jMeter - Quick Guide

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jMeter - Overview

Before going into the details of JMeter, let us first understand a few jargons associated with the testing of any application.

- **Performance Test** − This test sets the best possible performance expectation under a given configuration of infrastructure. It also highlights early in the testing process if any changes need to be made before the application goes into production.
- **Load Test** − This test is basically used for testing the system under the top load it was designed to operate under.
- **Stress Test** − This test is an attempt to break the system by overwhelming its resources.

What is JMeter?

JMeter is a software that can perform load test, performance-oriented business (functional) test, regression test, etc., on different protocols or technologies.

Stefano Mazzocchi of the Apache Software Foundation was the original developer of JMeter. He wrote it primarily to test the performance of Apache JServ (now called as Apache Tomcat project). Apache later redesigned JMeter to enhance the GUI and to add functional testing capabilities.

JMeter is a Java desktop application with a graphical interface that uses the Swing graphical API. It can therefore run on any environment / workstation that accepts a Java virtual machine, for example − Windows, Linux, Mac, etc.

The protocols supported by JMeter are −

- Web − HTTP, HTTPS sites 'web 1.0' web 2.0 (ajax, flex and flex-ws-amf)
- Web Services − SOAP / XML-RPC
- Database via JDBC drivers
- Directory − LDAP
- Messaging Oriented service via JMS
- Service − POP3, IMAP, SMTP
- FTP Service

JMeter Features

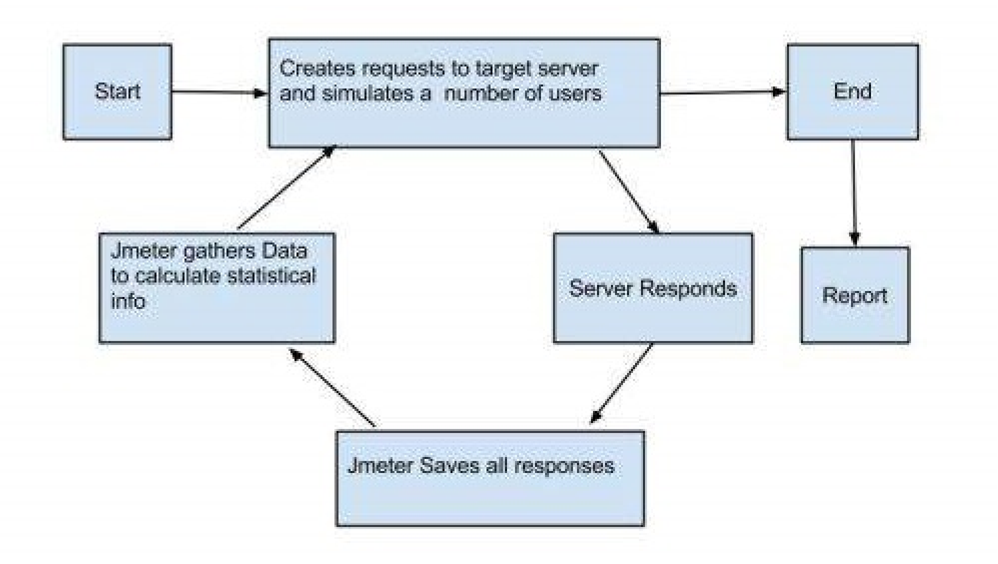
Following are some of the features of JMeter −

- Being an open source software, it is freely available.
- It has a simple and intuitive GUI.
- JMeter can conduct load and performance test for many different server types − Web - HTTP, HTTPS, SOAP, Database via JDBC, LDAP, JMS, Mail - POP3, etc.
- It is a platform-independent tool. On Linux/Unix, JMeter can be invoked by clicking on JMeter shell script. On Windows, it can be invoked by starting the jmeter.bat file.
- It has full Swing and lightweight component support (precompiled JAR uses packages javax.swing.*).
- JMeter store its test plans in XML format. This means you can generate a test plan using a text editor.
- Its full multi-threading framework allows concurrent sampling by many threads and simultaneous sampling of different functions by separate thread groups.
- It is highly extensible.
- It can also be used to perform automated and functional testing of the applications.

How JMeter Works?

JMeter simulates a group of users sending requests to a target server, and returns statistics that show the performance/functionality of the target server/application via tables, graphs, etc.

Take a look at the following figure that depicts how JMeter works −


Start
Creates requests to target server and simulates a number of users
End
Jmeter gathers Data to calculate statistical info
Server Responds
Report
Jmeter Saves all responses

jMeter - Environment

JMeter is a framework for Java, so the very first requirement is to have JDK installed in your machine.

System Requirement

JDK	1.6 or above.
Memory	No minimum requirement.
Disk Space	No minimum requirement.
Operating System	No minimum requirement.

Step 1: Verify Java Installation

First of all, verify whether you have Java installed in your system. Open your console and execute one of the following **java** commands based on the operating system you are working on.

OS	Task	Command
Windows	Open Command Console	c:\> java -version
Linux	Open Command Terminal	$ java -version
Mac	Open Terminal	machine: ~ joseph$ java -version

If you have Java installed in your system, you would get an appropriate output based on the OS you are working on.

OS	Output
Windows	java version "1.7.0_25" Java(TM) SE Runtime Environment (build 1.7.0_25-b15) Java HotSpot(TM) 64-Bit Server VM (build 23.25-b01, mixed mode)
Linux	java version "1.7.0_25" Java(TM) SE Runtime Environment (build 1.7.0_25-b15) Java HotSpot(TM) 64-Bit Server VM (build 23.25-b01, mixed mode)
Mac	java version "1.7.0_25" Java(TM) SE Runtime Environment (build 1.7.0_25-b15) Java HotSpot(TM) 64-Bit Server VM (build 23.25-b01, mixed mode)

If you do not have Java installed, install the Java Software Development Kit (SDK) from https://www.oracle.com/technetwork/java/javase/downloads/index.html . We are assuming Java 1.7.0_25 as the installed version for this tutorial.

Step 2: Set Java Environment

Set the **JAVA_HOME** environment variable to point to the base directory location, where Java is installed on your machine. For example −

OS	Output
Windows	Set the environment variable JAVA_HOME to C:\Program Files\Java\jdk1.7.0_25
Linux	export JAVA_HOME=/usr/local/java-current
Mac	export JAVA_HOME=/Library/Java/Home

Append Java compiler location to System Path.

OS	Output
Windows	Append the string; C:\Program Files\Java\jdk1.7.0_25\bin to the end of the system variable, Path.
Linux	export PATH=$PATH:$JAVA_HOME/bin/
Mac	not required

Verify Java Installation using **java -version** command as explained above.

Step 3: Download JMeter

Download the latest version of JMeter from https://jmeter.apache.org/download_jmeter.cgi . For this tutorial, we downloaded *apache-jmeter-2.9* and copied it into C:\>JMeter folder.

The directory structure should look like as shown below −

apache-jmeter-2.9

apache-jmeter-2.9\bin

apache-jmeter-2.9\docs

apache-jmeter-2.9\extras

apache-jmeter-2.9\lib\

apache-jmeter-2.9\lib\ext

apache-jmeter-2.9\lib\junit

apache-jmeter-2.9\printable_docs

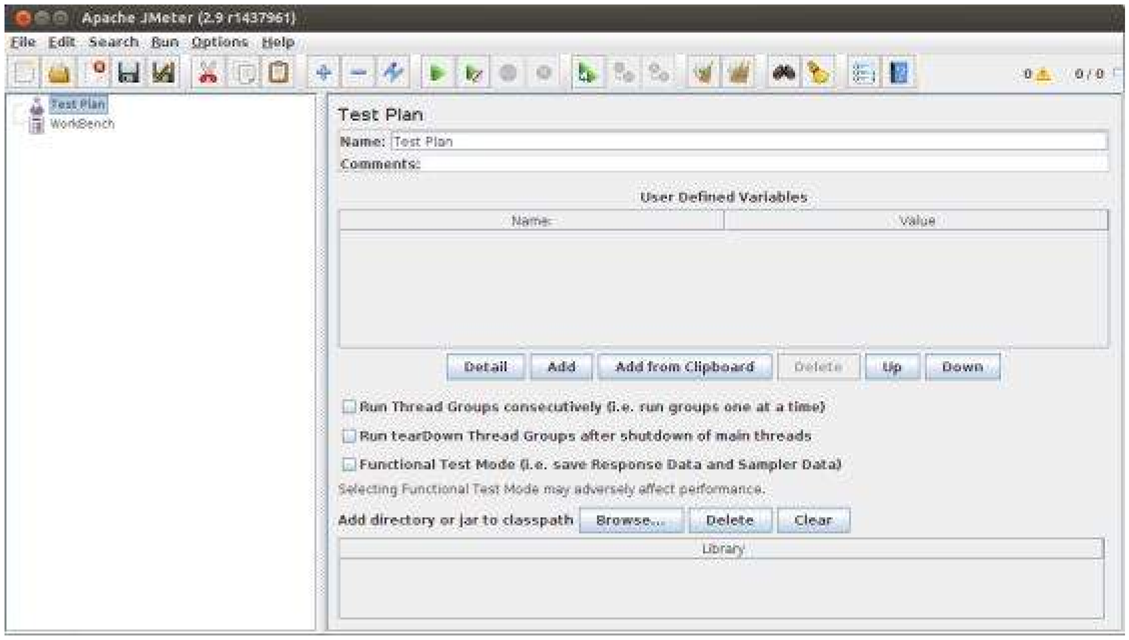
You can rename the parent directory (i.e. apache-jmeter-2.9) if you want, but do not change any of the sub-directory names.

Step 4: Run JMeter

After downloading JMeter, go to the *bin* directory. In this case, it is **/home/manisha/apache-jmeter-2.9/bin**. Now click on the following −

OS	Output
Windows	jmeter.bat
Linux	jmeter.sh
Mac	jmeter.sh

After a short pause, the JMeter GUI should appear, which is a Swing application, as seen in the following screenshot −


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Test Plan
WorkBench
Test Plan
Name: Test Plan
Comments:
User Defined Variables
Name:
Value
Detail
Add
Add from Clipboard
Delete
Up
Down
Run Thread Groups consecutively (i.e. run groups one at a time)
Run tearDown Thread Groups after shutdown of main threads
Functional Test Mode (i.e. save Response Data and Sampler Data)
Selecting Functional Test Mode may adversely affect performance.
Add directory or jar to classpath
Browse...
Delete
Clear
Library

This is the main page and the default page of the tool.

jMeter - Build Test Plan

What is a Test Plan?

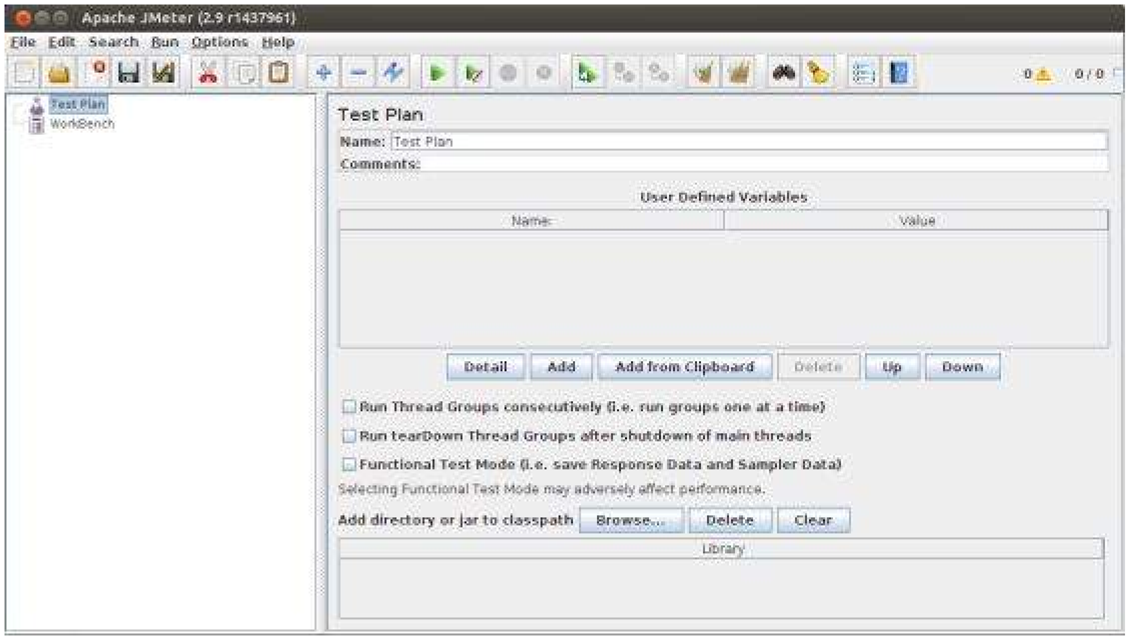
A Test Plan can be viewed as a container for running tests. It defines what to test and how to go about it. A complete test plan consists of one or more elements such as thread groups, logic controllers, sample-generating controllers, listeners, timers, assertions, and configuration elements. A test plan must have at least one thread group.

Writing a Test Plan

Follow the steps given below to write a test plan –

Step 1: Start the JMeter Window

Open the JMeter window by clicking **/home/manisha/apache-jmeter-2.9/bin/jmeter.sh**. The JMeter window will appear as below –


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Test Plan
WorkBench
Test Plan
Name: Test Plan
Comments:
User Defined Variables
Name:
Value
Detail
Add
Add from Clipboard
Delete
Up
Down
Run Thread Groups consecutively (i.e. run groups one at a time)
Run tearDown Thread Groups after shutdown of main threads
Functional Test Mode (i.e. save Response Data and Sampler Data)
Selecting Functional Test Mode may adversely affect performance.
Add directory or jar to classpath
Browse...
Delete
Clear
Library

This is a plain and blank JMeter window without any additional elements added to it. It contains two nodes –

Test Plan node – is where the real test plan is kept.

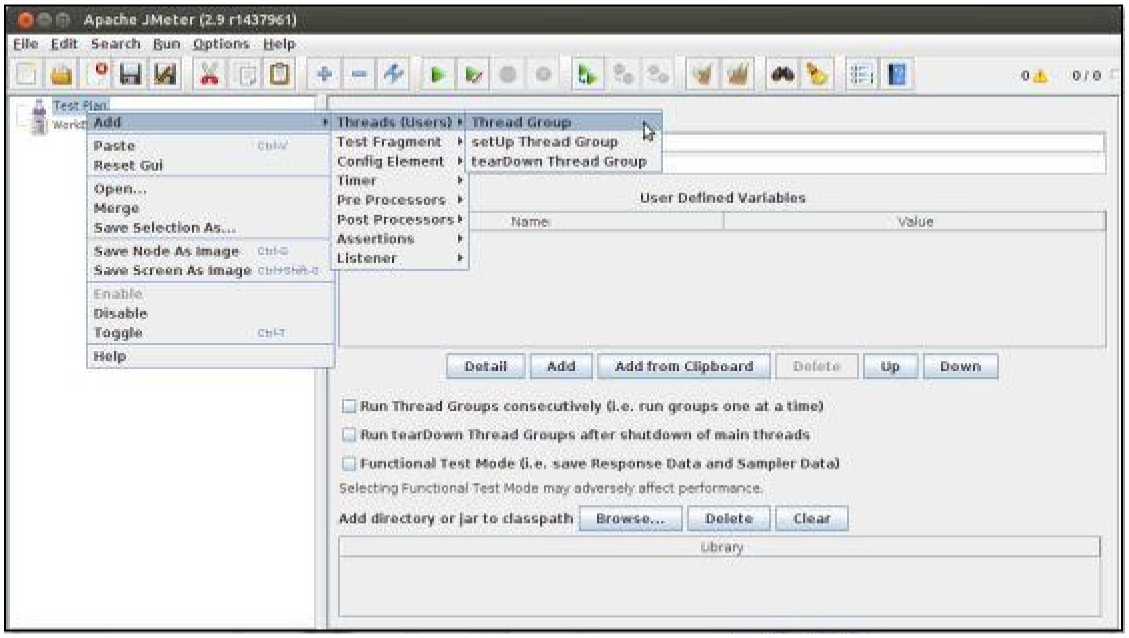
Workbench node – It simply provides a place to temporarily store test elements while not in use, for copy/paste purposes. When you save your test plan, Workbench items are not saved with it.

Step 2: Add/Remove Elements

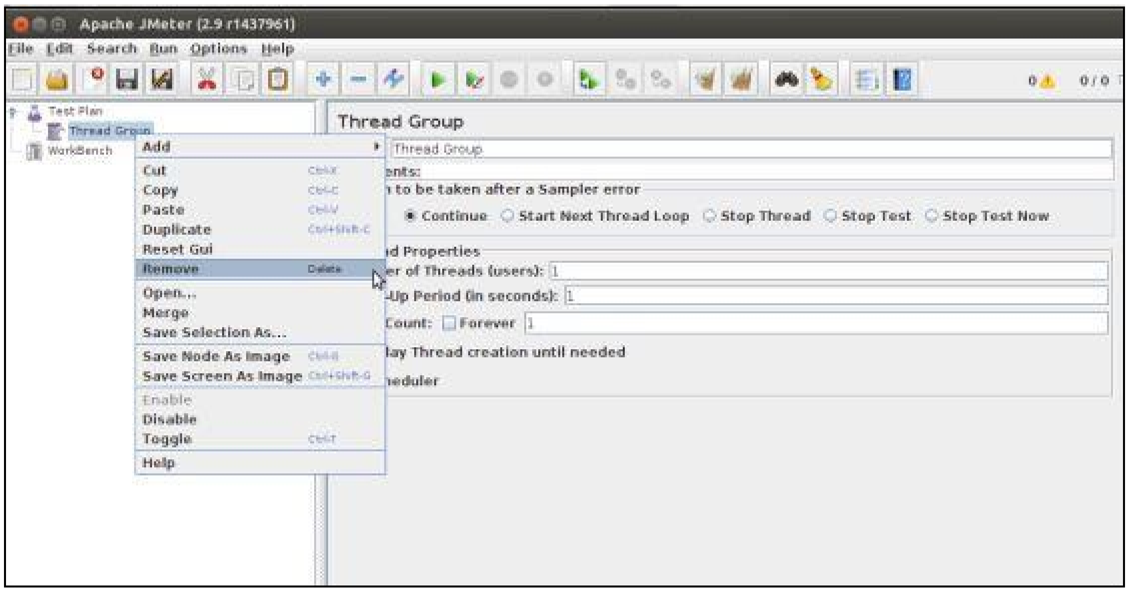
Elements (which will be discussed in the next chapter Test Plan Elements) can be added to a test plan by right-clicking on the Test Plan node and choosing a new element from the "add" list.

Alternatively, you can load an element from a file and add it by choosing the "merge" or "open" option.

For example, let us add a Thread Group element to a Test Plan as shown below –


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Test Plan
Add
Paste Ctrl-V
Reset Gui
Open...
Merge
Save Selection As...
Save Node As Image Ctrl-G
Save Screen As Image Ctrl+Shift-G
Enable
Disable
Toggle Ctrl-T
Help
Threads (Users)
Test Fragment
Config Element
Timer
Pre Processors
Post Processors
Assertions
Listener
Thread Group
setUp Thread Group
tearDown Thread Group
User Defined Variables
Name:
Value
Detail
Add
Add from Clipboard
Delete
Up
Down
Run Thread Groups consecutively (i.e. run groups one at a time)
Run tearDown Thread Groups after shutdown of main threads
Functional Test Mode (i.e. save Response Data and Sampler Data)
Selecting Functional Test Mode may adversely affect performance.
Add directory or jar to classpath
Browse...
Delete
Clear
Library

To remove an element, make sure the element is selected, right-click on the element, and choose the "remove" option.



Step 3: Load and Save the Elements

To load an element from file –

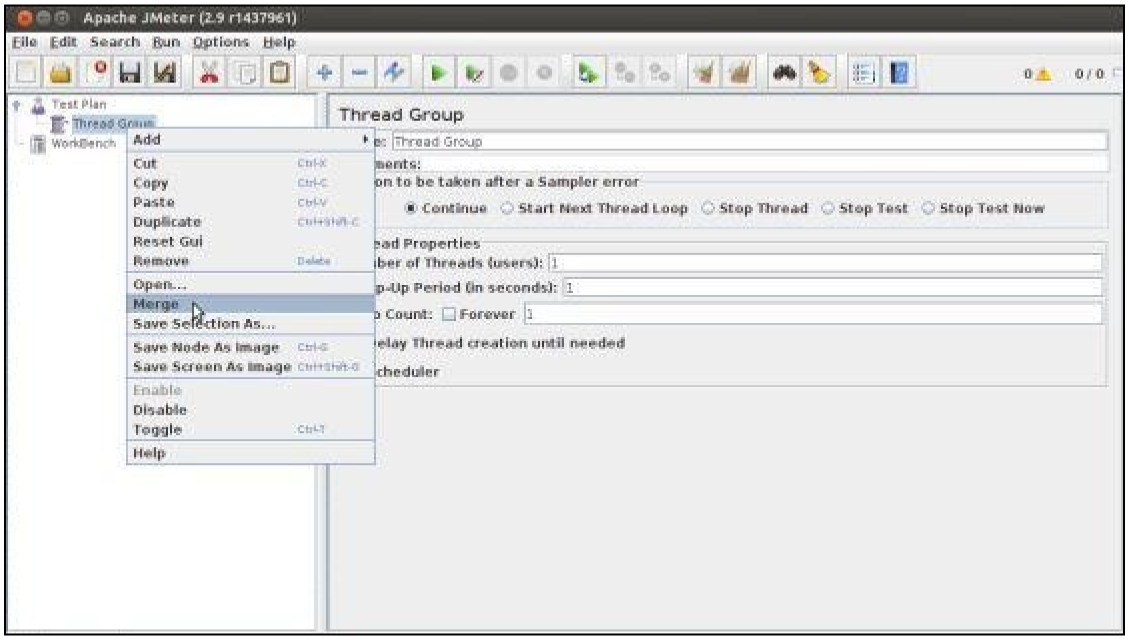
Right-click on the existing tree element to which you want to add the loaded element.

Select Merge.

Choose the file where you saved the elements.

JMeter will merge the elements into the tree.

By default, JMeter does not save the element, you need to explicitly save it.



To save tree elements –

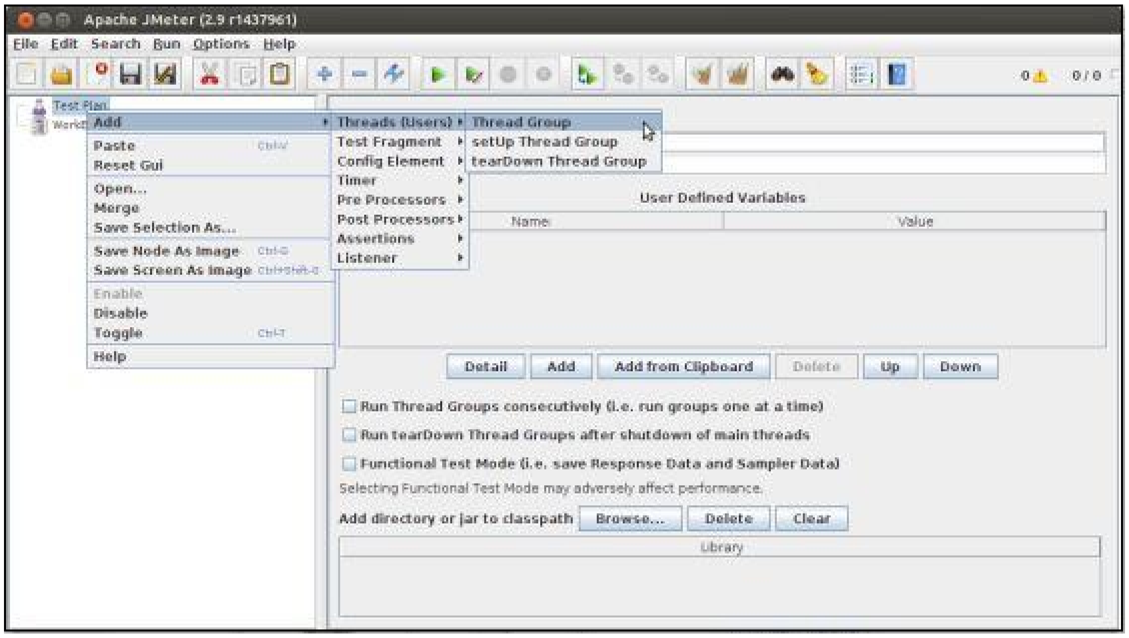
Right-click on the element.

Choose the *Save Selection As* ... option.

JMeter will save the element selected, plus all the child elements beneath it. By default, JMeter doesn't save the elements, you need to explicitly save it as mentioned earlier.

Step 4: Configuring the Tree Elements

Any element in the Test Plan can be configured using the controls present in JMeter's right-hand side frame. These controls allow you to configure the behavior of that particular test element. For example, the Thread Group can be configured for a number of users, ramp up periods, etc., as shown below –


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Test Plan
Add
Paste Ctrl-V
Reset Gui
Open...
Merge
Save Selection As...
Save Node As Image Ctrl-G
Save Screen As Image Ctrl+Shift-G
Enable
Disable
Toggle Ctrl-T
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Threads (Users)
Test Fragment
Config Element
Timer
Pre Processors
Post Processors
Assertions
Listener
Thread Group
setUp Thread Group
tearDown Thread Group
User Defined Variables
Name
Value
Detail
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Add from Clipboard
Delete
Up
Down
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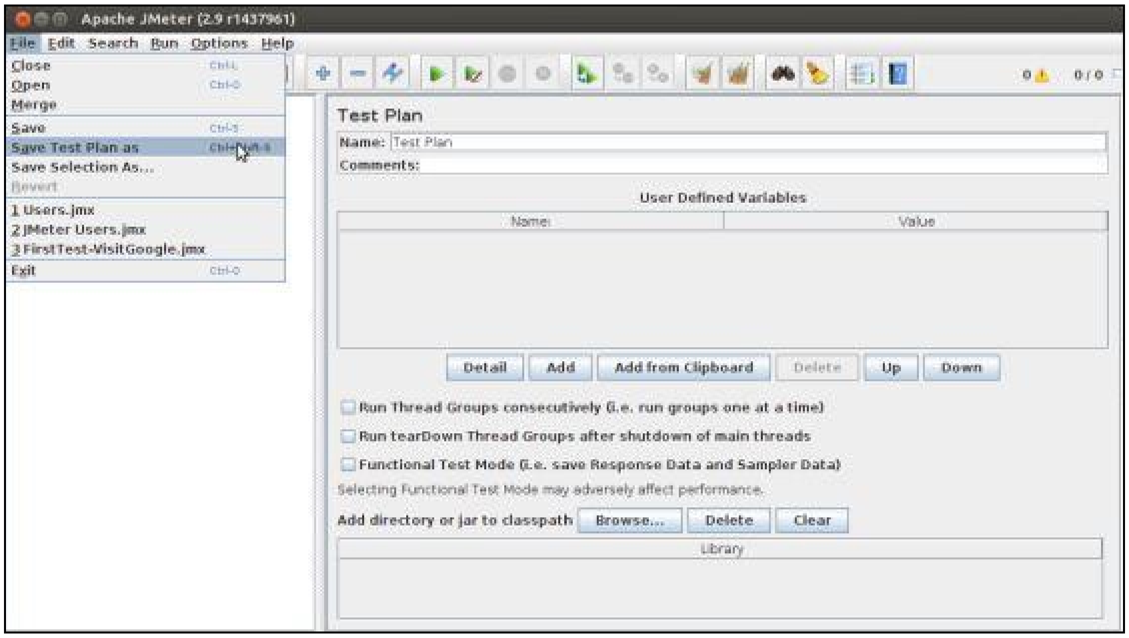
Run tearDown Thread Groups after shutdown of main threads
Functional Test Mode (i.e. save Response Data and Sampler Data)
Selecting Functional Test Mode may adversely affect performance.
Add directory or jar to classpath
Browse...
Delete
Clear
Library

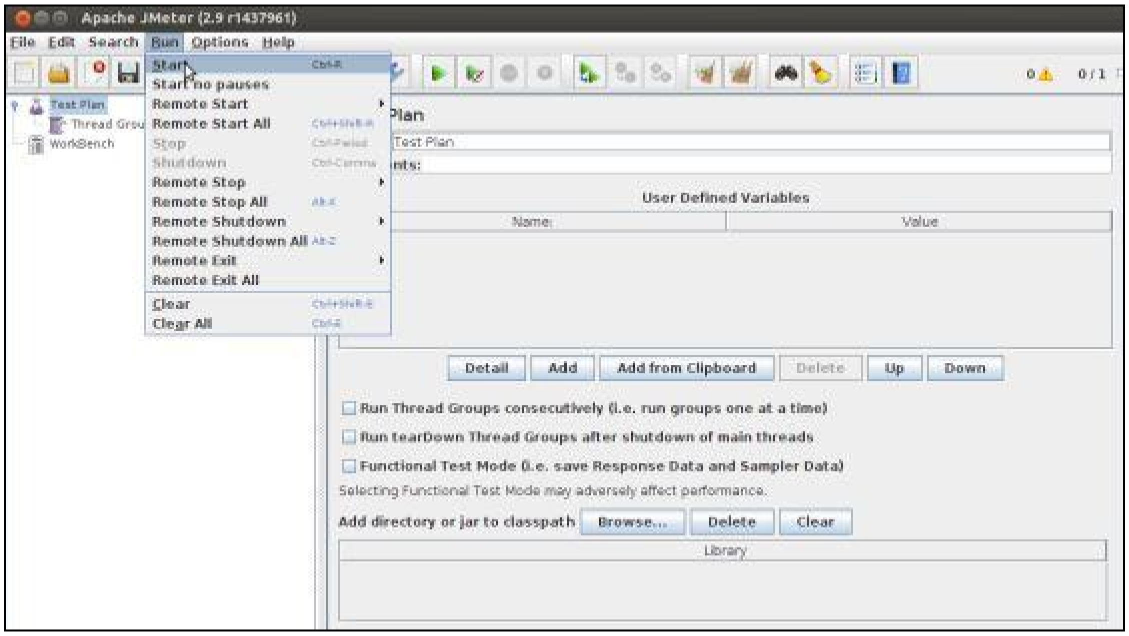
Step 5: Saving the Test Plan

You can save an entire Test Plan by using either **Save** or **"Save Test Plan As ..."** from the File menu.


