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## Chapter 1 | Installation, ENV Configuration, JMeter Test Recording Mode

## Why JMeter?

It was chosen for several reasons:

* open source, free tool, easy for installation and updating
* supports multi types protocols
* ability to record tests scenarios for different testing targets: Load Testing, Distributed Testing, Functional Testing, Stress Testing and Scalability Testing.
* intuitive GUI for the first acquaintance
* ability to make manual and automatic scripts recording
* it has a lot of tutorials and constant support
* many visualization reports (charts, tables, tree, for overall view of tests), understandable for development team and customer
* highly extensible
* JMeter is an independent java desktop application that’s why it can be run on multiple platforms
* can be integrated with Selenium, SOAP, Blazemeter, Jenkins, BadBoy, etc.

As you can see, Apache JMeter has many advantages over similar tools, but in our daily work we apply to it because it enables to execute load and performance tests for application at the different server types that include Web - HTTP, HTTPS, SOAP, Database via JDBC, LDAP, JMS, Mail - POP3.

## How to use Apache JMeter for https performance tests?

At first you should install Apache JMeter (version 2.10 or later, in this case we have 2.13), recording will be more effective with Oracle Java 7 or later and browser Mozilla Firefox. In our daily work we use HTTP(S) Test Script Recorder for recording HTTP and HTTP(S) requests in Tests plans which could be ran all the time during web application is under testing. In this article you can find steps for Test plan creation for web application with https protocols and it includes csrf tokens.

## How to create Test plan?

Start Apache JMeter, at first you should add Threats Group to save recording Test plan in.

Steps: Right mouse click on Test Plan/Add/Threads (Users)/Thread Group (1 element pic.1)

For displaying all results after performance tests running you should add reports view. Choose any Report in the list of Listeners.

Steps: Test Plan/Add/Listener/View Result Tree (2 element pic.1)

Add HTTP Cookie Manager to Thread Group to define additional cookie.

Steps: Right mouse click on Thread Group/Add/Config Element/HTTP Cookie Manager (3 element pic.1). Pic.1. Thread Group creation

## How circumvent https and record Test Plan automatically?

Add HTTP(S) Test Script Recorder to WorkBench

Steps: Right mouse click on WorkBench/Add/Non-Test Element/HTTP(S) Test Script Recorder (1 element pic.2)

Pic.2. Recording Test Plan

For bypassing bmp, js, gif etc. elements that are not relevant to test execution press 'Add suggested Excludes' button (2 element pic.2). Check that URL Patterns to Exclude were added (3 element pic.2). And remember that before start recording you should choose Target Controller. From drop-down menu you should choose Test Plan > Thread Group for saving recording plan to Threat Group (4 element pic.2).

## How to change Proxy configuration for recording tests?

We create and run tests using proxy server. Change Proxy configuration in browser. For tests recording use exclusively Mozilla FireFox browser because some other browsers (like Chrome, etc.) do not allow you to override system-wide configuration for their proxy settings. Open FireFox browser. Change proxy configuration

Steps: find tab 'Edit'/Preferences/Advanced/ tab Network /Settings.

At Connection settings window:

* choose ‘Manual proxy configuration’
* add ‘localhost’ to input ‘ HTTP proxy’
* add ‘8080’ to input ‘Port’.
* choose ‘Use this proxy server for all protocols’ and press ‘Ok’ button.

Check port at Test script Recorder, it should be 8080 (5 element pic.2) the same as in your FireFox browser.

Choose HTTP(S) Test Script Recorder, click 'Start' button (6 element pic.2). On the bottom of the Script Recorder window, JMeter proxy server will start and be used to intercept and record browser requests. If you are trying to record test at first time, it will display an error message that it cannot start because a certificate does not exist. Click ‘OK’ button, then click ‘Start’ one more time. You should find a message that says that a temporary certificate named Root CA certificate: ApacheJMeterTemporaryRootCA.crt created in JMeter bin directory (pic.3). Root Certificate CA was created and saved at Apache JMeter's 'bin' folder. The root certificates are used whenever you connect via an https connection to make sure that you are connecting to who you think you are. In our case we should use our own created certificate authority to issue certificates for internal web servers. Just click OK and try to continue recording actions in FireFox browser.

Pic.3. Created Root CA certificate

Open application that will be tested at FireFox browser and make test actions step by step. Use valid credentials for authorization. All steps made by user will be recorded to Test Plan set in JMeter. After making all tests actions stop recording.

Steps: open Apache JMeter/HTTP(S) Test Script Recorder/press 'Stop' button (7 element pic.2).

As a result all actions that user makes in application were recorded to Thread Group (1 element pic.4) .

Pic.4. Test scenario in JMeter. Tests Properties

If some actions were needless you can delete requests from created Test plan clicking right mouse button on excess request and finding Remove item.

