SELENIUM

web browser automation

tutorialspoint

SIMPLYEASYLEARNING

www.tutorialspoint.com

About the Tutorial

Selenium is an open-source tool that is used for test automation. It is licensed under Apache License 2.0. Selenium is a suite of tools that helps in automating only web applications.

This tutorial will give you an in-depth understanding of Selenium and its related tools and their usage.

Audience

This tutorial is designed for software testing professionals who would like to learn the basics of Selenium through practical examples. The tutorial contains enough ingredients to get you started with Selenium from where you can take yourself to higher levels of expertise.

Prerequisites

Before proceeding with this tutorial, you should have a basic understanding of Java or any other object-oriented programming language. In addition, you should be well-versed with the fundamentals of testing concepts.

Copyright & Disclaimer

Table of Contents

1. OVERVIEW

Introduction

Selenium is an open-source and a portable automated software testing tool for testing web applications. It has capabilities to operate across different browsers and operating systems. Selenium is not just a single tool but a set of tools that helps testers to automate web-based applications more efficiently.

Let us now understand each one of the tools available in the Selenium suite and their usage.

Tool	Description
Selenium IDE	Selenium Integrated Development Environment (IDE) is a Firefox plugin that lets testers to record their actions as they follow the workflow that they need to test.
Selenium RC	Selenium Remote Control (RC) was the flagship testing framework that allowed more than simple browser actions and linear execution. It makes use of the full power of programming languages such as Java, C#, PHP, Python, Ruby, and PERL to create more complex tests.
Selenium WebDriver	Selenium WebDriver is the successor to Selenium RC which sends commands directly to the browser and retrieves results.
Selenium Grid	Selenium Grid is a tool used to run parallel tests across different machines and different browsers simultaneously which results in minimized execution time.

Advantages of Selenium

QTP and Selenium are the most used tools in the market for software automation testing. Hence it makes sense to compare the pros of Selenium over QTP.

Selenium	QTP
Selenium is an open-source tool.	QTP is a commercial tool and there is a cost involved in each one of the licenses.
Can be extended for various technologies that expose DOM.	Limited add-ons and needs add-ons for each one of the technologies.
Has capabilities to execute scripts across different browsers.	Can run tests in specific versions of Firefox, IE, and Chrome.
Can execute scripts on various operating systems.	Works only with Windows.
Supports mobile devices.	Supports mobile devices with the help of third-party tools.
Executes tests within the browser, so focus is NOT required while script execution is in progress.	Needs Focus during script execution, as the tool acts on the browser (mimics user actions).
Can execute tests in parallel with the use of Selenium Grids.	QTP cannot execute tests in parallel, however integrating QTP with QC allows testers to execute in parallel. QC is also a commercial tool.

Disadvantages of Selenium

Let us now discuss the pitfalls of Selenium over QTP.

Selenium	QTP
Supports only web-based applications.	Can test both web and desktop applications.
No feature such as Object Repository/Recovery Scenario	QTP has built-in object repositories and recovery scenarios.
No IDE, so the script development won't be as fast as QTP.	More intuitive IDE; automation can be achieved faster.
Cannot access controls within the browser.	Can access controls within the browser such as favorites bar, backward, and forward buttons.
No default test report generation.	Default test result generation within the tool.
For parameterization, users has to rely on the programming language.	Parameterization is built-in and easy to implement.

2. SELENIUM – IDE

Selenium – IDE

The Selenium-IDE (Integrated Development Environment) is an easy-to-use Firefox plug-in to develop Selenium test cases. It provides a Graphical User Interface for recording user actions using Firefox which is used to learn and use Selenium, but it can only be used with Firefox browser as other browsers are not supported.

However, the recorded scripts can be converted into various programming languages supported by Selenium and the scripts can be executed on other browsers as well.

The following table lists the sections that we are going to cover in this chapter. .

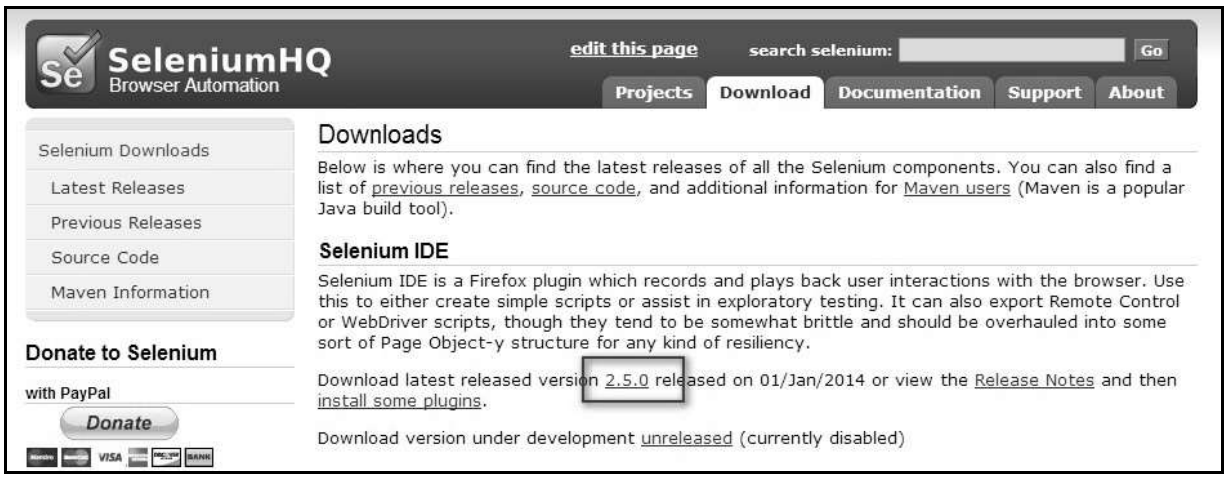
Title	Description
Download Selenium IDE	This section deals with how to download and configure Selenium IDE.
Selenium IDE Features	This section deals with the features available in Selenium IDE.
Creating Selenium IDE Tests	This section deals with how to create IDE tests using recording feature.
Selenium IDE Script Debugging	This section deals with debugging the Selenium IDE script.
Inserting Verification Points	This section describes how to insert verification points in Selenium IDE.

Selenium Pattern Matching	This section deals with how to work with regular expressions using IDE.
Selenium User Extensions	The Java script that allows users to customize or add new functionality.
Different Browser Execution	This section deals with how to execute Selenium IDE scripts on different browsers.

Download Selenium IDE

Step 1 : Launch Firefox and navigate to the following URL – http://seleniumhq.org/download/.

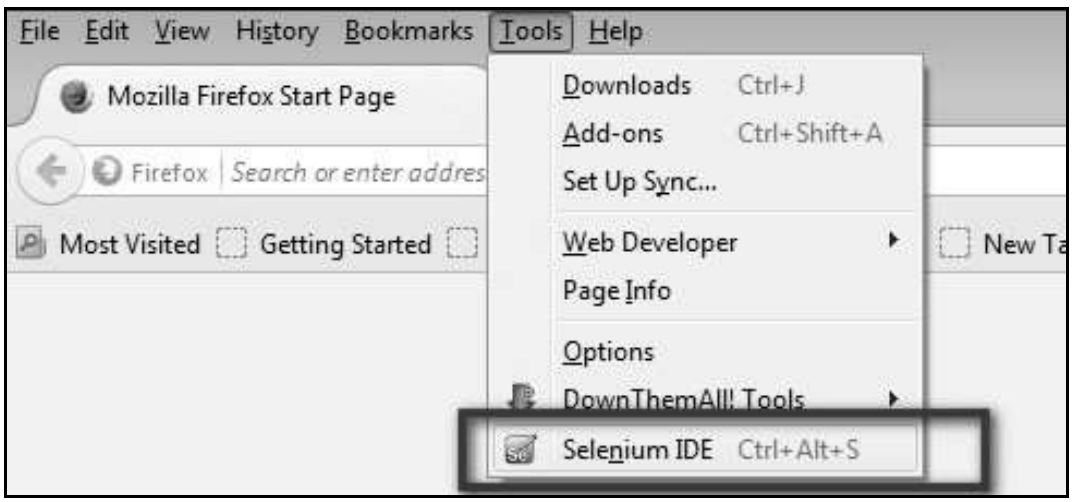
Under the Selenium IDE section, click on the link that shows the current version number as shown below.



Step 2 : Firefox add-ons notifier pops up with allow and disallow options. User has to allow the installation.

Step 3 : The add-ons installer warns the user about untrusted add-ons. Click 'Install Now'.

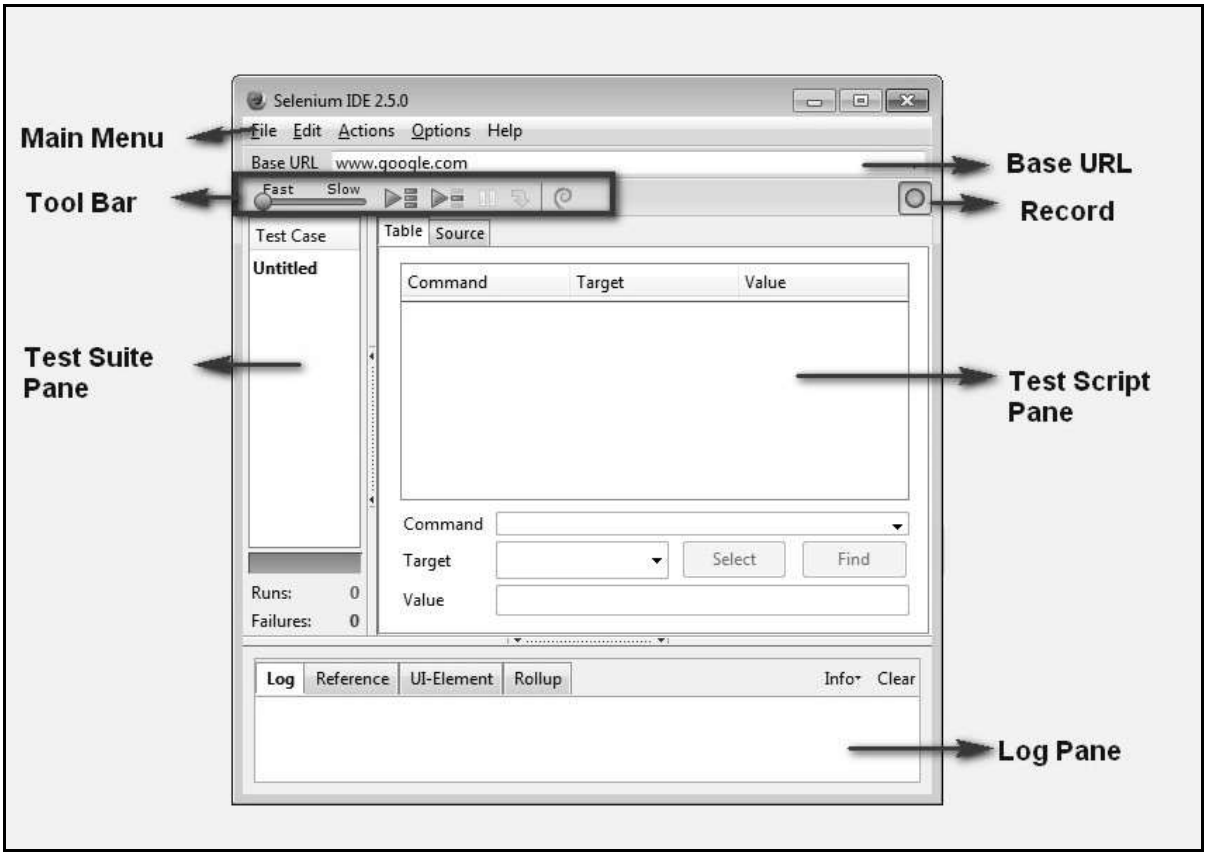
Step 4 : The Selenium IDE can now be accessed by navigating to Tools >> Selenium IDE.



Step 5 : The Selenium IDE can also be accessed directly from the quick access menu bar as shown below.

Features of Selenium IDE

The following image shows the features of Selenium IDE with the help of a simple tooltip.



The features of the record tool bar are explained below.

Control	Control Name	Description
	**Speed Control**	This helps in controlling the speed of the test case runs.
	**Run All**	Executes the entire test suite that contains multiple test cases.
	**Run**	Executes the currently selected test.
	**Pause/Resume**	Allows user to pause or resume the script execution. Enabled only during the execution.
	**Step**	Helps user to debug the test by executing only one step of a test case at a time.
	**Test Runner Mode**	Allows user to execute the test case in a browser loaded with the Selenium-Core. It is an obsolete functionality that is likely to be deprecated.
	**Apply Rollup Rules**	This feature allows repetitive sequences of Selenium commands to be grouped into a single action.
	**Record**	This feature helps user to Records the user's browser actions.

Creating Selenium IDE Tests

The following steps are involved in creating Selenium tests using IDE:

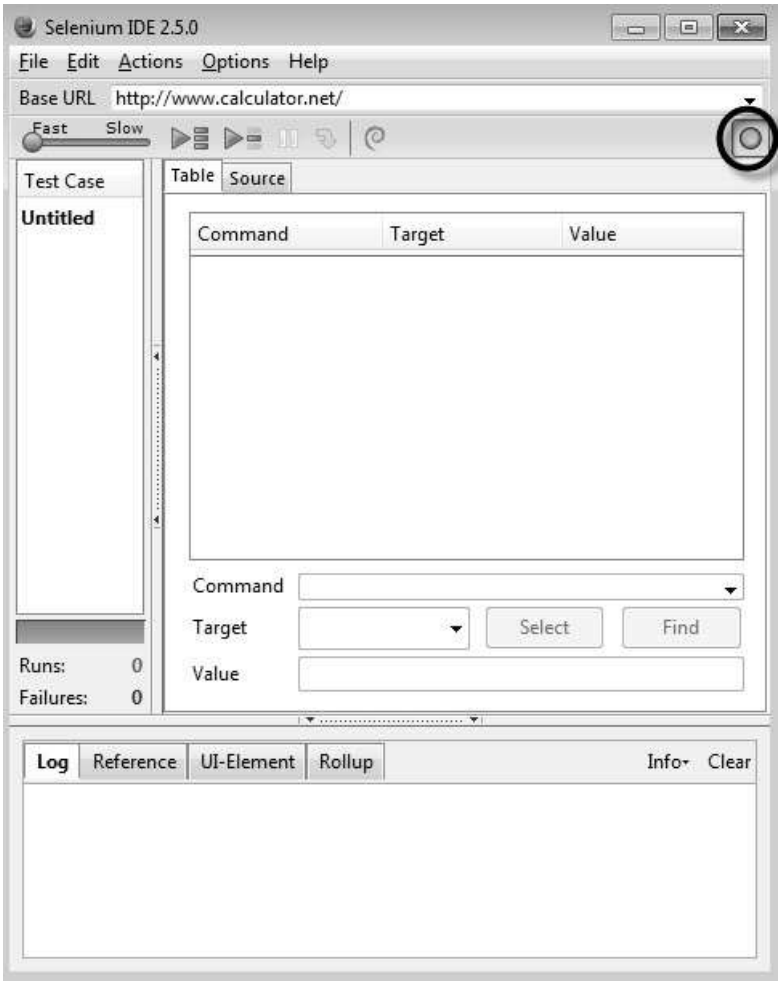
- Recording and adding commands in a test
- Saving the recorded test
- Saving the test suite
- Executing the recorded test

Recording and Adding Commands in a Test

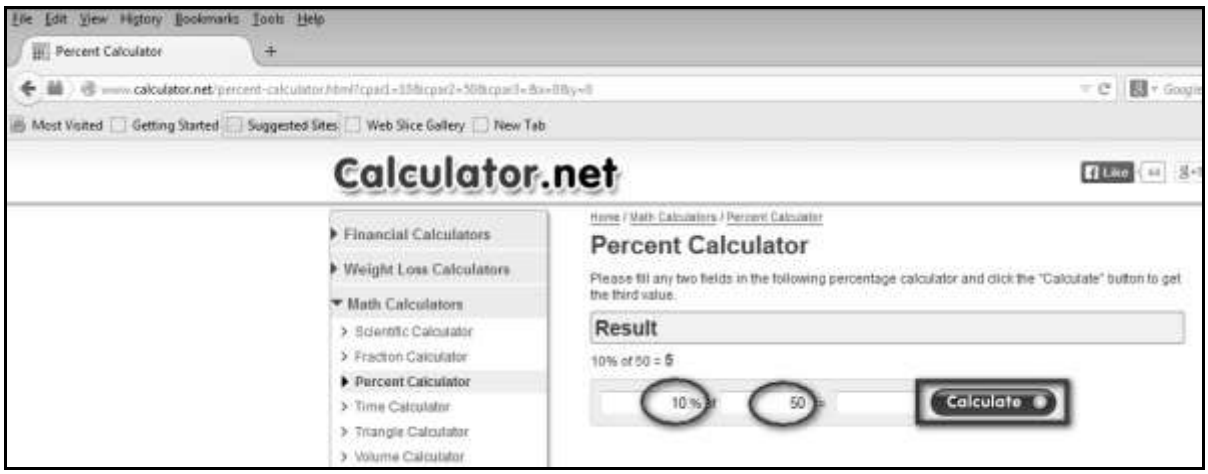
We will use www.ncalculators.com to demonstrate the features of Selenium.

Step 1 : Launch the Firefox browser and navigate to the website – http://www.ncalculators.com/

Step 2 : Open Selenium IDE from the Tools menu and press the record button that is on the top-right corner.

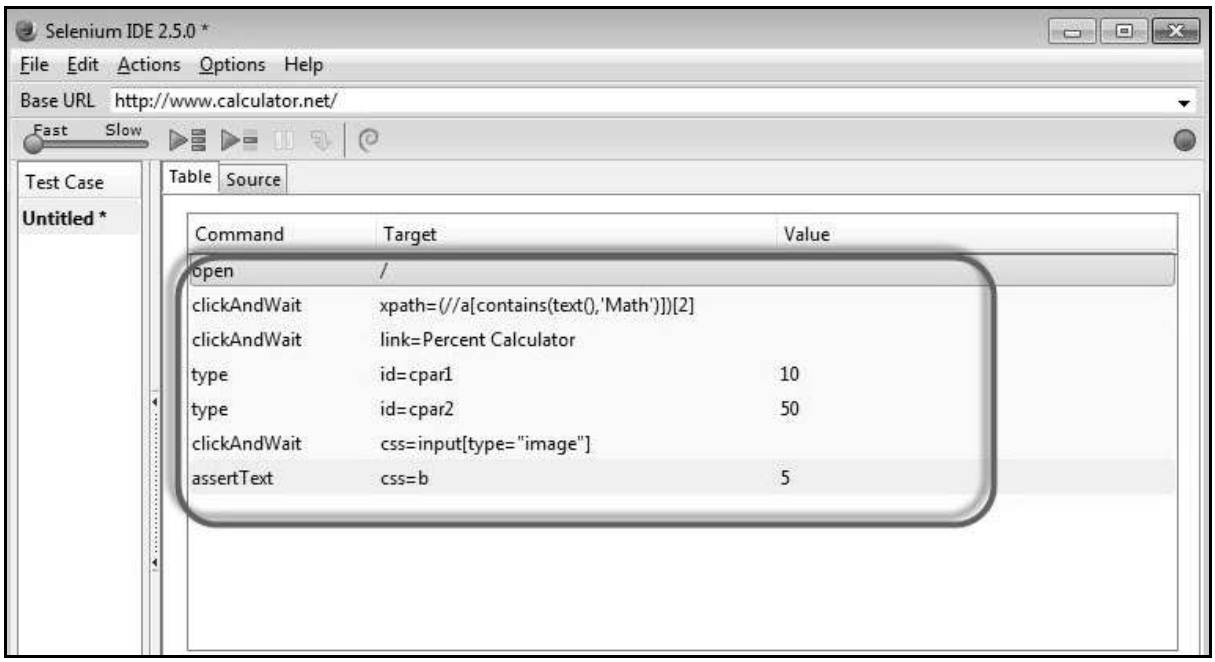


Step 3 : Navigate to "Math Calculator" >> "Percent Calculator >> enter "10" as number1 and 50 as number2 and click "calculate".



Step 4 : User can then insert a checkpoint by right clicking on the webelement and select "Show all available commands" >> select "assert text css=b 5"

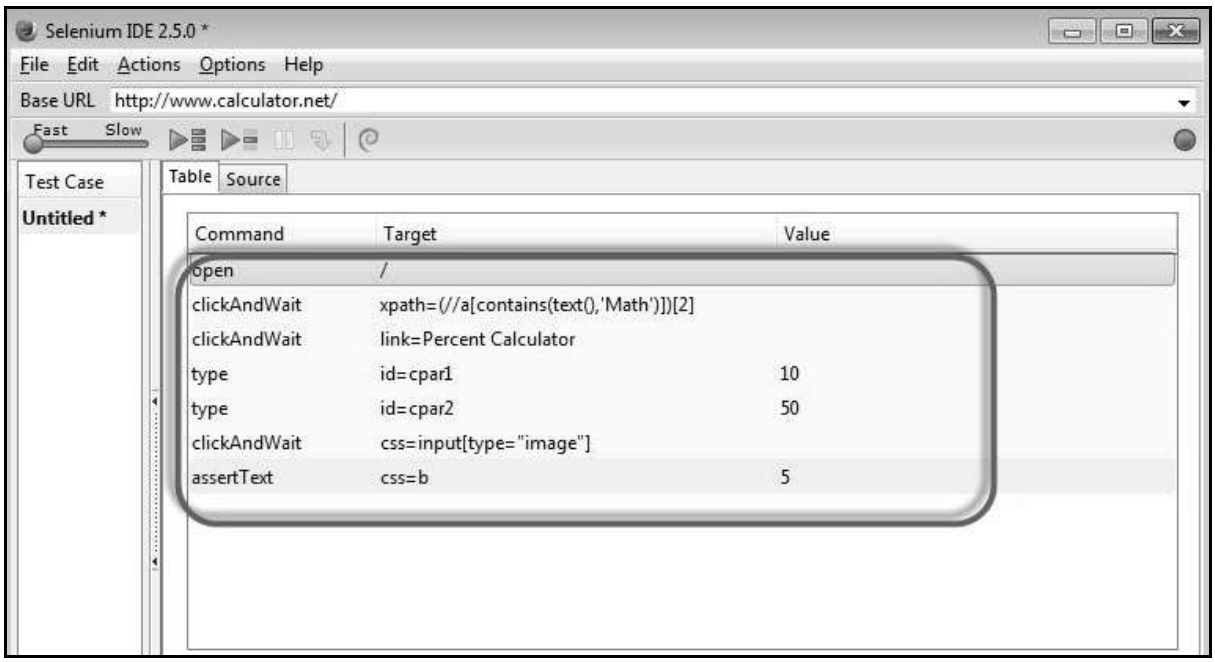
Step 5 : The recorded script is generated and the script is displayed as shown below.



Saving the Recorded Test

Step 1 : Save the Test Case by navigating to "File" >> "Save Test" and save the file in the location of your choice. The file is saved as .HTML as default.

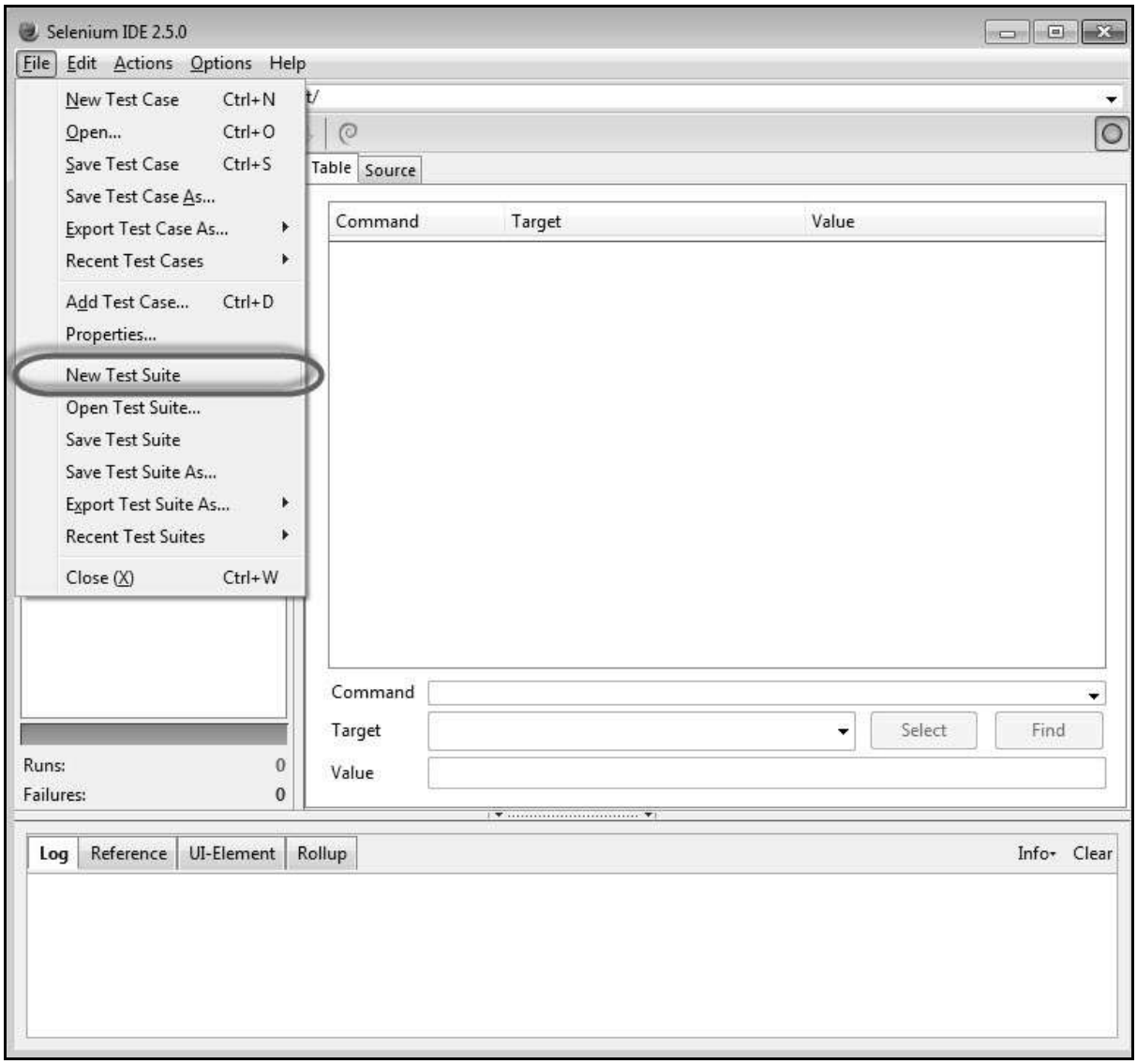
The test can also be saved with an extension htm, shtml, and xhtml.



Saving the Test Suite

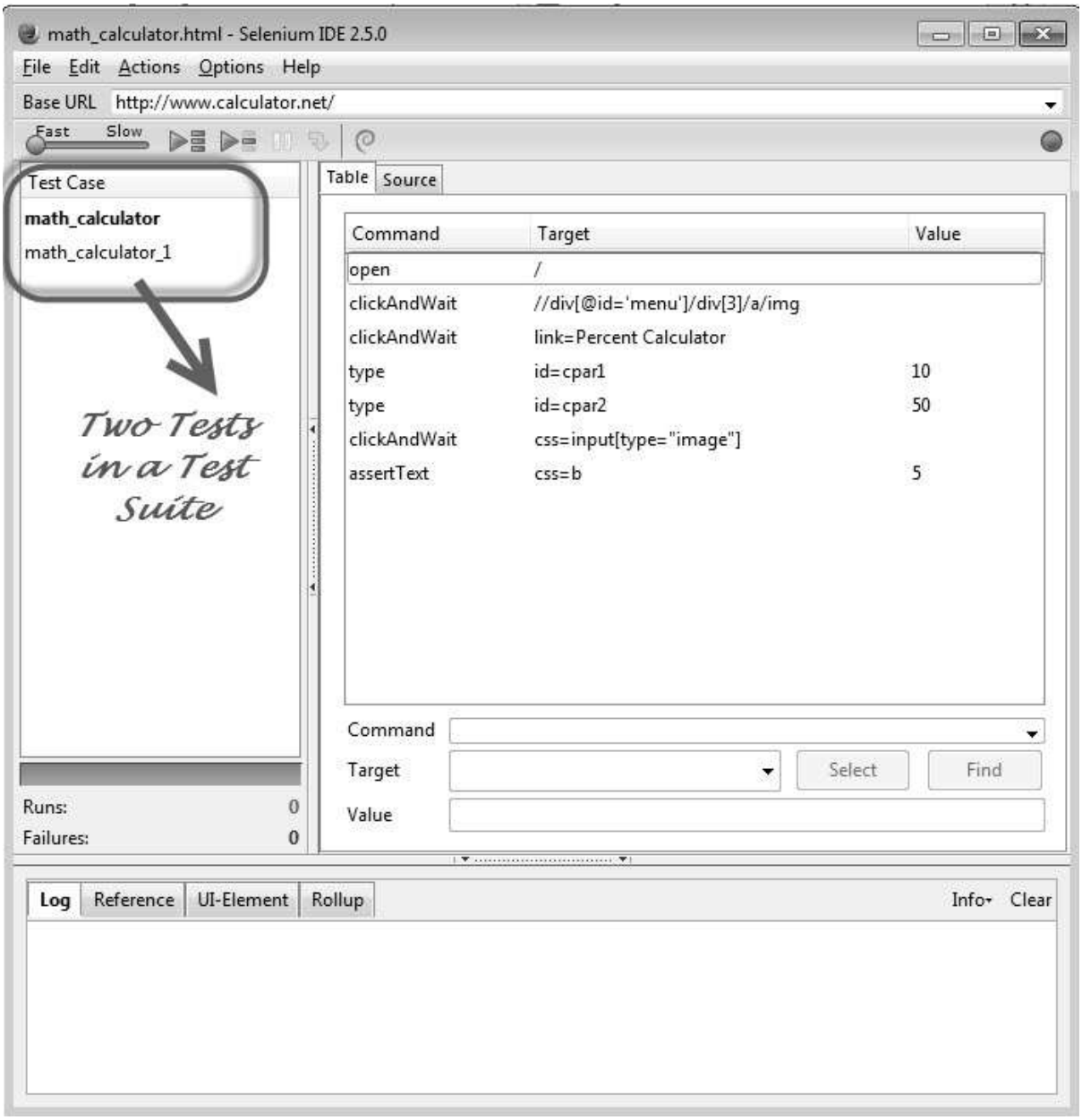
A test suite is a collection of tests that can be executed as a single entity.

Step 1 : Create a test suite by navigating to "File" >> "New Test Suite" as shown below.



Step 2 : The tests can be recorded one by one by choosing the option "New Test Case" from the "File" Menu.

Step 3 : The individual tests are saved with a name along with saving a "Test Suite".



Executing the Recorded Test

The recorded scripts can then be executed either by clicking "Play entire suite" or "Play current test" button in the toolbar.

Step 1 : The Run status can be seen in the status pane that displays the number of tests passed and failed.

Step 2 : Once a step is executed, the user can see the result in the "Log" Pane.

