate

While you are viewing a `.mon` or `.bdf` file in the Apama Studio editor, you can use the Quick Outline to jump to an event type, monitor, or action. Press Ctrl+O or select Navigate > Quick Outline to display the Quick Outline. Apama Studio pops up a list of event parameters and actions and monitor fields, actions, and listeners within actions for the current EPL file. Click an entry in the list to jump to the code that defines the item you click.

Jumping to an event or action definition or variable declaration

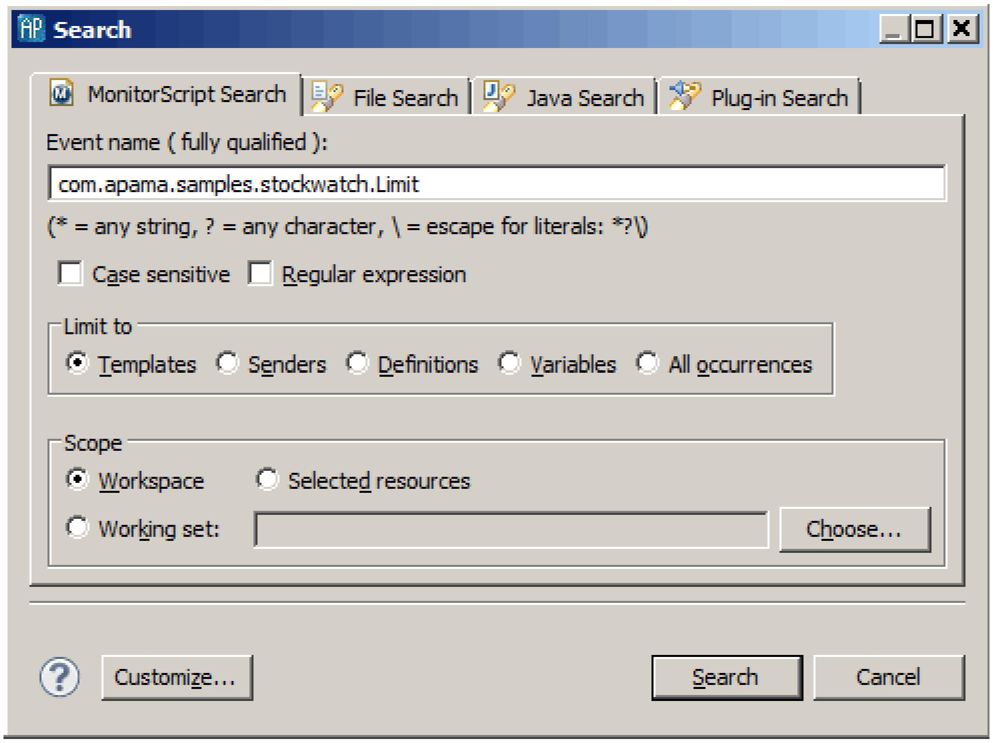
To jump to an event or action definition or variable declaration:

1. Select a reference to the event, action, or variable whose declaration you want to view.
2. Press F3 or choose Navigate > Open Declaration from the Apama Studio menu bar. Apama Studio highlights the line that begins the declaration for the selected event or variable.

Searching in EPL files

You can search for event types in your project's `.mon` or `.bdf` files. To start a search:

1. In either the **Developer** or **Workbench** perspective, select Search > Search from the menu bar. In the **Developer** perspective, you can also click the Search icon. The **Search** dialog is displayed. Make sure the MonitorScript Search tab is selected.



Event name (fully qualified): com.apama.samples.stockwatch.Limit

(* = any string, ? = any character, \ = escape for literals: *?\)

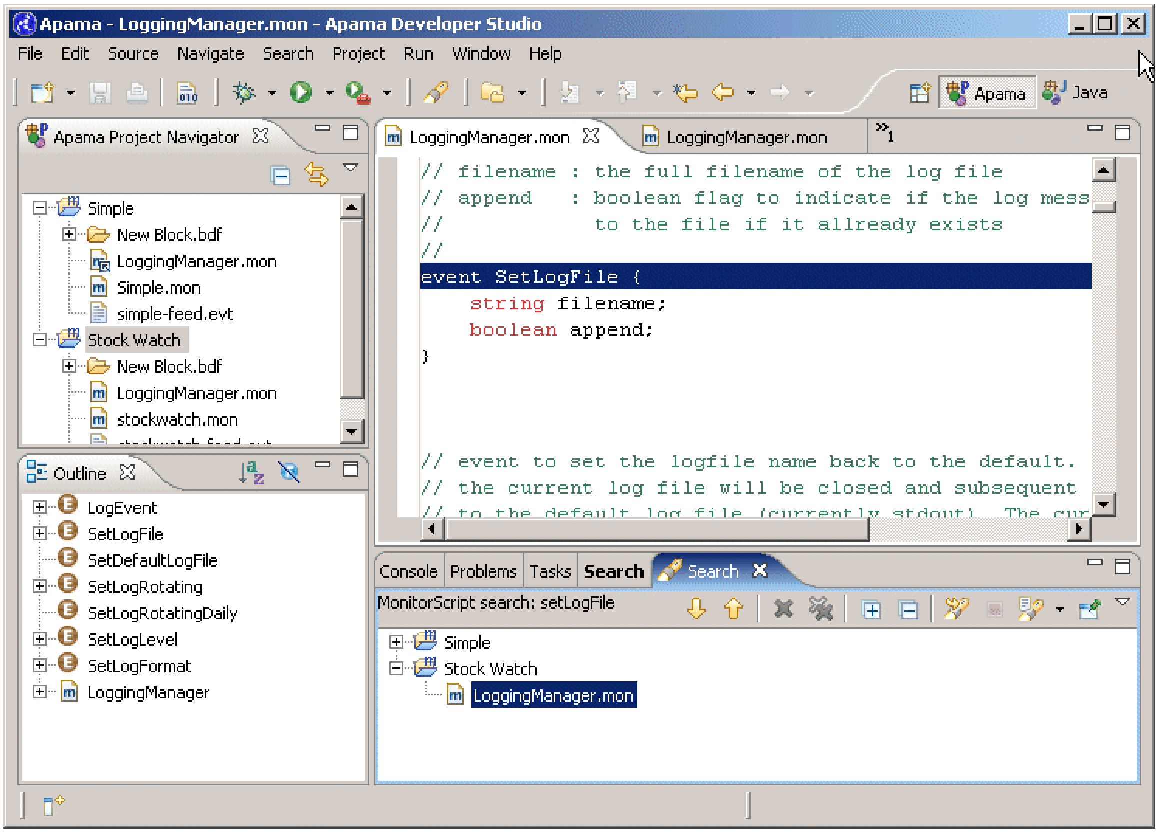
□ Case sensitive □ Regular expression

Limit to: ● Templates ○ Senders ○ Definitions ○ Variables ○ All occurrences

Scope: ● Workspace ○ Selected resources ○ Working set: Choose...

2. Type the event type you want to search for in the Event name (fully qualified) field. You can use wildcard characters and regular expressions in your search. Modify the search details as necessary, for example by specifying if the search should be case sensitive or if you want to limit the scope of the search. You can limit your search to templates (event listeners), senders (route, enqueue, and emit), and variables (event types are used as variables).

3. Click Search. Results are displayed in the Search view (Search tab), showing the files where the search term occurs and how many times it occurs. To display the first occurrence of the search term, double click the file name or click the Show Next Match ⇩ button. This opens the file containing the term in the appropriate editor. You can navigate through all occurrences of the search term with Show Next Match ⇩ and Show Previous Match ⇧ buttons.



```
// filename : the full filename of the log file
// append   : boolean flag to indicate if the log mess
//            to the file if it allready exists
//
event SetLogFile {
    string filename;
    boolean append;
}


// event to set the logfile name back to the default.
// the current log file will be closed and subsequent
// to the default log file (currently stdout). The cur
```

MonitorScript search: setLogFile

Building Apama projects

In Apama Studio, “building a project” refers to the process in which the project is validated, and any errors or warnings flagged to the user. This section describes the features Apama Studio provides to control when Apama Studio will build an Apama project.

Apama Studio includes options to:

- "Build automatically when a resource changes" on page 64
- "Build all Apama projects" on page 64
- "Build one Apama project" on page 64
- "Build a working set" on page 64
- "Clean and rebuild projects" on page 65

Apama Studio tries to complete each build. It does not stop when it finds an error. If Apama Studio finds problems during validation, it indicates them as follows:

- In the Problems view, the error icon ⊗ appears at the beginning of each line that describes an error.
- In the Project view, the error icon ⊗ appears at the beginning of the name of a project that contains at least one file that is not valid.
- In the Project view, the error icon ⊗ also appears at the beginning of the name of each file that is not valid.

- In the file editor, the error icon ⊗ appears at the beginning of each line that contains an error.
- In the overview scroll bar to the right of the editing pane, regardless of how long the file is, a mark ▬ appears for every error in the file. You can hover over a mark to view a description of the error that it flags, or you can click on any mark to display the line that contains that error.

Working with Projects

Build automatically when a resource changes

Apama Studio can automatically build a project whenever you add, delete, or change a resource in that project. This is the default and Apama strongly recommends that you leave this feature on. Building a project automatically ensures that content assistance menus are always up to date.

To toggle Build Automatically on or off:

1. Select Project in the Apama Studio menu.
2. In the drop-down menu that appears, if a checkmark appears in front of Build Automatically, automatic builds are already turned on. Otherwise, select Build Automatically to turn it on.

Build all Apama projects

To validate all Apama projects in your workspace, choose Project > Build All from the Apama Studio menu bar.

Build one Apama project

To validate one Apama project:

1. In the Apama Project Explorer view, select the project you want to build.
2. In the Apama Studio menu bar, choose Project > Build Project.

Build a working set

When an Apama project is large, you might find it more efficient to build a subset of the project rather than the entire project. To build a subset of an Apama project, specify a working set that contains the files you want to build. Then build the working set you defined.

To define a working set:

1. In the Apama Studio menu bar, choose Project > Build Working Set > Select Working Set.
2. In the **Select Working Set** dialog, click New.
3. Double-click Resource.

4. Specify a name for this working set.

5. Expand the project(s) that contains the file(s) that you want to be in the working set.

6. Select the file(s) that you want to be in the working set, and click Finish.

7. Back in the **Select Working Set** dialog, select the working set you just defined and click OK.

To build this working set, choose Project > Build Working Set > working_set_name from the Apama Studio menu bar.

Clean and rebuild projects

When Apama Studio cleans a project, it discards all build problems and build states. To rebuild a project from scratch, as though you have never built it before:

1. In the Apama Studio menu bar, choose Project > Clean.

2. Indicate which projects you want to rebuild from scratch or select Clean all projects.

3. Click OK.

Configuring the project build path

By default, Apama Studio will include all of the files in a project when building (and launching) it. However, for many applications it will be necessary to customize the build path, adding additional files from outside the project (and less commonly, limiting the set of files under the project directory that will be included). The set of files under the project directory that will be build can be customized using the Source tab. Apama Studio provides three ways to add additional files from outside the project to its build path:

- Required Projects
- External MonitorScript Dependencies
- Bundles

Project source files

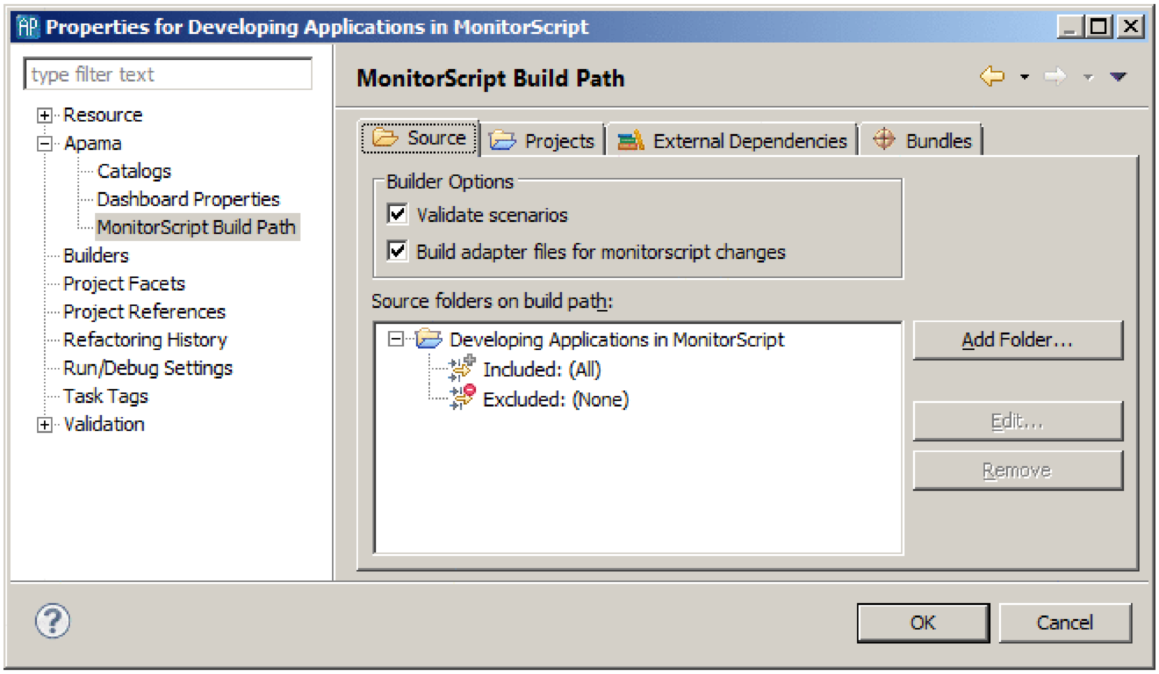
By default, all files in the project directory are included in the build path, but this can be customized. Files within a project are grouped into folders and you can specify which folders should be included when a project is built. In addition, within each folder you can specify patterns that determine which files should be included or excluded.

To specify files this way:

1. Select the project in the Project view and select Project > Properties from the Apama Studio menu.

2. Expand Apama.

3. In the **Properties** dialog, select MonitorScript Build Path, and display the Source tab.



Builder Options

☑ Validate scenarios

☑ Build adapter files for monitorscript changes

Source folders on build path:

- Developing Applications in MonitorScript
  - Included: (All)
  - Excluded: (None)

4. On the Source tab you add new folders and specify which files to include in the build process. For example, you can include all event files with the `.evt` extension. For folders in the project, you can also modify which files to include or exclude.

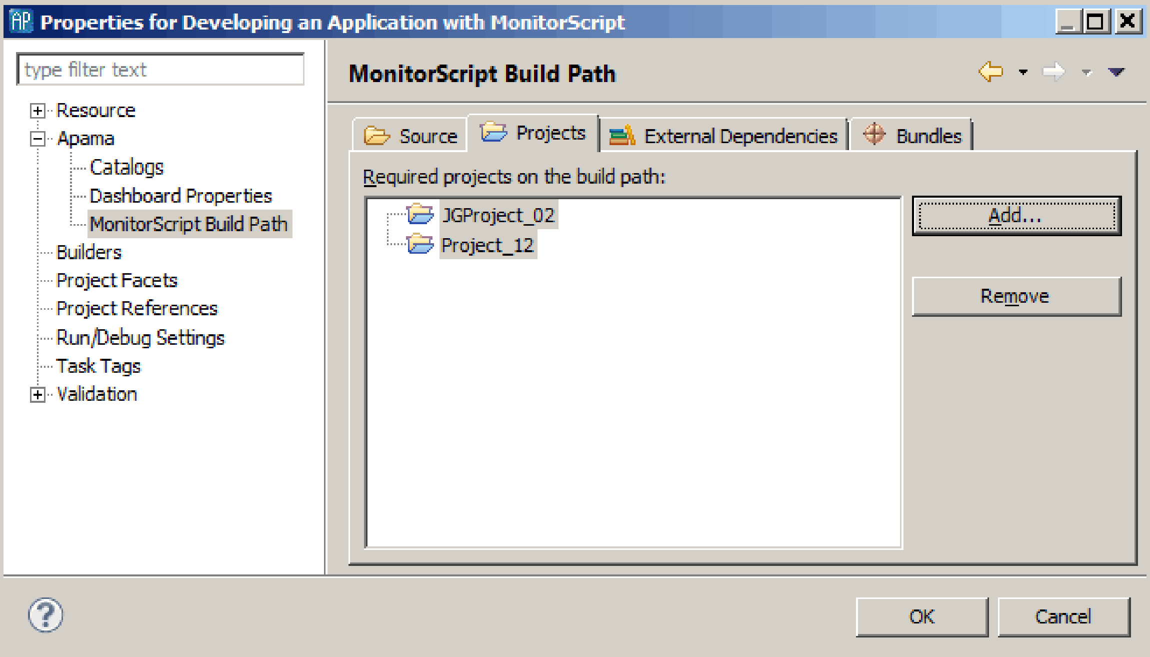
Specifying projects

A project can make use of other Apama Studio projects. To specify that your project should include another project in the build process:

1. Select the project that requires another project in the Project view and select Project > Properties from the Apama Studio menu.

2. Expand Apama.

3. In the **Properties** dialog, select MonitorScript Build Path, and display the Projects tab.



4. On the Projects tab, click Add to display the **Required Project Selection** dialog where you specify which projects to include in the build process.

Specifying external dependencies

When an EPL file in your project depends on an external EPL file, you must explicitly specify the dependency. For example, if you refer to event types or actions that are defined in other EPL files, you must specify the files that define those constructs. This ensures that Apama Studio includes the external file in the validated project. It also ensures that the Apama Studio builder, content assistance facility, and launcher have access to the most up-to-date version of each required file.

How you define dependencies depends on whether you are the only one using your project or you share the project with one or more users.

Specifying dependencies for a single-user project

When you are the only one using a project, specify a file that your EPL file depends on as follows:

1. Select the project for which you want to define a dependency.
2. In the Apama Studio menu bar, choose Project > Properties.
3. In the **Properties** dialog that appears, select Apama.
4. Click MonitorScriptBuild Path.
5. Display the External Dependencies tab.
6. Click Add External.
7. In the **MonitorScript File Selection** dialog, navigate to the file your project requires.
8. Double-click the file.
9. Click OK in the **Properties** dialog to specify the dependency.

Specifying dependencies for a multi-user project

When Apama Studio builds a project, it defines any dependencies in an XML file that hardcodes the path to the external file(s). This works correctly if you do not share projects among multiple users. However, if two or more users share a project, they might not store external files in the same location.

If you are sharing projects among two or more users, you should use a variable to define an external file on which your EPL file depends. For example, Apama Studio automatically defines APAMA_HOME and APAMA_WORK variables that can be used to locate files under either of those directories in a way that is independent of exactly where Apama has been installed on the current machine. To use a variable to define a dependency:

1. Select the project, or a file in the project, for which you want to define a dependency.
2. In the Apama Studio menu, choose Project > Properties.
3. In the **Properties** dialog that appears, expand Apama.
4. Click MonitorScriptBuild Path.
5. Display the External Dependencies tab.
6. Click Add Variable.
7. In the **New Variable Dependency Entry** dialog that appears, do one of the following:
   - If a variable already exists that identifies the required file, double-click that variable. Then click OK. You are done and can skip the remaining steps.
   - To define a new variable that identifies the required file, click Configure Variables.
8. In the **New Variable Entry** dialog, in the Name field, enter the name of the new variable. The convention is to use UPPER_CASE names for build path variables (for example, APAMA_HOME).
9. Click File... or Folder... according to which one you want the variable to represent.
10. Navigate to the appropriate folder or EPL file and double-click it.
11. Click OK twice.
12. Click OK in the **Preferences** dialog; Apama Studio confirms that the classpath variables have changed, and prompts you to indicate whether you want to rebuild your project so that it can use the new variable. Click Yes.

Defining MonitorScript Build Path variables

In any Apama project, you can define a variable that you can use in all your Apama projects. You might find it useful to define a variable in a situation where multiple users share the same project. If the project is dependent on one or more external files, not all users might have the external file stored in the same location. Each user defines a variable to specify the location of a shared file dependency.

To define an Apama project variable:

1. In the Apama Studio menu bar, choose Window > Preferences.
2. In the **Preferences** dialog that appears, expand Apama.
3. Click MonitorScript Path Variables.

4. In the **MonitorScript Path Variables** dialog, click New.

5. In the **New Variable Entry** dialog, in the Name field, enter the name of the new variable.

6. Click File... or Folder... according to which one you want the variable to represent. Choose whatever is convenient for you. If the variable represents a directory, you can use the same variable in the path for more than one file. If the variable represents a file, you can use that variable for only that file's path.

7. Navigate to the appropriate folder or EPL file and double-click it.

8. Click OK and in the **New Variable Entry** dialog, click OK again.

9. Click OK in the **Preferences** dialog; Apama Studio displays the **Build path Variables Changed** dialog asking if you want to perform a full build of your project. Click Yes to ensure that the current project state is consistent with the new variable. If you are sure that the new variable does not affect the current project state, you can click No.

Importing projects

To import an Apama Studio project created on another machine into this Apama Studio workspace:

1. Select File > Import > General > Existing Projects into Workspace from the Apama Studio menu. Click Next.

2. In Select root directory specify the root directory where the project is located.

3. Add a check box next to the project(s) you want to import.

4. Check the Copy projects into workspace checkbox if you want to copy all the project files into the workspace directory (located under `APAMA_WORK`)

   Leave the check box unchecked if you want to simply link to the project in its current location instead.

If you have an Apama application that is not currently part of an Apama project:

1. Select File > New > Apama Project from the Apama Studio menu.

2. Enter the name of the new project.

3. Uncheck the Use default location check box.

4. Specify the folder containing the files that you wish to import as a new project.

5. Click Finish.

A project that you import might have dependencies on environment variables, bundles, blocks, or functions that have not yet been added to Apama Studio. As an alternative to explicitly adding each dependency, see "Setting up the environment before importing projects" on page 70.

Working with Projects

Importing adapter configurations

You can import a Web service client adapter configuration from an archive file that has been generated in Apama Studio. To import a Web service client adapter configuration into an Apama Studio project:

1. In the **Project Explorer** view, right-click the name of the project and select Import from the pop-up menu. This displays the **Import** dialog.
2. In the **Import** dialog, expand Apama.
3. Select Adapter Configurations and click Next. The **Adapter Configurations Import Wizard** appears.
4. In the **Adapter Configurations Import Wizard**, specify the archive file that contains the adapter configuration you want to import. You can use the Browse button to navigate to the desired project.
5. Accept or specify the name of the project into which you want to import the adapter configuration. You can use the Browse button to navigate to the desired location.
6. Click Finish. This adds the adapter configuration to the specified Apama project.

Working with Projects

Setting up the environment before importing projects

A project that you want to import into Apama Studio might have dependencies on any of the following:

- Environment variables
- Catalogs of blocks, bundles or functions
- String substitutions

Before you can build your project, you would need to add each dependency to Apama Studio. An alternative to adding each dependency is to define the dependencies in a file, and place the file in the `$APAMA_HOME\studio\extensions` folder. When Apama Studio starts it collects any files in its `extensions` folder and uses them to set up the Apama Studio environment. When you then import your project its dependencies will already be in place.

Format of extensions file

A file in the `extensions` folder must have the `.ste` (Studio Tuning Extension) extension and the data it contains must be in the following format:

- Define each item to be added to Apama Studio on its own line.
- The first value in each line must be the type of the item you want to add. The type must be one of the following:
  - `BLOCK_CATALOG`
  - `BUNDLE_CATALOG`
  - `FUNCTION_CATALOG`
  - `STRING_SUBSTITUTION`
  - `VARIABLE`

- In each line, insert a semicolon between values.
- Insert # at the beginning of a line to make it a comment.
- The values you specify vary according to the specified type. Path specifications must be fully qualified; they cannot be relative. In a path specification, you can use a variable, which can be defined directly in Apama Studio or in any .ste file. You can specify the items in any order.
  - For block, bundle, or function catalogs, the format is the type followed by a path. For example:

    ```
    BLOCK_CATALOG ; C:\Program Files\MyCompany\MyApp\MyBlockCatalog
    ```

  - For string substitutions, the substitution value cannot be edited or removed in Apama Studio. For details, See Java development user guide > Reference > Preferences > Run/Debug > String Substitutions in the Eclipse help provided with Apama Studio. The format is as follows:

    ```
    STRING_SUBSTITUTION ; variable_name ; path ; description
    ```

    For example:

    ```
    STRING_SUBSTITUTION ; HOME ; C:\MyApp ; Install dir for my app
    ```

  - For variables, the variable's value cannot be edited and the variable cannot be removed in Apama Studio. The format is as follows:

    ```
    VARIABLE ; variable_name ; path
    ```

    For example:

    ```
    VARIABLE ; HOME ; C:\MyApp
    ```

Suppose you have a .ste file in place and you start Apama Studio. If you subsequently modify the content of that .ste file you must restart Apama Studio for the changes to take effect.

Results of using an extensions file

After you define an extensions file, place it in the `$APAMA_HOME\studio\extensions` folder and then start Apama Studio.

You should see the items you defined in the extensions file in the appropriate Apama Studio dialogs. For example, select Window > Preferences and then expand Apama and click Catalogs. Any catalogs you specified in the extensions file should appear in the appropriate tab. However, you cannot edit or remove any catalogs that were added to Apama Studio by means of an extensions file.

If you import a project that uses any of the items specified in the extensions file then the imported project will be valid with regard to any of these dependencies.

Working with Projects

Exporting project information

You can export a project's information for the following purposes:

- "Exporting a project initialization file list" on page 72
- "Exporting to a deployment script" on page 72
- "Exporting scenarios" on page 75
- "Exporting Correlator Deployment Packages" on page 75

- "Exporting adapter configurations" on page 76
- "Exporting ApamaDoc" on page 76

Working with Projects

Exporting a project initialization file list

To export a project initialization file list:

1. Select File > Export from the Apama Studio menu.
2. Expand Apama.
3. Select Project Initialization File List and click Next.
4. If you want the file list to also contain all event files from the project, select Include event files (*.evt).
5. Specify a name for the file to hold the initialization file list and click Finish.

This creates an ordered list of the files on the project build path and saves it in a text file (with one entry per line). This file can be imported into an Apama component's Initialization tab in the Enterprise Management and Monitoring console (EMM) to help convert a development Apama Studio project into a production EMM deployment.

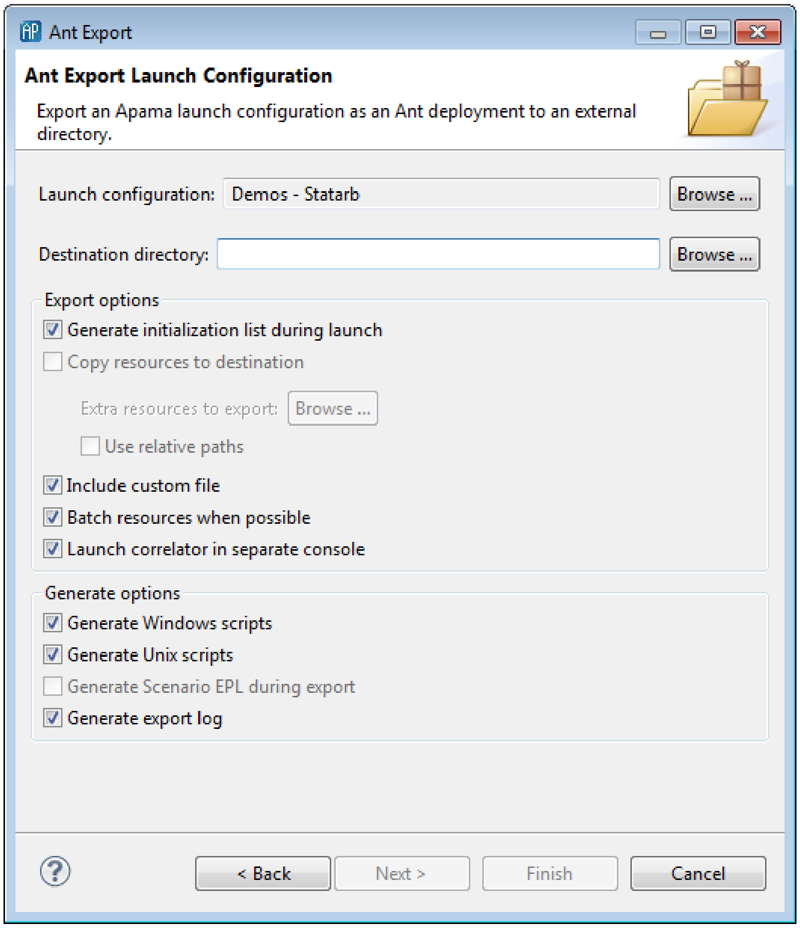
Note that at present this list does not include any scenario (`.sdf`) files on the build path. Scenarios should therefore be exported to an EPL file manually (using Event Modeler), and the EPL files added directly to EMM's initialization list once the Apama Studio Initialization File has been imported.

Exporting to a deployment script

You can export an application's launch configuration to create a deployment script. This generates the build files, configuration files, property definition files, scripts, and EPL files from scenarios and copies other resources such as dashboards that are used by Ant to build and launch the project on a different machine.

To export an Apama launch configuration to a deployment script:

1. In the Project Explorer view, right-click the name of the project and select Export from the pop-up menu. This displays the **Export** dialog.
2. In the **Export** dialog, expand Apama.
3. Select Apama Ant Export and click Next. The **Ant Export** dialog appears.



Ant Export Launch Configuration

Export an Apama launch configuration as an Ant deployment to an external directory.

Launch configuration: Demos - Statarb

Destination directory:

Export options

☑ Generate initialization list during launch

□ Copy resources to destination

Extra resources to export:

□ Use relative paths

☑ Include custom file

☑ Batch resources when possible

☑ Launch correlator in separate console

Generate options

☑ Generate Windows scripts

☑ Generate Unix scripts

□ Generate Scenario EPL during export

☑ Generate export log

4. In the **Ant Export** dialog, specify the settings as follows:

   - Launch configuration — The export operation uses the project’s default launch configuration, but if a project has multiple launch configurations, you can select which one to export. If you want to select a different launch configuration, click Browse. This will display the **Choose Launch Configuration** dialog.

   - Destination directory — The name of the directory for the exported files.

   - Generate initialization list during launch — Dynamically creates the file injection list from the project directory when the exported deployment script is executed, rather than during the export process.

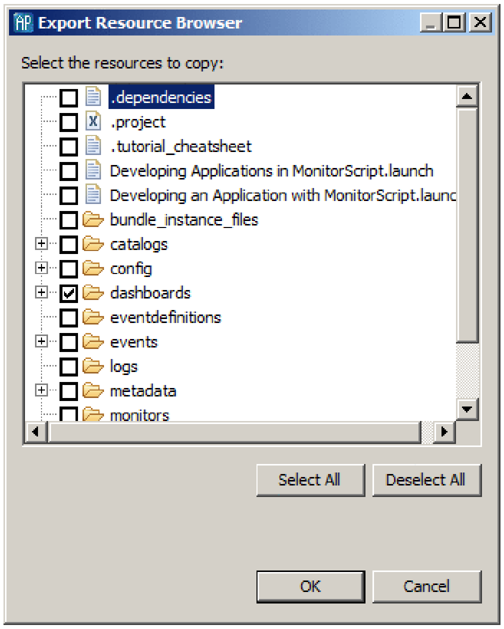
     When you select this option you need to export your project's launch configuration only once. The generated scripts specify the location of your project directory and then use the content of your project directory to create the file injection list at deployment time. If you do not select this option, then you must re-export the configuration each time you add, remove or edit a file in your application.

     For JMon applications that you develop in Apama Studio, Apama Studio creates the required `.jar` files whenever you modify your Java files. If you do not develop your JMon application in Apama Studio, see "Generating deployment descriptor files from annotations" in *Developing Apama Applications* for information about building the `.jar` file for your application. Ensure that your application's `.jar` file is in your project directory before export.

     If you selected a shared location when you created the launch configuration that you are exporting then Apama Studio generated two files that contain the launch information (`.deploy` and .launch) and put them in the specified shared location. After you create the launch configuration, any changes you make to the launch configuration are reflected in these files. Since the exported deployment script uses these files at deployment time, any launch configuration changes will also be reflected upon deployment. Except, if you change the shared location then you must re-export the launch configuration to a new Ant deployment script. If you do not, the old Ant deployment script fails because it cannot find the .deploy file.

When Generate initialization list during launch is selected the option to Generate Scenario EPL during export is not available. Instead, EPL .mon files are always created from scenario files upon deployment. Also, Copy resources to destination is not available because the script points to the project directory.

- Copy resources to destination — By default, the export operation copies only the project's dashboard definitions. To change the specific resources that Apama Studio exports, click Browse to display the **Export Resource Browser** dialog and specify the resources you want.



For an Apama query application, if you are not selecting Generate initialization list during launch, then you will need to use the Apama macros for Ant to inject the query application files. See the apama-macros.xml file is in the etc folder of your Apama installation directory.

- Use relative paths — By default, the generated build.xml file uses relative pathnames for the application's monitors, events, scenarios, jars, and adapter configurations and properties. Uncheck this box if you want to use absolute pathnames.
- Include custom file — If you want the exported launch configuration to perform other operations, select this option to generate a stub custom.xml file. The custom.xml file has pre-custom and post-custom targets where you can add the desired operations.
- Batch resources when possible — By default, the build.xml file generated by the export operation specifies that all monitors in the project will be injected in a batch when the application is launched. If you want to inject each monitor separately when the application is launched, uncheck this check box.
- Launch correlator in separate console — By default, the exported launch configuration will launch the correlator in a separate console. Uncheck this check box if you want to start the correlator in the console where the launch is started.

- Generate Windows scripts — Exports all scripts used by the launch configuration in Windows form.
- Generate Unix scripts — Exports all scripts used by the launch configuration in UNIX form.
- Generate Scenario EPL during export — Generates EPL files for scenarios during the export operation. If you do not select Generate initialization list during launch and you want to copy the scenario definition files instead of generating EPL files, uncheck this check box. Note that when you select Generate initialization list during launch any scenarios are converted to EPL `.mon` files when the launch configuration injects the files into the correlator. Consequently, this option is not available when Generate initialization list during launch is selected.
- Generate export log — By default the export operation generates a log file that records the export operation. Uncheck the check box if you do not want to record the log file.

Click Finish. Apama Studio generates the files in the specified destination directory.

Exporting scenarios

From Apama Studio's **Export** dialog, you can export a project's scenarios in two ways:

- As EPL code — See "Exporting scenarios as EPL" in *Developing Apama Applications.*
- As block templates — See "Exporting scenarios as block templates" in *Developing Apama Applications*.

Exporting Correlator Deployment Packages

You can export a project's EPL (`.mon` and `.qry` files) and scenario files to a Correlator Deployment Package (CDP). CDP files use a proprietary, non-plaintext format that treats EPL and scenario files in a manner similar to the way a JAR file treats a collection of Java files.

1. In the **Project Explorer** view, right-click the name of the project and select Export from the pop-up menu. This displays the **Export** dialog.
2. In the **Export** dialog, expand Apama.
3. Select Export as Correlator Deployment Package and click Next. The **Correlator Deployment Package** wizard is displayed.
4. On the first page of the **Correlator Deployment Package** wizard, if necessary specify a project in the Project field. You can use the Browse button to navigate to the desired project.
5. Also on the first page of the **Correlator Deployment Package** wizard, in the Package Filename field, specify the name of the CDP file you want to create. You can use the Browse button to navigate to the desired location.
6. Click Next. The second page of the **Correlator Deployment Package** wizard is displayed.
7. On the second page of the **Correlator Deployment Package** wizard, specify the files you want to add to the package as follows:
   a. On the Artifacts Selection tab, select the EPL and scenario files you want to include in the package.

   b. On the Injection Order tab, use the Move Up and Move Down buttons to specify the order in which you want to inject the EPL and scenario files.

8. Click Finish.

Exporting project information

Exporting adapter configurations

You can export a project's Web service client adapter configuration to an archive file, which you can generate in Apama Studio. To export a Web service client adapter configuration from an Apama Studio project:

1. In the **Project Explorer** view, right-click the name of the project and select Export from the pop-up menu. This displays the **Export** dialog.
2. In the **Export** dialog, expand Apama.
3. Select Adapter Configurations and click Next. The **Adapter Configurations Export Wizard** appears.
4. In the **Adapter Configurations Export Wizard**, if necessary, specify a project in the Project field. You can use the Browse button to navigate to the desired project.
5. In the Adapter Configurations field, select the adapter configurations you want to export.
6. In the Adapter Resources field, select the adapter resources you want to export.
7. In the To archive file: field, specify the archive file that you want to contain the exported adapter configuration. You can use the Browse button to navigate to the desired location.
8. Click Finish. This creates an archive file in the specified location. You can import this archive into any Apama project.

Exporting project information

Exporting ApamaDoc

In Apama Studio you can use the ApamaDoc tool to generate reference documentation for the EPL source code you add to a project. From the **Export** dialog, select ApamaDoc Export. This generates static HTML pages that document the structure of all EPL code in a project.

For detailed information on how to annotate your EPL source code and generate ApamaDoc, see "Generating documentation for your EPL code" in *Developing Apama Applications*.

Deleting projects and resources

If you want to delete projects or resources you should use Apama Studio to do so, rather trying to delete them directly from the file system.

Working with Projects

Deleting resources

To delete a resource from a project:

1. In the **Project Explorer** view or **Workbench Project** view, right-click the resource and select Delete from the pop-up menu or select the resource and select Edit > Delete from the Apama Studio menu. In the **Workbench Project** view you can select the resource and click the Delete button.
2. In the **Confirm Resource Delete** dialog, click Yes if you want to proceed.