Choose Thread Group and change test name (2 element pic.4). For loading web application properties at the Thread Group can be changed number of users, ramp-up, loop count can be chosen) (3 element pic.4).

If the goal is reached and result satisfies you, do not forget to save Test plan via File/Save Test plan as… after tests were saved, you may add them to any test plan that you have open by using the "Merge" menu item, and selecting your saved WorkBench. You can work with it via other testing tools like Soap, Blazemeter , etc. just download saved .jmx file.

For running tests push 'Start' button at the top menu (4 element pic.4) and find result at View Result Tree (5 element pic.4)

## What should you do with requests that do not run due to csrf tokens?

In this application there are some csrf tokens present and due to them we have some errors with code 403 (1 and 2 elements pic. 5). At test result view you can find Request and Response Data.

Pic.5. Tests result in JMeter

For successful testing of this web application we need to intercept csrf tokens value and put it to our request as variable values Open login request (1 elements pic. 6) and find post data (login, password and csrf token) (2 elements pic. 6).

Pic.6. Put csrf token to HTTP request as variable value

For bypassing csrf tokens value should be captured by Regular Expression Extractor and input to POST requests. Duplicate first test page at the Test Plan (using right mouse click). In our case it would be request 160/ (3 elements pic. 6). Rename it (in our case we rename it as ‘160/ token’ ), we have two similar HTTP(S) requests (4 elements pic. 6).

First HTTP(S) request for getting csrf token from the body of GET request via Regular Expression Extractor. Steps: find 160/ token, right mouse click Add/Post Processors/Regular Expression Extractor) (5 elements pic. 6).

Put data to Regular Expression Extractor inputs (1 element pic.7).

Pic.7. Get csrf token from the GET request

At 'View Result Tree' (1 element pic. 8) on the first test page 160/ (2 element pic. 8) find Response Data of the first request that gets csrftoken value (3 element pic.8)

Pic.8. Find tokens value in Response Data of GET request

At Regular Expression Extractor (1 element pic. 9) add csrf token line 'name='csrfmiddlewaretoken' value='xfgTXpJN5vkR4po4urpZI8tIyiuBrNvw'' to input 'Regular Expressions' Change csrf token value to variable value. Using (.+) construction (2 element pic.9).

Pic.9. Construction for changing csrf token value to variable value

Find login POST request (1 element pic.10), find ‘csrfmiddlewaretoken’ (2 element pic.10). Change csrfmiddlewaretoken to variable value using ${token} contraction (3 element pic.10).

Pic.10. Put csrf token to HTTP request as variable value for login

Run Test Plan and check result at View Results Tree (1 element pic.11). Login pass successfully (2 element pic.11).

Pic.11. Successful login result

Check Tasks marked red and find response data with error 403 (3 element pic.11). In this requests with errors (1,3,4,5,6 elements pic.12) you should put variable value to csrf tokens (2 element pic.12) at PUT requests with errors.

Pic.12. Put variable value to all HTTP request with csrf tokens error

Try to run Test plan and check that all test’s requests were passed.

If an application has high security, csrf tokens will always be refreshable in all requests. That’s why you need to put Regular Expression Extractor to all tasks that were not passed due to variable tokens (Duplicate GET requests and put variable value to csrf tokens at PUT requests). In our case we take first ‘take’ request in which we find value of scrf tokens - duplicated it and implemented Extractor

Pic.13. Add additional Regular Extractor

Try to run Test plan and check that all tests requests were passed.

Pic.14. Successful login and logout

In our case two Extractors (1, 2 elements at requests 3, 4 elements pic. 14 ) give ability to pass four requests which include csrf tokens (5-8 elements pic. 14).

For load, stress and performance testing we often used Apache Jmeter and Blazemeter together. It gives a more accurate and clear picture of user's experience and how a large number of users works with application simultaneously. Full statistics returns from server and reports through graphical diagrams, tables, etc.

### Download JMeter

### Installing JDK

### Setting Java environment

### Running JMeter

### JMeter Classpath

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### Running in Server mode

### Recording Script using HTTP Test Recorder

### Recording script using Chrome Brower Extension

### Converting HTTP Web Archives (HAR) to JMeter test plan

### Executing JMeter test

### Analyzing Test Result

## Chapter 2 | Anatomy of a JMeter Test

Anatomy of a JMeter test

**Test Plan**

This is the root element of the JMeter scripts and houses the other components, such as threads, config elements, times, Preprocessors, Postprocessors, assertions and listener. It also offer a few configuration of its own.

**Thread Groups**

- This is entry point of a test plan.

- They represent the number of threads/users JMeter will use to execute the test plan.

- All controllers and samplers for a test must reside under a thread group. Listener may remain under thread group or under test plan.

- Thread Group configuration provide options to specify the number of threads that will be used for the test plan, how long it will take for all threads to

become active (ramp up ) and the number of times test will be executed.