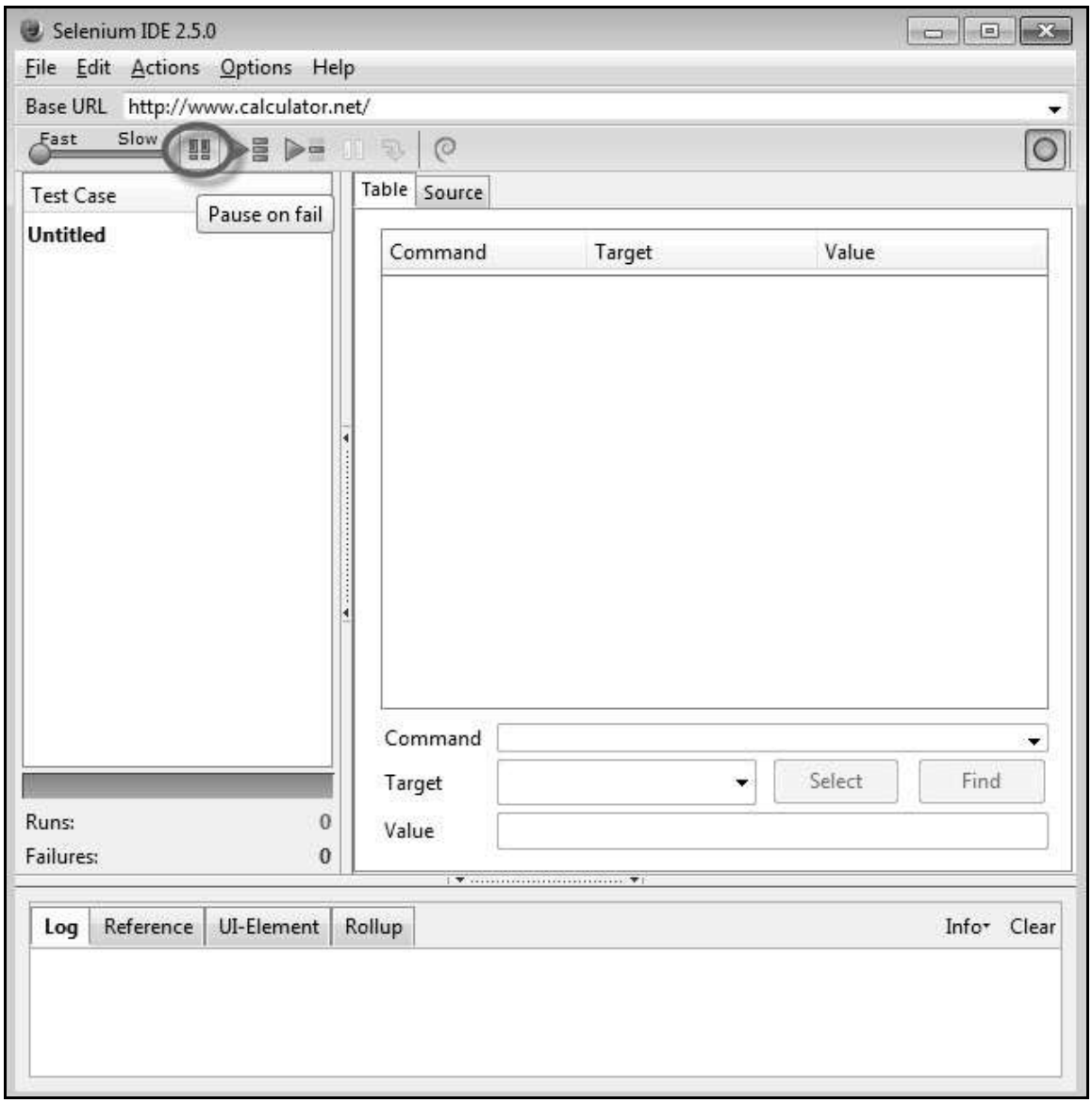
Step 3 : After executing each step, the background of the test step turns "Green" if passed and "Red" if failed as shown below.

Script Debugging

Debugging is the process of finding and fixing errors in the test script. It is a common step in any script development. To make the process more robust, we can use a plugin "Power Debugger" for Selenium IDE.

Step 1 : To install Power Debugger for Selenium IDE, navigate to https://addons.mozilla.org/en-US/firefox/addon/power-debugger-selenium-ide/ and click "Add to Firefox" as shown below.

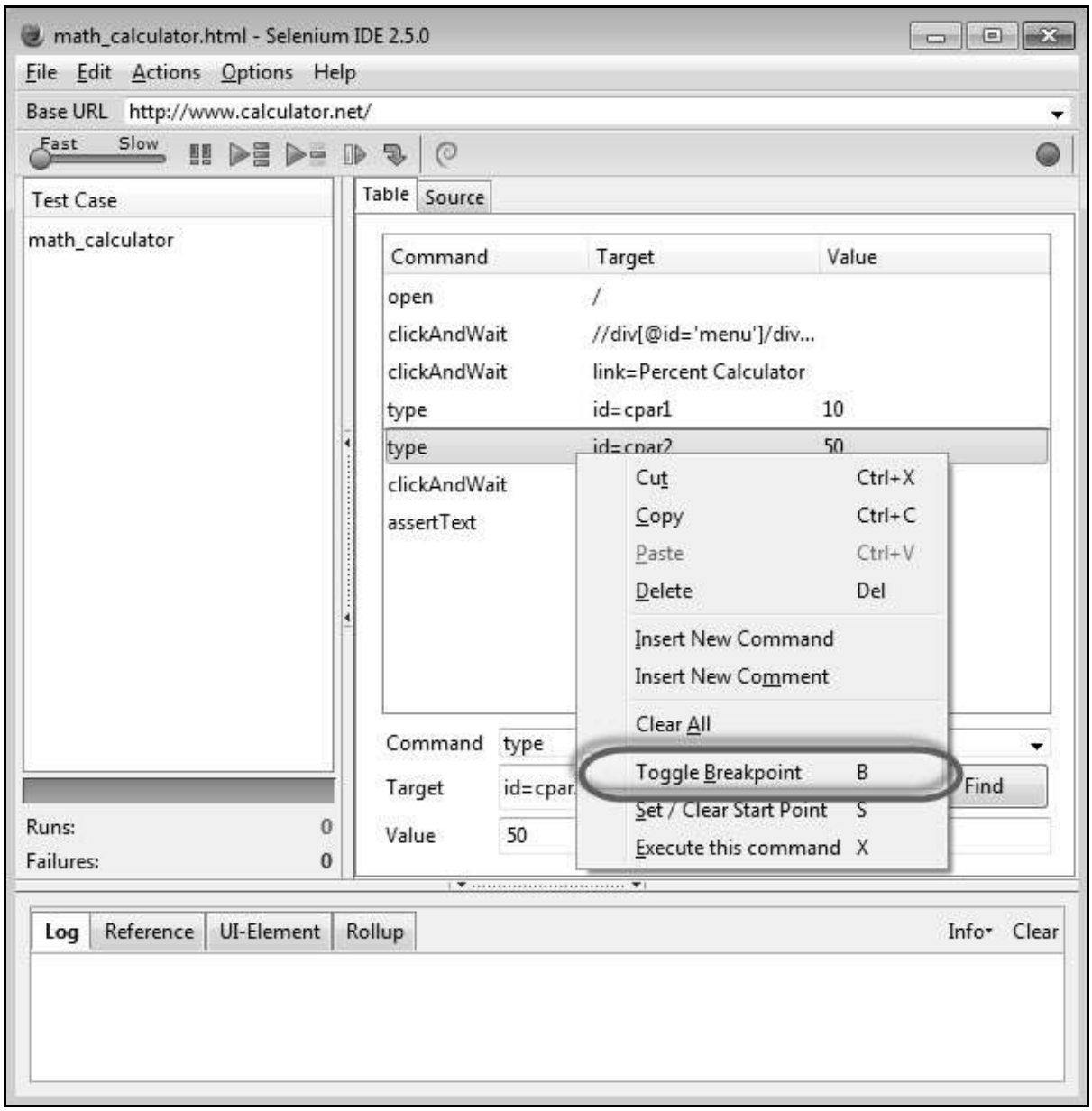
Step 2 : Now launch 'Selenium IDE' and you will notice a new icon, "Pause on Fail" on the recording toolbar as shown below. Click it to turn it ON. Upon clicking again, it would be turned "OFF".



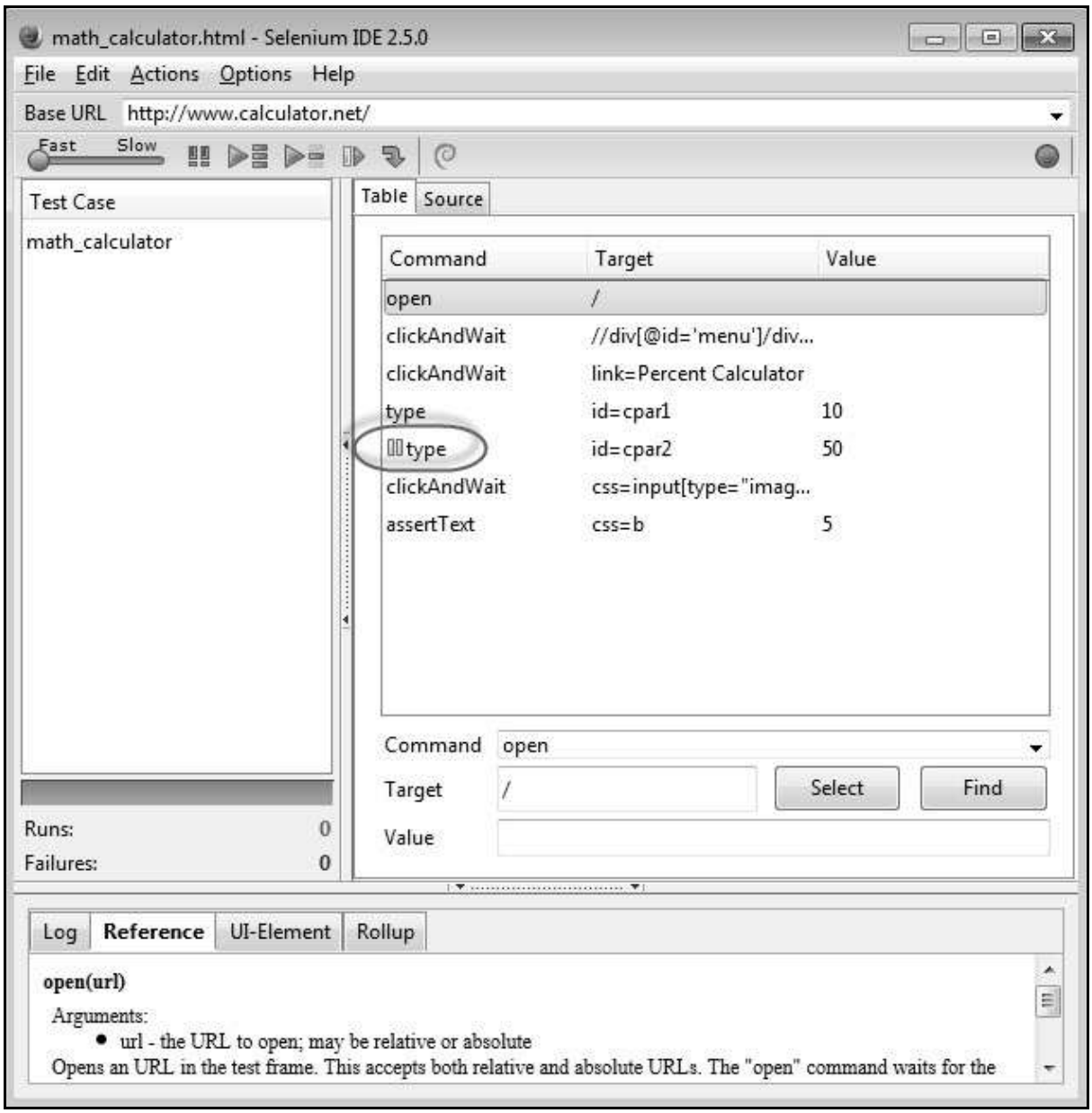
Step 3 : Users can turn "pause on fail" on or off any time even when the test is running.

Step 4 : Once the test case pauses due to a failed step, you can use the resume/step buttons to continue the test execution. The execution will **NOT** be paused if the failure is on the last command of any test case.

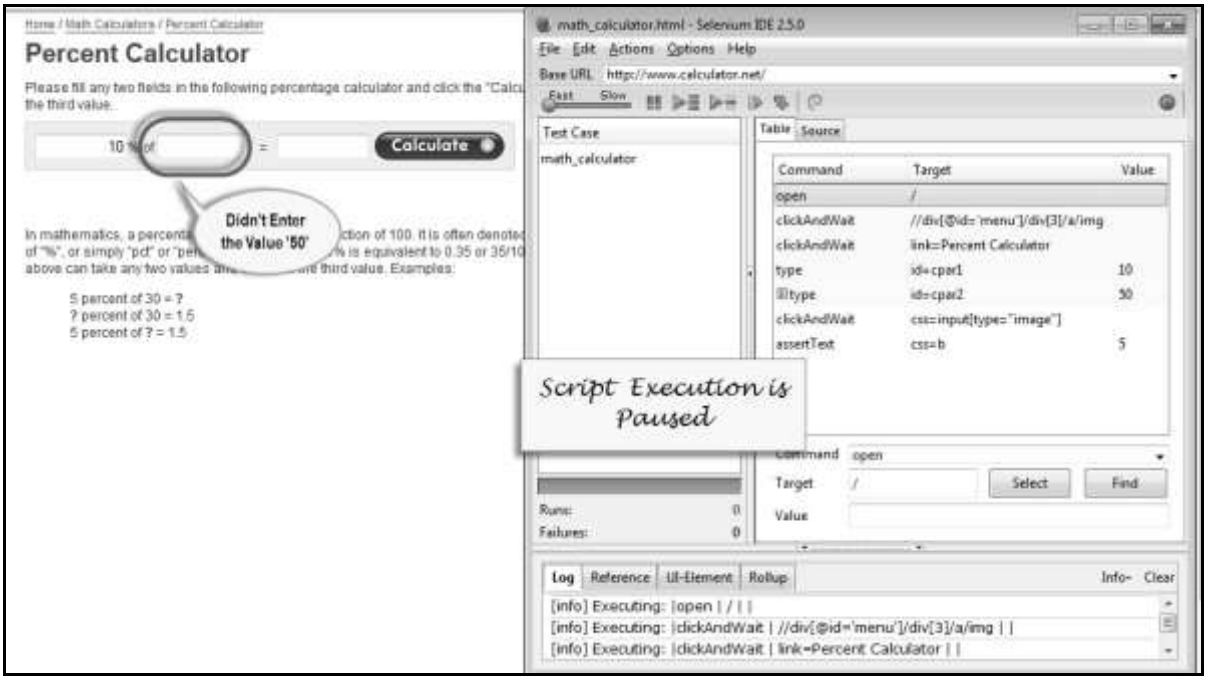
Step 5 : We can also use breakpoints to understand what exactly happens during the step. To insert a breakpoint on a particular step, "Right Click" and select "Toggle Breakpoint" from the context-sensitive menu.



Step 6 : Upon inserting the breakpoint, the particular step is displayed with a pause icon as shown below.



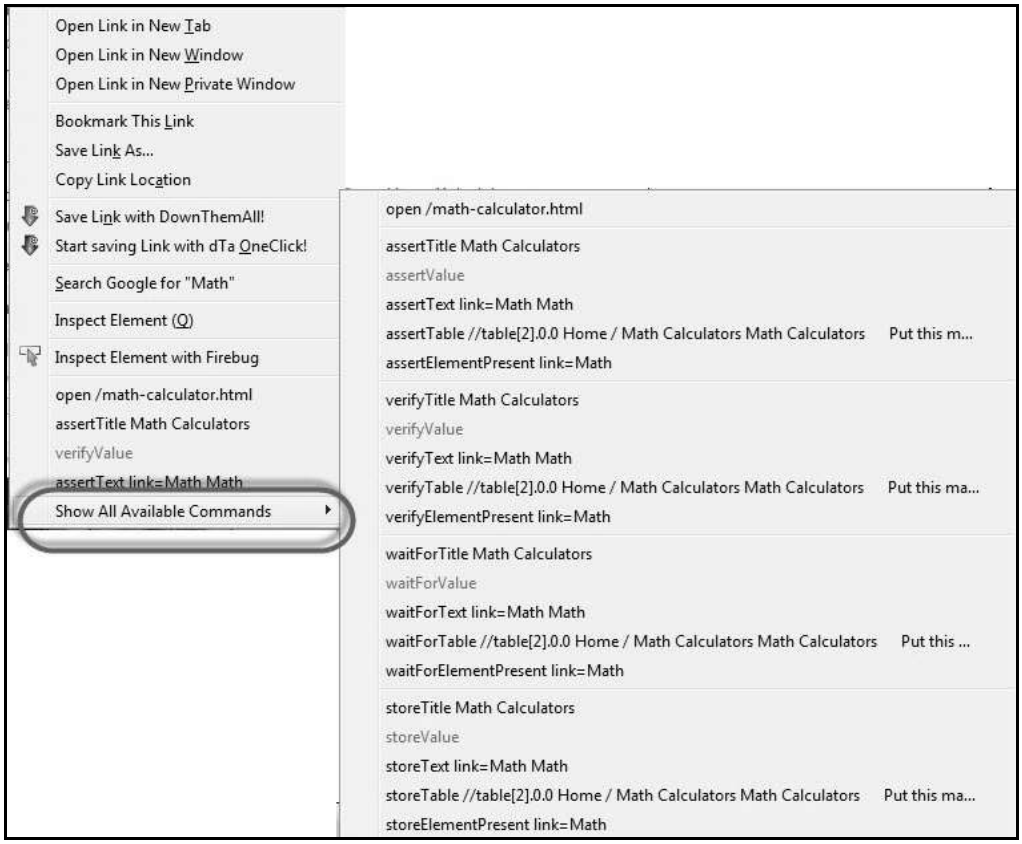
Step 7 : When we execute the script, the script execution is paused where the breakpoint is inserted. This will help the user to evaluate the value/presence of an element when the execution is in progress.



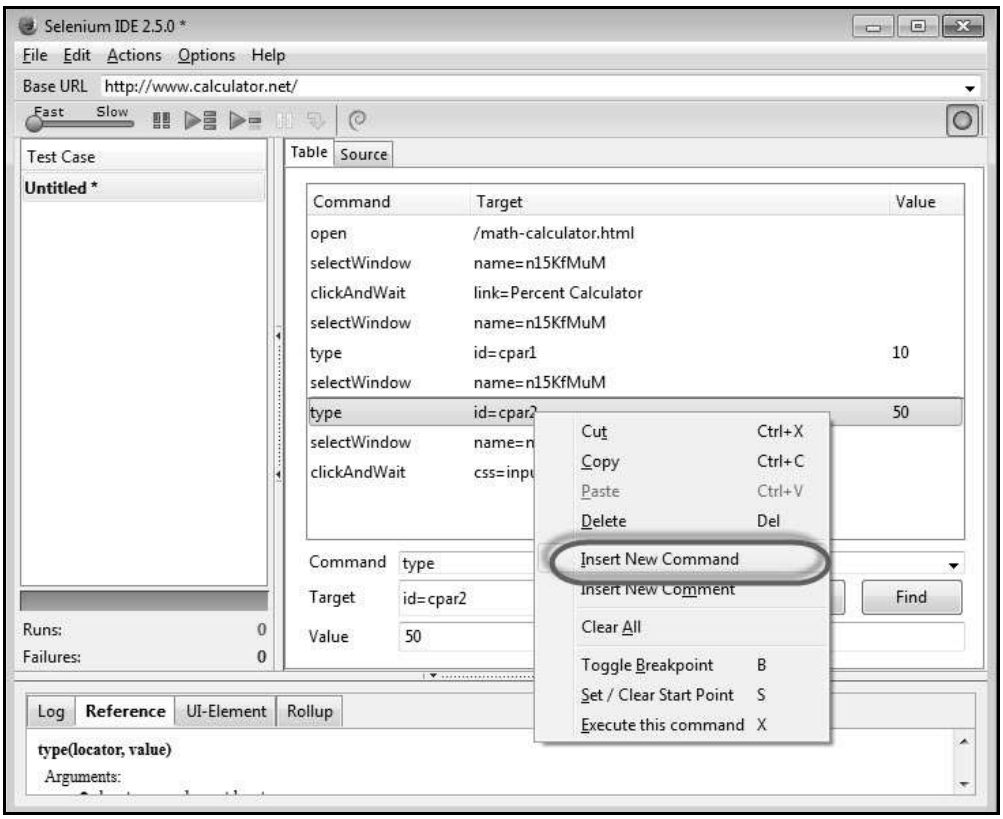
Inserting Verification Points

The test cases that we develop also need to check the properties of a web page. It requires assert and verify commands. There are two ways to insert verification points into the script.

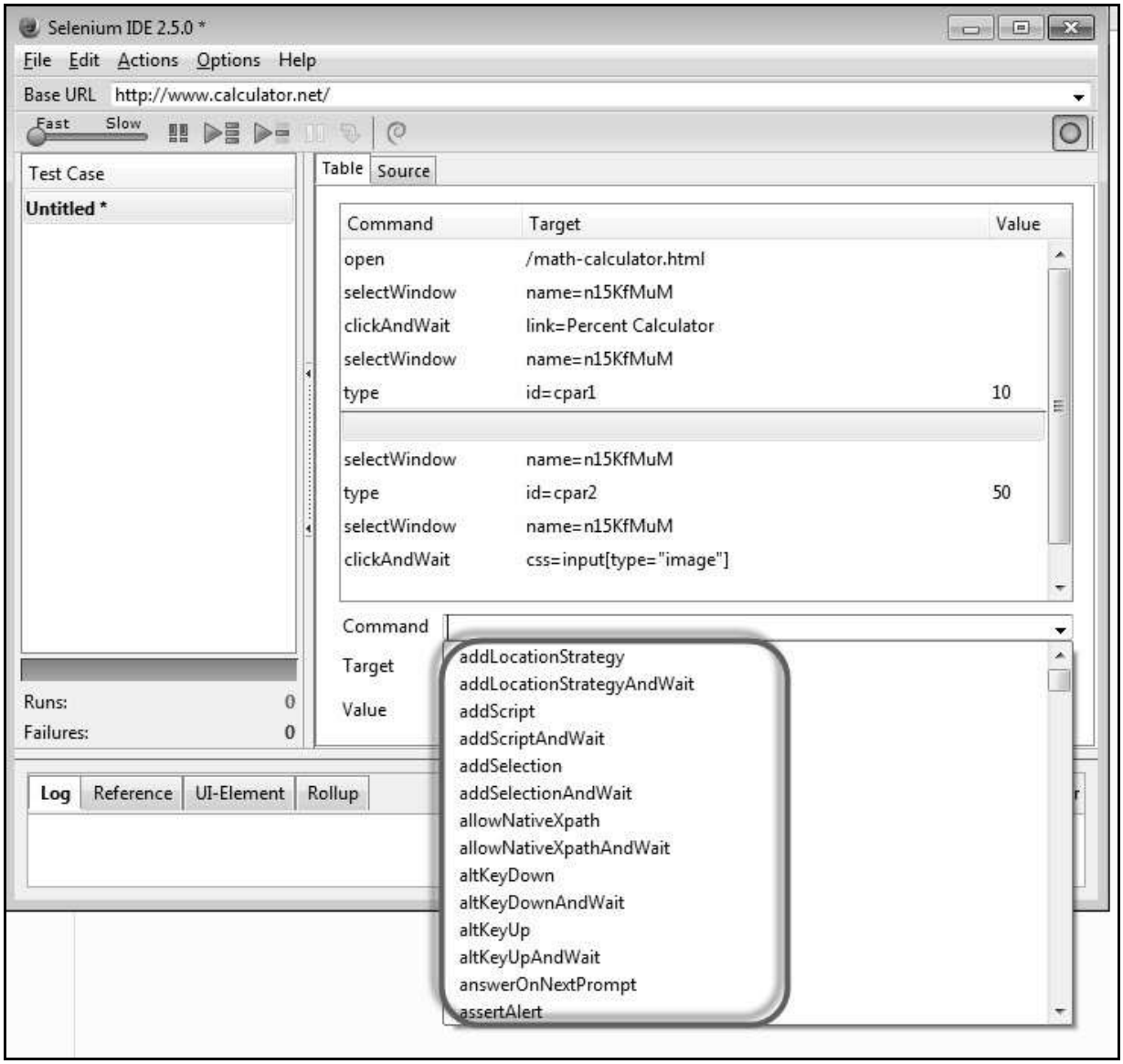
To insert a verification point in recording mode, "Right click" on the element and choose "Show all Available Commands" as shown below.



We can also insert a command by performing a "Right-Click" and choosing "Insert New Command".



After inserting a new command, click 'Command' dropdown and select appropriate verification point from the available list of commands as shown below.



Given below are the mostly used verification commands that help us check if a particular step has passed or failed.

- verifyElementPresent
- assertElementPresent
- verifyElementNotPresent
- assertElementNotPresent
- verifyText
- assertText

- verifyAttribute
- assertAttribute
- verifyChecked
- assertChecked
- verifyAlert
- assertAlert
- verifyTitle
- assertTitle

Synchronization Points

During script execution, the application might respond based on server load, hence it is required for the application and script to be in sync. Given below are a few commands that we can use to ensure that the script and application are in sync.

- waitForAlertNotPresent
- waitForAlertPresent
- waitForElementPresent
- waitForElementNotPresent
- waitForTextPresent
- waitForTextNotPresent
- waitForPageToLoad
- waitForFrameToLoad

Pattern Matching

Like locators, patterns are a type of parameter frequently used by Selenium. It allows users to describe patterns with the help of special characters. Many a time, the text that we would like to verify are dynamic; in that case, pattern matching is very useful.

Pattern matching is used with all the verification point commands – verifyTextPresent, verifyTitle, verifyAlert, assertConfirmation, verifyText, and verifyPrompt.

There are three ways to define a pattern:

- globbing,
- regular expressions, and
- exact patterns.

Globbing

Most techies who have used file matching patterns in Linux or Windows while searching for a certain file type like *.doc or *.jpg would be familiar with term "globbing".

Globbing in Selenium supports only three special characters: *, ?, and [ ].

- ***** - matches any number of characters.
- **?** - matches a single character.
- **[ ]** - called a character class, lets you match any single character found within the brackets. [0-9] matches any digit.

To specify a glob in a Selenium command, prefix the pattern with the keyword 'glob:'. For example, if you would like to search for the texts "tax year 2013" or "tax year 2014", then you can use the glob "tax year *" as shown below.

However the usage of "glob:" is optional while specifying a text pattern because globbing patterns are the default in Selenium.

Command	Target	Value
clickAndWait	link=search	
verifyTextPresent	glob: tax year *	

Exact Patterns

Patterns with the prefix 'exact:' will match the given text as it is. Let us say, the user wants an exact match with the value string, i.e., without the glob operator doing its work, one can use the 'exact' pattern as shown below. In this example, the operator '*' will work as a normal character rather than a pattern-matching wildcard character.

Command	Target	Value
clickAndWait	link=search	
verifyValue	exact: *.doc	

Regular Expressions

Regular expressions are the most useful among the pattern matching techniques available. Selenium supports the complete set of regular expression patterns that Javascript supports. Hence the users are no longer limited by *, ?, and [] globbing patterns.

To use RegEx patterns, we need to prefix with either "regexp:" or "regexpi:". The prefix "regexpi" is case-insensitive. The glob: and the exact: patterns are the subsets of the Regular Expression patterns. Everything that is done with glob: or exact: can be accomplished with the help of RegExp.

Example

For example, the following will test if an input field with the id 'name' contains the string 'tax year', 'Tax Year', or 'tax Year'.

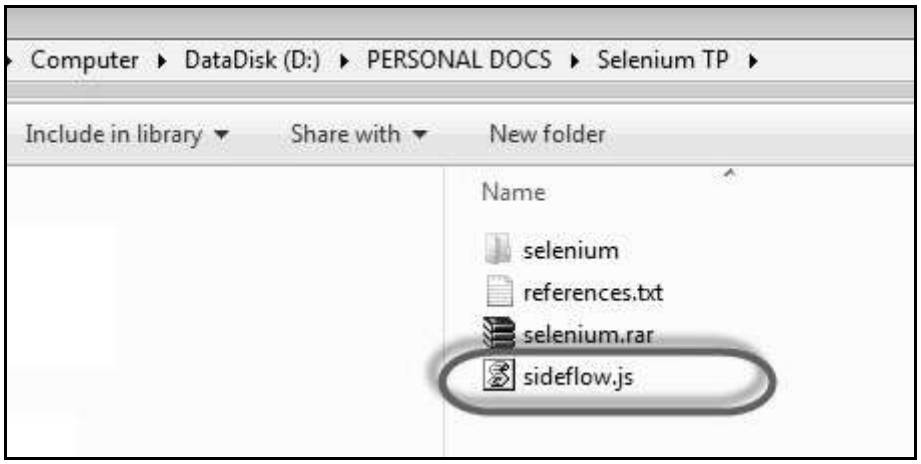
Command	Target	Value
clickAndWait	link=search	
verifyValue	id=name	regexp:[Tt]ax ([Yy]ear)

Selenium User Extensions

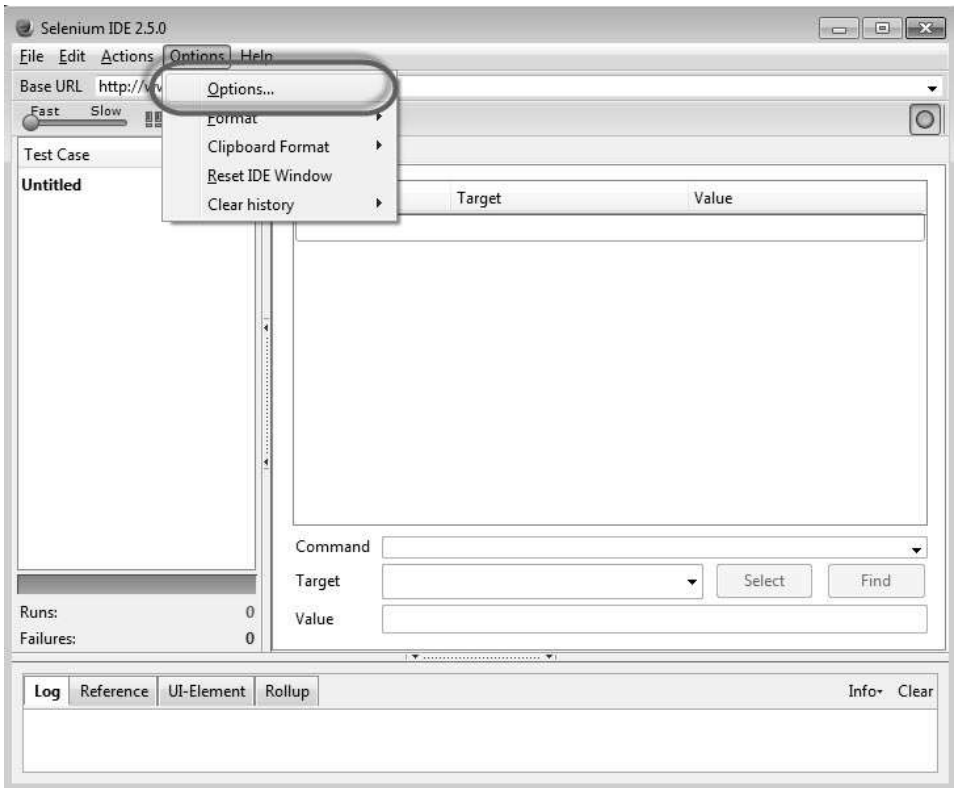
It is easy to extend Selenium IDE by adding customized actions, assertions, and locator-strategies. It is done with the help of JavaScript by adding methods to the Selenium object prototype. On startup, Selenium will automatically look through the methods on these prototypes, using name patterns to recognize which ones are actions, assertions, and locators.

Let us add a 'while' Loop in Selenium IDE with the help of JavaScript.

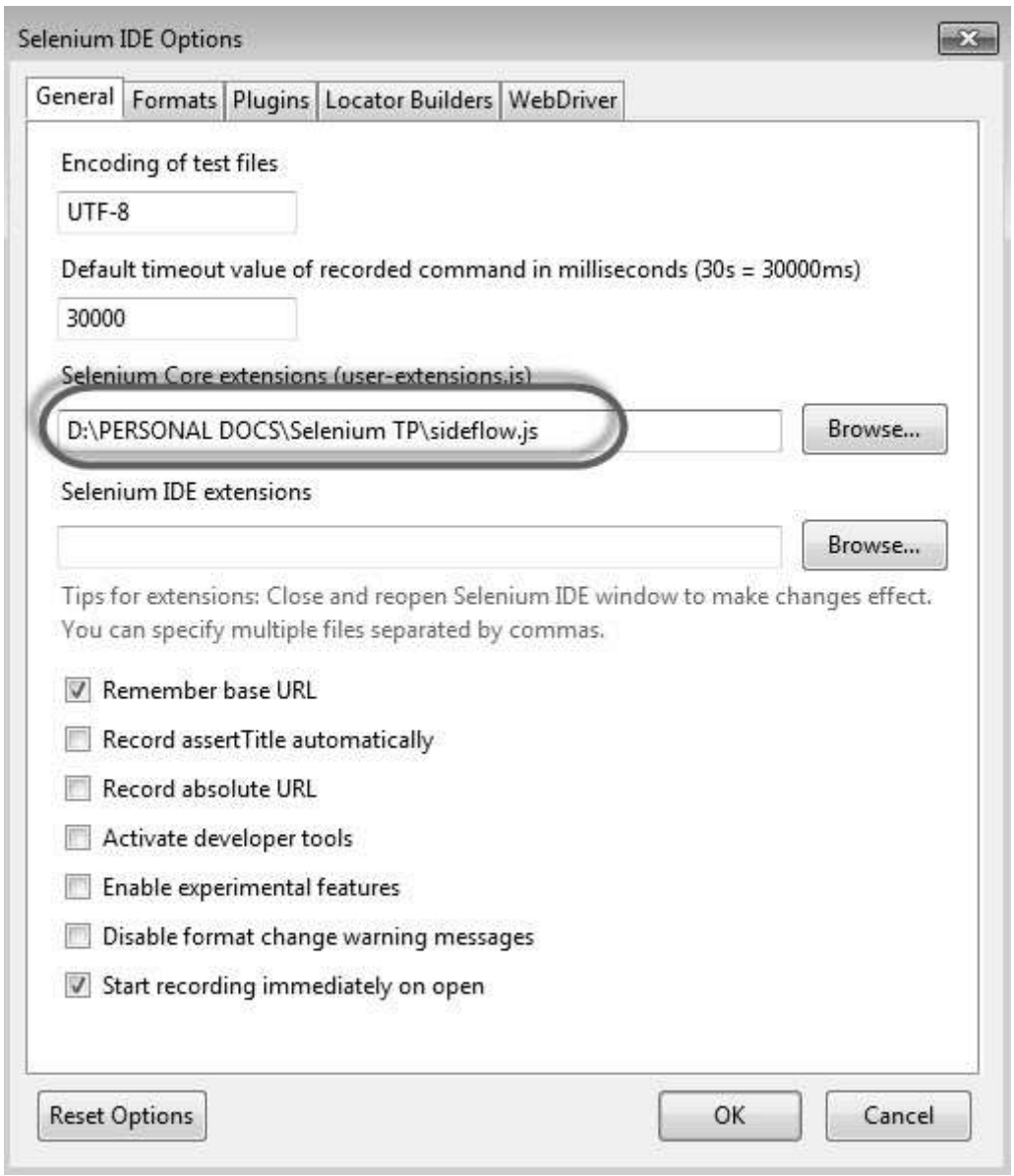
Step 1 : To add the js file, first navigate to https://github.com/darrenderidder/sideflow/blob/master/sideflow.js and copy the script and place save it as 'sideflow.js' in your local folder as shown below.