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Close
Open
Merge
Save
Save Test Plan as
Save Selection As...
Revert
1 Users.jmx
2 JMeter Users.jmx
3 FirstTest-VisitGoogle.jmx
Exit
Test Plan
Name: Test Plan
Comments:
User Defined Variables
Name: Value
Detail Add Add from Clipboard Delete Up Down
Run Thread Groups consecutively (i.e. run groups one at a time)
Run tearDown Thread Groups after shutdown of main threads
Functional Test Mode (i.e. save Response Data and Sampler Data)
Selecting Functional Test Mode may adversely affect performance.
Add directory or jar to classpath Browse... Delete Clear
Library

Step 6: Run the Test Plan

You can run the Test Plan by clicking **Start**(Control + r) from the **Run** menu item. When JMeter starts running, it shows a small green box at the right-hand end of the section just under the menubar.


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Start
Start no pauses
Remote Start
Remote Start All
Stop
Shutdown
Remote Stop
Remote Stop All
Remote Shutdown
Remote Shutdown All
Remote Exit
Remote Exit All
Clear
Clear All
Test Plan
Thread Group
WorkBench
User Defined Variables
Name: Value
Detail Add Add from Clipboard Delete Up Down
Run Thread Groups consecutively (i.e. run groups one at a time)
Run tearDown Thread Groups after shutdown of main threads
Functional Test Mode (i.e. save Response Data and Sampler Data)
Selecting Functional Test Mode may adversely affect performance.
Add directory or jar to classpath Browse... Delete Clear
Library

The numbers to the left of the green box are the number of active threads / total number of threads. These only apply to a locally run test; they do not include any threads started on remote systems when using client-server mode.

Step 7: Stop the Test Plan

You can stop your test in two ways –

Using **Stop** (Control + '.'). It stops the threads immediately if possible.

Using **Shutdown** (Control + ','). It requests the threads to stop at the end of any current work.

jMeter - Test Plan Elements

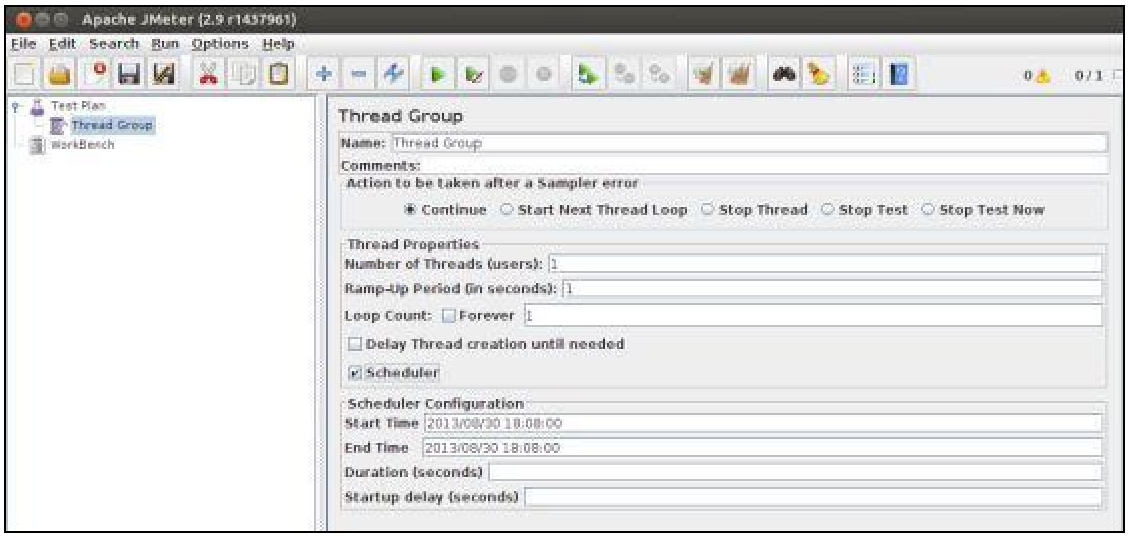
A JMeter Test Plan comprises of test elements discussed below. A Test Plan comprises of at least one Thread Group. Within each Thread Group, we may place a combination of one or more of other elements − Sampler, Logic Controller, Configuration Element, Listener, and Timer. Each Sampler can be preceded by one or more Pre-processor element, followed by Post-processor element, and/or Assertion element. Let us see each of these elements in detail −

Thread Group

Thread Group elements are the beginning points of your test plan. As the name suggests, the thread group elements control the number of threads JMeter will use during the test. We can also control the following via the Thread Group −

- Setting the number of threads
- Setting the ramp-up time
- Setting the number of test iterations

The Thread Group Control Panel looks like this −


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
0 0/1
Test Plan
Thread Group
WorkBench

Thread Group

Name: Thread Group

Comments:

Action to be taken after a Sampler error

[✓ Continue] Start Next Thread Loop Stop Thread Stop Test Stop Test Now

Thread Properties

Number of Threads (users): 1

Ramp-Up Period (in seconds): 1

Loop Count: Forever 1

Delay Thread creation until needed

[✓ Scheduler]

Scheduler Configuration

Start Time 2013/08/30 18:08:00

End Time 2013/08/30 18:08:00

Duration (seconds)

Startup delay (seconds)

The Thread Group Panel holds the following components −

Action to be taken after a Sampler error − In case any error occurs during test execution, you may let the test either −

- **Continue** to the next element in the test

Stop Thread to stop the current Thread.

Stop Test completely, in case you want to inspect the error before it continues running.

Number of Threads − Simulates the number of users or connections to your server application.

Ramp-Up Period Defines how long it will take JMeter to get all threads running.

Loop Count − Defines the number of times to execute the test.

Scheduler checkbox − Once selected, the Scheduler Configuration section appears at the bottom of the control panel.

Scheduler Configuration − You can configure the start and end time of running the test.

Controllers

JMeter has two types of Controllers − *Samplers* and *Logic Controllers*.

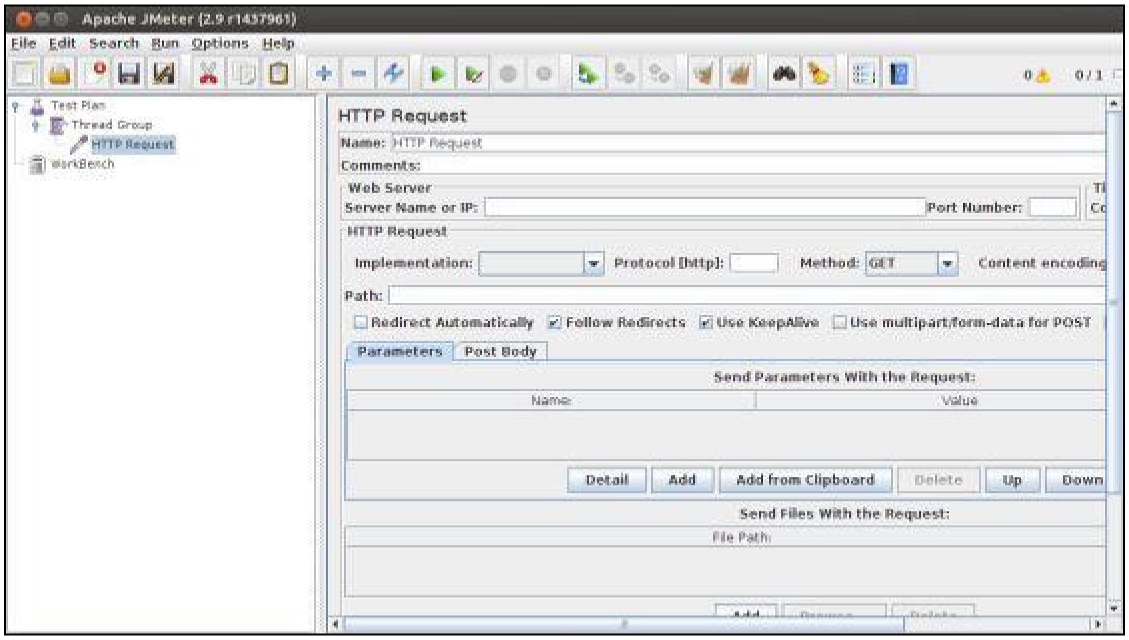
Samplers

Samplers allow JMeter to send specific types of requests to a server. They simulate a user request for a page from the target server. For example, you can add a HTTP Request sampler if you need to perform a POST, GET, or DELETE on a HTTP service.

Some useful samplers are −

- HTTP Request
- FTP Request
- JDBC Request
- Java Request
- SOAP/XML Request
- RPC Requests

The following screenshot shows an HTTP Request Sampler Control Panel −



HTTP Request
Name: HTTP Request
Comments:
Web Server
Server Name or IP:
Port Number:
HTTP Request
Implementation:
Protocol [http]:
Method: GET
Content encoding
Path:
☐ Redirect Automatically ☑ Follow Redirects ☑ Use KeepAlive ☐ Use multipart/form-data for POST
Send Parameters With the Request:

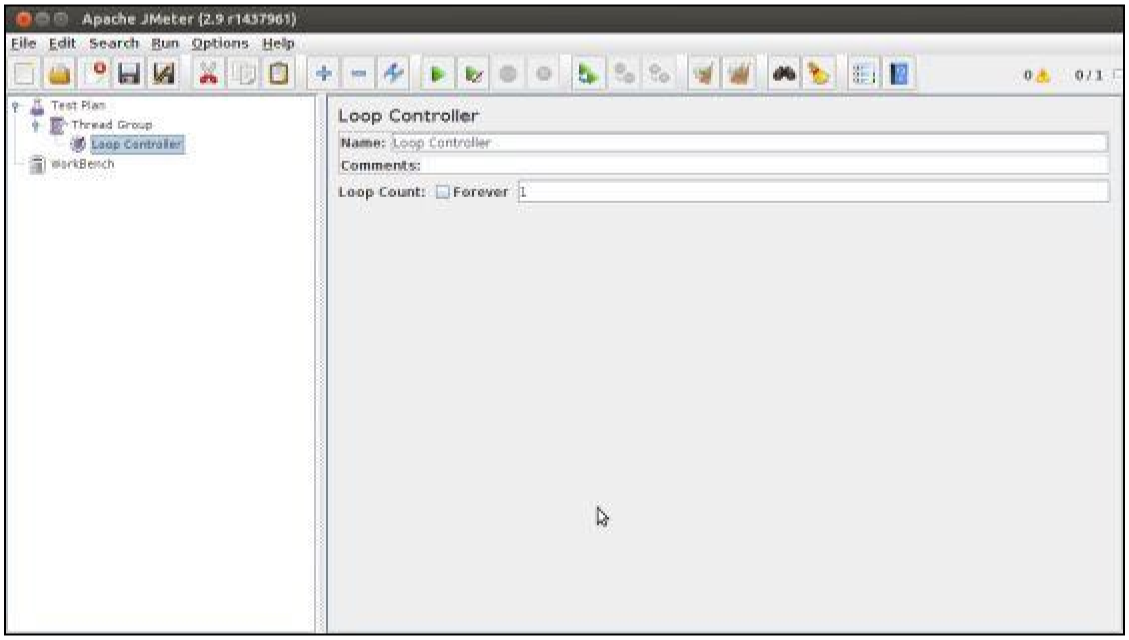
Name:	Value

Send Files With the Request:
File Path:

Logic Controllers

Logic Controllers let you control the order of processing of Samplers in a Thread. Logic controllers can change the order of a request coming from any of their child elements. Some examples are – ForEach Controller, While Controller, Loop Controller, IF Controller, Run Time Controller, Interleave Controller, Throughput Controller, and Run Once Controller.

The following screenshot shows a Loop Controller Control Panel –


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Test Plan
Thread Group
Loop Controller
WorkBench

Loop Controller
Name: Loop Controller
Comments:
Loop Count: ☐ Forever 1

The following list consists of all the Logic Controllers JMeter provides –

- Simple Controller
- Loop Controller
- Once Only Controller
- Interleave Controller

- Random Controller
- Random Order Controller
- Throughput Controller
- Runtime Controller
- If Controller
- While Controller
- Switch Controller
- ForEach Controller
- Module Controller
- Include Controller
- Transaction Controller
- Recording Controller

Test Fragments

A Test Fragment is a special type of element placed at the same level as the Thread Group element. It is distinguished from a Thread Group in that it is not executed unless it is referenced by either a Module Controller or an Include_Controller. This element is purely for code re-use within Test Plans.

Listeners

Listeners let you view the results of Samplers in the form of tables, graphs, trees, or simple text in some log files. They provide visual access to the data gathered by JMeter about the test cases as a Sampler component of JMeter is executed.

Listeners can be added anywhere in the test, including directly under the test plan. They will collect data only from elements at or below their level. The following list consists of all the Listeners JMeter provides −

- Sample Result Save Configuration
- Graph Full Results
- Graph Results
- Spline Visualizer
- Assertion Results
- View Results Tree
- Aggregate Report
- View Results in Table
- Simple Data Writer

- Monitor Results
- Distribution Graph (alpha)
- Aggregate Graph
- Mailer Visualizer
- BeanShell Listener
- Summary Report

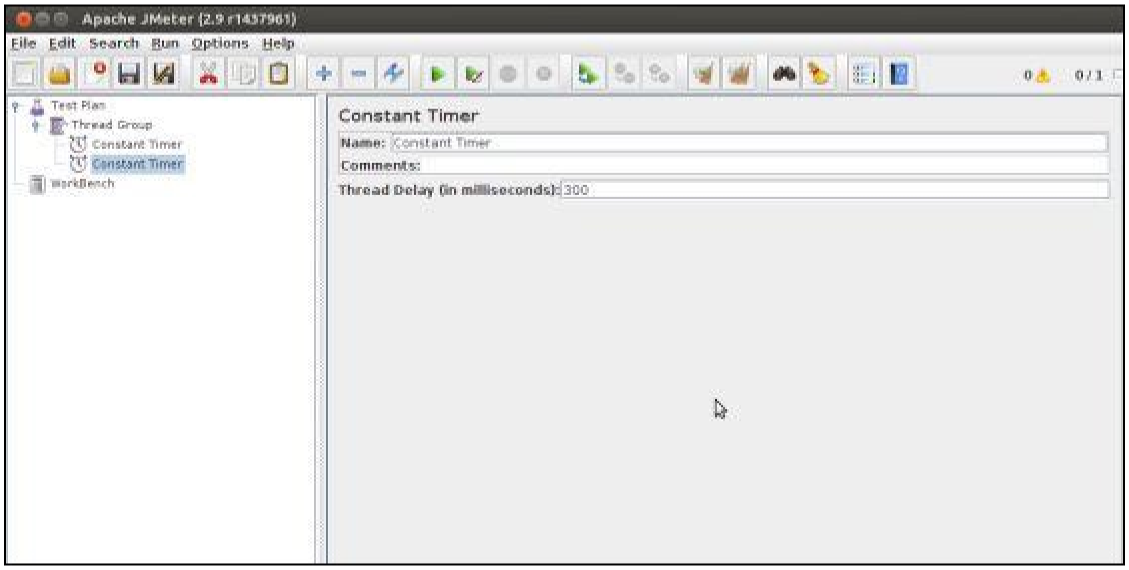
Timers

By default, a JMeter thread sends requests without pausing between each sampler. This may not be what you want. You can add a timer element which allows you to define a period to wait between each request.

The following list shows all the timers that JMeter provides –

- Constant Timer
- Gaussian Random Timer
- Uniform Random Timer
- Constant Throughput Timer
- Synchronizing Timer
- JSR223 Time
- BeanShell Time
- BSF Time
- Poisson Random Time

The following screenshot shows a Constant Timer Control Panel –


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Test Plan
Thread Group
Constant Timer
Constant Timer
WorkBench

Constant Timer

Name: Constant Timer

Comments:

Thread Delay (in milliseconds): 300

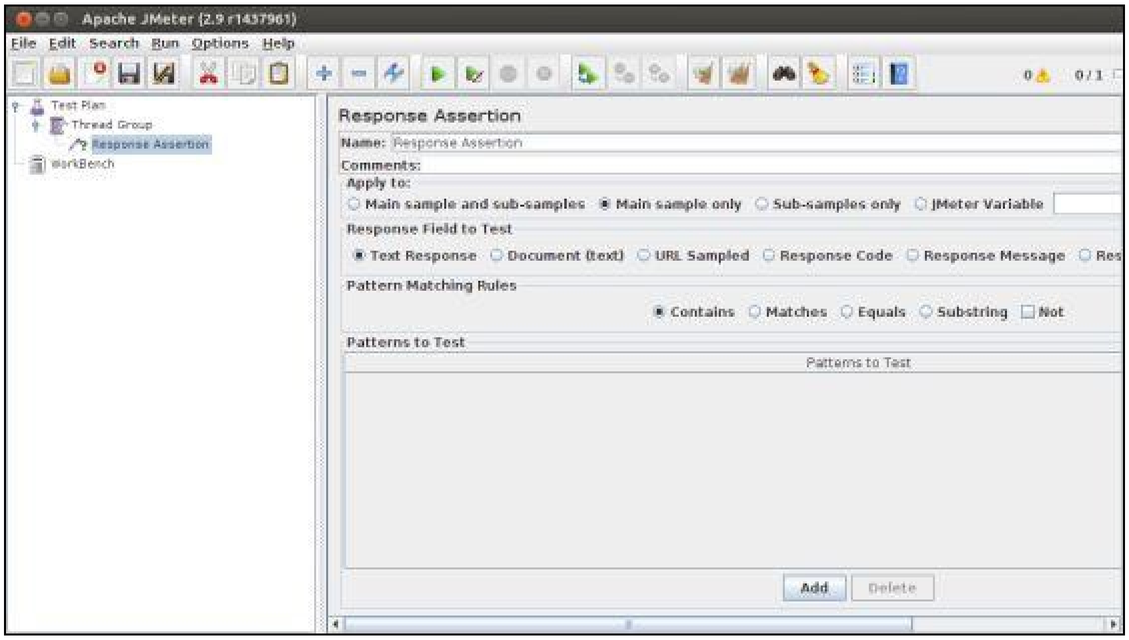
Assertions

Assertions allow you to include some validation test on the response of your request made using a Sampler. Using assertions you can prove that your application is returning the correct data. JMeter highlights when an assertion fails.

The following list consists of all the assertions JMeter provides –

- Beanshell Assertion
- BSF Assertion
- Compare Assertion
- JSR223 Assertion
- Response Assertion
- Duration Assertion
- Size Assertion
- XML Assertion
- BeanShell Assertion
- MD5Hex Assertion
- HTML Assertion
- XPath Assertion
- XML Schema Assertion

The following screenshot shows a Response Assertion Control Panel –


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Test Plan
Thread Group
Response Assertion
WorkBench
Add
Delete

Response Assertion
Name: Response Assertion
Comments:
Apply to:
○ Main sample and sub-samples ● Main sample only ○ Sub-samples only ○ JMeter Variable
Response Field to Test
● Text Response ○ Document (text) ○ URL Sampled ○ Response Code ○ Response Message ○ Res
Pattern Matching Rules
● Contains ○ Matches ○ Equals ○ Substring ☐ Not
Patterns to Test
Patterns to Test

Configuration Elements

Configuration Elements allow you to create defaults and variables to be used by Samplers. They are used to add or modify requests made by Samplers.

They are executed at the start of the scope of which they are part, before any Samplers that are located in the same scope. Therefore, a Configuration Element is accessed only from inside the branch where it is placed.

The following list consists of all the Configuration Elements that JMeter provides −

- Counter
- CSV Data Set Config
- FTP Request Defaults
- HTTP Authorization Manager
- HTTP Cache Manager
- HTTP Cookie Manager
- HTTP Proxy Server
- HTTP Request Defaults
- HTTP Header Manager
- Java Request Defaults
- Keystore Configuration
- JDBC Connection Configuration
- Login Config Element
- LDAP Request Defaults
- LDAP Extended Request Defaults
- TCP Sampler Config
- User Defined Variables
- Simple Config Element
- Random Variable

Pre-processor Elements

A pre-processor element is something that runs just before a sampler executes. They are often used to modify the settings of a Sample Request just before it runs, or to update variables that are not extracted from response text.

The following list consists of all the pre-processor elements that JMeter provides −

- HTML Link Parser
- HTTP URL Re-writing Modifier

- HTTP User Parameter Modifier
- User Parameters
- JDBC PreProcessor
- JSR223 PreProcessor
- RegEx User Parameters
- BeanShell PreProcessor
- BSF PreProcessor

Post-processor Elements

A post-processor executes after a sampler finishes its execution. This element is most often used to process the response data, for example, to retrieve a particular value for later use.

The following list consists of all the Post-Processor Elements JMeter provides −

- Regular Expression Extractor
- XPath Extractor
- Result Status Action Handler
- JSR223 PostProcessor
- JDBC PostProcessor
- BSF PostProcessor
- CSS/JQuery Extractor
- BeanShell PostProcessor
- Debug PostProcessor

Execution Order of Test Elements

Following is the execution order of the test plan elements −

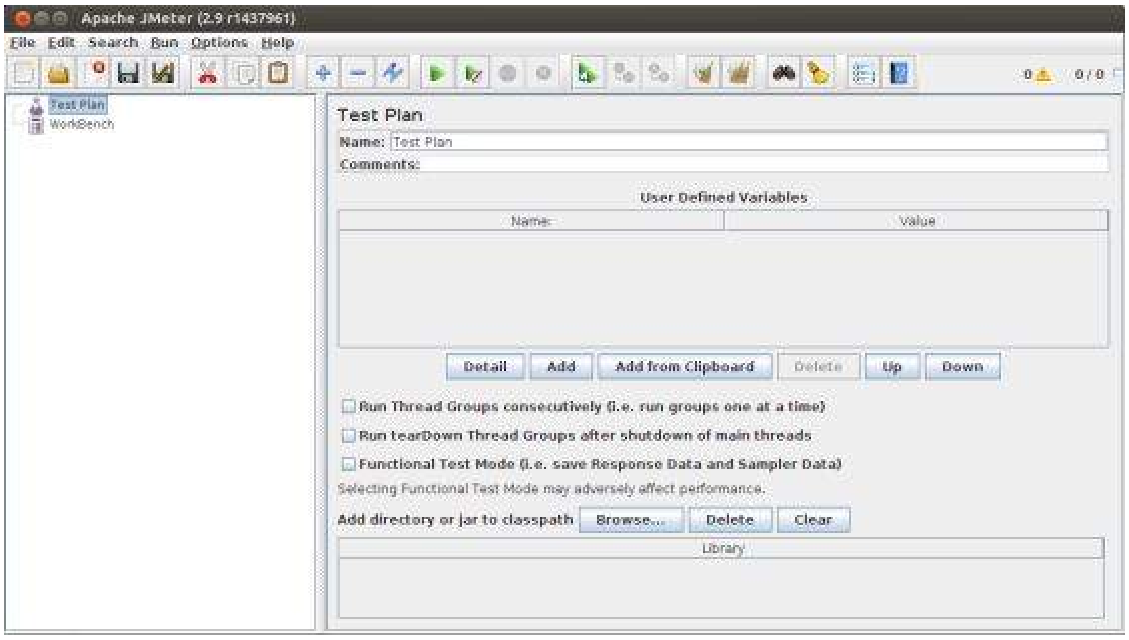
- Configuration elements
- Pre-Processors
- Timers
- Sampler
- Post-Processors (unless SampleResult is null)
- Assertions (unless SampleResult is null)
- Listeners (unless SampleResult is null)

jMeter - Web Test Plan

Let us build a simple test plan which tests a web page. We write a test plan in Apache JMeter so that we can test the performance of the web page shown by the URL − www.tutorialspoint.com .

Start JMeter

Open the JMeter window by clicking on **/home/manisha/apache-jmeter-2.9/bin/jmeter.sh**. The JMeter window appear as below −



Name: Test Plan

Comments:

☐ Run Thread Groups consecutively (i.e. run groups one at a time)

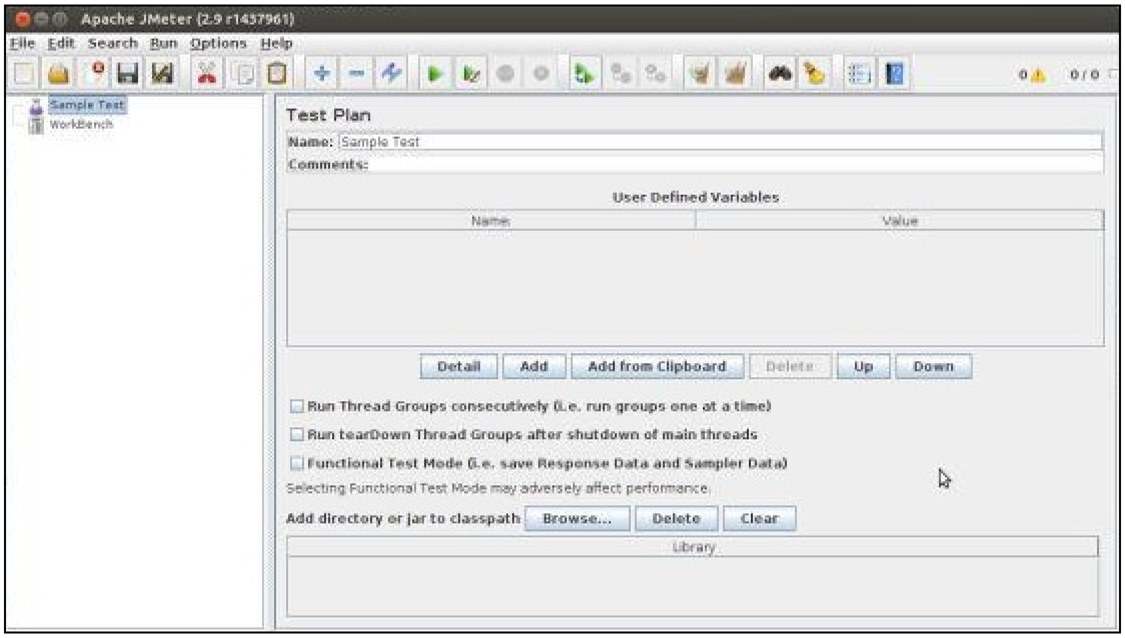
☐ Run tearDown Thread Groups after shutdown of main threads

☐ Functional Test Mode (i.e. save Response Data and Sampler Data)

Selecting Functional Test Mode may adversely affect performance.