Controllers - Controllers drive the processing of a test and comes in two flavors -

1. Sampler controller - sampler controller sends reqest to a server. These includes HTTP, FTP, JDBC etc.

List of sampler controllers -

1.1 HTTP request

1.2 JDBC Request

1.3 LDAP Request

1.4 SOAP/XML-RPC Requst

1.5 WebService (SOAP) reqest

1.6 FTP Request

2. Logical Controller - This allows the customization of the logic used to send the requets. Like loop controller can be used to repeat an operation a certain number of times. if controller is for selectively executing a request. Helps customzie the logic used to decide how requests are sent to server. They can modify requests, repeat reqest, interleave request, control the duration of request execution, switch request, measure the overall time taken to perform request. it is like a container which holds steps.

List of logical controller -

Test Fragments - A spcial type of controller is used purely for code reuse within a test plan. They exist on the test plan tree at the same level as the thread group element and are not executed unless referenced either by any include or module controller.

Listeners

Timers

Assertions

### Test Plan

#### ThreadGroup

#### Controllers

#### Sampler

#### Logic controller

### Test Fragments

#### Listeners

#### Timers

#### Assertions

### Configuration Elements

#### Preprocessor

#### Postprocessor

## Chapter 3 | Working on Forms

## Chapter 4 | Managing Sessions

### Managing session with cookies

### Managing session with URL Rewriting

## Chapter 5 | Handling Responses

### Regular Expression Extractor

### Regular Expression Tester

### CSS/JQuery Extractor

### XPath Extractor

### XML Extractor

### JSON Extractor

### HTML Extractor

**Performance Testing -** performance testing is in general, a testing practice performed to determine how a system performs in terms of responsiveness and stability under a particular workload. It can also serve to investigate, measure, validate or verify other quality attributes of the system, such as scalability, reliability and resource usage.

**Responsiveness** - response of application

**Throughput** - request per second, number of unit of work in a unit of time

**Reliablility** - should not throw denial of service

**Scalibility** - should have ability to handle extra work load without impacting performance

**Assertion** - are required for functional testing

**Listener** - are helpful to view result data

**Regular Expression**

. any number of characters

+ at least 1 character

[] - range of number / alphabet

[a-z] - any alphabet from a to z

[0-9]\* - any number of digit

<a class="theme-nav-link" href="/schedules" title="click to go to 'Schedules'" target="\_self" data-identifyelement="18">Schedules</a>

## Chapter 7

### Pre-Processor

### HTML Link Parser

### HTML URL rewriting Modifier

### User Parameters

### Post-Processors

### Regular Expression Extractor

### XPath Extractor

### Result Status Handler

### Debug Post Procesor

http://192.168.1.2:1080/WebTours/index.htm

## Chapter 8 – Timers

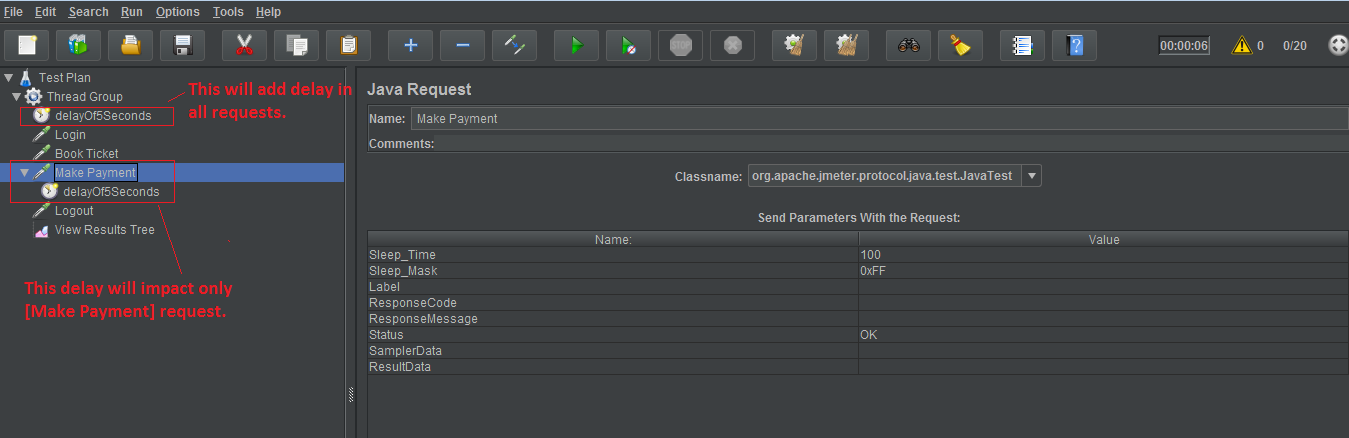
To make our script realistic we have to add some delay between two request called as think time. We can add delay in JMeter using Timer.

### Beanshell Timer

### BSF Timer

### Constant Timer

It add fix time delay between each request. Constant timer will add delay in all request in the scope. If you want to add delay in a particular request, add constant timer as a child of that request.