Step 2 : Now launch 'Selenium IDE' and navigate to "Options" >> "Options" as shown below.



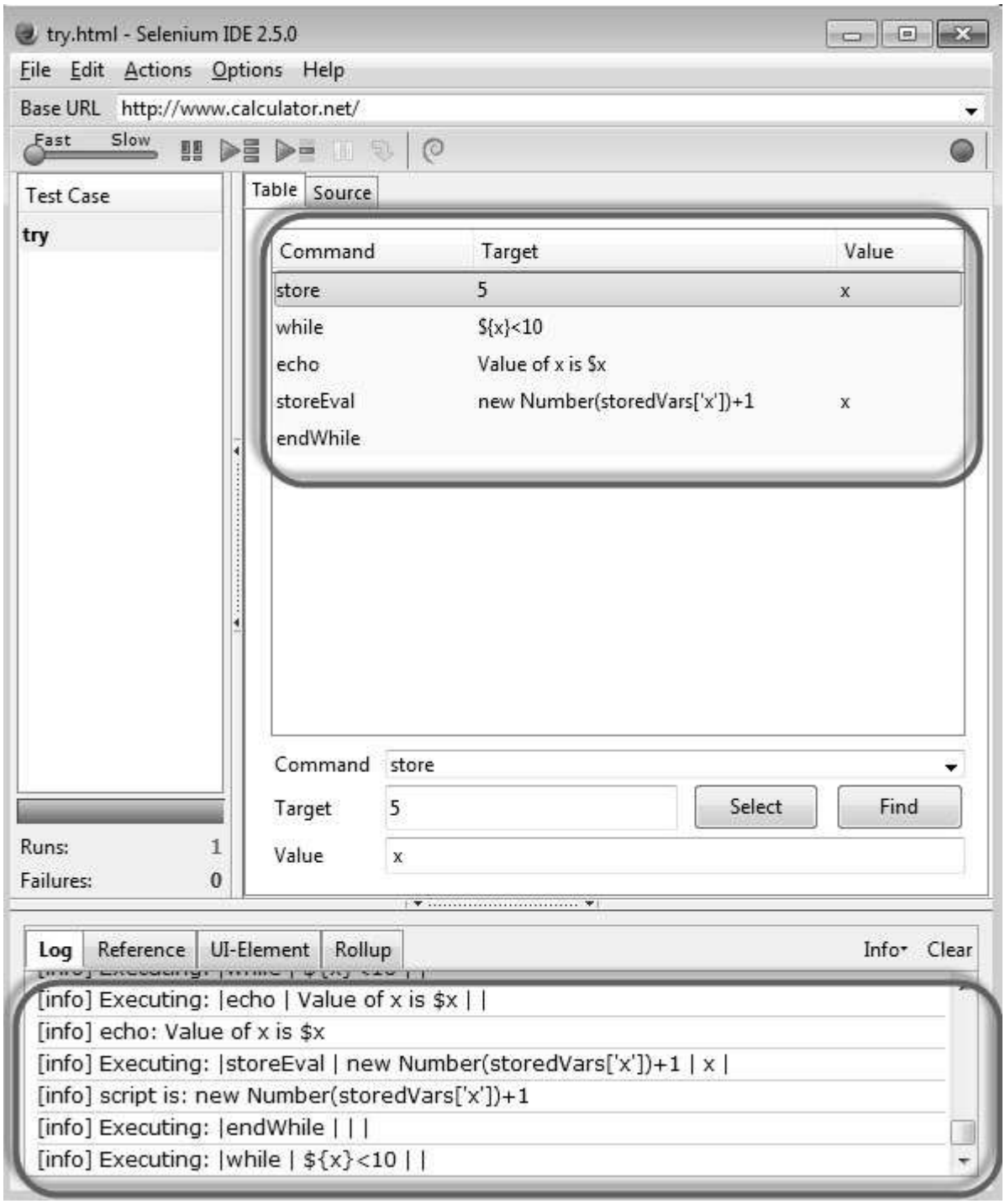
Step 3 : Click the 'Browse' button under 'Selenium Core Extensions' area and point to the js file that we have saved in Step 1.



Step 4 : Restart Selenium IDE.

Step 5 : Now you will have access to a few more commands such as "Label", "While", etc.

Step 6 : Now we will be able to create a While loop within Selenium IDE and it will execute as shown below.

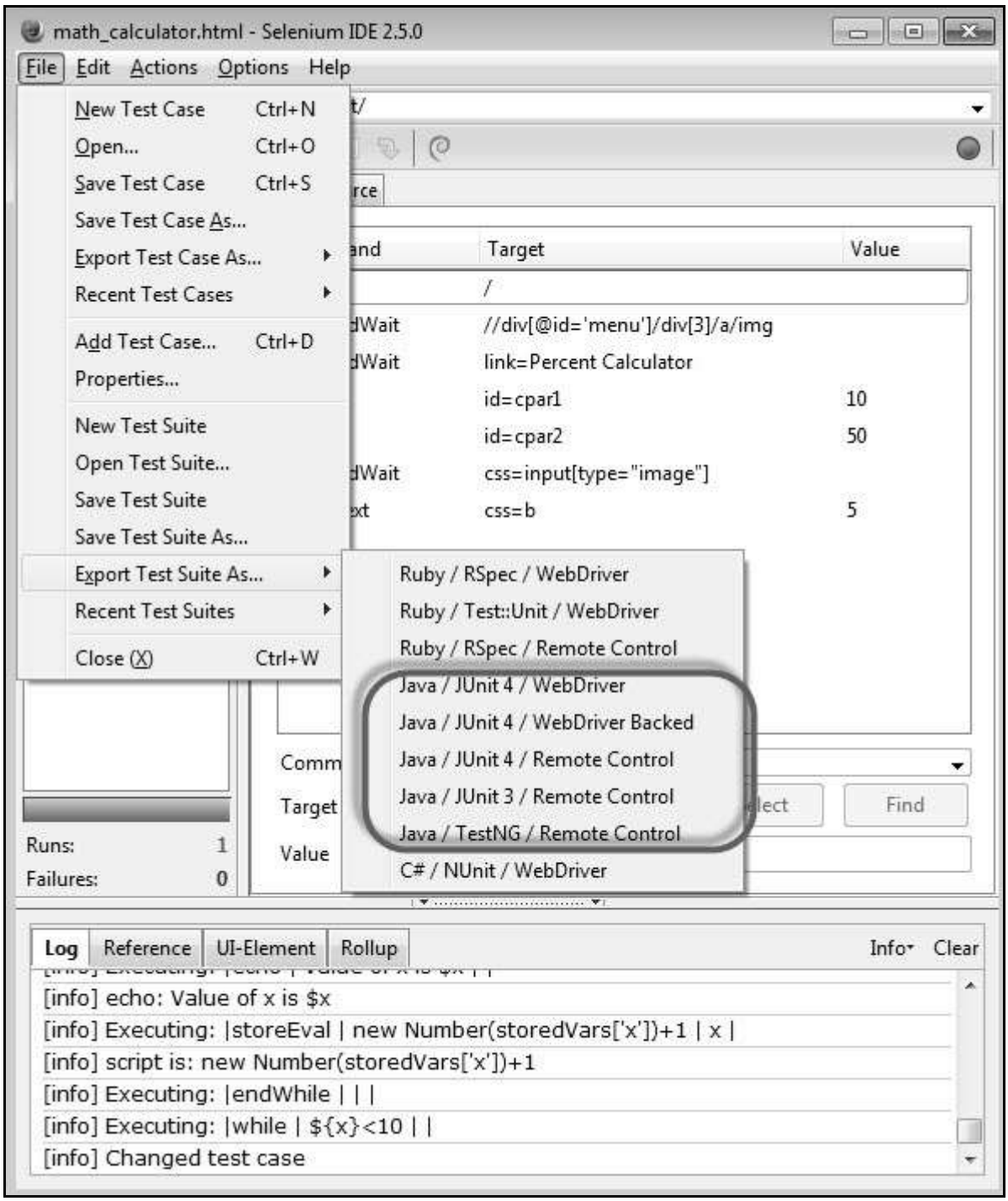


Different Browser Execution

Selenium scripts can run tests only against Firefox as the tool IDE itself is a plugin of Firefox. Tests developed using Selenium IDE can be executed against other browsers by saving it as Selenium WebDriver or Selenium Remote Control Script.

Step 1 : Open any saved Test in Selenium IDE.

Step 2 : Navigate to "File" menu and select "Export Test Suite As" and the options would be listed.



Step 3 : Now let us export the script to "WebDriver" and save it with a name.

Step 4 : The saved WebDriver file is displayed as shown below.

```
1  import junit.framework.Test;
2  import junit.framework.TestSuite;
3
4  public class percentcalc {
5
6    public static Test suite() {
7      TestSuite suite = new TestSuite();
8      suite.addTestSuite(math_calculator.class);
9      return suite;
10   }
11
12   public static void main(String[] args) {
13     junit.textui.TestRunner.run(suite());
14   }
15 }
```

3. ENVIRONMENT SETUP

In order to develop Selenium RC or WebDriver scripts, users have to ensure that they have the initial configuration done. Setting up the environment involves the following steps.

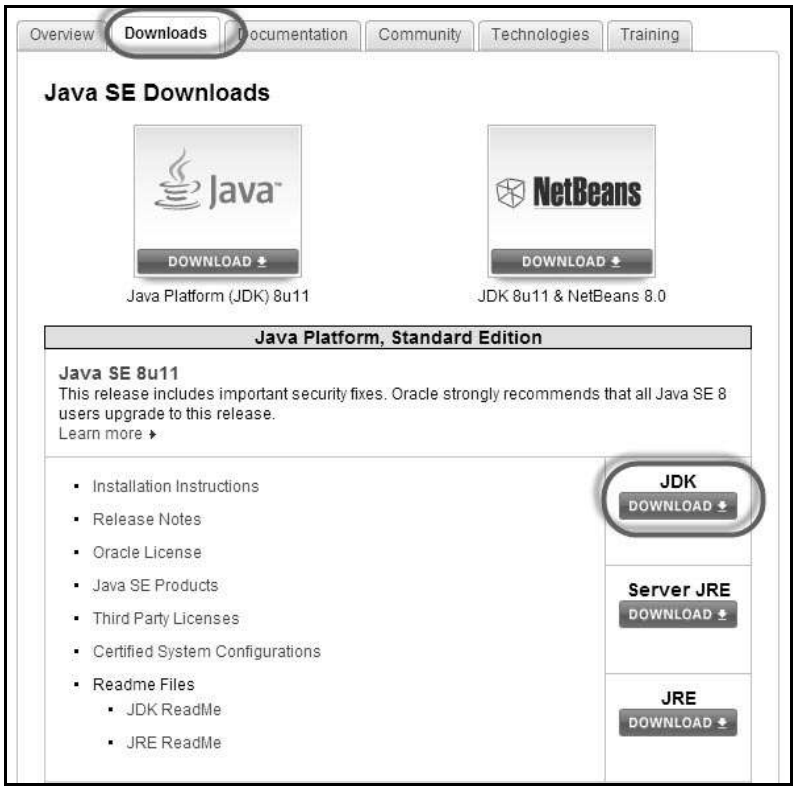
- Download and Install Java
- Download and Configure Eclipse
- Configure FireBug and FirePath
- Configure Selenium RC
- Configure Selenium WebDriver

Download and Install Java

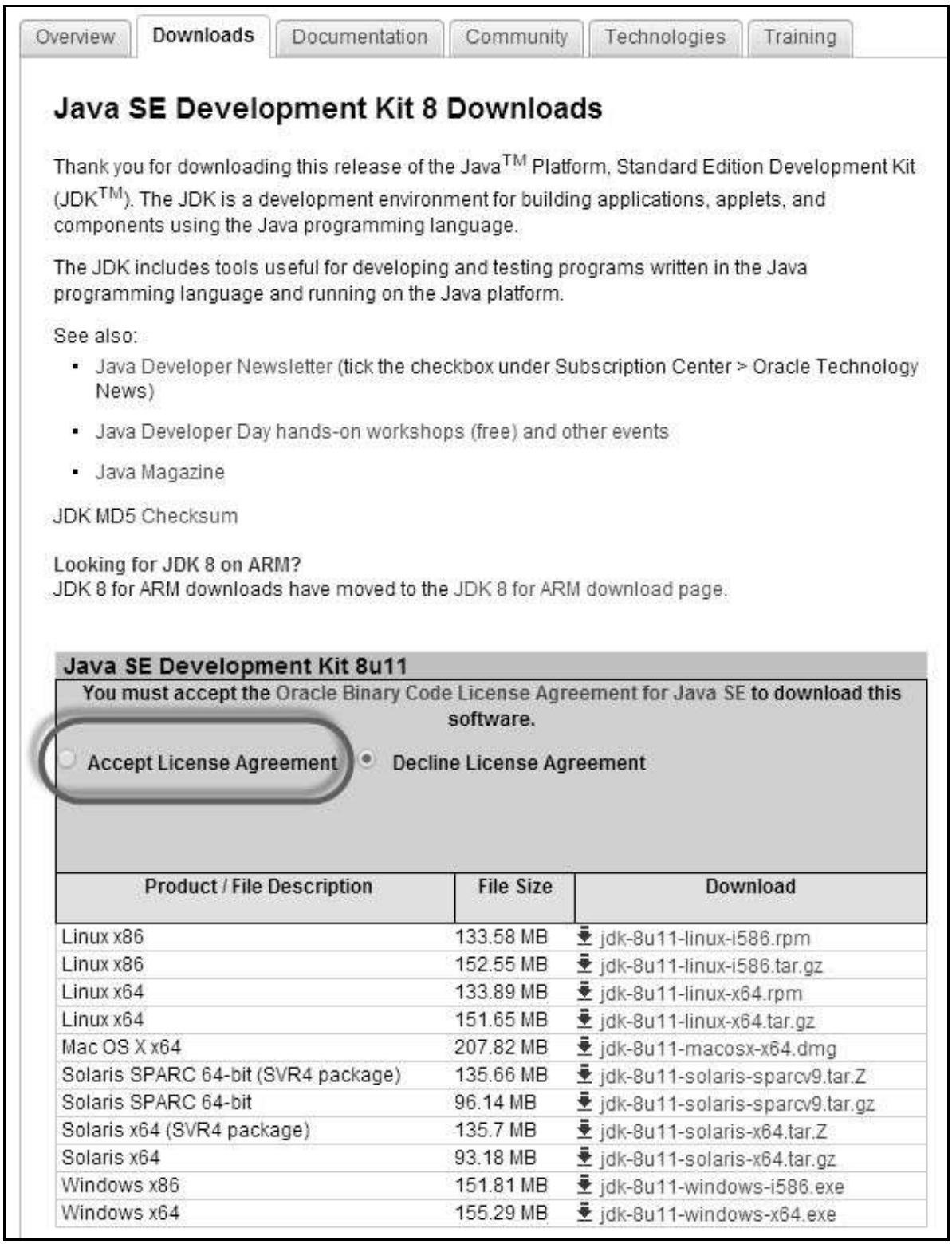
We need to have JDK (Java Development Kit) installed in order to work with Selenium WebDriver/Selenium. Let us see how to download and install Java.

Step 1: Navigate to the URL: http://www.oracle.com/technetwork/java/javase/downloads/index.html

Step 2: Go to "Downloads" section and select "JDK Download".



Step 3: Select "Accept License Agreement" radio button.



Overview | Downloads | Documentation | Community | Technologies | Training

Java SE Development Kit 8 Downloads

Thank you for downloading this release of the Java™ Platform, Standard Edition Development Kit (JDK™). The JDK is a development environment for building applications, applets, and components using the Java programming language.

The JDK includes tools useful for developing and testing programs written in the Java programming language and running on the Java platform.

See also:

- Java Developer Newsletter (tick the checkbox under Subscription Center > Oracle Technology News)
- Java Developer Day hands-on workshops (free) and other events
- Java Magazine

JDK MD5 Checksum

Looking for JDK 8 on ARM?
JDK 8 for ARM downloads have moved to the JDK 8 for ARM download page.

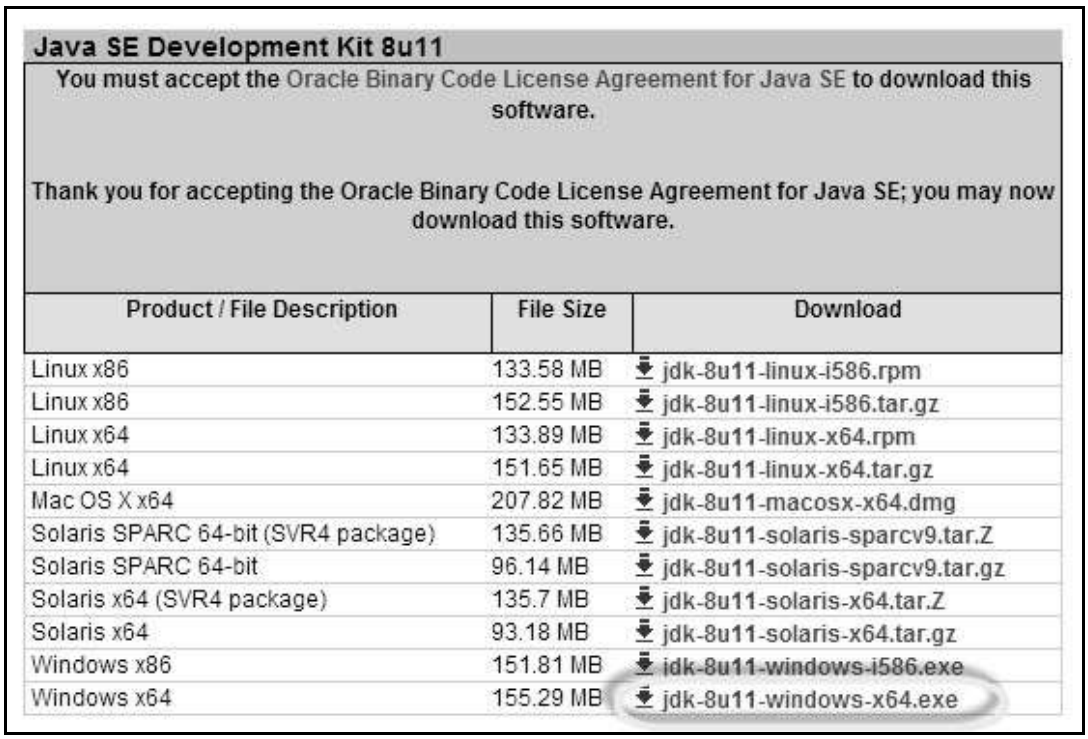
Java SE Development Kit 8u11

You must accept the Oracle Binary Code License Agreement for Java SE to download this software.

Accept License Agreement | Decline License Agreement

Product / File Description	File Size	Download
Linux x86	133.58 MB	jdk-8u11-linux-i586.rpm
Linux x86	152.55 MB	jdk-8u11-linux-i586.tar.gz
Linux x64	133.89 MB	jdk-8u11-linux-x64.rpm
Linux x64	151.65 MB	jdk-8u11-linux-x64.tar.gz
Mac OS X x64	207.82 MB	jdk-8u11-macosx-x64.dmg
Solaris SPARC 64-bit (SVR4 package)	135.66 MB	jdk-8u11-solaris-sparcv9.tar.Z
Solaris SPARC 64-bit	96.14 MB	jdk-8u11-solaris-sparcv9.tar.gz
Solaris x64 (SVR4 package)	135.7 MB	jdk-8u11-solaris-x64.tar.Z
Solaris x64	93.18 MB	jdk-8u11-solaris-x64.tar.gz
Windows x86	151.81 MB	jdk-8u11-windows-i586.exe
Windows x64	155.29 MB	jdk-8u11-windows-x64.exe

Step 4 : Select the appropriate installation. In this case, it is 'Windows 7-64' bit. Click the appropriate link and save the .exe file to your disk.



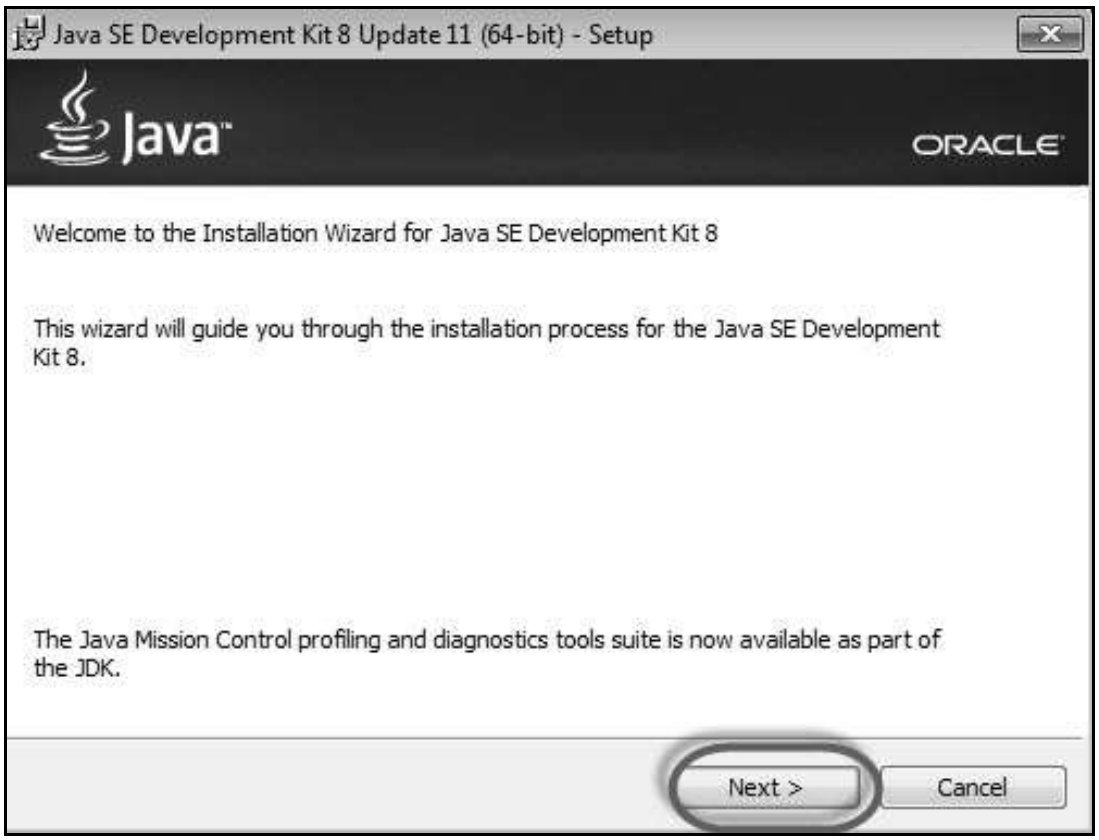
Java SE Development Kit 8u11

You must accept the Oracle Binary Code License Agreement for Java SE to download this software.

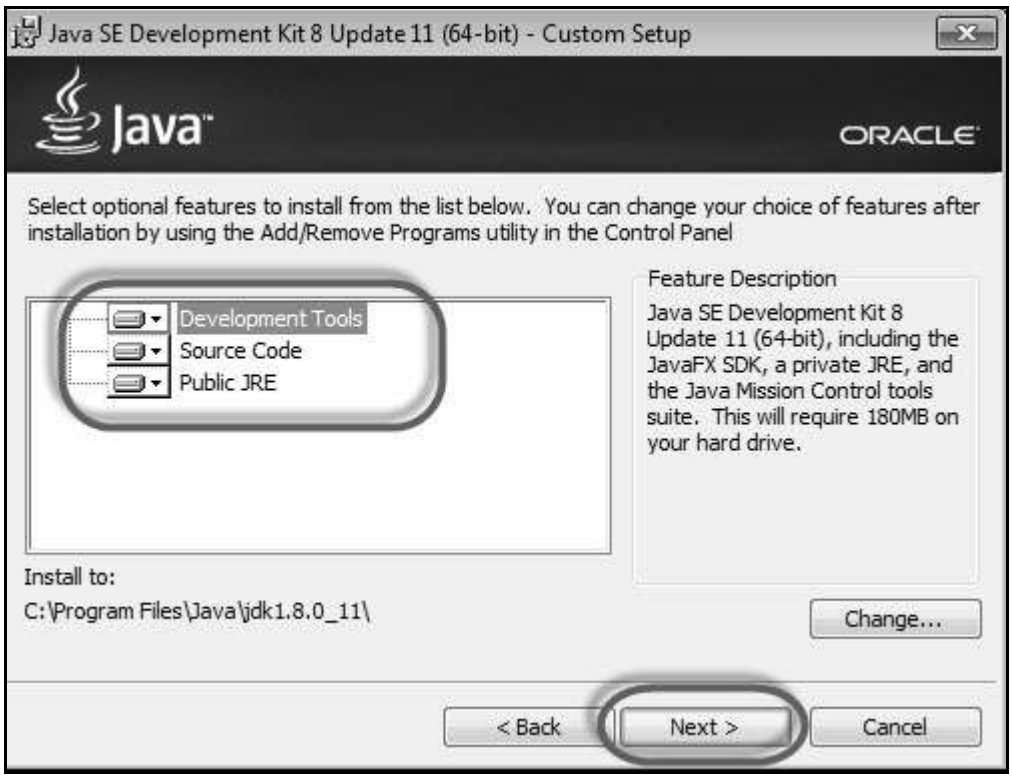
Thank you for accepting the Oracle Binary Code License Agreement for Java SE; you may now download this software.

Product / File Description	File Size	Download
Linux x86	133.58 MB	jdk-8u11-linux-i586.rpm
Linux x86	152.55 MB	jdk-8u11-linux-i586.tar.gz
Linux x64	133.89 MB	jdk-8u11-linux-x64.rpm
Linux x64	151.65 MB	jdk-8u11-linux-x64.tar.gz
Mac OS X x64	207.82 MB	jdk-8u11-macosx-x64.dmg
Solaris SPARC 64-bit (SVR4 package)	135.66 MB	jdk-8u11-solaris-sparcv9.tar.Z
Solaris SPARC 64-bit	96.14 MB	jdk-8u11-solaris-sparcv9.tar.gz
Solaris x64 (SVR4 package)	135.7 MB	jdk-8u11-solaris-x64.tar.Z
Solaris x64	93.18 MB	jdk-8u11-solaris-x64.tar.gz
Windows x86	151.81 MB	jdk-8u11-windows-i586.exe
Windows x64	155.29 MB	jdk-8u11-windows-x64.exe

Step 5 : Run the downloaded exe file to launch the Installer wizard. Click 'Next' to continue.



Step 6 : Select the features and click 'Next'.



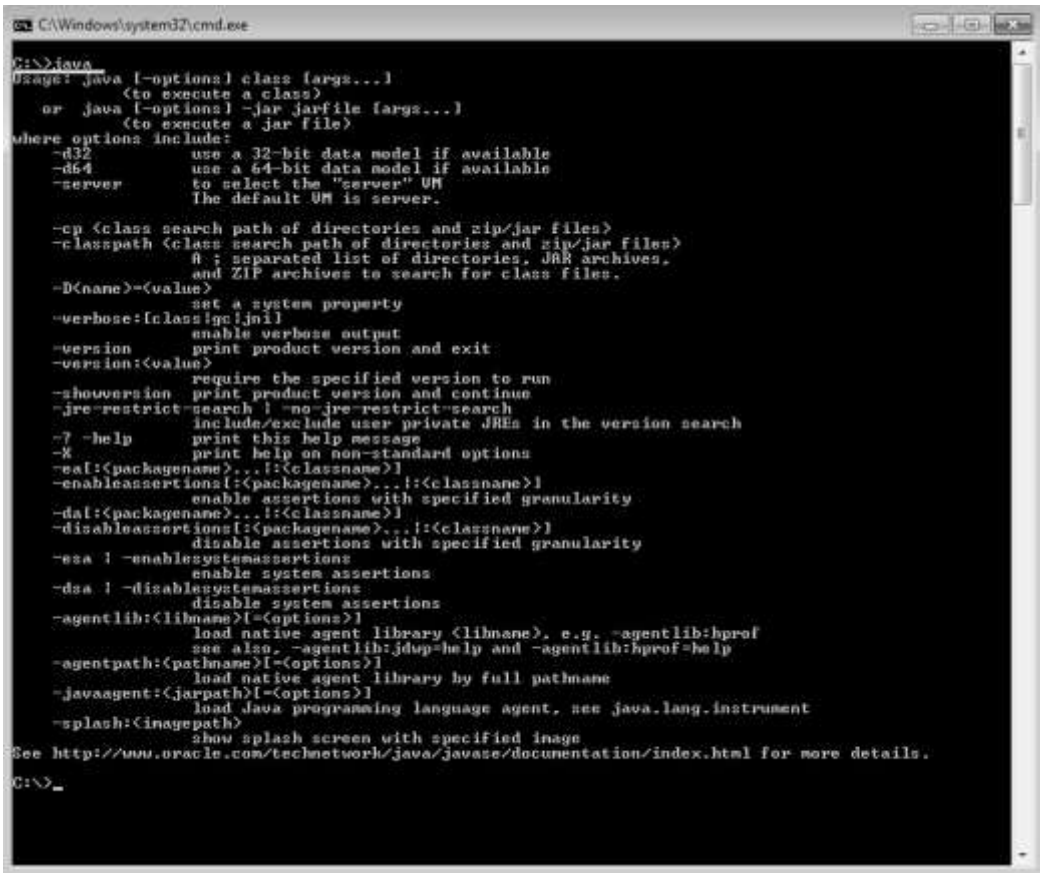
Step 7 : The installer is extracted and its progress is shown in the wizard.

Step 8 : The user can choose the install location and click 'Next'.

Step 9 : The installer installs the JDK and new files are copied across.

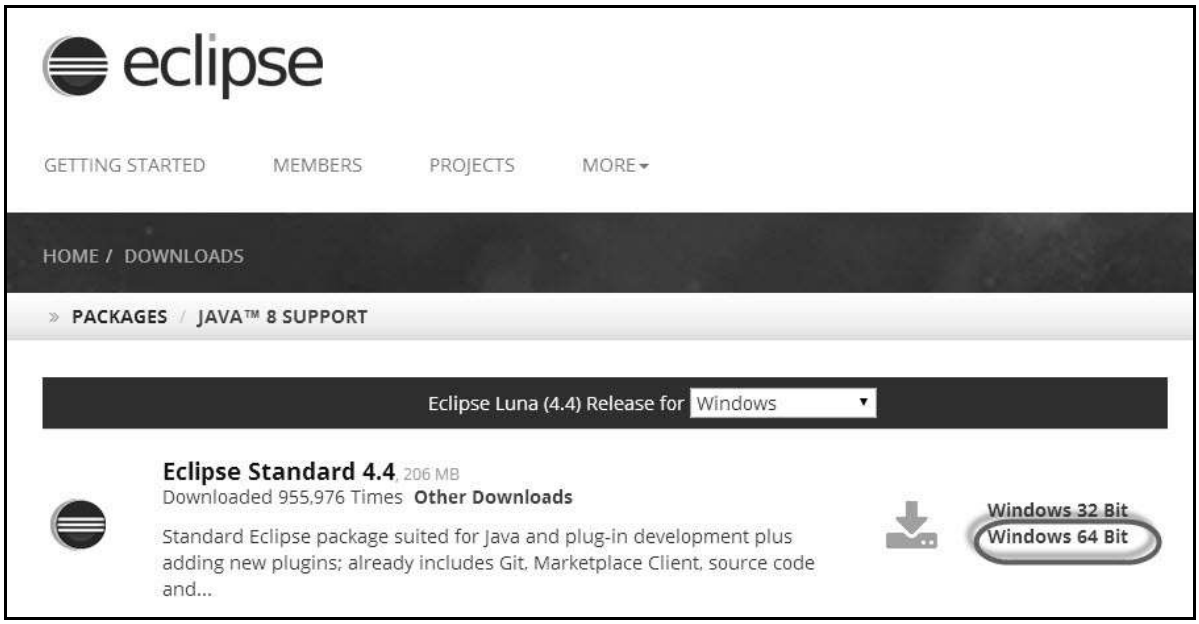
Step 10 : The Installer installs successfully and displays the same to the user.