Deleting projects and resources

Deleting projects

To delete a project:

1. In the **Project Explorer** view or **Workbench Project** view, right-click the project and select Delete from the pop-up menu or select the resource and select Edit > Delete from the Apama Studio menu. In the **Workbench Project** view you can select the resource and click the Delete button.
2. In the **Confirm Project Delete** dialog select whether or not you want to delete all the project's resources from the filesystem, or simply remove the project from the Project view leaving all files in place. After selecting the latter option, such projects can be added to the workspace again using the **Import** wizard (see "Importing projects" on page 69). In most cases it is more useful to select the option to delete the project's contents at the same time as the project itself, to avoid confusion.

Deleting projects and resources

Adding the Apama nature to a project

If you are working with a project that is not an Apama project, for example, a Java project, you can apply the Apama nature to the project with Apama Studio. The project then becomes an Apama project in addition to whatever natures it had before.

To add the Apama nature to a project:

1. In the Project Explorer view (or in the Package Explorer view if the project is a Java project), right click the project.
2. Select Apama > Add Apama Nature from the pop-up menu.

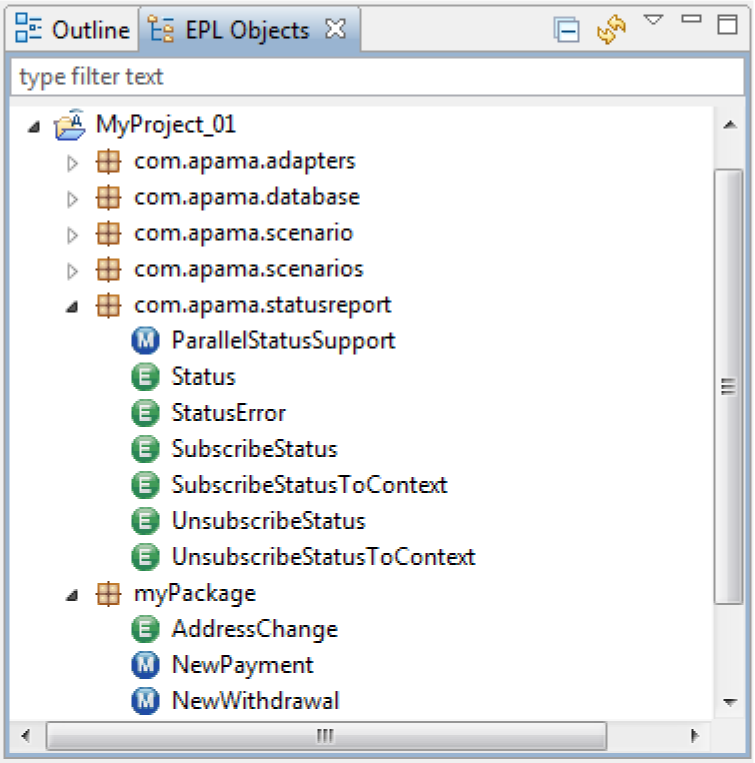
After you apply the Apama nature to a project, the project shares all the features of any other Apama project, for example, EPL errors will be detected and flagged, and the project can be launched in an Apama correlator.

Note that the Add Apama Nature menu item is not available if a project is already an Apama project.

Working with Projects

Viewing all EPL objects in all projects

The EPL Objects view shows all the EPL objects -- the Apama events, monitors and queries -- defined in the projects in your Apama Studio workspace. These objects are the events, monitors and queries that you define, as well as the events and monitors defined in the Apama bundles that are included in your projects.



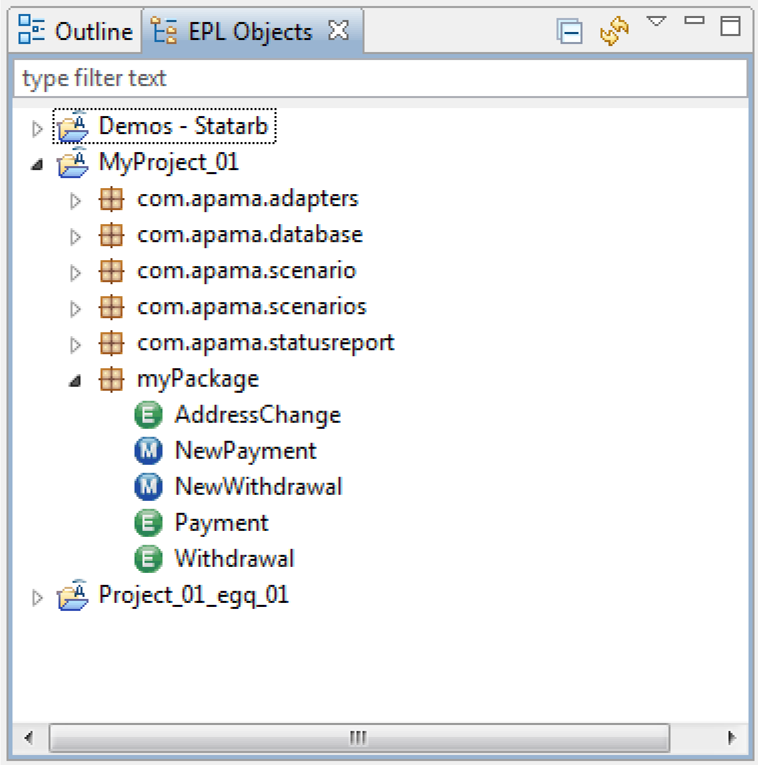
- MyProject_01
  - com.apama.adapters
  - com.apama.database
  - com.apama.scenario
  - com.apama.scenarios
  - com.apama.statusreport
    - M ParallelStatusSupport
    - E Status
    - E StatusError
    - E SubscribeStatus
    - E SubscribeStatusToContext
    - E UnsubscribeStatus
    - E UnsubscribeStatusToContext
  - myPackage
    - E AddressChange
    - M NewPayment
    - M NewWithdrawal

If the EPL Objects view is not displayed, from the Apama Studio menu select Window > Show View > Other > Apama > EPL Objects .

When you double-click on the name of an object in the EPL Objects view, Apama Studio opens the EPL file that defines the object.

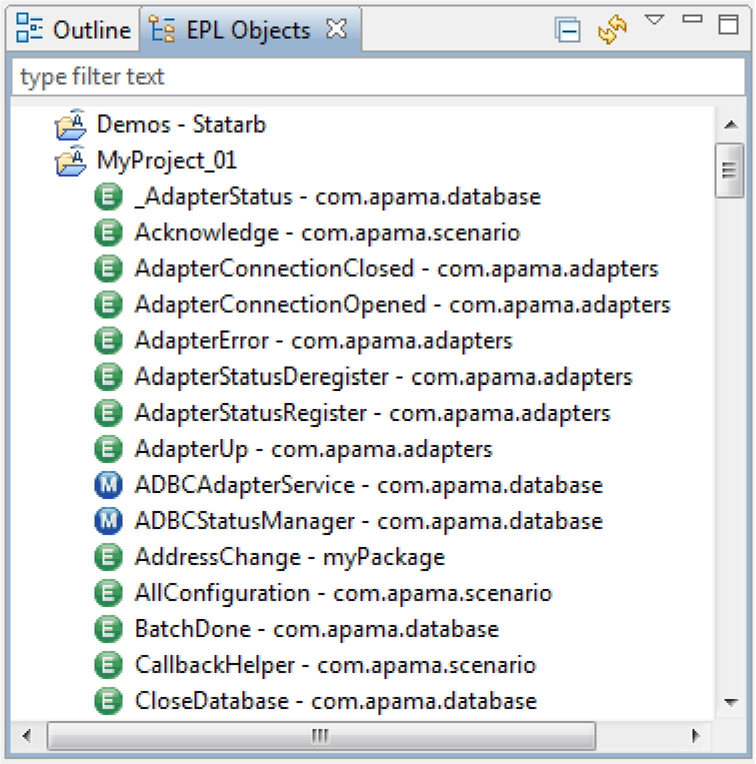
The EPL Objects view organizes the display of EPL objects by project. You can display events, monitors, and/or queries. To specify what type of objects you want to display, click the View Menu icon on the view's title bar ( ) and from the drop-down menu, select Customize View and then either Events, Monitors, Queries or Show All.

You can display the EPL objects in a project grouped by package name (Hierarchy):



- Demos - Statarb
- MyProject_01
  - com.apama.adapters
  - com.apama.database
  - com.apama.scenario
  - com.apama.scenarios
  - com.apama.statusreport
  - myPackage
    - AddressChange
    - NewPayment
    - NewWithdrawal
    - Payment
    - Withdrawal
- Project_01_egq_01

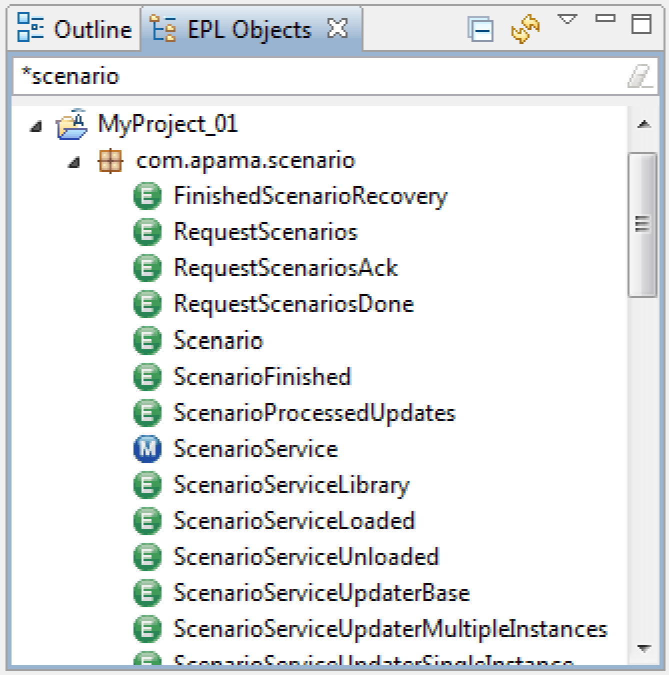
You can also display the EPL objects in a project alphabetically (Flat):



- Demos - Statarb
- MyProject_01
  - _AdapterStatus - com.apama.database
  - Acknowledge - com.apama.scenario
  - AdapterConnectionClosed - com.apama.adapters
  - AdapterConnectionOpened - com.apama.adapters
  - AdapterError - com.apama.adapters
  - AdapterStatusDeregister - com.apama.adapters
  - AdapterStatusRegister - com.apama.adapters
  - AdapterUp - com.apama.adapters
  - ADBCAdapterService - com.apama.database
  - ADBCStatusManager - com.apama.database
  - AddressChange - myPackage
  - AllConfiguration - com.apama.scenario
  - BatchDone - com.apama.database
  - CallbackHelper - com.apama.scenario
  - CloseDatabase - com.apama.database

To change the way the object names are displayed, click the View Menu icon on the view's title bar and from the drop-down menu, select Group By and then either Hierarchy or Flat.

You can also specify a regular expression in the text box to filter the EPL entries shown in the view. For example, entering `*scenario` in the text box results in showing only entries with "scenario" in their names.



Outline | EPL Objects

```
*scenario
MyProject_01
  com.apama.scenario
    FinishedScenarioRecovery
    RequestScenarios
    RequestScenariosAck
    RequestScenariosDone
    Scenario
    ScenarioFinished
    ScenarioProcessedUpdates
    ScenarioService
    ScenarioServiceLibrary
    ScenarioServiceLoaded
    ScenarioServiceUnloaded
    ScenarioServiceUpdaterBase
    ScenarioServiceUpdaterMultipleInstances
    ScenarioServiceUpdaterSingleInstance
```

Click on the Refresh icon in the view's title ( ) bar to reload the entries in the EPL Objects view.

Working with Projects

Internationalizing Apama applications

By default, Apama Studio saves Apama project files in your platform's native encoding. If you choose to save Apama project files in UTF-8 encoding in the Resource tab of a file or a folder's **Properties** dialog, Apama Studio adds a UTF-8 BOM character at the beginning of each file. This indicates that the contents are in UTF-8. The character is required to be compatible with other Apama tools.

To specify the encoding for Apama projects:

1. In the Apama Project Navigator view, click the project for which you want to define the encoding.
2. In the Apama Studio menu bar, choose Project > Properties.
3. In the **Properties** dialog, click Info.
4. In the Text File Encoding group box, click Other and select the encoding you want.
5. Click OK.

Working with Projects

Checking the error log

While using Apama Studio, you might receive a message that prompts you to check the error log. If the Error Log tab does not already appear with the Problems, Tasks, and Console tabs, display it as follows:

1. In the Apama Studio menu, choose Window > Show View > Other.
2. In the **Show View** dialog, expand General.
3. Double-click Error Log. The Error Log tab now appears with the Problems, Tasks, and Console tabs.

See the `APAMA_WORK\logs\apama_studio.log` file for more detailed information about any unexpected problems you encounter while using Apama Studio.

Working with Projects

Using Apama Studio to configure adapters that use UM

You can use Apama Studio to configure an IAF adapter to use Universal Messaging. To do this:

1. Add support for UM to your project. See "Adding Universal Messaging configuration to projects" on page 54.
2. Add one of the following adapters to your project:
   - File Adapter
   - JDBC Adapter
   - ODBC Adapter
   - Sim File Adapter
   - WebServices Client Adapter
3. Open the instance of the adapter you just added. In the Settings tab, you can see the following substitution variables:
   - `APAMA_MSG_ENABLED`
   - `UM_MSG_ENABLED`

   Use Apama Studio's launch configuration editor to manage these substitution variables.
4. Select Run > Run Configurations....
5. In the Run Configurations dialog, select the Apama project that contains the adapter you want to configure and then click the Components tab.
6. In the Components tab, double-click the adapter you want to configure.

   In the Adapter Configuration dialog, if you added UM support to your project, the default for a new adapter in your project is that the UM Messaging radio button is selected. Adding UM support to a project does not change an existing adapter configuration.
7. Ensure that UM Messaging is selected. This sets the related substitution variables as follows:

- APAMA_MSG_ENABLED is false.
- UM_MSG_ENABLED is true.

8. Click OK , Apply, and then Close to save the adapter configuration in that launch configuration.

Apama Studio manages the APAMA_MSG_ENABLED and UM_MSG_ENABLED substitution variables by means of the launch configuration.

If you click the XML Source tab you can see that the <apama> element and the <universal-messaging> element each contain the enabled attribute. In the <apama> element, Apama Studio sets the enabled attribute to the @APAMA_MSG_ENABLED@ substitution value. In the <universal-messaging> element, Apama Studio sets the enabled attribute to the @UM_MSG_ENABLED@ substitution value. When you launch the project Apama Studio uses the settings of the APAMA_MSG_ENABLED and UM_MSG_ENABLED substitution variables to set the value of the enabled attribute in each element.

The default is that the enabled attribute is set to true. Consequently, if you delete the enabled attribute, it is as if it is set to true.

See also: "Configuring adapters to use UM" in *Connecting Apama Applications to External Components*.

Working with Projects

Chapter 3: Using Query Designer

Apama Studio's Query Designer editor provides a graphical environment that business analysts can use to define and update Apama queries without the need to write source code. An Apama query monitors a very large number of real-world entities and processes events on a per-entity basis, for example, all events related to one credit card account.

See also: "Defining Queries", which describes the EPL constructs for writing query code, in *Developing Apama Applications* and "Deploying and Managing Queries" in *Deploying and Managing Apama Applications*.

Note: EPL monitors and EPL queries (also referred to as Apama queries) provide two different approaches to implementing an Apama application. See "Comparison of queries and monitors" in *Introduction to Apama*.

- Design — Business analysts define and update query definitions in this view. The Design tab provides an event palette and a canvas for defining an event pattern of interest. Toolbars, tooltips, and dialogs make it easy to define the events of interest to the query as well as any required parameters, conditions for finding matches, aggregate calculations and actions to take when a match set is found.
- Source — Application developers can examine and update query definition source code in the EPL code editor available from the Source tab.

Query Designer keeps the two views synchronized. Any changes made in the Design view are reflected in the Source view and vice versa.

Apama provides several sample query applications, which you can find in the `samples\queries` directory of your Apama installation directory.

Use cases for queries

Apama queries are useful when you want to monitor incoming events that provide information updates about a very large set of real-world entities such as credit cards, bank accounts, cell phones. Typically, you want to independently examine the set of events associated with each entity, that is, all events related to a particular credit card account, bank account, or cell phone. A query application operates on a huge number of independent sets with a relatively small number of events in each set.

One use case for Apama queries is to detect subsequent withdrawals from the same bank account but from locations that make it improbable that the withdrawals are legitimate. Very large numbers of withdrawal events would stream into your application. A query can segregate the transactions for each bank account from the transactions of any other bank account. Your query application can then check the transaction events for a particular account to determine if there have been withdrawals within, for example, a two-hour period from locations that are more than two hours apart. You can write a query application so that if it finds this situation the response is to contact the credit card holder.

Another use case is to detect repeated maximum withdrawals from the same automatic teller machine (ATM) within a short period of time. This might be due to a criminal with a stack of copied cards and identification numbers. In this case, a query can segregate events by ATMs. That is, the transactions conducted at a particular ATM would be in their own partition, separate from transactions conducted at any other ATM. Your query application can check the events in each partition to determine if, for example, there are repeated withdrawals of $500 within one hour. If such a situation is found your query can be written to send an alert message to the local police.

Another use case for Apama queries is to offer a better data plan to new smartphone users. Large numbers of events related to cell phone customers would come into the system. Your query application can create sets of events where each set, or partition, contains the events related to one cell phone customer. When your query detects an upgrade from a flip phone to a smart phone, your application can automatically send a message to that customer that outlines a better data plan.

In summary, the characteristics of an Apama query application include:

- You want to monitor a very large number of real-world entities.
- You want to process events on a per-entity basis, for example, all events related to one credit card account.
- The data you need to retain in order to run Apama queries is either too large to fit on to a single machine or there is a requirement to place it in shared, fast-access storage (a cache) to support resilience/availability requirements.

More information about the use cases for queries can be found in "Understanding queries" in *Introduction to Apama*.

Using Query Designer

Adding query files to projects

To add a query file to a project:

1. In **Project Explorer**, right-click the project you want to add a query to and select New > Query File.
2. In the New Apama Query File dialog, the Containing folder field shows the name of the project you selected. Accept this or enter the name of the project you want to add the query to.
3. In the File name field, enter a name for the query file.
4. In the Package field, you can optionally specify the EPL package that contains this query. If you do not specify a package then the query file is in the default package, which contains EPL files that do not specify a package name.
5. Click Finish.

Apama Studio adds the new query file to the project's queries folder and opens the new query in the Design tab of the Query Designer. Also, Apama Studio automatically adds the `Queries Support` bundle to your project, if your project does not already contain this bundle. A query application project must contain the `Queries Support` bundle.

After you add a query file to a project, you can view it along with the other EPL objects in your project. See "Viewing all EPL objects in all projects" on page 78.

Using Query Designer

Steps for using Apama Studio to implement queries

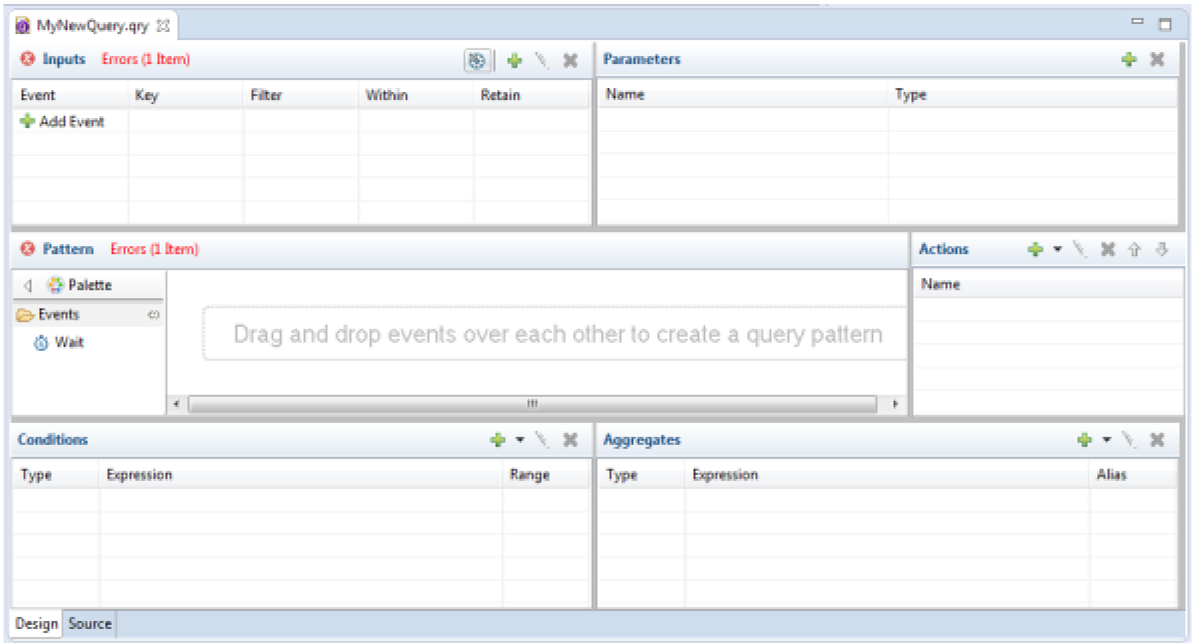
To use Apama Studio to implement a query application:

1. Create an Apama project for your query application. See "Creating Apama projects" on page 27.
2. Define the events you want your query to operate on. See "Creating new event definition files for EPL applications" on page 30.
3. Add a query file to your project. See "Adding query files to projects" on page 84.
4. Use Query Designer to define your query. See "Overview of creating a query in the Design tab" on page 85.
5. Use the default launch configuration to run and test your query application project. "Default launch configuration" on page 104.
6. If your query has parameters, then you must use the Scenario Browser to create instances before the queries runtime processes any incoming events to find possible pattern matches. You can also use the Scenario Browser to edit running instances that use parameters. See "Using the Scenario Browser view" on page 120.
7. Iteratively update and test your query application as needed.
8. Export your project to an Ant deployment script. See "Exporting to a deployment script" on page 72.

Using Query Designer

Overview of creating a query in the Design tab

After you add a query file to a project, Apama Studio opens Query Designer so that you can define the query. The Design tab presents several panes in which you can define the parts of the query. As you can see in the figure below, the initial display is empty:



Drag and drop events over each other to create a query pattern

Before you can define a query, you must define the events that you want the query to process. See "Writing event definitions" in "Overview of implementing queries", which is in *Developing Apama Applications*.

The typical steps for defining a query in the Design tab of Query Designer are as follows:

1. In the Inputs pane, click the Configure Query icon to configure the query to import event type definitions and aggregate functions. See "Configuring queries to import definitions" on page 87.
2. In the Inputs pane, click the plus sign to add an event type definition that you want the query to process. You must add one or more inputs before you can create the event pattern you are interested in. See "Adding query inputs" on page 88.
3. Optionally, in the Parameters pane, click the plus sign to add a query parameter. See "Adding query parameters" on page 90.
4. From the event Palette, select an input event and drag it onto the pattern canvas. See "Adding query patterns" on page 89.
5. Optionally, In the Conditions pane, click the plus sign to add a filter, time constraint or exclusion. Conditions let you identify the exact events you are interested in. You must add one or more inputs before you can add query conditions. See "Adding query conditions" on page 91.
6. Optionally, in the Aggregates pane, click the plus sign to add an aggregate expression to the find pattern. An aggregate expression aggregates event field values in order to find data based on many sets of events. See "Adding query aggregates" on page 94.
7. In the Actions pane, click the plus sign to define an action that the query executes when it finds the specified event pattern. See "Adding query actions" on page 97.

At any time, you can click the Source tab to view the code that defines your query.

Using Query Designer

Creating queries in Query Designer

As mentioned earlier, the Query Designer editor provides two views of a query definition:

- Design — Business analysts define and update query definitions in this view. The Design tab provides an event palette and a canvas for defining an event pattern of interest. Toolbars, tooltips, and dialogs make it easy to define the events of interest to the query as well as any required parameters, conditions for finding matches, aggregate calculations and actions to take when a match set is found.
- Source — Application developers can examine and update query definition source code in the EPL code editor available from the Source tab.

Query Designer keeps the two views synchronized. Any changes made in the Design view are reflected in the Source view and vice versa.

The following topics provide information and instructions for using Query Designer to create a query definition.

Using Query Designer

Configuring queries to import definitions

In the Configure Query dialog, you can import event types and aggregate functions. Importing event types and aggregate functions lets you use the short name of an event type or an aggregate function instead of the full name. For example, when you are writing an aggregate:

- If you have imported the built-in aggregate function avg (), to calculate the average value 'x' for all events 'e', you can write `avg (e.x)` instead of the fully qualified package name `com.apama.aggregates.avg(e.x).`
- If you have not imported the built-in aggregate function avg (), to calculate the average value 'x' for all events 'e', you have to write the fully qualified package name `com.apama.aggregates.avg(e.x).`

> **Note:** You can use the Configure Query dialog to clear the elements that are missing from the package.

1. In the Inputs toolbar, click the Configure Query icon . The Configure Query dialog appears with the list of event types and aggregate functions.
2. Optionally, in the Configure Query dialog, you can filter the event types and aggregate functions in the list using the drop down list at the text box.
   - Select Show Events to view only the event types.
   - Select Show Aggregates to view only the aggregates.
   - Select Show Both to view all the event types and aggregates.
3. In the Configure Query dialog, select the required event type or the aggregate function.

In the text box, you can also type the name of the event type or the aggregate function that you want the query to import.

Note: You cannot select the event types or aggregate functions that are selected by default. These event types and aggregates are implicitly available as they share the same package as the query file.

4. Click OK.

   Optionally, when an event has been renamed or removed from the event definition file, then the missing events or aggregates appear in the Configure Query dialog. You can clear the missing events or aggregates in the Configure Query dialog by clicking Clear List.

Creating queries in Query Designer

Adding query inputs

To specify the event pattern that you want your query to find, you must first define the event types that your query processes. The input definitions identify the events that you want the query to operate on. Perform these tasks in the Inputs pane in the Design tab of the Query Designer.

To add a query input:

1. In the Inputs toolbar, click the plus sign ✚ to select an event type. The New Query Input dialog appears.

2. In the New Query Input dialog, click the Choose button to select the event type you want to add in the Event Type Selection. Click OK.

3. In the New Query Input dialog, in the Key field, optionally you can select one or more fields to be the query key.

   A query key identifies one or more fields in the events being operated on. Each input definition for a given query must specify the same key. Apama uses the key to partition the incoming events. A partition contains a set of events that have the same key value. For example, you can partition `Withdrawal` events according to their `account` numbers. The query processes the set of events in a given partition independently of every other partition.

   The number, type, and order of the key fields in each input definition must be the same. You can specify event fields of type `boolean`, `decimal`, `float`, `integer`, `string` or `location`. If an event field does not have the same name as an existing input event, alias the key to the same name as the existing input key.

4. In the Filter field, optionally specify an expression that filters the events you want the query to process.

   For example, you might specify that you are interested in only the `Withdrawal` events whose `amount` field is greater than `10`. In the filter expression, you can specify event fields of type `boolean`, `decimal`, `float`, `integer`, `string` or `location`.

   If you want to refer to a parameter in a filter, then you must first add the parameter. See "Adding query parameters" on page 90.

5. In the Within field, optionally specify a `float` expression or time literal that specifies the duration of time that an event remains as a current event that the query operates on.

The query operates on the events that have been received within the time specified. You must specify a value in either the Within field or in the Retain field or both.

6. In the Retain field, optionally specify an `integer` expression that specifies the number of events to be retained in the window.

   You must specify a value in either the Within field or in the Retain field or both.

7. Click OK to add this input definition to your query.

   Query Designer displays the new input definition in a row in the Inputs section and the event type you specified appears in the Palette.

Repeat these steps for each event type you want your query to process. Apama recommends no more than four input definitions in a query. You cannot add the same event type as a query input more than once. The input event type must be unique.

Creating queries in Query Designer

Adding query patterns

Before you can add a pattern to a query, you must add input definitions to the query. See "Adding query inputs" on page 88.

To add a query pattern to a query:

1. If the query definition is not already displayed in Query Designer, expand the project's `queries` folder and double click the query file you want to edit.
2. In the Query Designer Design tab, from the Palette, drag and drop an event onto the canvas to the right.
3. To add a second event to the pattern, drag the event type from the Palette onto the canvas so that it hovers over the event that is already there.

   The same event type can appear multiple times in a pattern. Query Designer automatically gives each event in the pattern a unique identifier.

   Query Designer displays the followed-by (->) and `and` operators before and after the event that is already in the pattern.

4. Drag the event you are adding to the appropriate operator so that it is highlighted and drop it.

   Query Designer displays the updated pattern.

5. To add another event to the pattern, drag it from the Palette onto the canvas.
6. To relate the event being added to one of the events already in the pattern, hover the event being added over the event that is already in the pattern.

   To relate the event being added to two or more events already in the pattern, hover the event being added over the space between those events.

   Query Designer displays the followed-by (->) and `and` operators before and after the event(s) that is (are) already in the pattern.

7. Drag the event you are adding to the appropriate operator so that it is highlighted and drop it.

   Query Designer displays the updated pattern.

8. Repeat the previous three steps to add each additional event in the pattern you are looking for.

9. To add a period of time that must elapse before or after the event pattern occurs, drag Wait (⏱) from the palette onto the canvas and hover over the pattern for prompts to indicate where you can drop it.

   A waiting period is allowed at the beginning or end of an event pattern; it is not allowed between events.

10. Drag the Wait operator to the followed-by (->) operator at the beginning of the pattern or at the end of the pattern so that -> is highlighted and drop it.

    Query Designer displays the updated pattern. The Wait operator has a blue color in contrast to the green color of the events. Inside the Wait operator, Query Designer assigns a unique identifier and default time period of 10 seconds.

11. To change the length of time, double click 10.0 in the Wait operator and enter the required time period according to "Specifying a time period in Query Designer" on page 99.

12. If you need to delete an event or Wait operator from a pattern, right-click it and select Delete.

13. If you want to change the name of an event identifier in the pattern, double click that identifier and enter a new one.

    The identifier you enter can contain uppercase letters (A-Z), lowercase letters (a-z), digits (0-9), underscores, pound signs (#), and dollar signs. Characters not allowed include spaces, digit as first character, any other special characters, and EPL keywords.

After you define the query's event pattern, you might want to add conditions that determine when the query successfully finds a match for the pattern. See "Adding query conditions" on page 91.

Creating queries in Query Designer

Adding query parameters

A query can specify one or more parameters. Parameters enable a query definition to function as a template for multiple query instances. A query that defines parameters is referred to as a parameterized query. An instance of a parameterized query is referred to as a parameterization.

A parameterized query offers the following benefits:

- Patterns of interest may be customized from a single generic query. This can significantly reduce the amount of code that needs to be written and maintained.
- Parameterizations exist only at runtime. There is no need to maintain a file for each instance.
- Parameters can be used throughout the query in which they are defined. For example, you can use them in the definition of inputs, in `find` actions, in user-defined actions, and in specifying the within and retain fields. Values do not need to be hardcoded.

You can add zero, one, or more parameters to a query.

For more information about how the use of parameters affect queries, see "Query lifetime" in *Developing Apama Applications*.

To add a parameter to a query:

1. In the Query Designer Parameters pane, click the plus sign ✚ to add a new parameter.
2. In the Parameters pane, in the Name field, enter an identifier for the parameter.

   An identifier can include lowercase a-z, uppercase A-Z, digits, dollar sign, and underscore. An identifier cannot start with a digit and cannot include any other special characters.
3. Select the type of the parameter. A drop down in the Parameters pane provides the list of valid types applicable.

Query Designer displays the new parameter in a row in the Parameters pane. To modify the parameter, select it and then click the field to edit in the Parameters pane. To remove the parameter, select it and then click the Delete icon ✖. Also, the new parameter is immediately added to the source code in the `parameters` section of the query definition. If you modify the parameter definition in the Source tab this is reflected in the Parameters pane in the Design tab.

Creating queries in Query Designer

Adding query conditions

An Apama query can specify conditions that must be satisfied for there to be a match for the event pattern of interest. You can specify the following kinds of conditions:

- Filter — This is a Boolean expression that refers to the events in the specified pattern of interest. This expression must evaluate to true for there to be a match. There can be zero, one, or more query filter conditions. Adding a query filter condition inserts a `where` clause in the source view of the query.
- Time constraint — This is a time period during which some or all events in the pattern must have been received. There can be zero, one, or more time constraints. Adding a time constraint inserts a `within` clause in the source view of the query.
- Exclusion — This is the specification of an event whose presence prevents a match. If you need to prevent a match only when instances of this event have certain values you can add a filter that qualifies which instances of the specified event prevent a match. You can add zero, one or more exclusions. Adding an exclusion inserts a `without` clause in the source view of the query.

You add query conditions in the Conditions pane of the Design view. Click the down arrow to the right of the plus sign ✚ ▾, and select the kind of condition you want to add. Query Designer displays a dialog in which you define the condition. See one of the following topics for details:

- "Adding query condition filters (where)" on page 92
- "Adding query time constraints (within)" on page 92
- "Adding query exclusions (without)" on page 93

After you add a condition in the Design view, it appears in a row in the Conditions pane that shows the condition type, the expression that specifies the condition, and the range that the condition applies to if one was specified. Select the condition to edit or delete it.

When you add a condition it is immediately added to the source code. Any changes you make in the Source tab will be shown in the Design tab, and vice versa. If you introduce any syntax errors into the query source code, you must resolve them in the Source tab before you can view the query in the Design tab.

For more details about the EPL code for query conditions, see "Query conditions" in *Developing Apama Applications*.

Creating queries in Query Designer

Adding query condition filters (where)

A query can specify a Boolean expression that must evaluate to true for there to be a match. This is referred to as a query condition filter. You can add zero, one, or more condition filters to a query.

To add a condition filter to a query:

1. In Query Designer, add the event inputs to the query and define the event pattern you want to find. See "Adding query inputs" on page 88 and "Adding query patterns" on page 89.
2. In the Query Designer Conditions pane, click the down arrow next to the plus sign ➕ ▾ and select Filter (where).
3. In the New Query Condition Filter (where) dialog, enter a Boolean expression that refers to the events in the pattern of interest.

   For example, consider a `Withdrawal` event followed by another `Withdrawal` event, both for the same account. You are interested in this pattern only when the `country` fields in the two events are different. Using the aliases `w1` and `w2` for the two `Withdrawal` events, the following Boolean expression specifies the filter: `w2.country != w1.country`.
4. Click OK.

Query Designer displays the new filter in a row in the Conditions pane. To modify the filter, select it and then click the Edit ✎ icon. To remove the filter, select it and then click the Delete icon ✖. Also, the new filter is immediately added to the source code as a `where` clause in the `find` statement. If you modify the filter in the Source tab this is reflected in the Conditions pane in the Design tab.

Adding query conditions

Adding query time constraints (within)

A query time constraint sets the time period during which the set of events that match the pattern of interest must have been received. A query can specify zero, one or more time constraints. A time constraint can apply to the whole pattern or a portion of the pattern.

To add a time constraint to a query:

1. In Query Designer, add the event inputs to the query and define the event pattern you want to find. See "Adding query inputs" on page 88 and "Adding query patterns" on page 89.
2. In the Query Designer Conditions pane, click the down arrow next to the plus sign ➕ ▾ and select Time constraint (within).
3. In the New Time Constraint dialog, if the time constraint applies to all events in the pattern then leave All events in the pattern selected and skip the next step. Otherwise, select Only specific events.

For example, suppose you want to flag consecutive `Withdrawal` events for the same account that have different `country` field values. However, this is of interest only when the consecutive events both arrive within an hour. In this case, the time constraint applies to all events in the pattern.

4. To apply the time constraint to a portion of the pattern, select at least two events. The time constraint applies to only the events you select.

   For example, suppose that the pattern of interest is an `A` event followed by a `B` event followed by a `C` event. However, this pattern is of interest only when the `C` event is received within 10 seconds after the `B` event. You want the time constraint to apply only to the `B` and `C` events and so you need to select those two events.

5. In the field at the bottom of the dialog, specify the period of time during which the selected events must be received. The elapsed time from when the first selected event is received to when the last selected event is received must be less than the time period you specify. See "Specifying a time period in Query Designer" on page 99.

6. Click OK.

Query Designer displays the new time constraint in a row in the Conditions pane. To modify this time constraint, select it and then click the Edit ✎ icon. To remove this time constraint, select it and then click the Delete icon ✖. Also, the new time constraint is immediately added to the source code as a `within` clause in the `find` statement. If you modify the time constraint in the Source tab this is reflected in the Conditions pane in the Design tab.

Adding query conditions

Adding query exclusions (without)

A query exclusion specifies that the presence of a particular event prevents a match. A query can specify zero, one or more exclusions. An exclusion can include a filter and/or a range to limit which instances of the identified event prevent a match.

To add an exclusion condition to a query:

1. In Query Designer, add the event inputs to the query and define the event pattern you want to find. See "Adding query inputs" on page 88 and "Adding query patterns" on page 89.

2. In the Query Designer Conditions pane, click the down arrow next to the plus sign ➕ ▾ and select Exclusion (without).

3. In the New Query Exclusion dialog, in the Event Type field, select the event whose presence prevents a match. You can select only an event type that has been added as a query input. If the type you want to select is not listed then you must first add it as a query input.