If you add two constant timer in same scope, sum of both timer will get added as delay.

### Gaussian Random Timer

We have 3 random timer, Gaussian, Uniform & Poisson. This timer follows distribution of time as like bell curve.

### Uniform Random Timer

### Poisson Random Timer

### Synchronizing Timer

This timer blocks the thread until a given number is reached. Then all threads are released at once. This helps in creating large number of threads on server.

In case value zero is passed into timer, by default it will take 100 threads. It is mandatory to provide value else JMeter shows error.

Helps in simulating peak load on server.

We can use random() function to create random number of thread for each request.

### Constant Throughput Timer

It adds variable pauses to calculate a possible given number.

### Custom Timer – gets added from google plugin

## Chapter 9 – Assertions

JMeter comes bundled with assertion components. Assertion are used to perform additional checks on samplers and are processed by default after every sampler in the same scope, except for in cases whee they have been added as a direct child of a sampler. You can think of these as mini unit tests within your test plans that ensures the responses from server actually work fine. It is used in JMeter for functionality testing. We can use them for performance testing also, but they are more significant for functional testing. It inserts checkpoint or verification point on response.

For example – when you make HTTP request in a web application, the server responses may respond with different HTTP header status codes, denoting the success or failure of request. A status code

* 200, for example, means the request succeeded
* 401 means access was denied to the requested resource
* 500 means an internal server error occurred

Types of Assertions are follows –

1. Response Assertion
2. JSON Assertion
3. Duration Assertion
4. Size Assertion
5. XML Assertion
6. XML Schema Assertion
7. HTML Assertion
8. XPath Assertion
9. Compare Assertion
10. Bean Shell Assertion
11. JSR223 Assertion
12. MD5Hex Assertion
13. SMIME Assertion

### Duration Assertion

It measures time take by samplers. Assertion Result listener help us to understand assertion results.

**How to do it**

**Test Plan -> Add -> Assertion -> Response Assertion**

### Size Assertion

This verifies size of response. It has three parameter **Apply To**, **Response Size Field to Test**, **Size to Assert.**

### XML Assertion

It validates the response only if it is in XML format & XML is well formness (like all tags are closed). It helps to find out faulty xml.

### XML Schema Assertion

This validates XML Schema.

### HTML Assertion

It checks for correctness of HTML document, if there are any tag missing.

### Response Assertion

### XPath Assertion

Validates xpath

### Compare Assertion

It compares result from two different server. To see result of this assertion, special listener **Compare Assertion Visualizer**

## Chapter 10 – Config Elements

It is used to setup default variables for later use by sampler. According to priority of execution they are executed first in the scope they are found (before any sampler in the same scope).

### Counter

Maximum value you can pass in counter is 2 ^ 63 -1

### Random Variable

### FTP Request Default

FTP Request is used to exchange files, either to retrieve the file or store a file on a server from local.

### Login Config Element

It contains the login details & other sampler will fetch login credential from this config element. This will be effective on request which are in same scope.

### HTTP Request Default

### Java Request Default

### User Defined Variables

User defined variables will be processed at the start of test.

### CSV Data Set Config

### HTTP Authorization Manager

### HTTP Cookie manager

## Chapter 20 – JMeter Inbuilt Functions

Function syntax in JMeter ${\_\_funcName(v1,v2,v3)}

**${\_\_time(YMDHMS)}** – Append this function in request name, this will add timestamp when request was executed.

**${\_\_Random(2000,5000,refVar)} –** to set random value in constant timer. Add this function in **constant timer -> Thread delay (in milliseconds).** refVar variable contains value generated by this function

Analyzing the critical business scenarios

Analyzing the service level agreement objectives

Developing the test scripts

Enhancing the scripts by creating/implementing

Parameterization

Checkpoints

Transactions

Reusable functions

Correlations

Actions/Blocks

Iterations

Pacing

Think Time

Designing workload model

Test Execution

Test Monitoring

Analyzing the test results

Preparing the test report

## Pointers

https://github.com/uttesh/JmeterAPISample/tree/master/lib

https://github.com/sayems/JMeter

http://uttesh.blogspot.in/2015/04/jmeter-load-testing-by-code-jmeter-api.html

http://www.agileload.com

https://www.blazemeter.com

https://www.blazemeter.com/blog/how-analyze-results-load-test-using-blazemeter-0

http://www.performancetestingfun.com/bottlenecks/

https://www.soasta.com/blog/

http://www.radview.com/

https://en.wikipedia.org/wiki/Arithmetic\_mean

https://en.wikipedia.org/wiki/Skewed\_distribution

https://en.wikipedia.org/wiki/Median

http://www.skillsyouneed.com/num/averages.html

**Rajendra Singh Some more links...**

http://www.quotium.com/performance/90-percentile-response-time/

http://www.loadtestingtool.com/blog/wapt-usage/how-to-analyze-load-test-report-response-time/

http://www.performancetestingfun.com/bottleneckanalysis/

http://sqa.stackexchange.com/questions/10090/load-testing-result-analysis-please-help-understand-a-few-keywords

https://www.thoughtworks.com/insights/blog/performance-testing-nutshell

http://topobaseinsiders.typepad.com/the\_topobase\_insiders/2007/09/oracle-database.html