Step 11 : To verify if the installation was successful, go to the command prompt and just type 'java' as a command. The output of the command is shown below. If the Java installation is unsuccessful or if it had NOT been installed, it would throw an "unknown command" error.



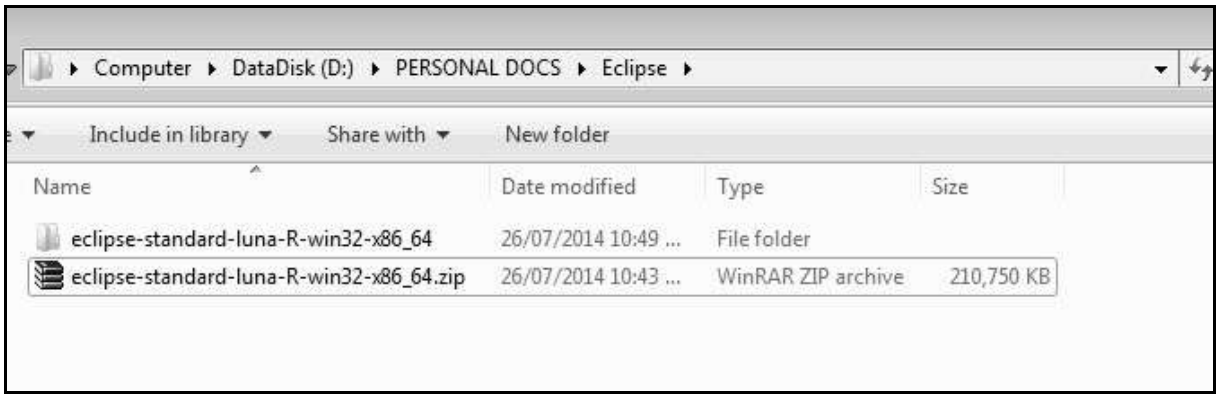
Download and Configure Eclipse

Step 1 : Navigate to the URL: http://www.eclipse.org/downloads/ and download the appropriate file based on your OS architecture.

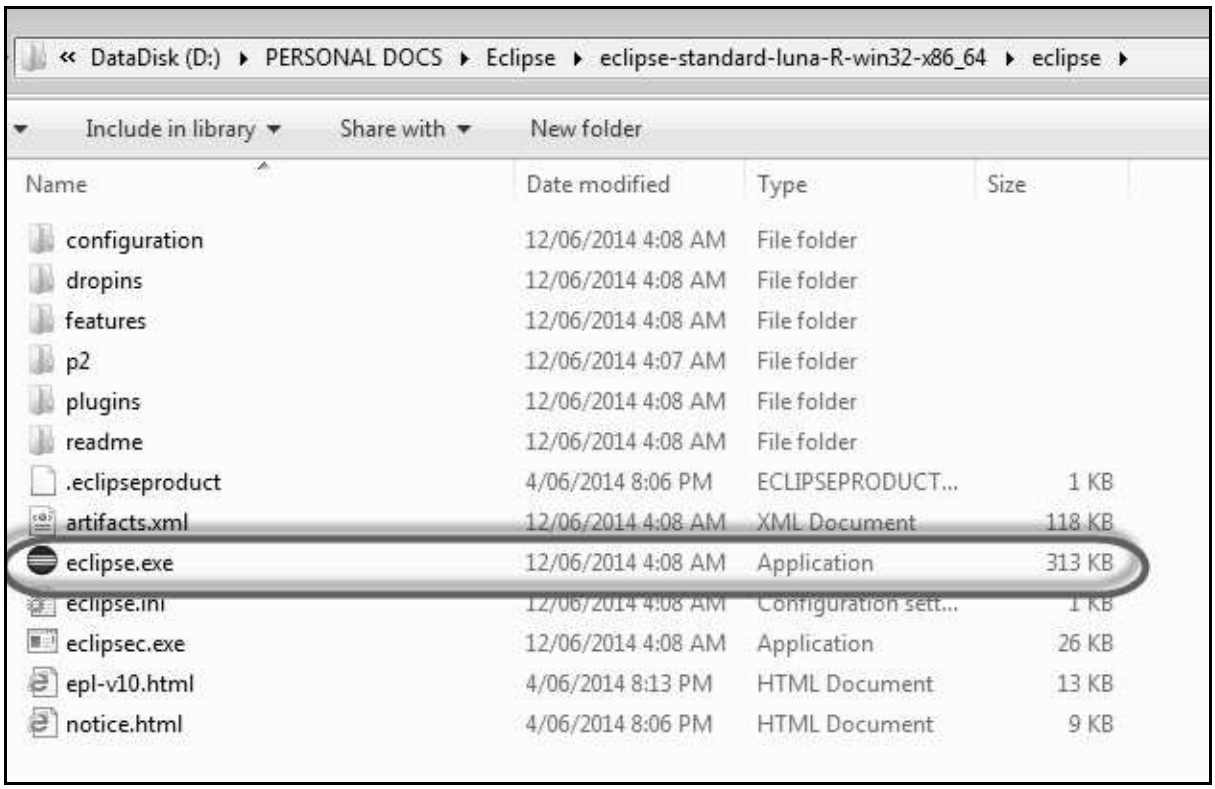


Step 2 : Click the 'Download' button.

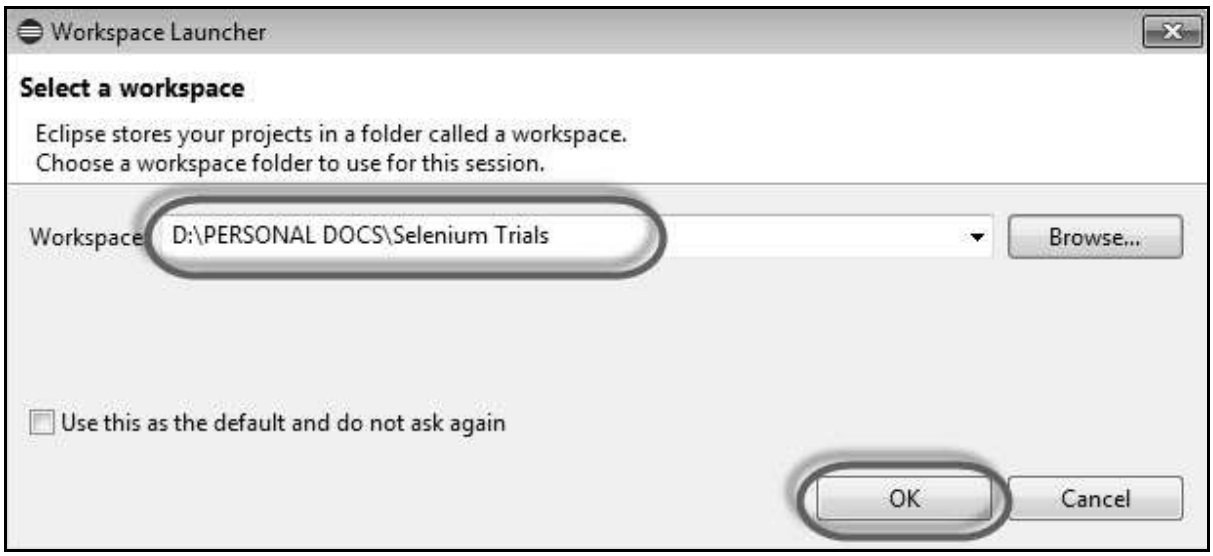
Step 3 : The download would be in a Zipped format. Unzip the contents.



Step 4 : Locate Eclipse.exe and double click on the file.



Step 5 : To configure the workspace, select the location where the development has to take place.



Step 6 : The Eclipse window opens as shown below.

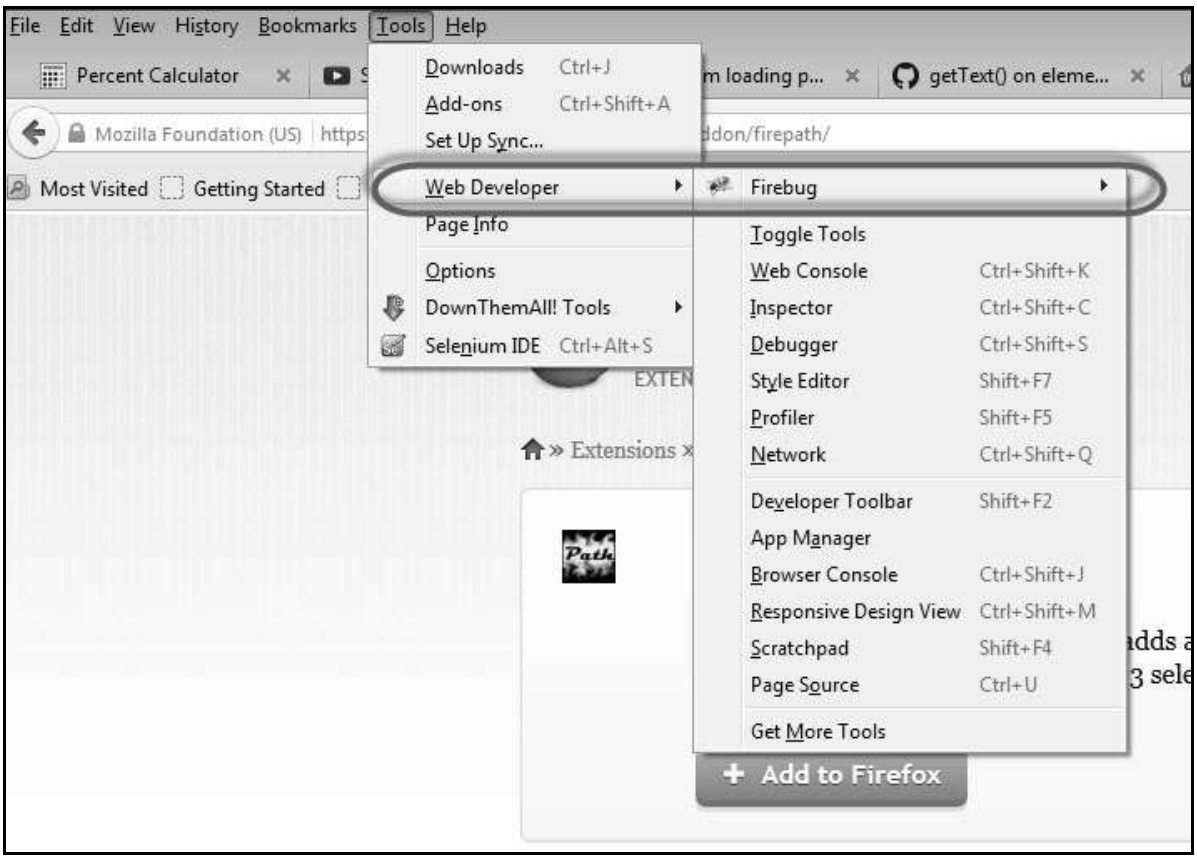
Configure FireBug and FirePath

To work with Selenium RC or WebDriver, we need to locate elements based on their XPath or ID or name, etc. In order to locate an element, we need tools/plugins.

Step 1 : Navigate to the URL: https://addons.mozilla.org/en-US/firefox/addon/firebug/ and download plugin.

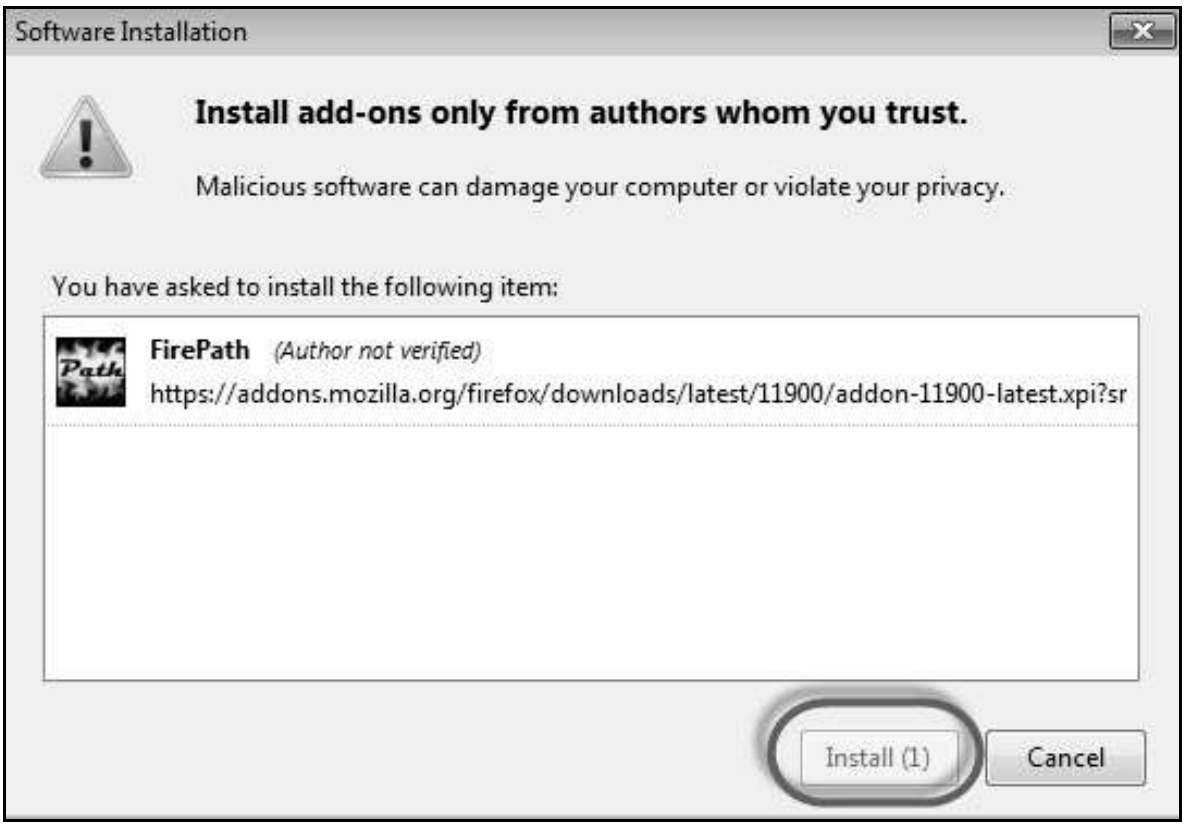
Step 2 : The add-on installer is shown to the user and it is installed upon clicking the 'Install' button.

Step 3 : After installing, we can launch the plugin by navigating to "Web Developer" >> "Firebug".



Step 4 : FirePath, a plugin that works within Firebug, helps users to grab the 'XPath' of an element. Install FirePath by navigating to "https://addons.mozilla.org/en-US/firefox/addon/firepath/"

Step 5 : The add-on installer is shown to the user and it is installed upon clicking the 'Install' button.



Step 6 : Now launch "Firebug" by navigating to "Tools" >> "Webdeveloper" >> "Firebug".

Example

Now let us understand how to use FireBug and FirePath with an example. For demonstration, we will use www.google.com and capture the properties of the text box of "google.com".

Step 1 : First click on the arrow icon as highlighted in the following screenshot and drag it to the object for which we would like to capture the properties. The HTML/DOM of the object would be displayed as shown below. We are able to capture the 'ID' of the input text box with which we can interact.

Step 2 : To fetch the XPath of the object, go to 'firepath' tab and perform the following steps.

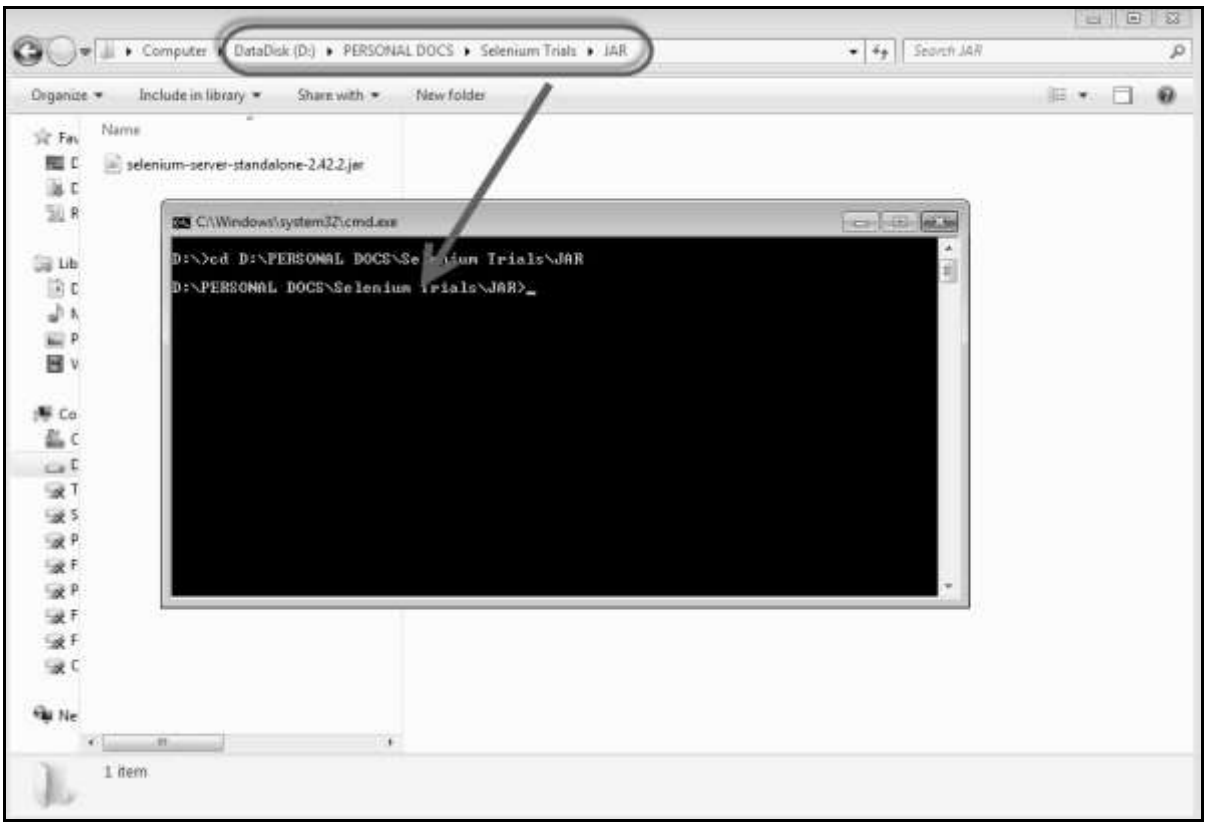
- Click the Spy icon.
- Select the Control for which we would like to capture the XPath.
- XPath of the selected control would be generated.

Configure Selenium RC

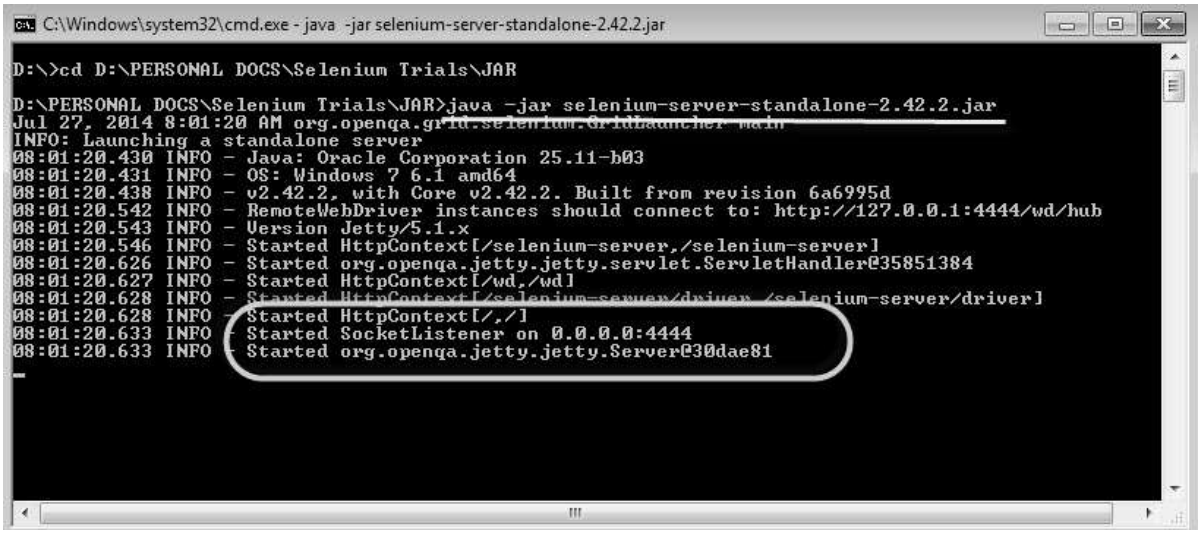
Now let us look at how to configure Selenium Remote control. We will understand how to develop scripts with Selenium RC in later chapters, however for now, we will understand just the configuration part of it.

Step 1 : Navigate to the Selenium downloads section http://www.seleniumhq.org/download/ and download Selenium Server by clicking on its version number as shown below.

Step 2 : After downloading, we need to start the Selenium Server. To do so, open command prompt and navigate to the folder where the downloaded JAR file is kept as shown below.



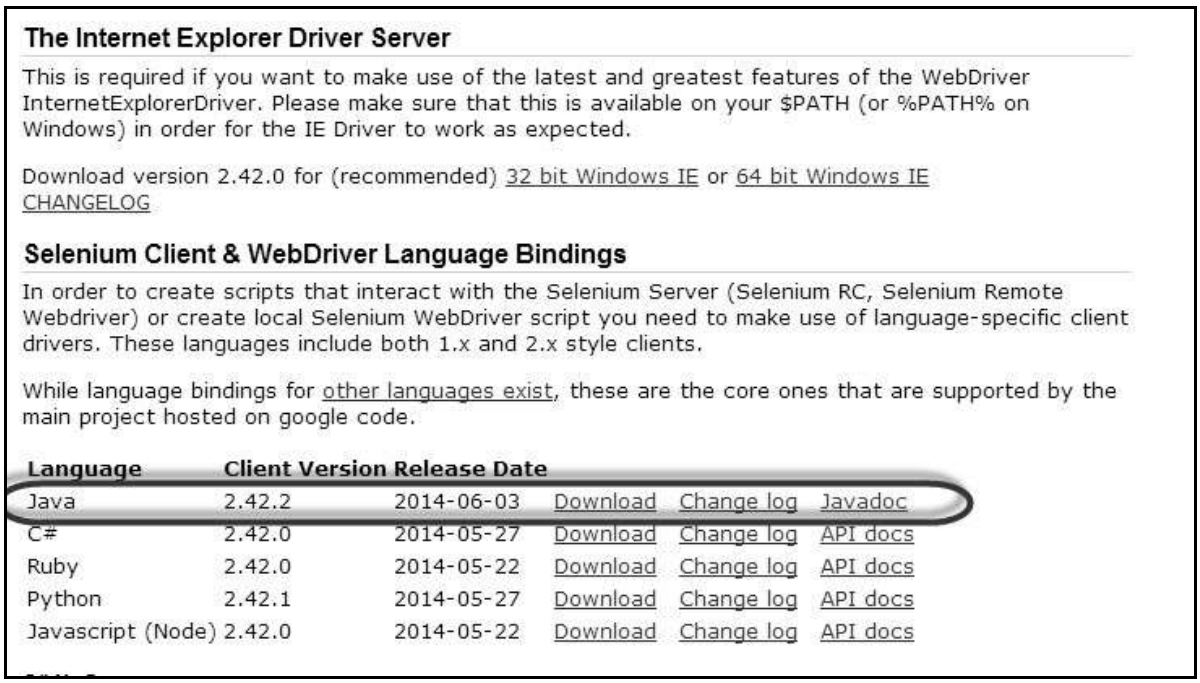
Step 3 : To start the server, use the command 'java -jar <<downloaded jar name >> and if java JDK is installed properly, you would get a success message as shown below. Now we can start writing Selenium RC scripts.



Configure Selenium WebDriver

Now let us look at how to configure Selenium WebDriver. We will understand how to develop scripts with Selenium WebDriver in later chapters, however for now, we will understand just the configuration part of it.

Step 1 : Navigate to the selenium downloads section http://www.seleniumhq.org/download/ and download Selenium WebDriver by clicking on its version number as shown below.



The Internet Explorer Driver Server

This is required if you want to make use of the latest and greatest features of the WebDriver InternetExplorerDriver. Please make sure that this is available on your $PATH (or %PATH% on Windows) in order for the IE Driver to work as expected.

Download version 2.42.0 for (recommended) 32 bit Windows IE or 64 bit Windows IE
CHANGELOG

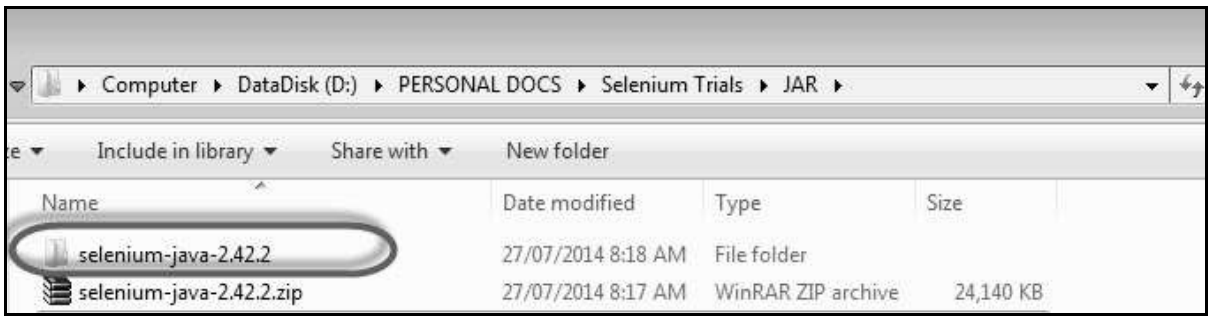
Selenium Client & WebDriver Language Bindings

In order to create scripts that interact with the Selenium Server (Selenium RC, Selenium Remote Webdriver) or create local Selenium WebDriver script you need to make use of language-specific client drivers. These languages include both 1.x and 2.x style clients.

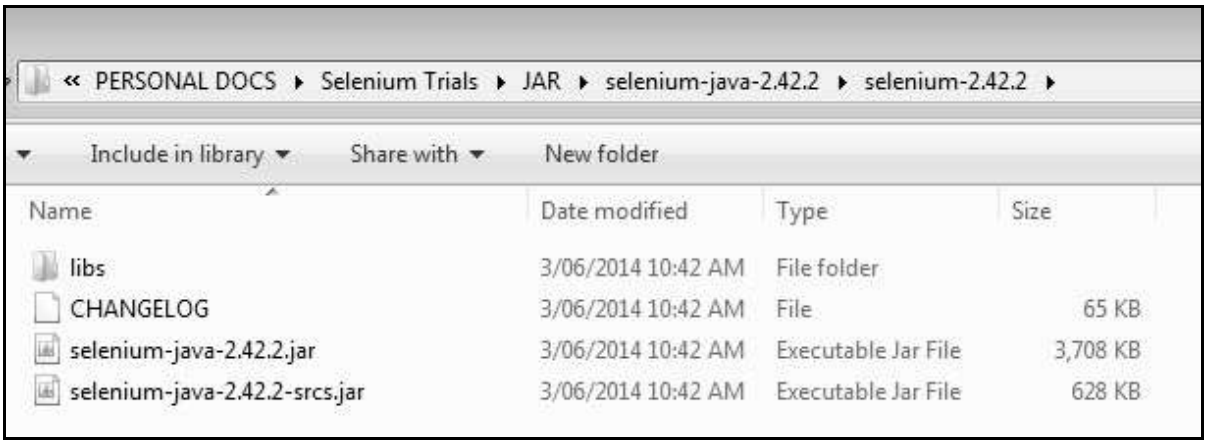
While language bindings for other languages exist, these are the core ones that are supported by the main project hosted on google code.

Language	Client Version	Release Date			
Java	2.42.2	2014-06-03	Download	Change log	Javadoc
C#	2.42.0	2014-05-27	Download	Change log	API docs
Ruby	2.42.0	2014-05-22	Download	Change log	API docs
Python	2.42.1	2014-05-27	Download	Change log	API docs
Javascript (Node)	2.42.0	2014-05-22	Download	Change log	API docs

Step 2 : The downloaded file is in Zipped format and one has to unzip the contents to map it to the project folder.



Step 3 : The Unzipped contents would be displayed as shown below. How to map it to the project folder and how to start scripting would be dealt in the WebDriver chapter.



4. SELENIUM RC

What is Selenium RC?

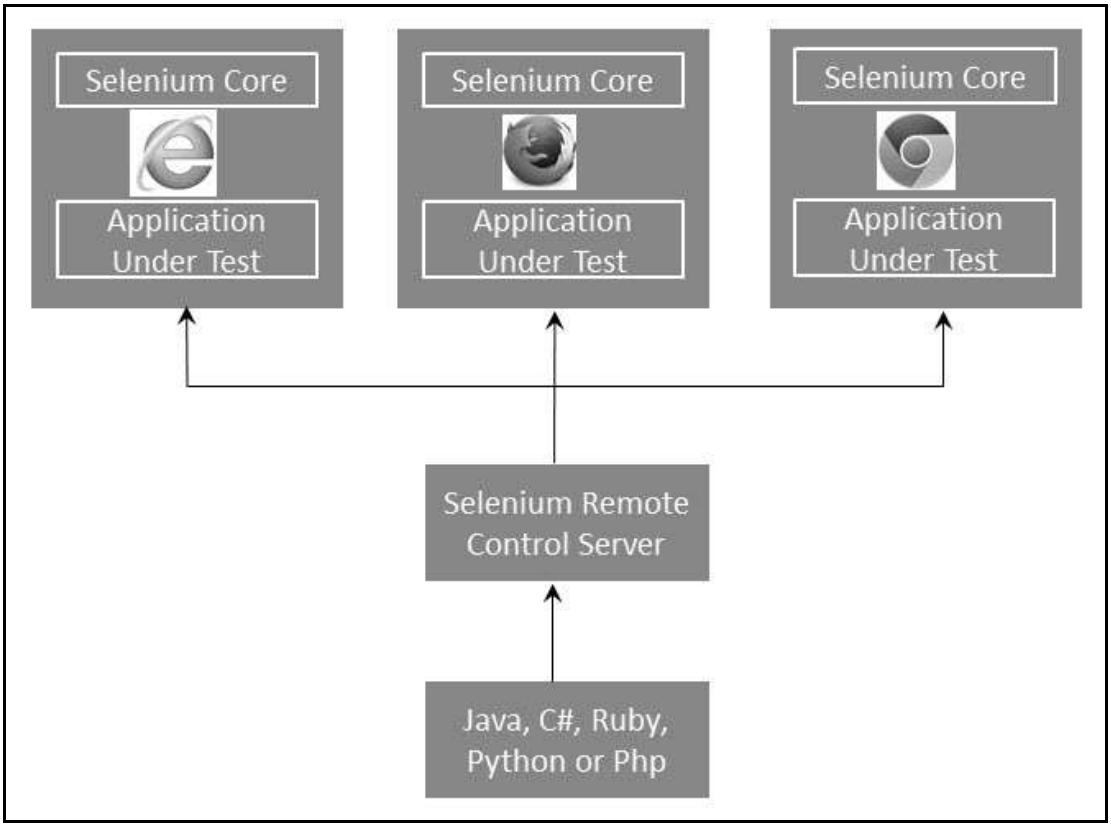
Selenium Remote Control (RC) was the main Selenium project that sustained for a long time before Selenium WebDriver (Selenium 2.0) came into existence. Now Selenium RC is hardly in use, as WebDriver offers more powerful features, however users can still continue to develop scripts using RC.

It allows us to write automated web application UI tests with the help of full power of programming languages such as Java, C#, Perl, Python, and PHP to create more complex tests such as reading and writing files, querying a database, and emailing test results.

Selenium RC Architecture

Selenium RC works in such a way that the client libraries can communicate with the Selenium RC Server passing each Selenium command for execution. Then the server passes the Selenium command to the browser using Selenium-Core JavaScript commands.

The browser executes the Selenium command using its JavaScript interpreter.



Selenium RC comes in two parts.