Rename the Test Plan

Change the name of test plan node to *Sample Test* in the *Name* text box. You need to change the focus to workbench node and back to the Test Plan node to see the name getting reflected.


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Sample Test
WorkBench
Test Plan
User Defined Variables
Name
Value
Detail
Add
Add from Clipboard
Delete
Up
Down
Run Thread Groups consecutively (i.e. run groups one at a time)
Run tearDown Thread Groups after shutdown of main threads
Functional Test Mode (i.e. save Response Data and Sampler Data)
Selecting Functional Test Mode may adversely affect performance.
Add directory or jar to classpath
Browse...
Delete
Clear
Library

Name: Sample Test
Comments:

Add Thread Group

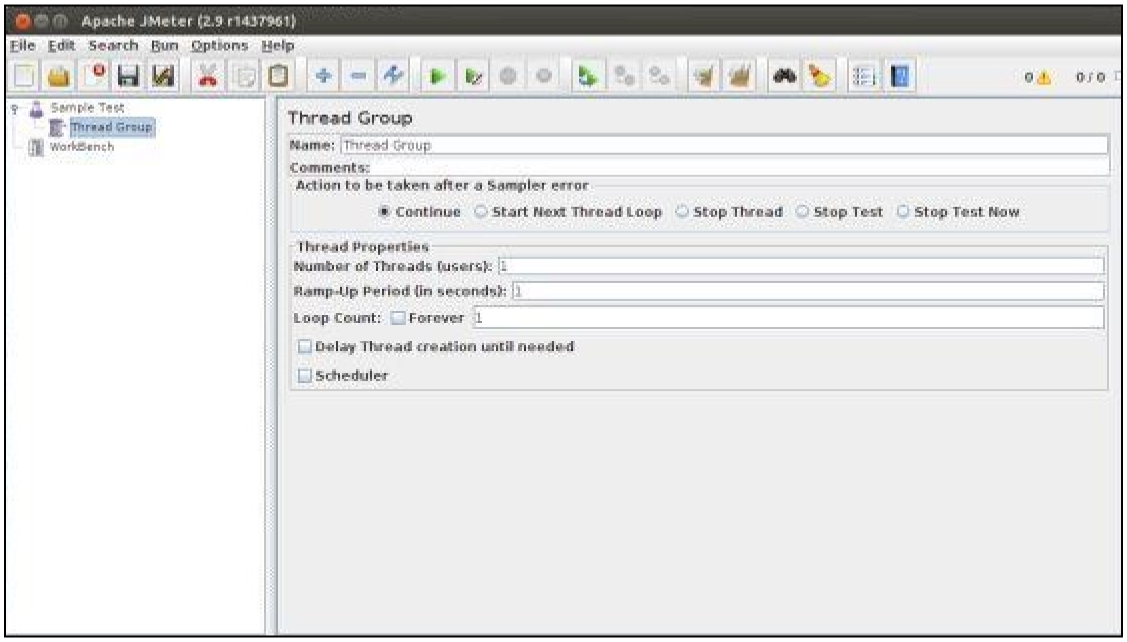
Now we add our first element in the window. We add one Thread Group, which is a placeholder for all other elements like Samplers, Controllers, and Listeners. We need one so we can configure number of users to simulate.

In JMeter, all the node elements are added by using the context menu.

Right-click the element where you want to add a child element node.

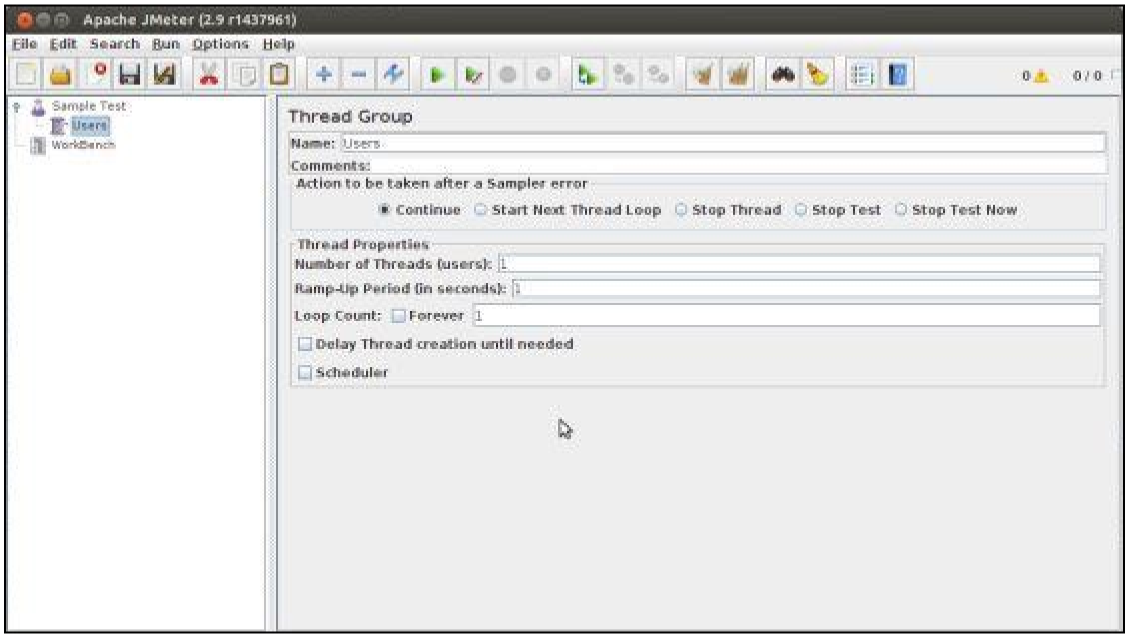
Choose the appropriate option to add.

Right-click on the Sample Test (our Test Plan) → Add → Threads (Users) → Thread Group. Thus, the Thread Group gets added under the Test Plan (Sample Test) node.


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Sample Test
Thread Group
WorkBench
Thread Group
Action to be taken after a Sampler error
Thread Properties
Delay Thread creation until needed
Scheduler

Name: Thread Group
Comments:
Action to be taken after a Sampler error: [✓ Continue] Start Next Thread Loop Stop Thread Stop Test Stop Test Now
Number of Threads (users): 1
Ramp-Up Period (in seconds): 1
Loop Count: Forever 1

Name the Thread Group as *Users*. For us, this element means users visiting the TutorialsPoint Home Page.


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
0 0 / 0
Sample Test
Users
WorkBench

Thread Group

Name: Users

Comments:

Action to be taken after a Sampler error

● Continue ○ Start Next Thread Loop ○ Stop Thread ○ Stop Test ○ Stop Test Now

Thread Properties

Number of Threads (users): 1

Ramp-Up Period (in seconds): 1

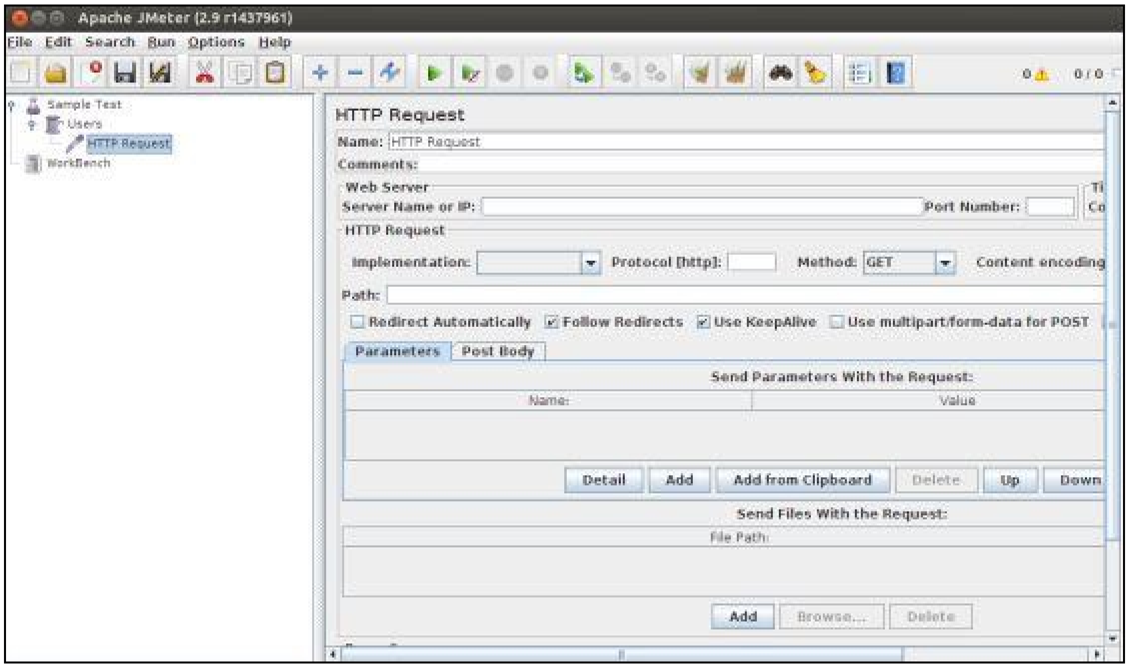
Loop Count: ☐ Forever 1

☐ Delay Thread creation until needed

☐ Scheduler

Add Sampler

We need to add one Sampler in our Thread Group (Users). As done earlier for adding Thread group, this time we will open the context menu of the Thread Group (Users) node by right-clicking and we will add HTTP Request Sampler by choosing Add → Sampler → HTTP request option.



HTTP Request

Name: HTTP Request

Comments:

Web Server

Server Name or IP: Port Number:

HTTP Request

Implementation: Protocol [http]: Method: GET Content encoding

Path:

☐ Redirect Automatically ☑ Follow Redirects ☑ Use KeepAlive ☐ Use multipart/form-data for POST

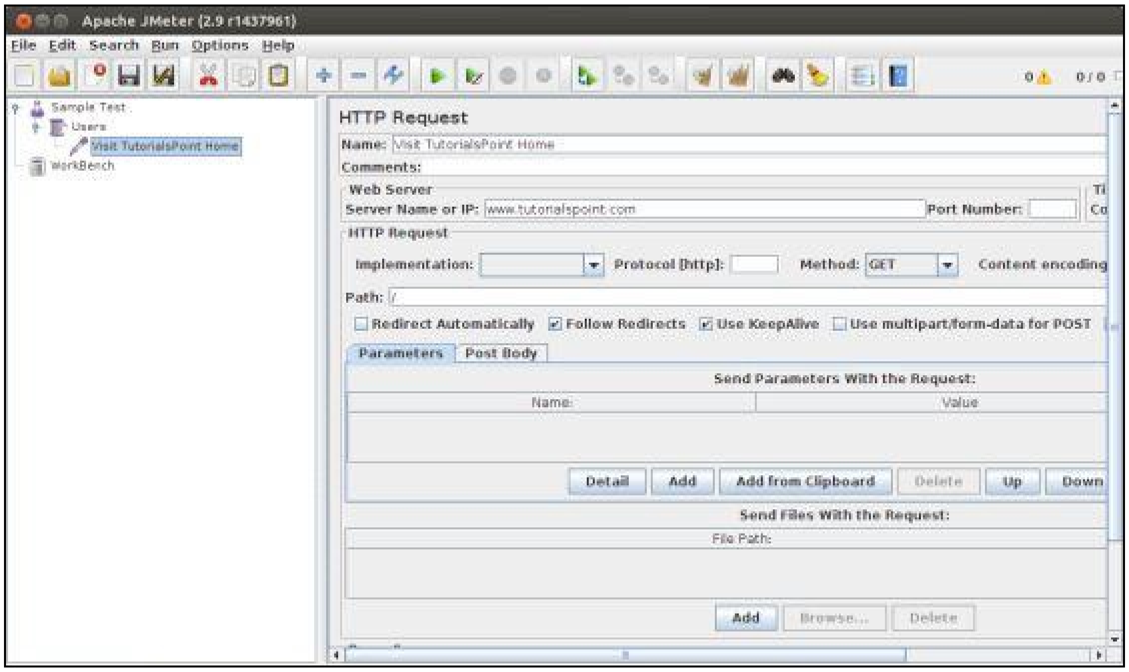
Send Parameters With the Request:

Name:	Value

Send Files With the Request:

File Path:

It will add one empty HTTP Request Sampler under the Thread Group (Users) node. Let us configure this node element –



HTTP Request

Name: Visit TutorialsPoint Home

Comments:

Web Server

Server Name or IP: www.tutorialspoint.com Port Number:

HTTP Request

Implementation: Protocol [http]: Method: GET Content encoding

Path: /

☐ Redirect Automatically ☑ Follow Redirects ☑ Use KeepAlive ☐ Use multipart/form-data for POST

Send Parameters With the Request:

Name:	Value

Send Files With the Request:

File Path:

Name – We will change the name to reflect the action what we want to achieve. We will name it as **Visit TutorialsPoint Home Page**

Server Name or IP – Here, we have to type the web server name. In our case it is **www.tutorialspoint.com**. (http:// part is not written this is only the name of the server or its IP)

Protocol – We will keep this blank, which means we want HTTP as the protocol.

Path – We will type path as / (slash). It means we want the root page of the server.

Add Listener

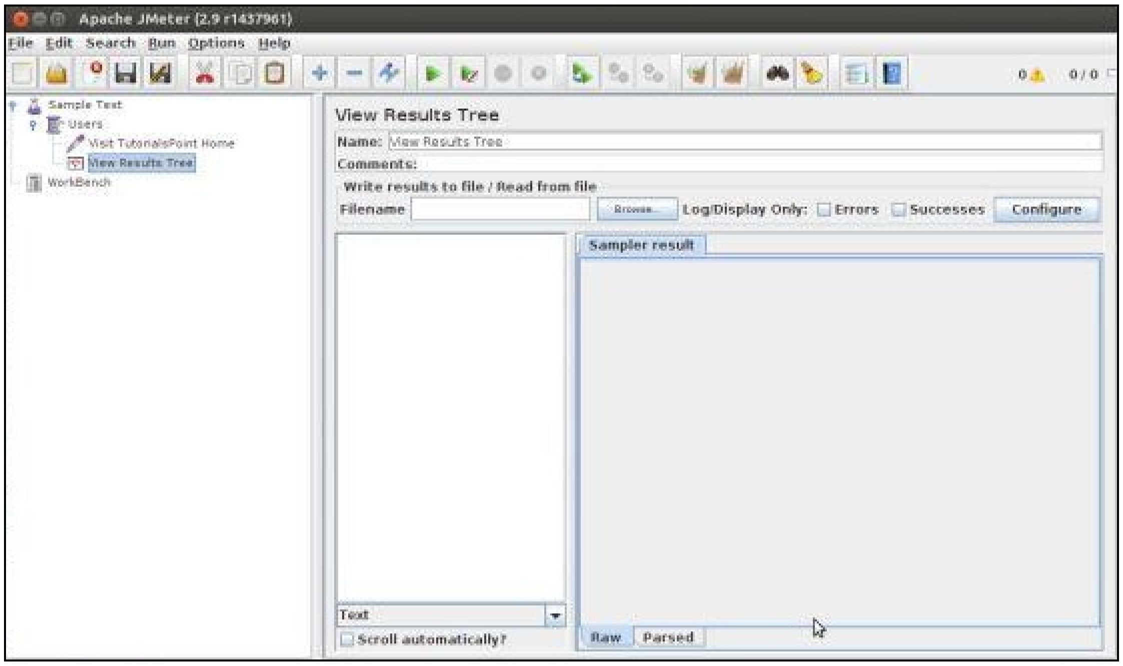
We will now add a listener. Let us add View Results Tree Listener under the Thread Group (User) node. It will ensure that the results of the Sampler will be available to view in this Listener node element.

To add a listener –

Open the context menu

Right-click the Thread Group (Users)

Choose Add → Listener → View Results Tree option

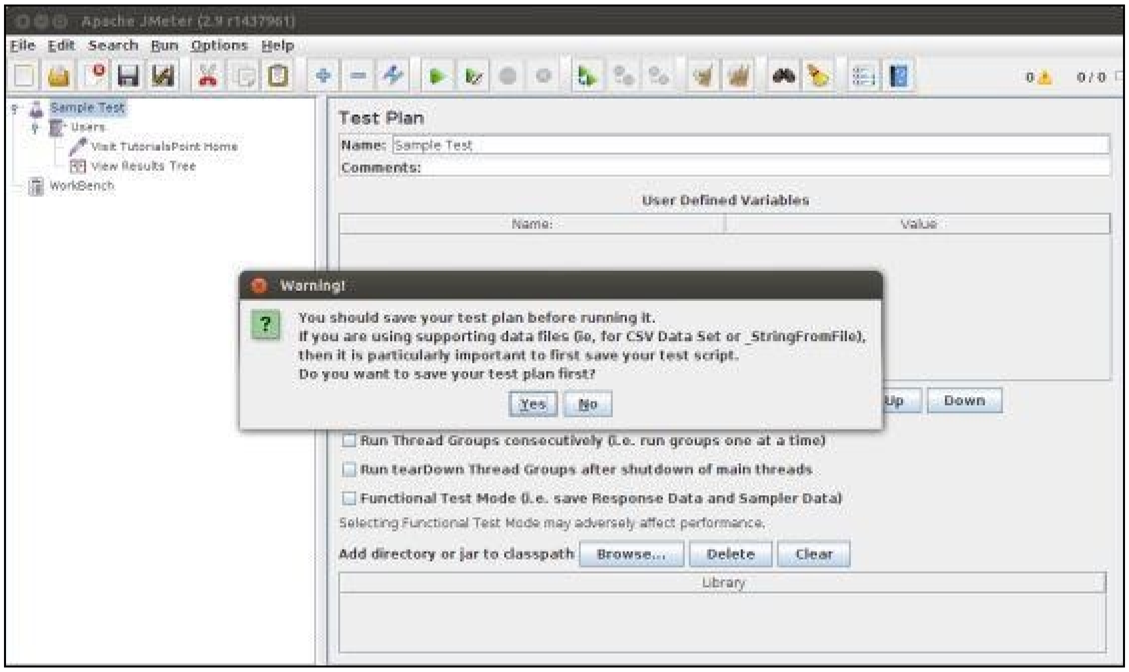


Run the Test Plan

Now with all the setup, let us execute the test plan. With the configuration of the Thread Group (Users), we keep all the default values. It means JMeter will execute the sampler only once. It is similar to a single user, only once.

This is similar to a user visiting a web page through browser, with JMeter sampler. To execute the test plan, Select Run from the menu and select Start option.

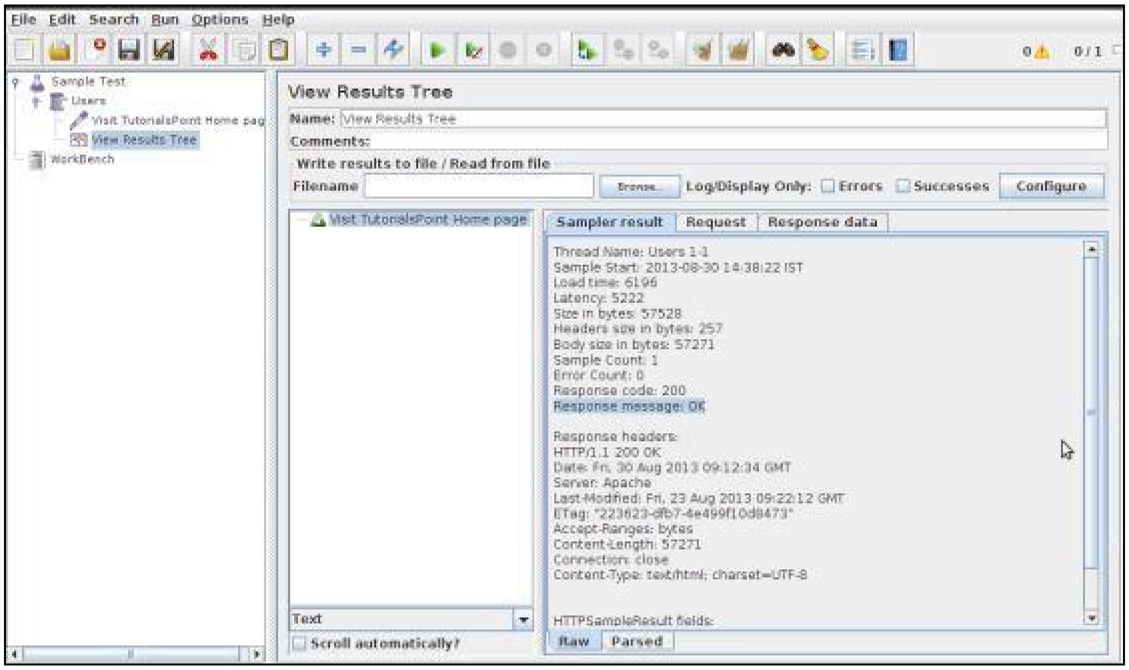
Apache JMeter asks us to save the test plan in a disk file before actually starting the test. This is important if you want to run the test plan multiple times. You can opt for running it without saving too.


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Sample Test
Users
Visit TutorialsPoint Home
View Results Tree
WorkBench
Test Plan
Name: Sample Test
Comments:
User Defined Variables
Name:
Value
Warning!
Yes
No
Up
Down
Run Thread Groups consecutively (i.e. run groups one at a time)
Run tearDown Thread Groups after shutdown of main threads
Functional Test Mode (i.e. save Response Data and Sampler Data)
Selecting Functional Test Mode may adversely affect performance.
Add directory or jar to classpath
Browse...
Delete
Clear
Library

You should save your test plan before running it.
If you are using supporting data files (ie, for CSV Data Set or _StringFromFile), then it is particularly important to first save your test script.
Do you want to save your test plan first?

View the Output

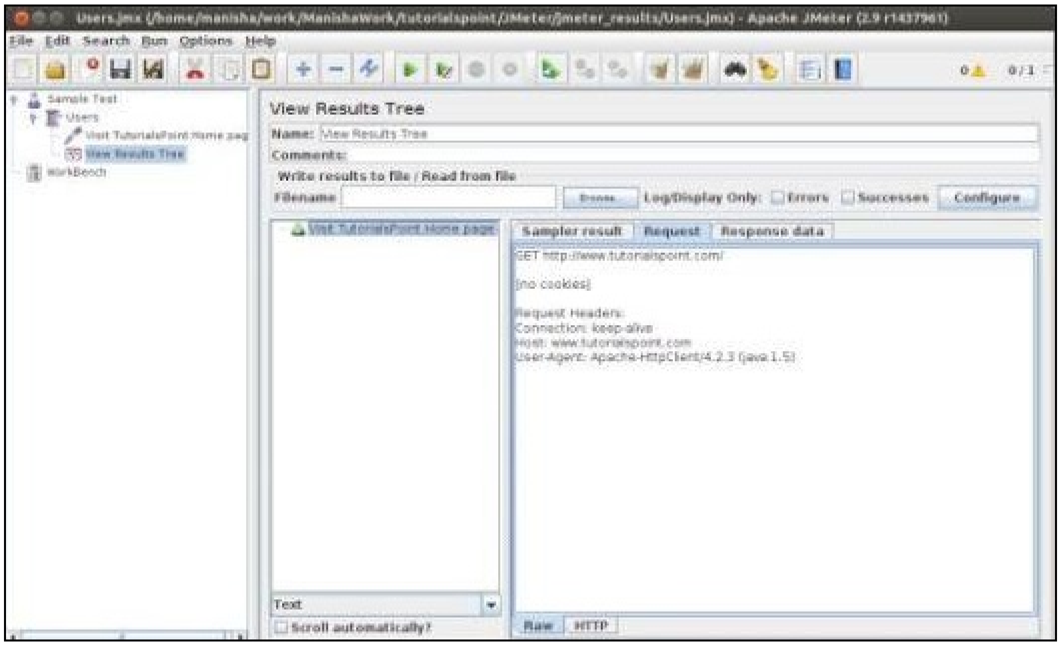
We have kept the setting of the thread group as single thread (one user only) and loop for 1 time (run only one time), hence we will get the result of one single transaction in the View Result Tree Listener.



```
Thread Name: Users 1-1
Sample Start: 2013-08-30 14:38:22 IST
Load time: 6196
Latency: 5222
Size in bytes: 57528
Headers size in bytes: 257
Body size in bytes: 57271
Sample Count: 1
Error Count: 0
Response code: 200
Response message: OK

Response headers:
HTTP/1.1 200 OK
Date: Fri, 30 Aug 2013 09:12:34 GMT
Server: Apache
Last-Modified: Fri, 23 Aug 2013 09:22:12 GMT
ETag: "223623-dfb7-4e499f10d8473"
Accept-Ranges: bytes
Content-Length: 57271
Connection: close
Content-Type: text/html; charset=UTF-8


HTTPSampleResult fields:
```

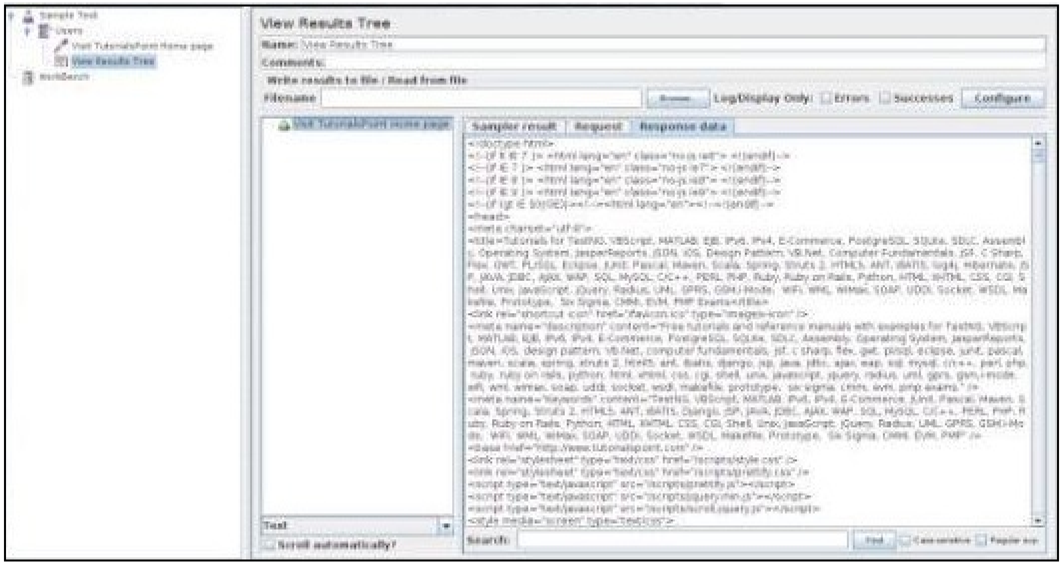
Details of the above result are −

- Green color against the name *Visit TutorialsPoint Home Page* indicates success.
- JMeter has stored all the headers and the responses sent by the web server and ready to show us the result in many ways.
- The first tab is Sampler Results. It shows JMeter data as well as data returned by the web server.
- The second tab is Request, which shows all the data sent to the web server as part of the request.