**Open source performance monitoring tools**

\* http://www.slideshare.net/adrianco

\* http://www.strangeloopnetworks.com/blog/

\* http://www.perfdynamics.com/

\* http://www.igvita.com/

\* http://highscalability.com/

\* http://velocityconf.com/

\* http://blogs.impetus.com/test\_engineering/performance\_engineering/J2EEPerformanceTestingAndBottleneckIdentification.do

http://www.soasta.com/products/mpulse/

<https://www.blazemeter.com/blog/how-monitor-your-server-health-performance-during-jmeter-load-test>

## Performance Testing Strategy

* Determine the user load that will use the application during the peak time.
* We should gather these requirements from the customer, product owner or the business analysts.
* We should have scenario where we will have a set of virtual users who will cover the maximum load and the average load.
* We should design scenarios where we hit the system with a maximum load of users once and also a scenarios where will hit the system slowly as a group.
* We should also have a baseline established when we are going test against the newly added features.
* We should have a procedure to run a test against existing code (baseline) and then run the same test against the newly added code where we are able to measure against.
* performance test environment which is similar to the production environment. Otherwise we would not yield correct performance test results. The hardware configurations, database servers and the user load should be similar to the production site.
* We should perform the performance test near to the area where the application being deployed. If we do the performance test remotely the network latency will affect our performance test results.
* As a server side performance testing. We should note that we should performance test the web services and it the load to the web services and see whether they will work with the maximum load specified.
* We should also have access to the applications server hardware as we may have to obtain the information of server's processor, memory, databases and also OS processes that are being run, when we are doing performance testing. We should keep a close eye on these parameters as the utilization rate will increase ones there is high load of users.
* From database side, We should look at the utilization of stored procedures, how many stored procedures are executed and whether there are unwanted database calls created. This DB calls are also an underlying reason for performance issues in many of the web solutions.
* We should also be mindful to create end to end performance scenarios rather testing each feature separately, as testing end to end gives more realistic view.
* Tools - JMeter, Neoload

### Good Resources about JSON

<http://www.json.org/>

<https://en.wikipedia.org/wiki/JSON>

<https://www.w3schools.com/js/js_json_intro.asp>

## Interview Questions

1. **Explain the architecture of Jmeter**

JMeter is a Java based open source application that is basically designed for the purpose of Load Testing.

It supports all major protocols that are supported in Load Runner. Unlike any browser, Jmeter works on levels of protocols and does not execute JavaScript present in HTML web pages.

1. **Does Jmeter simulate actual browser behavior?**

No, Jmeter does not support the actual browser behavior. It does not render the HTML webpages as the normal browser does. Response can be viewed in HTML format but the actual timings are not present in the generated samples.

1. **What is Distributed testing?**

Distributed Testing means using multiple machines for load testing in which one of the machine can be made master and others can be kept as slave. It is very important to note that all the machines should be on the  same network and should have the same version of Java and Jmeter

1. **What is the use of Regular Expression in Jmeter?**

Regular Expression can be used for extracting some values dynamically from the responses so as to use to it in the subsequent request or save it for reporting purposes. Regular Expression is used in both Pre-Processors as well as Post Processors.

1. **What are the types of processors in Jmeter?**

Basically there are two types of processors in JMeter namely Pre-Processor and Post Processor.

**Pre-Processors** execute before the main sampler and can change the scope of the sampler. List of Pre-Processors –

1. JSR223 Pre-Processor
2. User Parameters
3. HTML Link parser
4. HTML URL Re-Writing Modifier
5. JDBC Pre-Processor
6. RegEx User Parameter
7. Sample Timeout
8. Bean Shell Pre-Processor

**Post-Processors** execute after the main sampler and are applicable to all samplers in the same scope of Test Plan. They can be used to extract some fields from the server response and store them in variables. List of Post-Processor is as follows –

1. CSS Selector Extractor
2. JSON Extractor
3. Boundary Extractor
4. Regular Expression Extractor
5. JSR223 PostProcessor
6. Debug PostProcessor
7. JDBC PostProcessor
8. Result Status Action Handler
9. Xpath Extractor
10. Xpath2 Extractor
11. Bean Shell Post-Processor
12. **What are the different ways of Data Parametrization in Jmeter?**

Data Parameterization makes the scripts reusable where the values need not be hardcoded for the same request with different parameters.

**Below is the data parametrization that is supported in Jmeter:**

* CSV Data Set Config
* User Defined Variables.