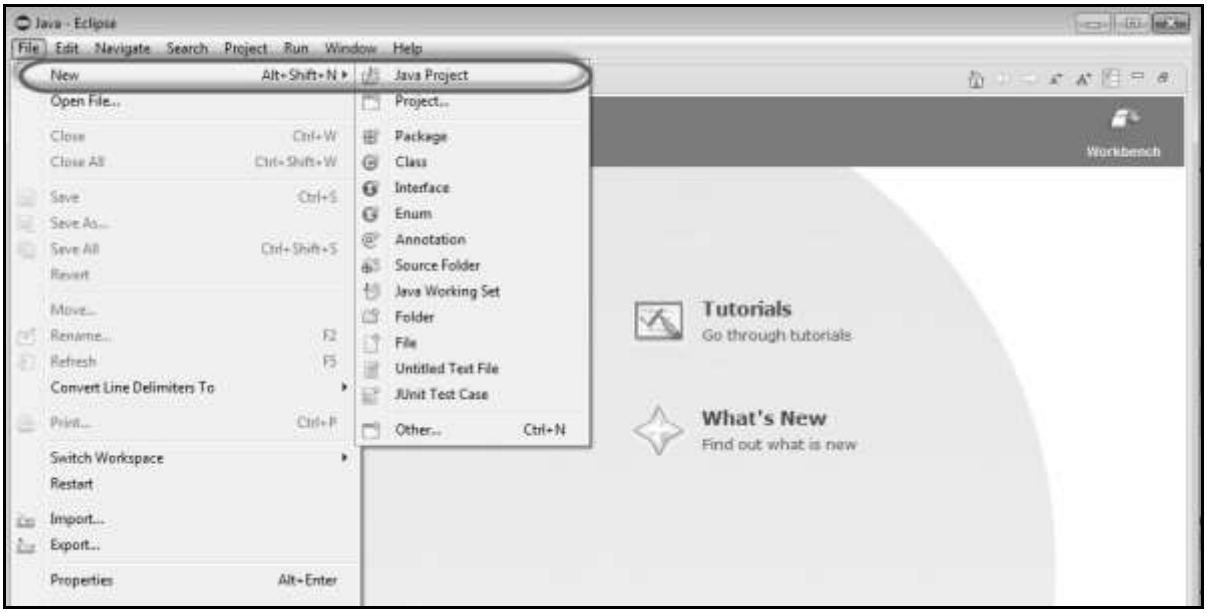
- The Selenium Server launches and kills browsers. In addition to that, it interprets and executes the Selenese commands. It also acts as an HTTP proxy by intercepting and verifying HTTP messages passed between the browser and the application under test.
- Client libraries that provide an interface between each one of the programming languages (Java, C#, Perl, Python, and PHP) and the Selenium-RC Server.

RC – Scripting

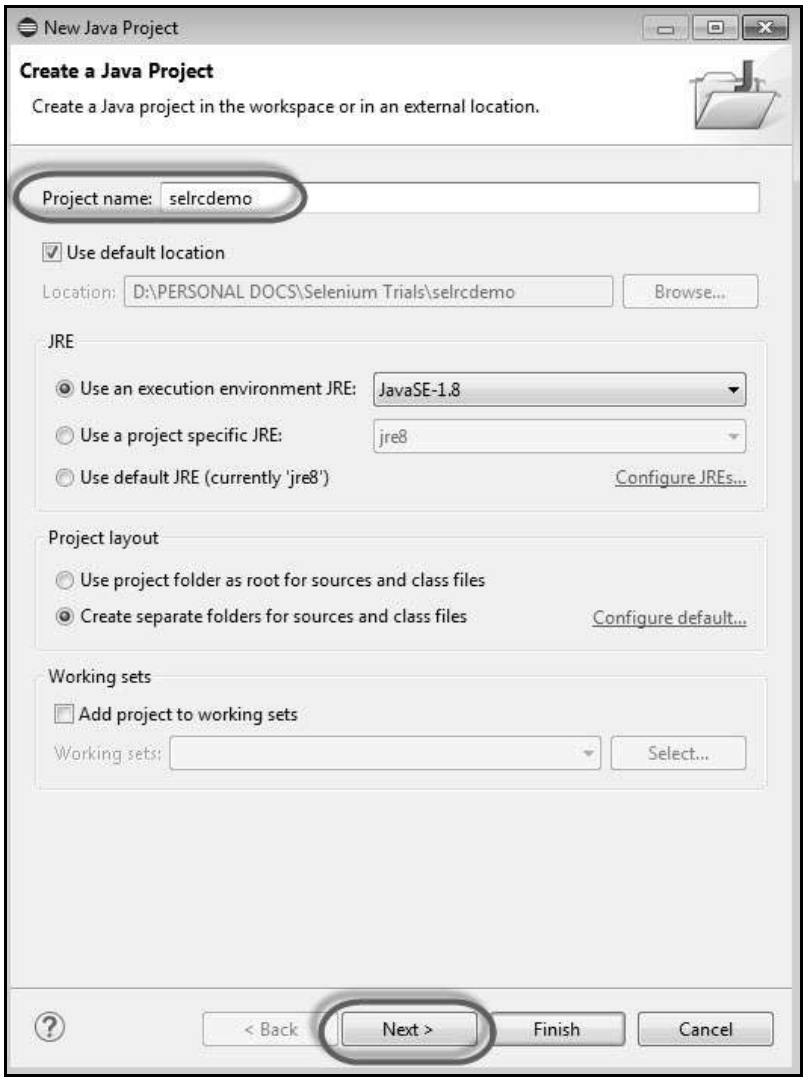
Now let us write a sample script using Selenium Remote Control. Let us use http://www.calculator.net/ for understanding Selenium RC. We will perform a Percent calculation using 'Percent Calculator' that is present under the 'Math Calculators' module.

Step 1 : Start Selenium Remote Control (with the help of command prompt).

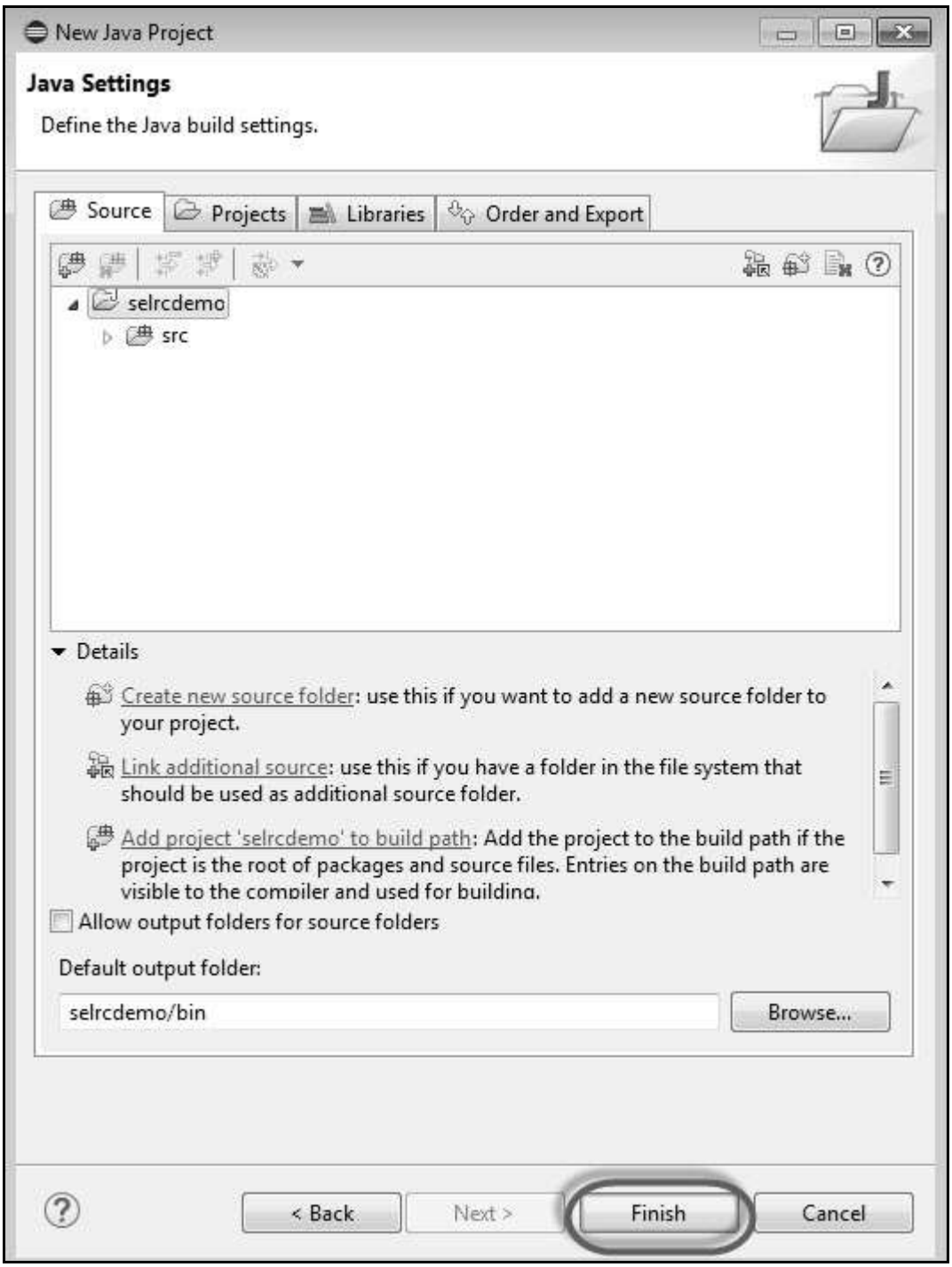
Step 2 : After launching Selenium RC, open Eclipse and create a "New Project" as shown below.



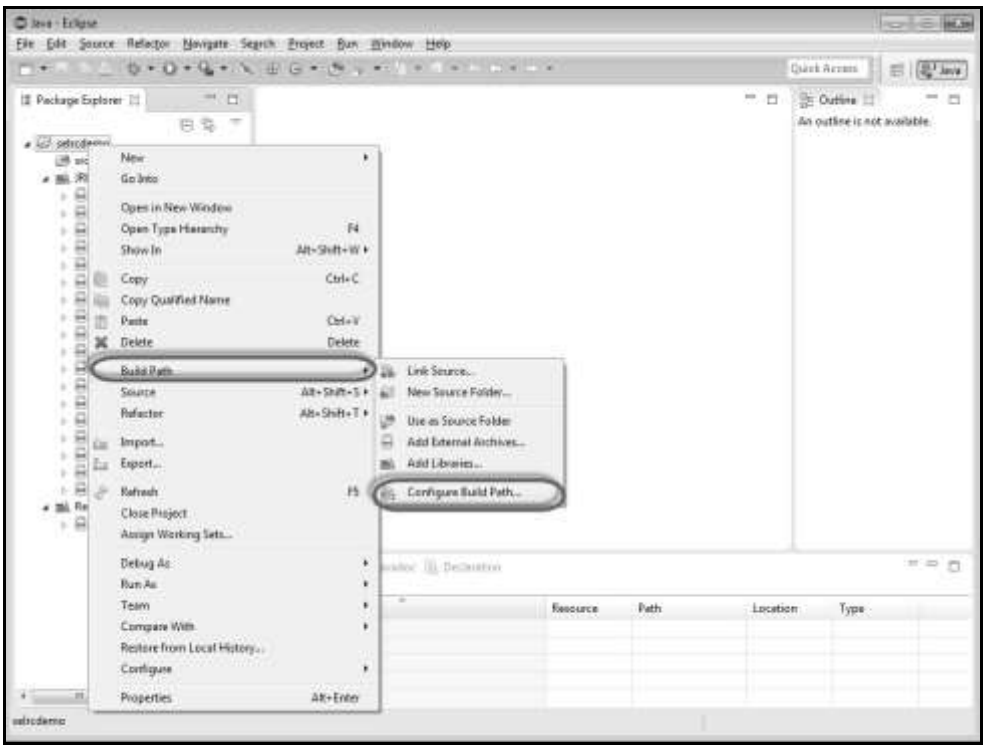
Step 3 : Enter the project name and click 'Next' button.



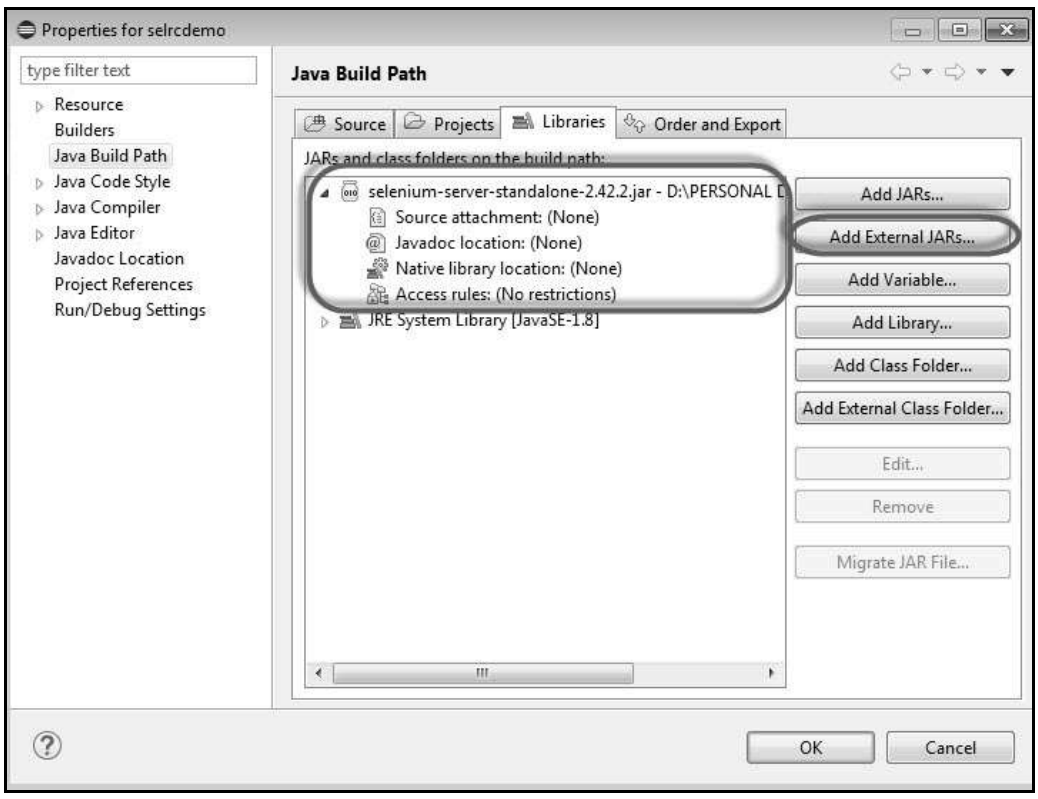
Step 4 : Verify the Source, Projects, Libraries, and Output folder and click 'Finish'.



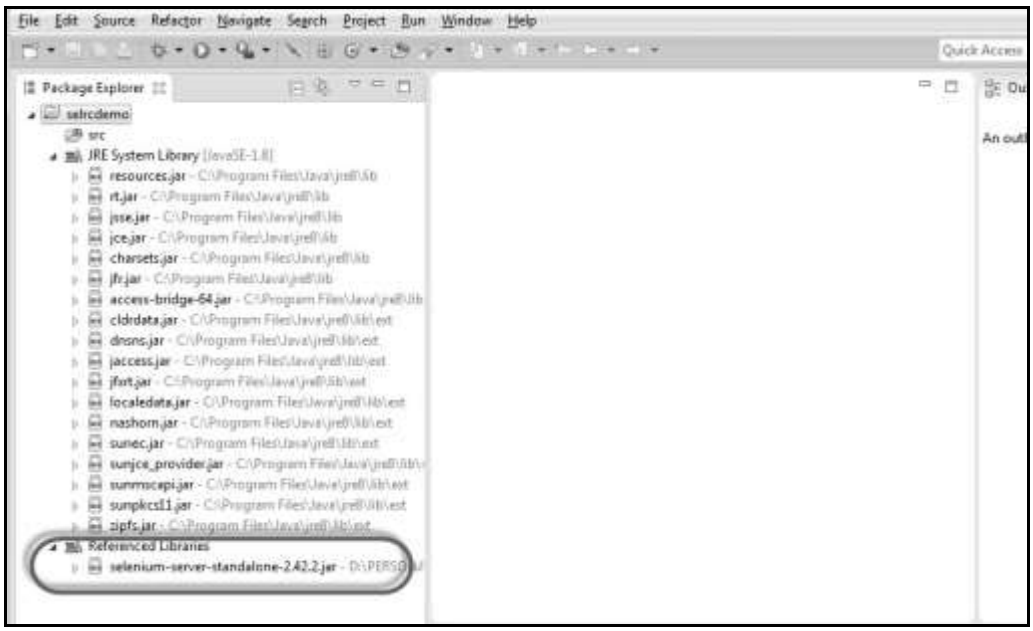
Step 5 : Right click on 'project' container and choose 'Configure Build Path'.



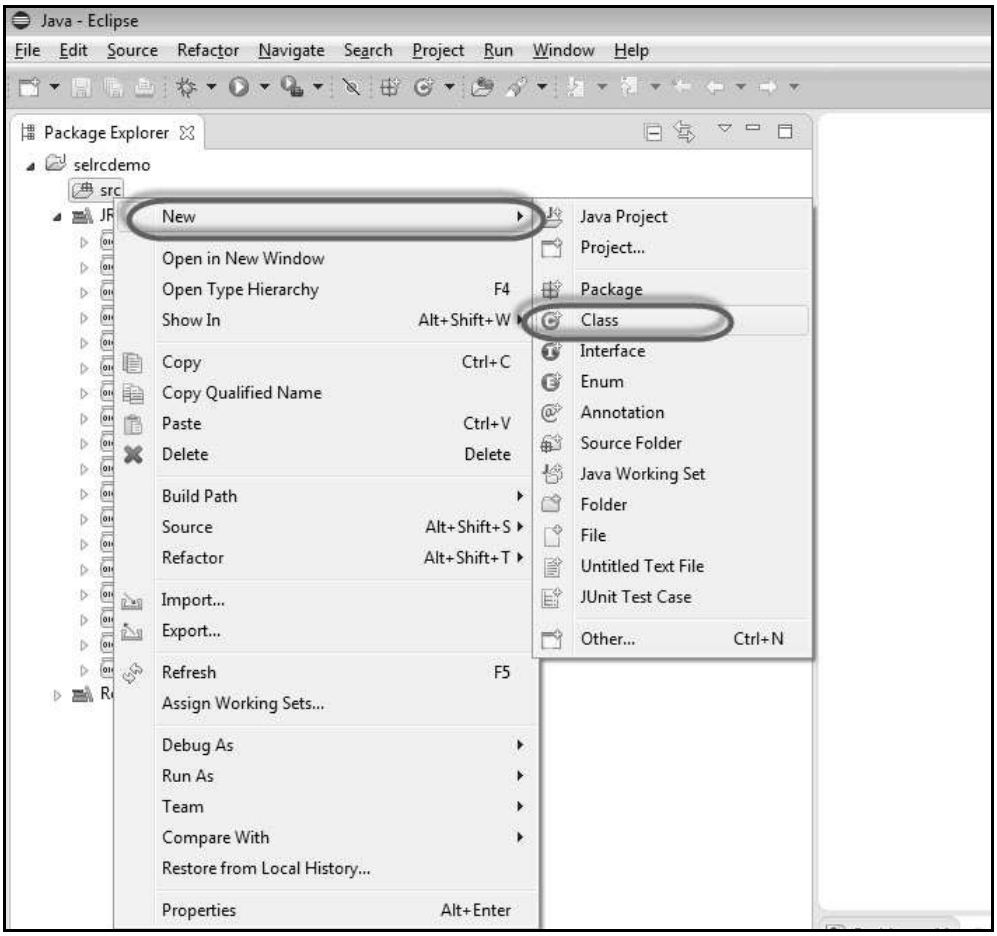
Step 6 : Properties for 'selrcdemo' opens up. Navigate to 'Libraries' tab and select 'Add External JARs'. Choose the Selenium RC jar file that we have downloaded and it would appear as shown below.



Step 7 : The referenced Libraries are shown as displayed below.

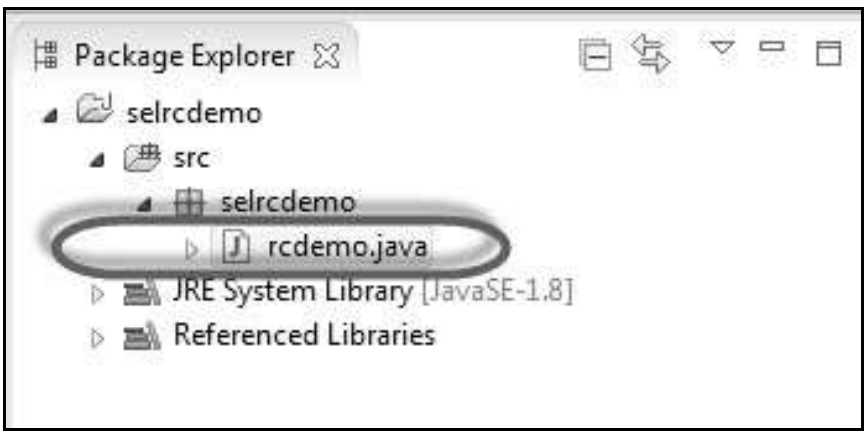


Step 8 : Create a new class file by performing a right click on 'src' folder and select 'New' >> 'class'.



Step 9 : Enter a name of the class file and enable 'public static void main' as shown below.

Step 10 : The Created Class is created under the folder structure as shown below.

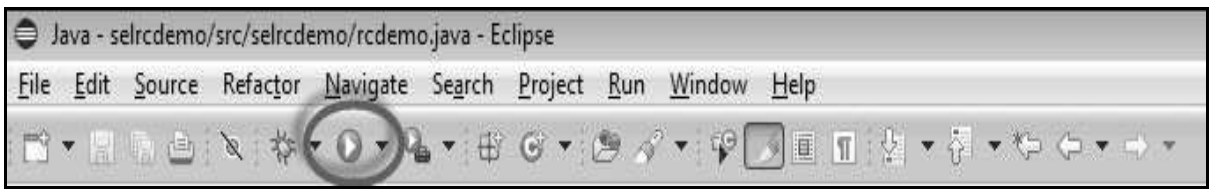


Step 11 : Now it is time for coding. The following code has comments embedded in it to make the readers understand what has been put forth.

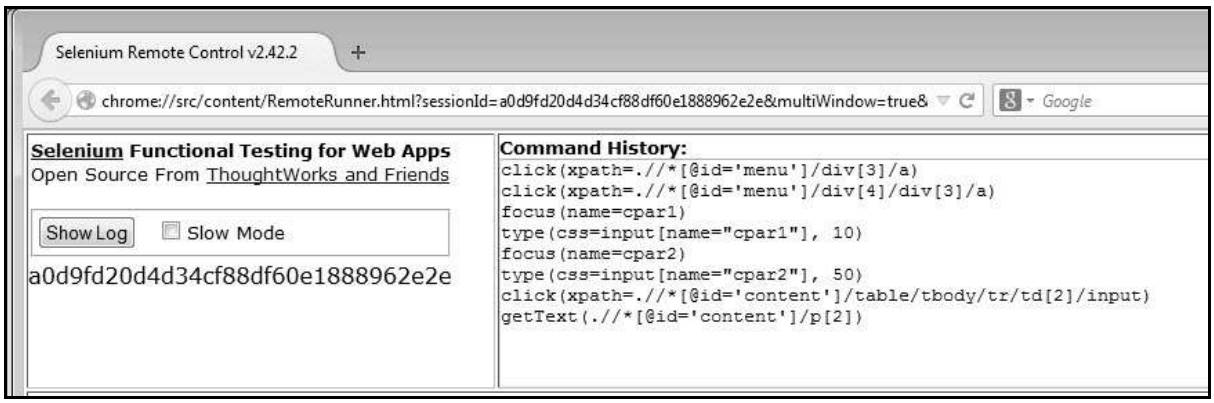
```
package selrcdemo;
import com.thoughtworks.selenium.DefaultSelenium;
import com.thoughtworks.selenium.Selenium;

public class rcdemo
{
     public static void main(String[] args) throws InterruptedException
     {

     // Instatiate the RC Server
     Selenium selenium = new DefaultSelenium("localhost", 4444,
     "firefox", "http://www.calculator.net");
     selenium.start();                    // Start
     selenium.open("/");                  // Open the URL
     selenium.windowMaximize();

     // Click on Link Math Calculator
     selenium.click("xpath=.//*[@id='menu']/div[3]/a");
     Thread.sleep(2500);                  // Wait for page load

     // Click on Link Percent Calculator
     selenium.click("xpath=.//*[@id='menu']/div[4]/div[3]/a");
     Thread.sleep(4000);                  // Wait for page load

     // Focus on text Box
     selenium.focus("name=cpar1");

     // enter a value in Text box 1
     selenium.type("css=input[name=\"cpar1\"]", "10");
```

```
      // enter a value in Text box 2
      selenium.focus("name=cpar2");
      selenium.type("css=input[name=\"cpar2\"]", "50");

      // Click Calculate button
      selenium.click("xpath=.//*[@id='content']/table/tbody/tr/td[2]/input");

      // verify if the result is 5
      String result = selenium.getText(".//*[@id='content']/p[2]");

      if (result == "5")
      {
            System.out.println("Pass");
      }else
      {
            System.out.println("Fail");
      }

      }
}
```

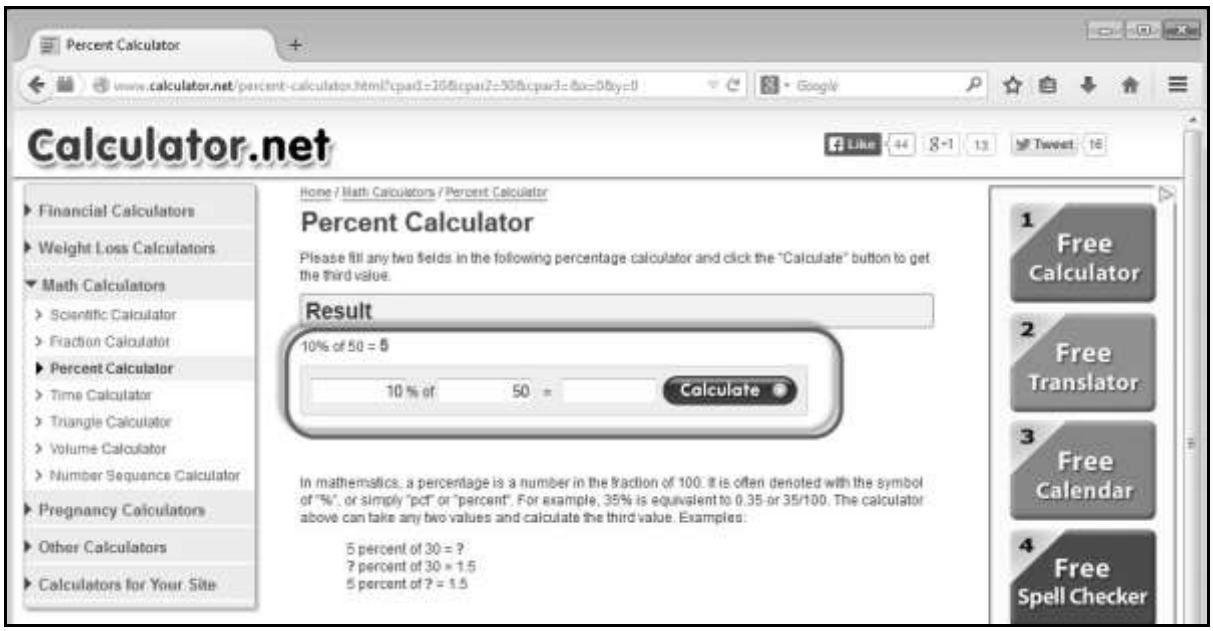
Step 11 : Now, let us execute the script by clicking the 'Run' Button.



Step 12 : The script would start executing and the user would be able to see the command history under the 'Command History' Tab.



Step 13 : The final state of the application is shown as below. The percentage is calculated and it displays the result on the screen as shown below.



Step 14 : The output of the test is printed on the Eclipse console as shown below, as we have printed the output to the console. In real time, the output is written to an HTML file or in a simple Text file.

5. SELENESE COMMANDS

A command refers to what Selenium has to do and the commands in Selenium are of three types:

- Actions
- Accessors
- Assertions

Actions

Actions are commands that manipulate the state of the application. Upon execution, if an action fails, the execution of the current test is stopped. For example, "click a link" and "select an option".

The following table lists the Selenium action commands that are used very frequently, however the list is note exhaustive.

Command/Syntax	Description
click (locator)	Clicks on a link, button, checkbox or radio button
clickAt (locator, coordString)	Clicks on an element with the help of locator and co-ordinates
close ()	Simulates the user clicking the "close" button in the title bar of a popup window or tab.
contextMenuAt (locator, coordString)	Simulates opening the context menu of the specified element from a

	specified location
doubleClick (locator)	Double clicks on a webelement based on the specified element.
dragAndDrop (locator, movementsString)	Drags an element and then drops it based on specified distance.
dragAndDropToObject (Dragobject, dropobject)	Drags an element and drops it on another element.
Echo (message)	Prints the specified message on console which is used for debugging.
fireEvent (locator,eventName)	Explicitly simulate an event, to trigger the corresponding "onevent" handler
focus (locator)	Move the focus to the specified element
highlight (locator)	Changes the background color of the specified element to yellow which is useful for debugging purposes.
mouseDown (locator)	Simulates a user pressing the left mouse button on the specified element.

mouseDownAt (locator, coordString)	Simulates a user pressing the left mouse button at the specified location on the specified element.
mouseUp (locator)	Simulates the event that occurs when the user releases the mouse button
mouseUpAt (locator, coordString)	Simulates the event that occurs when the user releases the mouse button at the specified location.
open (url)	Opens a URL in the specified browser and it accepts both relative and absolute URLs.
openWindow (url, windowID)	Opens a popup window. After opening the window, user need to activate it using the selectWindow command.
pause (waitTime)	Waits for the specified amount of time (in milliseconds)
refresh()	Simulates the user clicking the "Refresh" button on their browser.
select (selectLocator, optionLocator)	Select an option from a drop-down using an option

	locator.
selectWindow (windowID)	Selects a popup window using a window locator; once a popup window has been selected, all focus shifts to that window.
store (expression, variableName)	The name of a variable in which the result is to be stored and expression is the value to store.
type (locator, value)	Sets the value of an input field, similar to user typing action.
typeKeys (locator, value)	Simulates keystroke events on the specified element, as though you typed the value key-by-key.
waitForCondition (script, timeout)	Executes the specified JavaScript snippet repeatedly until it evaluates to "true".
waitForPageToLoad (timeout)	Waits for a new page to load.
waitForPopUp (windowID, timeout)	Waits for a popup window to appear and load.
windowFocus()	Gives focus to the currently

	selected window
windowMaximize()	Resize the currently selected window to take up the entire screen

Accessors

Accessors evaluate the state of the application and store the results in a variable which is used in assertions. For example, "storeTitle".

The following table lists the Selenium accessors that are used very frequently, however the list is not exhaustive.

Command/Syntax	Description
assertErrorOnNext (message)	Pings Selenium to expect an error on the next command execution with an expected message.
storeAllButtons (variableName)	Returns the IDs of all buttons on the page.
storeAllFields (variableName)	Returns the IDs of all input fields on the page.
storeAllLinks (variableName)	Returns the IDs of all links on the page.
storeAllWindowIds (variableName)	Returns the IDs of all windows that the browser knows about in an array.

storeAllWindowTitles (variableName)	Returns the names of all windows that the browser knows about in an array.
storeAllWindowNames (variableName)	Returns the titles of all windows that the browser knows about in an array.
storeAttribute (attributeLocator, variableName)	Gets the value of an element attribute. The value of the attribute may differ across browsers.
storeBodyText (variableName)	Gets the entire text of the page.
storeConfirmation (variableName)	Retrieves the message of a JavaScript confirmation dialog generated during the previous action.
storeElementIndex (locator, variableName)	Get the relative index of an element to its parent (starting from 0).
storeLocation (variableName)	Gets the absolute URL of the current page.
storeSelectedIds (selectLocator, variableName)	Gets all element IDs for selected options in the specified select or multi-select element.

storeSelectedIndex (selectLocator, variableName)	Gets index (option number, starting at 0) for selected option in the specified select element.
storeSelectedLabel (selectLocator, variableName)	Gets label (visible text) for selected option in the specified select element..
storeSelectedValue (selectLocator, variableName)	Gets value (value attribute) for selected option in the specified select element.
storeSelectOptions (selectLocator, variableName)	Gets all labels in the specified select drop-down.
storeTable (tableCellAddress, variableName)	Gets the text from a cell of a table. The cellAddress syntax: tableLocator.row.column, where row and column start at 0.
storeText (locator, variableName)	Gets the text of an element. This works for any element that contains text.
storeTitle (variableName)	Gets the title of the current page.
storeValue (locator, variableName)	Gets the (whitespace-trimmed) value of an

	input field.
storeChecked (locator, variableName)	Gets whether a toggle-button (checkbox/radio) is checked.
storeElementPresent (locator, variableName)	Verifies that the specified element is somewhere on the page.
storeTextPresent (pattern, variableName)	Verifies that the specified text pattern appears somewhere on the rendered page shown to the user.
storeVisible (locator, variableName)	Determines if the specified element is visible.