Users.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/Users.jmx) - Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Sample Test
Users
Visit TutorialsPoint Home page
View Results Tree
WorkBench
View Results Tree
Name: View Results Tree
Comments:
Write results to file / Read from file
Filename
Browse...
Log/Display Only:
Errors
Successes
Configure
Visit TutorialsPoint Home page
Sampler result
Request
Response data
Text
Scroll automatically?
Raw
HTTP

```
GET http://www.tutorialspoint.com/

[no cookies]

Request Headers:
Connection: keep-alive
Host: www.tutorialspoint.com
User-Agent: Apache-HttpClient/4.2.3 (java 1.5)
```

The last tab is Response data. In this tab, the listener shows the data received from server in text format.



```
<!doctype html>
<!--[if IE 7 ]> <html lang="en" class="no-js ie7"> <![endif]-->
<!--[if IE 7 ]> <html lang="en" class="no-js ie7"> <![endif]-->
<!--[if IE 8 ]> <html lang="en" class="no-js ie8"> <![endif]-->
<!--[if IE 9 ]> <html lang="en" class="no-js ie9"> <![endif]-->
<!--[if (gt IE 9)|!(IE)]><!--><html lang="en"><!--<![endif]-->
<head>
<meta charset="utf-8">
<title>Tutorials for TestNG, VBScript, MATLAB, EJB, IPv6, IPv4, E-Commerce, PostgreSQL, SQLite, SDLC, Assembl
y, Operating System, JasperReports, JSON, iOS, Design Pattern, VB.Net, Computer Fundamentals, JSF, C Sharp,
Flex, GWT, PL/SQL, Eclipse, JUnit, Pascal, Maven, Scala, Spring, Struts 2, HTML5, ANT, iBATIS, Log4j, Hibernate, JS
P, JAVA, JDBC, AJAX, WAP, SQL, MySQL, C/C++, PERL, PHP, Ruby, Ruby on Rails, Python, HTML, XHTML, CSS, CGI, S
hell, Unix, JavaScript, jQuery, Radius, UML, GPRS, GSM-Mode, WiFi, WML, WiMax, SOAP, UDDI, Socket, WSDL, Ma
kefile, Prototype, Six Sigma, CMMI, EVM, PMP Exams</title>
<link rel="shortcut icon" href="/favicon.ico" type="image/x-icon" />
<meta name="description" content="Free tutorials and reference manuals with examples for TestNG, VBScrip
t, MATLAB, EJB, IPv6, IPv4, E-Commerce, PostgreSQL, SQLite, SDLC, Assembly, Operating System, JasperReports,
JSON, iOS, design pattern, vb.net, computer fundamentals, jsf, c sharp, flex, gwt, plsql, eclipse, junit, pascal,
maven, scala, spring, struts 2, html5, ant, ibatis, django, jsp, java, jdbc, ajax, wap, sql, mysql, c++, perl, php,
ruby, ruby on rails, python, html, xhtml, css, cgi, shell, unix, javascript, jquery, radius, uml, gprs, gsm-mode,
wifi, wml, wimax, soap, uddi, socket, wsdl, makefile, prototype, six sigma, cmmi, evm, pmp exams." />
<meta name="keywords" content="TestNG, VBScript, MATLAB, IPv6, IPv4, E-Commerce, JUnit, Pascal, Maven, S
cala, Spring, Struts 2, HTML5, ANT, iBATIS, Django, JSP, JAVA, JDBC, AJAX, WAP, SQL, MySQL, C/C++, PERL, PHP, R
uby, Ruby on Rails, Python, HTML, XHTML, CSS, CGI, Shell, Unix, JavaScript, jQuery, Radius, UML, GPRS, GSM-Mo
de, WiFi, WML, WiMax, SOAP, UDDI, Socket, WSDL, Makefile, Prototype, Six Sigma, CMMI, EVM, PMP" />
<base href="http://www.tutorialspoint.com/" />
<link rel="stylesheet" type="text/css" href="/scripts/style.css" />
<link rel="stylesheet" type="text/css" href="/scripts/prettify.css" />
<script type="text/javascript" src="/scripts/prettify.js"></script>
<script type="text/javascript" src="/scripts/jquery.min.js"></script>
<script type="text/javascript" src="/scripts/scroll.jquery.js"></script>
<style media="screen" type="text/css">
```

This is just a simple test plan which executes only one request. But JMeter's real strength is in sending the same request, as if many users are sending it. To test the web servers with multiple users, we need to change the Thread Group (Users) settings.

jMeter - Database Test Plan

In this chapter, we will see how to create a simple test plan to test the database server. For our test purpose we use the MYSQL database server. You can use any other database for testing. For installation and table creation in MYSQL please refer MYSQL Tutorial .

Once MYSQL is installed, follow the steps below to setup the database −

Create a database with name "tutorial".

Create a table *tutorials_tbl*.

Insert records into *tutorials_tbl* as shown below −

```
mysql> use TUTORIALS;
Database changed
mysql> INSERT INTO tutorials_tbl
   ->(tutorial_title, tutorial_author, submission_date)
   ->VALUES
   ->("Learn PHP", "John Poul", NOW());

Query OK, 1 row affected (0.01 sec)
mysql> INSERT INTO tutorials_tbl
   ->(tutorial_title, tutorial_author, submission_date)
   ->VALUES
   ->("Learn MySQL", "Abdul S", NOW());

Query OK, 1 row affected (0.01 sec)
mysql> INSERT INTO tutorials_tbl
   ->(tutorial_title, tutorial_author, submission_date)
   ->VALUES
   ->("JAVA Tutorial", "Sanjay", '2007-05-06');

Query OK, 1 row affected (0.01 sec)
mysql>
```

Copy the appropriate JDBC driver to **/home/manisha/apache-jmeter-2.9/lib**.

Create JMeter Test Plan

Let us start the JMeter from **/home/manisha/apache-jmeter-2.9/bin/jmeter.sh**.

Add Users

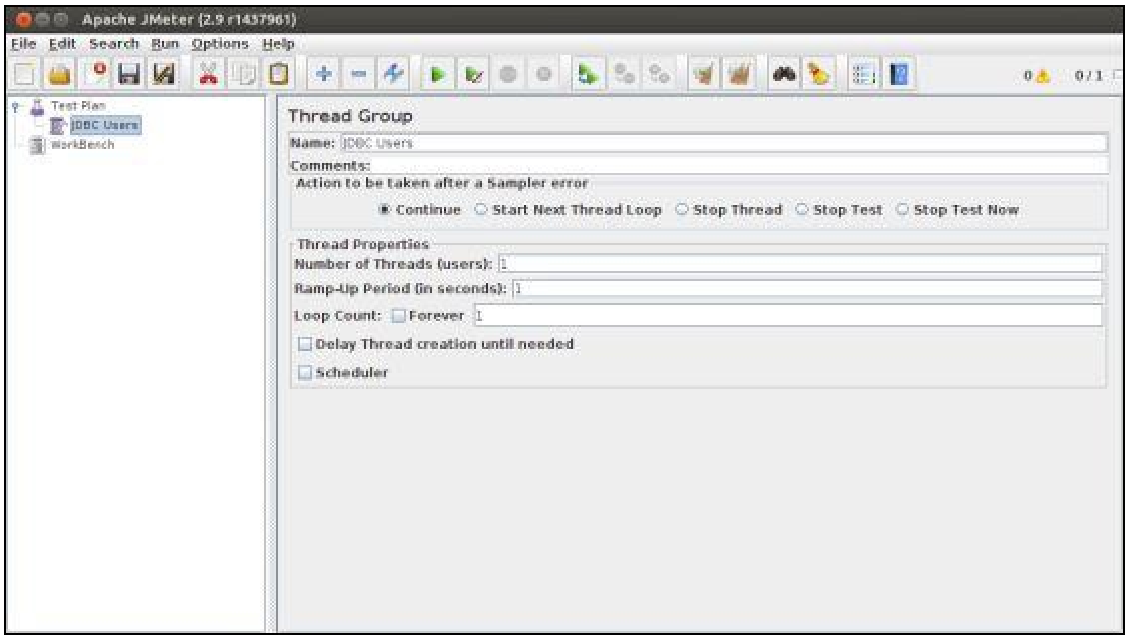
To create a Thread group,

Right-click on Test Plan.

Select Add → Threads (Users) → Thread Group.

Thus, thread group gets added under the Test Plan node.

Rename this Thread Group as *JDBC Users*.


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
0 0 / 1
Test Plan
JDBC Users
WorkBench

Thread Group

Name: JDBC Users

Comments:

Action to be taken after a Sampler error

[✓ Continue] Start Next Thread Loop Stop Thread Stop Test Stop Test Now

Thread Properties

Number of Threads (users): 1

Ramp-Up Period (in seconds): 1

Loop Count: ☐ Forever 1

☐ Delay Thread creation until needed

☐ Scheduler

We will not change the default properties of the Thread Group.

Adding JDBC Requests

Now that we defined our users, it is time to define the tasks that they will be performing. In this section, specify the JDBC requests to perform.

Right-click on the JDBC Users element.

Select **Add** → **Config Element** → **JDBC Connection Configuration**.

Set up the following fields (we are using MySQL database called tutorial) −

Variable name bound to pool. This needs to identify the configuration uniquely. It is used by the JDBC Sampler to identify the configuration to be used. We have named it as *test*.

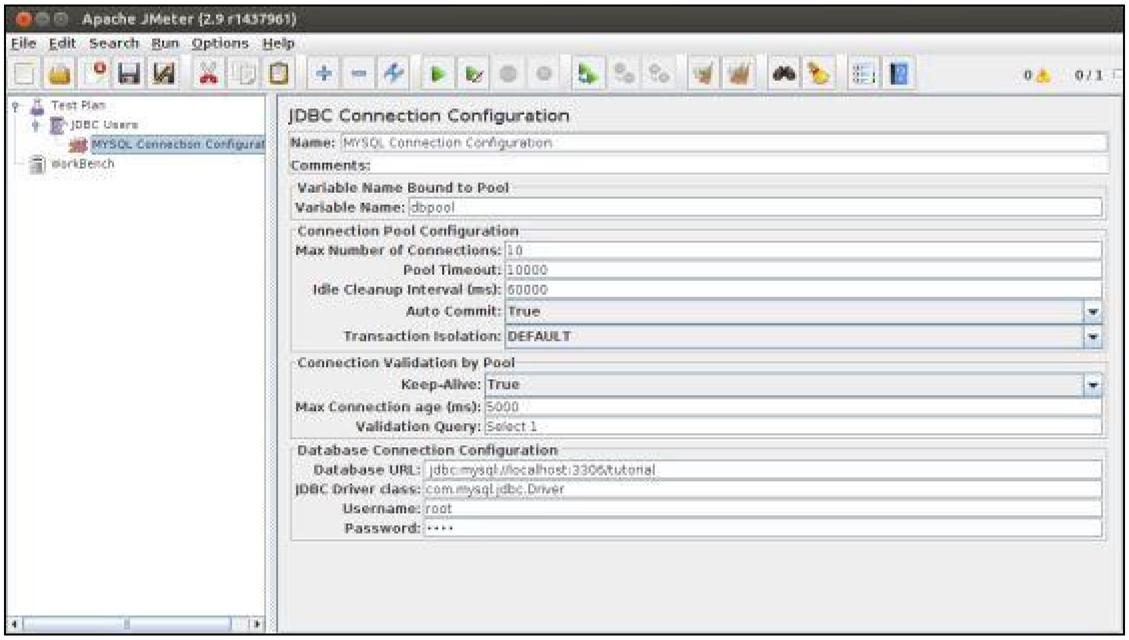
Database URL − jdbc:mysql://localhost:3306/tutorial.

JDBC Driver class: com.mysql.jdbc.Driver.

Username: root.

Password: password for root.

The other fields on the screen are left as defaults as shown below −


Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
0 0/1
Test Plan
JDBC Users
MYSQL Connection Configurat
WorkBench

JDBC Connection Configuration

Name: MYSQL Connection Configuration
Comments:

Variable Name Bound to Pool
Variable Name: dbpool

Connection Pool Configuration
Max Number of Connections: 10
Pool Timeout: 10000
Idle Cleanup Interval (ms): 60000
Auto Commit: True
Transaction Isolation: DEFAULT

Connection Validation by Pool
Keep-Alive: True
Max Connection age (ms): 5000
Validation Query: Select 1

Database Connection Configuration
Database URL: jdbc:mysql://localhost:3306/tutorial
JDBC Driver class: com.mysql.jdbc.Driver
Username: root
Password: ••••

Now add a JDBC Request which refers to the JDBC Configuration pool defined above. Select JDBC Users element.

Click your right mouse button to get the Add menu

Select **Add → Sampler → JDBC Request.**

Select this new element to view its Control Panel.

Edit the properties as shown below –

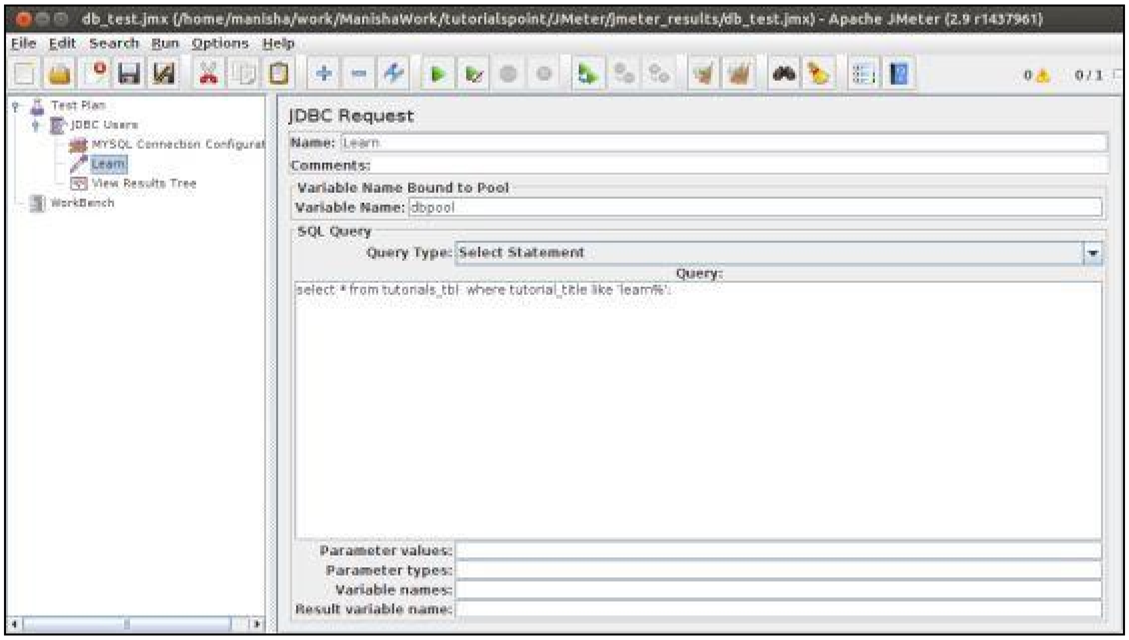
Variable name bound to pool. This needs to uniquely identify the configuration. It is used by the JDBC Sampler to identify the configuration to be used. Named it as *test*.

Name – Learn.

Enter the Pool Name – test (same as in the configuration element).

Query Type – Select statement.

Enter the SQL Query String field.


db_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/db_test.jmx) - Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Test Plan
JDBC Users
MYSQL Connection Configurat
Learn
View Results Tree
WorkBench

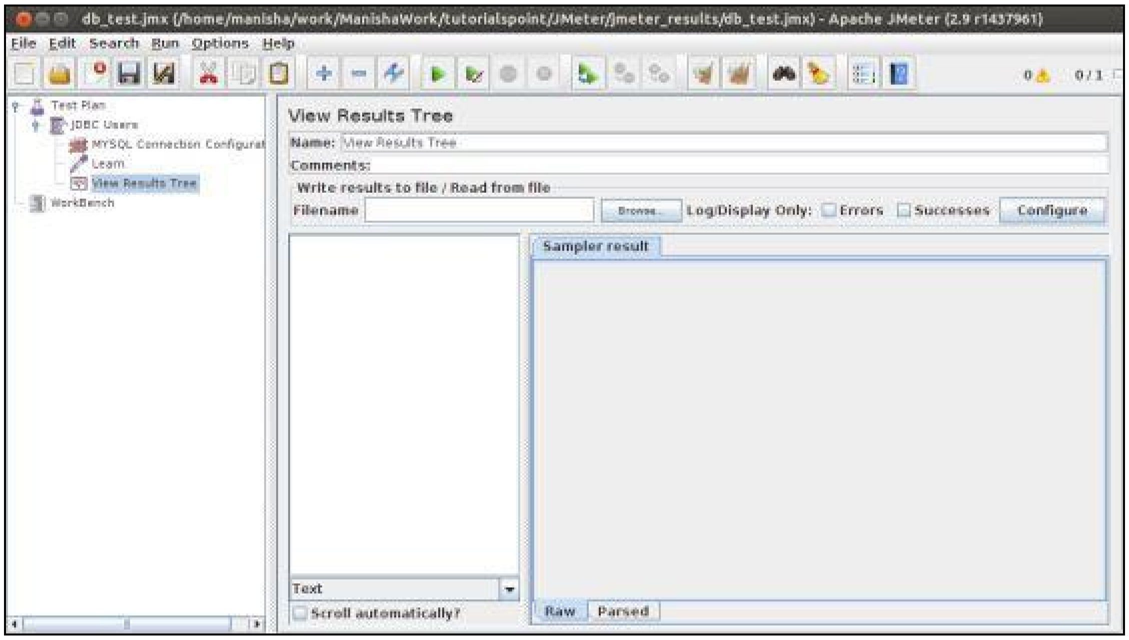
JDBC Request
Name: Learn
Comments:
Variable Name Bound to Pool
Variable Name: dbpool
SQL Query
Query Type: Select Statement
Query:
select * from tutorials_tbl where tutorial_title like 'learn%';
Parameter values:
Parameter types:
Variable names:
Result variable name:

Create Listener

Now add the Listener element. This element is responsible for storing all of the results of your JDBC requests in a file and presenting a visual model of the data.

Select the JDBC Users element

Add a View Results Tree listener (**Add** → **Listener** → **View Results Tree**).

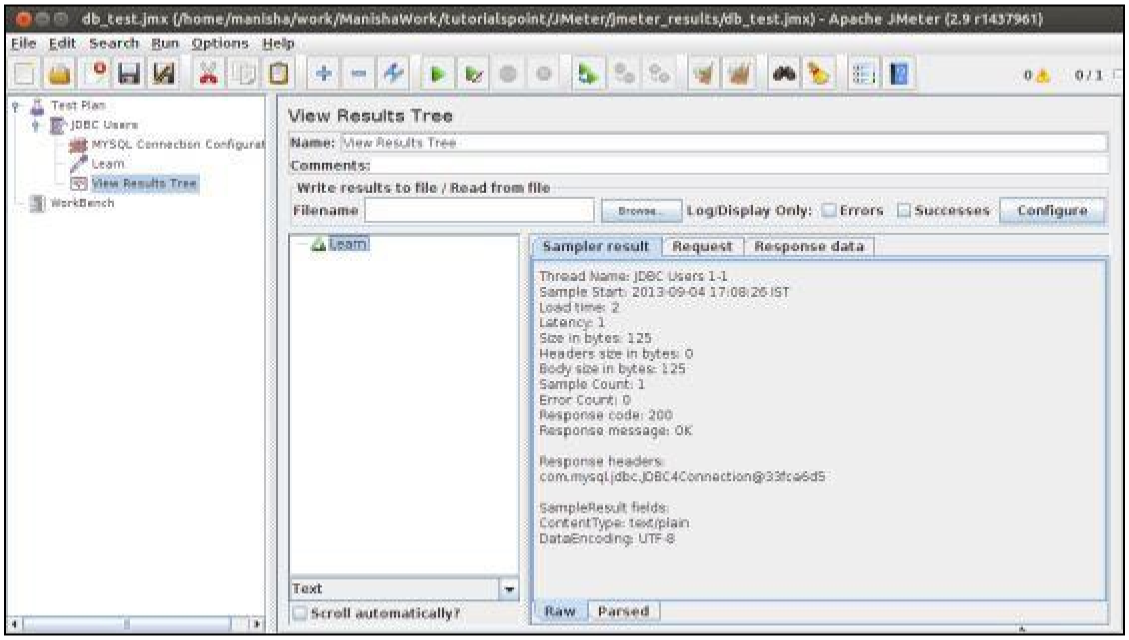

db_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/db_test.jmx) - Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Test Plan
JDBC Users
MYSQL Connection Configurat
Learn
View Results Tree
WorkBench
Browse...
Configure
Sampler result
Raw
Parsed

View Results Tree
Name: View Results Tree
Comments:
Write results to file / Read from file
Filename
Log/Display Only: Errors Successes
Text
Scroll automatically?

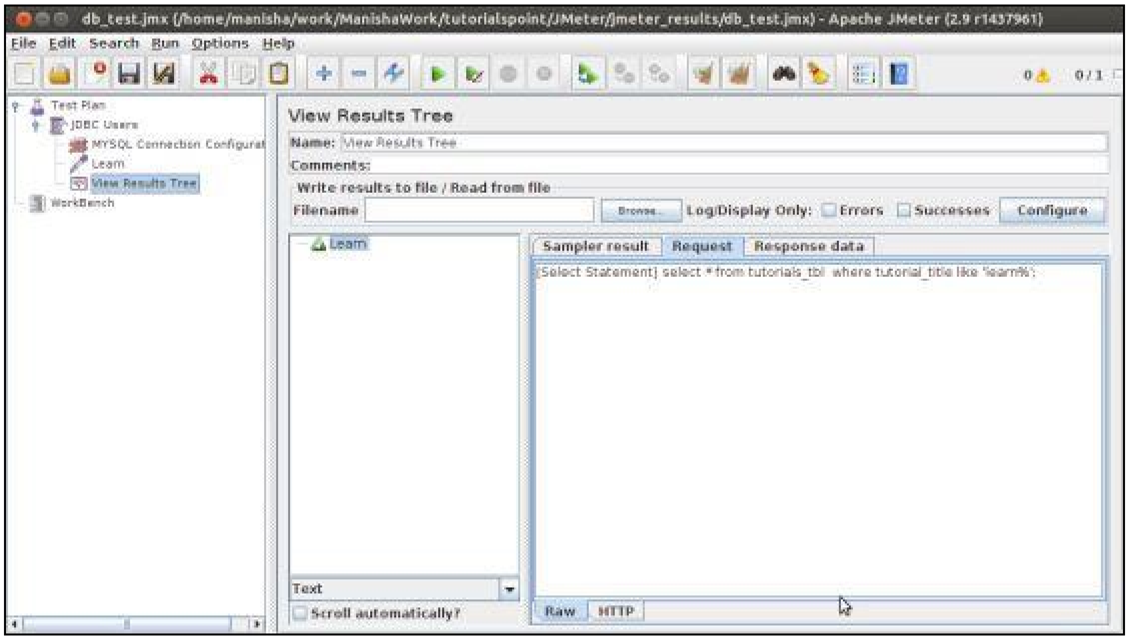
Save and Execute Test Plan

Now save the above test plan as *db_test.jmx*. Execute this test plan using **Run** → **Start** option.

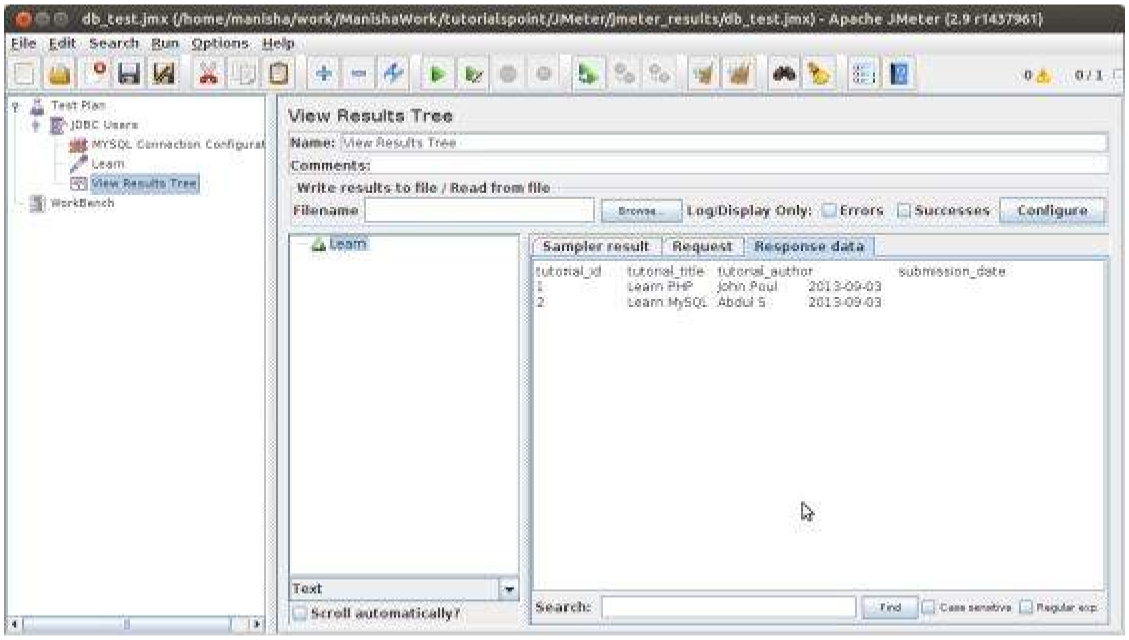
Verify the Output


db_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/db_test.jmx) - Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Test Plan
JDBC Users
MYSQL Connection Configurat
Learn
View Results Tree
WorkBench
View Results Tree
Name: View Results Tree
Comments:
Write results to file / Read from file
Filename
Browse...
Log/Display Only: Errors Successes
Configure
Learn
Sampler result
Request
Response data
Text
Scroll automatically?
Raw
Parsed

```
Thread Name: JDBC Users 1-1
Sample Start: 2013-09-04 17:08:26 IST
Load time: 2
Latency: 1
Size in bytes: 125
Headers size in bytes: 0
Body size in bytes: 125
Sample Count: 1
Error Count: 0
Response code: 200
Response message: OK

Response headers:
com.mysql.jdbc.JDBC4Connection@33fca6d5

SampleResult fields:
ContentType: text/plain
DataEncoding: UTF-8
```


db_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/db_test.jmx) - Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Test Plan
JDBC Users
MYSQL Connection Configurat
Learn
View Results Tree
WorkBench
View Results Tree
Name: View Results Tree
Comments:
Write results to file / Read from file
Filename
Browse...
Log/Display Only: Errors Successes
Configure
Learn
Sampler result
Request
Response data
Text
Scroll automatically?
Raw
HTTP

```
[Select Statement] select * from tutorials_tbl  where tutorial_title like 'learn%';
```


db_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/db_test.jmx) - Apache JMeter (2.9 r1437961)
File Edit Search Run Options Help
Test Plan
JDBC Users
MYSQL Connection Configurat
Learn
View Results Tree
WorkBench
View Results Tree
Name: View Results Tree
Comments:
Write results to file / Read from file
Filename
Browse...
Log/Display Only: Errors Successes
Configure
Learn
Sampler result
Request
Response data
Text
Scroll automatically?
Search:
Find
Case sensitive
Regular exp.

```
tutorial_id    tutorial_title  tutorial_author          submission_date
1              Learn PHP       John Poul     2013-09-03
2              Learn MySQL     Abdul S       2013-09-03
```

In the last image, you can see that two records are selected.

jMeter - FTP Test Plan

In this chapter, we will see how to test a FTP site using JMeter. Let us create a Test Plan to test the FTP site.

Rename Test Plan

Open the JMeter window by clicking /home/manisha/apache-jmeter-2.9/bin/jmeter.sh

Click on the Test Plan node.

Rename this Test Plan node as TestFTPSite.

Add Thread Group

Add one Thread Group, which is placeholder for all other elements like Samplers, Controllers, and Listeners.

Right click on TestFTPSite (our Test Plan)

Select Add → Threads(Users) → Thread Group. Thread Group will get added under the Test Plan (TestFTPSite) node.

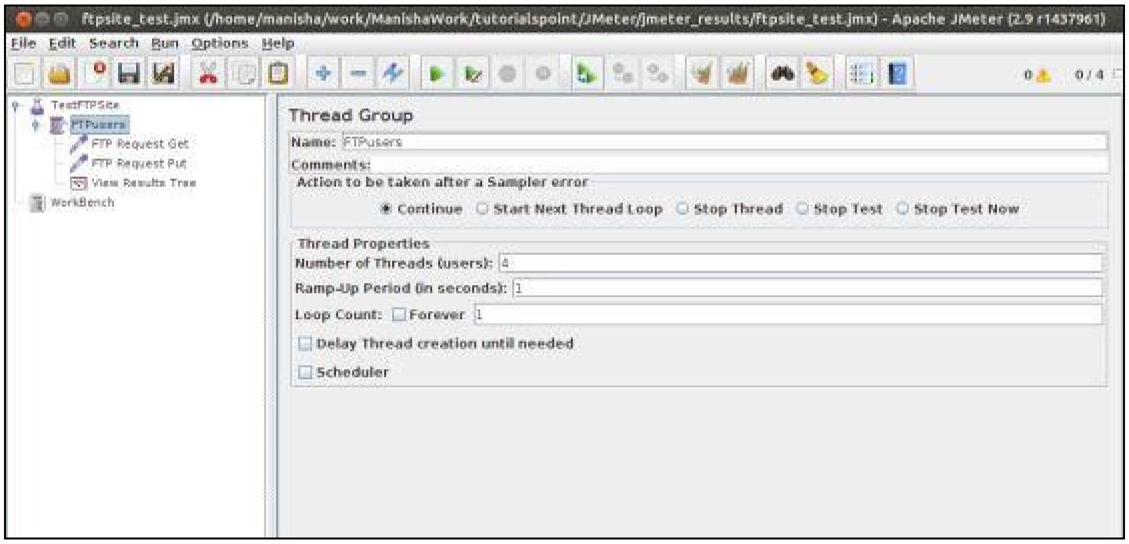
Modify the default properties of the Thread Group to suit our testing as follows −

Name − FTPusers

Number of Threads (Users) − 4

Ramp-Up Period − leave the the default value of 0 seconds.