1. **What are the maximum recommended threads on a single system?**

It depends on the hardware configuration of your system which includes a processor, JVM, allocated memory -Xmx, etc.

Other factors which impact this are the number of components in your test plan i.e. the number of config elements or processors and it also depends on whether you are using GUI/Non-GUI Mode.

1. **Explain the difference between Gaussian and Poisson Timers.**

Both Gaussian and Poisson Timers work on a mathematical formula with some constant Delay and additional offset. Difference between the two lies in the fact how the lambda value is calculated in case of Poisson timer and how deviation is calculated in case of Gaussian Timer.

1. **What is the use of co-relation in Jmeter?**

Co-relation is a process in which values can be extracted from the server response and stored in a variable and then can be used in any other request which is to follow.

**For Example,** for testing any login functionality if you have to use session ID/cookie ID , you can extract the value from the response of GET request of the login page and then dynamically use the same while making POST request for login.

1. **What are the different types of listeners?**

Listeners are used for storing the execution results of load testing in different forms be it a table, graph, tree or in any other presentable format so that it can be presented to the client. There are different type of inbuilt listeners in Jmeter and many others can be imported into it by using plugins as per the requirement.

**Below are some of the inbuild listeners:**

* View Results in Table
* View Results Tree
* Graph Results
* Aggregate Graph
* Aggregate Report
* Assertion Results
* Response Time Graph

1. **Explain the flow of Test Script Recorder.**

HTTP(s) Test Script Recorder is used to record all the http(s) request going to the server from your application. There are some configurations which need to be done in Jmeter in order to make it work.

**Below are the steps followed to record https traffic:**

* Add HTTP(s) Test Script Recorder to Test Plan.
* Enter the port number which you want to start your proxy server from.
* Choose the Target either as “Workbench” only or add a Recording Controller in your test plan and select the same as Target so that all the recordings are stored under it.
* Start the Proxy Server now.
* Configure your browser with manual proxy settings pointing to the same port number used in the test script recorder.

1. **Can Jmeter record actions from Mobile? If yes, how?**

Yes, Jmeter can record HTTP or https request going to the server from your mobile application also. Mobile and Jmeter should be on the same network.

**Below is the configuration required:**

* Configure your proxy server in JMeter to run at a specified port.
* Set up a proxy on your mobile wifi settings and enter the same port number that is used in the recorder.
* Install the Root CA certificate on your mobile.
* Hit server request from your mobile and observe it getting captured by the specified controller.

1. **How to do master-slave configuration in Jmeter?**

Master-Slave configuration is a part of Distributed Testing in which more than one machine is used to perform load testing of the server under test.

It is very important that all machines are on the same network and all have the same version of Jmeter. In distributed testing, one machine is made as the Master and the others are kept as slaves by doing some configurations.

**The process is specified below:**

* On master machine, edit the jmeter.properties file and add the IP addresses of slave machines against the remote\_host field in the file.
* Save the file and open the Jmeter again.
* Now from the RUN menu in Jmeter, select Remote Start and choose the IP of the machine to be invoked.
* Choose RUN menu and select Remote Start all to start all the slave machines for your testing.

1. **What are the Jmeter supported protocols?**

**Jmeter supports various standard protocols as listed below:**

* HTTP/HTTPs
* SOAP
* LDAP
* FTP
* SMTP
* TCP

1. **Explain the Syntax of Jmeter variables and functions.**

Just as in any other programming language, variables and functions are used in Jmeter also in order to make the scripts reusable.

**Syntax of Variable** – ${var}

There are many inbuilt functions that are available in JMeter to perform various actions. Function string can be generated from the Function Dialogue Box itself.

**For example,** if you want to get the machine IP stored in a machineIP variable, you can use the string ${\_\_machineIP(machineIP)}.

## 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. |

1. **Why is it recommended to run Jmeter in Non-GUI mode?**

JMeter tests can be run both GUI as well as Non-GUI Mode.

It is highly recommended to run the load test in Non-GUI mode because AWT Event Thread can kill the tests in case of high load scenarios.

**There are various Non-GUI mode supported with Jmeter such as:**

* Command Line
* ANT Plugin
* MAVEN Plugin
* Jenkins

1. **Is it possible to run Selenium scripts in Jmeter? If yes, how?**

Yes, it is possible to run selenium scripts in Jmeter to get some ideas on their performance.

There are two ways of doing it. Either you can use Junit libraries to build Selenium scripts and save as Jars and copy the same in Jmeter directory. And then add Junit sampler to your test plan and import the Jar file.

Otherwise, Webdriver sampler plugin can be added in the JMeter ext folder and then restart the Jmeter. Write your selenium code in the Webdriver sampler and then execute to see the performance.

1. **How do you manage sessions and cookies in Jmeter?**

Sessions and cookies can be managed in Jmeter by using config elements such as HTTP Cache Manager which provides an option to clear the cookies in every iteration and also allows to add user-defined cookies.