Assertions

Assertions enable us to verify the state of an application and compares against the expected. It is used in 3 modes, viz. - "assert", "verify", and "waitfor". For example, "verify if an item from the dropdown is selected".

The following table lists the Selenium assertions that are used very frequently, however the list is not exhaustive.

Command/Syntax	Description
waitForErrorOnNext (message)	Waits for error; used with the accessor assertErrorOnNext.

verifySelected (selectLocator, optionLocator)	Verifies that the selected option of a drop-down satisfies the optionSpecifier.
waitForSelected (selectLocator, optionLocator)	Waits for getting the option selected; used with the accessor assertSelected.
waitForNotSelected (selectLocator, optionLocator)	Waits for not getting the option selected; used with the accessor assertSelected.
verifyAlert (pattern)	Verifies the alert text; used with the accessor storeAlert.
waitForAlert (pattern)	Waits for the alert; used with the accessor storeAlert.
verifyAllButtons (pattern)	Verifies the button; used with the accessor storeAllButtons.
waitForAllButtons (pattern)	Waits for the button to load; used with the accessor storeAllButtons.
verifyAllLinks (pattern)	Verifies all links; used with the accessor storeAllLinks.

waitForAllLinks (pattern)	Waits for all links; used with the accessor storeAllLinks.
verifyAllWindowIds (pattern)	Verifies the window id; used with the accessor storeAllWindowIds.
waitForAllWindowIds (pattern)	Waits the window id; used with the accessor storeAllWindowIds.
verifyAttribute (attributeLocator, pattern)	Verifies an attribute of an element; used with the accessor storeAttribute.
waitForAttribute (attributeLocator, pattern)	Waits for an attribute of an element; used with the accessor storeAttribute.
verifyBodyText(pattern)	Verifies the body text; used with the accessor storeBodyText.
waitForBodyText(pattern)	Waits for the body text; used with the accessor storeBodyText.
waitForConfirmation(pattern)	Waits for confirmation; used with the accessor storeConfirmationPresent

Locators

Element Locators help Selenium to identify the HTML element the command refers to. All these locators can be identified with the help of FirePath and FireBug plugin of Mozilla. Please refer the Environment Setup chapter for details.

- **identifier=id** Select the element with the specified "id" attribute and if there is no match, select the first element whose @name attribute is id.
- **id=id** Select the element with the specified "id" attribute.
- **name=name** Select the first element with the specified "name" attribute
- **dom=javascriptExpression** Selenium finds an element by evaluating the specified string that allows us to traverse through the HTML Document Object Model using JavaScript. Users cannot return a value but can evaluate as an expression in the block.
- **xpath=xpathExpression** Locate an element using an XPath expression.
- **link=textPattern** Select the link element (within anchor tags) which contains text matching the specified pattern.
- **css=cssSelectorSyntax** Select the element using css selector.

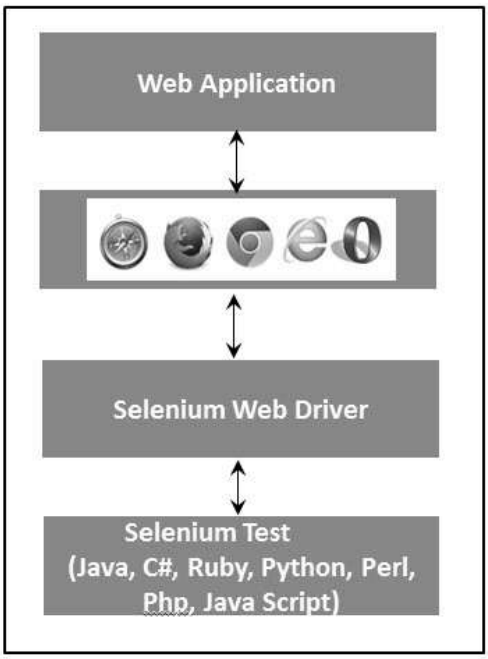
6. WEBDRIVER

WebDriver is a tool for automating testing web applications. It is popularly known as Selenium 2.0. WebDriver uses a different underlying framework, while Selenium RC uses JavaScript Selenium-Core embedded within the browser which has got some limitations. WebDriver interacts directly with the browser without any intermediary, unlike Selenium RC that depends on a server. It is used in the following context:

- Multi-browser testing including improved functionality for browsers which is not well-supported by Selenium RC (Selenium 1.0).
- Handling multiple frames, multiple browser windows, popups, and alerts.
- Complex page navigation.
- Advanced user navigation such as drag-and-drop.
- AJAX-based UI elements.

Architecture

WebDriver is best explained with a simple architecture diagram as shown below.



Selenium RC Vs WebDriver

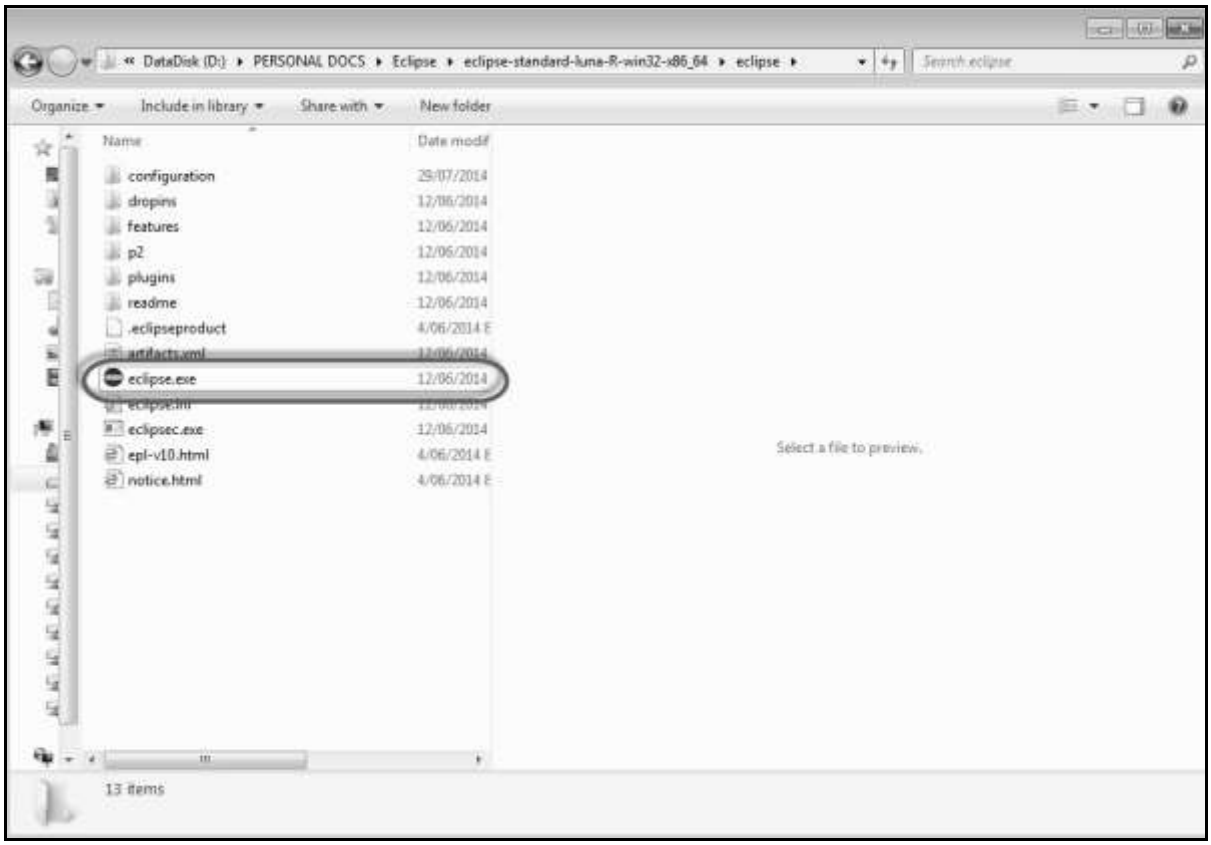
Selenium RC	Selenium WebDriver
The architecture of Selenium RC is complicated, as the server needs to be up and running before starting a test.	WebDriver's architecture is simpler than Selenium RC, as it controls the browser from the OS level.
Selenium server acts as a middleman between the browser and Selenese commands.	WebDriver interacts directly with the browser and uses the browser's engine to control it.
Selenium RC script execution is slower, since it uses a Javascript to interact with RC.	WebDriver is faster, as it interacts directly with the browser.
Selenium RC cannot support headless execution, as it needs a real browser to work with.	WebDriver can support the headless execution.
It’s a simple and small API.	Complex and a bit large API as compared to RC.
Less object-oriented API.	Purely object-oriented API.
Cannot test mobile Applications.	Can test iPhone/Android applications.

Scripting using WebDriver

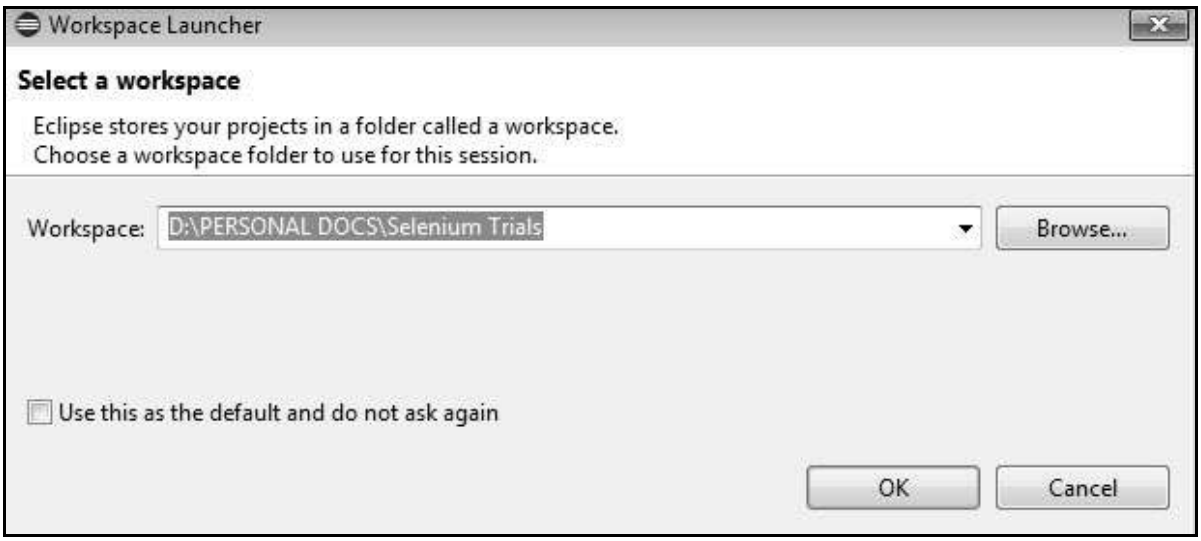
Let us understand how to work with WebDriver. For demonstration, we would use http://www.calculator.net/. We will perform a "Percent Calculator" which is

located under "Math Calculator". We have already downloaded the required WebDriver JAR's. Refer the chapter "Environmental Setup" for details.

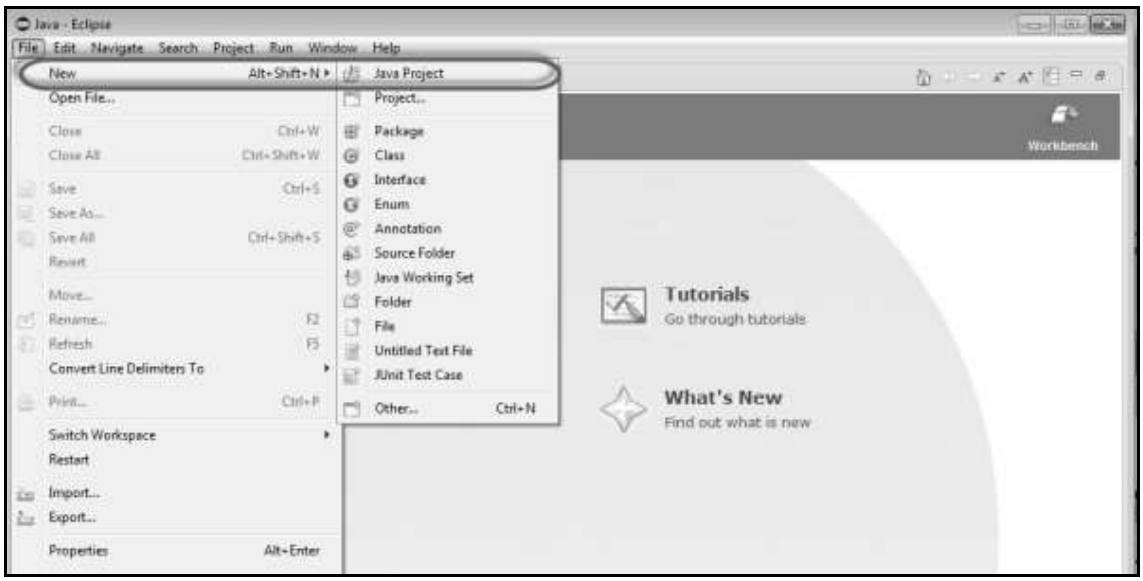
Step 1 : Launch "Eclipse" from the Extracted Eclipse folder.



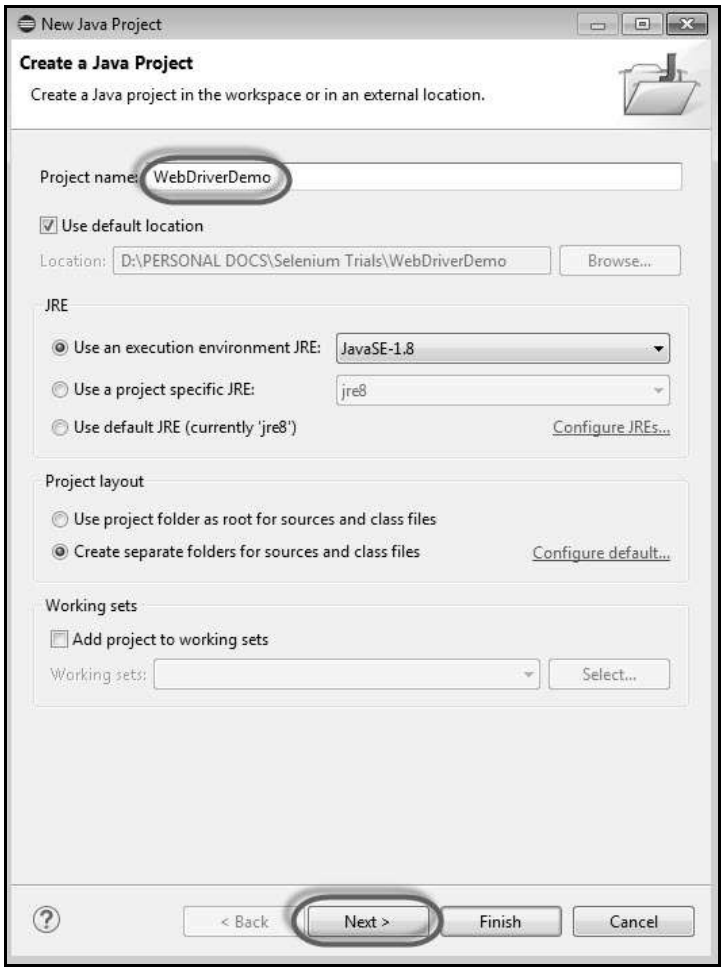
Step 2 : Select the Workspace by clicking the 'Browse' button.



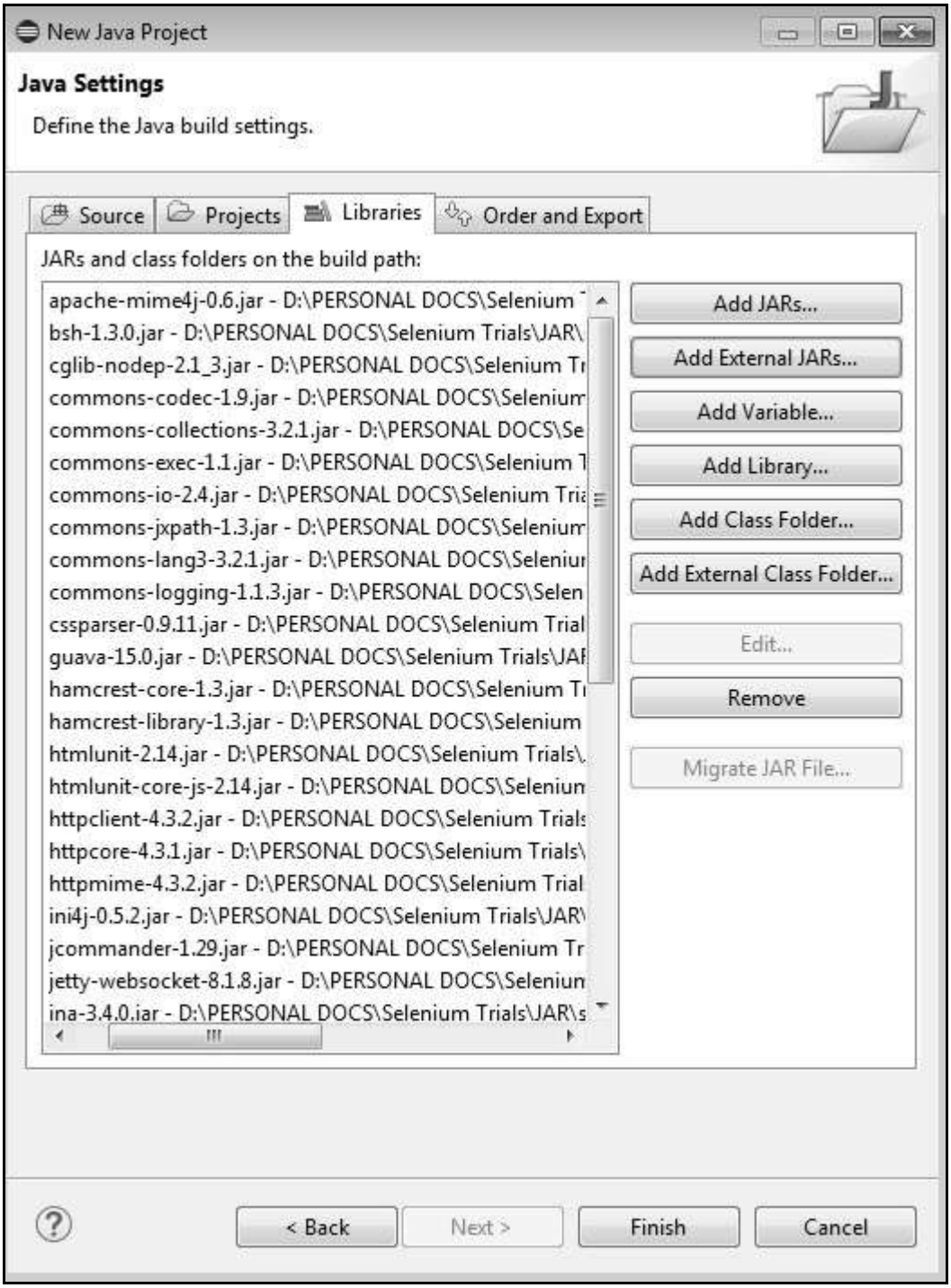
Step 3 : Now create a 'New Project' from 'File' menu.



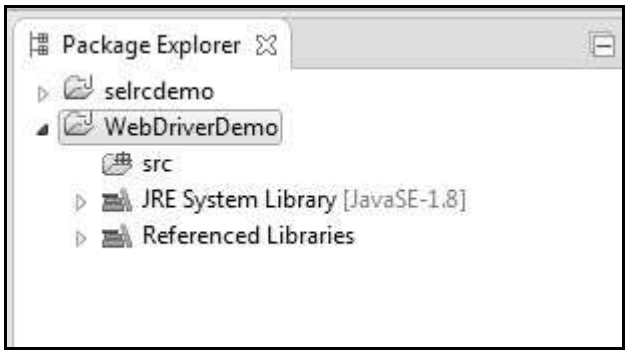
Step 4 : Enter the Project Name and Click 'Next'.



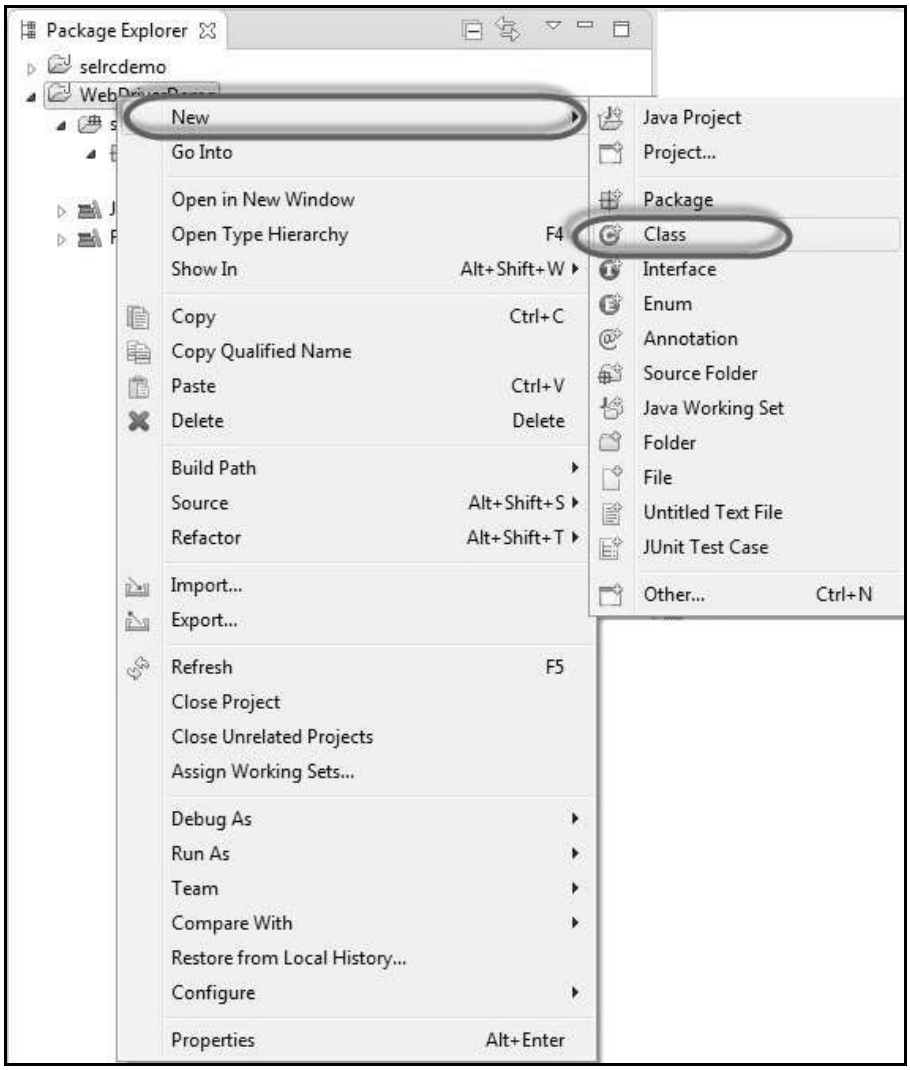
Step 5 : Go to Libraries Tab and select all the JAR's that we have downloaded. Add reference to all the JAR's of Selenium WebDriver Library folder and also selenium-java-2.42.2.jar and selenium-java-2.42.2-srcs.jar.



Step 6 : The Package is created as shown below.

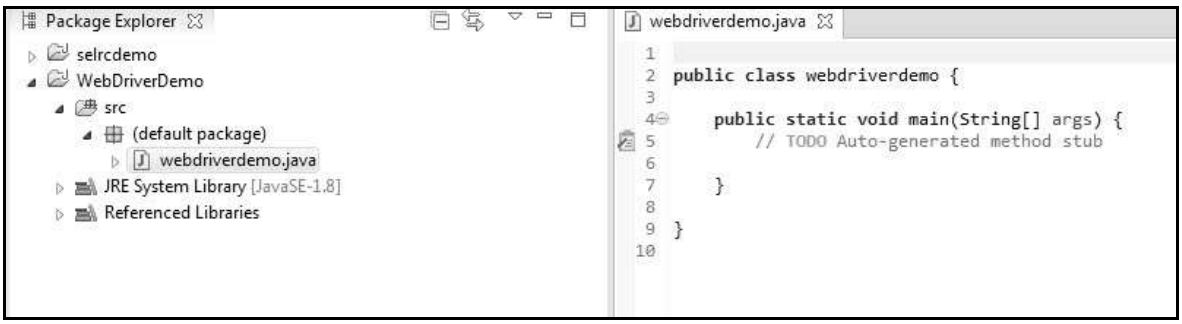


Step 7 : Now right-click on the package and select 'New' >> 'Class' to create a 'Class'.



Step 8 : Now name the class and make it the main function.

Step 9 : The class outline is shown as below.



Step 10 : Now it is time to code. The following script is easier to understand, as it has comments embedded in it to explain the steps clearly. Please take a look at the chapter "Locators" to understand how to capture object properties.

```
import java.util.concurrent.TimeUnit;
import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;

public class webdriverdemo
{
  public static void main(String[] args)
  {
     WebDriver driver = new FirefoxDriver();

     // Puts an Implicit wait, Will wait for 10 seconds
     // before throwing exception
     driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);

     // Launch website
     driver.navigate().to("http://www.calculator.net/");

     // Maximize the browser
     driver.manage().window().maximize();

     // Click on Math Calculators
     driver.findElement(By.xpath(".//*[@id='menu']/div[3]/a")).click();
```

```
      // Click on Percent Calculators
      driver.findElement(By.xpath(".//*[@id='menu']/div[4]/div[3]/a")).click();

      // Enter value 10 in the first number of the percent Calculator
      driver.findElement(By.id("cpar1")).sendKeys("10");

      // Enter value 50 in the second number of the percent Calculator
      driver.findElement(By.id("cpar2")).sendKeys("50");

      // Click Calculate Button
      driver.findElement(By.xpath(".//*[@id='content']/table/tbody
      /tr/td[2]/input")).click();

      // Get the Result Text based on its xpath
      String result =
      driver.findElement(By.xpath(".//*[@id='content']/p[2]/span/font/b")
)
      .getText();

      //Print a Log In message to the screen
      System.out.println(" The Result is " + result);

      //Close the Browser.
      driver.close();
   }
}
```

Step 11 : The output of the above script would be printed in Console.

Most Used Commands

The following table lists some of the most frequently used commands in WebDriver along with their syntax.

Command	Description
driver.get("URL")	To navigate to an application.
element.sendKeys("inputtext")	Enter some text into an input box.
element.clear()	Clear the contents from the input box.
select.deselectAll()	Deselect all OPTIONs from the first SELECT on the page.
select.selectByVisibleText("some text")	Select the OPTION with the input specified by the user.
driver.switchTo().window("windowName")	Move the focus from one window to another.
driver.switchTo().frame("frameName")	Swing from frame to frame.
driver.switchTo().alert()	Helps in handling alerts.
driver.navigate().to("URL")	Navigate to the URL.

driver.navigate().forward()	To navigate forward.
driver.navigate().back()	To navigate back.
driver.close()	Closes the current browser associated with the driver.
driver.quit()	Quits the driver and closes all the associated window of that driver.
driver.refresh()	Refreshes the current page.

7. LOCATORS

Locating elements in Selenium WebDriver is performed with the help of findElement() and findElements() methods provided by WebDriver and WebElement class.

- findElement() returns a WebElement object based on a specified search criteria or ends up throwing an exception if it does not find any element matching the search criteria.
- findElements() returns a list of WebElements matching the search criteria. If no elements are found, it returns an empty list.

The following table lists all the Java syntax for locating elements in Selenium WebDriver.

Method	Syntax	Description
By ID	driver.findElement(By.id(<element ID>))	Locates an element using the ID attribute
By name	driver.findElement(By.name(<element name>))	Locates an element using the Name attribute
By class name	driver.findElement(By.className(<element class>))	Locates an element using the Class attribute
By tag name	driver.findElement(By.tagName(<htmltagname>))	Locates an element using the

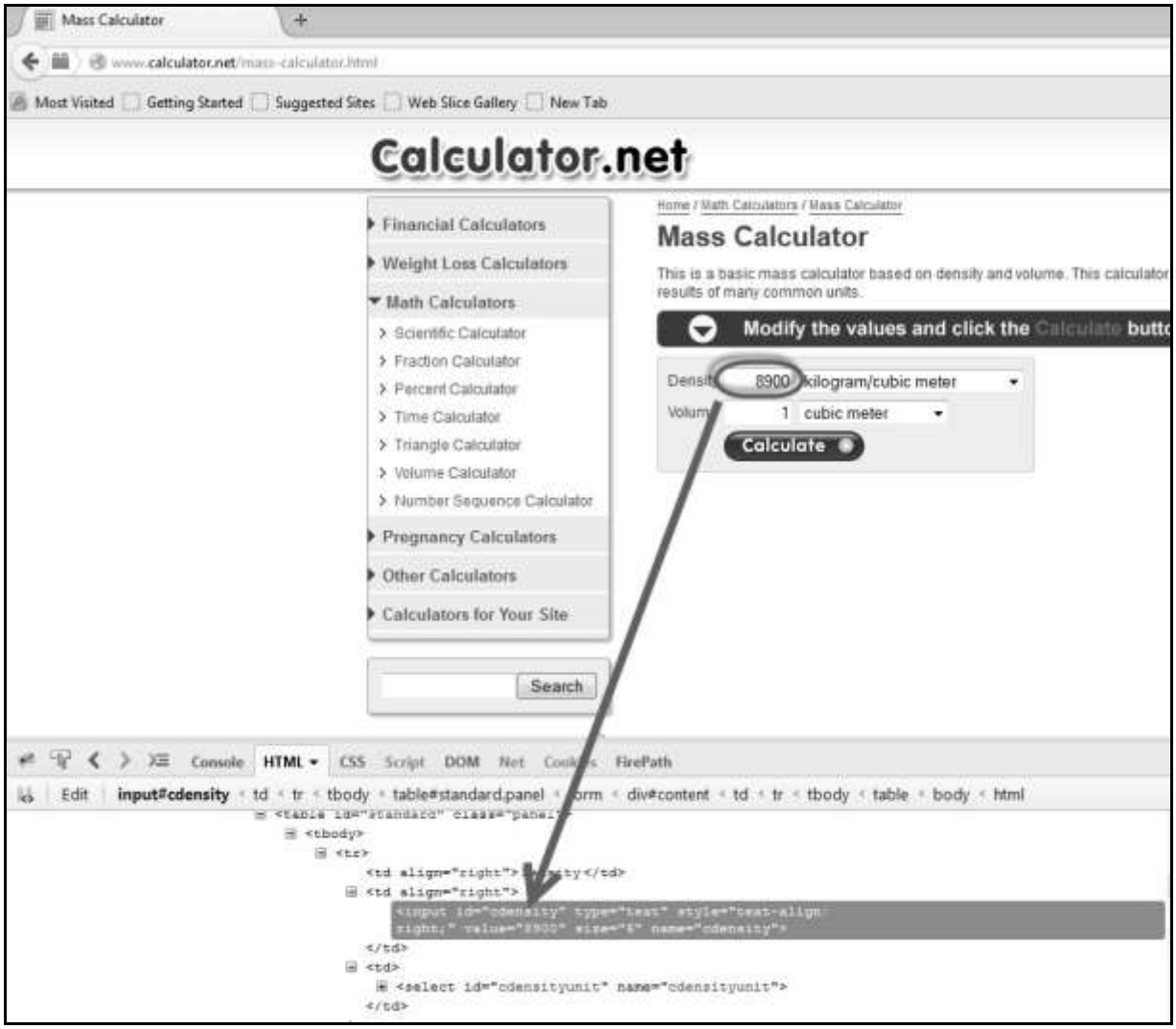
		HTML tag
By link text	driver.findElement(By.linkText(<linktext>))	Locates a link using link text
By partial link text	driver.findElement(By.partialLinkText(<linktext>))	Locates a link using the link's partial text
By CSS	driver.findElement(By.cssSelector(<css selector>))	Locates an element using the CSS selector
By XPath	driver.findElement(By.xpath(<xpath>))	Locates an element using XPath query

Locators Usage

Now let us understand the practical usage of each of the locator methods with the help of http://www.calculator.net