   For example, consider consecutive `Withdrawal` events that have different `country` field values. You want an alert when this occurs except when a `TravelNotification` event is received before the second `Withdrawal` event. In this case, select `TravelNotification` as the event type that prevents a match.

4. In the Name field, Query Designer displays a name that it automatically generates. This is an alias for the selected event and is unique across all aliases in the query. You have the option of using this alias in the next step.

5. Optionally, specify a Boolean expression that must evaluate to true for the presence of an event of the selected type to prevent a match.

   For example, you might want a `TravelNotification` event to prevent a match only when its `date` field has the same value as the `date` field of the first `Withdrawal` event. If the event aliases `w1`, `w2`, and `t1` are used, the following Boolean expression defines the exclusion filter: `w1.date = t1.date`. When the `date` fields of the first `Withdrawal` event and the `TravelNotification` event have the same value then the presence of the `TravelNotification` event between two consecutive `Withdrawal` events will prevent a match and an alert will not be sent. When the `date` fields of the first `Withdrawal` event and the `TravelNotification` event have different values then the presence of the `TravelNotification` event between two consecutive `Withdrawal` events will allow a match and an alert will be sent.

6. At the bottom of the dialog, indicate when the presence of the selected event prevents a match. If you accept During the whole pattern then select OK. You are done adding an exclusion.

7. If the presence of the selected event prevents a match only when it is received In between specific events, then select that option.

8. Select at least two events.

9. Click OK.

Query Designer displays the new exclusion in a row in the Conditions pane. To modify this exclusion, select it and then click the Edit ✎ icon. To remove this exclusion, select it and then click the Delete icon ✖. Also, the new exclusion is immediately added to the source code as a `without` clause in the `find` statement. If you modify the exclusion in the Source tab this is reflected in the Conditions pane in the Design tab.

Adding query conditions

Adding query aggregates

An Apama query can specify aggregates that let the query find data based on many sets of events. You can add one or more of each of the following to your query definition:

- Aggregate calculation — Adding an aggregate calculation inserts a `select` clause in the source view of the query.
- Aggregate filter — This is a Boolean expression that refers to the events in the specified pattern of interest. This expression must evaluate to true for there to be a match. There can be zero, one, or more query aggregate filter conditions. Adding an aggregate filter inserts a `having` clause in the source view of the query.

You add query aggregates in the Aggregates pane of the Design view. Click the down arrow to the right of the plus sign ✚ ▾, and select the kind of aggregate you want to add. Query Designer displays a dialog in which you define the aggregate. The following topics provide more information:

- "Adding query aggregate calculations" on page 95
- "Adding query aggregate filters" on page 96

After you add an aggregate in the Design view, it appears in a row in the Aggregates pane that shows the aggregate type, the expression that specifies the aggregate, and an alias for the aggregation. Select the aggregate to edit or delete it.

When you add an aggregate, it is immediately added to the source code. Any changes you make in the Source tab will be shown in the Design tab. If you introduce any syntax errors into the query source code then you must resolve them in the Source tab before you can view the query in the Design tab.

For more details about the EPL code for query conditions, see "Aggregating event field values" in *Developing Apama Applications*.

Creating queries in Query Designer

Adding query aggregate calculations

A query can specify an aggregate calculation that computes a single value based on multiple events, such as the average of a series of numbers. The built-in aggregate functions shown in the table below are available. For details about these functions, see "Built-in aggregate functions" in *Developing Apama Applications*.

`avg()`	`min()`	`last()`	`stddev()`	`prior()`
`sum()`	`max()`	`wavg()`	`stddev2()`	
`count()`	`first()`	`mean()`	`nth()`	

When a query does not specify an aggregate calculation or filter, only the most recent set of events that match the pattern are used to invoke the actions and any other procedural code. With an aggregate calculation or filter, every set of events, in the current set of events, that matches the pattern is available for use by the aggregate function, provided that the latest event is present in one of the sets of events. Any events or combinations of events that do not match the pattern or do not meet specified query conditions, are ignored; their values are not used by the aggregate function.

To add an aggregate calculation to a query:

1. In the Query Designer Aggregates pane, click the down arrow next to the plus sign ➕▾ and select Calculation (select).
2. In the New Query Aggregate Calculation dialog, specify an expression that uses an aggregate function with identifiers from the pattern. You can also use parameters.

   For example, the following aggregate calculation determines the average price of trades:

   ```
   avg(trade1.price, trade1.amount)
   ```
3. The field at the bottom of the dialog displays the identifier for this calculation. You can change the identifier. You can refer to this identifier in a query action.
4. Click OK.

Query Designer displays the new aggregate calculation in a row in the Aggregates pane.

To modify the aggregate calculation, select it and then click the Edit ✎ icon.

To remove the calculation, select it and then click the Delete icon ✖.

Also, the new calculation is immediately added to the source code as a `select` clause in the `find` statement. If you modify the calculation in the Source tab, this is reflected in the Aggregates pane in the Design tab.

You can add one or more aggregate calculations as well as one or more aggregate filters. The order in which they appear in the Aggregates pane is the order in which they are executed in the query.

See also: "Aggregating event field values" in *Developing Apama Applications*.

Adding query aggregates

Adding query aggregate filters

A query can specify a Boolean expression that uses an aggregate function and that must evaluate to true for the query actions and any other procedural code are invoked. The built-in aggregate functions shown in the table below are available. For details about these functions, see "Built-in aggregate functions" in *Developing Apama Applications*.

`avg()`	`min()`	`last()`	`stddev()`	`prior()`
`sum()`	`max()`	`wavg()`	`stddev2()`	
`count()`	`first()`	`mean()`	`nth()`	

When a query does not specify an aggregate calculation or filter, only the most recent set of events that match the pattern are used to invoke the actions and any other procedural code. With an aggregate calculation or filter, every set of events, in the current set of events, that matches the pattern is available for use by the aggregate function, provided that the latest event is present in one of the sets of events. Any events or combinations of events that do not match the pattern or do not meet specified query conditions, are ignored; their values are not used by the aggregate function.

To add an aggregate filter to a query:

1. In the Query Designer Aggregates pane, click the down arrow next to the plus sign ➕ ▾ and select Filter (having).
2. In the New Query Aggregate Filter dialog, specify a Boolean expression that uses an aggregate function with identifiers from the pattern. You can also use parameters.

   For example, this aggregate filter causes the query actions to be invoked only when the average price of trades is greater than 100.0:

   ```
   avg(trade1.price) > 100.0
   ```
3. Click OK.

Query Designer displays the new aggregate filter in a row in the Aggregates pane.

To modify the aggregate filter, select it and then click the Edit ✏ icon.

To remove the filter, select it and then click the Delete icon ✖.

Also, the new filter is immediately added to the source code as a `having` clause in the `find` statement. If you modify the filter in the Source tab this is reflected in the Aggregates pane in the Design tab.

You can add one or more aggregate calculations as well as one or more aggregate filters. The order in which they appear in the Aggregates pane is the order in which they are executed in the query.

When you add more than one aggregate filter to a query, then all of them must evaluate to true for the query actions to be invoked.

See also: "Aggregating event field values" in *Developing Apama Applications*.

Adding query aggregates

Adding query actions

In a query definition, you specify the actions you want Apama to perform when it finds a match for the event pattern specified in the query. You can add one or more actions and there are two kinds of actions that you can add:

- Send event actions send an event to a channel that you specify.
- Custom EPL actions can do anything that can be defined in an EPL action.

Before you define query actions, you should add the query input events and specify the query pattern. If this is a parameterized query, you should add the query parameters before you add actions. You can then refer to the parameters in the actions.

You add query actions in the Actions pane of the Design view. Click the down arrow to the right of the plus sign ✚ ▾ and select the kind of action you want to add. Query Designer displays a dialog in which you define the action. See one of the following topics for details:

- "Adding query send event actions" on page 97
- "Adding query custom EPL actions" on page 98

After you add an action in the Design view, its name appears in a row in the Actions pane. Select the action name to edit or delete it.

When you add an action, it is immediately added to the source code. Any changes you make in the Source tab will be shown in the Design tab, and vice versa. If you introduce any syntax errors into the query source code then you must resolve them in the Source tab before you can view the query in the Design tab.

For more details about the EPL code for custom EPL actions, see "Defining actions in queries" in *Developing Apama Applications*.

Creating queries in Query Designer

Adding query send event actions

In the Query Designer Actions pane, add the send event action(s) you want Apama to perform when it finds a match for the event pattern specified in the query. You can specify one or more send actions as well as one or more custom actions.

Before you define query actions, you should add the query input events and specify the query pattern. If this query uses parameters, you should add the query parameters before you add actions. You can then refer to the parameters in the actions.

To add a send action to a query:

1. In the Actions pane of the Query Designer, click the drop down arrow to the right of the plus sign ✚ ▾ and select Send Event to create a send event action. The New Query Send Event Action dialog appears.
2. Click the Choose button, and select the Event type.
3. In the Name field, enter a name for the send event action.
4. In the Description field, optionally enter a description of what the action performs.
5. In the Channel field, specify an EPL expression to which the event will be sent. The EPL expression must evaluate to a string. If you are using a string literal, you have to enclose the string literal within quotes.

   The Fields table displays event fields and the values to be specified for the event. Values can be any valid EPL expression of the same type as the field. Only string literals need to be enclosed within quotes.

   If any fields that are not present in the event definition have been incorrectly added to the Send Event action's event in the Source editor tab, then these fields will be listed in the missing fields table. These missing fields and values are persisted with the Send Event action when you click OK. If you do not want these missing fields and values to persist, click Clear List. Clear List removes all the missing fields and values from the Send Event action.
6. Click OK when the send action definition is complete.

If you look at the Source view of the query, you can see that for each action you define, Query Designer inserts a `%send` statement in the EPL query definition. The `%send()` statements appear in the `find` statement block and can be interleaved with regular EPL.

In the Source view, the modifications you can make to `%send` statements are to modify the quoted name, the quoted description, and the channel. Any changes you make in the Source view will appear in Query Designer. If there is a syntax error in the Source view, you cannot display the Design view until you correct the error. The recommendation is that only Query Designer should insert `%send()` statements. At runtime when the query finds a match, it executes all specified actions in the order in which they are listed in the Actions pane. The arrows at the top of the Actions pane let you change this order. To change the order, select the action you want to move and then click the appropriate arrow as many times as needed.

To edit a send event action, select the send event action and click the edit sign ✎.

To delete a send event action, select the send event action and click the delete sign ✖.

Adding query actions

Adding query custom EPL actions

In the Query Designer Actions pane, add the custom EPL actions you want Apama to perform when it finds a match for the event pattern specified in the query. You can specify one or more custom actions as well as one or more send actions. See "Adding query actions" on page 97 for an understanding of these two kinds of actions.

Before you define query actions, you should add the query input events and specify the query pattern. If this is a parameterized query, you should add the query parameters before you add actions. You can then refer to the parameters in the actions.

To add a custom action to a query:

1. In the Query Designer Actions pane, click the down arrow to the right of the plus sign ✚ ▾ and select Custom EPL to display the New Query Custom EPL Action dialog.
2. In the Name field, enter a name for the custom action.
3. In the Description field, optionally enter a description of what the action does.
4. In the Custom EPL code editor, enter the EPL code that defines the action. You define an action in a query in the same way that you define an action in a monitor except that when you use the New Query Custom EPL Action wizard, you cannot specify action arguments nor an action return value. The numbers in the left column approximately indicate the lines that the code you enter will be on if you click the Source tab to view the query code.

   As you define your action, Query Designer can help you with completion proposals. See "Obtaining content assistance" on page 55 and "Using auto-completion" on page 56.
5. The Errors field displays information about any errors in the EPL you enter. You must resolve any errors before you can save the action.
6. Click OK when the action definition is complete.

   If you look at the Source view of the query, you can see that for each action you define, Query Designer inserts a `%custom` statement in the EPL query definition. The `%custom()` statements appear in the `find` statement block and can be interleaved with regular EPL.

   In the Source view, the modifications you can make to `%custom` statements are to modify the quoted name, the quoted description, or the EPL in the block. The block contains the action definition you entered in the Custom EPL code editor. Any changes you make in the Source view will appear in Query Designer. If you make a syntactically invalid change in the source then you cannot display the Design view until you correct the error.

   The recommendation is that only the Query Designer should insert `%custom()`statements.
7. At runtime, when the query finds a match it executes all specified actions in the order in which they are listed in the Actions pane. Two arrows at the top of the Actions pane let you change this order. To change the order, select the action you want to move and then click the appropriate arrow as many times as needed.

Adding query actions

Specifying a time period in Query Designer

In Query Designer, you can specify a length of time:

- In the within clause for an input event to specify the duration of time that an event remains as a current event that the query operates on.
- To wait before or after an event pattern occurs. This is in the Wait operator in an event pattern.

- In which all events in the pattern or some events in the pattern must be received. This is in a query time constraint condition.

When you specify a time period, it must be one of the following:

- A time literal, which is an `integer` or `float` value, followed by a space, followed by one of the following:
  - `day`
  - `days`
  - `hour`
  - `hours`
  - `min`
  - `minute`
  - `minutes`
  - `sec`
  - `second`
  - `seconds`
  - `msec`
  - `millisecond`
  - `milliseconds`

  Insert a space between consecutive time literals. For example, you could enter `5 min 10.0 sec`.

  You have to specify the time literal in descending order of temporal magnitude. For example, you could enter `1 day 1 hour 1 min`.
- A `float` literal, which can be a `float` value or an expression that resolves to a `float` value. An expression can use constants and parameters. A `float` literal always indicates a number of seconds.

For example, the following specifications are valid:

- `10 sec`
- `3.5 hours`
- `5 days`
- `90 min 30.0 sec`
- `60.0`

Creating queries in Query Designer

Editing source code in Query Designer

The Query Designer **Design** tab supports the definition of queries without the need to write code. However, it also provides a **Source** tab, so that an application developer can view or modify the EPL source code for the query definition. Changes made in the Design tab are reflected in the Source tab, and vice versa.

Query Designer provides an Actions pane that lets you specify actions to perform when a match set is found. For each action added in the Actions pane, Query Designer inserts a `%custom` statement in the EPL query definition. The recommendation is that only Query Designer should insert `%custom()` statements.

The `%custom()` statements appear in the `find` statement block and can be interleaved with regular EPL. `%custom()` signifies a block of EPL that was added in the Actions pane of the Design tab. You can modify the string that contains the name of the action, the string that contains the description of the action, or the EPL inside the braces, `{` and `}`, of the `%custom()` statement. You should not modify other content inside the parentheses.

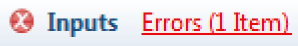
For example, For example, you should edit only the highlighted text in the following code block:

```
package com.apama.samples.usercomplaints;

query FindUsersComplainingAfterNoService
{
  inputs
   {
    SupportCall() key subscriberId within 3 days;
    CallDataRecord() key customerId as subscriberId within 3 days;
   }

   // Identifies subscribers who have not been able to make any successful calls after 2 days,
   // and have made two support calls, the second of which escalated the problem.
  find wait (2 days):previous -> SupportCall:firstCall -> SupportCall:secondCall
      where secondCall.escalated
      without CallDataRecord:cdr where cdr.callSucceeded between (previous firstCall)
      {
         %custom("title":"sendCustomerEscalationAlert","description":"Send a warning about escalated a support call
           {
send CustomerEscalationAlert(firstCall.subscriberId, "User escalated support request") to "com.apama.samples.user_c
           }
      }
}
```

Creating queries in Query Designer

Errors in query definitions

In the Design tab of Query Designer, as you add and edit the information that defines the query, Query Designer immediately displays error messages if you enter text that is not allowed or if you leave out a required item. If there is an error in the query definition then Apama Studio displays an error icon in the Query Designer section that defines the part of the query that contains the error, for example:



This appears in the toolbar of the section that contains the error. Hover over the "`Errors (1 Item)`" text, for example, to display a message that describes the error.

Any syntax errors in the Source tab prevents the Design tab from being used. You must correct any syntax errors in the Source tab before you can view the query in the Design tab..

A query file fails to run in the Correlator at the time of launching the Apama project if the query file has the following errors:

- Syntax error — These errors prevent the Design tab from appearing. The syntax errors include errors such as mismatching brackets or quotes, missing semicolon (;) from the end of statements.
- Validation error — These errors prevent reporting of semantic errors, and are highlighted in the sections of the Design tab. The Completion proposals do not appear in the Custom EPL dialog. The validation errors include errors such as inconsistent keys across the inputs.
- Semantic error — These errors are highlighted in the sections of the Design tab if there are no validation errors. The semantic errors include errors such as using the wrong type in an expression, or using a variable or field that does not exist.

Creating queries in Query Designer

Defining query preferences

This section describes how to define the preferences for a query in Apama Studio.

1. In the Apama Studio menu bar, choose Window > Preferences.
2. In the **Preferences** dialog that appears, expand Apama.
3. Expand Query.
4. Click Syntax Coloring.

   The Syntax Coloring options appear.
5. Select the Token Styles to apply the formats.

   Click Change to apply more formatting options.

   Click Restore Defaults to restore the default formatting options.
6. Click OK in the **Preferences** dialog.

Creating queries in Query Designer

Configuring query projects

For a query application that will be deployed on a cluster of correlators, you need to add Java Message Service (JMS) support and Universal Messaging (UM) support to your project. See "Correlator arguments" on page 110 and "Adding Universal Messaging configuration to projects" on page 54.

Also, you must map JMS messages and EPL events. See "Mapping Apama events and JMS messages" in *Connecting Apama Applications to External Components*.

Using Query Designer

Exporting query deployment scripts

To deploy an Apama query application, you can export the project's launch configuration to create a deployment script. This generates the build files, configuration files, property definition files, scripts, and EPL files and copies other resources such as dashboards that are used by Ant to build and launch the project on a different machine.

See "Exporting to a deployment script" on page 72.

Using Query Designer

Chapter 4: Launching Projects

As you develop your applications, you can test them by running them from Apama Studio. Projects contain *launch configurations* that specify which resources in the project need to be started and any initialization information they need. By default, a single launch configuration is created for each project the first time it is launched, but you can create others to test an application with a different set of monitors or a different version of a block.

This section contains the following topics:

- "Running Apama projects" on page 104
- "Monitoring apama applications" on page 117

For information about creating launch configurations for debugging and profiling purposes, see the following:

- "Debugging EPL Applications" on page 127
- "Debugging JMon Applications" on page 136
- "Profiling EPL Applications" on page 148

Running Apama projects

Apama Studio uses a project's launch configuration to start the application. You can use the project's default launch configuration or you can define one or more configurations for launching your Apama project in different ways.

Default launch configuration

An application's default launch configuration starts the default correlator and uses all the monitors, events and queries defined in the project. A project's default launch configuration is available in both the **Workbench** and **Developer** perspectives.

Workbench perspective

To start the default launch configuration for the current project from the **Workbench** perspective:

1. In the **Workbench Project** view, click the Start button ▶. This starts the default correlator with all the project's monitors, events and scenarios. If the project includes a default dashboard, Apama Studio launches it in the Dashboard Viewer. Information about the running application is shown in the **Console** view and if the project has a scenario, the **Scenario Browser** view is displayed.

2. To restart the application, click the Restart button in the**Workbench Project** view.

3. To stop the click the Stop button in the**Workbench Project** view. In addition to halting the application, this closes the Dashboard Viewer

Developer perspective

To start the default launch configuration for a project from the **Developer** perspective:

1. In the **Project Explorer** view, select the project you want to run.
2. Select Run > Run from the Apama Studio menu. This starts the default correlator with all the project’s monitors, events and scenarios. If the project includes a default dashboard, Apama Studio launches it in Dashboard Viewer. Information about the running application is shown in Apama Studio’s **Console** view.
3. If you want to inspect the behavior of the project’s scenarios in the Scenario Browser, select Window > Show View > Scenario Browser.
4. To stop a running application click the Terminate button in the **Console** view. If the launch configuration started Dashboard Viewer, you may want to stop Dashboard Viewer before stopping the application otherwise when you stop the application Dashboard Viewer will display a message its connection to the correlator was lost.

Defining custom launch configurations

In many cases you may want to create custom launch configurations, for example to run your applications with a subset of the monitors in your project or if your application relies on an IAF adapter. Note that the **Apama Workbench** perspective is targeted at creation of simple applications and so does not provide much support for projects with multiple launch configurations. If you need the power of multiple launch configurations use the **Apama Developer** perspective.

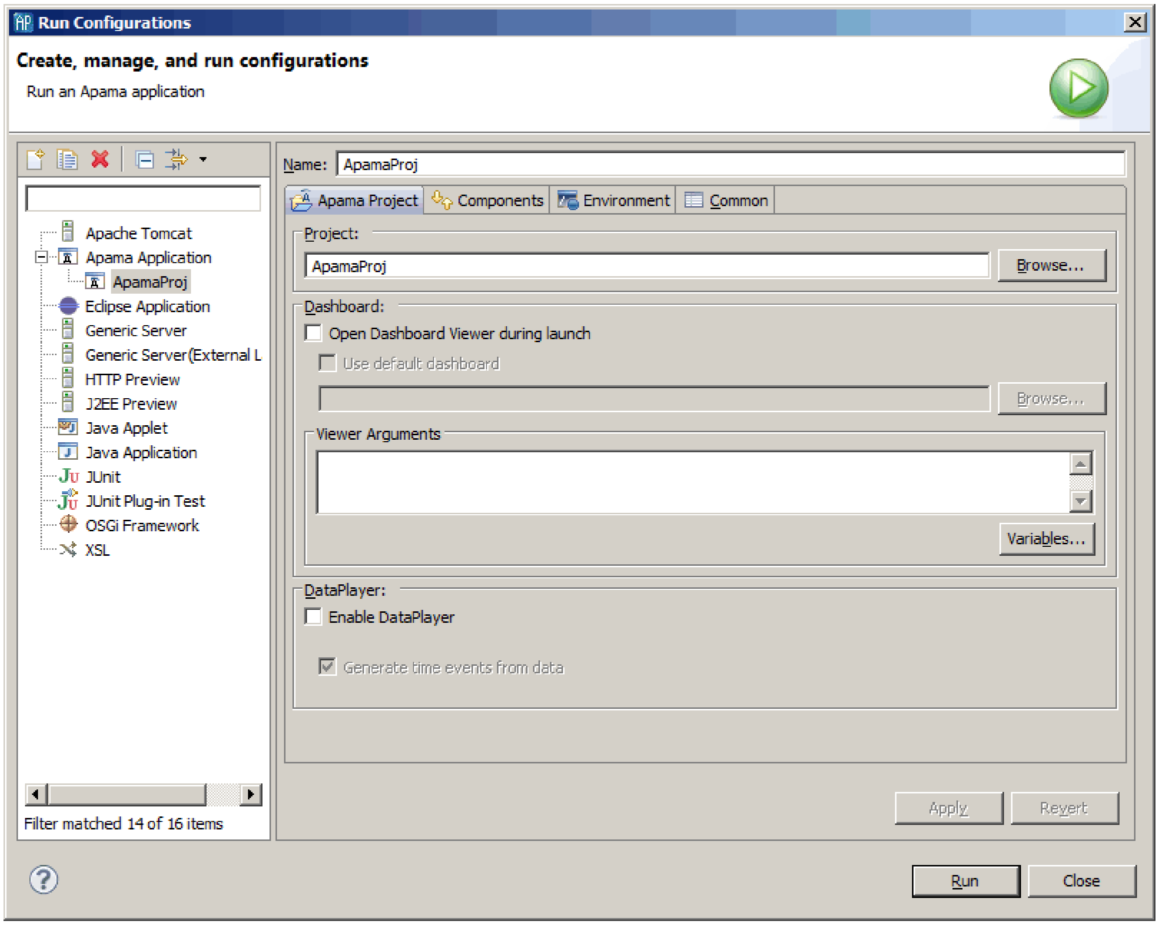
When you create a new shared custom launch configuration Apama Studio creates two files and places them in the directory specified by Shared file. The names of these files have the following format and the launch configuration information is split between them:

- `*launch_config_name*.deploy`
- `*launch_config_name*.launch`

Any changes you make to the launch configuration will be reflected in the `.deploy` file. However, if you export a launch configuration to an Ant deployment script and then the shared location changes then you must re-export the launch configuration to a new Ant deployment script. If you do not, the old Ant deployment script fails because it cannot find the `.deploy` file. See

To create a launch configuration:

1. In the **Project Explorer** view, select the project you want.
2. If you are using the **Apama Developer** perspective, select Run > Run Configurations from the Apama Studio menu. The **Create, manage, and run configurations** wizard starts. The wizard has four tabs, the Apama Project tab, the Components tab, the Environment tab, and the Common tab.



Run Configurations

Create, manage, and run configurations

Run an Apama application

Name: ApamaProj

Project: ApamaProj

Dashboard:

☐ Open Dashboard Viewer during launch

☐ Use default dashboard

Viewer Arguments

DataPlayer:

☐ Enable DataPlayer

☑ Generate time events from data

Filter matched 14 of 16 items

If you are using the **Apama Workbench** perspective, select the project of interest in the **Workbench Project** view and then click the Edit button just above the Start, Stop, and Restart buttons in the launch control panel. This allows the default launch configuration for the project to be edited. Creating multiple launch configurations is not recommended for **Workbench** perspective users

3. In the wizard's Name field assign a name to the launch configuration

4. On the Apama Project tab fill in the following information:

   - Project — The project field specifies the project to launch.

   - Dashboards — This contains information about launching a dashboard when the project runs. It contains the following fields:

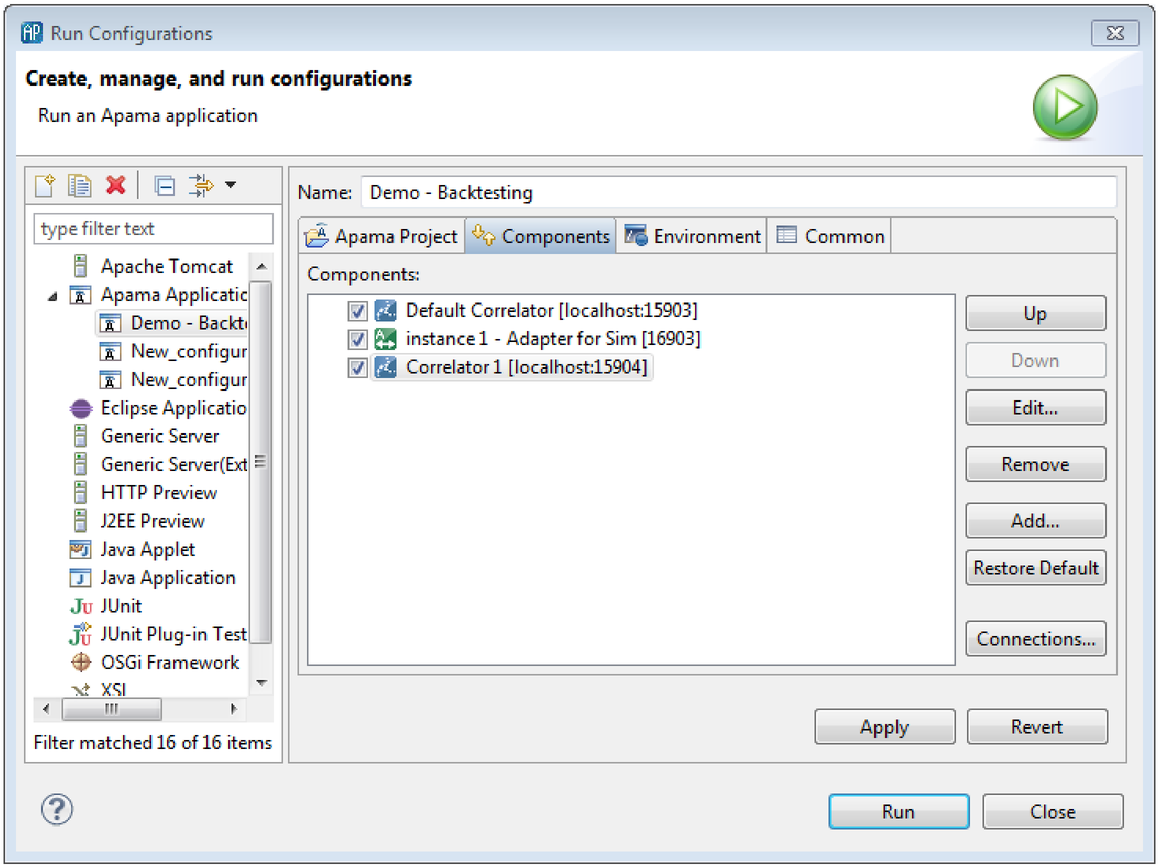
   Open Dashboard Viewer during launch — Specifies whether or not the Dashboard Viewer should be launched when running the project. The default is to run the Dashboard Viewer.

   Use default dashboard — The default dashboard is the dashboard project in the `dashboards` directory of the project. You can launch another dashboard by disabling the default dashboard and specifying the project relative path of the dashboard to launch.

   viewer Arguments — Specify any arguments to be added to the end of the command line for the dashboard viewer process.

5. The Components tab lists the components that are needed by the project such as additional correlators or external processes. You can add and remove components, edit their specifications, change the order in which they are started, or specify connections between correlators. Components are started in the order

in which they appear in the Components tab from top to bottom. However, there is no waiting for one component to finish its startup before the next component is started. In other words, you cannot depend on startup for one component to already be complete when a subsequent component is started.


Run Configurations

Create, manage, and run configurations

Run an Apama application

Name: Demo - Backtesting

Components:

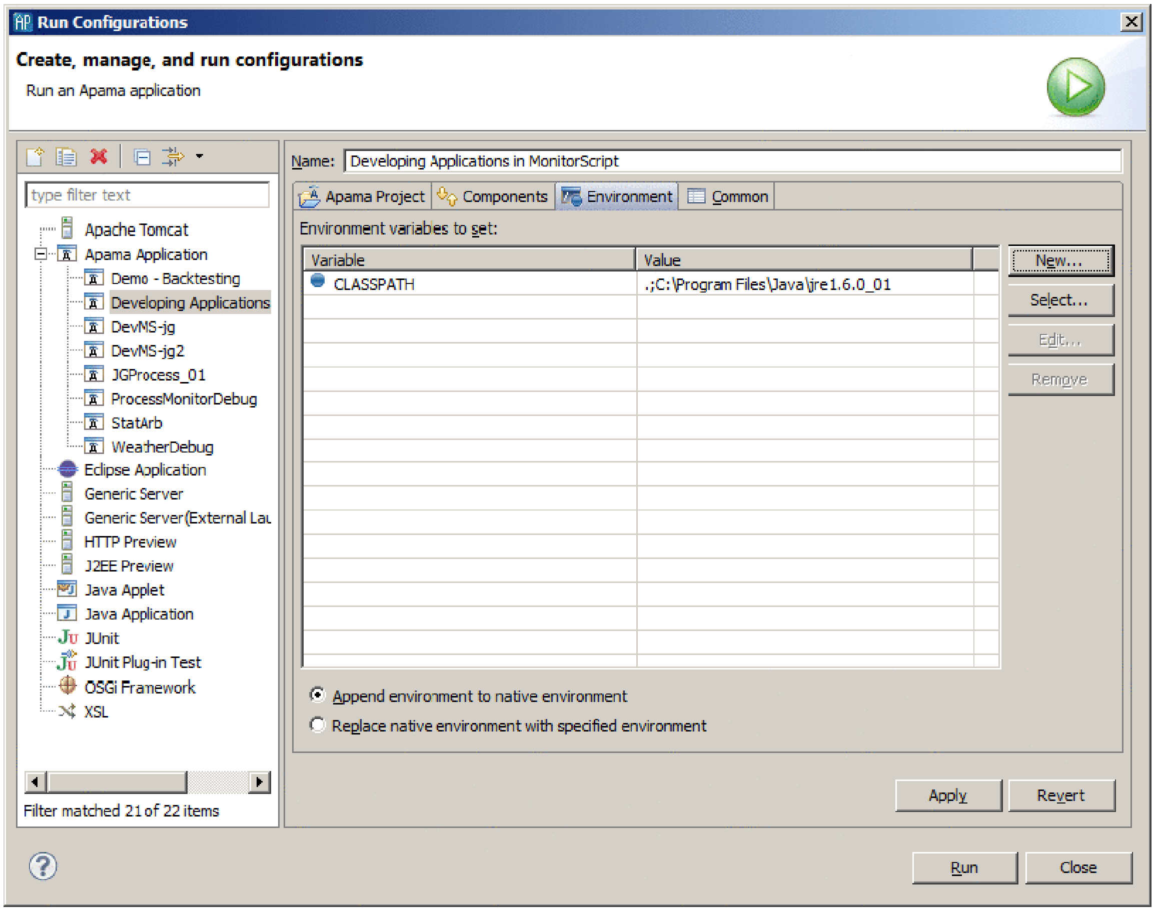
☑ Default Correlator [localhost:15903]
☑ instance 1 - Adapter for Sim [16903]
☑ Correlator 1 [localhost:15904]

Filter matched 16 of 16 items

You specify information on this tab as follows:

- Up — Moves the component up in the order in which it starts.
- Down — Moves the component down in the order in which it starts.
- Edit — Allows you to modify the settings for the component.
- Remove — Removes the component from the launch configuration
- Add — Allows you to add a correlator or an external process to the launch configuration. To add a component, click the Add button and select the type of component you want to add.
- Restore Default — Sets the launch configuration to use the default launch configuration.
- Connections — Displays the Connections dialog, which lets you add and remove connections between correlators. See "Connecting correlators" on page 115.

6. The Environment tab lists any additional environment variables needed to run any of the processes started by this launch configuration.



Name: Developing Applications in MonitorScript

Environment variables to set:

Variable	Value
CLASSPATH	.;C:\Program Files\Java\jre1.6.0_01

● Append environment to native environment

○ Replace native environment with specified environment

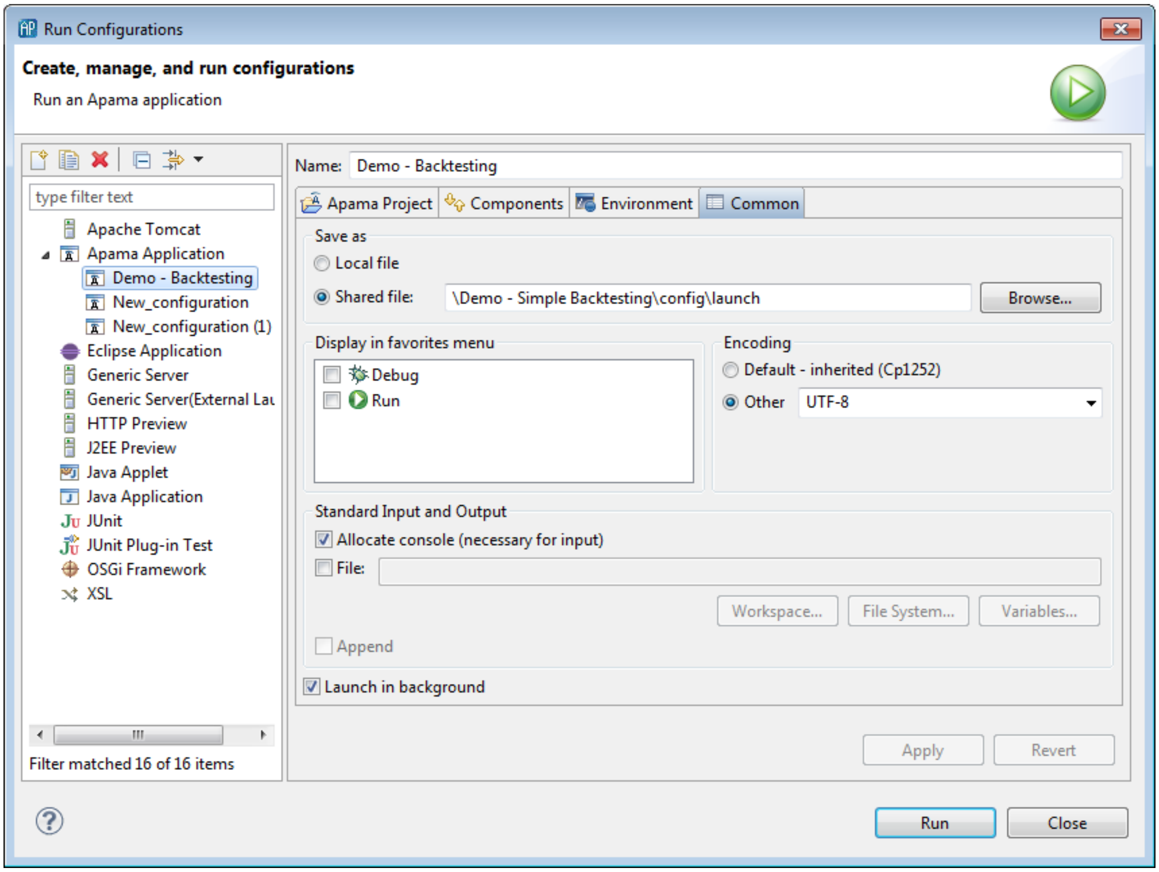
Then provide information here in the following ways:

- New —Specify a new environment variable.
- Select — Select an environment variable from the list of Eclipse environment variables.
- Edit —Modify the value of an environment variable.
- Remove — Remove an environment variable from this configuration.

Apama recommends that you append new environment settings to the native environment as otherwise it will be necessary to manually specify the standard Apama environment variables in order for the process to start correctly.

Note that to add a suffix or prefix to an existing environment variable, a new environment variable of that name should be created, and the existing value specified as part of the variable's value, for example, `PATH=${env_var:PATH};C:\my path`.