Loop Count − 1


ftpsite_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/ftpsite_test.jmx) - Apache JMeter (2.9 r1437961)

Thread Group

Name: FTPusers

Comments:

Action to be taken after a Sampler error

[✓ Continue] Start Next Thread Loop Stop Thread Stop Test Stop Test Now

Thread Properties

Number of Threads (users): 4

Ramp-Up Period (in seconds): 1

Loop Count: Forever 1

Delay Thread creation until needed

Scheduler

Add Sampler – FTP Request

Now that we have defined our users, it is time to define the tasks that they will be performing. Add FTP Request elements. We add two FTP request elements, one which retrieves a file and the other which puts a file on the ftp site.

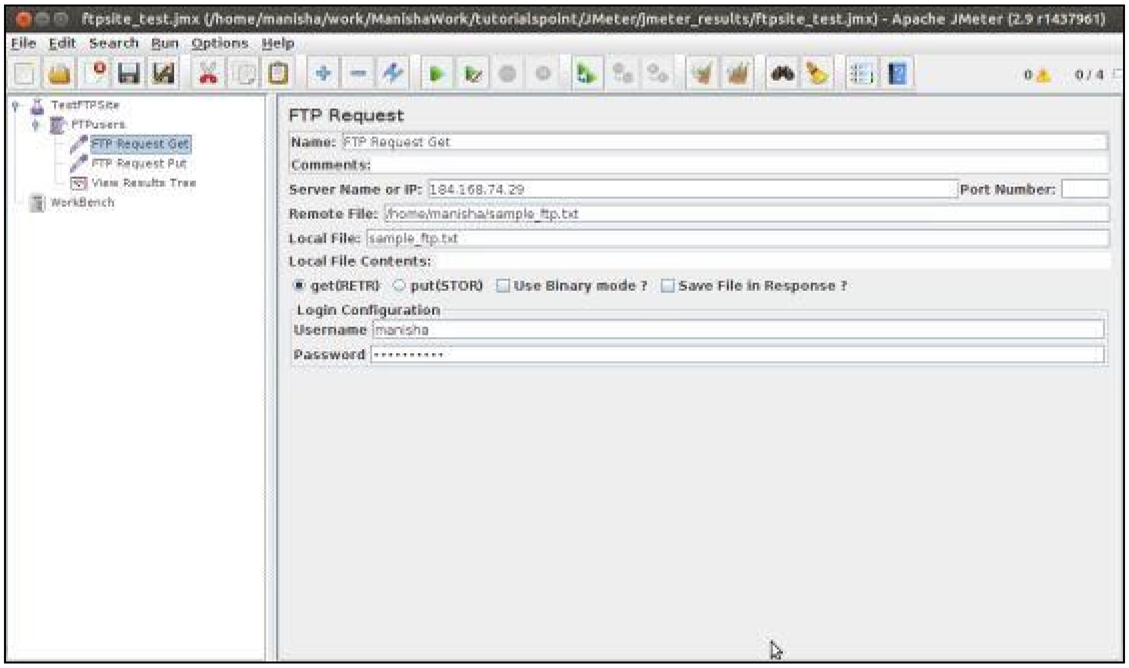
Select the FTPusers element.

Right-click the mouse button to get the Add menu

Select Add → Sampler → FTP Request.

Select the FTP Request element in the tree.

Edit the following properties as shown below –



ftpsite_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/ftpsite_test.jmx) - Apache JMeter (2.9 r1437961)

FTP Request

Name: FTP Request Get

Comments:

Server Name or IP: 184.168.74.29 Port Number:

Remote File: /home/manisha/sample_ftp.txt

Local File: sample_ftp.txt

Local File Contents:

[✓ get(RETR)] put(STOR) Use Binary mode ? Save File in Response ?

Login Configuration

Username manisha

Password ••••••••••

The following details are entered in this element –

Name – FTP Request Get

Server Name or IP – 184.168.74.29

Remote File – /home/manisha/sample_ftp.txt

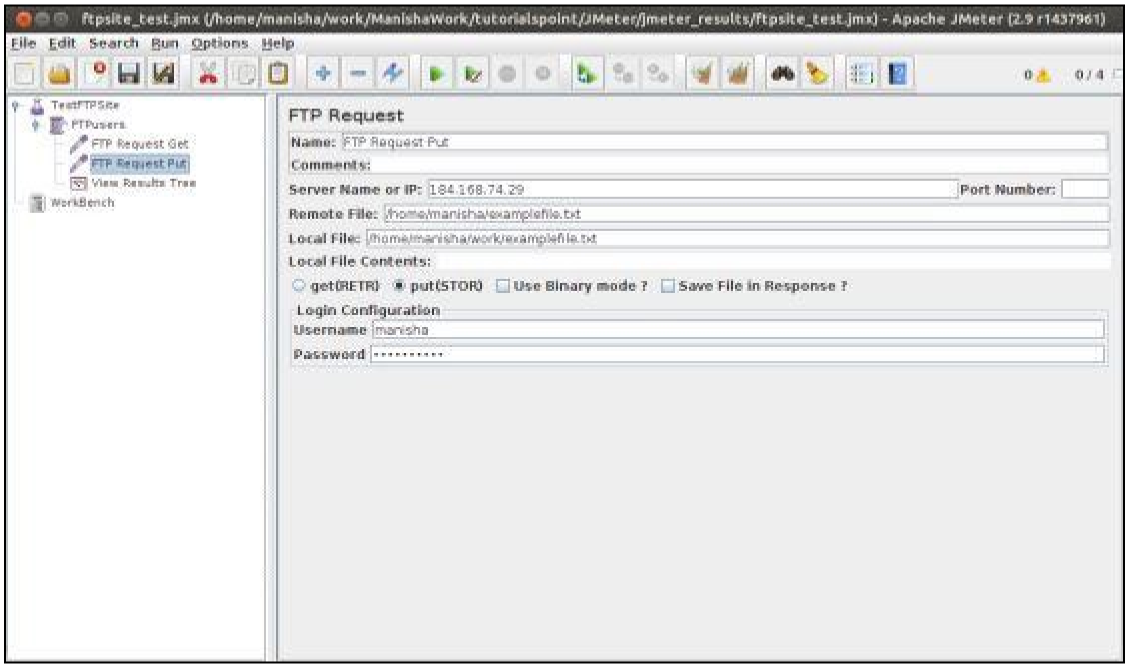
Local File – sample_ftp.txt

Select get(RETR)

Username – manisha

Password – manisha123

Now add another FTP request as above and edit the properties as shown in the following screenshot –



ftpsite_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/ftpsite_test.jmx) - Apache JMeter (2.9 r1437961)

- TestFTPSite
  - FTPusers
    - FTP Request Get
    - FTP Request Put
    - View Results Tree
- WorkBench

FTP Request

Name: FTP Request Put
Comments:
Server Name or IP: 184.168.74.29 Port Number:
Remote File: /home/manisha/exampleflle.txt
Local File: /home/manisha/work/examplefile.txt
Local File Contents:
○ get(RETR) ● put(STOR) ☐ Use Binary mode ? ☐ Save File in Response ?
Login Configuration
Username manisha
Password ••••••••••

The following details are entered in this element –

Name – FTP Request Put

Server Name or IP – 184.168.74.29

Remote File – /home/manisha/examplefile.txt

Local File – /home/manisha/work/examplefile.txt

Select put(STOR)

Username – manisha

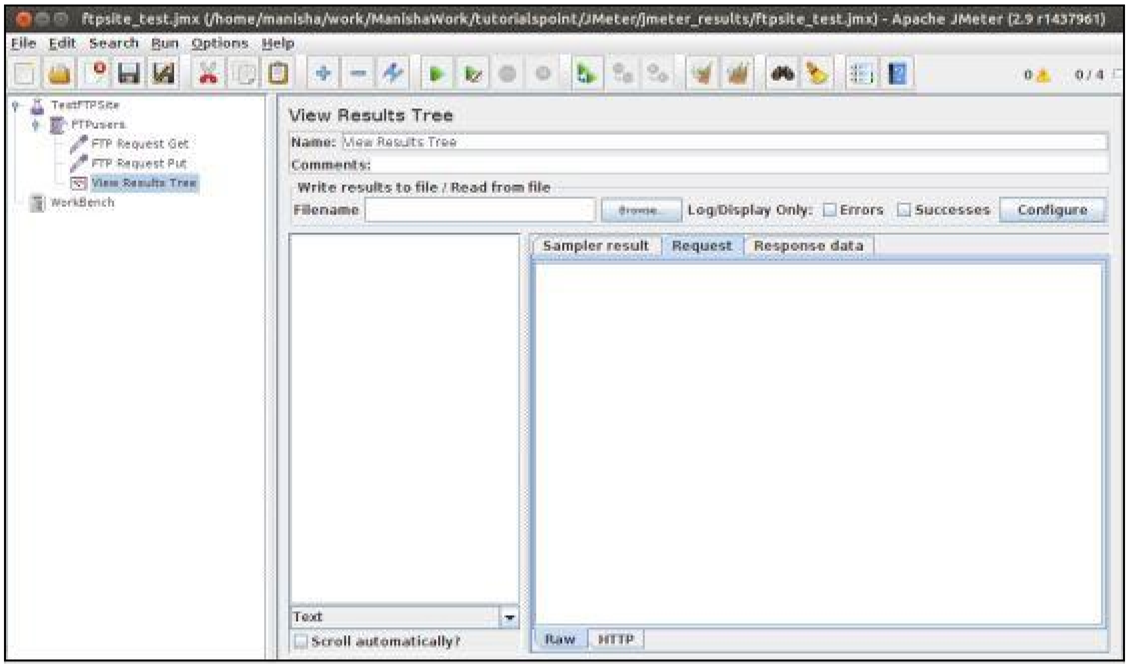
Password – manisha123

Add Listener

The final element you need to add to your Test Plan is a Listener. This element is responsible for storing all of the results of your FTP requests in a file and presenting a visual model of the data.

Select the FTPusers element.

Add a View Results Tree listener by selecting Add > Listener > View Results Tree.

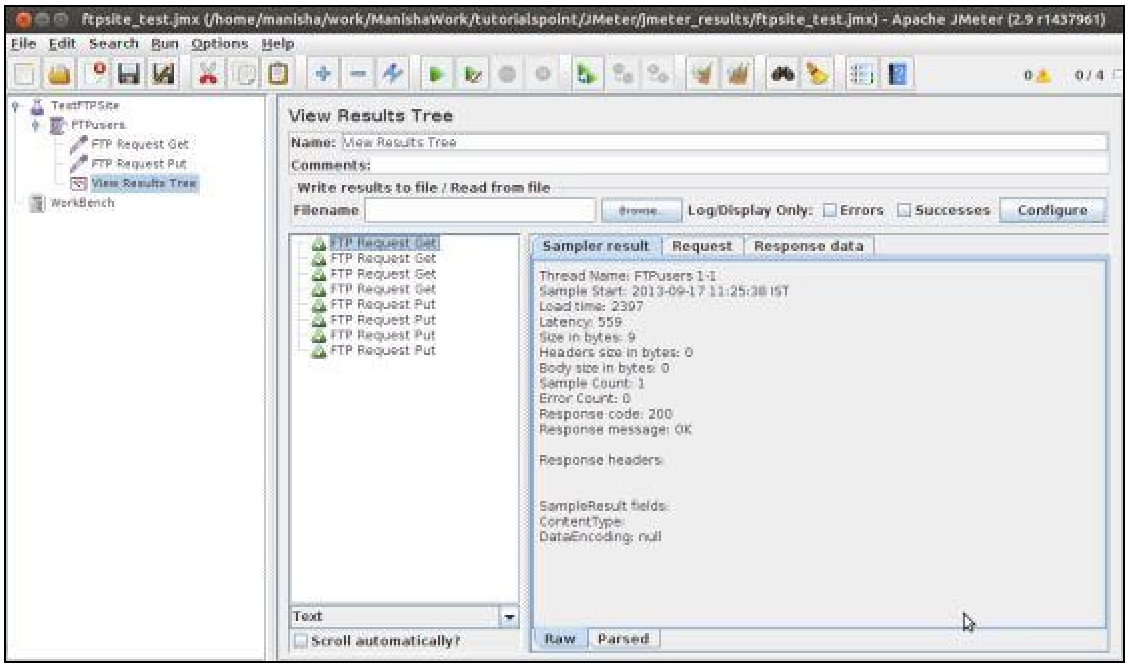


Run the Test Plan

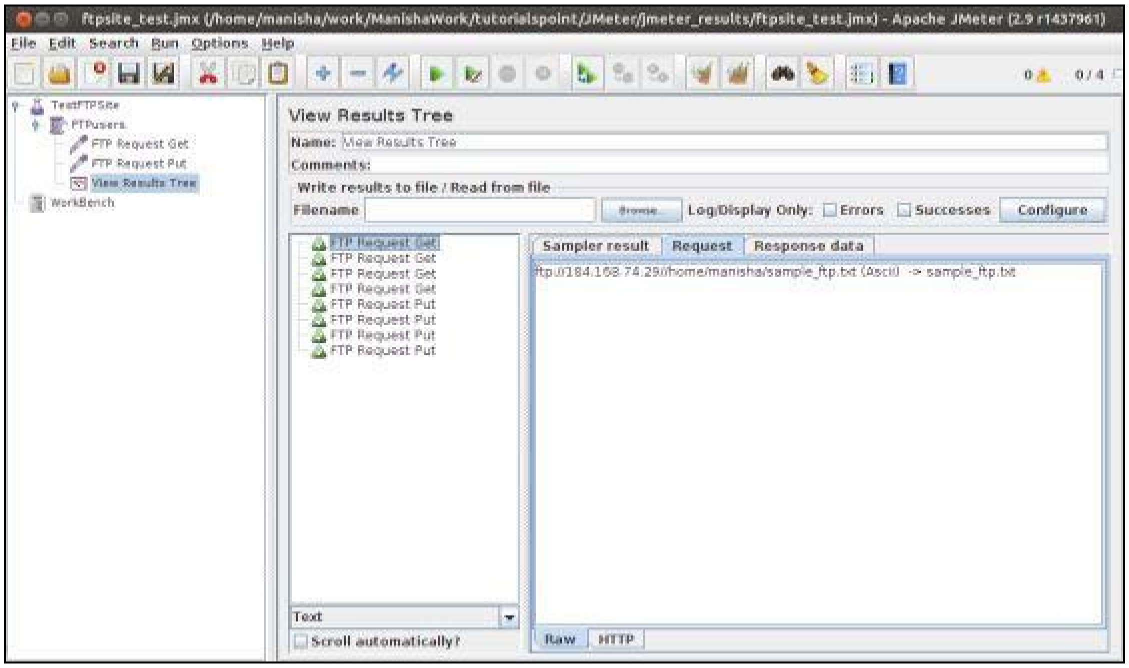
Now save the above test plan as *ftpsite_test.jmx*. Execute this test plan using **Run** → **Start** option.

View the Output

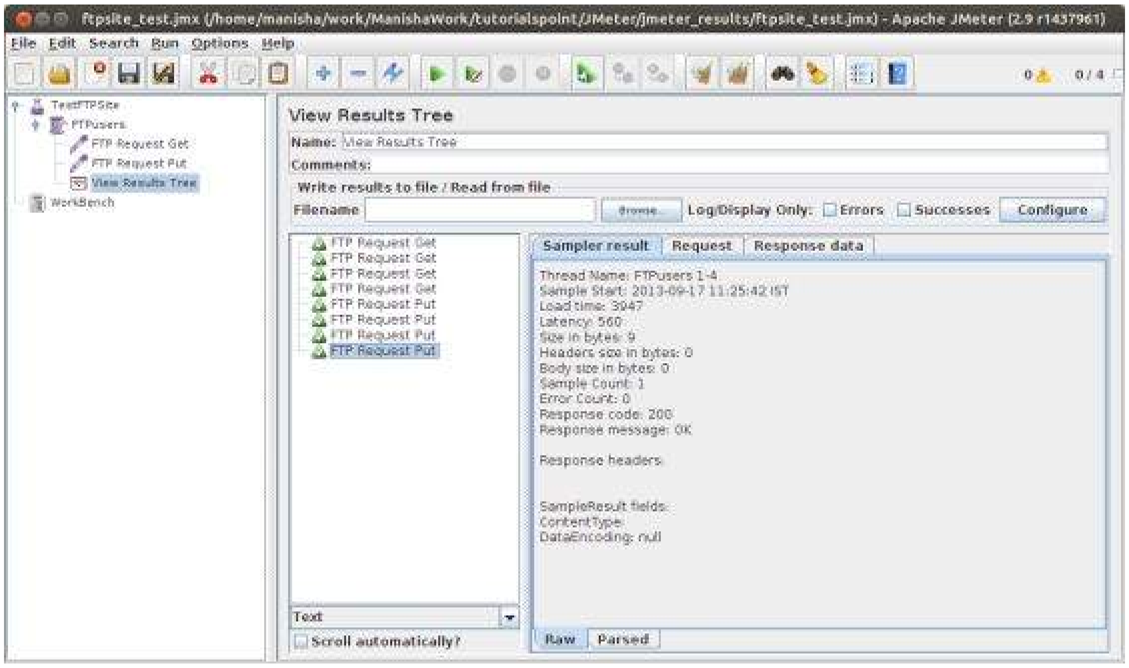
The following output can be seen in the listener.



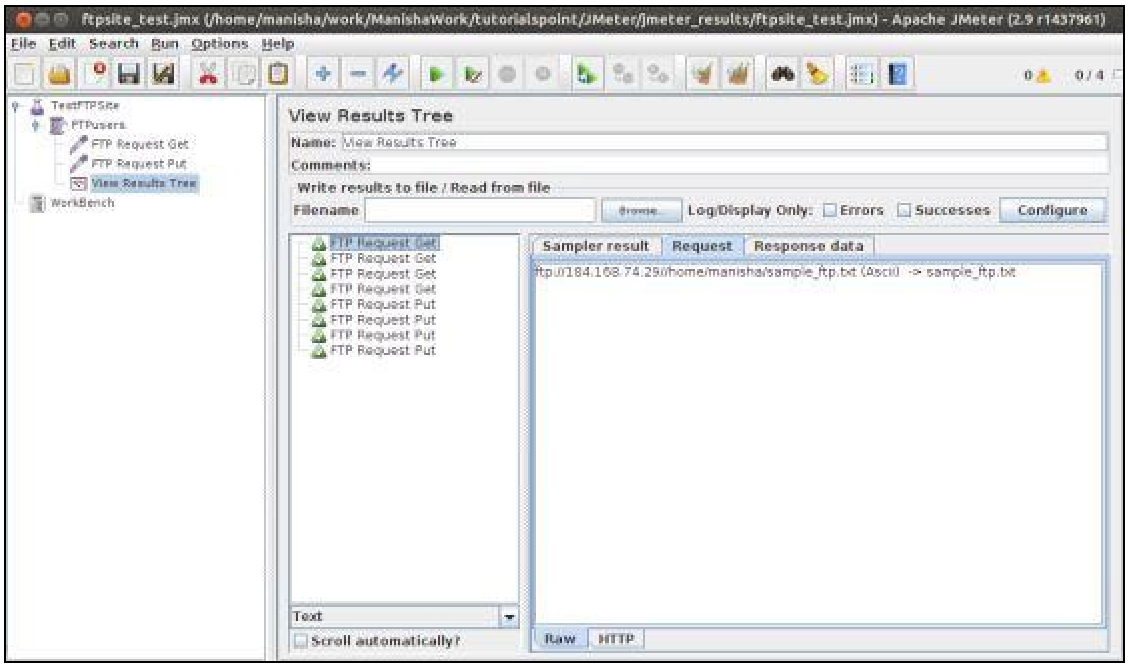
```
Thread Name: FTPusers 1-1
Sample Start: 2013-09-17 11:25:38 IST
Load time: 2307
Latency: 559
Size in bytes: 9
Headers size in bytes: 0
Body size in bytes: 0
Sample Count: 1
Error Count: 0
Response code: 200
Response message: OK

Response headers:


SampleResult fields:
ContentType:
DataEncoding: null
```



```
ftp://184.168.74.29//home/manisha/sample_ftp.txt (Ascii)  -> sample_ftp.txt
```



```
Thread Name: FTPusers 1-4
Sample Start: 2013-09-17 11:25:42 IST
Load time: 3947
Latency: 560
Size in bytes: 9
Headers size in bytes: 0
Body size in bytes: 0
Sample Count: 1
Error Count: 0
Response code: 200
Response message: OK

Response headers:


SampleResult fields:
ContentType:
DataEncoding: null
```



```
ftp://184.168.74.29//home/manisha/sample_ftp.txt (Ascii) -> sample_ftp.txt
```

You can see that four requests are made for each FTP request and the test is successful. The retrieved file for GET request is stored in the /bin folder. In our case, it is **/home/manisha/apache-jmeter-2.9/bin/**. For PUT request, the file is uploaded at the path **/home/manisha/**.

jMeter - Webservice Test Plan

In this chapter, we will learn how to create a Test Plan to test a WebService. For our test purpose, we have created a simple webservice project and deployed it on the Tomcat server locally.

Create Webservice Project

To create a webservice project, we have used Eclipse IDE. First write the Service Endpoint Interface **HelloWorld** under the package **com.tutorialspoint.ws**. The contents of the HelloWorld.java are as follows −

```
package com.tutorialspoint.ws;

import javax.jws.WebMethod;
import javax.jws.WebService;
import javax.jws.soap.SOAPBinding;
import javax.jws.soap.SOAPBinding.Style;

//Service Endpoint Interface
@WebService
@SOAPBinding(style = Style.RPC)

public interface HelloWorld {
   @WebMethod String getHelloWorldMessage(String string);
}
```

This service has a method **getHelloWorldMessage** which takes a String parameter.

Next, create the implementation class **HelloWorldImpl.java** under the package **com.tutorialspoint.ws**.

```
package com.tutorialspoint.ws;

import javax.jws.WebService;

@WebService(endpointInterface="com.tutorialspoint.ws.HelloWorld")
public class HelloWorldImpl  implements HelloWorld  {
   @Override

   public String getHelloWorldMessage(String myName) {
      return("Hello "+myName+" to JAX WS world");
   }
}
```

Let us now publish this web service locally by creating the Endpoint publisher and expose the service on the server.

The publish method takes two parameters –

- Endpoint URL String.
- Implementor object, in this case the HelloWorld implementation class, which is exposed as a Web Service at the endpoint identified by the URL mentioned in the parameter above.

The contents of HelloWorldPublisher.java are as follows –

```
package com.tutorialspoint.endpoint;

import javax.xml.ws.Endpoint;
import com.tutorialspoint.ws.HelloWorldImpl;

public class HelloWorldPublisher {
   public static void main(String[] args) {
      Endpoint.publish("http://localhost:9000/ws/hello", new HelloWorldImpl());
   }
}
```

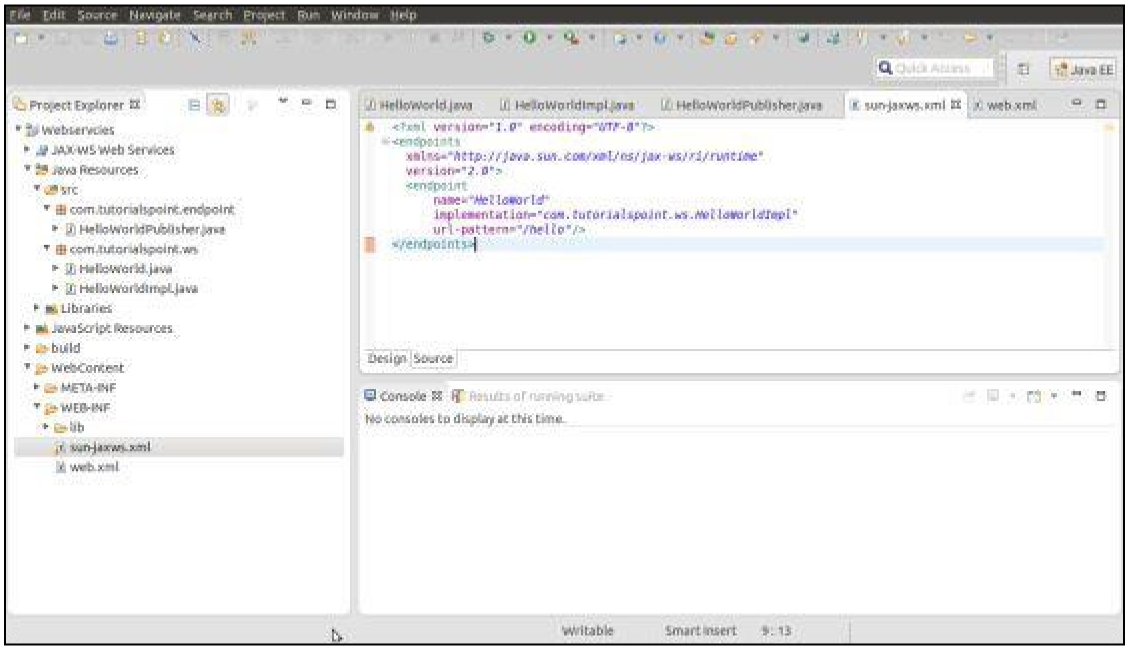
Modify the web.xml contents as shown below –

```
<?xml version = "1.0" encoding = "UTF-8"?>
<!DOCTYPE web-app PUBLIC "-//Sun Microsystems,
Inc.//DTD Web Application 2.3//EN" "http://java.sun.com/j2ee/dtds/web-app_2_3.dtd">

<web-app>
   <listener>
      <listener-class>
         com.sun.xml.ws.transport.http.servlet.WSServletContextListener
      </listener-class>
   </listener>

   <servlet>
      <servlet-name>hello</servlet-name>
      <servlet-class>com.sun.xml.ws.transport.http.servlet.WSServlet</servlet-class>
      <load-on-startup>1</load-on-startup>
   </servlet>

   <servlet-mapping>
      <servlet-name>hello</servlet-name>
      <url-pattern>/hello</url-pattern>
   </servlet-mapping>

   <session-config>
      <session-timeout>120</session-timeout>
   </session-config>

</web-app>
```

To deploy this application as a webservice, we would need another configuration file **sun-jaxws.xml**. The contents of this file are as follows –

```
<?xml version = "1.0" encoding = "UTF-8"?>
<endpoints
   xmlns = "http://java.sun.com/xml/ns/jax-ws/ri/runtime"
   version = "2.0">

   <endpoint name = "HelloWorld"
      implementation = "com.tutorialspoint.ws.HelloWorldImpl"
      url-pattern = "/hello"/>
</endpoints>
```

Now that all the files are ready, the directory structure would look as shown in the following screenshot –



```
Webservices
  JAX-WS Web Services
  Java Resources
    src
      com.tutorialspoint.endpoint
        HelloWorldPublisher.java
      com.tutorialspoint.ws
        HelloWorld.java
        HelloWorldImpl.java
    Libraries
  JavaScript Resources
  build
  WebContent
    META-INF
    WEB-INF
      lib
      sun-jaxws.xml
      web.xml
```

```
<?xml version="1.0" encoding="UTF-8"?>
<endpoints
  xmlns="http://java.sun.com/xml/ns/jax-ws/ri/runtime"
  version="2.0">
  <endpoint
      name="HelloWorld"
      implementation="com.tutorialspoint.ws.HelloWorldImpl"
      url-pattern="/hello"/>
</endpoints>
```

No consoles to display at this time.

Now create a WAR file of this application.

Choose the project → right click → Export → WAR file.

Save this as **hello.war** file under the **webapps** folder of Tomcat server.

Now start the Tomcat server.