By ID

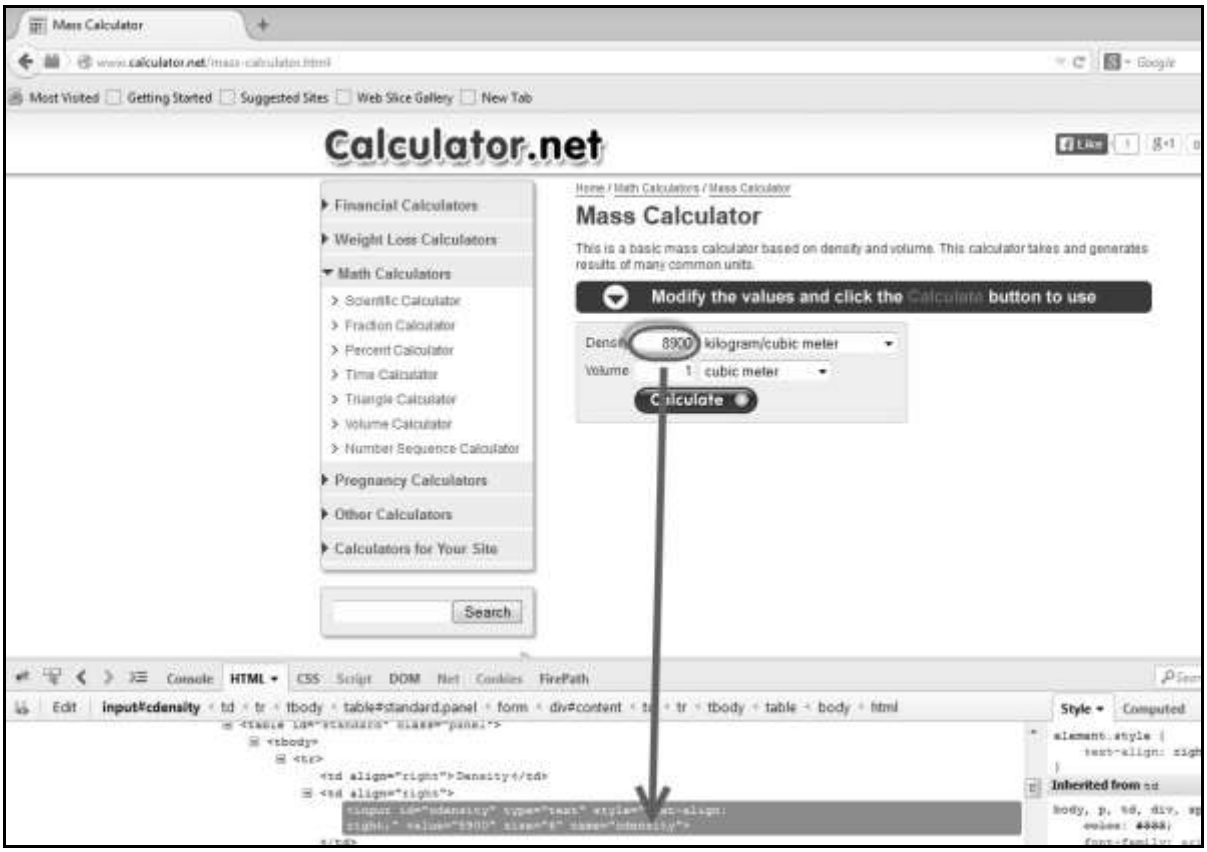
Here an object is accessed with the help of IDs. In this case, it is the ID of the text box. Values are entered into the text box using the sendkeys method with the help of ID(cdensity).




```
driver.findElement(By.id("cdensity")).sendKeys("10");
```

By Name

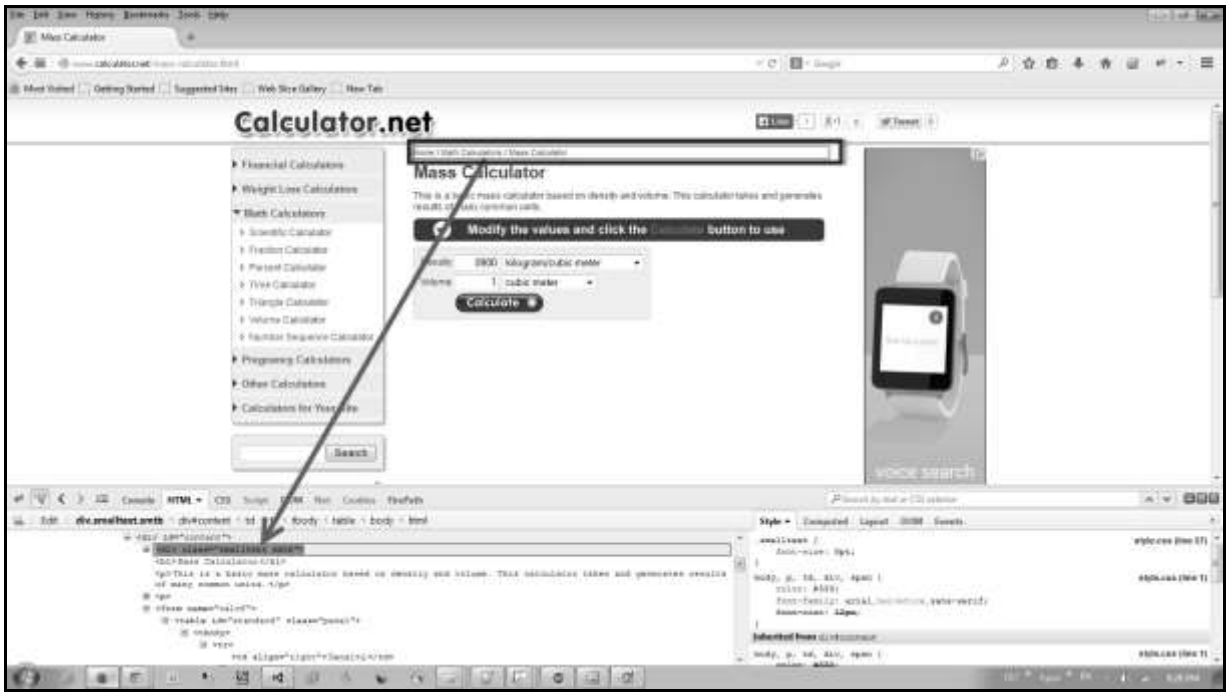
Here an object is accessed with the help of names. In this case, it is the name of the text box. Values are entered into the text box using the sendkeys method with the help of ID(cdensity).




```
driver.findElement(By.name("cdensity")).sendKeys("10");
```

By Class Name

Here an object is accessed with the help of Class Names. In this case, it is the Class name of the WebElement. The Value can be accessed with the help of the gettext method.




```
List<WebElement> byclass = driver.findElements(By.className("smalltext
smtb"));
```

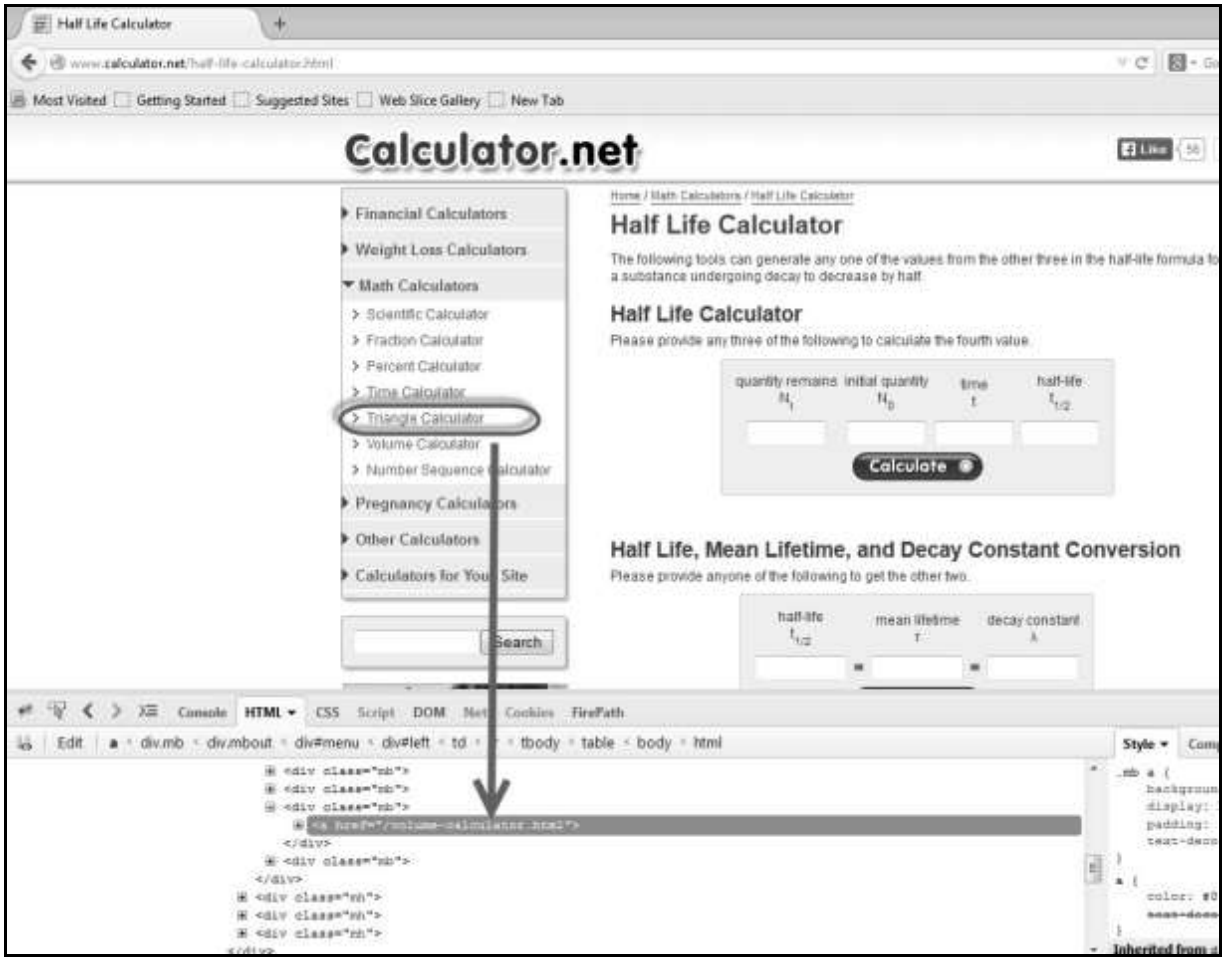
By Tag Name

The DOM Tag Name of an element can be used to locate that particular element in the WebDriver. It is very easy to handle tables with the help of this method. Take a look at the following code.

```
WebElement table = driver.findElement(By.id("calctable"));
List<WebElement> row = table.findElements(By.tagName("tr"));
int rowcount = row.size();
```

By Link Text

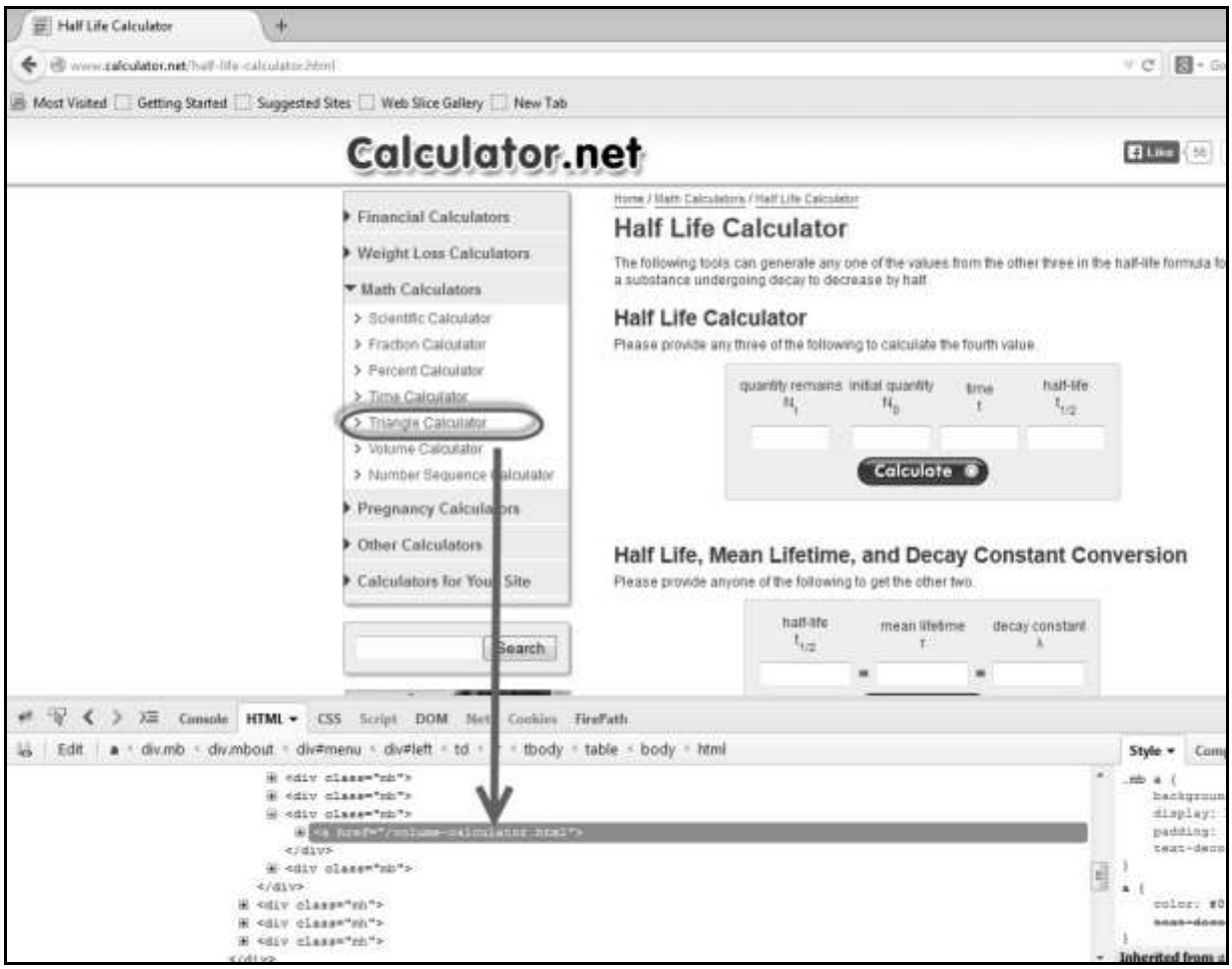
This method helps to locate a link element with matching visible text.




```
driver.findElements(By.linkText("Volume")).click();
```

By Partial Link Text

This method helps locate a link element with partial matching visible text.




```
driver.findElements(By.partialLinkText("Volume")).click();
```

By CSS

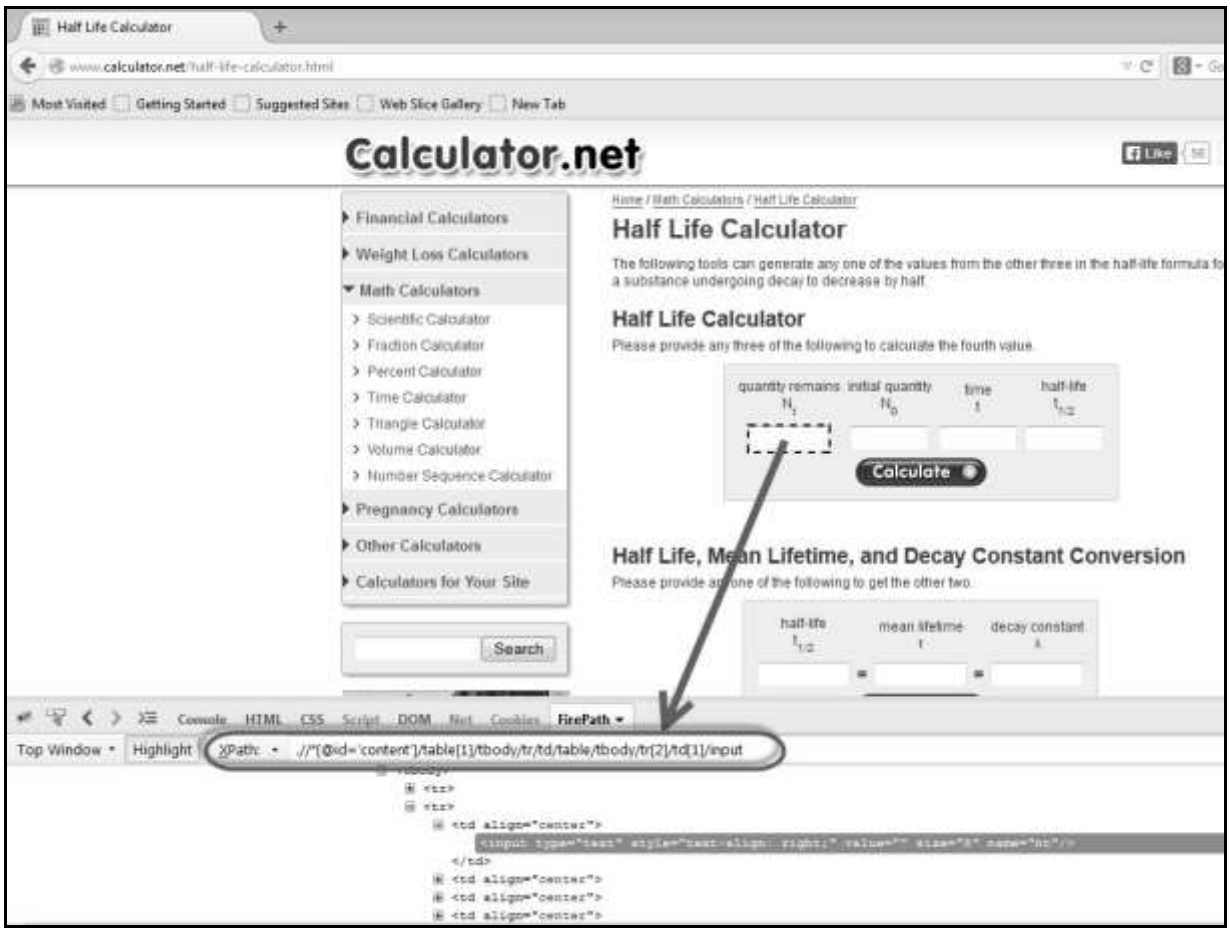
The CSS is used as a method to identify the webobject, however NOT all browsers support CSS identification.

```
WebElement loginButton =
driver.findElement(By.cssSelector("input.login"));
```

By XPath

XPath stands for XML path language. It is a query language for selecting nodes from an XML document. XPath is based on the tree representation of XML

documents and provides the ability to navigate around the tree by selecting nodes using a variety of criteria.




```
driver.findElement(By.xpath(".//*[@id='content']/table[1]/tbody/tr/td/table/tbody/tr[2]/td[1]/input")).sendkeys("100");
```

8. INTERACTIONS

User Interactions

Selenium WebDriver is the most frequently used tool among all the tools available in the Selenium tool set. Therefore it is important to understand how to use Selenium to interact with web apps. In this module, let us understand how to interact with GUI objects using Selenium WebDriver.

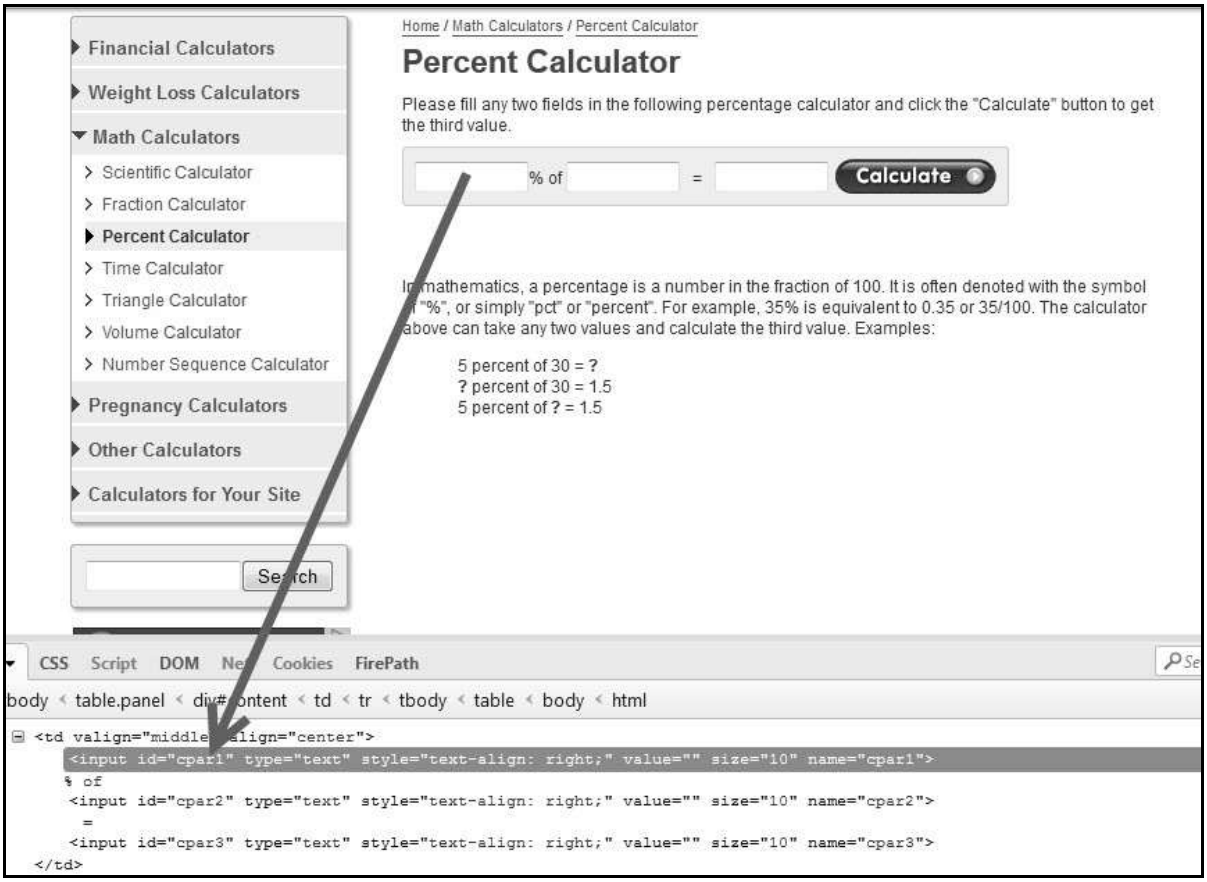
We need to interact with the application using some basic actions or even some advanced user action by developing user-defined functions for which there are no predefined commands.

Listed below are the different kinds of actions against those GUI objects:

- Text Box Interaction
- Radio Button Selection
- Check Box Selection
- Drop Down Item Selection
- Synchronization
- Drag & Drop
- Keyboard Actions
- Mouse Actions
- Multi Select
- Find All Links

Text Box Interaction

In this section, we will understand how to interact with text boxes. We can put values into a text box using the 'sendkeys' method. Similarly, we can also retrieve text from a text box using the getattribute("value") command. Take a look at the following example.

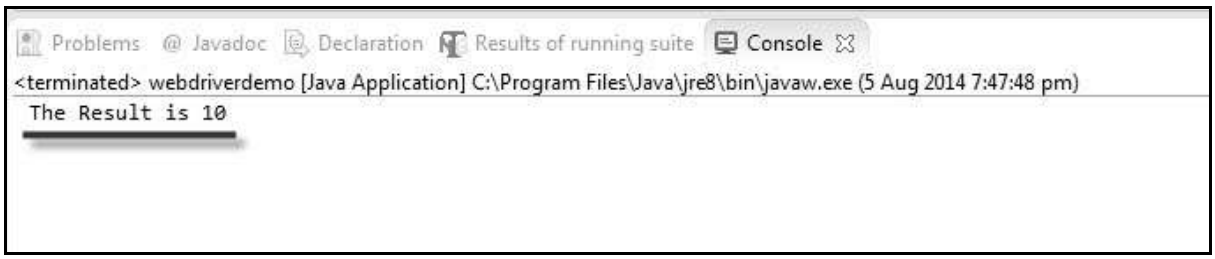



```
import java.util.concurrent.TimeUnit;
import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;

public class webdriverdemo
{
   public static void main(String[] args) throws InterruptedException
   {
      WebDriver driver = new FirefoxDriver();

      // Puts an Implicit wait, Will wait for 10 seconds
      // before throwing exception
      driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);

      // Launch website
      driver.navigate().to("http://www.calculator.net
```

```
        /percent-calculator.html");

        // Maximize the browser
        driver.manage().window().maximize();

        // Enter value 10 in the first number of the percent Calculator
        driver.findElement(By.id("cpar1")).sendKeys("10");

        Thread.sleep(5000);

        // Get the text box from the application
        String result =
        driver.findElement(By.id("cpar1")).getAttribute("value");

        // Print a Log In message to the screen
        System.out.println(" The Result is " + result);

        // Close the Browser
        driver.close();
    }
}
```

Output

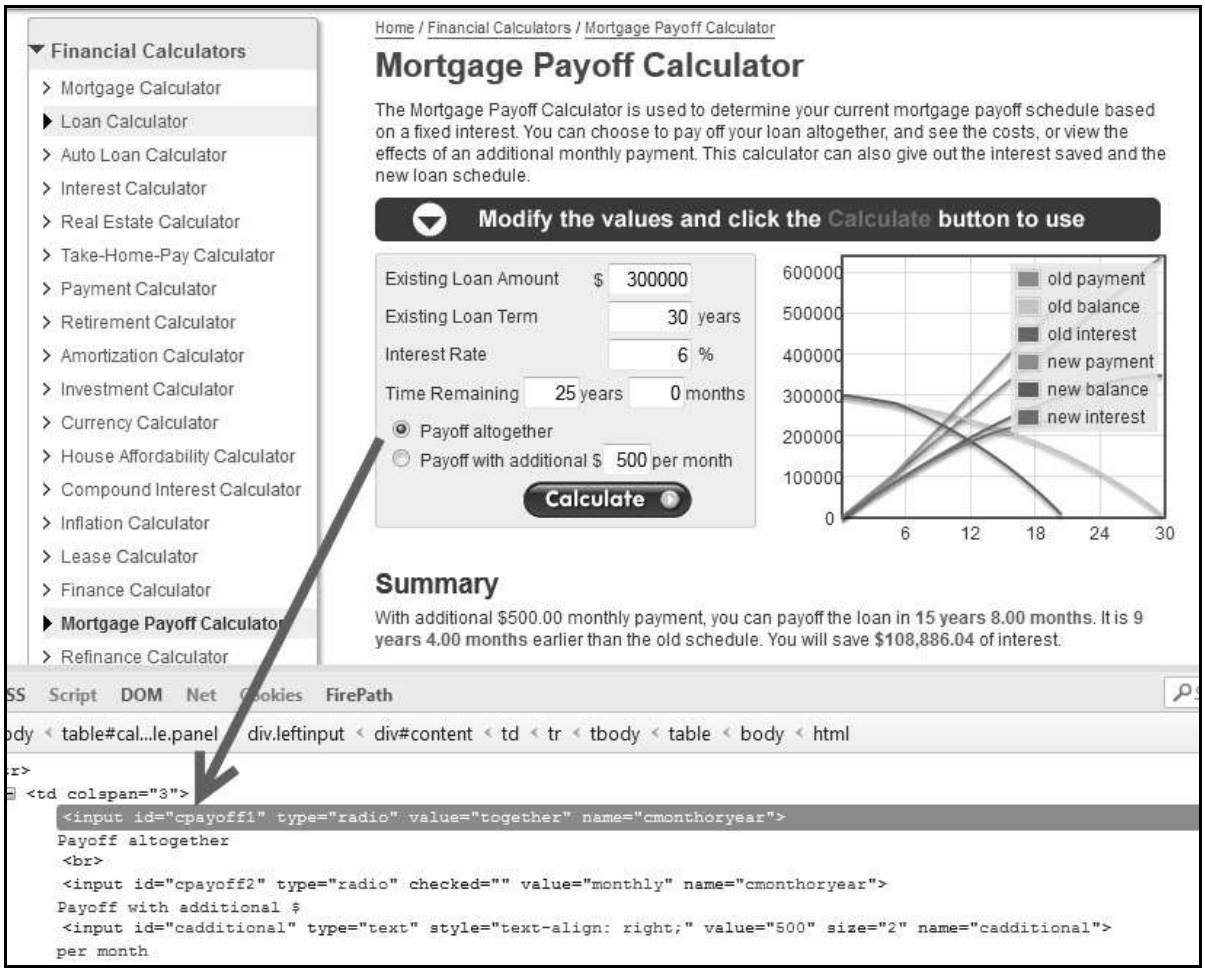
The output of the above script is displayed as shown below.



Radio Button Interaction

In this section, we will understand how to interact with Radio Buttons. We can select a radio button option using the 'click' method and unselect using the same 'click' method.

Let us understand how to interact with radio buttons using http://www.calculator.net/mortgage-payoff-calculator.html. We can also check if a radio button is selected or enabled.




```
import java.util.concurrent.TimeUnit;
import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;

public class webdriverdemo
{
   public static void main(String[] args) throws InterruptedException
   {
```

```
      WebDriver driver = new FirefoxDriver();

      // Puts an Implicit wait, Will wait for 10 seconds
      // before throwing exception
      driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);



      // Launch website
      driver.navigate().to("http://www.calculator.net
      /mortgage-payoff-calculator.html");
      driver.manage().window().maximize();

      // Click on Radio Button
      driver.findElement(By.id("cpayoff1")).click();

      System.out.println("The Output of the IsSelected " +
      driver.findElement(By.id("cpayoff1")).isSelected());

      System.out.println("The Output of the IsEnabled " +
      driver.findElement(By.id("cpayoff1")).isEnabled());

      System.out.println("The Output of the IsDisplayed " +
      driver.findElement(By.id("cpayoff1")).isDisplayed());

      driver.close();

      // Close the Browser.
      driver.close();
  }
}
```

Output

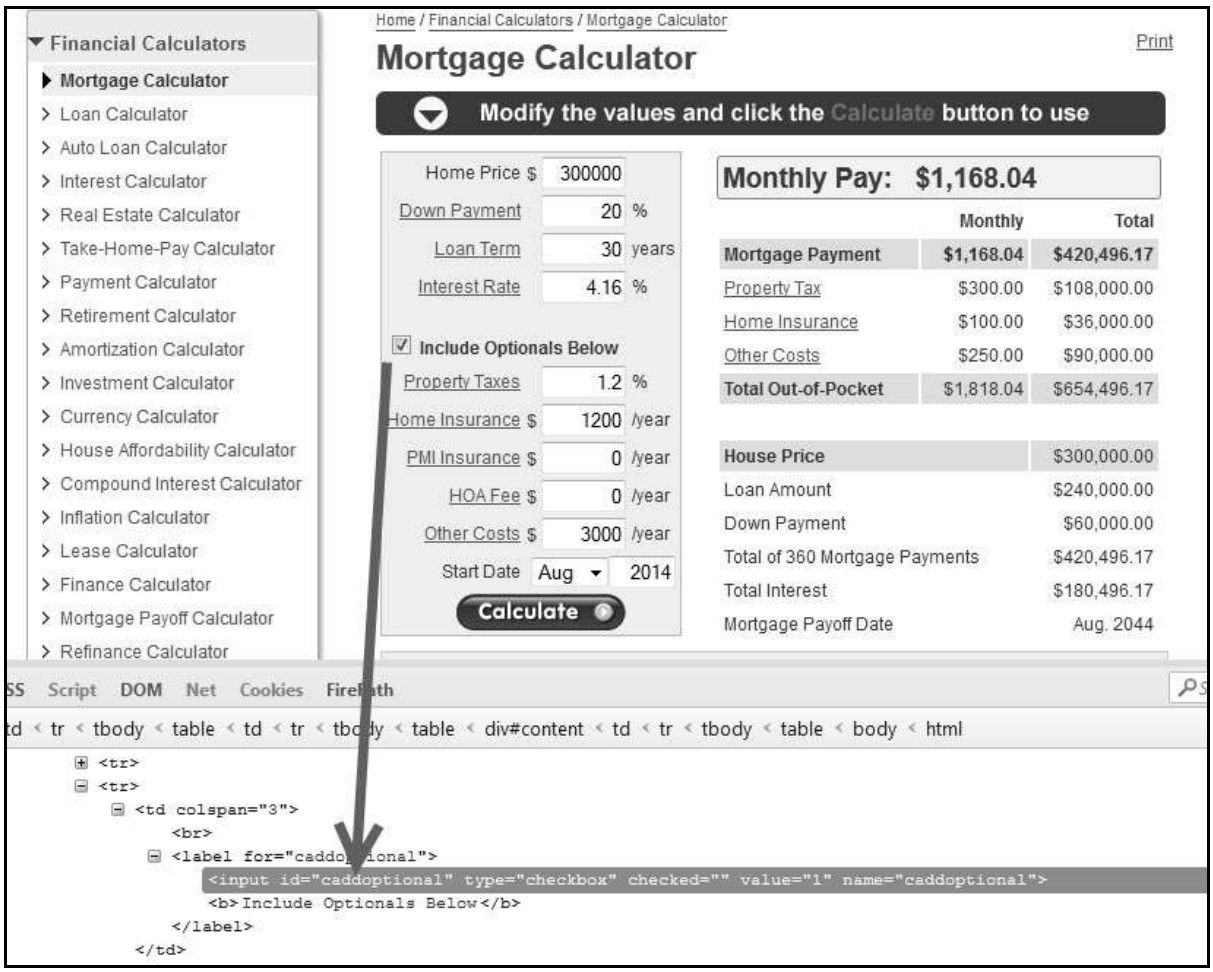
Upon execution, the radio button is selected and the output of the commands are displayed in the console.

```
Problems  @ Javadoc  Declaration  Results of running suite  Console
<terminated> webdriverdemo [Java Application] C:\Program Files\Java\jre8\bin\javaw.exe (5 Aug 2014 12:03:03 pm)
The Output of the IsSelected true
The Output of the IsEnabled true
The Output of the IsDisplayed true
```

Check Box Interaction

In this section, we will understand how to interact with Check Box. We can select a check box using the 'click' method and uncheck using the same 'click' method.