7. The Common tab specifies additional attributes for running this launch configuration.



Name: Demo - Backtesting

Save as
○ Local file
● Shared file: \Demo - Simple Backtesting\config\launch

Display in favorites menu
□ Debug
□ Run

Encoding
○ Default - inherited (Cp1252)
● Other UTF-8

Standard Input and Output
☑ Allocate console (necessary for input)
□ File:
□ Append

☑ Launch in background

This tab displays the following fields:

- Save as
  - Local file
  - Shared file — This is the default selection and the default path is the `config\launch` folder in your project directory. Click Browse to navigate to and select another location that is available to all users sharing this project.
- Display in favorites menu

  Select the appropriate checkbox to display this configuration as a choice in the drop-down menu of the Debug or Run button in the Apama Studio toolbar.
- Console encoding — The default encoding for output to the console is Cp1252. To encode console output in a different format, click Other and select the encoding you want. For example, UTF-8.
- Standard Input and Output

  Allocate Console (necessary for input) — For correlator launch configurations, there are no reasons not to allocate a console. Allocating a console does not affect performance.

  File — If you want to capture correlator output in a file, navigate to and select a file to contain the correlator output.

  Append — When you capture correlator output in a file, indicate whether you want to append the output to the specifies file.
- Launch in background — The default is that the correlator runs as a background process.

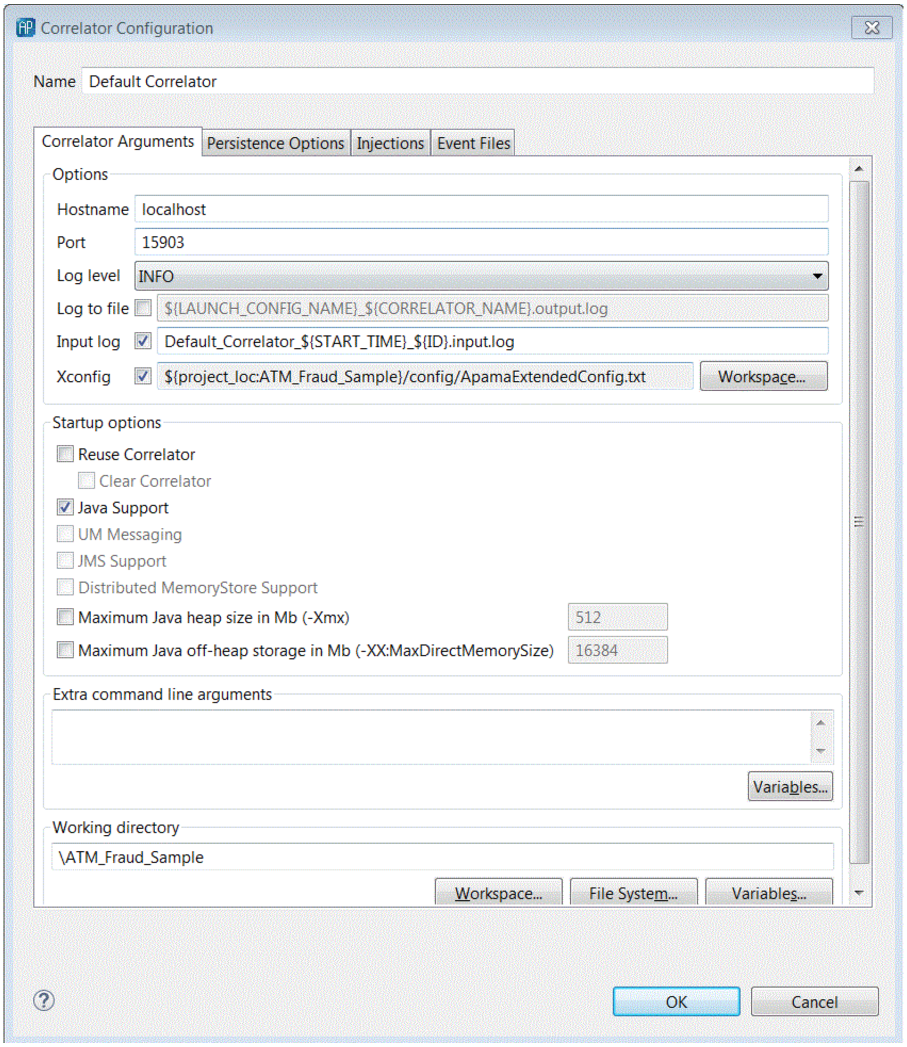
Adding a correlator

When you add a correlator to the launch configuration, Apama Studio displays the Correlator Configuration dialog, which includes these tabs:

- Correlator Arguments
- Persistence Options
- Injections
- Event Files

Correlator arguments

The Correlator Arguments tab specifies the options and arguments that Apama Studio uses to start the correlator.



Name: Default Correlator

Hostname: localhost
Port: 15903
Log level: INFO
Log to file ☐ ${LAUNCH_CONFIG_NAME}_${CORRELATOR_NAME}.output.log
Input log ☑ Default_Correlator_${START_TIME}_${ID}.input.log
Xconfig ☑ ${project_loc:ATM_Fraud_Sample}/config/ApamaExtendedConfig.txt

☐ Reuse Correlator
☐ Clear Correlator
☑ Java Support
☐ UM Messaging
☐ JMS Support
☐ Distributed MemoryStore Support
☐ Maximum Java heap size in Mb (-Xmx) 512
☐ Maximum Java off-heap storage in Mb (-XX:MaxDirectMemorySize) 16384

Working directory: \ATM_Fraud_Sample

You can accept the default values or change one or more arguments. You can also add arguments. In addition, you can also control the behavior with the following options:

- Hostname — `localhost`. The name of the correlator host machine.
- Port — This is the port on which the correlator listens for monitoring and management requests.
- Log level — Default is INFO.
- Log to file — Default is `${LAUNCH_CONFIG_NAME}_${CORRELATOR_NAME}.output.log`. This is the correlator status log.
- Input log — Default is `Correlator_1_${START_TIME}_${ID}.input.log`. This log contains all incoming messages. See *Using an input log to diagnose problems* in *Deploying and Managing Apama Applications*.
- Xconfig — Select this option to provide additional configurations to the correlator using a text file. For example, per-package logging settings. See *Using the Apama component extended configuration file* in *Deploying and Managing Apama Applications*.
- Reuse Correlator — Select this option to use an already running correlator.
- Clear Correlator — Select this option to delete all the correlator contents when the launch starts.
- Java Support — Select this option to provide Java support for JMon applications. Normally this is automatically selected when a JMon application is created in Apama Studio.
- UM Messaging — Select this option to inject the project's `UM-config.properties` file, which is in the project's `config` folder. This is equivalent to specifying the `-UMconfig` option when starting a correlator. Uncheck this box if you want to run the project without using UM. If the project does not contain a UM configuration properties file, this option is disabled.

  See "Using Universal Messaging" in *Connecting Apama Applications to External Components*.
- JMS Support — Select this option to provide JMS support for correlator-integrated messaging. Normally this is automatically selected when the correlator-integrated adapter for JMS is added to an Apama application.
- Distributed MemoryStore Support — Select this option to provide support for distributed MemoryStore. With the distributed MemoryStore, you can create distributed stores that provide access to data that will be shared among Apama applications running in separate correlators.
- Maximum java heap size in Mb (-Xmx). Default is 512.
- Maximum java off-heap storage in Mb (-XX:MaxDirectMemorySize). Default is 16384.
- Extra command line arguments. Specify any additional arguments for starting the correlator. See *Starting the event correlator* in *Deploying and Managing Apama Applications*.

Persistence options

The Persistence Options tab specifies the correlator persistence settings Apama Studio will use when it runs this launch configuration.

- Enable correlator persistence — When set, this tells the correlator to start with the persistence option.
- Directory location — This specifies the location on disk of the persistent store used to preserve correlator state.
- Startup options — These options specify the startup behavior of the correlator with respect to how it handles its persistent store.

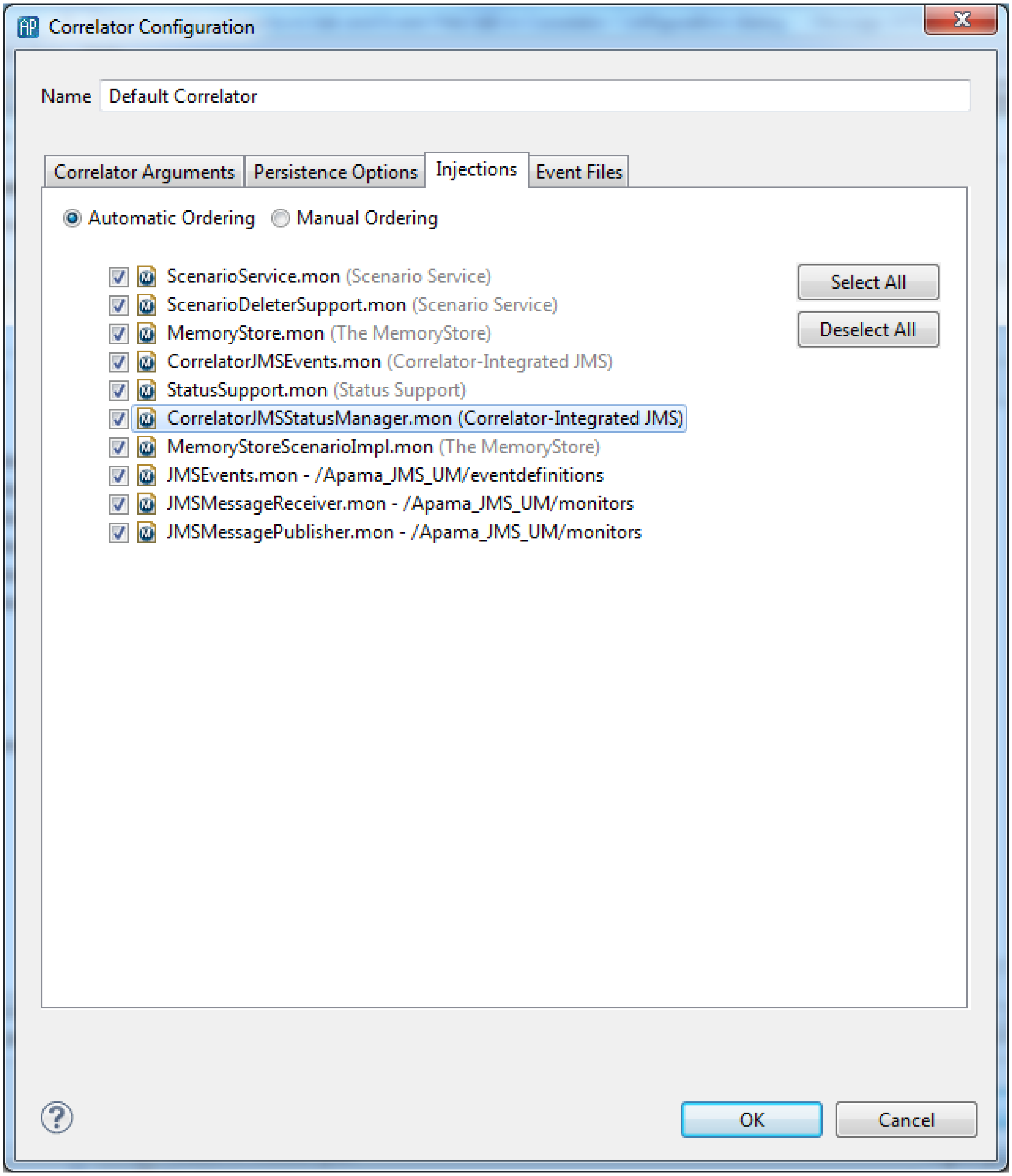
- Clear state and re-inject — Specifies that you want to clear the contents of the recovery datastore.
- Resume from persistent state — Specifies that the correlator will restart using the state from its persistent store as of the last committed snapshot.
- Prompt for startup options dialog during correlator launch — Specifies that Apama Studio will present a dialog when launching the application. The dialog asks whether to clear the correlator state information and re-inject the application code or to resume from the state information stored in the last committed snapshot.

For more information on correlator persistence, see "Using Correlator Persistence" in *Developing Apama Applications*.

For more information on persistence options for starting the correlator, see "Starting the event correlator" in *Deploying and Managing Apama Applications*.

Injections

The Injections tab lists the files, except event files, that will be injected or sent into the correlator when Apama Studio runs this launch configuration. This includes the files that are in your project as well as additional files that have been added to the project build path. See "Defining custom launch configurations" on page 105.



Name: Default Correlator

● Automatic Ordering ○ Manual Ordering

☑ ScenarioService.mon (Scenario Service)
☑ ScenarioDeleterSupport.mon (Scenario Service)
☑ MemoryStore.mon (The MemoryStore)
☑ CorrelatorJMSEvents.mon (Correlator-Integrated JMS)
☑ StatusSupport.mon (Status Support)
☑ CorrelatorJMSStatusManager.mon (Correlator-Integrated JMS)
☑ MemoryStoreScenarioImpl.mon (The MemoryStore)
☑ JMSEvents.mon - /Apama_JMS_UM/eventdefinitions
☑ JMSMessageReceiver.mon - /Apama_JMS_UM/monitors
☑ JMSMessagePublisher.mon - /Apama_JMS_UM/monitors

By default the Injections tab lists all EPL files in the project. The files are listed in dependency order. This is the order in which Apama Studio will load the files. Apama Studio determines the dependency order when it builds the project. In almost all projects, you do not need to change the order. However, if necessary, you use this tab to change the order in which Apama Studio injects the project's EPL files.

When Automatic Ordering is selected you have the option to exclude files from the launch configuration by unchecking them. When you run this project the unchecked files are not injected.

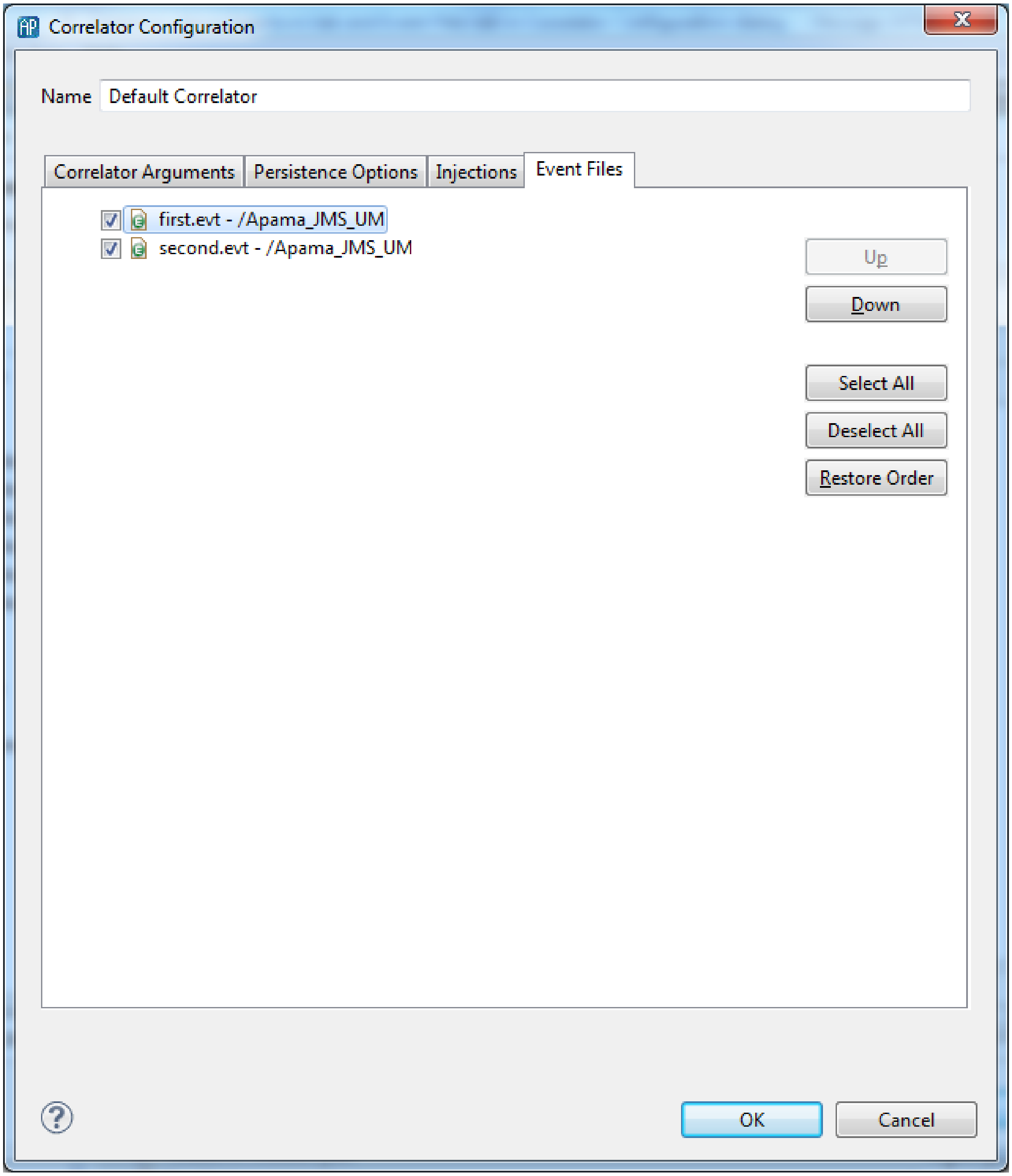
When you select Manual Ordering the Up and Down buttons appear. Select the file whose position you want to change and click the Up or Down button as many times as needed. When Manual Ordering is selected Apama Studio does not resolve any conflicts. It is up to you to correctly order the files.

If you uncheck a check box, the corresponding file remains in the list, but will not be loaded during this launch configuration.

All selected EPL files are injected and then all selected `.evt` files (on the Event Files tab) will be injected.

Event Files

The Event Files tab lists the event files that will be injected or sent into the correlator when Apama Studio runs this launch configuration. This includes event files that are in your project as well as additional event files that have been added to the project build path. See "Defining custom launch configurations" on page 105.



Name Default Correlator

☑ first.evt - /Apama_JMS_UM

☑ second.evt - /Apama_JMS_UM

By default the Event Files tab lists all .evt files in the project. The files are listed in lexicographic order by file name. This is the order in which Apama Studio will inject the files.

If necessary, you use this tab to change the order in which Apama Studio injects the project's event files. Select the file whose position you want to change and click the Up or Down button as many times as needed. It is up to you to ensure that the files are injected in the correct order.

If you uncheck a check box, the corresponding event file remains in the list, but will not be injected during this launch configuration.

All selected EPL files (listed on the Injections tab) are injected and then all selected .evt files will be injected.

Connecting correlators

When you are creating a custom launch configuration you can specify connections between correlators. This is similar to connecting correlators with the `engine_connect` correlator utility.

Each connection you add goes in only one direction. For example, suppose you define a connection from `correlatorA` to `correlatorB`. This connection lets `correlatorA` send events to `correlatorB`. If you want `correlatorA` to receive events from `correlatorB` you must add a second connection that specifies `correlatorB` as the source of the connection and `correlatorA` as the target of the connection.

To connect correlators:

1. In the Run Configurations dialog, select the Components tab and ensure that the correlators you want to connect are listed as components. See "Adding a correlator" on page 110.
2. Click Connections.
3. In the Connections dialog, click Add, which activates a row in the connections table.
4. In the activated row, in the From field, select the name of the correlator that is the source of this connection. If the name of the correlator you want to connect does not appear, click Cancel to return to the Components tab and then select Add > Add Correlator.
5. In the To field, select the name of the correlator that is the target of this connection.
6. In the Channel field, specify one or more channels to be used by this connection. Use a comma as a separator. For example, `channelA, channelB`.
7. In the Flags field, specify any options that are supported by the `engine_connect` utility.

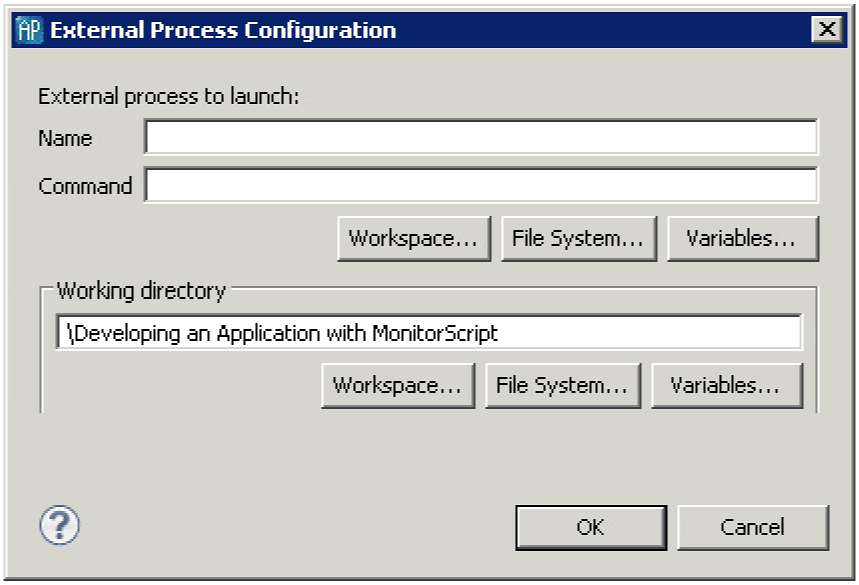
   See "Event correlator pipelining" in *Deploying and Managing Apama Applications*.

After adding the desired connections, click OK to return to the Components tab.

To remove a connection, select the row that defines the connection and click Remove.

Adding an external process

When you add an external process to the launch configuration, Apama Studio displays the **External Process Configuration** dialog.



\Developing an Application with MonitorScript

This dialog allows the user to add and edit an external process associated with the launcher. You can enter the relevant information in the following fields:

- Name — The name is a unique name in the launcher.
- Command — This is the command line string that is used to invoke the external process. This command string can use the variables from the Workspace, File System, or Variables configured in Eclipse. These variables are replaced with their corresponding values when launched.

Testing a subset of your apama application

In a large Apama application, you might want to test a subset instead of the entire application. The best way to do this is to define a launch configuration that injects only the monitors you want to test. Use this configuration only to test the subset. Create a different launch configuration to test the entire application.

The reason you want a separate configuration for testing the subset is that you must disable the monitors in your project that are not in the subset you want to test.

To disable a file in a launch configuration:

1. Define the launch configuration as you normally would. See "Defining custom launch configurations" on page 105.
2. In the Create, manage, and run configurations dialog, on the Components tab, select the correlator in which you want to perform the testing and click Edit. Or, click Add > Add Correlator to add the correlator on which you want to do the testing.
3. In the Correlator Configuration dialog that appears, on the Initialization tab, deselect the file(s) you do not want to inject.
4. Click OK, Apply, and then Run or Close.

Monitoring apama applications

Apama Studio provides various ways to monitor a running Apama application.

- **Console** view
- **Engine Information** view
- **Engine Receive** view
- **Engine Status** view
- **Scenario Browser**
- Dashboards

Note that in the **Developer** perspective it is possible to launch multiple projects at any one time. By default, the **Console** view and the **Scenario Browser** view will display information about the most recently launched correlator. To monitor a different correlator, select Window > Show View > Other > Debug from the Apama Studio menu and select the **Debug** view — this lists all running launches. Select the correlator that you wish to monitor from this list.

Opening the **Apama Runtime** perspective (either from the perspective shortcut bar in the top right, or selecting Window > Open Perspective > Other > Apama Runtime from the Apama Studio menu) results in a convenient layout of all the available Apama Runtime views. This is the recommended way to make use of these views. You can switch back to the Apama **Developer** or **Workbench** perspective at any time.

Console view

The **Console** view displays information concerning a running Apama application. An application can have several consoles:

- Correlator — Displays output from the correlator.
- Engine Inject —Displays initialization information injected to the correlator.
- Engine Send — Displays information from Apama components such as dashboards that stream data to the correlator.
- Correlator Initialization — Displays information about the correlator initialization including the Java files, `.mon` files (monitors), and `.sdf` files (scenarios) that have been injected and the `.evt` files (events) that have been sent and whether the actions succeeded or failed.

To view one of these consoles, click the drop down arrow of the Display Selected Console button and select the console you want.

Using the Engine Information view

The **Engine Information** view inspects a running correlator and displays defined contents of the correlator. It displays the same information as the Apama command line tool `engine_inspect`.

The information is grouped as follows (click on the right-facing triangle to view the contents of each group):

Aggregates — The names of custom (user-defined) aggregate functions that have been injected. You use aggregate functions in stream queries. Apama built-in aggregate functions are not listed.

Contexts — The names of any user-defined contexts, how many monitor instances are running in each context, how many entries are on each context's input queue, and the names of any channels each context is subscribed to.

Events — The names of all event types in the correlator, and the number of templates of each type, as defined in listener specifications.

Java Monitors — The names of all Java applications in the event correlator and the number of event listeners each Java application has created.

Monitors — The names of all monitors in the event correlator and the number of monitor instances each monitor has spawned.

Plugin Receivers— The names of any plug-in receivers, the channels each plug-in receiver is subscribed to, and the number of items on each plug-in receiver's input queue. A p;ug-in receiver is a correlator plug-in that is subscribed to one or more channels.

Receivers— The names of any external receivers, the address of each external receiver, the channels each external receiver is subscribed to, and the number of entries on the output queue of each external receiver.

Timers — Displays the current EPL timers active within the system. The four types of timers that might be displayed here are `wait`, `within`, `at`, and `stream`. The `stream` timers are those set up to support the operation of a stream network.

This view allows direct deletion of the defined named entities using the Delete button ✖ on the tool bar or from the context (right-click) menu.

The user can send an event from this view as well using the send operation by clicking the Send button E on the toolbar or via the context menu. Double clicking an event item also invokes this operation.

Displaying information in the **Engine Information** view can slow performance, so you may want to close the view if Studio is not very responsive.

Using the Engine Receive view

The **Engine Receive** view shows all events generated from the connected correlator. Each batch of events is separated with an optional separator.

- Select All — Select all text in the console.
- Clear — Clear all text in the console.
- Copy — Copy all selected text to the clipboard

- Show Separator — Show a separator line in each event batch.
- Show Date/Time of batch — Show a date/time of each event batch

You can also change whether to display the separator line and change how it is displayed by clicking the drop down arrow at the top right of the view to display the menu and select Options. See "Engine Receive Viewer preferences" on page 119.

Click the Toggle Connection button to temporarily disconnect the **Engine Receive** view from the correlator.

When the Toggle Connection button is pressed, the console will not update any further events from correlator. The background of the console will be changed to indicate the temporary disconnect mode. The Select All, Clear, and Copy actions will still work in this mode.

To resume from the temporary disconnect mode, simply click on the Toggle Connection button again to resume the connection. The console will be cleared and new events will be shown in the console again.

Engine Receive Viewer preferences

You can change the display options of the **Engine Receive** view by clicking the drop down arrow at the top right of the view. From the menu select Options, which displays the**Engine Receive Viewer Preferences** dialog. This dialog contains settings that specify how information is displayed in the **Engine Receive** view.

Display a separator — Toggles whether each batch of events is visually separated.

Display date/time for batch — Toggles whether the date and time for each batch of events is displayed.

Custom text for separator — Specifies the characters composing the separator.

Max window size (KB) — Select a setting between 100 and 10000.

Using the Engine Status view

The **Engine Status** view displays the information about the correlator status. The information is the same as the output of Apama command line tool `engine_watch`.

Uptime(ms) — The time in milliseconds since this correlator was started. This figure is unaffected if the state of the correlator is restored from a checkpoint file.

Number of contexts — The number of contexts in the correlator. This includes the main context plus any created contexts.

Number of monitors — The number of monitor definitions injected into the correlator. This figure changes upwards and downwards as monitors are injected, deleted or just expire. A monitor expires when each of its instances dies, has no listeners left, or causes a runtime error.

Number of sub-monitors — The number of monitor instances across all contexts in the correlator. In monitors, spawn actions create monitor instances. This figure changes upwards and downwards as monitor instances are spawned, killed or just expire.

Number of java applications — The number of JMon applications loaded in the correlator. JMon applications do not expire, so this value only decreases when you explicitly unload a JMon application.

Number of listeners — The number of event listeners created by monitor instances across all contexts, plus the number of JMon applications.

Number of sub-listeners — The number of sub-listeners that have been created by listeners across all contexts.

Number of event types — The total number of event types defined within the correlator. This figure decreases when you delete event types from the correlator.

Events on input queue — The sum of the number of events on the input queue of each context. The main context has its own input queue and any user-defined contexts each have an input queue.

Events received — The total number of events ever received by the correlator. A checkpoint preserves this value. If you restore the state of the correlator from a checkpoint file, this number reflects the total number of the events seen by the correlator from which the checkpoint was originally made. Note that if an event is on an input queue, it has been received but not processed.

Events processed — The total number of events processed by the correlator in all contexts. This includes external events and events routed to contexts by monitors. An event is considered to have been processed when all listeners that were waiting for it have been triggered, or when it has been determined that there are no listeners for the event.

Events on internal queue — The sum of the number of routed events on the input queue of each context. The internal routing queue in each context is a high priority queue for events that you internally routed with the `route` instruction in your EPL files. The correlator always processes routed events before processing events on the input queue.

Events routed internally — The sum of the number of events routed in each context since the correlator started. A checkpoint preserves this value. If you restore the state of a correlator from a checkpoint file, this number reflects the total number of the events routed to the internal queues for the correlator from which the checkpoint was originally made.

Number of consumers — The number of event consumers registered with the correlator. Event consumers receive events emitted by the correlator.

Events on output queue — The number of events waiting on the correlator’s output queue to be dispatched to any registered event consumers.

Output events created — The total number of output events created by the correlator. A checkpoint preserves this value. If you restore the state of a correlator from a checkpoint file, this number reflects the total number of output events created by the correlator from which the checkpoint was originally made.

Output events sent — The total number of output events that the correlator has sent to event consumers. For example, suppose the correlator created 10 output events and sent each event to two consumers. The number of output events sent is 20. A checkpoint preserves this value. If you restore the state of a correlator from a checkpoint file, this number reflects the total number of output events sent by the correlator from which the checkpoint was originally made.

Using the Scenario Browser view

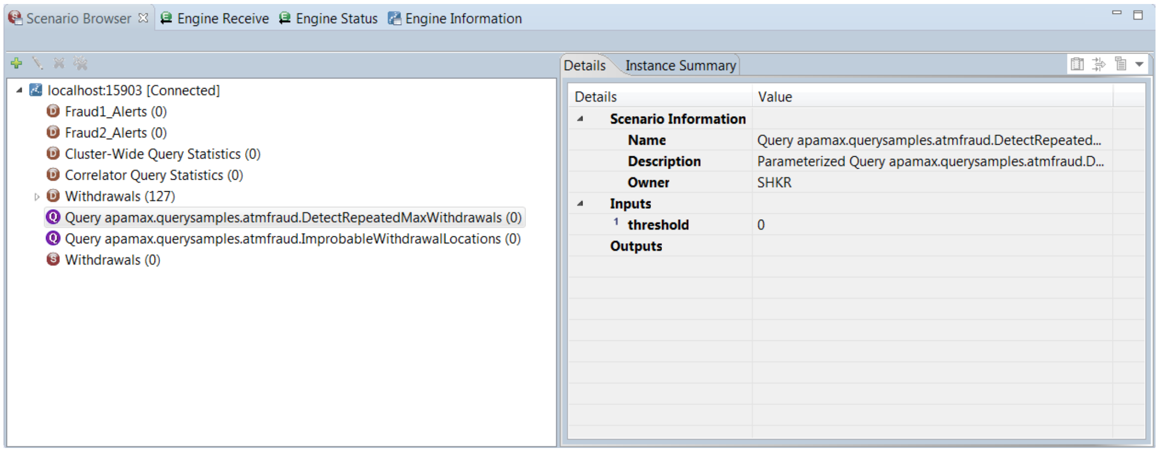
Apama Studio's **Scenario Browser** view displays the scenario and query definitions loaded into the correlator along with the metadata for those scenarios and queries. For queries, **Scenario Browser** displays parameterized and non-parameterized queries that are running along with the query parameter values. In the **Scenario Browser** you can add, edit, and delete scenario and parameterized query instances.

Note: A non-parameterized query contains a single default instance. You cannot edit or delete the default instance. Editing and deleting options are disabled for the default instance.

Displaying the Scenario Browser

By default, in the **Workbench** perspective, the Scenario Browser is opened when you launch an application. In the **Developer** perspective you need to display the **Scenario Browser** view manually by selecting Window > Show View > Scenario Browser from the Apama Studio menu. **Developer** perspective users may find it more convenient to switch to the **Runtime** perspective, either from the perspective shortcut bar in the top right, or by selecting Window > Open Perspective > Other > Apama Runtime. You can switch back to the **Apama Developer** perspective at any time.

The illustration displays the **Scenario Browser** showing running scenarios or queries in the left pane.



localhost:15903 [Connected]
- Fraud1_Alerts (0)
- Fraud2_Alerts (0)
- Cluster-Wide Query Statistics (0)
- Correlator Query Statistics (0)
- Withdrawals (127)
- Query apamax.querysamples.atmfraud.DetectRepeatedMaxWithdrawals (0)
- Query apamax.querysamples.atmfraud.ImprobableWithdrawalLocations (0)
- Withdrawals (0)

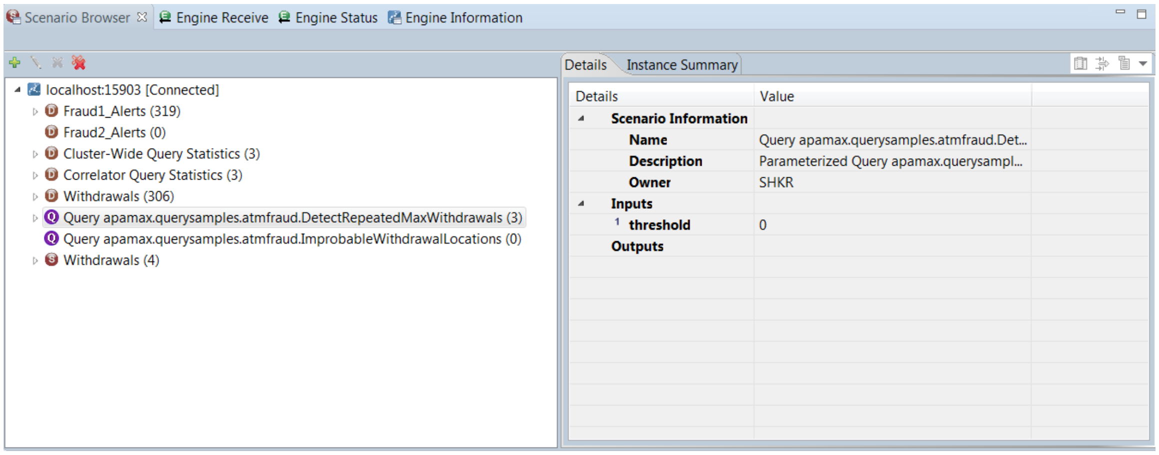
Details	Value
Scenario Information	
Name	Query apamax.querysamples.atmfraud.DetectRepeated...
Description	Parameterized Query apamax.querysamples.atmfraud.D...
Owner	SHKR
Inputs	
1 **threshold**	0
Outputs	

The details of the selected correlator are shown in the right pane.

Browsing scenarios and query definitions

To examine a scenario definition or a query definition, click the name of scenario definition or query definition in the left pane. The illustration below shows the details of a query definition. The Scenario Browser displays the information in two tabs in the right pane: the Details tab and the Instance Summary tab.

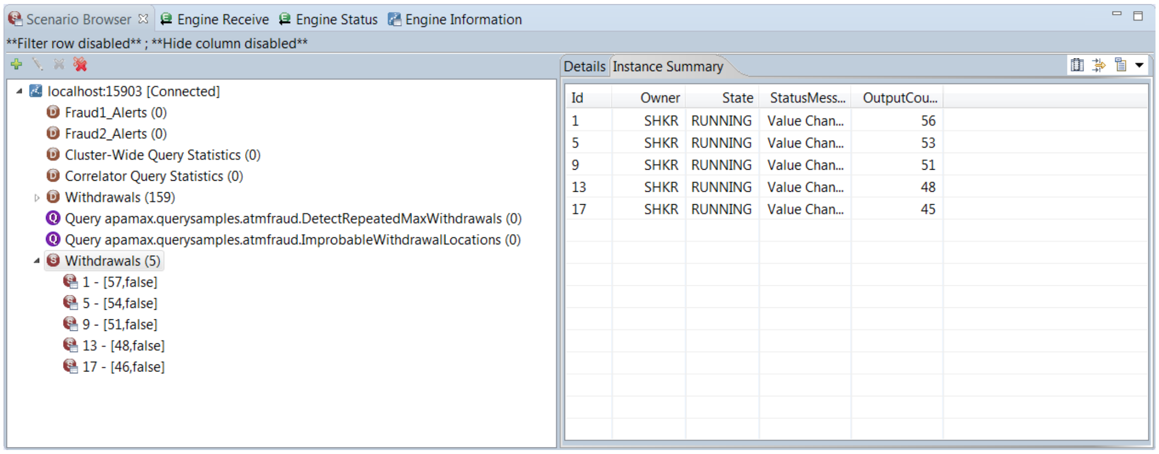
The Details tab shows the metadata of the selected scenario or query.