Once the server is started, you should be able to access the webservice with the URL – http://localhost:8080/hello/hello

Create JMeter Test plan

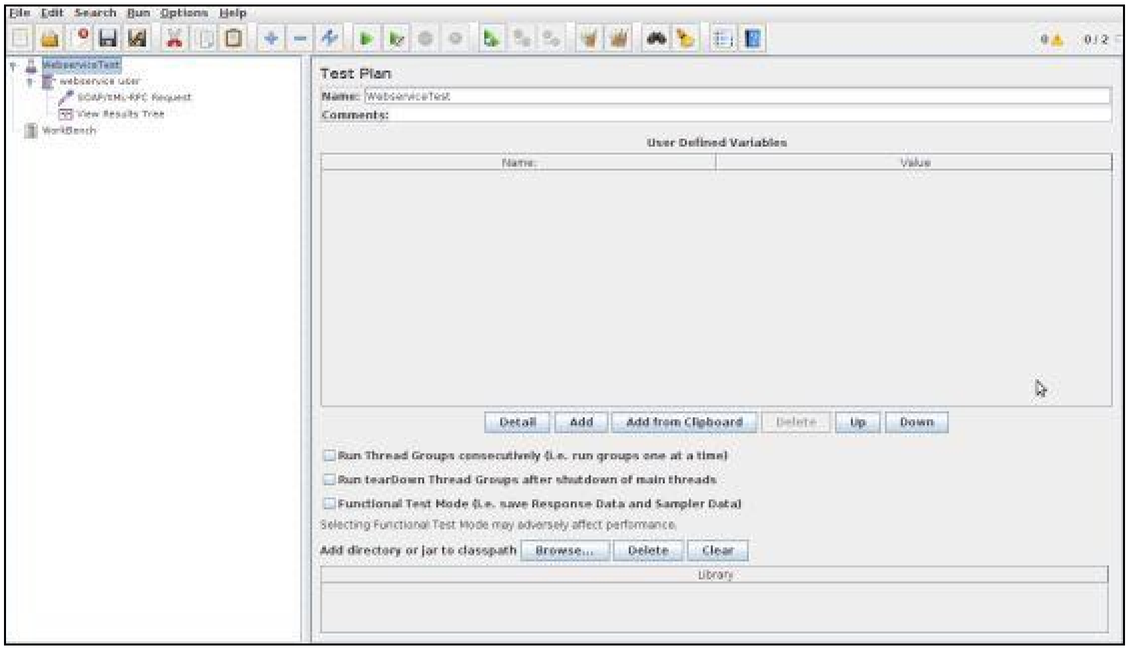
Now let us create a test plan to test the above webservice.

Rename the Test Plan

Open the JMeter window by clicking /home/manisha/apache-jmeter2.9/bin/jmeter.sh.

Click the Test Plan node.

Rename this Test Plan node as WebserviceTest.



Name: WebserviceTest

Comments:

☐ Run Thread Groups consecutively (i.e. run groups one at a time)

☐ Run tearDown Thread Groups after shutdown of main threads

☐ Functional Test Mode (i.e. save Response Data and Sampler Data)

Selecting Functional Test Mode may adversely affect performance.

Add directory or jar to classpath

Add Thread Group

Add one Thread Group, which is placeholder for all other elements like Samplers, Controllers, and Listeners.

Right click on WebserviceTest (our Test Plan) → Add → Threads (Users) → Thread Group. Thread Group will get added under the Test Plan (WebserviceTest) node.

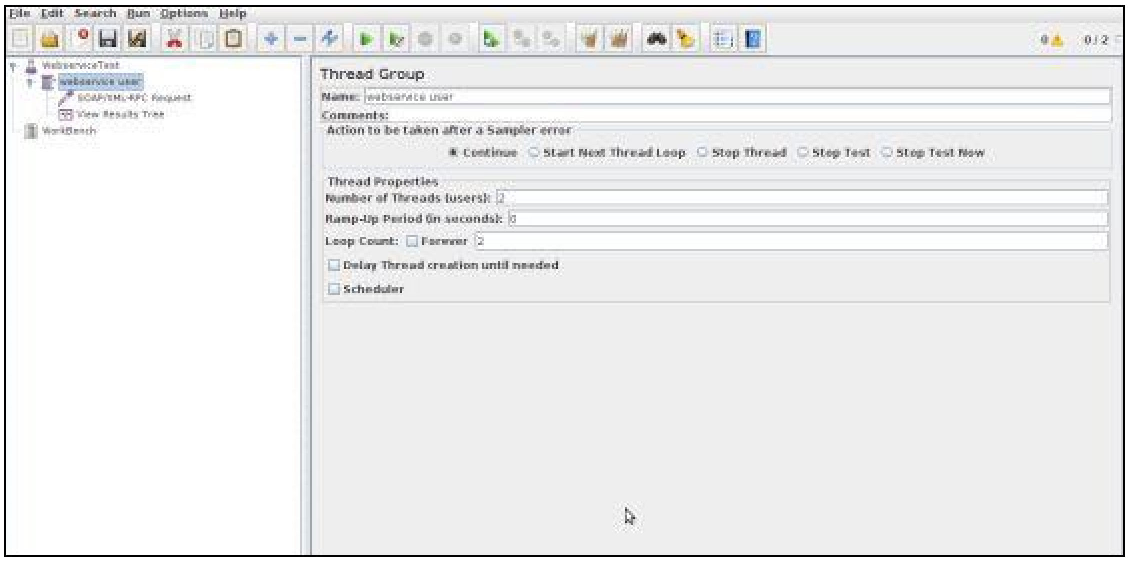
Next, let us modify the default properties of the Thread Group to suit our testing. Following properties are changed –

Name – webservice user

Number of Threads (Users) – 2

Ramp-Up Period – leave the the default value of 0 seconds.

Loop Count – 2



Thread Group

Name: webservice user

Comments:

Action to be taken after a Sampler error

[✓ Continue] Start Next Thread Loop Stop Thread Stop Test Stop Test Now

Thread Properties

Number of Threads (users): 2

Ramp-Up Period (in seconds): 0

Loop Count: ☐ Forever 2

☐ Delay Thread creation until needed

☐ Scheduler

Add Sampler - SOAP/XML-RPC Request

Now that we have defined the users, it is time to define the tasks that they will be performing.

We will add SOAP/XML-RPC Request element –

Right-click mouse button to get the Add menu.

Select Add → Sampler → SOAP/XML-RPC Request.

Select the SOAP/XML-RPC Request element in the tree

Edit the following properties as in the image below –

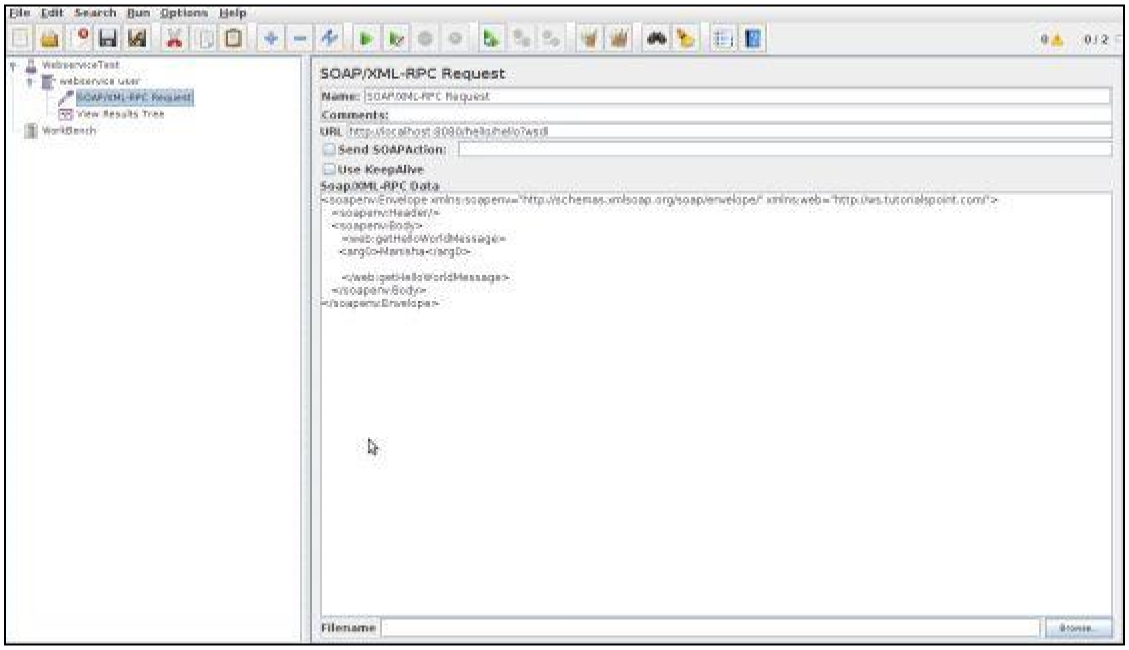
The following details are entered in this element –

Name – SOAP/XML-RPC Request

URL – http://localhost:8080/hello/hello?wsdl

Soap/XML-RPC Data – Enter the below contents

```
<soapenv:Envelope xmlns:soapenv = "http://schemas.xmlsoap.org/soap/envelope/" xmlns:web = "http:/
   <soapenv:Header/>

   <soapenv:Body>

      <web:getHelloWorldMessage>
         <arg0>Manisha</arg0>
      </web:getHelloWorldMessage>

   </soapenv:Body>

</soapenv:Envelope>
```



SOAP/XML-RPC Request

Name: SOAP/XML-RPC Request

Comments:

URL http://localhost:8080/hello/hello?wsdl

Send SOAPAction:

Use KeepAlive

Soap/XML-RPC Data

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/" xmlns:web="http://ws.tutorialspoint.com/">
  <soapenv:Header/>
  <soapenv:Body>
    <web:getHelloWorldMessage>
   <arg0>Manisha</arg0>

    </web:getHelloWorldMessage>
  </soapenv:Body>
</soapenv:Envelope>
```

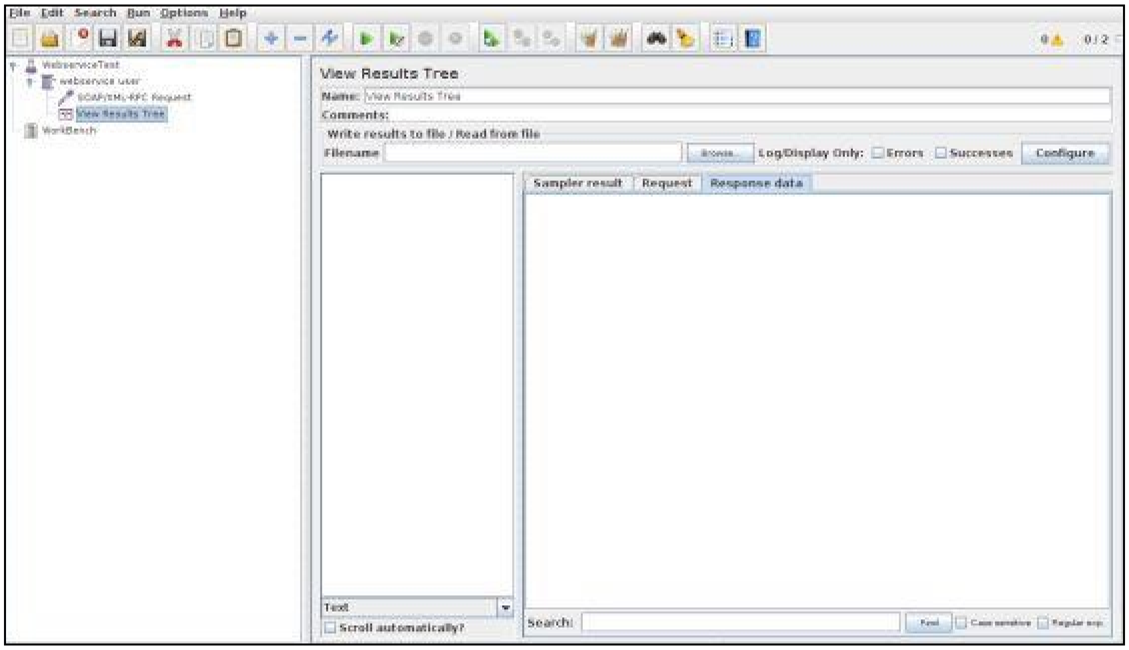
Filename

Add Listener

The final element you need to add to your Test Plan is a Listener. This element is responsible for storing all of the results of your HTTP requests in a file and presenting a visual model of the data.

Select the webservice user element.

Add a View Results Tree listener by selecting Add → Listener → View Results Tree.



View Results Tree

Name: View Results Tree

Comments:

Write results to file / Read from file

Filename Log/Display Only: Errors Successes

Scroll automatically?

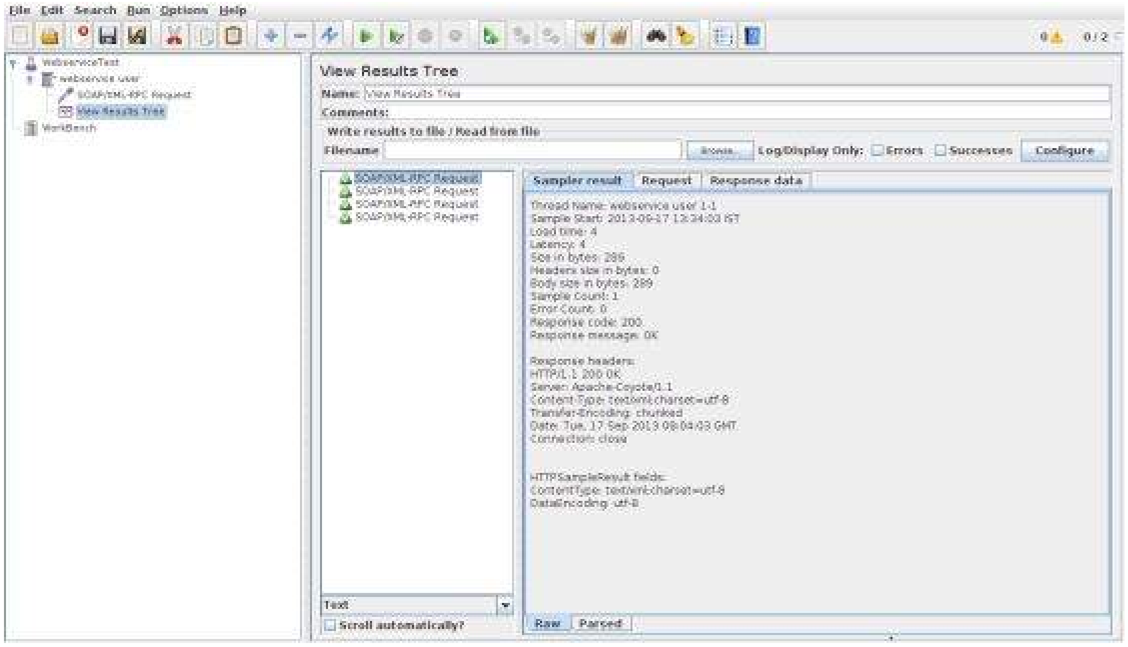
Search: Case sensitive Regular exp.

Run the Test Plan

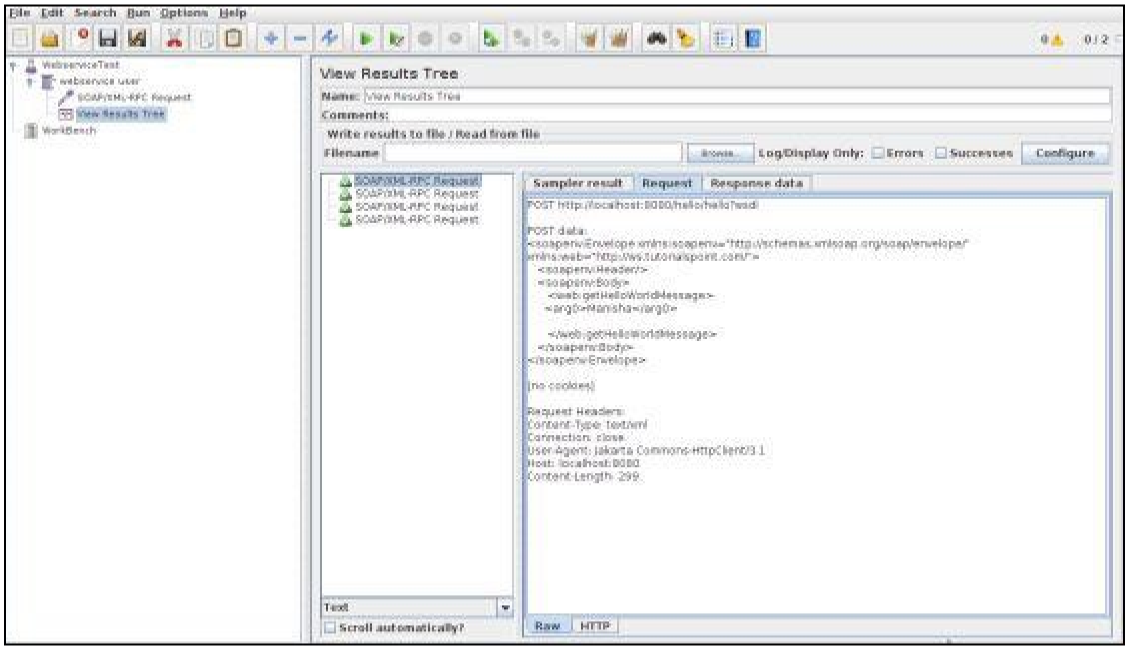
Now save the above test plan as *test_webservice.jmx*. Execute this test plan using Run → Start option.

View the Output

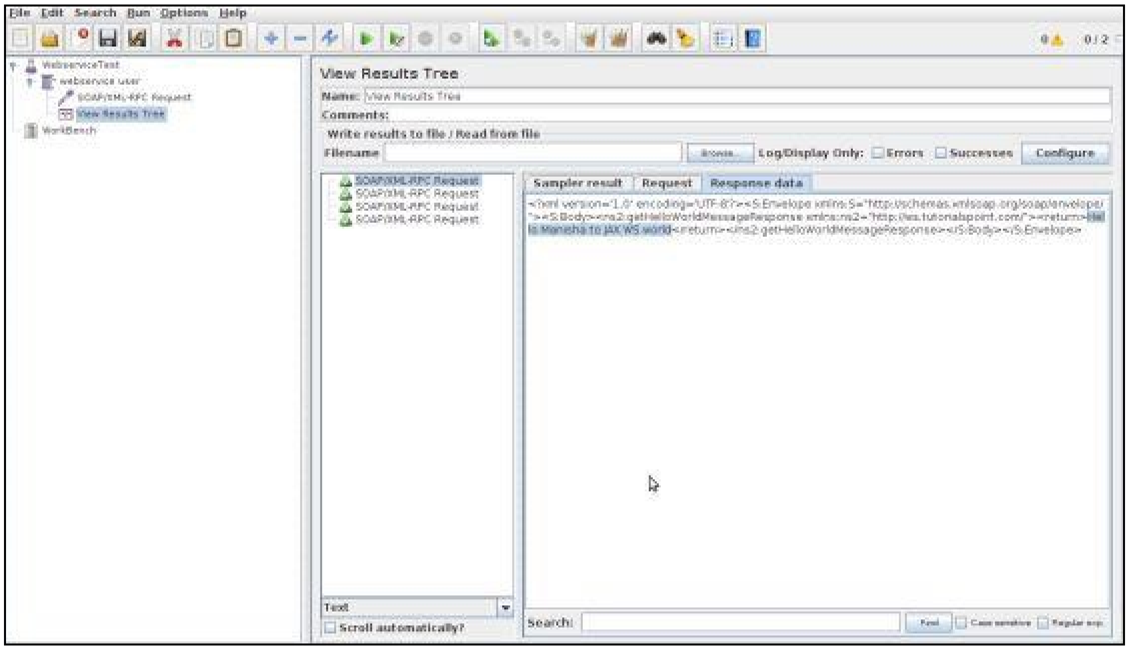
The following output can be seen in the listener.



```
Thread Name: webservice user 1-1
Sample Start: 2013-09-17 13:34:03 IST
Load time: 4
Latency: 4
Size in bytes: 289
Headers size in bytes: 0
Body size in bytes: 289
Sample Count: 1
Error Count: 0
Response code: 200
Response message: OK

Response headers:
HTTP/1.1 200 OK
Server: Apache-Coyote/1.1
Content-Type: text/xml;charset=utf-8
Transfer-Encoding: chunked
Date: Tue, 17 Sep 2013 08:04:03 GMT
Connection: close


HTTPSampleResult fields:
ContentType: text/xml;charset=utf-8
DataEncoding: utf-8
```



```
POST http://localhost:8080/hello/hello?wsdl

POST data:
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:web="http://ws.tutorialspoint.com/">
  <soapenv:Header/>
  <soapenv:Body>
    <web:getHelloWorldMessage>
    <arg0>Manisha</arg0>

    </web:getHelloWorldMessage>
  </soapenv:Body>
</soapenv:Envelope>

[no cookies]

Request Headers:
Content-Type: text/xml
Connection: close
User-Agent: Jakarta Commons-HttpClient/3.1
Host: localhost:8080
Content-Length: 299
```



```
<?xml version="1.0" encoding="UTF-8"?><S:Envelope xmlns:S="http://schemas.xmlsoap.org/soap/envelope/
"><S:Body><ns2:getHelloWorldMessageResponse xmlns:ns2="http://ws.tutorialspoint.com/"><return>Hel
lo Manisha to JAX WS world</return></ns2:getHelloWorldMessageResponse></S:Body></S:Envelope>
```

In the last image, you can see the response message "Hello Manisha to JAX WS world".

jMeter - JMS Test Plan

In this chapter, we will learn how to write a simple test plan to test Java Messaging Service (JMS). JMS supports two types of messaging −

Point-to-Point messaging − Queue messaging is generally used for transactions where the sender expects a response. Messaging systems are quite different from normal HTTP requests. In HTTP, a single user sends a request and gets a response.

Topic messaging − Topic messages are commonly known as pub/sub messaging. Topic messaging is generally used in cases where a message is published by a producer and consumed by multiple subscribers.

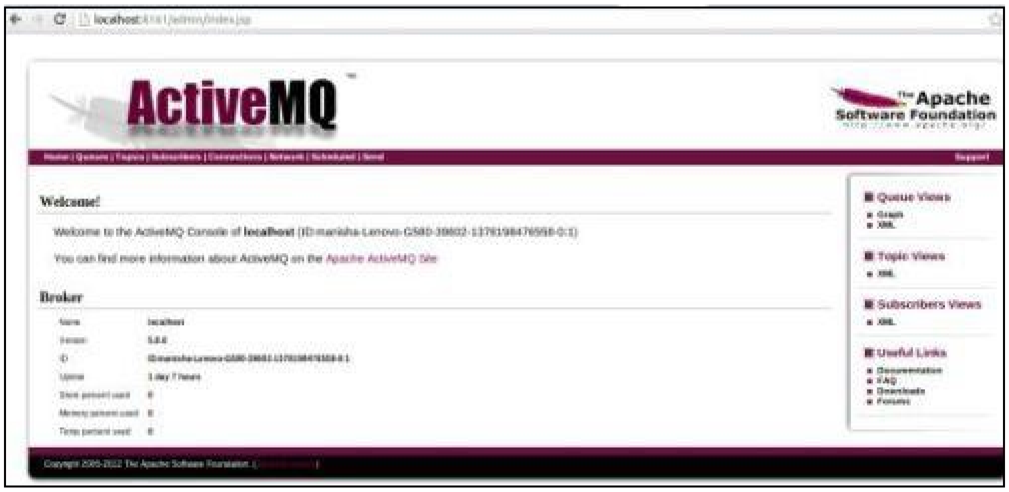
Let us see a test example for each of these. The pre-requisites for testing JMS are −

We use Apache ActiveMQ in the example. There are various JMS servers like IBM WebSphere MQ (formerly MQSeries), Tibco, etc. Download it from the binaries from the Apache ActiveMQ website.

Unzip the archive, go to the decompressed directory, and run the following command from the command console to start the ActiveMQ server −

```
.\bin\activemq  start
```

You can verify if the ActiveMQ server has started by visiting the admin interface at the following address **http://localhost:8161/admin/**. If it asks for authentication, then enter the userid and password as *admin*. The screen is similar as shown below −


localhost:8161/admin/index.jsp
ActiveMQ
The Apache Software Foundation
Home | Queues | Topics | Subscribers | Connections | Network | Scheduled | Send
Support
Queue Views
Graph
XML
Topic Views
XML
Subscribers Views
XML
Useful Links
Documentation
FAQ
Downloads
Forums

Welcome!

Welcome to the ActiveMQ Console of **localhost** ([illegible])

You can find more information about ActiveMQ on the Apache ActiveMQ Site

Broker

Name	localhost
Version	5.8.0
ID	[illegible]
Uptime	1 day 7 hours
Store percent used	0
Memory percent used	0
Temp percent used	0

Copyright 2005-2012 The Apache Software Foundation. ([illegible])

Now copy the activemq-all-x.x.x.jar (XXX depending on the version) from the ActiveMQ unzipped directory to **/home/manisha/apache-jmeter-2.9/lib.**

With the above setup, let us build the test plan for −

JMS Point-to-Point Test Plan

JMS Topic Test Plan

jMeter - Monitor Test Plan

In this chapter, we will discuss how to create a Test Plan using JMeter to monitor webservers. The uses of monitor tests are as follows −

Monitors are useful for a stress testing and system management.

Used with stress testing, the monitor provides additional information about server performance.

Monitors make it easier to see the relationship between server performance and response time on the client side.

As a system administration tool, the monitor provides an easy way to monitor multiple servers from one console.

We need Tomcat 5 or above for monitoring. For our test purpose, we will monitor Tomcat 7.0.42 server. You can test any servlet container that supports Java Management Extension (JMX). Let us write a test case to monitor the Tomcat server. Let us first set up our tomcat server.

Setup Tomcat Server

We start with opening the Tomcat service status. To do this, edit the configuration file for users, **<TOMCAT_HOME>/conf/tomcat-users.xml**. This file contains a tomcat-users section (commented) as shown −

```
<tomcat-users>

<!--
   <role rolename = "tomcat"/>
   <role rolename = "role1"/>
   <user username = "tomcat" password = "tomcat" roles = "tomcat"/>
   <user username = "both" password = "tomcat" roles = "tomcat,role1"/>
   <user username = "role1" password = "tomcat" roles = "role1"/>
-->

</tomcat-users>
```

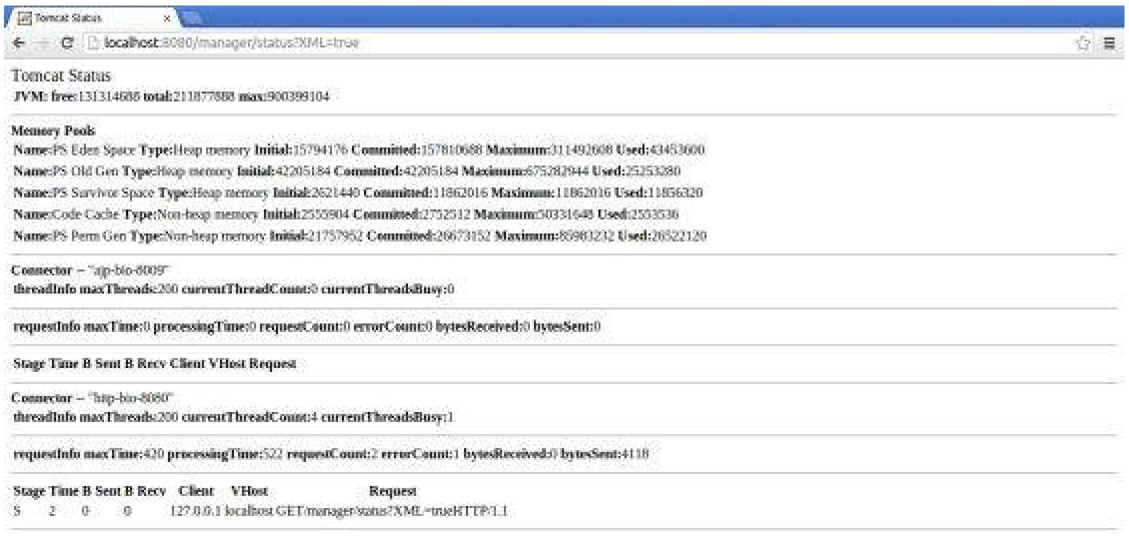
We need to change this section to add the admin roles, manager, manager-gui and assign the user "admin". The revised file is as follows –