HTTP Cache manager helps you in clearing cache after each iteration as per your requirement in the load tests and also limits the number of elements which can be stored in the cache. Both of these config elements can be attached to the HTTP sampler.

1. **What are the important steps for testing JDBC request?**

JDBC Requests are used to establish a connection with the databases and then measure the response time of the queries.

**Important steps for testing JDBC requests are:**

* **Setting up Config Element** – JDBC Connection Configuration in which Database URL and JDBC Driver Class needs to be added as per the database which is being used. Also, add the variable name for this connection configuration so as to use it in sampler.
* Add JDBC Request, add the same variable name added above and write your queries to test.

1. **What is BeanShell scripting?**

BeanShell is a lightweight Java scripting that is used in JMeter to perform some complex task.

BeanShell sampler can perform various functions with the use of coding. You can print the thread number, get the current sampler executed, fetch the cookies etc.

1. **Can Jmeter measure the performance of a complete application? For example, you have multiple screens in your mobile app. Can Jmeter measure the time taken to flip the screens?**

No, JMeter does not measure the transition time between the screens. It can only measure the server actions not the UI interactions.

1. **What is a Root CA Certificate?**

HTTPS connection requires a certificate to authenticate the connections which get established when the browser hits the web server.

Jmeter generates it temporarily to intercept the SSL traffic in order to record the actions. For recording actions via mobile, you need to have this certificate in your mobile to record the actions.

1. **Which factors decide the maximum threads that one should generate per system?**

It depends on the hardware of the system.

**For Example,** on a 2-3 GHz CPU, 400-600 threads can be generated. It also depends on the components in your test plan. More the processors and XML parsing elements, more the CPU load and hence less threads.  For high load, it is recommended to use multiple machines for load testing.

1. **What is Tidy Parsing?**

Tidy Parsing is a type of parsing that is used in Xpath extractor.

If the response is in pure XML then tidy parsing is not required whereas, in case of XHTML, it is mandatory to check the tidy parsing option in order to fetch the correct results.

1. **What are the important plugins that are supported in Jmeter?**

Jmeter supports different types of plugins which are helpful in generating high quality results.

**Below are the major plugins that are supported:**

* Thread Group Plugin – Stepping Thread Group Plugin.
* Samplers Plugins like Webdriver.
* Listeners plugins.

1. **What are the types of controller in Jmeter?**

Controllers are used in Jmeter to control the flow of execution of requests.

**Below are the controllers that are used in JMeter:**

* Recording Controller
* IF Controller
* While Controller
* Transaction Controller
* Loop Controller
* Simple Controller
* Module Controller

1. **What are the different types of Performance Testing techniques?**  
   The different types of performance testing are-

* **Load Testing** - Type of performance testing to measure the application behaviour under expected workload.
* **Stress Testing** - Evaluating application's behaviour under load higher than application's threshold or peak load conditions.
* **Endurance Testing** - Testing application under prolonged load test, usually used to detect memory leaks in application.
* **Spike testing** - Evaluating application's behaviour on sudden increase in the number of users.
* **Volume testing** - Testing the application with large amount of data(usually with large records of data in the database).

1. **What all activities are performed during performance testing of any application?**  
   Activities performed during performance testing-
2. **Performance Test Requirements Gathering & Analysis** - In this phase, all the details about the application are gathered from the client and other stakeholders of the application.
3. **Testing Tool Selection** - This phase involves selection of the performance test tools.
4. **Performance Tests Planning** - The test planning phase includes planning the whole performance testing process, infrastructure and environment setup; use case scenarios to be scripted etc.
5. **Test Script Implementation** - In this phase, the performance test scripts are created using the tool selected in the previous phases.
6. **Performance Test Execution** - In this phase, the test script are executed for a predefined time specified during the planning phase.
7. **Test Result Analysis** - The result analysis phase includes consolidating the test results for determining the different performance attributes of the application and finding the performance bottlenecks.
8. **What kind of applications can be tested using JMeter?**  
   Ans. The different kinds of applications that can be tested using JMeter are-

* Websites
* Web services both - REST and SOAP
* Databases(JDBC)
* Shell scripts
* FTP
* LDAP
* TCP
* SMTP, POP3, IMAP

1. **What is a thread group in JMeter?**  
   A Thread Group is an element of JMeter test plan that represents a pool of virtual users performing a set of operations.