- localhost:15903 [Connected]
  - Fraud1_Alerts (319)
  - Fraud2_Alerts (0)
  - Cluster-Wide Query Statistics (3)
  - Correlator Query Statistics (3)
  - Withdrawals (306)
  - Query apamax.querysamples.atmfraud.DetectRepeatedMaxWithdrawals (3)
  - Query apamax.querysamples.atmfraud.ImprobableWithdrawalLocations (0)
  - Withdrawals (4)

Details	Value
Scenario Information	
Name	Query apamax.querysamples.atmfraud.Det...
Description	Parameterized Query apamax.querysampl...
Owner	SHKR
Inputs	
1 threshold	0
Outputs	

The Instance Summary tab shows the output fields of the selected scenario. Each column represents a scenario output field. The following illustration shows the Instance Summary tab for the selected scenario.



Filter row disabled ; **Hide column disabled**

- localhost:15903 [Connected]
  - Fraud1_Alerts (0)
  - Fraud2_Alerts (0)
  - Cluster-Wide Query Statistics (0)
  - Correlator Query Statistics (0)
  - Withdrawals (159)
  - Query apamax.querysamples.atmfraud.DetectRepeatedMaxWithdrawals (0)
  - Query apamax.querysamples.atmfraud.ImprobableWithdrawalLocations (0)
  - Withdrawals (5)
    - 1 - [57,false]
    - 5 - [54,false]
    - 9 - [51,false]
    - 13 - [48,false]
    - 17 - [46,false]

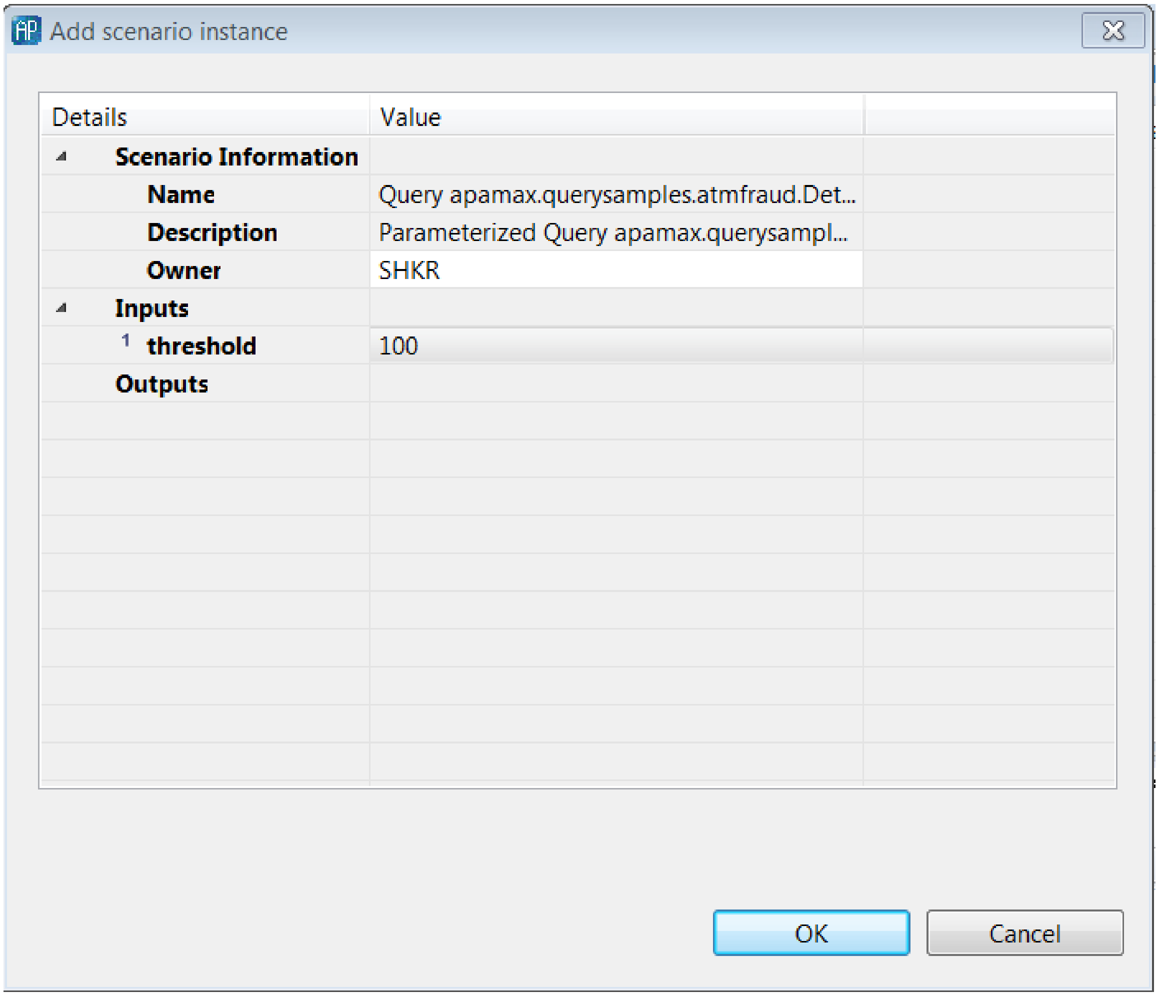
Id	Owner	State	StatusMess...	OutputCou...
1	SHKR	RUNNING	Value Chan...	56
5	SHKR	RUNNING	Value Chan...	53
9	SHKR	RUNNING	Value Chan...	51
13	SHKR	RUNNING	Value Chan...	48
17	SHKR	RUNNING	Value Chan...	45

Creating a new instance of a scenario or a parameterized query

In the **Scenario Browser** view, you can create new instances of a scenario or a parameterized query that is running in the application.

1. In the Scenario Browser's left pane, select the scenario or query for which you want to create a new instance.

2. Click the Add Scenario Instance button . The **Add Scenario Instance** dialog appears, showing the details including the input and output variables that make up the scenario or query definition in the left-hand column. The right-hand column displays the values of those variables.



Details	Value	
Scenario Information		
Name	Query apamax.querysamples.atmfraud.Det...	
Description	Parameterized Query apamax.querysampl...	
Owner	SHKR	
Inputs		
1 threshold	100	
Outputs		

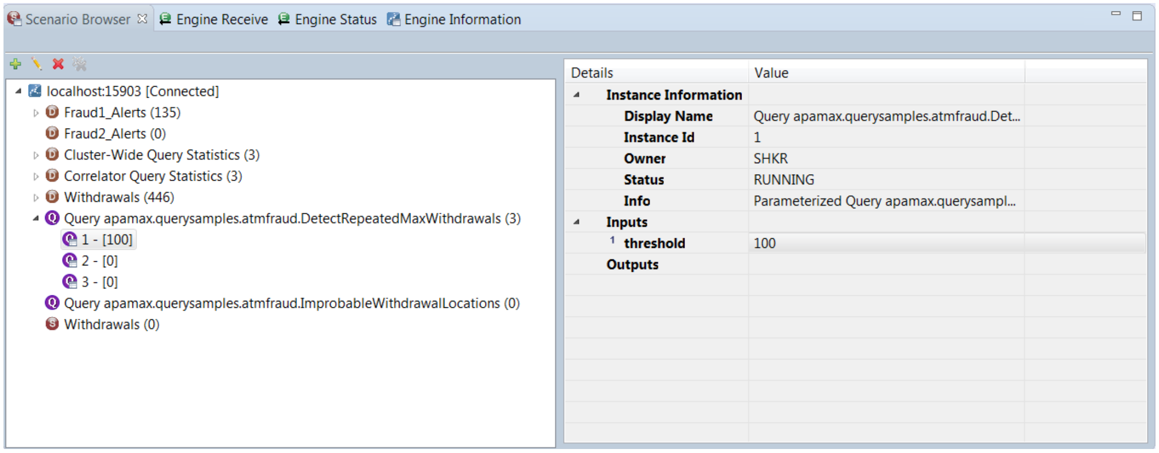
3. To create an instance of a scenario or parameterized query, you must specify values for the input fields in the right-hand column. Fields with default values are already filled in. You can add or edit values in cells that have a white background. To specify a value, double click in the empty cell and enter the information.

4. Click OK.

Viewing the instances of a scenario or a query

You can display the details of a scenario instance or a query instance in the **Scenario Browser**.

1. In the Scenario Browser, select the instance ID of the scenario or the query. In the right pane, Apama Studio displays the names of the variables in the left column and the current values of the variables in the right column. The values of the output variables are continuously updated. The following illustration shows an example for a query instance:



- localhost:15903 [Connected]
  - Fraud1_Alerts (135)
  - Fraud2_Alerts (0)
  - Cluster-Wide Query Statistics (3)
  - Correlator Query Statistics (3)
  - Withdrawals (446)
  - Query apamax.querysamples.atmfraud.DetectRepeatedMaxWithdrawals (3)
    - 1 - [100]
    - 2 - [0]
    - 3 - [0]
  - Query apamax.querysamples.atmfraud.ImprobableWithdrawalLocations (0)
  - Withdrawals (0)

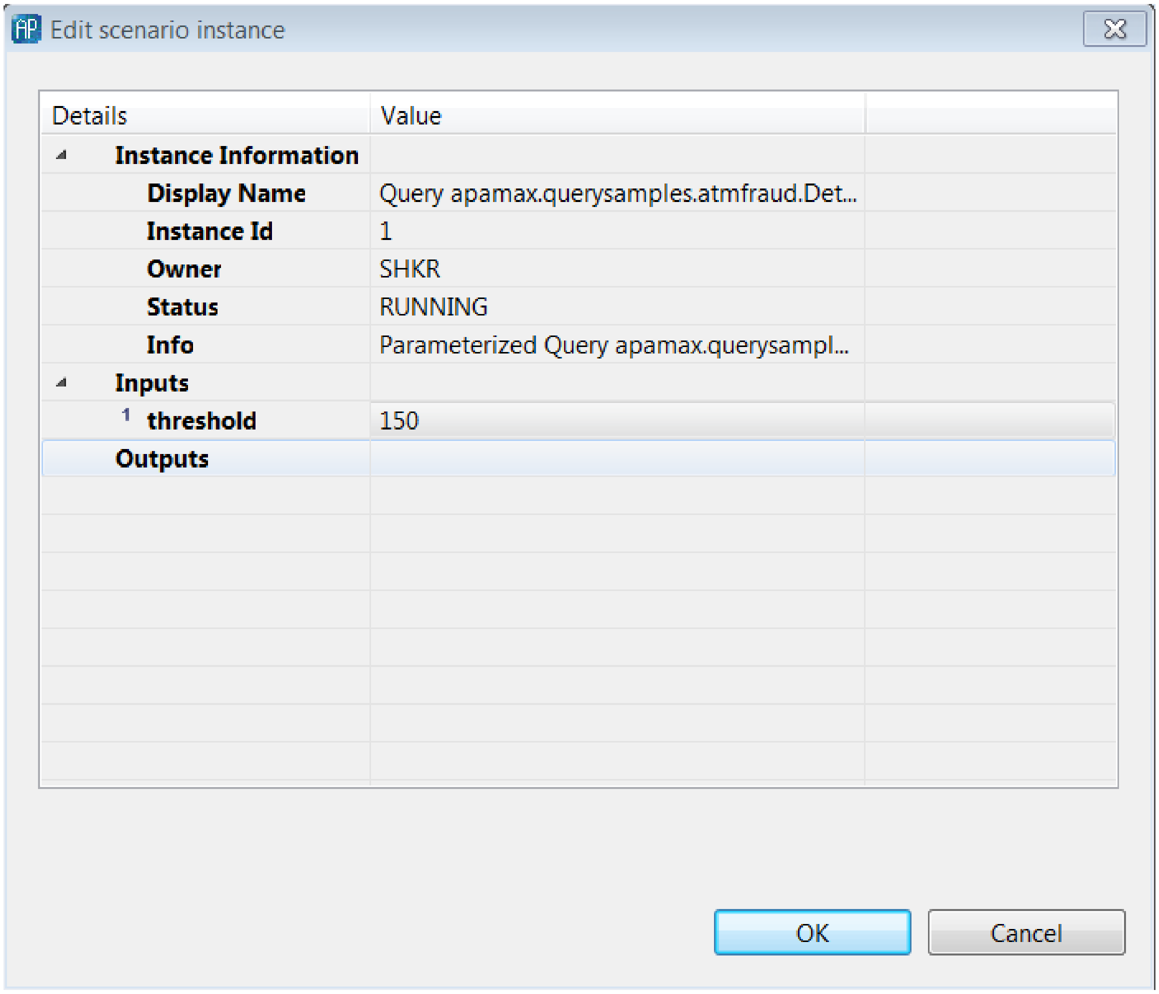
Details	Value
Instance Information	
Display Name	Query apamax.querysamples.atmfraud.Det...
Instance Id	1
Owner	SHKR
Status	RUNNING
Info	Parameterized Query apamax.querysampl...
Inputs	
1 **threshold**	100
Outputs	

You can expand and collapse the display in the right pane by clicking the plus and minus symbols.

Editing an instance of a scenario or a parameterized query

To edit the input values of a scenario instance or a parameterized query instance:

1. In the left pane of the Scenario Browser, select the instance ID of the scenario or the query you want to edit.
2. Click the Edit button . The **Edit scenario instance** dialog appears. While you are editing the values in the dialog, Apama Studio suspends the display of output information.



Details	Value
Instance Information	
Display Name	Query apamax.querysamples.atmfraud.Det...
Instance Id	1
Owner	SHKR
Status	RUNNING
Info	Parameterized Query apamax.querysampl...
Inputs	
1 threshold	150
Outputs	

3. Edit the values for the input fields in the right-hand column by double clicking in the desired cell and entering the new value.

4. Click OK. Apama Studio resumes displaying output values.

Deleting an instance of a scenario or a parameterized query

To delete a scenario instance or a parameterized query instance:

1. In the left pane of the Scenario Browser, select the instance ID of the scenario or the query you want to delete.

2. Click the Delete button ✖.

Deleting all instances of a scenario or a parameterized query

To delete all instances of a given scenario or a parameterized query:

1. In the left pane of the Scenario Browser, select the name of scenario or query for which you want to delete all the instances.

2. Click the Delete All button ✖.

Dashboards

When you launch a project that contains a dashboard, by default Apama Studio automatically starts the Dashboard Viewer and displays the project's default dashboard. If desired you can change this behavior as described in "Defining custom launch configurations" on page 105. You can specify that you do not want Dashboard Viewer to start automatically or that Viewer should display a dashboard other than the project's default dashboard. When you define a launch configuration you can also specify any command line options to need to be passed to the Dashboard Viewer.

Chapter 5: Debugging EPL Applications

You can debug Apama applications written in EPL in Apama Studio. As is the case when debugging other applications in Eclipse, when you debug EPL applications, you can set breakpoints to suspend the application at specific points, examine the contents of variables, and step through the application.

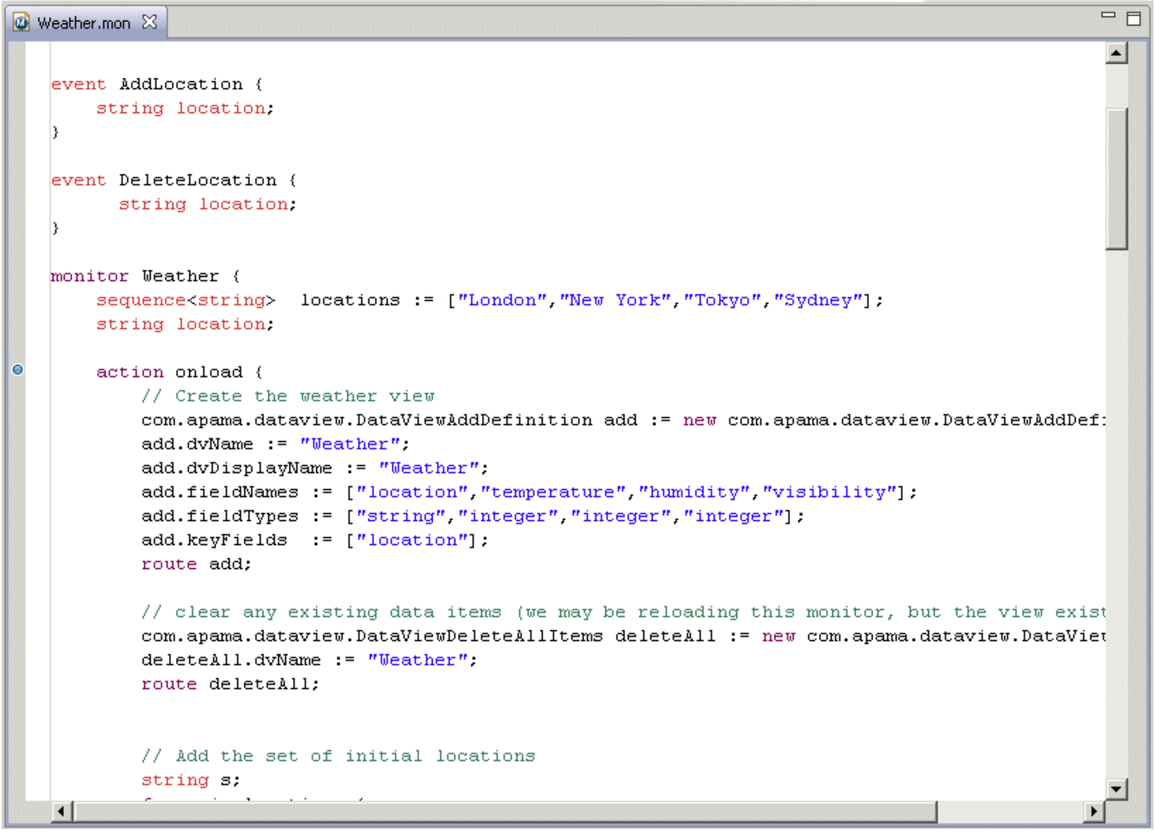
The basic tasks involved in debugging an EPL application in Apama Studio are:

1. Set breakpoints in the **Developer** perspective.
2. Create a debug launch configuration for the project.
3. Review the executing application in the **Debug** perspective, examining information such as the call stack, context status, and variable values.

Adding breakpoints

You can add breakpoints to any of the EPL files included in the project. To add a breakpoint to an EPL file:

1. In the **Developer** perspective open the EPL file in which you want to add a breakpoint.
2. Double click in the left margin of the desired line in the EPL file or right click in the left margin and select Toggle Breakpoint from the pop-up menu. The breakpoint is indicated by a solid blue circle in the left margin, as shown in the `action onload` line in the illustration below.



```
event AddLocation {
    string location;
}

event DeleteLocation {
      string location;
}

monitor Weather {
    sequence<string>  locations := ["London","New York","Tokyo","Sydney"];
    string location;

    action onload {
        // Create the weather view
        com.apama.dataview.DataViewAddDefinition add := new com.apama.dataview.DataViewAddDef:
        add.dvName := "Weather";
        add.dvDisplayName := "Weather";
        add.fieldNames := ["location","temperature","humidity","visibility"];
        add.fieldTypes := ["string","integer","integer","integer"];
        add.keyFields  := ["location"];
        route add;

        // clear any existing data items (we may be reloading this monitor, but the view exist
        com.apama.dataview.DataViewDeleteAllItems deleteAll := new com.apama.dataview.DataViet
        deleteAll.dvName := "Weather";
        route deleteAll;


        // Add the set of initial locations
        string s;
```

3. Repeat Step 1 and Step 2 for each breakpoint you want to set.

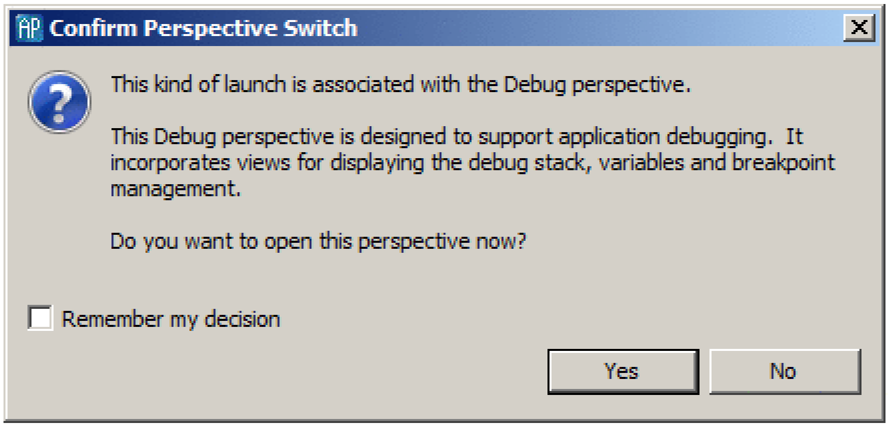
Note, when debugging an application on a remote machine, breakpoints are supported only inside EPL actions of monitors and events. Breakpoints inside listeners of actions or breakpoints outside of actions are not supported. See "Debugging a remote application" on page 131.

Debugging EPL Applications

Launching a debug session

If a Debug Configuration has been defined for the Apama project, start a debugging session as follows. (If you need to create a Debug Configuration, see "Creating a debug configuration" on page 129)

1. From the Apama Studio menu, select Run > Debug Configurations.
2. From the **Debug Configuration** dialog, select the desired Debug Configuration and click Debug. The **Confirm Perspective Switch** dialog opens



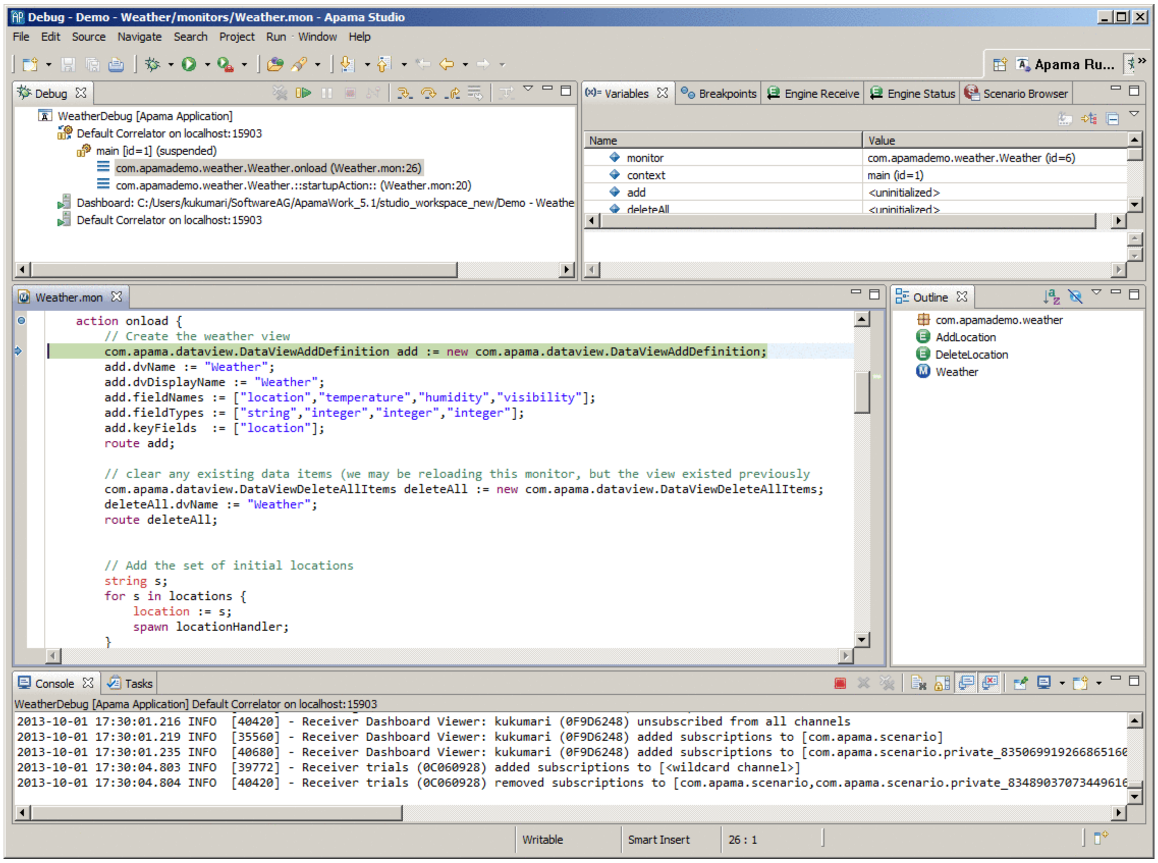
This kind of launch is associated with the Debug perspective.

This Debug perspective is designed to support application debugging. It incorporates views for displaying the debug stack, variables and breakpoint management.

Do you want to open this perspective now?

□ Remember my decision

3. Click Yes to display the **Debug** Perspective (and add a check to the Remember my decision check box if desired). The **Debug** perspective is opened.



WeatherDebug [Apama Application]
Default Correlator on localhost:15903
main [id=1] (suspended)
com.apamademo.weather.Weather.onload (Weather.mon:26)
com.apamademo.weather.Weather.::startupAction:: (Weather.mon:20)
Dashboard: C:/Users/kukumari/SoftwareAG/ApamaWork_5.1/studio_workspace_new/Demo - Weathe
Default Correlator on localhost:15903

Name	Value
monitor	com.apamademo.weather.Weather (id=6)
context	main (id=1)
add	<uninitialized>
deleteAll	<uninitialized>

```
    action onload {
        // Create the weather view
        com.apama.dataview.DataViewAddDefinition add := new com.apama.dataview.DataViewAddDefinition;
        add.dvName := "Weather";
        add.dvDisplayName := "Weather";
        add.fieldNames := ["location","temperature","humidity","visibility"];
        add.fieldTypes := ["string","integer","integer","integer"];
        add.keyFields  := ["location"];
        route add;

        // clear any existing data items (we may be reloading this monitor, but the view existed previously
        com.apama.dataview.DataViewDeleteAllItems deleteAll := new com.apama.dataview.DataViewDeleteAllItems;
        deleteAll.dvName := "Weather";
        route deleteAll;


        // Add the set of initial locations
        string s;
        for s in locations {
            location := s;
            spawn locationHandler;
        }
```

com.apamademo.weather
AddLocation
DeleteLocation
Weather

WeatherDebug [Apama Application] Default Correlator on localhost:15903

```
2013-10-01 17:30:01.216 INFO  [40420] - Receiver Dashboard Viewer: kukumari (0F9D6248) unsubscribed from all channels
2013-10-01 17:30:01.219 INFO  [35560] - Receiver Dashboard Viewer: kukumari (0F9D6248) added subscriptions to [com.apama.scenario]
2013-10-01 17:30:01.235 INFO  [40680] - Receiver Dashboard Viewer: kukumari (0F9D6248) added subscriptions to [com.apama.scenario.private_835069919266865160
2013-10-01 17:30:04.803 INFO  [39772] - Receiver trials (0C060928) added subscriptions to [<wildcard channel>]
2013-10-01 17:30:04.804 INFO  [40420] - Receiver trials (0C060928) removed subscriptions to [com.apama.scenario,com.apama.scenario.private_834890370734496l6
```

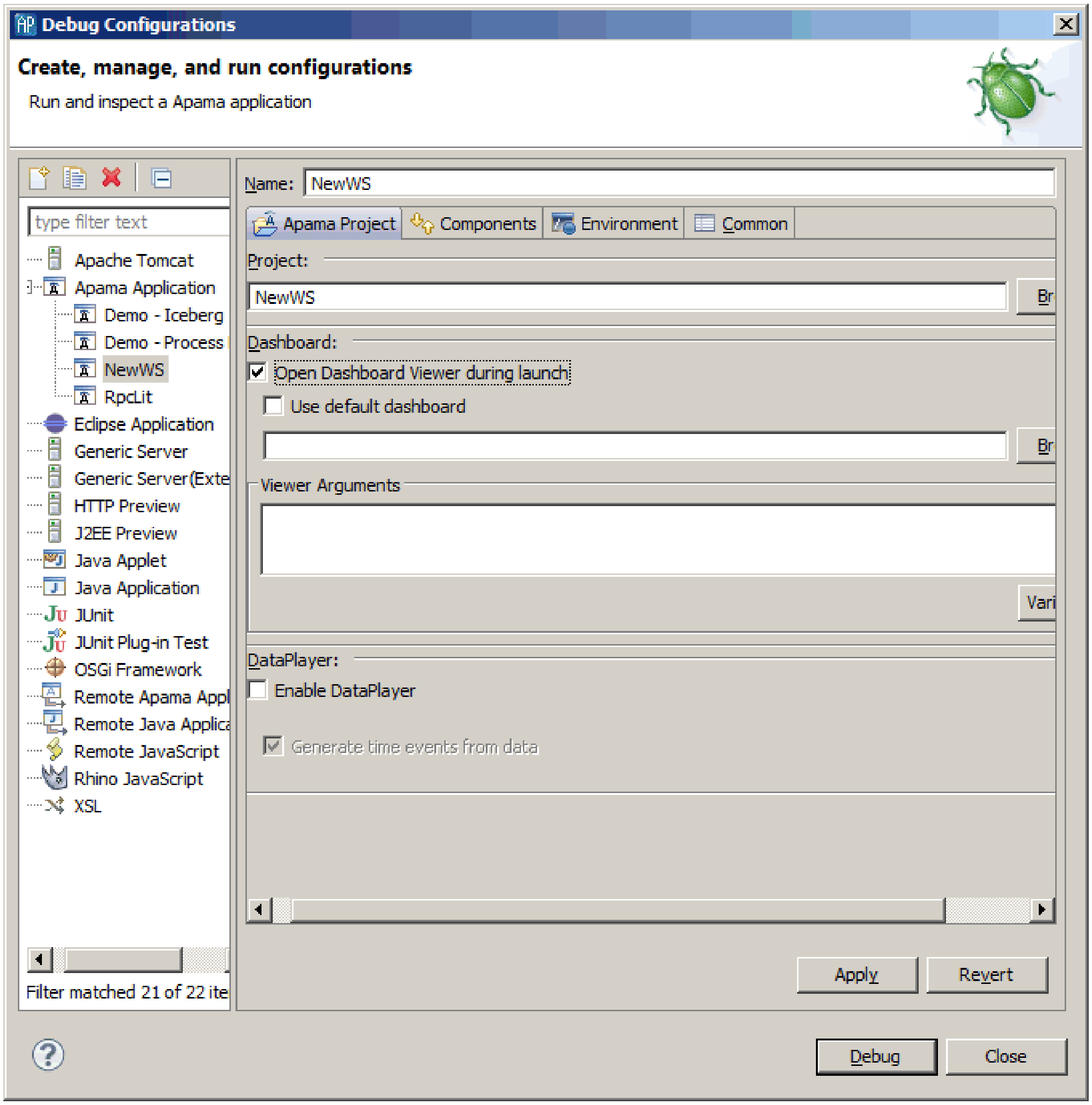
When debugging an EPL application, the **Debug** perspective is similar in operation to the standard Eclipse **Debug** perspective and includes the **Debug**, **Breakpoints**, and **Variables** views.

Debugging EPL Applications

Creating a debug configuration

If you need to create a new Debug Configuration:

1. From the Apama Studio menu, select Run > Debug Configurations. The **Profile configurations** wizard starts.



Debug Configurations

Create, manage, and run configurations

Run and inspect a Apama application

Name: NewWS

Project: NewWS

Dashboard:

☑ Open Dashboard Viewer during launch

□ Use default dashboard

Viewer Arguments

DataPlayer:

□ Enable DataPlayer

☑ Generate time events from data

Filter matched 21 of 22 ite

2. In the left pane, select Apama Application and click the New launch configuration button ( ).

3. In the right pane, on the Apama Project tab, specify the Name and the Project.

4. If you are going to debug an application running on a remote correlator:

   a. Select the Components tab.

   b. Click Add and select Add Correlator.

   c. In the **Correlator Configuration** wizard, on the Correlator Arguments tab, specify the Host, Port, and other Options.

      When creating a debug launch configuration, you do not need to specify the `-g` option in the Correlator Arguments tab. When you select Run > Debug , Apama Studio automatically starts the correlator with the `-g` option, which disables optimizations that hinder debugging. However, if you use Apama Studio to debug in a remote correlator, you must ensure that the remote correlator was started with the `-g` option. You cannot debug in a correlator that was started without specification of the `-g` option. See options information in "Starting the event correlator" in *Deploying and Managing Apama Applications*.

   d. If necessary, specify any initialization options on the Initialization tab.

   e. Click OK.

5. Click Debug. The **Confirm Perspective Switch** dialog opens.
6. Click Yes. Apama Studio switches to the **Debug** perspective.

Launching a debug session

Debugging a remote application

In Apama Studio you can debug an Apama application running in a correlator on a remote machine. The correlator on the remote machine must be started with the `-g` option, which disables optimizations that interfere with debugging.

To debug an application on a remote machine:

1. Start the application on the remote machine.
2. In Apama Studio on the local machine where you will do the debugging, select Run > Debug Configurations. This displays the **Debug Configurations** wizard.
3. In the **Debug Configurations** wizard, in the left pane select `Remote Apama Application` and click the New launch configuration button ( ).
4. In the right pane, on the Apama Project tab:
   a. Specify the Name of the debug configuration and the Project on the local machine where the debugging session is being run. The application in the project should match the application that is being debugged.

   b. Specify the Host and the Port of the correlator running on the remote machine.

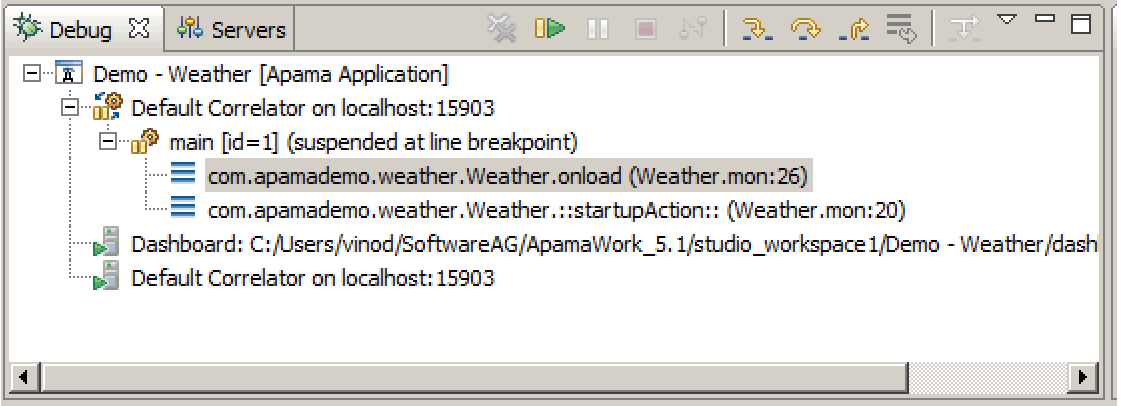
   c. If desired, click Test Connection to verify the connection to the correlator on the remote machine can be made.
5. If desired, on the Source tab, add any needed resources. Generally, the project on the local machine would contain all the necessary resources.
6. Click Debug. The **Confirm Perspective Switch** dialog opens.
7. Click Yes. Apama Studio switches to the **Debug** perspective.

Note, when debugging a remote application, breakpoints are supported only inside actions of monitors and events. Breakpoints inside listener actions or outside of actions are not supported.

Debugging EPL Applications

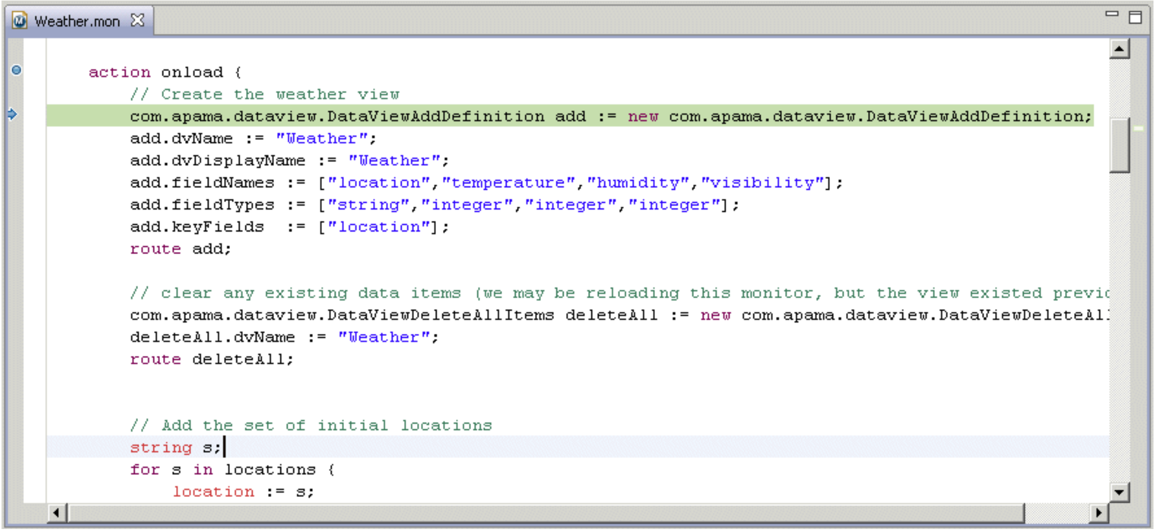
Debug view

The **Debug** view shows the call stack and status of current contexts in the Apama application. When execution reaches a breakpoint, Apama Studio highlights the current context in the **Debug** view.



```
Demo - Weather [Apama Application]
    Default Correlator on localhost:15903
        main [id=1] (suspended at line breakpoint)
            com.apamademo.weather.Weather.onload (Weather.mon:26)
            com.apamademo.weather.Weather.::startupAction:: (Weather.mon:20)
    Dashboard: C:/Users/vinod/SoftwareAG/ApamaWork_5.1/studio_workspace1/Demo - Weather/dash
    Default Correlator on localhost:15903
```

Also, when a breakpoint is reached, the EPL editor indicates the breakpoint in the code with an arrow in the left margin. The line of code that will be executed next is highlighted.



```
    action onload {
        // Create the weather view
        com.apama.dataview.DataViewAddDefinition add := new com.apama.dataview.DataViewAddDefinition;
        add.dvName := "Weather";
        add.dvDisplayName := "Weather";
        add.fieldNames := ["location","temperature","humidity","visibility"];
        add.fieldTypes := ["string","integer","integer","integer"];
        add.keyFields  := ["location"];
        route add;

        // clear any existing data items (we may be reloading this monitor, but the view existed previ
        com.apama.dataview.DataViewDeleteAllItems deleteAll := new com.apama.dataview.DataViewDeleteAll
        deleteAll.dvName := "Weather";
        route deleteAll;


        // Add the set of initial locations
        string s;
        for s in locations {
            location := s;
```

When a stack frame is highlighted in the **Debug** view, the **Variable** view displays the names and values of the associated variables, see "Variables view" on page 134.