```
<tomcat-users>

   <role rolename = "manager-gui"/>
   <role rolename = "manager-script"/>
   <role rolename = "manager-jmx"/>
   <role rolename = "manager-status"/>
   <user username = "admin" password = "admin" roles = "manager-gui,manager-script,manager-jmx,ma

</tomcat-users>
```

Now start the tomcat server <TOMCAT_HOME>/bin/startup.sh for Linux and <TOMCAT_HOME>/bin/startup.bat for windows. Once started, check that the Tomcat supervision works by entering the following link in your browser –

```
http://localhost:8080/manager/status?XML=true
```

An authentication window appears in the browser. Enter the tomcat login and password associated (in our case it is admin). Then, the browser shows the execution status of Tomcat as below –



```
Tomcat Status
 JVM: free:131314688 total:211877888 max:900399104

Memory Pools
 Name:PS Eden Space Type:Heap memory Initial:15794176 Committed:157810688 Maximum:311492608 Used:43453600
 Name:PS Old Gen Type:Heap memory Initial:42205184 Committed:42205184 Maximum:675282944 Used:25253280
 Name:PS Survivor Space Type:Heap memory Initial:2621440 Committed:11862016 Maximum:11862016 Used:11856320
 Name:Code Cache Type:Non-heap memory Initial:2555904 Committed:2752512 Maximum:50331648 Used:2553536
 Name:PS Perm Gen Type:Non-heap memory Initial:21757952 Committed:26673152 Maximum:85983232 Used:26522120

Connector – "ajp-bio-8009"
 threadInfo maxThreads:200 currentThreadCount:0 currentThreadsBusy:0

 requestInfo maxTime:0 processingTime:0 requestCount:0 errorCount:0 bytesReceived:0 bytesSent:0

 Stage Time B Sent B Recv Client VHost Request

Connector – "http-bio-8080"
 threadInfo maxThreads:200 currentThreadCount:4 currentThreadsBusy:1

 requestInfo maxTime:420 processingTime:522 requestCount:2 errorCount:1 bytesReceived:0 bytesSent:4118

 Stage Time B Sent B Recv   Client    VHost                  Request
 S      2      0      0      127.0.0.1 localhost GET/manager/status?XML=trueHTTP/1.1
```

From the above screenshot, we can note a few things −

In the URL, note that *XML = true* (note the case sensitivity) allows a clean display of the supervisory Tomcat necessary for the JMeter functioning.

Also note that there are default two connectors. The AJP connector used in general coupled with the mod_jk Apache HTTPD front module and the HTTP connector which is commonly used connector for direct access to Tomcat via port 8080.

Write JMeter Test Plan

Let us monitor the Tomcat server by writing a test plan −

Rename Test Plan

Open the JMeter window by clicking /home/manisha/apache-jmeter2.9/bin/jmeter.sh.

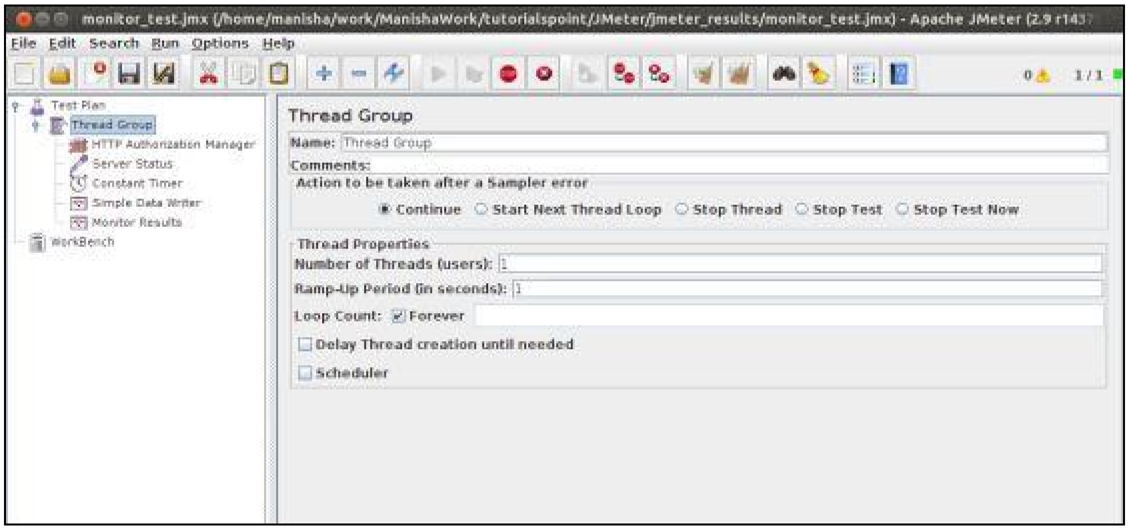
Click the Test Plan node.

Add a thread group as explained in the next step.

Add Thread Group

Right-click on **Test Plan** → **Add** → **Threads(Users)** → **Thread Group**. Thread Group will get added under the Test Plan node.

Change the loop count to forever (or some large number) so that enough samples are generated.


monitor_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/monitor_test.jmx) - Apache JMeter (2.9 r143
File Edit Search Run Options Help
Test Plan
Thread Group
HTTP Authorization Manager
Server Status
Constant Timer
Simple Data Writer
Monitor Results
WorkBench

Thread Group

Name: Thread Group

Comments:

Action to be taken after a Sampler error

[✓ Continue] Start Next Thread Loop Stop Thread Stop Test Stop Test Now

Thread Properties

Number of Threads (users): 1

Ramp-Up Period (in seconds): 1

Loop Count: [✓ Forever]

☐ Delay Thread creation until needed

☐ Scheduler

HTTP Authorization Manager

Add HTTP Authorization Manager to the Thread Group element by selecting Add → Config element → HTTP Authorization Manager. This element manages authentication requested by the browser to see the Tomcat server status.

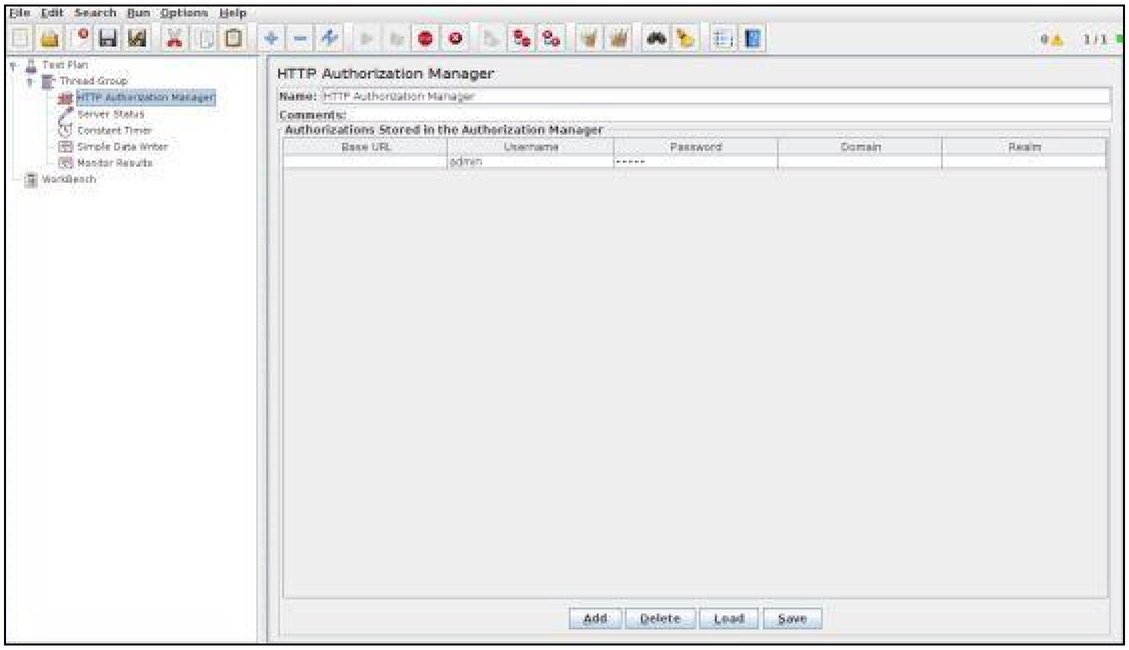
Select the HTTP Authorization Manager.

Edit the following details –

Username – admin (depending on the configuration in tomcat-users.xml file)

Password – admin (depending on the configuration in the tomcatusers.xml file)

The other fields are left empty.



HTTP Authorization Manager

Name: HTTP Authorization Manager

Comments:

Authorizations Stored in the Authorization Manager

Base URL	Username	Password	Domain	Realm
	admin	-----		

Add Sampler-HTTP Request

Now that we have defined our users, it is time to define the tasks that they will be performing. We add HTTP Request element.

Right click the mouse button to get the Add menu.

Select Add → Sampler → HTTP Request.

Then, select the HTTP Request element in the tree.

Edit the following properties as in the image below –

The following details are entered in this element –

Name – Server Status

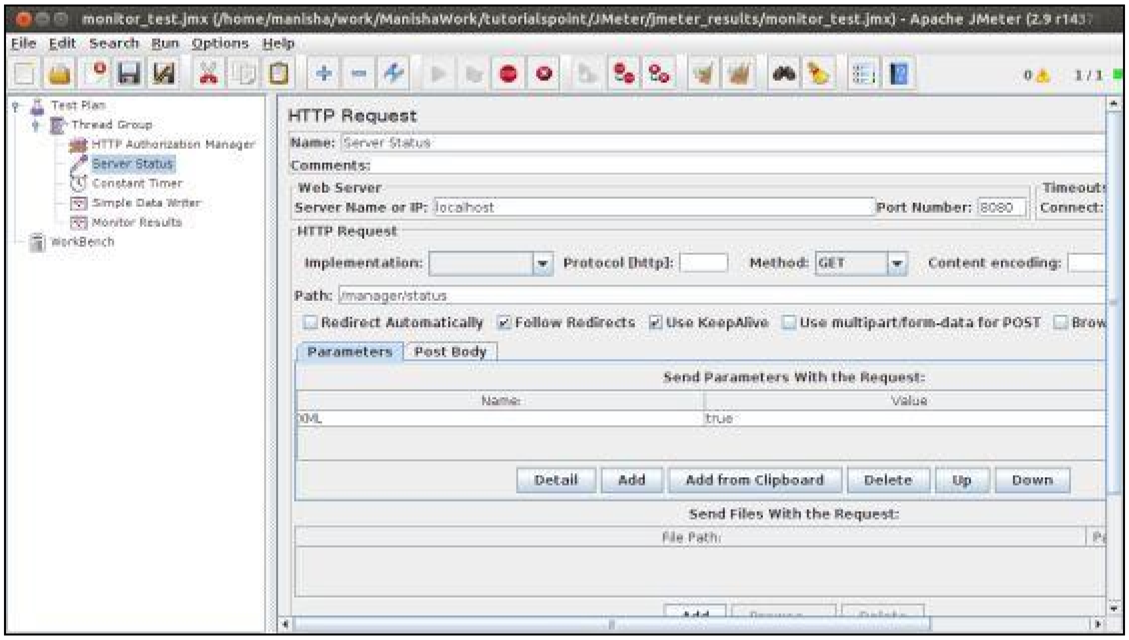
Server Name or IP – localhost

Port – 8080

Path – /manager/status

Parameters – Add a request parameter named "XML" in uppercase. Give it a value of "true" in lowercase.

Optional Tasks – Check "Use as Monitor" at the bottom of the sampler.



monitor_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/monitor_test.jmx) - Apache JMeter (2.9 r143

HTTP Request

Name: Server Status

Web Server: Server Name or IP: localhost, Port Number: 8080

HTTP Request: Method: GET, Path: /manager/status

Follow Redirects ✓, Use KeepAlive ✓

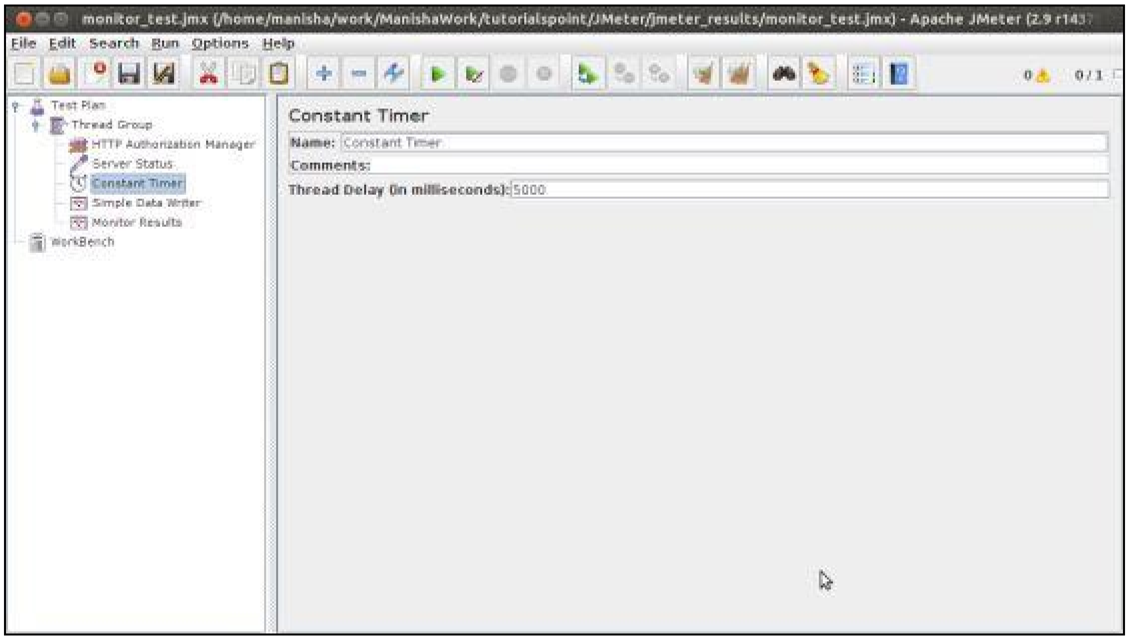
Send Parameters With the Request:

Name:	Value:
XML	true

Add a Constant Timer

To request the status of the server periodically, add a Constant Timer which will allow a time interval between each request. Add a timer to this thread group by selecting Add → Timer → Constant Timer.

Enter 5000 milliseconds in the *Thread Delay* box. In general, using intervals shorter than 5 seconds may add stress to your server. Find out what is an acceptable interval before you deploy the monitor in your production environment.



monitor_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/monitor_test.jmx) - Apache JMeter (2.9 r143

Constant Timer

Name: Constant Timer

Thread Delay (in milliseconds): 5000

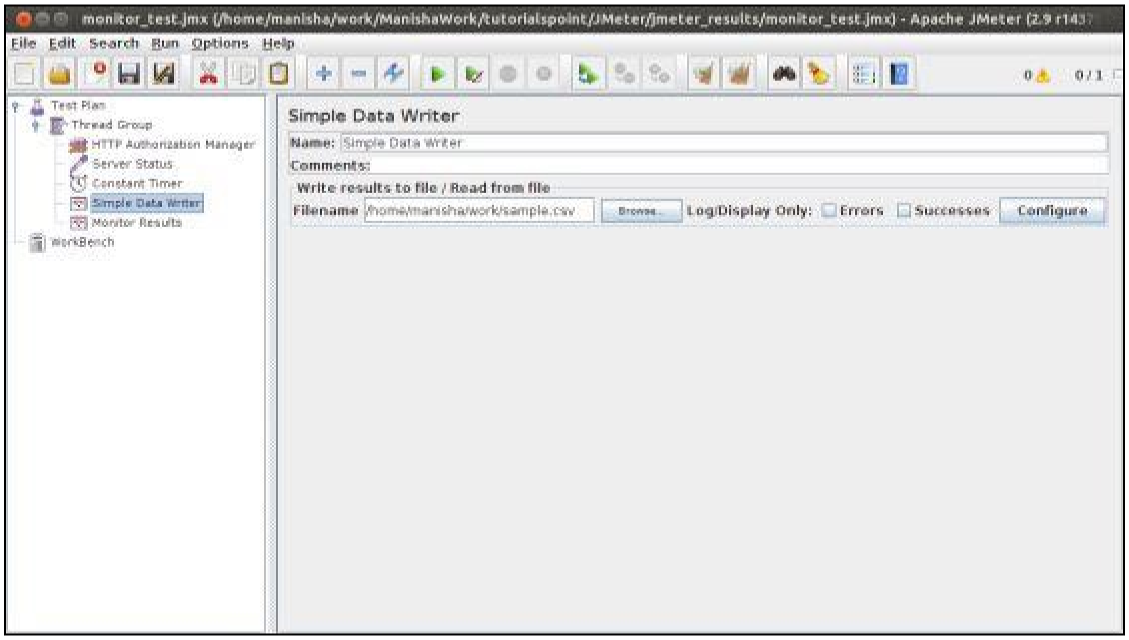
Add Listener

The final element you need to add to your Test Plan is a Listener. We add two types of listeners. One that stores results in a file and second that shows the graphical view of the results.

Select the thread group element.

Add a Simple Data Writer listener Add → Listener → Simple Data Writer.

Specify a directory and filename of the output file (in our case, it is /home/manisha/work/sample.csv)



monitor_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/monitor_test.jmx) - Apache JMeter (2.9 r143

Simple Data Writer

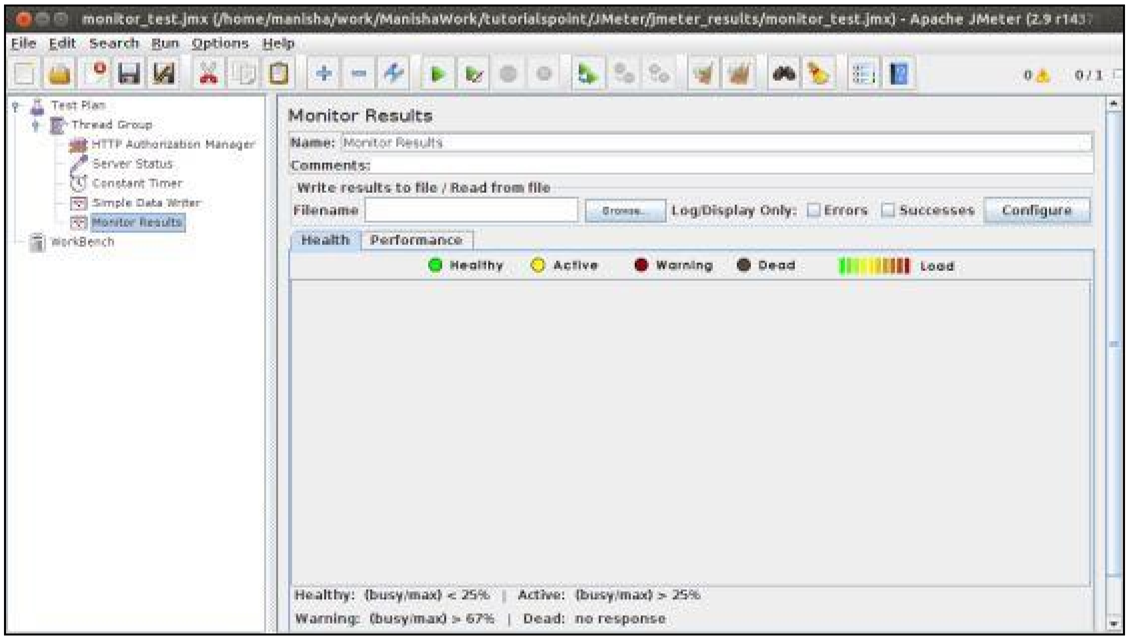
Name: Simple Data Writer

Comments:

Write results to file / Read from file

Filename /home/manisha/work/sample.csv Log/Display Only: ☐ Errors ☐ Successes

Let us add another listener by selecting the test plan element Add → Listener → Monitor Results.



monitor_test.jmx (/home/manisha/work/ManishaWork/tutorialspoint/JMeter/jmeter_results/monitor_test.jmx) - Apache JMeter (2.9 r143

Monitor Results

Name: Monitor Results

Comments:

Write results to file / Read from file

Filename Log/Display Only: ☐ Errors ☐ Successes

Healthy: (busy/max) < 25% | Active: (busy/max) > 25%

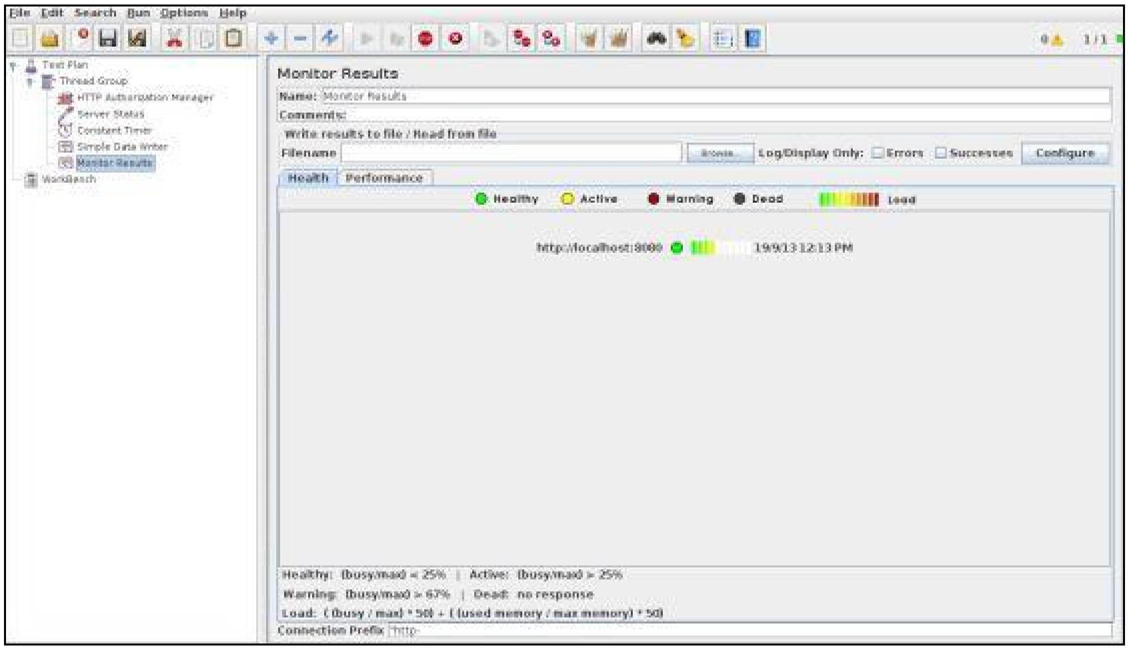
Warning: (busy/max) > 67% | Dead: no response

Run the Test Plan

Now save the above test plan as *monitor_test.jmx*. Execute this test plan using Run → Start option.

View the Output

Results will be saved in /home/manisha/work/sample.csv file. You can also see a graphical result in the Monitor result listener as in the image below.



Name: Monitor Results

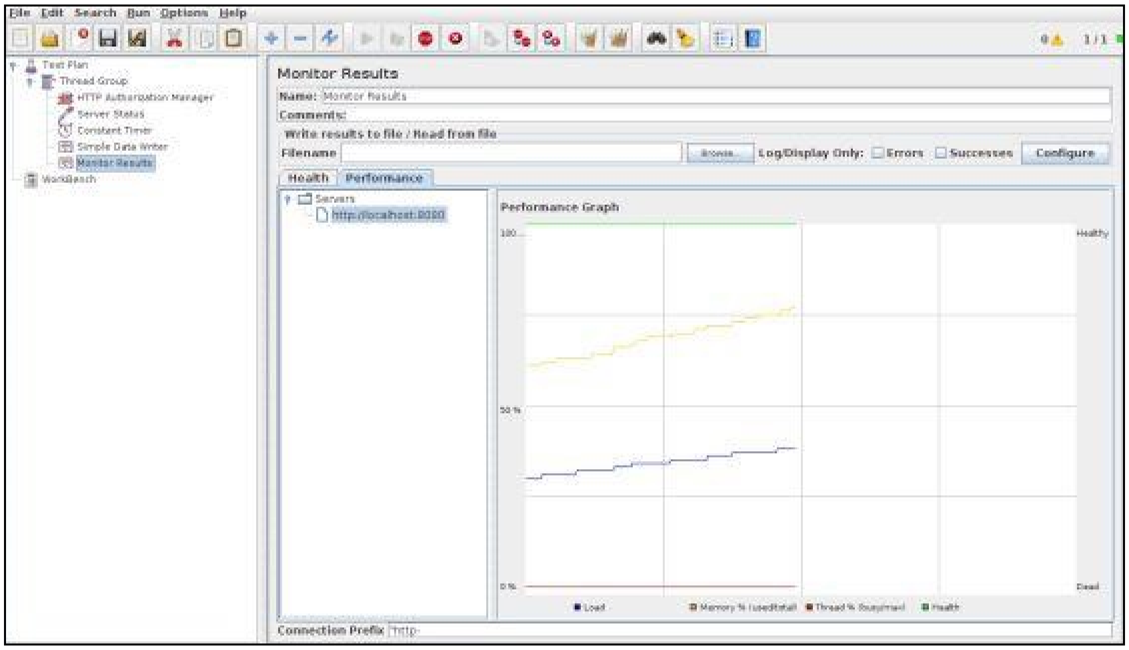
http://localhost:8080 19/9/13 12:13 PM

Healthy: (busy/max) < 25% | Active: (busy/max) > 25%

Warning: (busy/max) > 67% | Dead: no response

Load: ((busy / max) * 50) + ((used memory / max memory) * 50)

Connection Prefix http:



Note the graph has captions on both sides of the graph. On the left is percent and the right is dead/healthy. If the memory line spikes up and down rapidly, it could indicate memory thrashing. In those situations, it is a good idea to profile the application with Borland OptimizeIt or JProbe. What you want to see is a regular pattern for load, memory and threads. Any erratic behavior usually indicates poor performance or a bug of some sort.

jMeter - Listeners

Listeners provide access to the information JMeter gathers about the test cases while JMeter runs. The results or information gathered by listeners can be shown in the form of −

- tree
- tables
- graphs
- log file

All listeners write the same raw data to the output file when one is specified.

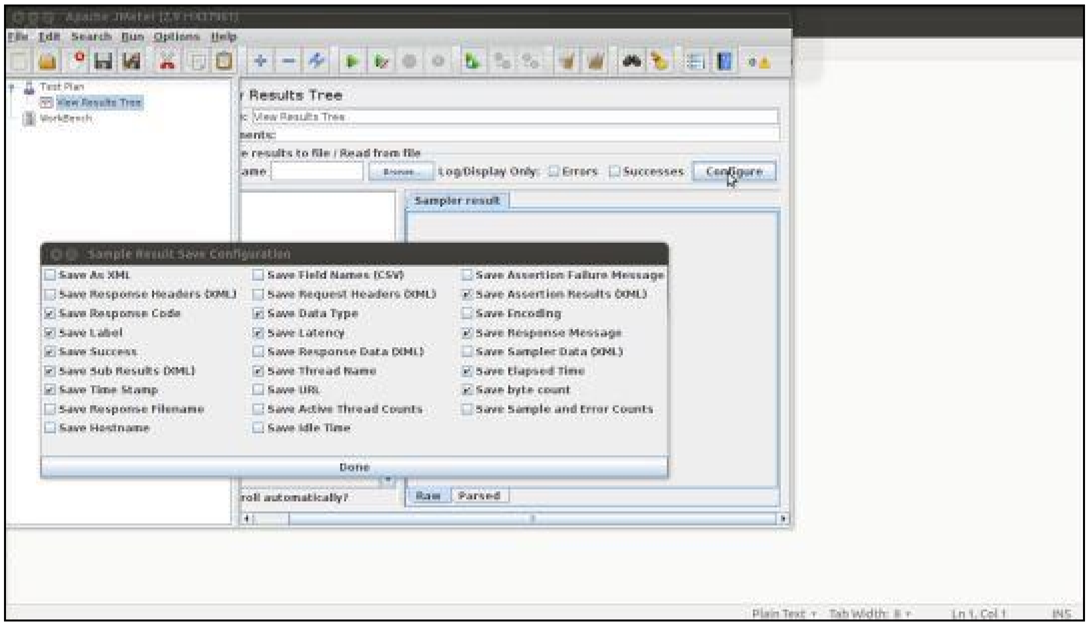
Default Configuration

The default items to be saved can be defined in one of the following two ways −

- In the **jmeter.properties** (or user.properties) file. This file is present in the **/bin** folder of JMeter.To change the default format, find the following line in jmeter.properties −