1. **What is ramp up period?**  
   At the beginning of load test of an application instead of putting all the users live, we slowly ramp up the number of users in order to study their effect in the application's performance. In JMeter ramp-up period defines the time period within which the all the specified users get in running state.
2. **What are samplers in JMeter?**  
   Ans. Samplers are used for sending different types of requests to the server. Some of the commonly used samplers are - HTTP Request, JDBC Request, SOAP-XML Request, JUnit request, TCP Sampler etc.
3. **What are Listeners in JMeter? State some of the widely used Listeners?**  
   Ans. Listeners are used for viewing, saving of test results and also help in tabular and graphical analysis of the test results. Some of the widely used Listeners are - Aggregate Report, Aggregate Graph, Graph Results, View Results Tree etc.
4. **What are the different timers in JMeter?**  
   Timers are used for halting the test execution of a thread for a certain predefined time. These timers are used for simulating the real user think time. The different types of timers available in JMeter are - Constant Timer, Gaussian Random Timer, Uniform Random Timer, Constant Throughput Timer, Synchronizing Timer, Beanshell timer, BSF Timer etc.
5. **What is a Rendezvous Point?**  
   The Rendezvous point in JMeter is used to perform spike testing. It is performed using "Synchronizing Timer" by waiting till the number of active users reach a certain specified value during the load test.
6. **What are assertions in JMeter? Explain the available assertions in JMeter.**  
   Assertions in JMeter are used for verification of certain values in the response of Samplers requests. The commonly used assertions are - response assertion, size assertion, XML assertion, beanshell assertion, HTML Assertion, XPath assertion etc.
7. **What is the use of Configuration elements?**  
   Ans. Configuration elements are used for customising the sampler requests e.g. CSV Data Set Config can be used for parameterizing the sampler requests with values fetched from external csv file.
8. **What are Pre-Pocessors?**  
   Ans. Pre-processors are test plan elements that are executed before the sampler request execution. Some commonly used pre-processor in JMeter are BeanShell PreProcessor, HTML Link Parser, HTTP URL Re-writing Modifier, RegEx User Parameters etc.
9. **What are Post-processors?**  
   Ans. Post-processors are the test plan elements that are executed after the sampler request execution. Generally post processors are used for fetching some values from the sampler response.
10. **How can we run JMeter in non-GUI mode?**  
    Command to run JMeter in non-GUI mode-  
    jmeter -n -t test.jmx -l test.jtl where,   
    n specifies that JMeter will run in non-GUI mode  
    -t for test script file  
    -l for jtl file having each sample's result
11. **How can we reduce the resource requirement in JMeter?**  
    To make the best out of the available resources and in general as a practice, following practices should be incorporated in the tests-

* 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.
* Don't use "View Results Tree" or "View Results in Table" listeners during the load test, use them only during scripting phase to debug your scripts.
* 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. [The Include Controller does not help here, as it adds all the test elements in the file to the test plan.]
* Don't use JMeter's functional mode during the load test executions.
* Use CSV output rather than XML.
* Only save the data that you need.
* Use as few Assertions as possible.

1. **What is 90% line in JMeter?**  
   The aggregate report listener have 90% line as one of the metric. The Apache JMeter manual describes 90% line as- "90% of the samples took no more than this time". It is actually the 90 percentile of the response times of the samples -  
   90 percentile = (90/100)\*N+1/2 where N is the number of samples  
   So, if there are 10 samples then 90%line will be 9.5 or 9. It means the 9th value in the sorted list of samples (sorted according to ascending order of their response times) will be the 90%line value.
2. **Mention the execution order of Test Elements?**

The test plans elements execution order is

* Configuration elements
* Pre-processors
* Timers
* Samplers
* Post-processors
* Assertions
* Listeners

1. **What does “contain” and “matches” indicates in the regular expression?**

In the regular expression, contains indicates that the regular expression matched at least some part of the target. While matches mean the regular expression matched the whole target. So, ‘alphabet’ is “matched” by ‘al.\*t.’

**13) Explain what is Test Fragment?**

1. Test fragment is also a type of element like Thread Group element. The only difference is test fragment is not implemented unless it is referenced by either a Module controller or an Include controller.
2. **Explain how you can perform spike testing in JMeter?**

By synchronizing, timer JMeter spike [Testing](https://www.guru99.com/software-testing.html) can be achieved. Synchronizing timer blocks thread until a specific amount of threads has been blocked and then release them all together thus creating large instantaneous load.

1. **Explain how you can capture the script of the authentication window in JMeter?**

Normally, you can capture script by recording.

* First, you have to Threadgroup in Testplan and then make HTTPProxyServer in Workbench
* After that, set port number in the Global Setting box (e.g., 8911) and modify your connection setting in IE as localhost in address 8911 as in port Then you can start http proxy server in JMeter and run your application for login

1. **In JMeter is it necessary to call embedded resources explicitly?**

You can eliminate all embedded resources from being explicitly called. Requests have a checkbox at the bottom that says “retrieve embedded resources.” It would grab all CSS, JPG, etc. It is a brilliant way to find resources and broken link in a web App.

<https://www.linkedin.com/in/shuja-rahman-923b1bb9/detail/recent-activity/posts/>

<https://steelkiwi.com/blog/graphical-representation-performance-testing/>