The tool bar for the **Debug** view contains the following buttons for controlling execution:

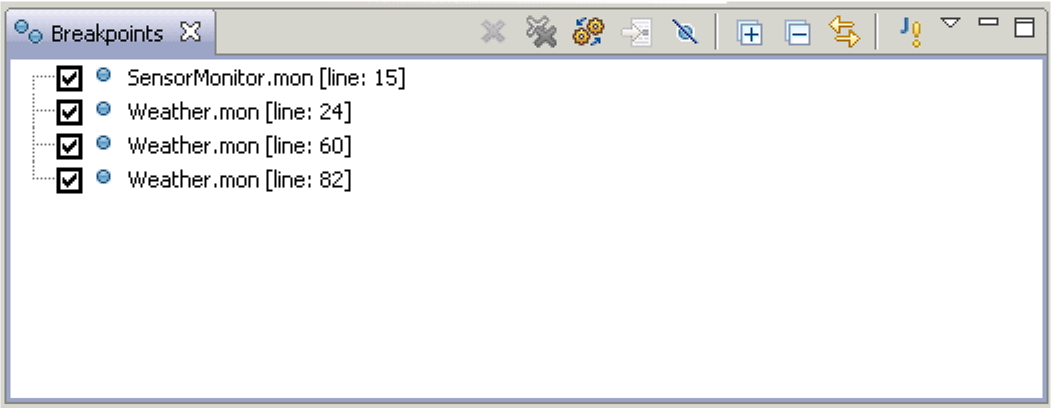
- Remove All Terminated Launches — Clears all terminated debug targets from the **Debug** view display.
- Resume — Resumes a suspended debug target.
- Suspend— Halts the execution of currently selected target.
- Terminate — Terminate the selected debug target.
- Step Into — Execute the current line and proceed to the next statement.

- Step Over — Steps over the highlighted statement and continues executing at the next line either in the same method or (if at the end of a method) continues in the method from which the current method was called.
- Step Return — Steps out of the current method. This stops execution after exiting the current method.

Debugging EPL Applications

Breakpoints view

The **Breakpoints** view lists the breakpoints you have set in the project.Double clicking a breakpoint displays the line in the EPL file that contains the breakpoint in the EPL editor. In the **Breakpoints** view, you can enable and disable the listed breakpoints.



☑ SensorMonitor.mon [line: 15]
☑ Weather.mon [line: 24]
☑ Weather.mon [line: 60]
☑ Weather.mon [line: 82]

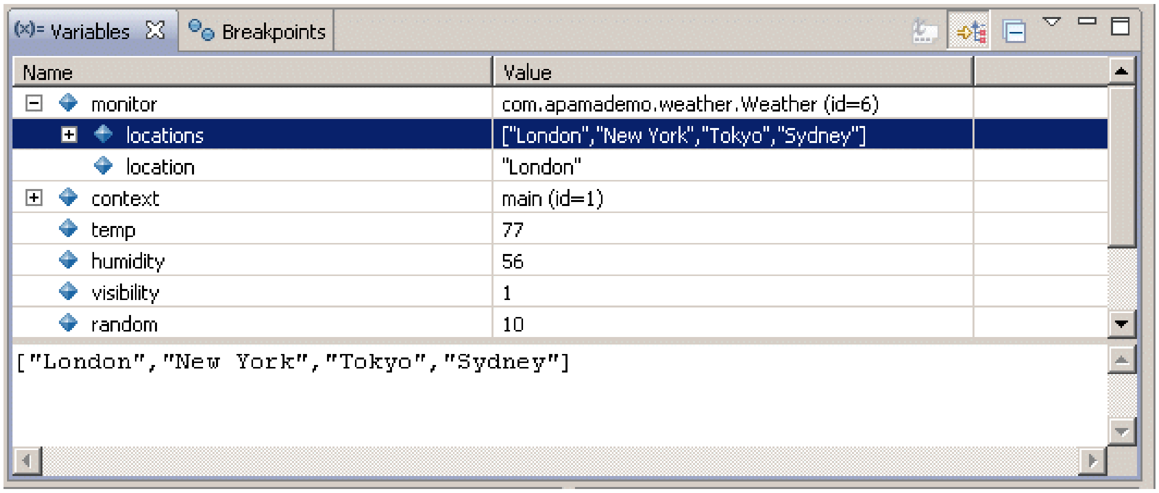
The tool bar for the **Breakpoints** view contains the following buttons for controlling execution:

- Remove Selected Breakpoints — Remove the selected breakpoint from the debug session.
- Remove All Breakpoints — Remove all breakpoints from the debug session.
- Show Breakpoints Supported by Selected Targets — Show breakpoints for selected target.
- Go to File for Breakpoint — Open file containing the selected breakpoint.
- Skip All Breakpoints — Skip all breakpoints.
- Expand All — Expand all of the items in the **Breakpoints** view.
- Collapse All — Collapse the display of all items in the **Breakpoints** view.
- Link with Debug view — Toggles whether or not the **Breakpoints** view is automatically updated when the **Debug** view changes.

Debugging EPL Applications

Variables view

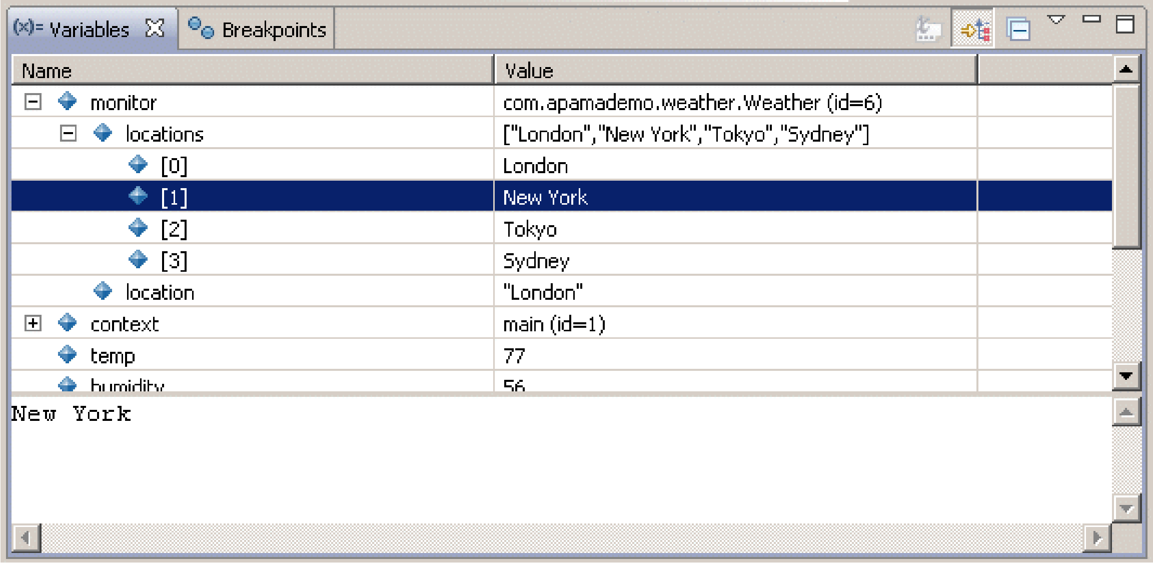
The **Variables** view displays information about the variables associated with the stack frame that is currently selected in the **Debug** view. The variables can be expanded to show their fields. The detail pane the area at the bottom of the view displays text. For a variable of a primitive type, this is the value of the object; for a complex variable, such as a sequence, dictionary, or event, it is the text representation of the object as returned by the object's `toString()` method.



Name	Value
⊟ monitor	com.apamademo.weather.Weather (id=6)
⊞ locations	["London","New York","Tokyo","Sydney"]
location	"London"
⊞ context	main (id=1)
temp	77
humidity	56
visibility	1
random	10

```
["London","New York","Tokyo","Sydney"]
```

For complex variables, you can click the Show Logical Structure button ()to expand the variables to show their sub-values.



Name	Value
⊟ monitor	com.apamademo.weather.Weather (id=6)
⊟ locations	["London","New York","Tokyo","Sydney"]
[0]	London
[1]	New York
[2]	Tokyo
[3]	Sydney
location	"London"
⊞ context	main (id=1)
temp	77
humidity	56

```
New York
```

In the **Variables** view, you can change the layout of the display. Click the Drop-Down Menu button (▽) to the right side of the **Variables** view title bar and select Layout from the menu.

Debugging EPL Applications

Command-line debugger

You can also use Apama's `engine_debug` tool to control execution of your EPL code in the correlator and inspect correlator state. This tool is a correlator client that runs a single command from the command line. It is not an interactive command-line debugger. The interactive debugger in Apama Studio is more useful during the development of an application. In general, the command-line `engine_debug` tool is expected to be most useful during or after deployment of your application.

For more information on `engine_debug`, see "Using the command line debugger" in *Deploying and Managing Apama Applications*.

Debugging EPL Applications

Chapter 6: Debugging JMon Applications

This section describes practical information for developing and debugging JMon applications with Apama Studio. General knowledge of Java and Apama application development is assumed.

Apama Studio is built on the Eclipse IDE framework and as such running and debugging JMon applications for the Apama correlator engine is no more different than with any standard Java application. There are however a few things to consider:

- Single thread — For JMon applications, the correlator uses a single thread of execution. When programming in Java consider the importance of maintaining determinism by not routing, emitting, or enqueueing an event in a thread other than the current thread. Java provides no guarantee on execution order for separate threads, so try to keep your JMon applications single threaded at all times. Although multiple threads are currently allowed for JMon applications, this might change in the future, with the correlator JVM issuing a warning or possibly an error.
- Event definitions — To instantiate event definitions in your JMon application, the `Event` subclass in question needs to be defined and included in your `JAR` file. This is because the correlator uses a separate classloader for each application (that is, each JMon `JAR` file injected) and hence cannot share the event definitions across separate JMon applications. Also, a JMon application cannot make use of any event definition already present in the correlator. Any event definition (either a subclass of the JMon `Event` class or a definition in an EPL file) must be replicated for each JMon application and for your injected EPL files.

Preparing the correlator for remote debugging

Launching the correlator with the `-j` option enables the Java Virtual Machine (JVM) as a subprocess in correlator execution. When launching an Apama project in Apama Studio, specification of the `-j` option launches the correlator and launches its JVM as an external process. Consequently, you must enable a socket connection to the JVM so that you can connect the Apama Studio debugger to it. This also applies to launching a correlator through any other means.

Enable debugging in the correlator JVM by specifying the Java options for the correlator component in the launch configuration. The Java Debug Wire Protocol (JDWP) is the protocol used for communication between a debugger and the Java virtual machine (VM) that it debugs. Oracle's VM implementations require command line options to load the JDWP agent for debugging. JDWP is optional; it might not be available in some implementations of the Java™ 2 SDK. The existence of JDWP can allow the same debugger to work.

From Java 5.0 (or 1.5.0) onwards, specify the `-agentlib:jdwp` option to load and specify options to the JDWP agent. For Java releases prior to 5.0, the `-Xdebug` and `-Xrunjdwp` options are used. (The 5.0

implementation also supports the `-Xdebug` and `-Xrunjdwp` options but the newer `-agentlib:jdwp` option is preferable as the JDWP agent in 5.0 uses the JVMTI interface to the VM rather than the older JVMDI interface.) Specify this option in the correlator component in your launch configuration or when launching the correlator independently:

```
-J -agentlib:jdwp=transport=dt_socket,address=8787,server=y,suspend=n
```

This tells the JVM to use a socket transport on port `8787`. You can change this at will and use your own options. For more Java debugging/agent options see:

"http://docs.oracle.com/javase/1.5.0/docs/guide/jpda/conninv.html#Invocation" on page

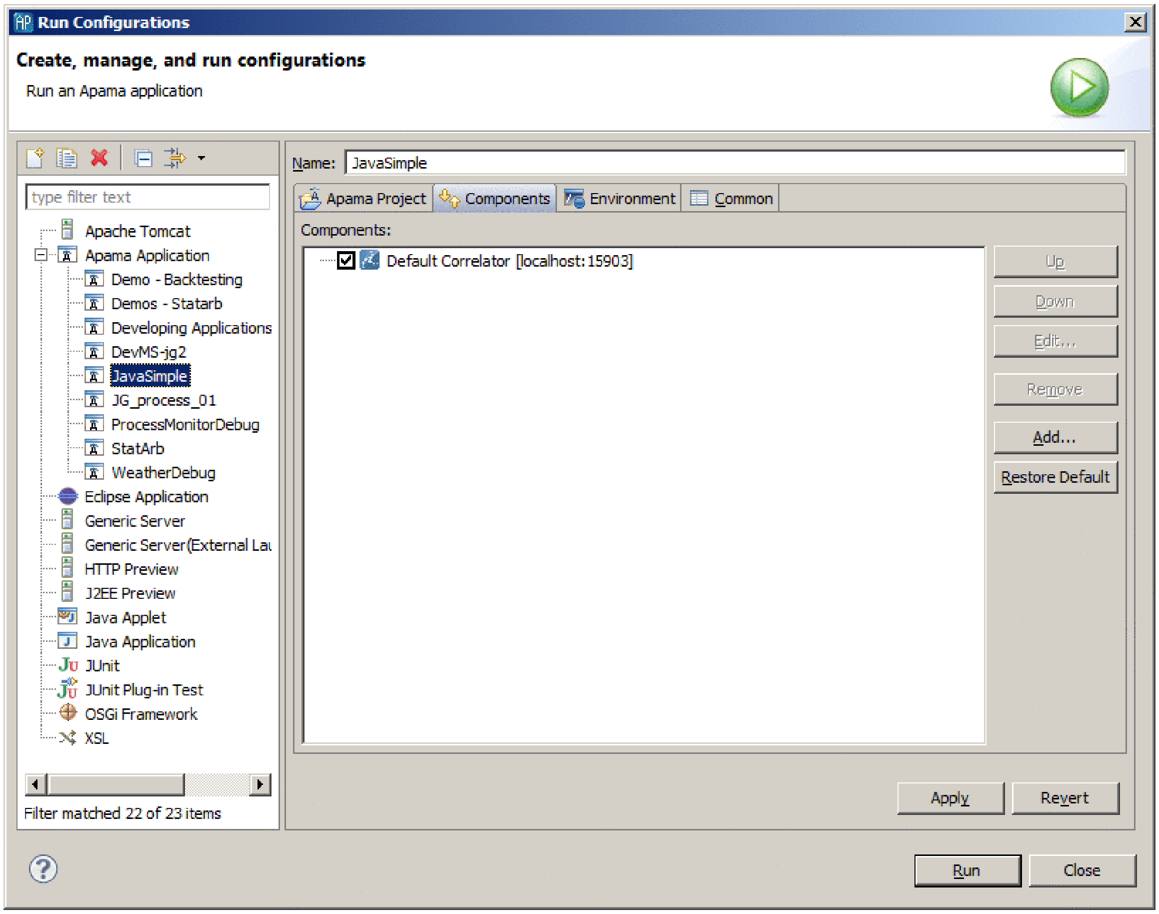
To launch the correlator with Java and remote debugging enabled, you can use a command line or Apama Studio.

On the command line, invoke the correlator with the following arguments:

```
correlator -l license.txt -j -J
-agentlib:jdwp=transport=dt_socket,address=8787,server=y,suspend=n
```

In Apama Studio, invoke the correlator as follows:

1. From the main Apama Studio menubar, select Run > Run Configurations.
2. Click the Components tab.
3. Select the correlator you want to start and click Edit.



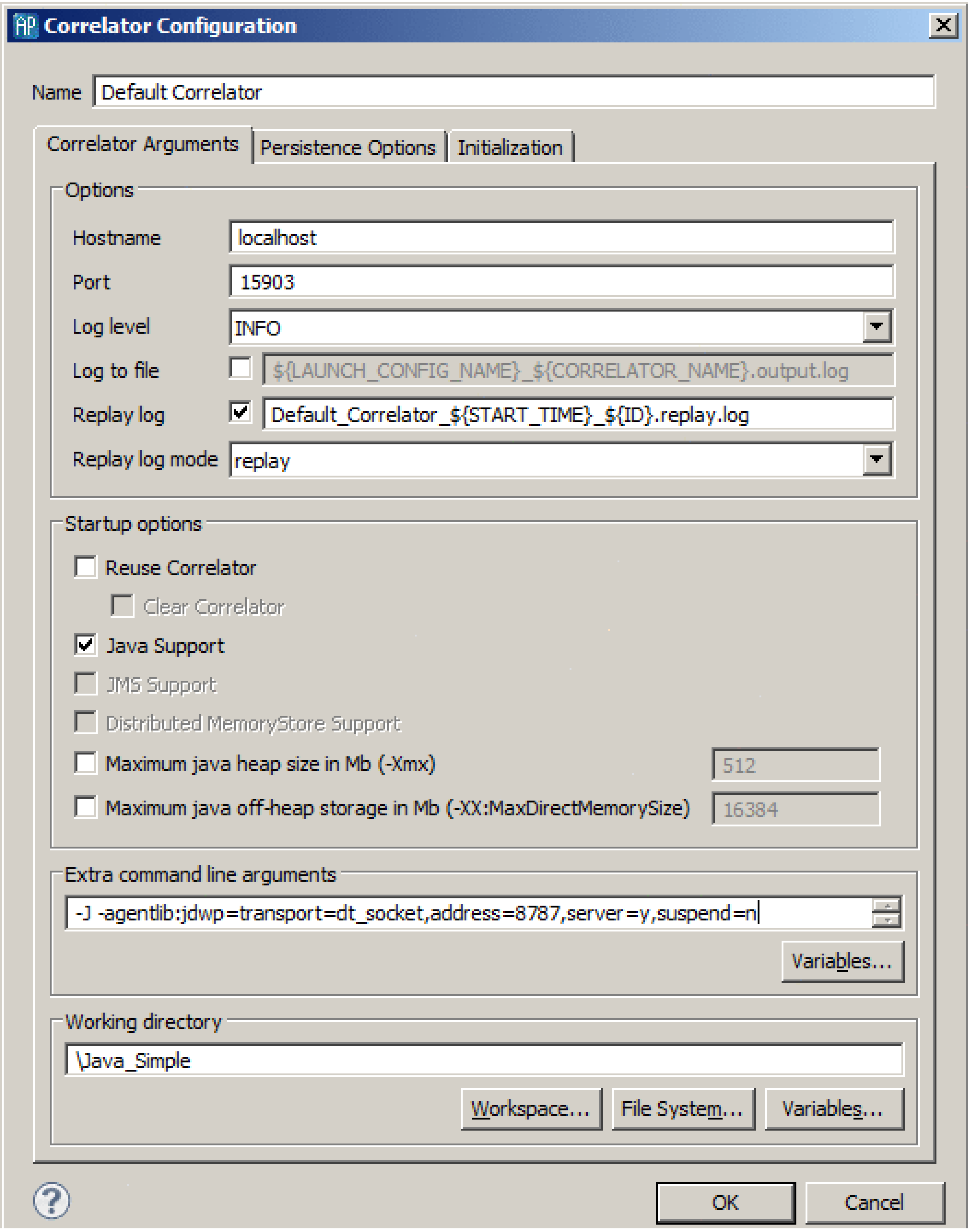
Name: JavaSimple

Components:

☑ Default Correlator [localhost:15903]

4. Enter the following in the Extra command line arguments field:

```
-J -agentlib:jdwp=transport=dt_socket,address=8787,server=y,suspend=n
```



Name: Default Correlator

Options

Hostname: localhost
Port: 15903
Log level: INFO
Log to file: □ ${LAUNCH_CONFIG_NAME}_${CORRELATOR_NAME}.output.log
Replay log: ☑ Default_Correlator_${START_TIME}_${ID}.replay.log
Replay log mode: replay

Startup options

□ Reuse Correlator
□ Clear Correlator
☑ Java Support
□ JMS Support
□ Distributed MemoryStore Support
□ Maximum java heap size in Mb (-Xmx) 512
□ Maximum java off-heap storage in Mb (-XX:MaxDirectMemorySize) 16384

Extra command line arguments

```
-J -agentlib:jdwp=transport=dt_socket,address=8787,server=y,suspend=n
```

Working directory

\Java_Simple

5. Select OK and then Run to start the correlator.

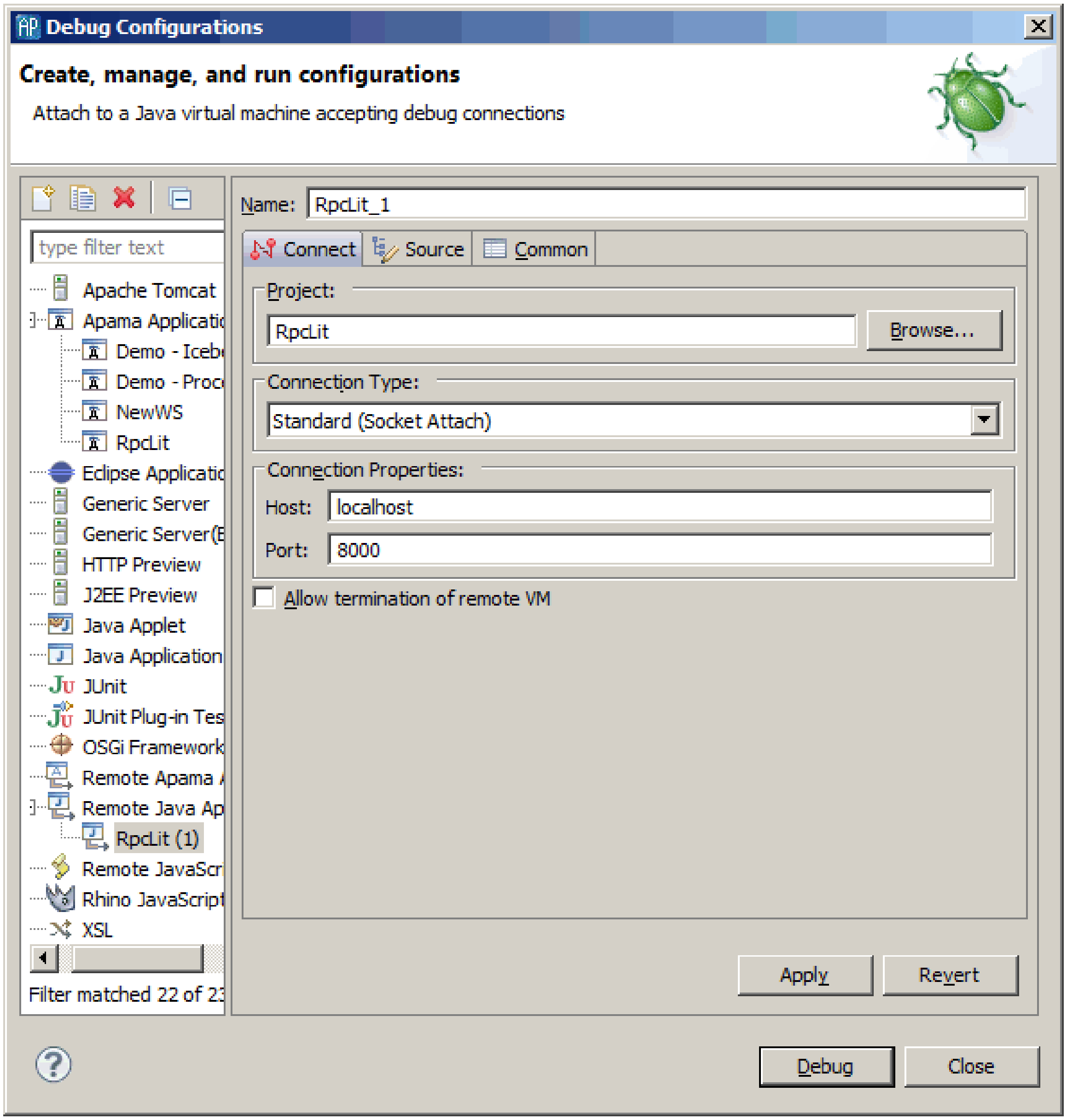
The correlator is now enabled for Java debugging. The next section discusses how to connect to the correlator with the Apama Studio debugger.

Debugging JMon Applications

Creating a debug run configuration

After you have a running correlator that is enabled for remote debugging, you must create a debug run configuration that you use to connect to the correlator:

1. From the Apama Studio menubar, select Run > Debug Configurations.
2. In the **Debug** dialog, on the left, select Remote Java Application.
3. From the **Debug** dialog toolbar, select New launch configuration .
4. Select the Connect tab, if it is not already selected.
5. Enter a name for your project and set the host and port for the remote JVM connection you previously specified as Java options when you started the correlator.



Debug Configurations

Create, manage, and run configurations

Attach to a Java virtual machine accepting debug connections

Name: RpcLit_1

Project: RpcLit

Connection Type: Standard (Socket Attach)

Connection Properties:

Host: localhost

Port: 8000

□ Allow termination of remote VM

6. Click the Source tab and add the path to the Java source for your JMon application.
7. Click Apply and then Debug.

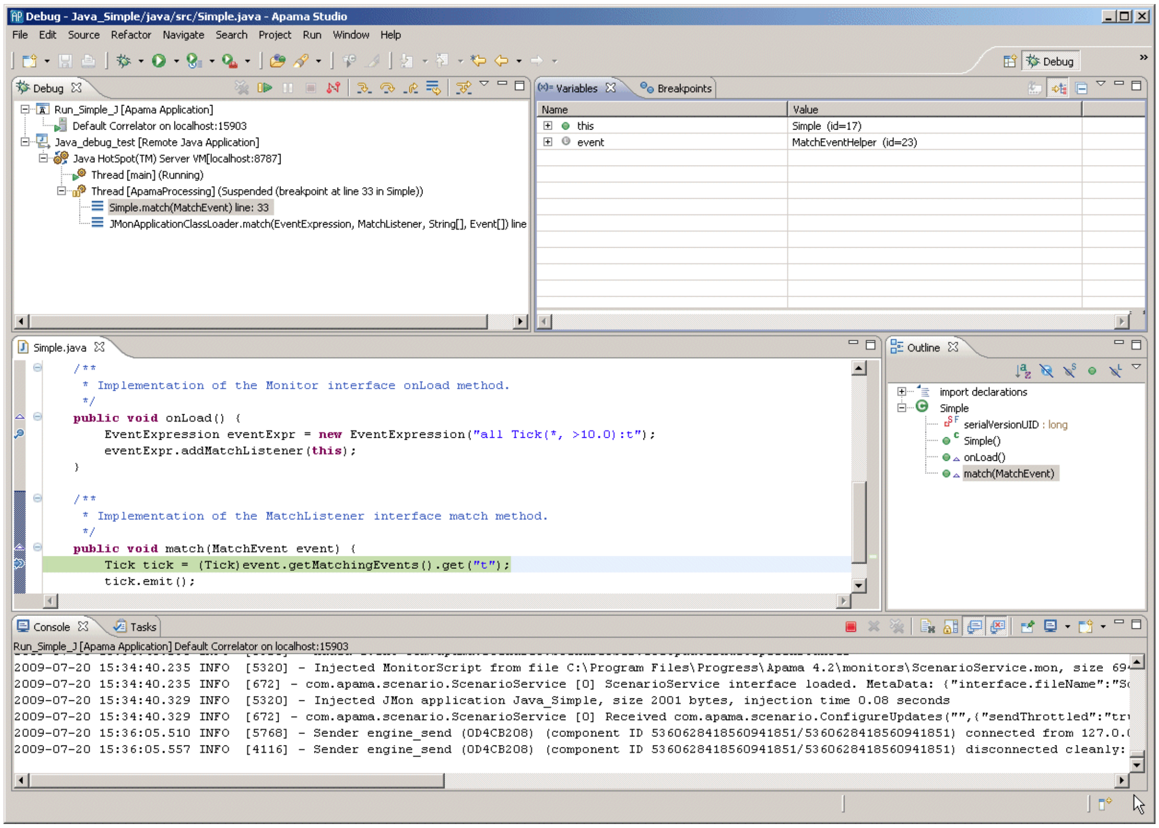
This launch configuration immediately connects to the remote JVM process in the correlator and Apama Studio switches to the **Apama Runtime**perspective, which you use for debugging. You are now ready to remotely debug your JMon application. Debugging a JMon application in Apama Studio is the same as debugging any other Java application in Eclipse.

Debugging JMon Applications

Debug perspective

The **Debug** perspective appears automatically when you start a debug session. The default **Debug** perspective has five panels that you can use for debugging:

- The top-left panel is the **Debug** view which shows the application's stack frame. See "Using the Debug view" on page 141.
- The top-right panel provides a tabs for viewing the **Breakpoints** view and the **Variables** view. See "Working with breakpoints" on page 142 and "Viewing stack frame variables" on page 142.
- The middle-left panel is the code editor view.
- The middle-right panel is the code **Outline** view.
- The bottom panel includes the standard tabs for the console output, tasks, errors, problems, search results, display, and so on.


Debug - Java_Simple/java/src/Simple.java - Apama Studio
File Edit Source Refactor Navigate Search Project Run Window Help
Debug
Debug
Variables
Breakpoints
Simple.java
Outline
Console
Tasks

```
Run_Simple_J [Apama Application]
    Default Correlator on localhost:15903
Java_debug_test [Remote Java Application]
    Java HotSpot(TM) Server VM[localhost:8787]
        Thread [main] (Running)
        Thread [ApamaProcessing] (Suspended (breakpoint at line 33 in Simple))
            Simple.match(MatchEvent) line: 33
            JMonApplicationClassLoader.match(EventExpression, MatchListener, String[], Event[]) line
```

Name	Value
this	Simple (id=17)
event	MatchEventHelper (id=23)

```
    /**
     * Implementation of the Monitor interface onLoad method.
     */
    public void onLoad() {
        EventExpression eventExpr = new EventExpression("all Tick(*, >10.0):t");
        eventExpr.addMatchListener(this);
    }

    /**
     * Implementation of the MatchListener interface match method.
     */
    public void match(MatchEvent event) {
        Tick tick = (Tick)event.getMatchingEvents().get("t");
        tick.emit();
```

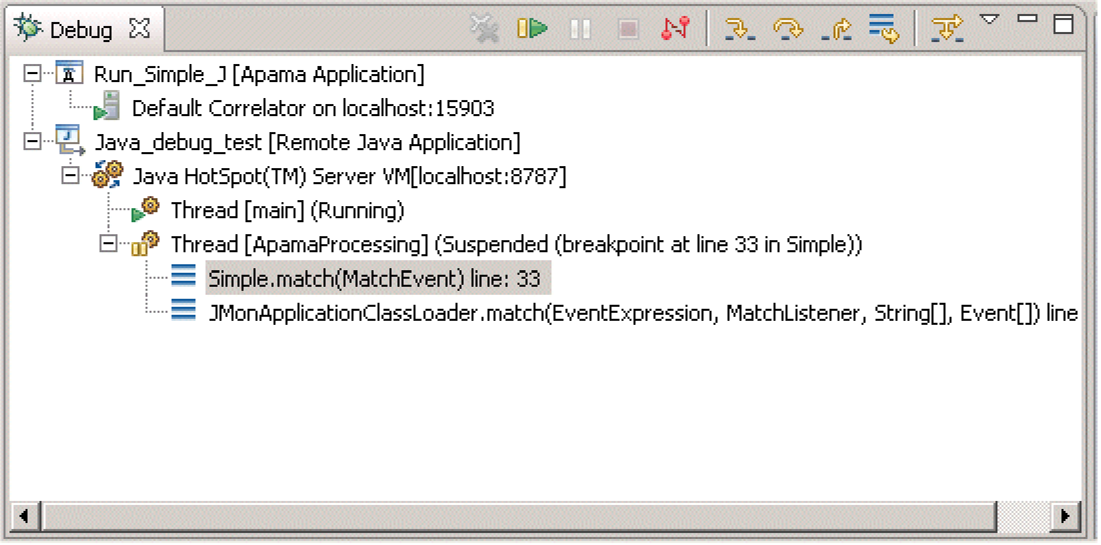
```
import declarations
Simple
    serialVersionUID : long
    Simple()
    onLoad()
    match(MatchEvent)
```

```
Run_Simple_J [Apama Application] Default Correlator on localhost:15903
2009-07-20 15:34:40.235 INFO  [5320] - Injected MonitorScript from file C:\Program Files\Progress\Apama 4.2\monitors\ScenarioService.mon, size 69
2009-07-20 15:34:40.235 INFO  [672] - com.apama.scenario.ScenarioService [0] ScenarioService interface loaded. MetaData: {"interface.fileName":"S
2009-07-20 15:34:40.329 INFO  [5320] - Injected JMon application Java_Simple, size 2001 bytes, injection time 0.08 seconds
2009-07-20 15:34:40.329 INFO  [672] - com.apama.scenario.ScenarioService [0] Received com.apama.scenario.ConfigureUpdates("",{"sendThrottled":"tr
2009-07-20 15:36:05.510 INFO  [5768] - Sender engine_send (0D4CB208) (component ID 5360628418560941851/5360628418560941851) connected from 127.0.
2009-07-20 15:36:05.557 INFO  [4116] - Sender engine_send (0D4CB208) (component ID 5360628418560941851/5360628418560941851) disconnected cleanly:
```

Debugging JMon Applications

Using the Debug view

The top left view is the main debug panel and shows the call stack and status of current threads, including any threads that have already run to completion. Whenever execution reaches a breakpoint, Apama Studio highlights the current thread.



```
Run_Simple_J [Apama Application]
    Default Correlator on localhost:15903
Java_debug_test [Remote Java Application]
    Java HotSpot(TM) Server VM[localhost:8787]
        Thread [main] (Running)
        Thread [ApamaProcessing] (Suspended (breakpoint at line 33 in Simple))
            Simple.match(MatchEvent) line: 33
            JMonApplicationClassLoader.match(EventExpression, MatchListener, String[], Event[]) line
```

This panel provides code execution controls. These allow you to suspend and resume execution, step through breakpoints in various ways, jump between stack frames, connect/disconnect to remote JVMs process, and so on. Following are descriptions of the most important controls:

	Resume	Select the Resume command to resume execution of the currently suspended debug target.
	Suspend	Select the Suspend command to halt execution of the currently selected thread in a debug target.
	Terminate	Ends the selected debug session and/or process. The impact of this action depends on the type of the item selected in the **Debug** view.
	Disconnect	Detaches the debugger from the selected process (useful for debugging attached processes).
	Step Into	Select to execute the current line, including any routines, and proceed to the next statement.
	Step Over	Select to execute the current line, following execution inside a routine.
	Step Return	Select to continue execution to the end of the current routine, then follow execution to the routine’s caller.

	Drop to Frame	Select the Drop to Frame command to re-enter the selected stack frame in the **Debug** view.
	Use Step Filters	Select the Use Step Filters command to change whether step filters should be used in the **Debug** view.

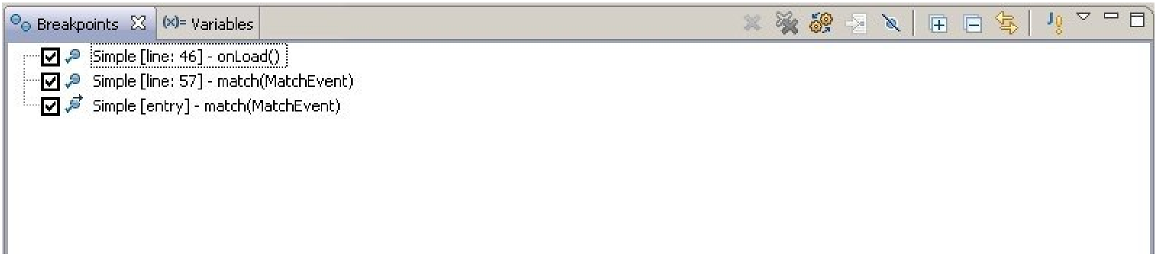
Debug perspective

Working with breakpoints

You can set breakpoints in your code in a number of ways. The most straightforward way is to select a line in your Java code and double click on the gray area to the left of the line. This sets a breakpoint before the execution of that line. The debugger will suspend execution when it reaches that line, allowing you to inspect variable values and results of expressions, either as defined in the code or created by you in real-time. These expressions can also be used in conditions for breakpoints.

You can set breakpoints on particular Java exceptions, on particular line numbers, on particular method calls, on conditions such as after a certain number of hits on a particular statement, and so on.

The breakpoint panel allows you to view and control all your currently defined breakpoints. After execution reaches a breakpoint, you can control process execution by stepping forwards or backwards through your code execution, or by simply resuming execution until the next breakpoint or until your program terminates.