```
jmeter.save.saveservice.output_format=
```

- By using the Config popup as shown in the following screenshot −



Sample Result Save Configuration

☐ Save As XML	☐ Save Field Names (CSV)	☐ Save Assertion Failure Message
☐ Save Response Headers (XML)	☐ Save Request Headers (XML)	✓ Save Assertion Results (XML)
✓ Save Response Code	✓ Save Data Type	☐ Save Encoding
✓ Save Label	✓ Save Latency	✓ Save Response Message
✓ Save Success	☐ Save Response Data (XML)	☐ Save Sampler Data (XML)
✓ Save Sub Results (XML)	✓ Save Thread Name	✓ Save Elapsed Time
✓ Save Time Stamp	☐ Save URL	✓ Save byte count
☐ Save Response Filename	☐ Save Active Thread Counts	☐ Save Sample and Error Counts
☐ Save Hostname	☐ Save Idle Time	

JMeter creates results of a test run as JMeter Text Logs(JTL). These are normally called JTL files, as that is the default extension – but any extension can be used.

If multiple tests are run using the same output file name, then JMeter automatically appends new data at the end of the file.

The listener can record results to a file but not to the UI. It is meant to provide an efficient means of recording data by eliminating GUI overhead.

When running in −

- **GUI mode** − use the listener Simple Data Writer
- **non-GUI mode** − the -l flag can be used to create a data file.

Listeners can use a lot of memory if there are a lot of samples. To minimize the amount of memory needed, use the Simple Data Write with CSV format.

CSV Log format

The CSV log format depends on which data items are selected in the configuration. Only the specified data items are recorded in the file. The order of appearance of columns is fixed, and is as follows −

Field	Description	Value Example
timeStamp	in milliseconds since 1/1/1970	1354223881017
elapsed	in milliseconds	1858
label	sampler label	HTTP Request
responseCode	e.g. 200, 404	200
responseMessage	e.g. OK	OK
threadName		Thread Group 1-1
dataType	e.g. text	text
success	true or false	true
failureMessage	if any	
bytes	number of bytes in the sample	34908
grpThreads	number of active threads in this thread group	1
allThreads	total number of active threads in all groups	1
URL		http://tutorialspoint.com
Filename	if Save Response to File was used	
latency	time to first response	132
encoding		utf-8
SampleCount	number of samples (1, unless multiple samples are aggregated)	1

ErrorCount	number of errors (0 or 1, unless multiple samples are aggregated)	0
Hostname	where the sample was generated	LaptopManisha
IdleTime	number of milliseconds of 'Idle' time (normally 0)	
Variables	if specified	

Saving Response Data

The response data can be saved in the XML log file if required. However it does not allow to save large files and images. In such cases, use the Post-Processor Save_Responses_to_a_file. This generates a new file for each sample, and saves the file name with the sample. The file name can then be included in the sample log output. The data will be retrieved from the file if necessary when the sample log file is reloaded.

Loading (reading) response data

To view an existing results file, you can use the file "Browse..." button to select a file. If necessary, just create a dummy testplan with the appropriate Listener in it.

Saving the Listener GUI Data

JMeter is capable of saving any listener as a PNG file. To do so,

Select the listener in the left panel by selecting Edit → Save As Image. A file dialog appears.

Enter the desired name.

Save the listener.

jMeter - Functions

JMeter Functions and User Variables

JMeter functions are special values that can populate fields of any Sampler or other element in a test tree.

A function call looks like this −

```
${__functionName(var1,var2,var3)}
```

_functionName matches the name of a function. For example **${__threadNum}**.

If a function parameter contains a comma, then make sure you escape this with "\" as shown below −

```
${__time(EEE\, d MMM yyyy)}
```

Variables are referenced as −

```
${VARIABLE}
```

List of Functions

Following table lists a group of functions loosely grouped into types −

Function Type	Name	Comment
Information	threadNum	Get thread number.
Information	samplerName	Get the sampler name (label).
Information	machineIP	Get the local machine IP address.
Information	machineName	Get the local machine name.
Information	time	Return current time in various formats.
Information	log	Log (or display) a message (and return the value).
Information	logn	Log (or display) a message (empty return value).
Input	StringFromFile	Read a line from a file.
Input	FileToString	Read an entire file.
Input	CSVRead	Read from CSV delimited file.
Input	XPath	Use an XPath expression to read from a file.
Calculation	counter	Generate an incrementing number.
Calculation	intSum	Add int numbers.
Calculation	longSum	Add long numbers.
Calculation	Random	Generate a random number.
Calculation	RandomString	Generate a random string.

Calculation	UUID	Generate a random type 4 UUID.
Scripting	BeanShell	Run a BeanShell script.
Scripting	javaScript	Process JavaScript (Mozilla Rhino).
Scripting	jexl, jexl2	Evaluate a Commons Jexl expression.
Properties	property	Read a property.
Properties	P	Read a property (shorthand method).
Properties	setProperty	Set a JMeter property.
Variables	split	Split a string into variables.
Variables	V	Evaluate a variable name.
Variables	eval	Evaluate a variable expression.
Variables	evalVar	Evaluate an expression stored in a variable.
String	regexFunction	Parse previous response using a regular expression.
String	escapeOroRegexpChars	Quote meta chars used by ORO regular expression.
String	char	Generate Unicode char values from a list of numbers.
String	unescape	Process strings containing Java escapes (e.g. \n & \t).
String	unescapeHtml	Decode HTML-encoded strings.
String	escapeHtml	Encode strings using HTML encoding.
String	TestPlanName	Return name of current test plan.

There are two kinds of functions −

User-defined static values (or variables)

Built-in functions

User-defined static values allow the user to define variables to be replaced with their static value when a test tree is compiled and submitted to be run.

The variables cannot be nested; i.e **${Var${N}}** does not work.

The __V (variable) function (versions after 2.2) can be used to do this − ${__V(Var${N})}.

This type of replacement is possible without functions, but it is less convenient and less intuitive.

Where to Use Functions And Variables

Functions and variables can be written into any field of any test component.

The following functions should work well in a test plan −

- intSum
- longSum
- machineName
- BeanShell
- javaScript
- jexl
- random
- time
- property functions
- log functions

Functions which are used on the Test Plan have some restrictions. JMeter thread variables will have not been fully set up when the functions are processed, so variable names passed as parameters will not be set up and variable references will not work. Hence, *split()* and *regex()* and the variable evaluation functions will not work. The *threadNum()* function will not work and it does not make sense at test plan level.

Referencing Variables and Functions

Referencing a variable in a test element is done by bracketing the variable name with '${' and '}'.

Functions are referenced in the same manner, but by convention, the names of functions begin with "__" to avoid conflict with user value names.

Some functions take arguments to configure them, and these go in parentheses, comma-delimited. If the function takes no arguments, the parentheses can be omitted. For example −

```
${__BeanShell(vars.put("name"\,"value"))}
```

Alternatively, you can define your script as a variable, e.g. on the Test Plan −

```
SCRIPT     vars.put("name","value")
```

The script can then be referenced as follows −

```
${__BeanShell(${SCRIPT})}
```

The Function Helper Dialog

The Function Helper Dialog is available from JMeter's **Options** tab.

Using the Function Helper, you can select a function from the pull down, and assign values for its arguments. The left column in the table provides a brief description of the argument, and the right column is where you write the value for that argument. Different functions take different arguments.

Once you have done this, click the “Generate" button, and the appropriate string is generated, which you can copy-paste into the test plan wherever you need to.

Pre-defined Variables

Some variables are defined internally by JMeter. They are −

COOKIE_cookiename − contains the cookie value.

JMeterThread.last_sample_ok − whether or not the last sample was OK − true/false. Note − this is updated after PostProcessors and Assertions have been run.

START variables.

Pre-defined Properties

Some built-in properties are defined by JMeter. These are listed below. For convenience, the START properties are also copied to variables with the same names.

START.MS − JMeter start time in milliseconds.

START.YMD − JMeter start time as yyyyMMdd.

START.HMS − JMeter start time as HHmmss.

TESTSTART.MS − test start time in milliseconds.

Note that the START variables / properties represent JMeter startup time, not the test start time. They are mainly intended for use in file names etc.

jMeter - Regular Expressions

Regular expressions are used to search and manipulate text, based on patterns. JMeter interprets forms of regular expressions or patterns being used throughout a JMeter test plan, by including the pattern matching software Apache Jakarta ORO .

With the use of regular expressions, we can certainly save a lot of time and achieve greater flexibility as we create or enhance a Test Plan. Regular expressions provide a simple method to get information from pages when it is impossible or very hard to predict an outcome.

> A standard usage example of using expressions is to get a session ID from the server response. If the server returns a unique session key we can easily get it using expressions in our load script.

To use regular expressions in your test plan, you need to use the Regular Expression Extractor of JMeter. You can place regular expressions in any component in a Test Plan.

It is worth stressing the difference between **contains** and **matches**, as used on the Response Assertion test element −

contains means that the regular expression matched at least some part of the target, so 'alphabet' "contains" 'ph.b.' because the regular expression matches the substring 'phabe'.

matches means that the regular expression matched the whole target. Hence the 'alphabet' is "matched" by 'al.*t'.

Suppose you want to match the following portion of a web-page −

```
name = "file" value = "readme.txt"
```

And you want to extract readme.txt. A suitable regular expression would be −

```
name = "file" value = "(.+?)">
```

The special characters above are −

(and **)** − these enclose the portion of the match string to be returned

. − match any character

+ − one or more times

? − stop when first match succeeds

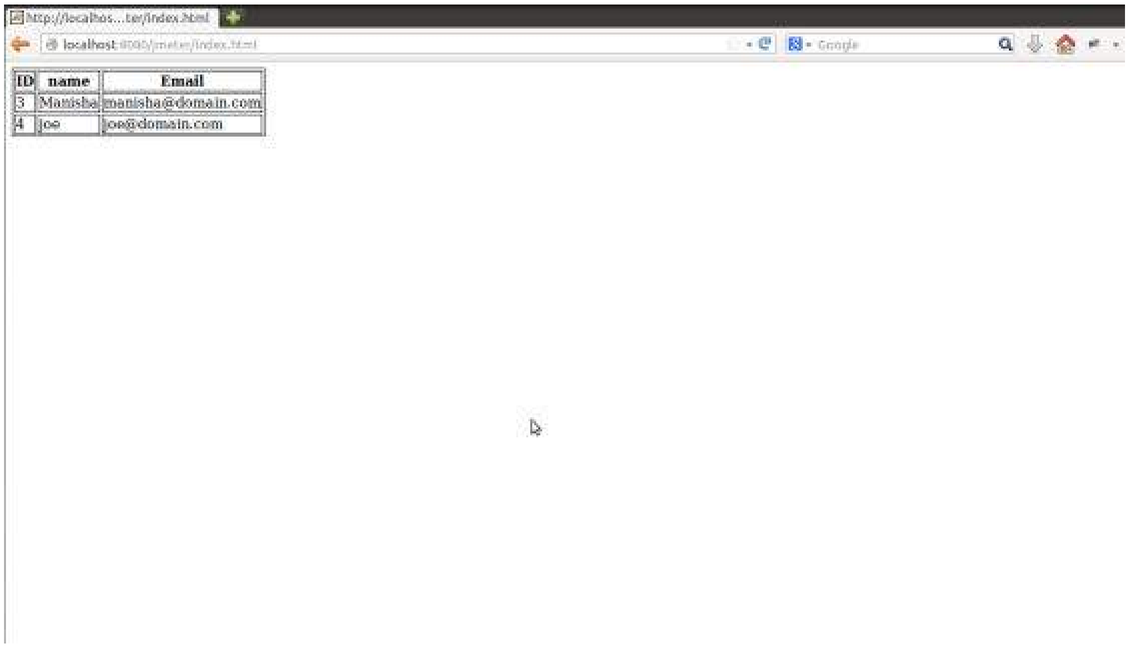
Create JMeter Test Plan

Let us understand the use of Regular expressions in the Regular Expression Extractor—a Post-Processor Element by writing a test plan. This element extracts text from the current page using a Regular Expression to identify the text pattern that a desired element conforms with.

First we write an HTML page which a list of people and their email IDs. We deploy it to our tomcat server. The contents of html (index.html) are as follows –

```
<html>
   <head>
   </head>

   <body>
      <table style = "border: 1px solid #000000;">

         <th style = "border: 1px solid #000000;">ID</th>
         <th style = "border: 1px solid #000000;">name</th>
         <th style = "border: 1px solid #000000;">Email</th>

         <tr>
            <td id = "ID" style = "border: 1px solid #000000;">3</td>
            <td id = "Name" style = "border: 1px solid #000000;">Manisha</td>
            <td id = "Email" style = "border: 1px solid #000000;">manisha@domain.com</td>
         </tr>

         <tr>
            <td id = "ID" style = "border: 1px solid #000000;">4</td>
            <td id = "Name" style = "border: 1px solid #000000;">joe</td>
            <td id = "Email" style = "border: 1px solid #000000;">joe@domain.com</td>
         </tr>

      </table>
   </body>
</html>
```

On deploying it on the tomcat server, this page would look like as shown in the following screenshot –

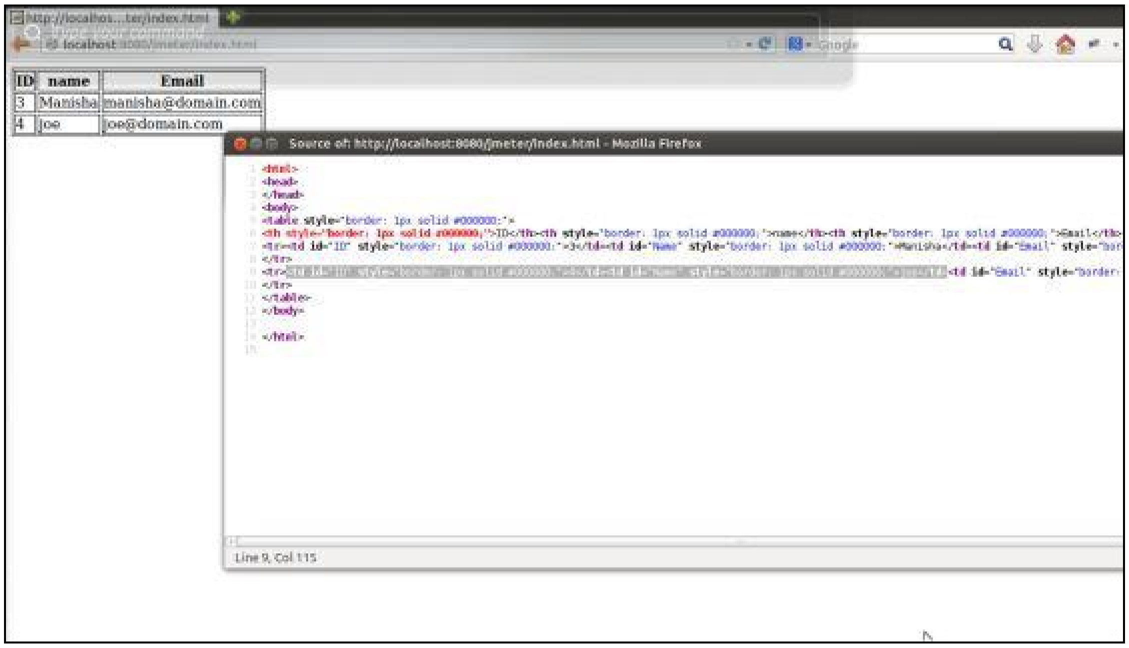


http://localhost:8080/jmeter/index.html

ID	name	Email
3	Manisha	manisha@domain.com
4	joe	joe@domain.com

In our test plan, we will select the person in the first row of the person table seen in the person list page above. To capture the ID of this person, let us first determine the pattern where we will find the person in the second row.

As can be seen in the following snapshot, the ID of the second person is surrounded by <td id = "ID"> and </td >, and it is the second row of data having this pattern. We can use this to match the exact pattern that we want to extract information from. As we want to extract two pieces of information from this page, the person ID and the person name, the fields are defined as follows −



ID	name	Email
3	Manisha	manisha@domain.com
4	joe	joe@domain.com

Source of: http://localhost:8080/jmeter/index.html - Mozilla Firefox

```
<html>
<head>
</head>
<body>
<table style="border: 1px solid #000000;">
<th style="border: 1px solid #000000;">ID</th><th style="border: 1px solid #000000;">name</th><th style="border: 1px solid #000000;">Email</th>
<tr><td id="ID" style="border: 1px solid #000000;">3</td><td id="Name" style="border: 1px solid #000000;">Manisha</td><td id="Email" style="bor
</tr>
<tr><td id="ID" style="border: 1px solid #000000;">4</td><td id="Name" style="border: 1px solid #000000;">joe</td><td id="Email" style="border:
</tr>
</table>
</body>

</html>
```

Line 9, Col 115

Start JMeter, add a Thread group **Test Plan** → **Add**→ **Threads(Users)**→ **Thread Group**.

Next add a sampler HTTP Request, select the test plan, right click **Add** → **Sampler** → **HTTP Request** and enter the details as shown below −

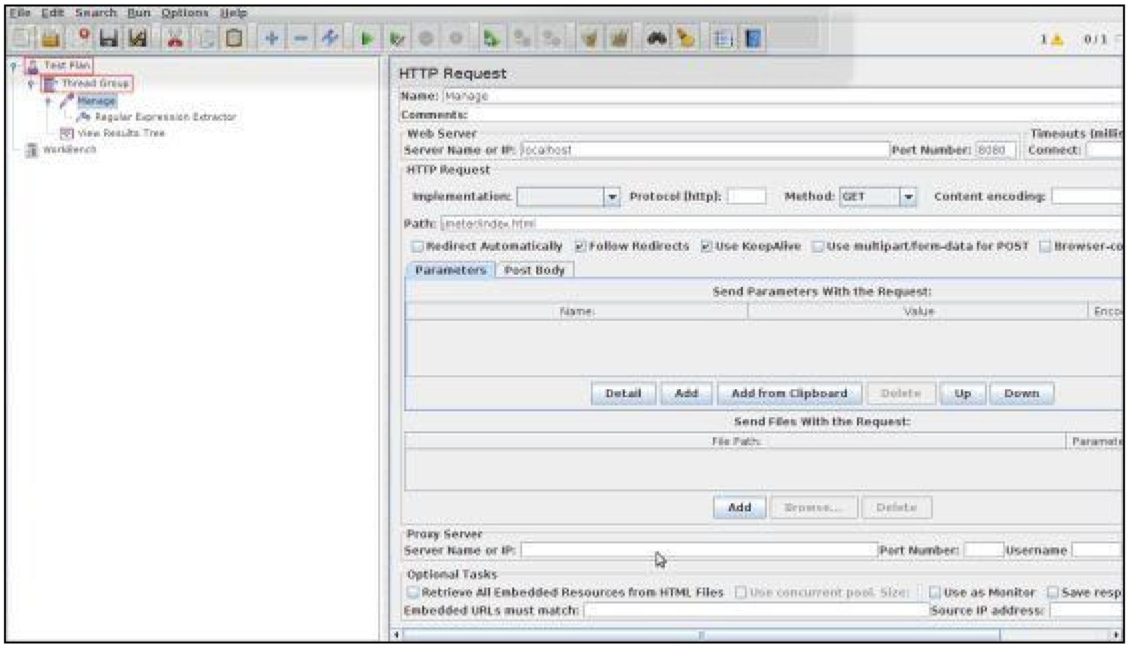
Name − Manage

Server Name or IP – localhost

Port Number – 8080

Protocol – We will keep this blank, which means we want HTTP as the protocol.

Path – jmeter/index.html


HTTP Request

Name: Manage

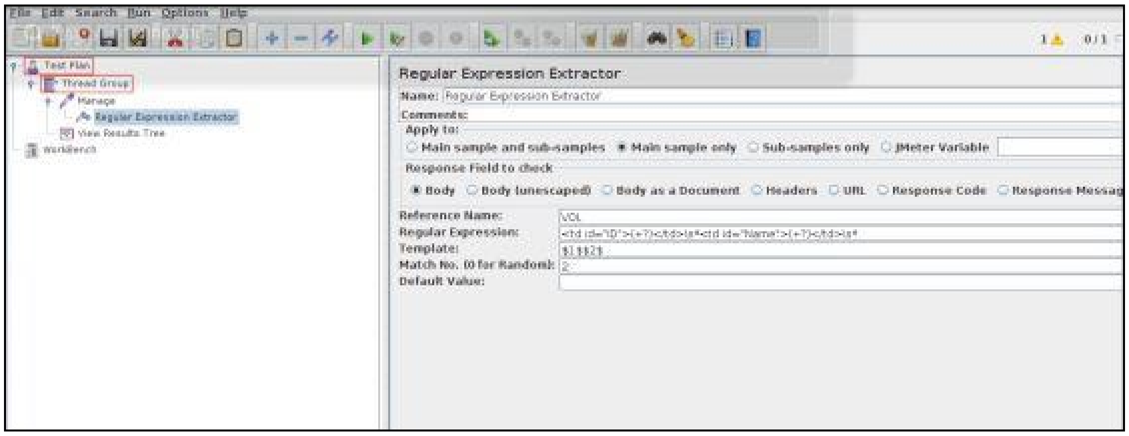
Server Name or IP: localhost   Port Number: 8080

Implementation: Protocol [http]:   Method: GET   Content encoding:

Path: jmeter/index.html

☐ Redirect Automatically ☑ Follow Redirects ☑ Use KeepAlive ☐ Use multipart/form-data for POST

Next, add a Regular Expression Extractor. Select the HTTP Request Sampler (Manage), right click **Add** → **Post Processor** → **Regular Expression Extractor**.


Regular Expression Extractor

Name: Regular Expression Extractor

Apply to: ○ Main sample and sub-samples [✓ Main sample only] ○ Sub-samples only ○ JMeter Variable

Response Field to check: [✓ Body] ○ Body (unescaped) ○ Body as a Document ○ Headers ○ URL ○ Response Code ○ Response Message

Reference Name: VOL

Regular Expression: <td id="ID">(+?)</td>\s*<td id="Name">(+?)</td>\s*

Template: $1$$2$

Match No. (0 for Random): 2

Default Value:

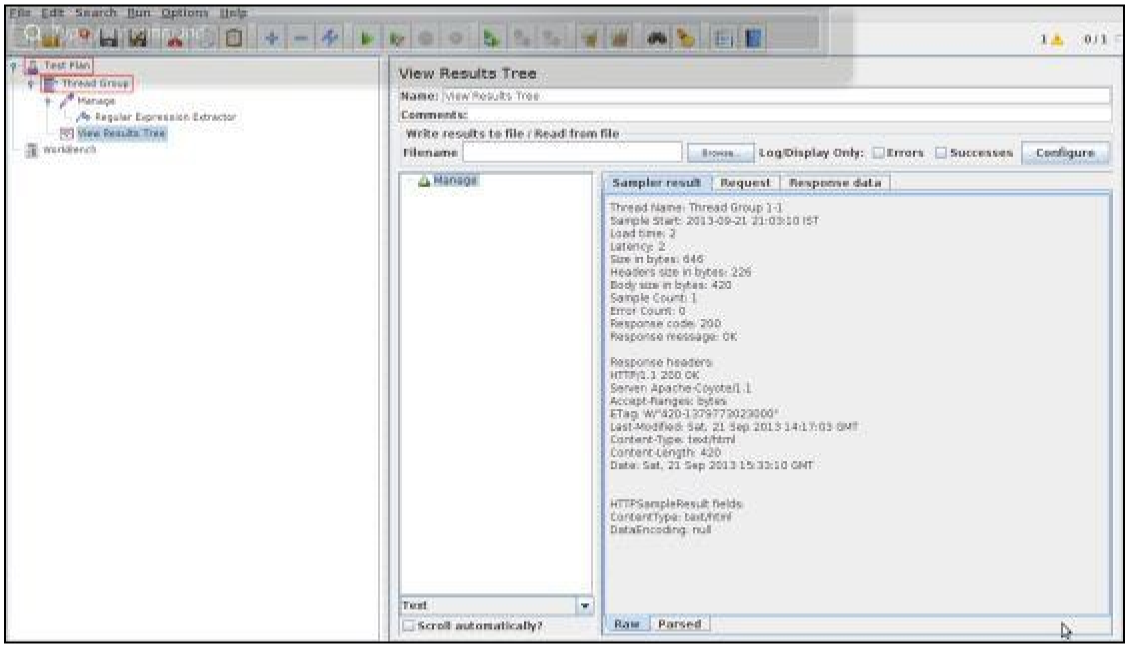
The following table provides a description of the fields used in the above screenshot –

Sr.No	Field & Description
1	**Reference Name** The name of the variable in which the extracted test will be stored (refname).
2	**Regular Expression** The pattern against which the text to be extracted will be matched. The text groups that will extracted are enclosed by the characters '(' and ')'. We use '.+?'

	to indicate a single instance of the text enclosed by the <td..>..</td> tags. In our example the expression is − <td id = "ID">(+?)</td>\s*<td id = "Name">(+?)</td>\s*
3	**Template** Each group of extracted text placed as a member of the variable Person, following the order of each group of pattern enclosed by '(' and ')'. Each group is stored as refname_g#, where refname is the string you entered as the reference name, and # is the group number. 1 to refers to group 1, 2 to refers to group 2, etc. 0 refers to whatever the entire expression matches. In this example, the ID we extract is maintained in Person_g1, while the Name value is stored in Person_g2.
4	**Match No.** Since we plan to extract only the second occurrence of this pattern, matching the second volunteer, we use value 2. Value 0 would make a random matching, while a negative value needs to be used with the ForEach Controller.
5	**Default** If the item is not found, this will be the default value. This is an optional field. You may leave it blank.

Add a listener to capture the result of this Test Plan. Right-click the Thread Group select Add → Listener → View Results Tree option to add the listener.

Save the test plan as *reg_express_test.jmx* and run the test. The output would be a success as shown in the following screenshot −



```
Thread Name: Thread Group 1-1
Sample Start: 2013-09-21 21:03:10 IST
Load time: 2
Latency: 2
Size in bytes: 646
Headers size in bytes: 226
Body size in bytes: 420
Sample Count: 1
Error Count: 0
Response code: 200
Response message: OK

Response headers:
HTTP/1.1 200 OK
Server: Apache-Coyote/1.1
Accept-Ranges: bytes
ETag: W/"420-1379773023000"
Last-Modified: Sat, 21 Sep 2013 14:17:03 GMT
Content-Type: text/html
Content-Length: 420
Date: Sat, 21 Sep 2013 15:33:10 GMT


HTTPSampleResult fields:
ContentType: text/html
DataEncoding: null
```

jMeter - Best Practices

JMeter has some limitations especially when it is run in a distributed environment. Following these guidelines will assist in creating a real and continuous load −

- Use multiple instances of JMeter in case, the number of threads are more.
- Check the Scoping Rules and design accordingly.
- Use naming conventions always for all elements.
- Check the default browser Connectivity settings, before executing scripts.
- Add Listeners appropriately.
- Here are some suggestion to reduce resource requirements −
  - Use non-GUI mode: jmeter -n -t test.jmx -l test.jtl.
  - Use as few Listeners as possible; if using the -l flag as above, they can all be deleted or disabled.
  - Disable the “View Result Tree” listener as it consumes a lot of memory and can result in the console freezing or JMeter running out of memory. It is, however, safe to use the “View Result Tree” listener with only “Errors” checked.
  - Rather than using lots of similar samplers, use the same sampler in a loop, and use variables (CSV Data Set) to vary the sample. Or perhaps use the Access Log Sampler.
  - Do not use functional mode.
  - Use CSV output rather than XML.

Only save the data that you need.

Use as few Assertions as possible.

Disable all JMeter graphs as they consume a lot of memory. You can view all of the real time graphs using the JTLs tab in your web interface.

Do not forget to erase the local path from CSV Data Set Config if used.

Clean the Files tab prior to every test run.

Previous Page Next Page