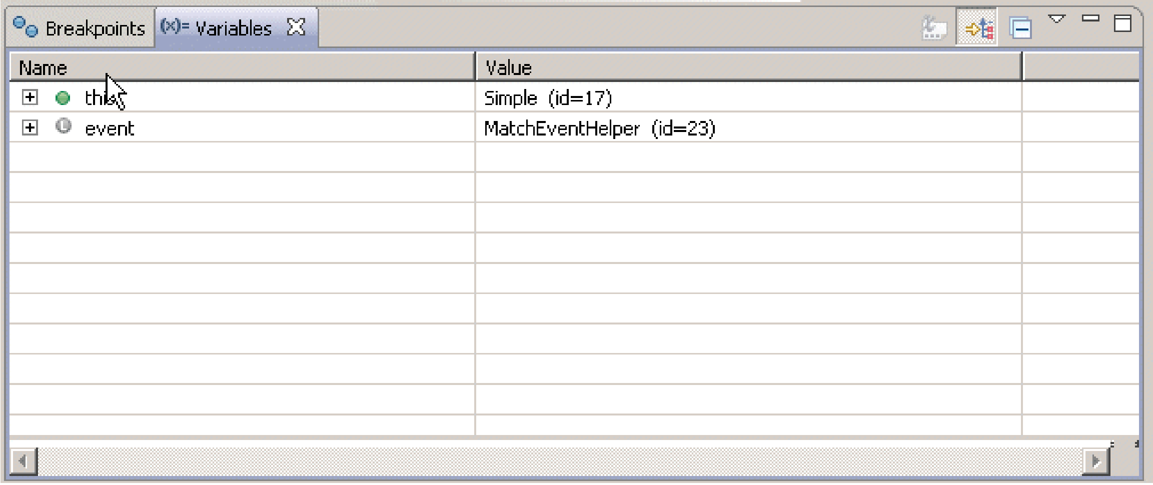


☑ Simple [line: 46] - onLoad()
☑ Simple [line: 57] - match(MatchEvent)
☑ Simple [entry] - match(MatchEvent)

Debug perspective

Viewing stack frame variables

When selecting a particular stack frame in the **Debug** view the variables panel on the top right side lets you inspect all variables as defined in the current stack context. Of course, you can also view variables alongside other variable values (globules, constants, and so on) if they are specified in the options. For more information, see the Eclipse debugging documentation.



Name	Value
this	Simple (id=17)
event	MatchEventHelper (id=23)

Debug perspective

Example debug session

This section provides a very simple example that highlights some of the basic debugging concepts. It shows the basic steps for creating a JMon `JAR` file and injecting it into a debug enabled correlator. Familiarity with how to develop JMon applications is assumed and some steps are omitted based on this assumption.

The steps for developing a JMon application are as follows:

1. Implement the Java code.
2. Annotate the Java code with required JMon information.
3. Generate the classes from the code.
4. Package the classes into a `JAR` file.
5. Create the JMon `JAR` manifest manually or by using the `JarProcessor` utility.
6. Inject the `JAR` file into a running correlator that is enabled with the JVM and with the proper Java options for remote debugging.

This section provides details as follows:

- "Debug example of preparing code and JAR file" on page 143
- "Debug example of starting correlator and injecting application" on page 145
- "Example of debugging in Apama Studio" on page 145

Debugging JMon Applications

Debug example of preparing code and JAR file

Consider the following sample Java code, which is the basis for a JMon application. The files containing the complete code are `Simple.java` and `Tick.java`, which are located in the `samples\java_monitor\simple\src` directory of your Apama installation.

```
@Application(name = "Simple",
          author = "John Doe",
          version = "1.0",
          company = "Apama",
          description = "sample",
          classpath = ""
          )
@MonitorType(description = "A simple Java monitor")

public class Simple implements Monitor, MatchListener {
   public Simple() {}
   public void onLoad() {
      EventExpression eventExpr =
         new EventExpression("all Tick(*, >10.0):t");
      eventExpr.addMatchListener(this);
   }

   public void match(MatchEvent event) {
      Tick tick = (Tick)event.getMatchingEvents().get("t");
      tick.emit();
   }
}
```

Here is the `Tick` class (`Tick.java`):

```
@EventType(description = "Event that signals a stock trade")
public class Tick extends Event {
   public String name;
   public double price;
   public Tick() {
      this("", 0);
   }

   public Tick(String name, double price){
      this.name = name;
      this.price = price;
   }
}
```

Assume that `Simple.java` is part of your Apama Studio project. Open or create the project in Apama Studio and add the code if necessary. Note that this code is already annotated with the information required for creating the JMon `JAR` manifest.

The next step is to compile and pack the class bytecode into a `JAR` file, and create the manifest that flags and describes this `JAR` file as a JMon application. You can do this by setting up a new builder in the project properties in Apama Studio or through the command line. For the sake of simplicity, the standard command line calls are described below:

1. Compile the Java code. For example:

   ```
   javac -classpath "%APAMA_HOME%/lib/correlator_extension_api5.3.jar;%APAMA_HOME%/lib/util5.3.jar"
   *.java
   ```

2. Package the classes into your `JAR` file:

   ```
   jar cf simple-jmon.jar *.class
   ```

3. Use the `JarProcessor` utility to create the manifest for the `JAR` file. For example, if the `JAR` is called `simple-jmon.jar`, enter:

   ```
   java -classpath "%APAMA_HOME%/lib/correlator_extension_api5.3.jar"
   com.apama.jmon.annotation.JarProcessor simple-jmon.jar
   ```

Debug example of starting correlator and injecting application

Start a local correlator with remote debugging enabled. For example, if you specify port `8787`, the command line looks like this:

```
correlator -l license.txt -j -J
-agentlib:jdwp=transport=dt_socket,address=8787,server=y,suspend=n
```

Inject the `JAR` into the running correlator. For example:

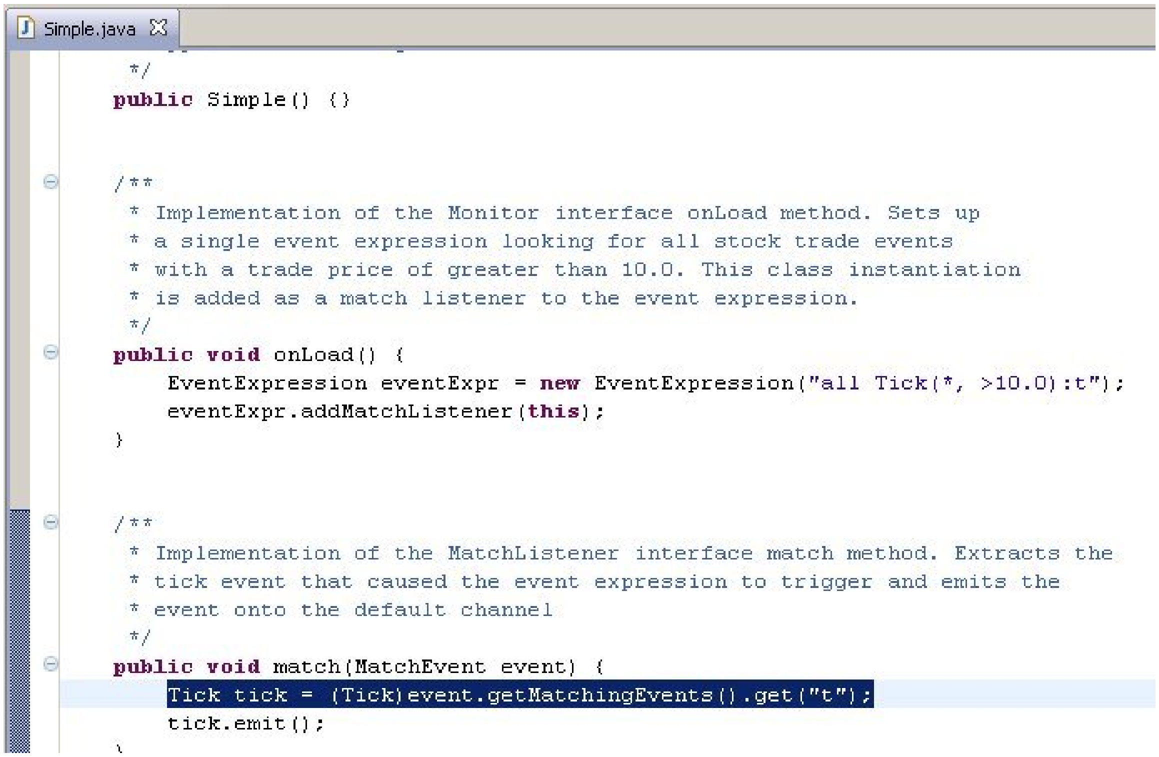
```
engine_inject -j simple-jmon.jar
```

You are ready to start an Apama Studio debug session.

Example of debugging in Apama Studio

You want to connect to the remote correlator and debug the JMon application in Apama Studio. To do this, you must open the JMon project (or the Apama project with Java support enabled) in Apama Studio and create a debug launch configuration. This launch configuration connects to the remote Java application, which is the JVM in the running correlator.

For test purposes, suppose that you create a simple breakpoint in the `match()` method in `Simple.java`. This suspends execution when the correlator reaches a matching event listener.



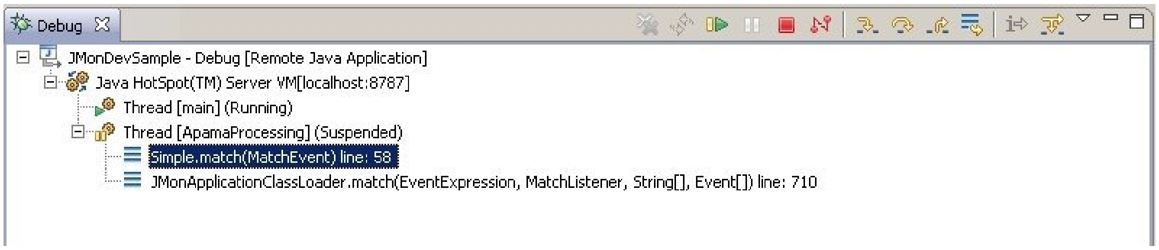
```
     */
    public Simple() {}


    /**
     * Implementation of the Monitor interface onLoad method. Sets up
     * a single event expression looking for all stock trade events
     * with a trade price of greater than 10.0. This class instantiation
     * is added as a match listener to the event expression.
     */
    public void onLoad() {
        EventExpression eventExpr = new EventExpression("all Tick(*, >10.0):t");
        eventExpr.addMatchListener(this);
    }


    /**
     * Implementation of the MatchListener interface match method. Extracts the
     * tick event that caused the event expression to trigger and emits the
     * event onto the default channel
     */
    public void match(MatchEvent event) {
        Tick tick = (Tick)event.getMatchingEvents().get("t");
        tick.emit();
```

Send the following events to the correlator to trigger the breakpoint:

```
Tick("ibm", 1.0)
Tick("ibm", 5.0)
Tick("ibm", 15.0)
Tick("msft", 15.0)
```

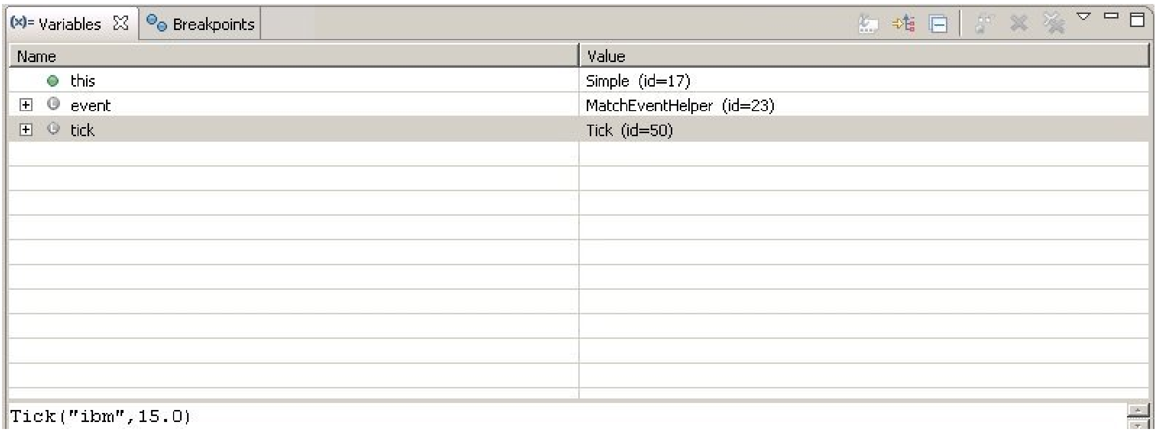
As you can see, the debugger stops execution at the specified code breakpoint after the listener finds the first `Tick` event with a price greater than `10.0`, that is `Tick("ibm", 15.0)`.

Suppose that you want to examine the heap context, that is, the values of the variables. You can observe this in the top left Debug panel of the **Apama Runtime** perspective. Select the Simple.match method stack frame from Thread[ApamaProcessing]. For example:



```
JMonDevSample - Debug [Remote Java Application]
  Java HotSpot(TM) Server VM[localhost:8787]
    Thread [main] (Running)
    Thread [ApamaProcessing] (Suspended)
      Simple.match(MatchEvent) line: 58
      JMonApplicationClassLoader.match(EventExpression, MatchListener, String[], Event[]) line: 710
```

Note that the top right **Variables** view now shows the proper stack frame context with all relevant heap space variable values. The `tick` variable, defined in the code, is not yet visible. This is because execution was suspended before the current line was executed. To execute the current line, which extracts the matching `Tick` event and assigns it to the `tick` variable, click Step Over in the Debug panel toolbar. As you can see, the tick variable now appears in the **Variables** view. You can select it to inspect its value, which is, of course, `Tick("ibm", 15.0)`.



Name	Value
this	Simple (id=17)
event	MatchEventHelper (id=23)
tick	Tick (id=50)

```
Tick("ibm",15.0)
```

Additional resources for Java debugging

This section introduces the basic concepts for debugging JMon applications in Apama Studio. There are a number of Apama Studio debugging features not mentioned, but the mechanisms are essentially the same as for other Java applications. For additional information about available debugging options, see the following Eclipse information:

- Running and debugging Java in Eclipse:

  http://help.eclipse.org/kepler/index.jsp?topic=/org.eclipse.jdt.doc.user/tasks/task-running_and_debugging.htm

- Eclipse And Java: Using the Debugger (Video Tutorial):

  http://www.eclipse.org/resources/resource.php?id=405

- JDB (Java debugger):

http://docs.oracle.com/javase/1.5.0/docs/tooldocs/windows/jdb.html

- Good video tutorials and practice exercises for debugging Java in Eclipse:

  http://eclipsetutorial.sourceforge.net/debugger.html

- IBM debugging with Eclipse:

  http://www.ibm.com/developerworks/library/os-ecbug/

Debugging JMon Applications

Chapter 7: Profiling EPL Applications

You can profile Apama applications written in EPL with Apama Studio. Data collected in the profiler allows you to identify possible bottlenecks in an EPL application. The Apama Studio profiler consists of the **Apama Profiler** perspective which includes a variety of views. With the Apama Studio EPL Profiler, you can profile applications running on both local and remote correlators.

Launching profiling sessions

You can profile an Apama EPL application using a default launch configuration. You can also create custom profile launch configurations for launching profiling session. For example, you may want the profiler to launch the application using a correlator different from the project's default correlator or to profile an application running on a remote correlator.

- When a default profile configuraton is launched, it starts the profiler and the default correlator and the application if they aren't already running. If they are already running the profiler just starts profiling the running application. See "Launching a default profiling session" on page 149 for more information on launching a default profiling session.
- If you want to profile an application that runs on a non-default correlator, you need to create a launch configuration that points to the run configuration associated with the desired correlator. See "Launching a custom profiling session" on page 149 for more information for creating and launching a custom profiling configuration.
- If you want to profile an application that runs on a remote correlator, you need to create a launch configuration that points to the machine where the correlator is running. In order to profile an application running on a remote correlator, the remote application needs to be running before you launch the profiling session. See "Launching a remote profiling session" on page 150 for more information on creating and launching a configuration for a remote profiling session.

Profiling EPL Applications

Launching a default profiling session

You can profile an Apama EPL application using a default launch configuration or you can create a custom profiler launch configuration for an application running on a remote correlator.

To launch a profiling session in Apama Studio using the default launch configuration:

1. From the Apama Studio menu, select Run > Profile.
2. By default, Apama Studio displays the **Confirm Perspective Switch** dialog asking if you want to use the **Apama Profiler** perspective. Click Yes. Apama Studio switches to the **Apama Profiler** perspective and begins collecting data from the EPL application.

   Note, you can change the behavior of the **Confirm Perspective Switch** dialog by changing a setting in the **Profiling Monitor** view's Preferences wizard; see "Displaying Apama perspective preferences" on page 159.

Launching a custom profiling session

You can create custom launch configurations for profiling Apama EPL applications. See "Creating a custom profile launch configuration" on page 149 for more information on creating a custom profiler launch configuration.

To launch a profiling session in Apama Studio using a custom launch configuration, assuming that you have defined a custom profiler launch configuration:

1. In the **Project Explorer** right-click the project name and select Profile As > Apama Correlator Profiler. The **Select Profile Application** dialog is displayed.
2. In the **Select Profile Application** dialog, select the launch configuration you want to use and click OK.
3. By default, Apama Studio displays the **Confirm Perspective Switch** dialog asking if you want to use the **Apama Profiler** perspective. Click Yes. Apama Studio switches to the **Apama Profiler** perspective and begins collecting data from the EPL application.

   Note, you can change the behavior of the **Confirm Perspective Switch** dialog by changing a setting in the **Profiling Monitor** view's Preferences wizard; see "Displaying Apama perspective preferences" on page 159.

Launching profiling sessions

Creating a custom profile launch configuration

You can create custom profile launch configurations for launching profiling session. For example, you may want the profiler to launch the application using a correlator different from the project's default correlator.

1. In the **Project Explorer** right-click the project and select Profile As > Profile Configurations. The **Profile Configurations** wizard starts.
2. In the **Profile Configurations** wizard, click the New launch configuration button.

3. In the **Profile Configurations** wizard, replace the default name in the Name field if desired.
4. In the **Profile Configurations** wizard, on the Connection Details tab, in the Profile a field, use the default Apama Launch configuration selection.
5. In the Launch Configuration field, click the Browse button. The **Choose Launch Configuration** dialog is displayed.
6. In the **Choose Launch Configuration** dialog, select the run configuration you want to profile and click OK.
7. In the **Profile Configurations** wizard, click Apply to save the profile configuration or Profile to save and launch the profiling session.

Launching a custom profiling session

Launching a remote profiling session

In Apama Studio you can profile an Apama application running on a remote correlator by creating a custom profiler launch configuration that points to the remote machine where the correlator is running.

Before you launch a profiling session for an application running on a remote correlator, the remote application needs to be already running. To launch a profiling session for an application on a remote correlator, assuming that you have already created a remote profiler launch configuration:

1. In the **Project Explorer** right-click the project name and select Profile As > Apama Correlator Profiler. The **Select Profile Application** dialog is displayed.
2. In the **Select Profile Application** dialog, select the launch configuration you want to use to connect to the remote correlator and click OK.
3. By default, Apama Studio displays the **Confirm Perspective Switch** dialog asking if you want to use the **Apama Profiler** perspective. Click Yes. Apama Studio switches to the **Apama Profiler** perspective and begins collecting data from the EPL application.

   Note, you can change the behavior of the **Confirm Perspective Switch** dialog by changing a setting in the **Profiling Monitor** view's Preferences wizard; see "Displaying Apama perspective preferences" on page 159.

Launching profiling sessions

Creating a remote profiler launch configuration

You can create custom profile launch configurations for profiling Apama applications running on remote correlators.

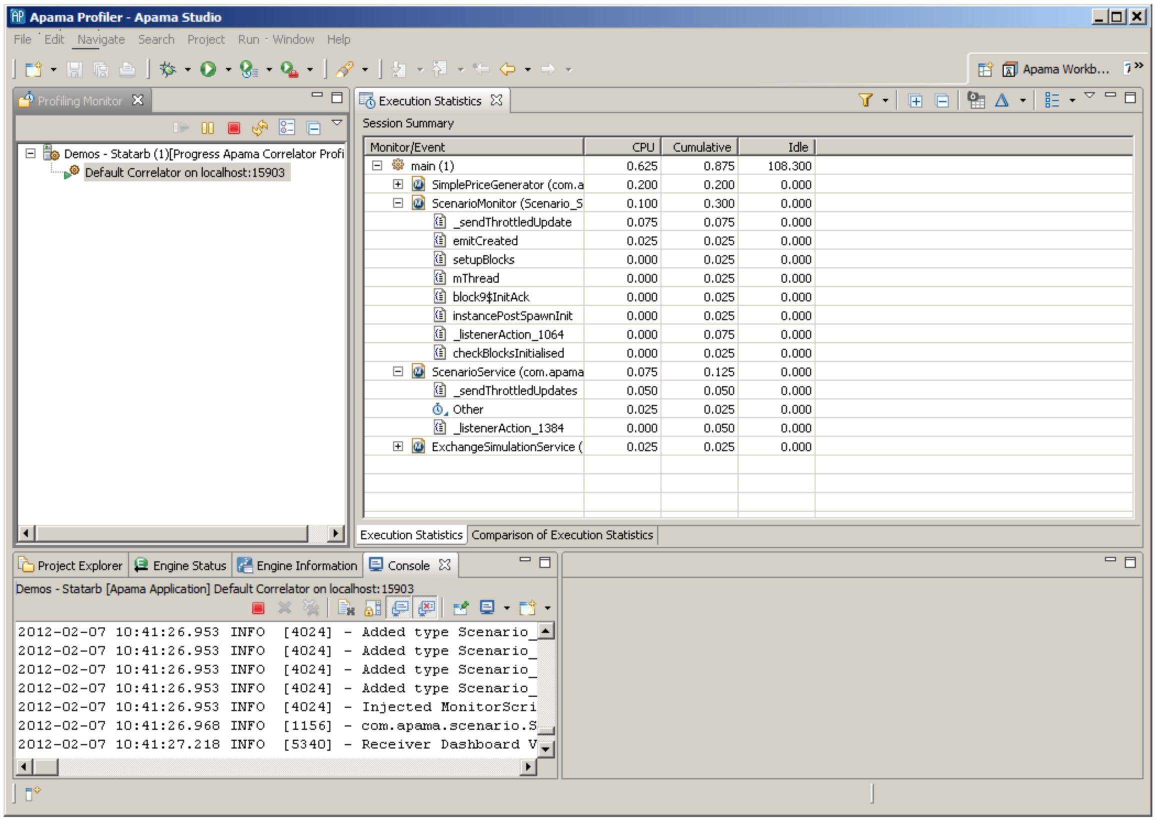
1. From the **Project Explorer**, right-click the project and select Profile As > Profile Configurations. The **Profile Configurations** wizard is displayed.
2. In the **Profile Configurations** wizard, enter a meaningful name for the configuration in the Name field if you do not want to use the default name.
3. On the Connection Details tab, in the Profile a field, select Remote Apama correlator.
4. In the Remote Correlator Details section, enter the name of the host and the port in the Host and Port fields.

5. If desired, and if the remote correlator is running, click Test Connection to confirm the specified location information is correct.
6. Click Apply to save the profile configuration or Profile to save and launch the profiling session.

Launching a remote profiling session

The Apama Profiler perspective

The following illustration shows an active profiling session.


Apama Profiler - Apama Studio
File
Edit
Navigate
Search
Project
Run
Window
Help
Apama Workb...
Profiling Monitor
Demos - Statarb (1)[Progress Apama Correlator Profi
Default Correlator on localhost:15903
Execution Statistics
Comparison of Execution Statistics
Project Explorer
Engine Status
Engine Information
Console

Session Summary

Monitor/Event	CPU	Cumulative	Idle
main (1)	0.625	0.875	108.300
SimplePriceGenerator (com.a	0.200	0.200	0.000
ScenarioMonitor (Scenario_S	0.100	0.300	0.000
_sendThrottledUpdate	0.075	0.075	0.000
emitCreated	0.025	0.025	0.000
setupBlocks	0.000	0.025	0.000
mThread	0.000	0.025	0.000
block9$InitAck	0.000	0.025	0.000
instancePostSpawnInit	0.000	0.025	0.000
_listenerAction_1064	0.000	0.075	0.000
checkBlocksInitialised	0.000	0.025	0.000
ScenarioService (com.apama	0.075	0.125	0.000
_sendThrottledUpdates	0.050	0.050	0.000
Other	0.025	0.025	0.000
_listenerAction_1384	0.000	0.050	0.000
ExchangeSimulationService (	0.025	0.025	0.000

Demos - Statarb [Apama Application] Default Correlator on localhost:15903

```
2012-02-07 10:41:26.953 INFO  [4024] - Added type Scenario_
2012-02-07 10:41:26.953 INFO  [4024] - Added type Scenario_
2012-02-07 10:41:26.953 INFO  [4024] - Added type Scenario_
2012-02-07 10:41:26.953 INFO  [4024] - Added type Scenario_
2012-02-07 10:41:26.953 INFO  [4024] - Injected MonitorScri
2012-02-07 10:41:26.968 INFO  [1156] - com.apama.scenario.S
2012-02-07 10:41:27.218 INFO  [5340] - Receiver Dashboard V
```

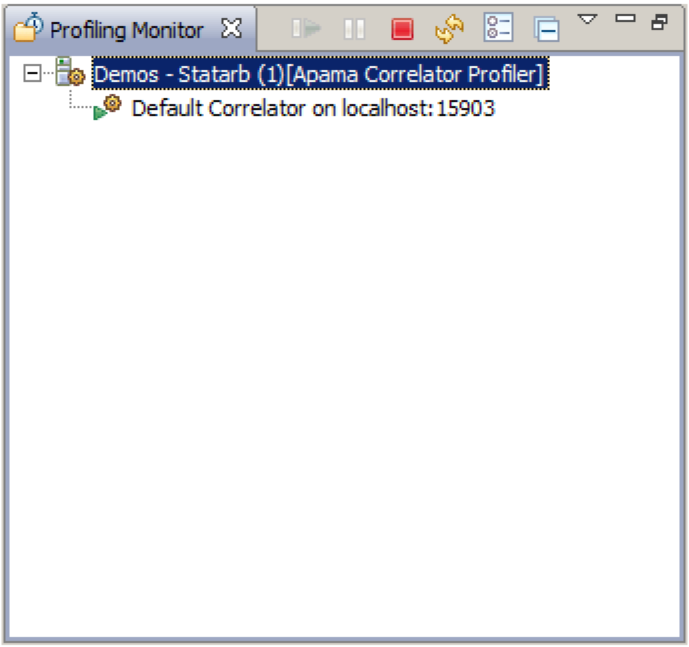
The **Apama Profiler** perspective consists of the following views:

- **Profiling Monitor** view
- **Execution Statistics** view

Profiling EPL Applications

Profiling Monitor view

The **Profiling Monitor** view shows a tree view of the available profiler sessions. These sessions could be associated with different applications or associated with applications running on different correlators.



Demos - Statarb (1)[Apama Correlator Profiler]

Default Correlator on localhost:15903

The tool bar for the **Profiling Monitor** view contains the following buttons:

- ⏵ — Resume the profiling session.
- ⏸ — Pause the profiling session.
- ■ — Stop the profiling session.
- ↻ — Manually refresh the **Execution Statistics** view with collected data. By default the data is automatically refreshed at 10 second intervals; you can change the refresh behavior with the Preferences button described below.
- ☰ — Displays a **Preferences** wizard where you can change the following:
  - Specify whether a profiler automatically displays the **Apama Profiler** perspective.
  - Specify how often to refresh the **Execution Statistics** view with new data.

    For more information on refreshing profiler data, see "Updating profile data" on page 158.
- ⊟ — Collapse the entries in the tree view displayed in the **Profiling Monitor** view.
- ▽ — Display the **Profiling Monitor** view's drop down menu.

The Apama Profiler perspective

Execution Statistics view

The **Execution Statistics** view displays the timing details of the profiled EPL application. This view includes the following tabs:

- Execution Statistics
- Comparison of Execution Statistics

You can adjust the way the information is displayed using the buttons on the view's tool bar. The following tools are available:

- — Apply and manage filters for displaying subsets of the profiling data. This tool is not available for the Comparison of Execution Statistics tab. For more information on filtering the data, see "Using filters" on page 155
- — Expand the entire of tree of entries.
- — Collapse the entire of tree of entries.
- — Take a snapshot of the profiling data.
- — Manage snapshots.
- — Specify how to organize the profiling information by Contexts, Monitors/Events, or Action.
- — Choose which columns to display. You can also change the order in which the columns are displayed.

The Apama Profiler perspective

The Execution Statistics tab

The Execution Statistics tab carries a sub-title of "Session Summary". By default the left-hand column displays a tree view of the application's contexts, monitors, and actions organized by contexts. You can change the display to show profiler information organized by monitors/events and by actions using the Organize View By button [].

You can filter the profiler information in order to focus on specific application behavior using the Filter button []. For more information on using filters, see "Using filters" on page 155.

By default the display includes the following three columns of information:

- CPU time — The time in seconds this action has been executing.
- Cumulative time — The time in seconds spent in this action and all its child actions.
- Idle — The time in seconds this context has been idle, waiting for events.

You can also display the following information, by using the Choose Columns button [[].

- Empty — The time in seconds this context has been empty, that is, without monitors.
- Non-Idle — The time in seconds this context has been non-idle, in other words, when it has had events to process.

- Runnable — The time in seconds this context has had work to do, but during which the work has not been executed by the scheduler.
- Plugin — The time in seconds spent in a plug-in call.
- Blocked — The time in seconds this context has been blocked, for example, waiting for a queue to become non-full.

Execution Statistics view

Comparison of Execution Statistics tab

This tab compares the most recent profiling data with that of a previous set. For each type of information there are three associated columns, for example CPU, Old CPU, and Diff CPU. The leftmost column is the current information, the column labelled "Old" is the information from the previous set, and the column labelled "Diff" is the change between the new and the previous information. The previous set is considered the baseline.

By default, the "previous set" consists of the data from the last time it was refreshed. You can change this behavior to compare the most recent data to data captured in a snapshot at a particular moment in time. For information on capturing data in a snapshot, see "Taking snapshots" on page 157

As with the Execution Statistics tab, you can change the type of information and how it is displayed on the Comparison Execution Statistics tab as follows.

- Use the Organize View By button [☰ ▾] to organize the profiler information by Contexts, Monitors/Events, or Actions.
- Use the Choose Columns button [▽] to add, remove, or change the order of the information columns.

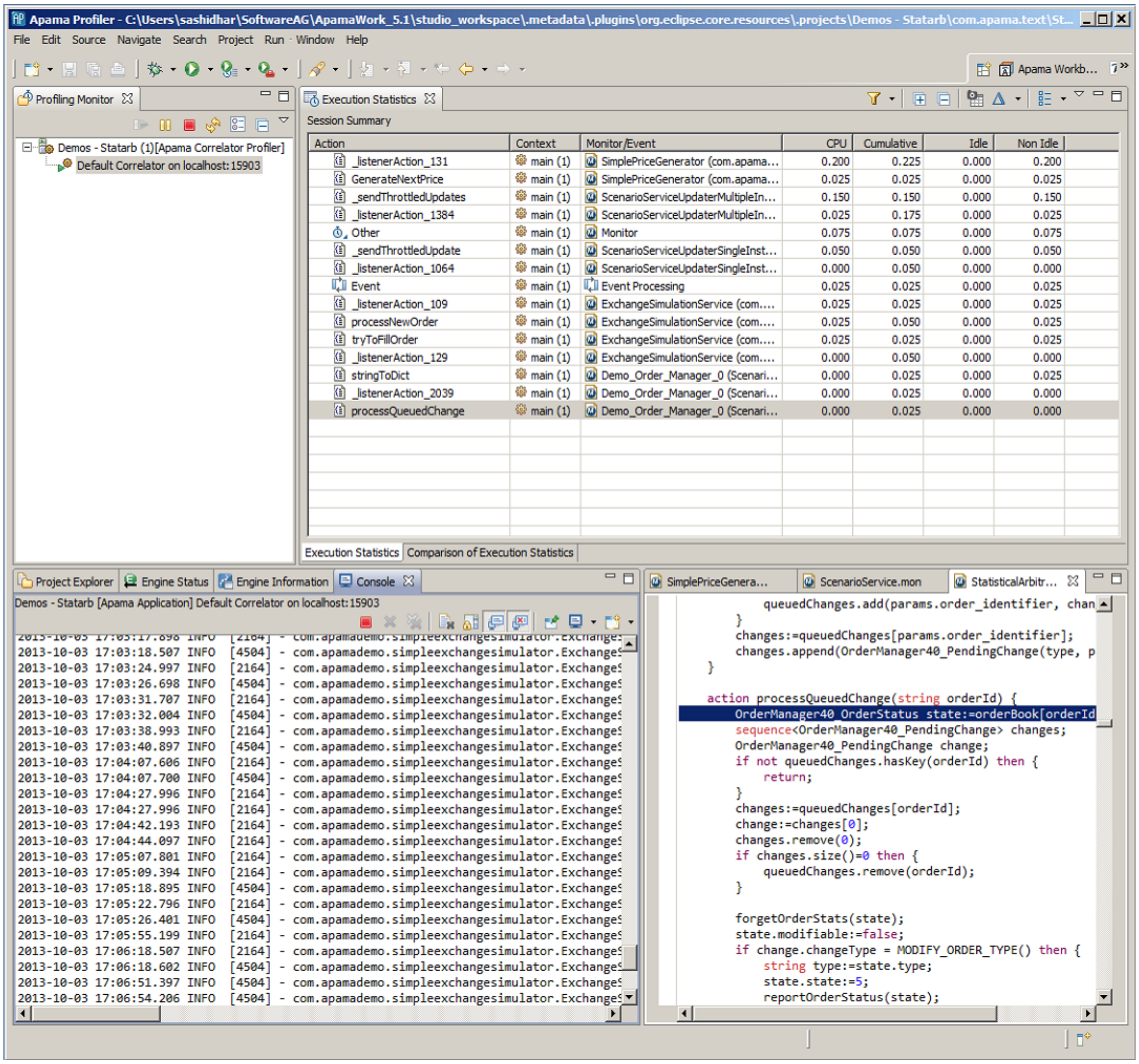
Execution Statistics view

Viewing EPL code

In the **Execution Statistics** view you can display the EPL code for a specific action or listener. Only the action-level entries that are shown with the code icon [🗎] are able to display the associated code. There are other entries, such as garbage collector timings (that is, GC-mark, GC etc.), events and others for which there is no code association.

To display the code for an action or listener:

In the **Execution Statistics** view, double-click the action or listener for which you want to view the code. The EPL source file containing the code for the action or listener opens (if it is not already open) in the EPL editor.


Apama Profiler - C:\Users\sashidhar\SoftwareAG\ApamaWork_5.1\studio_workspace\.metadata\.plugins\org.eclipse.core.resources\.projects\Demos - Statarb\com.apama.text\St...
File Edit Source Navigate Search Project Run Window Help
Apama Workb...
Profiling Monitor
Demos - Statarb (1)[Apama Correlator Profiler]
Default Correlator on localhost:15903
Execution Statistics
Session Summary
Execution Statistics
Comparison of Execution Statistics
Project Explorer
Engine Status
Engine Information
Console
Demos - Statarb [Apama Application] Default Correlator on localhost:15903
SimplePriceGenera...
ScenarioService.mon
StatisticalArbitr...

Action	Context	Monitor/Event	CPU	Cumulative	Idle	Non Idle
_listenerAction_131	main (1)	SimplePriceGenerator (com.apama...	0.200	0.225	0.000	0.200
GenerateNextPrice	main (1)	SimplePriceGenerator (com.apama...	0.025	0.025	0.000	0.025
_sendThrottledUpdates	main (1)	ScenarioServiceUpdaterMultipleIn...	0.150	0.150	0.000	0.150
_listenerAction_1384	main (1)	ScenarioServiceUpdaterMultipleIn...	0.025	0.175	0.000	0.025
Other	main (1)	Monitor	0.075	0.075	0.000	0.075
_sendThrottledUpdate	main (1)	ScenarioServiceUpdaterSingleInst...	0.050	0.050	0.000	0.050
_listenerAction_1064	main (1)	ScenarioServiceUpdaterSingleInst...	0.000	0.050	0.000	0.000
Event	main (1)	Event Processing	0.025	0.025	0.000	0.025
_listenerAction_109	main (1)	ExchangeSimulationService (com....	0.025	0.025	0.000	0.025
processNewOrder	main (1)	ExchangeSimulationService (com....	0.025	0.050	0.000	0.025
tryToFillOrder	main (1)	ExchangeSimulationService (com....	0.025	0.025	0.000	0.025
_listenerAction_129	main (1)	ExchangeSimulationService (com....	0.000	0.050	0.000	0.000
stringToDict	main (1)	Demo_Order_Manager_0 (Scenari...	0.000	0.025	0.000	0.025
_listenerAction_2039	main (1)	Demo_Order_Manager_0 (Scenari...	0.000	0.025	0.000	0.000
processQueuedChange	main (1)	Demo_Order_Manager_0 (Scenari...	0.000	0.025	0.000	0.000

```
2013-10-03 17:03:17.898 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:03:18.507 INFO  [4504] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:03:24.997 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:03:26.698 INFO  [4504] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:03:31.707 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:03:32.004 INFO  [4504] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:03:38.993 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:03:40.897 INFO  [4504] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:04:07.606 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:04:07.700 INFO  [4504] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:04:27.996 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:04:27.996 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:04:42.193 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:04:44.097 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:05:07.801 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:05:09.394 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:05:18.895 INFO  [4504] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:05:22.796 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:05:26.401 INFO  [4504] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:05:55.199 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:06:18.507 INFO  [2164] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:06:18.602 INFO  [4504] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:06:51.397 INFO  [4504] - com.apamademo.simpleexchangesimulator.ExchangeS
2013-10-03 17:06:54.206 INFO  [4504] - com.apamademo.simpleexchangesimulator.ExchangeS
```

```
            queuedChanges.add(params.order_identifier, chan
        }
        changes:=queuedChanges[params.order_identifier];
        changes.append(OrderManager40_PendingChange(type, p
    }

    action processQueuedChange(string orderId) {
        OrderManager40_OrderStatus state:=orderBook[orderId
        sequence<OrderManager40_PendingChange> changes;
        OrderManager40_PendingChange change;
        if not queuedChanges.hasKey(orderId) then {
            return;
        }
        changes:=queuedChanges[orderId];
        change:=changes[0];
        changes.remove(0);
        if changes.size()=0 then {
            queuedChanges.remove(orderId);
        }

        forgetOrderStats(state);
        state.modifiable:=false;
        if change.changeType = MODIFY_ORDER_TYPE() then {
            string type:=state.type;
            state.state:=5;
            reportOrderStatus(state);
```

The Apama Profiler perspective

Using filters

When viewing the Execution Statistics tab of the **Execution Statistics** view, you can focus on specific data by applying a filter to the profiling information.

Profiling EPL Applications

Creating a Filter

You can create filters in order concentrate on particular profiling data. To create a filter:

1. On the Execution Statistics tab, click the Filter button [ ] on the view's tool bar and select Manage Filters. The **Manage Filters** dialog is displayed.
2. In the **Manage Filters** dialog, click Add. The **Create Filter** dialog is displayed.

3. In the **Create Filter** dialog, specify the Filter Name and an optional Filter Description.
4. In the **Create Filter** dialog, click the Add New Row button [✚]. This adds a row in the table field as indicated by a new set of parenthesis marks ( ).
5. Specify the filter criteria as follows:
    a. Click the Type column and from the drop-down list select the type of data you want to filter for.
    b. Click on the Operation column and from the drop-down list specify the operation that is appropriate to the Type you are filtering for.
    c. Double-click in the Value column and enter an appropriate value; then click in a blank area of the table to accept the value you specified.
    d. You can add other criteria to the filter by ANDing or ORing. In the AND/OR column, select the appropriate operator from the drop-down list, click the Add New Row and specify the additional filter criteria as described above.
6. Click OK.
7. In the **Manage Filters** dialog, select the filter you want and click Apply.

    The Execution Statistics tab is updated according to your filter criteria.

Using filters

Managing Filters

Use the Filter tool to manage the use of filters. You can add, edit, or remove filters; change which filter is used; and revert to the default display of unfiltered data. To manage filters:

1. On the Execution Statistics tab, click the Filter tool [▾] and select Manage Filters from the pop-up menu. The **Manage Filters** dialog is displayed.
    - If you want to create a new filter click Add. The **Create Filter** dialog is displayed. See "Creating a Filter" on page 155 for more information on creating filters.
    - If you want to edit an existing filter click, select the name of the filter and click Edit. The **Edit Filter** dialog displays the current filter criteria. Edit the filter information as necessary and click OK.
    - If you want to remove a filter, select the name of the filter and click Delete.
2. Select the filter you want and click Apply. If you remove all the filters and click Apply, the profiler displays shows the default unfiltered set of information.

If you are looking at a filtered data set and want to return to the default display of unfiltered data, click the Filter tool [▾] and select Reset Filter from the pop-up menu.

Using filters

Taking snapshots

You can capture profiling data at any moment in time by taking snapshots. You can then compare current profiling data to the data represented in a snapshot. To take a snapshot:

1. In the **Execution Statistics** view, click the Take Snapshot button []. The **Create Snapshot** dialog is displayed.
2. Enter a meaningful name in the Snapshot Name field.
3. Specify the source of the data you want to use to create the snapshot as follows:
   - To populate the snapshot with data that the correlator captures at this point in time, select Current correlator.
   - To populate the snapshot with data that has previously been stored on disk in a `.csv` file select Select from file. This data would typically be collected using the `engine_management` tool as, for example

     ```
     engine_management -r "profiling get" > myfile.csv
     ```

     Note, however to be used this way, the `.csv` file must have been generated using Apama release 5.0.1 or later.

     For more information on the `engine_management` utility, see "Shutting down and managing components" in *Deploying and Managing Apama Applications*.
4. Click OK.

In the Comparison of Execution Statistics tab the baseline columns (labelled "Old") display the data captured in the snapshot and the columns labelled "Diff" are similarly updated to compare the current information with that captured in the snapshot. For more information on managing snapshots, see "Using snapshots" on page 157.

Profiling EPL Applications

Using snapshots

After you create a snapshot the display on the Comparison of Execution Statistics tab is updated to compare the current data with that captured in the snapshot. You can change this to compare the current data to another snapshot or the default setting that compares the current data to the data seen the previous time the data was refreshed. To change the compared sets of data:

In the Comparison of Execution Statistics tab, click the Show Previous Snapshots button [Δ ▾].

- If you want to use the data from another snapshot, select the name you assigned to it.
- If you want to return to the profiler's default comparison, select Compare last data.
- If you want to manage your snapshots
  1. Select Manage snapshots.
  2. Select the name of the snapshot you want to apply or remove.

3. Click OKto apply the snapshot or Remove to remove the snapshot.

- If you want remove all snapshots, select Clear Snapshots.

Profiling EPL Applications

Choosing profiling information columns

You can specify which information to display in the **Execution Statistics** view. You can also change the order in which the columns are displayed. By default, the following columns are displayed:

- CPU — The time in seconds this action has been executing.
- Cumulative — The time in seconds spent in this action and all its child actions.
- Idle — The time in seconds this context has been idle, waiting for events.

1. In the **Execution Statistics** view, click the View menu button [▽] and select Choose columns. The **Choose Columns** dialog is displayed.
2. Add a check to the check boxes that correspond to the columns you want to display.
3. Click OK.

The **Execution Statistics** view is updated to show all the selected the columns.

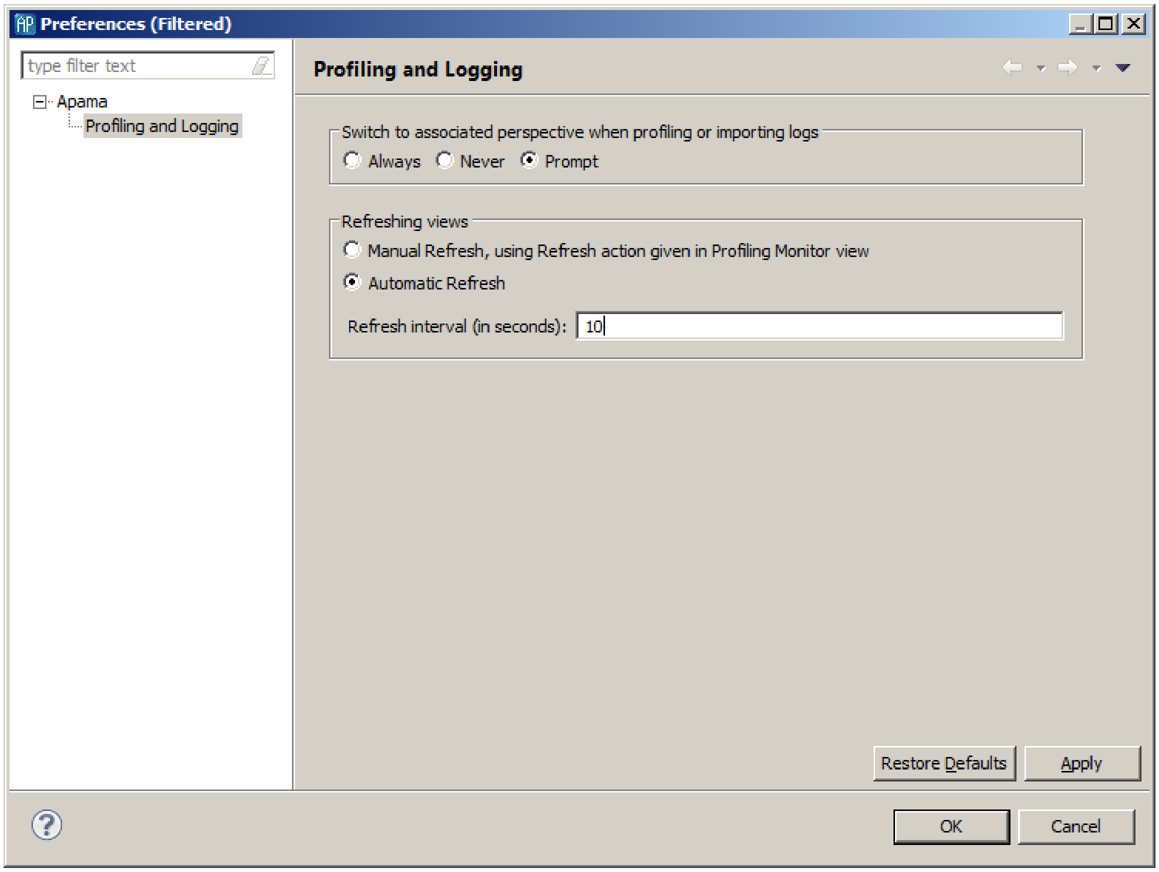
Profiling EPL Applications

Updating profile data

By default, the Apama Studio profiler polls for data every 10 seconds and then updates the display in the **Execution Statistics** view. You can change the polling frequency. You can also change the way the profiler updates the data from a polling mode (Automatic Refresh) to an on-demand mode (Manual Refresh). Using the on-demand mode is useful, for example, if you want to let your application run up to a certain point and then retrieve profile data or if you want to inject a set of test events and then examine the profile deltas.

To change the way the profiler updates data:

1. In the **Profiling Montior** view, click the Preferences button [☰]. The **Preferences** wizard is displayed.



Profiling and Logging

Switch to associated perspective when profiling or importing logs

○ Always ○ Never ● Prompt

Refreshing views

○ Manual Refresh, using Refresh action given in Profiling Monitor view

● Automatic Refresh

Refresh interval (in seconds): 10

2. In the **Preferences** wizard, select the Apama > Profiling and Logging node in the left pane. In the right pane, in the Refreshing views field, select the behavior you want and click OK.

   If you select Automatic, you can also specify the refresh interval.

Profiling EPL Applications

Displaying Apama perspective preferences

By default, when you launch a profiling session, Apama Studio displays the **Confirm Perspective Switch** dialog asking if you want to switch to the **Apama Profiler** perspective.

You can change the this behavior by changing the setting in the **Profiling Monitor** view's Preferences.

To change this behavior:

1. In the **Profiling Monitor** view, click the Preferences icon [☰]. This displays the **Preferences** wizard.
2. In the **Preferences** wizard, select the Apama > Profiling and Logging node in the left pane. In the right pane, in the Switch to associated perspective when profiling or importing logs field, select the behavior you want and click OK.

Profiling EPL Applications

Chapter 8: Using the Data Player

With the Apama Data Player you can play back previously saved event data as you develop your application. During playback, you can analyze the behavior of your application. Or, if you modify the saved event data, you can analyze how your application performs with the altered data. Apama Studio plays back event data that has been stored in standard data formats.

Introduction to the Data Player

The Data Player relies on Apama Database Connector (ADBC) adapters that are specific to standard ODBC and JDBC database formats as well as the proprietary Apama Sim format. These adapters run in the Apama Integration Application Framework (IAF), which connects the data sources to the correlator.

For more information, see "Using the Apama Database Connector" and "The Integration Adapter Framework" in *Connecting Apama Applications to External Components*.

The Apama Data Player consists of both the Query Editor and the Data Player Control.

Using the Data Player

Using the Data Player

In addition to the normal operations for running an application in Apama Studio, in order to play back event data in the Data Player, you need to perform a few other steps. Broadly, these steps are:

1. Configure the Apama Studio project to use the appropriate ADBC adapter for the data source and database and specify the event types that will be played back along with the appropriate IAF mapping.
2. Launch the project so it can establish a connection to the data source.
3. Specify a Data Player playback query to determine what data from the database you want to play back.
4. Use the Data Player control to specify the following: how fast you want to play back the data; over what time range; and what throttling period to use.
5. Run the playback session.

Adding the ADBC adapter

If you want to use the Apama Data Player in your project, you need to add and configure the Apama Database Connector adapter that is appropriate to the data source used by the project: ODBC, JDBC, or Sim.

1. There are two ways of adding an ADBC adapter to a project.

   If you are creating a new Apama project, select File > Project > New > Apama , give it a name, and click Next.

   If you are adding an ADBC adapter to an existing project:

   a. In the Project Explorer right-click the project and select Apama > Add Adapter. The **Add Adapter Instance** dialog opens.

   b. If desired, in the **Add Adapter Instance** dialog, create a new name for the adapter instance or accept the default instance name. Apama Studio prevents you from using a name that is already in use.

2. In the **New Apama Project** dialog or the **Add Adapter Instance** dialog, select the ADBC adapter bundle that is appropriate to the kind of data source your application will use. Click Finish or OK.

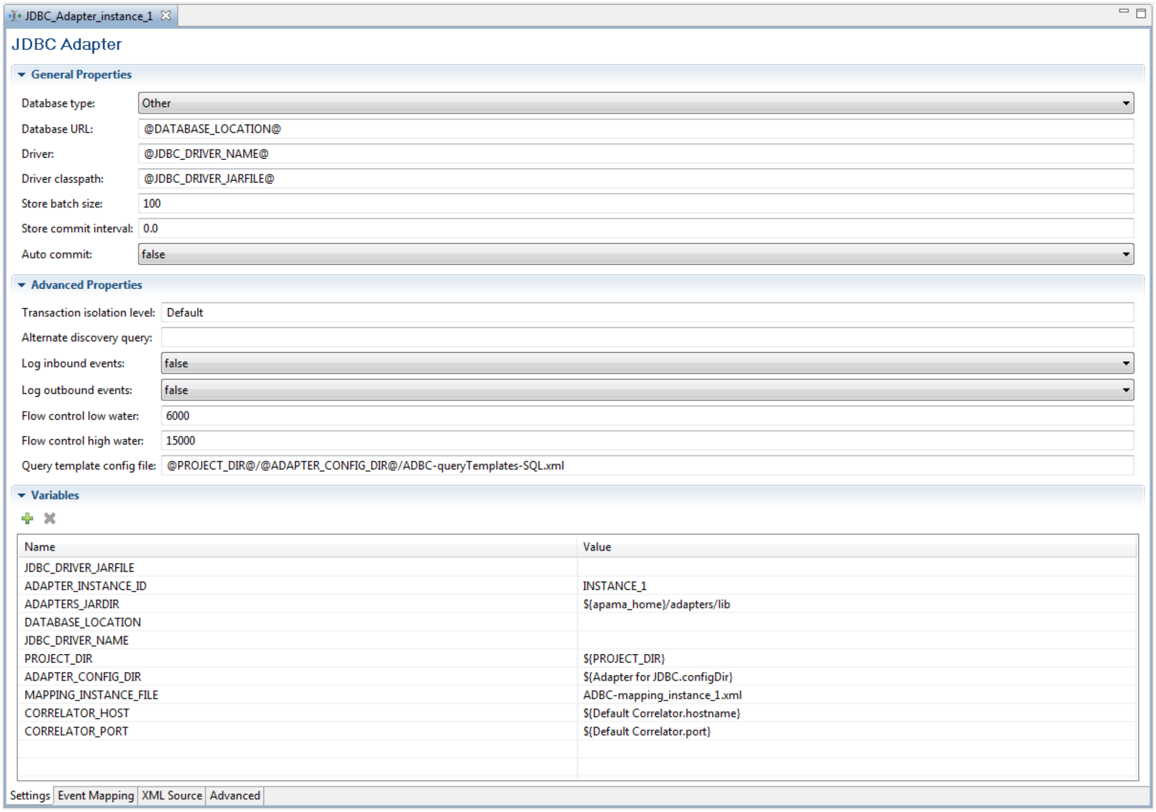
Apama Studio adds an `Adapters` node to your project if not already present. The node will contain a node for the new adapter. The adapter node contains an instance of the new adapter.

When you add a data source-specific adapter, the ADBC Adapter common (Apama Database Connector Common common) bundle will be added to the project automatically.

Configuring the ADBC adapter

To configure an instance of an ADBC adapter:

1. In the Project Explorer, expand the project's `Adapters` node and open the adapter folder (either `Adapter for JDBC` or `Adapter for Sim`).
2. Double-click the entry for the adapter instance you want to configure. The configuration file opens in the adapter editor. For example, a configuration file for an instance of the ADBC-JDBC adapter looks like this:



JDBC Adapter

General Properties

Database type: Other

Database URL: @DATABASE_LOCATION@

Driver: @JDBC_DRIVER_NAME@

Driver classpath: @JDBC_DRIVER_JARFILE@

Store batch size: 100

Store commit interval: 0.0

Auto commit: false

Advanced Properties

Transaction isolation level: Default

Alternate discovery query:

Log inbound events: false

Log outbound events: false

Flow control low water: 6000

Flow control high water: 15000

Query template config file: @PROJECT_DIR@/@ADAPTER_CONFIG_DIR@/ADBC-queryTemplates-SQL.xml

Variables

Name	Value
JDBC_DRIVER_JARFILE	
ADAPTER_INSTANCE_ID	INSTANCE_1
ADAPTERS_JARDIR	${apama_home}/adapters/lib
DATABASE_LOCATION	
JDBC_DRIVER_NAME	
PROJECT_DIR	${PROJECT_DIR}
ADAPTER_CONFIG_DIR	${Adapter for JDBC.configDir}
MAPPING_INSTANCE_FILE	ADBC-mapping_instance_1.xml
CORRELATOR_HOST	${Default Correlator.hostname}
CORRELATOR_PORT	${Default Correlator.port}

The editor's graphical display presents configuration information in three separate sections:

- General Properties
- Advanced Properties
- Variables

For an instance of the ADBC-Sim adapter, the display only shows the Variables section.

For more information on specifying ADBC properties and variables, see "Configuring an ADBC adapter" in *Connecting Apama Applications to External Components*.

Launching the project

To create queries most efficiently, the project needs to be running so that you can see what data sources, databases, and existing queries are available. If you need to create a new run configuration the steps are as follows:

1. Select the project for which to create the run configuration.
2. In the Apama Studio menu bar, select Run > Run Configuration.
3. In the **Run Configuration** wizard, select Apama Application and click the New launch configuration button (📄).
4. On the Apama Project tab, specify the following:
   - Specify the Name of the run configuration.

- Select or accept the Project.
- Select the Enable DataPlayer check box. If this box is not checked, the Query Editor and Data Player control are disabled.
- Select Generate time events from data if you want the correlator to use external time events (starting the correlator with the `-Xclock` option). The Generate time events from data check box is available only if you checked the Enable DataPlayer check box. For details about the format of correlator `&TIME` events, see *Generating events that keep time* in *Developing Apama Applications*.

  When Generate time events from data is checked, the time field specified in the Data Player playback query must be a float value that represents a number of seconds since the epoch. The data player transforms these values into &TIME events.

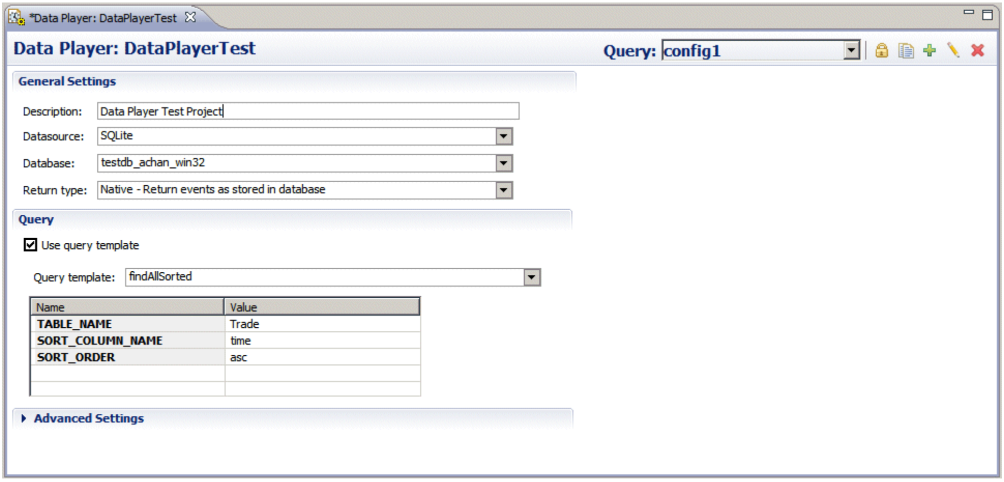
  When Generate time events from data is disabled (unchecked), the Data Player's Speed and Play to controls are disabled.

5. Click Run to save and launch the project. Or click Apply to save the configuration without running the project.

Specifying Data Player playback queries

You create and modify Data Player queries with the Data Player Query Editor. The information for the Data Player queries is stored in the project's `dataplayer_queries.xml` file. To create or modify a Data Player query:

1. In the **Project Explorer** view, expand the project and then expand the `config` folder. Double click on the `dataplayer_queries.xml` file. Apama Studio opens the Data Player Query Editor. If the project is running, you will be able to make selections from the Datasource, Database, and Query drop-down lists. If the project is not running, most of the controls are disabled.



Data Player: DataPlayerTest

Query: config1

General Settings

Description: Data Player Test Project

Datasource: SQLite

Database: testdb_achan_win32

Return type: Native - Return events as stored in database

Query

☑ Use query template

Query template: findAllSorted

Name	Value
TABLE_NAME	Trade
SORT_COLUMN_NAME	time
SORT_ORDER	asc

If the project is not running the Data Player Query Editor will report that it is offline; in this mode, you cannot select Data Sources or Databases and all the controls are disabled.

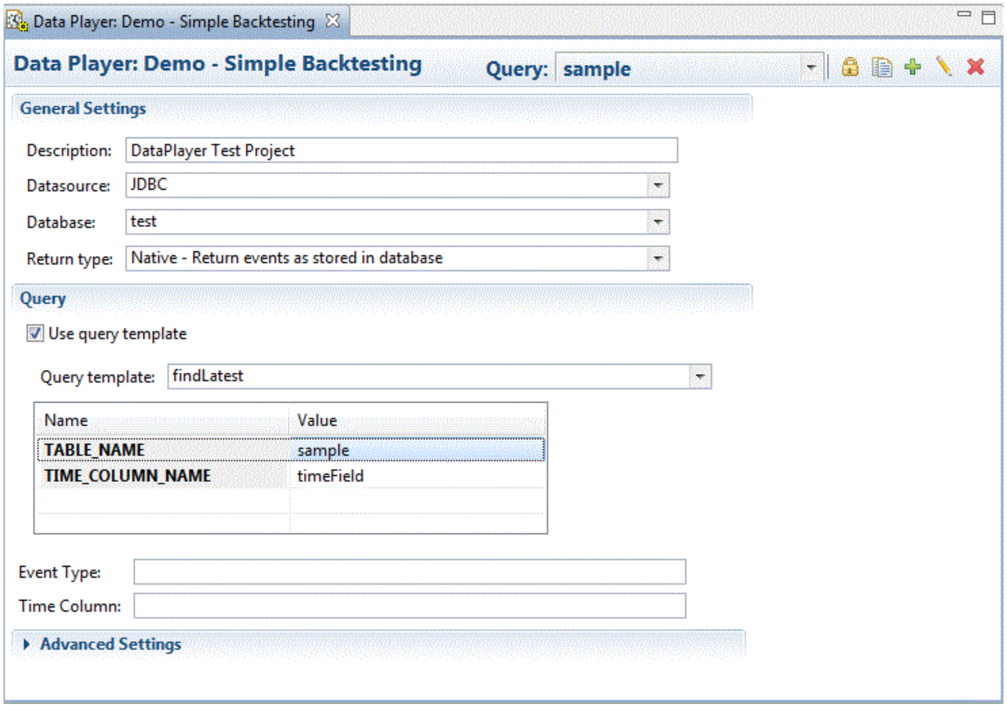
If you are creating a new Data Player query, you can also right-click on the name of the project and select New > Data Player Query from the pop-up menu. Use this method if you are working on an imported project that does not yet contain a `dataplayer_queries.xml` file.

2. Click the Add Query button(✚). The **New Query** dialog is displayed.
3. Provide a name for the new Data Player query and click OK.
4. In the General Settings section, specify the following properties for the Data Player query:
   - Description — Provide a description of the Data Player query.
   - Data Source — Select an available Data Source from the drop down list.
   - Database — Select an available Database from the drop down list.
   - Return Type — The choices are `Native` or `Wrapped`. When `Native` is selected, each matching event will be sent as-is to the correlator. When `Wrapped` is selected, each matching event will be "wrapped" in a container event. The container event will be named using the event name. For example a `Tick` event would be wrapped in a `WrappedTick` event. Event wrapping allows events to be sent to the correlator without triggering application listeners. A separate user monitor can listen for wrapped events, modify the contained event, and reroute it such that application listeners can match on it.
5. In the Query section, the Use Query Template check box specifies whether you want to use a Data Player Query Template (checked) or a Raw Query (unchecked).

   If you are using a Query Template:

   a. Select a Data Player Query Template from the drop-down list. The choices are the canned Data Player queries supplied with the Apama installation: findAll, findEarliest, findLatest, and getCount. You can add your own Data Player Query Templates; see "Creating Data Player query templates" on page 168.

   b. If the Data Player Query Template uses replaceable parameters, they will be displayed in the Name and Value table in the Query section of the editor.



Data Player: Demo - Simple Backtesting   Query: sample

General Settings

Description: DataPlayer Test Project

Datasource: JDBC

Database: test

Return type: Native - Return events as stored in database

Query

☑ Use query template

Query template: findLatest

Name	Value
TABLE_NAME	sample
TIME_COLUMN_NAME	timeField

Event Type:

Time Column:

6. Double click a cell in the Value column and type the entry to use for the Data Player query, for example the name of a database table or column.

If you are using a Raw Query, in the Query String text area specify the statement to execute as follows:

- For ODBC and JDBC data sources, use SQL syntax.
- For an Apama Sim data source, use the following keywords (keywords are case insensitive):

  `TIME` with =, <, >, >=, and <= comparators and the time. Use one or two `TIME` statements. If two `TIME` statements are used, only data that matches both statements will be returned.

  `INCLUDE` plus the event type to retrieve.

  `EXCLUDE` plus the event type to not retrieve.

Examples of this syntax are:

```
TIME=12345
TIME=12345;INCLUDE=(com.apama.something)
TIME=12345;INCLUDE=(com.apama.something);EXCLUDE=(com.apama.something.abc)
TIME>12345;TIME<20000
```

7. In the Event Type field, specify unmapped-sql when the database table contains an `eventString` column that contains stringified Apama events. However, if the database table contains individual columns that are mapped to event fields in the ADBC adapter, then specify the name of the specific event in the Event Type field.

   The value that you specify in the Event Type field becomes the value for `_ADBCType` in the ADBC adapter.

8. In the Time Column field, specify the time column in your table. For example, if your table contains a `TransactionTime` column then you could specify TransactionTime in the Time Column field. Ensure that the value in the time column is a float value that represents a number of seconds since the epoch.

9. In the Advanced Settings section specify any Extra Parameters.

   a. Right click in the Name column and select Add from the pop up menu (or double click in the Name column).

   b. Specify the Name of the Extra Parameter.

   c. In the Value column, specify the value of the extra parameter.

10. Save the Data Player query.

    When you save the Data Player query, the Data Player query name is added to the **Data Player Control** view's drop down query list.

    The Query Editor tool bar contains the following buttons:

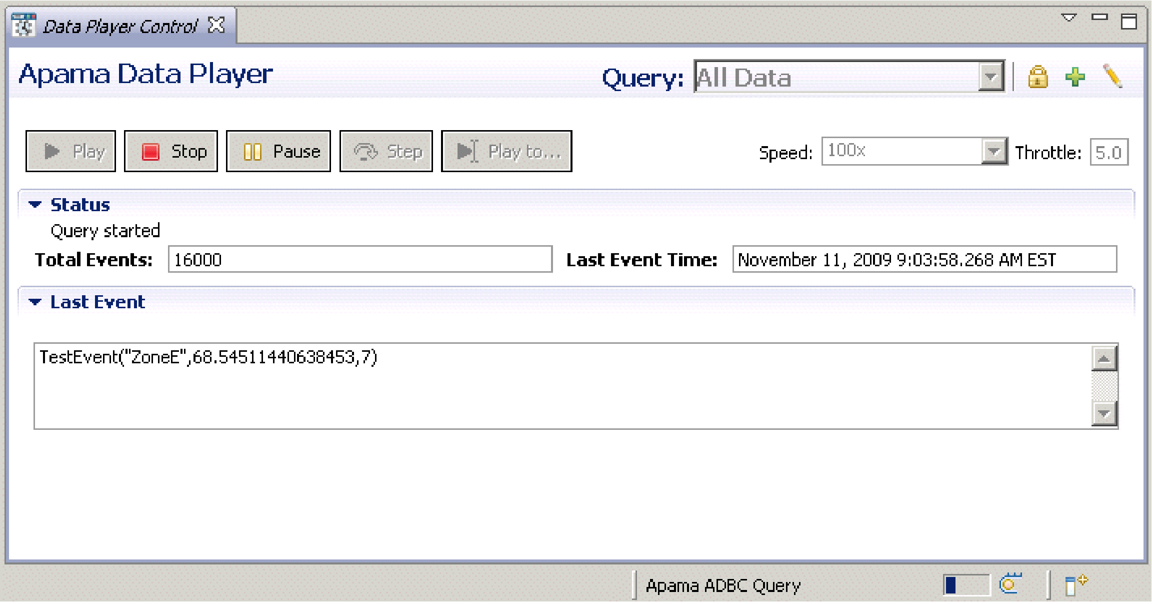
    - Configure Credentials — This displays the **Credential for selected data source** dialog where you add a user name and password for the current Data Player query if they are required for accessing the data source and select the scope of the credentials from a drop-down list. You can specify if the credentials apply globally, to a specific data source, or to a specific Data Player query. Credentials entered here are shared by the Data Player Query Editor and the Data Player.

    - Clone Query — Select this if you want to make a copy of the current Data Player query. The **Clone Query** dialog prompts you for the name of the copy. You can then edit the specifications for the Data Player query.

- Add Query — Select this if you want to add a new Data Player query. The **New Query** dialog prompts you for the name of the new Data Player query.
- Rename Query — Select this if you want to rename the Data Player query. The **Rename Query** dialog prompts for the new name of the Data Player query.
- Delete Query — Select this if you want to delete the Data Player query. The **Delete Query** dialog prompts you to confirm that this is what you want to do.

Data Player Control view

The **Data Player Control** view is enabled when the project is launched if Enable DataPlayer has been checked in the project's Run Configuration. The tab for this view is located in the lower right of the **Apama Developer** perspective next to the Console and Tasks views. If the **Data Player Control** view is not shown, select Window > Show View > Data Player Control from the Apama Studio menu.



Query: All Data

Speed: 100x Throttle: 5.0

Query started

Total Events: 16000

Last Event Time: November 11, 2009 9:03:58.268 AM EST

TestEvent("ZoneE",68.54511440638453,7)

Using the Data Player

Playback settings

The individual controls available on title bar of the **Data Player Control** view are:

- Query — The available queries are listed in the Query drop-down list on the title bar.
- Preferences — The **Preferences** dialog is displayed by clicking the view Menu down arrow at the right-hand side of the control's title bar. From the **Preferences** dialog you can select default Time Zone to use and the Date/Time Format to use during playback.
- Speed — Specify playback speed from the drop-down list; 10x is generally a good balance between speed and understandability.

- Throttle — This specifies the Data Player throttling period. The Data Player coalesces scenario update events sent to dashboards and other clients over a throttling period in order to enhance playback performance. The default setting is 5.0 seconds. You can change this setting to match your application. If data overwhelms the correlator or clients, increase the setting. If data arrives too slowly for clients to operate optimally, reduce the setting. Setting the value to 0.0 turns it off.

Data Player Control view

Playback controls

The Data Player playback controls are:

- Play — Start the playback.
- Stop — Stop the playback.
- Pause — Pause the playback.
- Step — Plays back a single event at a time.
- Play to — Displays the **Choose Date Time** dialog so you can select a specified date and time at which the playback will pause.

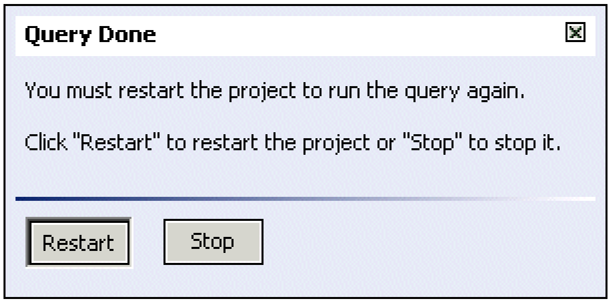
Data Player Control view

Playback status

The Data Player displays the following status information:

- Total Events — Shows the total events that have been played back during the current playback operation.
- Last Event Time — Shows the recorded time of the last event played back.
- Last Event — Shows the contents of the last event played back.

When a playback session has run to completion or if you click the Stop button and Generate time events from data has been enabled, the Data Player control displays the **Query Done** dialog. You can move the dialog box around if it covers up status information needed in order to decide whether to restart or stop the project.



Query Done

You must restart the project to run the query again.

Click "Restart" to restart the project or "Stop" to stop it.

- Restart — Click Restart if you want to run another playback session. In the **Terminate launch** dialog click No. You can then display the Data Player control again and start another playback session.
- Stop — Click Stop if you want to terminate all processes associated with the playback session.

Data Player Control view

Creating Data Player query templates

If you want to create a new Data Player query template, you need to specify them in the project's query template file. The Data Player query template file is found in the project's `bundle_instance_files` folder and is named `ADBC-queryTemplates-SQL.xml` if you are using an ODBC or JDBC data source or `ADBC-queryTemplates-Sim.xml` if you are using a Sim data source. To add a Data Player query template:

1. In the **Project Explorer** view, expand the project's `bundle_instance_files` folder and then expand either the `ADBC_for_ODBC`, `ADBC_for_JDBC`, or `ADBC_for_Sim` folder as appropriate.
2. Double click the query templates file, either `ADBC-queryTemplates-SQL.xml` or or `ADBC-queryTemplates-Sim.xml`. The file opens in the Apama Studio text editor. The following is the standard `findLatest` Data Player query template for ODBC and JDBC data sources.

```
<query
  name="findLatest"
  description="Get the row with the latest time."
  implementationFunction="substitution"
  inputString="select * from ${TABLE_NAME} order by
         ${TIME_COLUMN_NAME} desc limit 1">
    <parameter
      description="Name of a table to query"
      name="TABLE_NAME"
      type="String"
      default=""/>
    <parameter
      description="Name of the time column"
      name="TIME_COLUMN_NAME"
      type="String"
      default="timeField"/>
</query>
```

3. The Data Player query templates are defined in the `<query>` element. The available attributes you can specify are:
   - `name` — A short name that will be displayed in the Query Template drop-down list.
   - `description` — A short description of the Data Player query.
   - `implementationFunction` — Currently Data Player query templates support the `substitution` function. This allows a token to be used as a place holder in a SQL query.
   - `inputString` — For ODBC and JDBC data sources, use standard SQL syntax, from the example above:

```
inputString="select * from ${TABLE_NAME} order by
     ${TIME_COLUMN_NAME} desc limit 1">
```

In the above example, `$(TABLE_NAME)` and `$(TIME_COLUMN_NAME)` are parameters that will be replaced with a database table and column name when you create a Data Player query from the template (see `parameter`, below).

For Sim data sources use the `TIME` keyword plus the comparators `=`, `&gt;&lt;&gt;=`, `&lt;=` plus the time. You can use one or two `TIME` expressions. Note, because you are adding the expression to an xml file, you need to use `&gt;` and `&lt;` instead of the characters > and <. Do not use spaces before or after `&gt;` and `&lt;`.

The `inputString` expression can also use the `INCLUDE`, and `EXCLUDE` keywords, for example:

```
TIME=12345;INCLUDE=(com.apama.something);EXCLUDE=(com.apama.something.abc)
TIME&gt;12345;TIME&lt;20000
```

- `parameter` — For ODBC and JDBC data sources you can specify parameters and default values for the Data Player query template. This allows you to create different Data Player queries from the same template that, for example, query different tables or different columns in the database. From the above example:

```
<parameter
  description="Name of a table to query"
  name="TABLE_NAME"
  type="String"
  default=""/>
<parameter
  description="Name of the time column"
  name="TIME_COLUMN_NAME"
  type="String"
  default="timeField"/>
```

When you create a Data Player query from a template that has the parameters shown above in the Data Player Query Editor, you will specify the names of the database table and column to use with the Data Player query.

4. Save the Data Player query template file when you finish modifying it.

Using the Data Player

Command-line Data Player interface

When you are ready to test your application, you can use the Data Player command-line interface to write scripts and unit tests to exercise the API layers. In some cases it might be easier to play back events to the correlator using the command-line interface as compared to using the Data Player GUI in Apama Studio.

To use the command-line interface to the Data Player, you must have already used the GUI interface in Apama Studio to define Data Player queries and Data Player query configurations in Apama Studio. When you use the command-line interface, you specify the Data Player query names and Data Player query configurations that you created in Apama Studio.

For more information on using the Data Player command line interface, see "Using the Data Player command line interface" in *Deploying and Managing Apama Applications*.

Using the Data Player