Let us understand how to interact with a check box using http://www.calculator.net/mortgage-calculator.html. We can also check if a check box is selected/enabled/visible.




```
import java.util.concurrent.TimeUnit;
import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;
```

```
public class webdriverdemo
{
   public static void main(String[] args) throws InterruptedException
   {
      WebDriver driver = new FirefoxDriver();

      // Puts an Implicit wait, Will wait for 10 seconds
      // before throwing exception
      driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);

      // Launch website
      driver.navigate().to("http://www.calculator.net
      /mortgage-calculator.html");
      driver.manage().window().maximize();

      // Click on check box
      driver.findElement(By.id("caddoptional")).click();

      System.out.println("The Output of the IsSelected " +
      driver.findElement(By.id("caddoptional")).isSelected());

      System.out.println("The Output of the IsEnabled " +
      driver.findElement(By.id("caddoptional")).isEnabled());

      System.out.println("The Output of the IsDisplayed " +
      driver.findElement(By.id("caddoptional")).isDisplayed());

      driver.close();

   }
}
```

Output

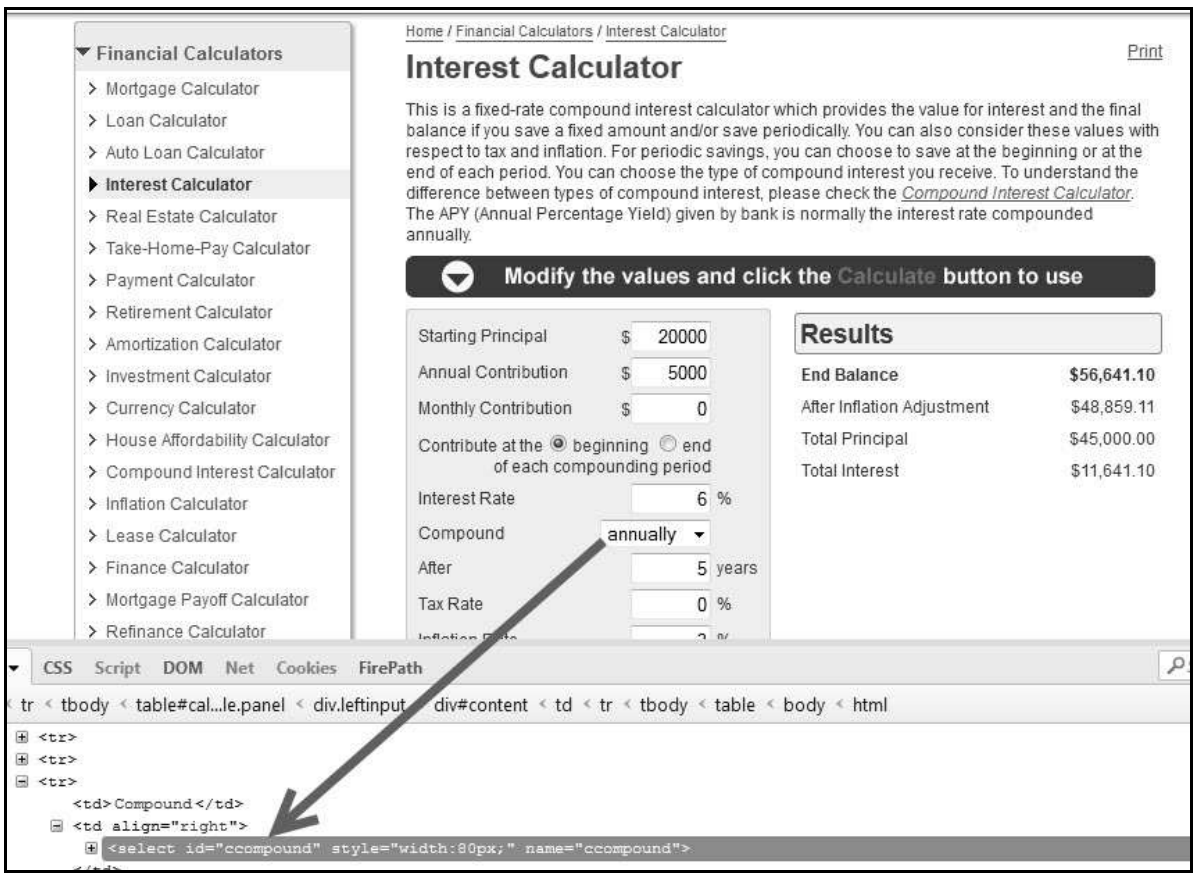
Upon execution, the check box is unchecked after the click command (as it was checked by default) and the output of the commands are displayed in the console.

```
Problems  @ Javadoc  Declaration  Results of running suite  Console
<terminated> webdriverdemo [Java Application] C:\Program Files\Java\jre8\bin\javaw.exe (5 Aug 2014 12:09:07 pm)
The Output of the IsSelected false
The Output of the IsEnabled true
The Output of the IsDisplayed true
```

Dropdown Interaction

In this section, we will understand how to interact with Dropdown Boxes. We can select an option using 'selectByVisibleText' or 'selectByIndex' or 'selectByValue' methods.

Let us understand how to interact with a dropdown box using http://www.calculator.net/interest-calculator.html. We can also check if a dropdown box is selected/enabled/visible.

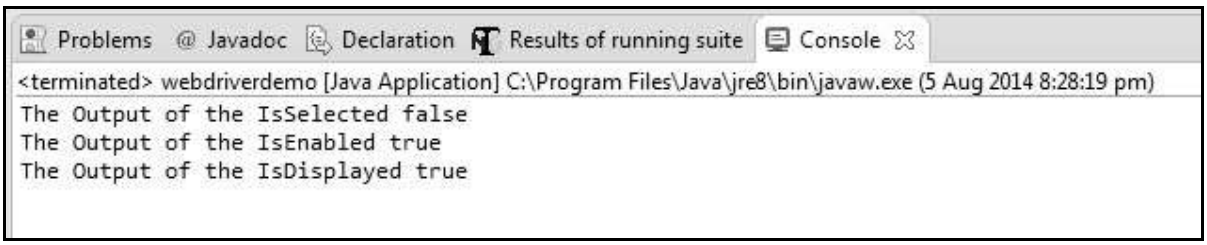


```
import java.util.concurrent.TimeUnit;

import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;
import org.openqa.selenium.support.ui.Select;

public class webdriverdemo
{
   public static void main(String[] args) throws InterruptedException
   {
      WebDriver driver = new FirefoxDriver();

      // Puts an Implicit wait, Will wait for 10 seconds
      // before throwing exception
      driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);



      // Launch website
      driver.navigate().to("http://www.calculator.net
      /interest-calculator.html");
      driver.manage().window().maximize();

      // Selecting an item from Drop Down list Box
      Select dropdown =
      new Select(driver.findElement(By.id("ccompound")));

      dropdown.selectByVisibleText("continuously");

      // you can also use dropdown.selectByIndex(1) to
      // select second element as index starts with 0.
      // You can also use dropdown.selectByValue("annually");

      System.out.println("The Output of the IsSelected " +
```

```
        driver.findElement(By.id("ccompound")).isSelected());

        System.out.println("The Output of the IsEnabled " +
        driver.findElement(By.id("ccompound")).isEnabled());

        System.out.println("The Output of the IsDisplayed " +
        driver.findElement(By.id("ccompound")).isDisplayed());

        driver.close();

    }
}
```

Output

Upon execution, the dropdown is set with the specified value and the output of the commands are displayed in the console.



Synchronization

To synchronize between script execution and application, we need to wait after performing appropriate actions. Let us look at the ways to achieve the same.

Thread.Sleep

Thread.Sleep is a static wait and it is not a good way to use in scripts, as it is sleep without condition.

```
Thread.Sleep(1000); //Will wait for 1 second.
```

Explicit Waits

An 'explicit wait' waits for a certain condition to occur before proceeding further. It is mainly used when we want to click or act on an object once it is visible.

```
WebDriver driver = new FirefoxDriver();

driver.get("Enter an URL"S);

WebElement DynamicElement = (new WebDriverWait(driver,
10)).until(ExpectedConditions.presenceOfElementLocated(By.id("DynamicEle
ment")));
```

Implicit Wait

Implicit wait is used in cases where the WebDriver cannot locate an object immediately because of its unavailability. The WebDriver will wait for a specified implicit wait time and it will not try to find the element again during the specified time period.

Once the specified time limit is crossed, the WebDriver will try to search the element once again for one last time. Upon success, it proceeds with the execution; upon failure, it throws an exception.

It is a kind of global wait which means the wait is applicable for the entire driver. Hence, hardcoding this wait for longer time periods will hamper the execution time.

```
WebDriver driver = new FirefoxDriver();

driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);

driver.get("Enter an URL");

WebElement DynamicElement = driver.findElement(By.id("DynamicElement"));
```

Fluent Wait

A FluentWait instance defines the maximum amount of time to wait for a condition to take place, as well as the frequency with which to check the existence of the object condition.

Let us say we will 60 seconds for an element to be available on the page, but we will check its availability once in every 10 seconds.

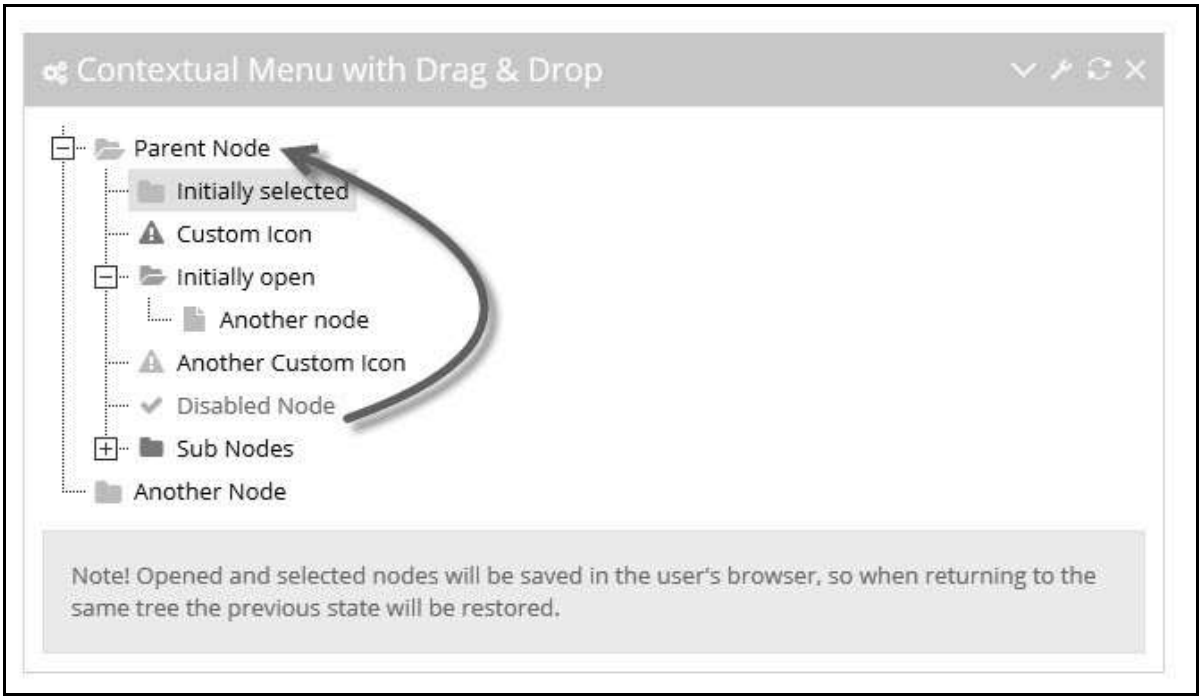
```
Wait wait = new FluentWait(driver)

    .withTimeout(60, SECONDS)

    .pollingEvery(10, SECONDS)

    .ignoring(NoSuchElementException.class);

WebElement dynamicelement = wait.until(new
Function<webdriver,webElement>()

{
```

```
    public WebElement apply(WebDriver driver)
    {
        return driver.findElement(By.id("dynamicelement"));
    }
 }
);
```

Drag & Drop

As a tester, you might be in a situation to perform a 'Drag & drop' operation. We will perform a drag and drop operation by picking up a tree grid that is available for us on http://www.keenthemes.com/preview/metronic/templates/admin/ui_tree.html.

In the example, we would like to drag an element 'Disable Node' from 'initially open' folder to 'Parent Node' Folder.

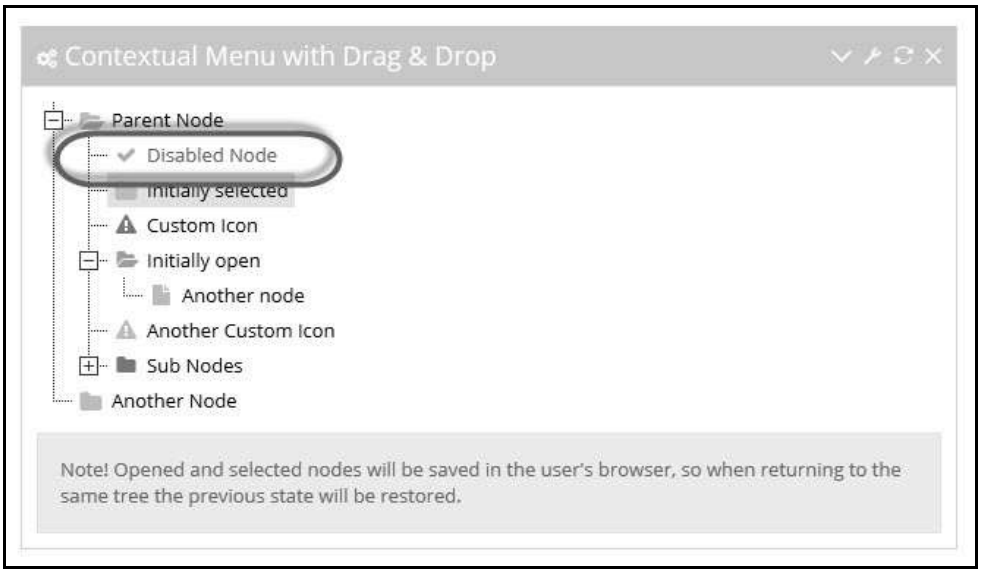



```
import java.util.concurrent.TimeUnit;
import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;
import org.openqa.selenium.interactions.Actions;
import org.openqa.selenium.interactions.Action;
```

```
public class webdriverdemo
{
   public static void main(String[] args) throws InterruptedException
   {
      WebDriver driver = new FirefoxDriver();

      // Puts an Implicit wait, Will wait for 10 seconds
      // before throwing exception
      driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);

      // Launch website
      driver.navigate().to("http://www.keenthemes.com/preview/
      metronic/templates/admin/ui_tree.html");
      driver.manage().window().maximize();

      WebElement From =
      driver.findElement(By.xpath(".//*[@id='j3_7']/a"));

      WebElement To =
      driver.findElement(By.xpath(".//*[@id='j3_1']/a"));

      Actions builder = new Actions(driver);
      Action dragAndDrop = builder.clickAndHold(From)
                .moveToElement(To)
                .release(To)
                .build();
      dragAndDrop.perform();

      driver.close();

   }
}
```

Output

After performing the drag-drop operation, the output would be as shown below.



Keyboard Actions

Given below are the methods to perform keyboard actions:

- **sendKeys** - Sends keys to the keyboard representation in the browser. Special keys that are not text, represented as Keys are recognized both as part of sequences of characters, or individually.
- **pressKey** - Press a key on the keyboard that is NOT text. The keys such as function keys "F1", "F2", "Tab", "Control", etc. If keyToPress is a sequence of characters, different driver implementations may choose to throw an exception or to read only the first character in the sequence.
- **releaseKey** - Release a key on the keyboard after executing the keypress event. It usually holds good for non-text characters.

Here are the syntax to call keyboard functions using Selenium WebDriver.

```
void sendKeys(java.lang.CharSequence keysToSend)

void pressKey(java.lang.CharSequence keyToPress)

void releaseKey(java.lang.CharSequence keyToRelease)
```

Mouse Actions

Listed below are some of the key mouse actions that one would come across in most of the applications:

- **Click** - Performs a Click. We can also perform a click based on coordinates.
- **contextClick** - Performs a context click/right-click on an element or based on the coordinates.
- **doubleClick** - Performs a double-click on the webelement or based on the coordinates. If left empty, it performs double-click on the current location.
- **mouseDown** - Performs a mouse-down action on an element or based on coordinates.
- **mouseMove** - Performs a mouse-move action on an element or based on coordinates.
- **mouseUp** - Releases the mouse usually followed by mouse-down and acts based on coordinates.

Here are the syntax to call mouse actions using Selenium WebDriver:

```
void click(WebElement onElement)
void contextClick(WebElement onElement)
void doubleClick(WebElement onElement)
void mouseDown(WebElement onElement)
void mouseUp(WebElement onElement)
void mouseMove(WebElement toElement)
void mouseMove(WebElement toElement, long xOffset, long yOffset)
```

Multi Select Action

Sometimes we would be in a situation to select two or more items in a list box or text area. To understand the same, we would demonstrate multiple selection from the list using 'http://demos.devexpress.com/aspxeditorsdemos/ListEditors/MultiSelect.aspx'.

Example

Let us say, we want to select 3 items from this list as shown below:

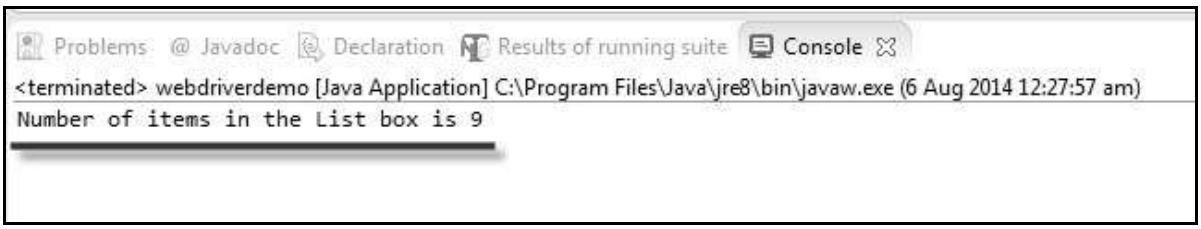
Let us see how to code for this functionality:

```
import java.util.List;
import java.util.concurrent.TimeUnit;

import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;
import org.openqa.selenium.interactions.Actions;
import org.openqa.selenium.interactions.Action;

public class webdriverdemo
{
   public static void main(String[] args) throws InterruptedException
   {
      WebDriver driver = new FirefoxDriver();

      driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);

      driver.navigate().to("http://demos.devexpress.com
      /aspxeditorsdemos/ListEditors/MultiSelect.aspx");

      //driver.manage().window().maximize();

      driver.findElement(By.id("ContentHolder_lbSelectionMode_I")).click();
      driver.findElement(By.id("ContentHolder_lbSelectionMode
```

```
        _DDD_L_LBI1T0")).click();

        Thread.sleep(5000);

        // Perform Multiple Select
        Actions builder = new Actions(driver);
        WebElement select =
        driver.findElement(By.id("ContentHolder_lbFeatures_LBT"));
        List<WebElement> options = select.findElements(By.tagName("td"));
        System.out.println(options.size());
        Action multipleSelect = builder.keyDown(Keys.CONTROL)
             .click(options.get(2))
             .click(options.get(4))
             .click(options.get(6))
             .build();
         multipleSelect.perform();

         driver.close();

    }
}
```

Output

Upon executing the script, the items would be selected as displayed above and the size of the list box would also be printed in the console.



Find All Links

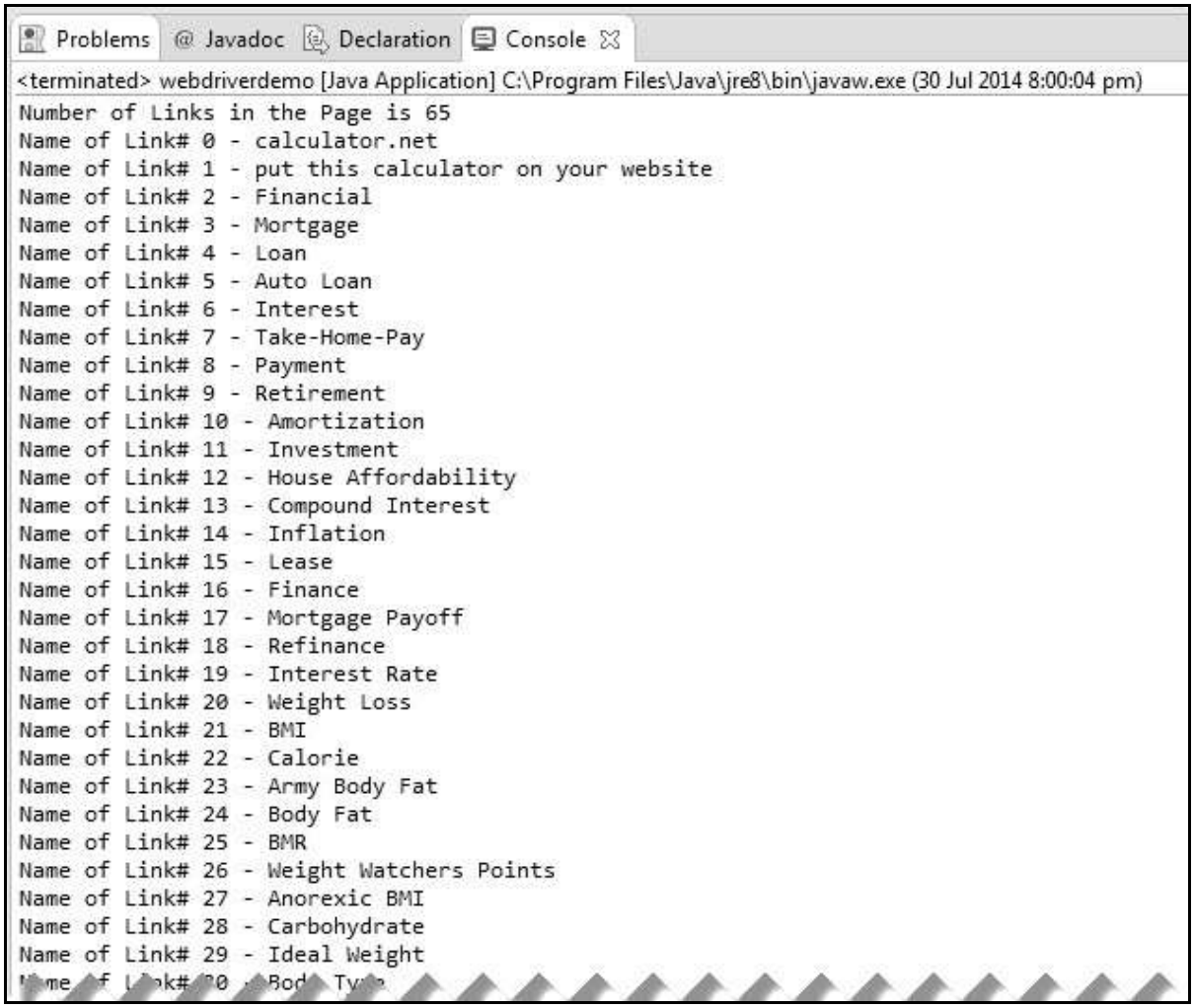
Testers might be in a situation to find all the links on a website. We can easily do so by finding all elements with the Tag Name "a", as we know that for any link reference in HTML, we need to use "a" (anchor) tag.

Example

```
import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;
public class getalllinks
{
   public static void main(String[] args)
   {
       WebDriver driver = new FirefoxDriver();
       driver.navigate().to("http://www.calculator.net");
       java.util.List<WebElement> links =
       driver.findElements(By.tagName("a"));
       System.out.println("Number of Links in the Page is " +
       links.size());
       for (int i = 1; i<=links.size(); i=i+1)
       {
           System.out.println("Name of Link# " + i - +
           links.get(i).getText());
       }
   }
}
```

Output

The output of the script would be thrown to the console as shown below. Though there are 65 links, only partial output is shown below.


Problems
Javadoc
Declaration
Console
<terminated> webdriverdemo [Java Application] C:\Program Files\Java\jre8\bin\javaw.exe (30 Jul 2014 8:00:04 pm)
Number of Links in the Page is 65
Name of Link# 0 - calculator.net
Name of Link# 1 - put this calculator on your website
Name of Link# 2 - Financial
Name of Link# 3 - Mortgage
Name of Link# 4 - Loan
Name of Link# 5 - Auto Loan
Name of Link# 6 - Interest
Name of Link# 7 - Take-Home-Pay
Name of Link# 8 - Payment
Name of Link# 9 - Retirement
Name of Link# 10 - Amortization
Name of Link# 11 - Investment
Name of Link# 12 - House Affordability
Name of Link# 13 - Compound Interest
Name of Link# 14 - Inflation
Name of Link# 15 - Lease
Name of Link# 16 - Finance
Name of Link# 17 - Mortgage Payoff
Name of Link# 18 - Refinance
Name of Link# 19 - Interest Rate
Name of Link# 20 - Weight Loss
Name of Link# 21 - BMI
Name of Link# 22 - Calorie
Name of Link# 23 - Army Body Fat
Name of Link# 24 - Body Fat
Name of Link# 25 - BMR
Name of Link# 26 - Weight Watchers Points
Name of Link# 27 - Anorexic BMI
Name of Link# 28 - Carbohydrate
Name of Link# 29 - Ideal Weight

9. TEST DESIGN TECHNIQUES

There are various components involved in designing the tests. Let us understand some of the important components involved in designing a framework as well. We will learn the following topics in this chapter:

- Page Object Model
- Parameterizing using Excel
- Log4j Logging
- Exception Handling
- Multi Browser Testing
- Capture Screenshots
- Capture Videos

Page Object Model

Selenium acts on webelements with the help of their properties such ID, name, XPath, etc. Unlike QTP which has an inbuilt object repository (OR), Selenium has no inbuilt ORs.

Hence we need to build an OR which should also be maintainable and accessible on demand. Page Object Model (POM) is a popular design pattern to create an Object Repository in which each one of those webelements properties are created using a class file.

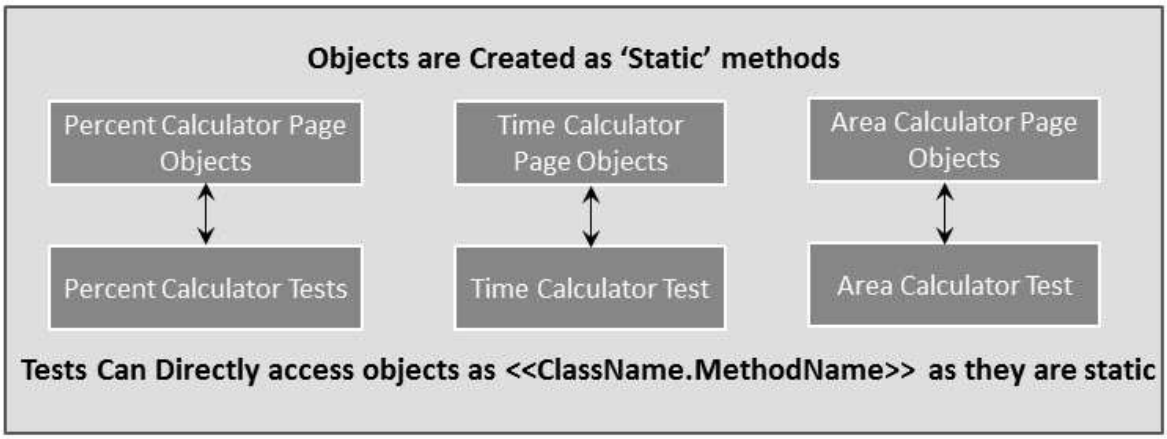
Advantages

- POM is an implementation where test objects and functions are separated from each other, thereby keeping the code clean.
- The objects are kept independent of test scripts. An object can be accessed by one or more test scripts, hence POM helps us to create objects once and use them multiple times.
- Since objects are created once, it is easy to access as well as update a particular property of an object.

POM Flow Diagram

Objects are created for each one of the pages and methods are developed exclusively to access to those objects. Let us use http://calculator.net for understanding the same.

There are various calculators associated with it and each one of those objects in a particular page is created in a separate class file as static methods and they all are accessed through the 'tests' class file in which a static method would be accessing the objects.



Example

Let us understand it by implementing POM for percent calculator test.

Step 1 : Create a simple class (page_objects_perc_calc.java) file within a package and create methods for each one of those object identifiers as shown below.

```
package PageObject;

import org.openqa.selenium.*;

public class page_objects_perc_calc
{
    private static WebElement element = null;

    // Math Calc Link
     public static WebElement lnk_math_calc(WebDriver driver)
     {
         element =
         driver.findElement(By.xpath(".//*[@id='menu']/div[3]/a"));
         return element;
     }
```

```
// Percentage Calc Link
public static WebElement lnk_percent_calc(WebDriver driver)
{
    element =
    driver.findElement(By.xpath(".//*[@id='menu']/div[4]/div[3]/a"));
    return element;
}

// Number 1 Text Box
public static WebElement txt_num_1(WebDriver driver)
{
    element = driver.findElement(By.id("cpar1"));
    return element;
}

// Number 2 Text Box
public static WebElement txt_num_2(WebDriver driver)
{
     element = driver.findElement(By.id("cpar2"));
     return element;
}

// Calculate Button
public static WebElement btn_calc(WebDriver driver)
{
   element =
   driver.findElement(By.xpath(".//*[@id='content']/table/tbody
   /tr/td[2]/input"));
   return element;
}

// Result
public static WebElement web_result(WebDriver driver)
```

```
    {
        element =
        driver.findElement(By.xpath(".//*[@id='content']/p[2]/span/font/b"));
        return element;
    }
}
```

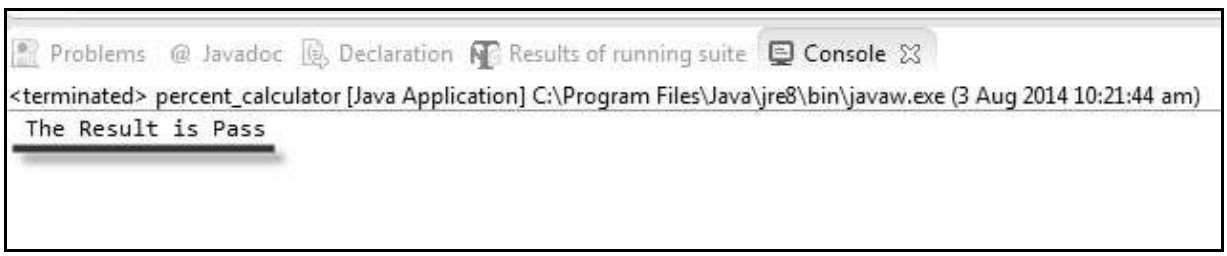
Step 2 : Create a class with main and import the package and create methods for each one of those object identifiers as shown below.

```
package PageObject;

import java.util.concurrent.TimeUnit;

import org.openqa.selenium.WebDriver;
import org.openqa.selenium.firefox.FirefoxDriver;

public class percent_calculator
{
   private static WebDriver driver = null;

   public static void main(String[] args)
   {
      driver = new FirefoxDriver();
      driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);
      driver.get("http://www.calculator.net");

      // Use page Object library now
      page_objects_perc_calc.lnk_math_calc(driver).click();
      page_objects_perc_calc.lnk_percent_calc(driver).click();

      page_objects_perc_calc.txt_num_1(driver).clear();
      page_objects_perc_calc.txt_num_1(driver).sendKeys("10");
      page_objects_perc_calc.txt_num_2(driver).clear();
      page_objects_perc_calc.txt_num_2(driver).sendKeys("50");
```

```
        page_objects_perc_calc.btn_calc(driver).click();

        String result =
        page_objects_perc_calc.web_result(driver).getText();

        if(result.equals("5"))
        {
             System.out.println(" The Result is Pass");
        }
        else
        {
             System.out.println(" The Result is Fail");
        }

        driver.close();
    }
}
```

Output

The test is executed and the result is printed in the console. Given below is the snapshot of the same.

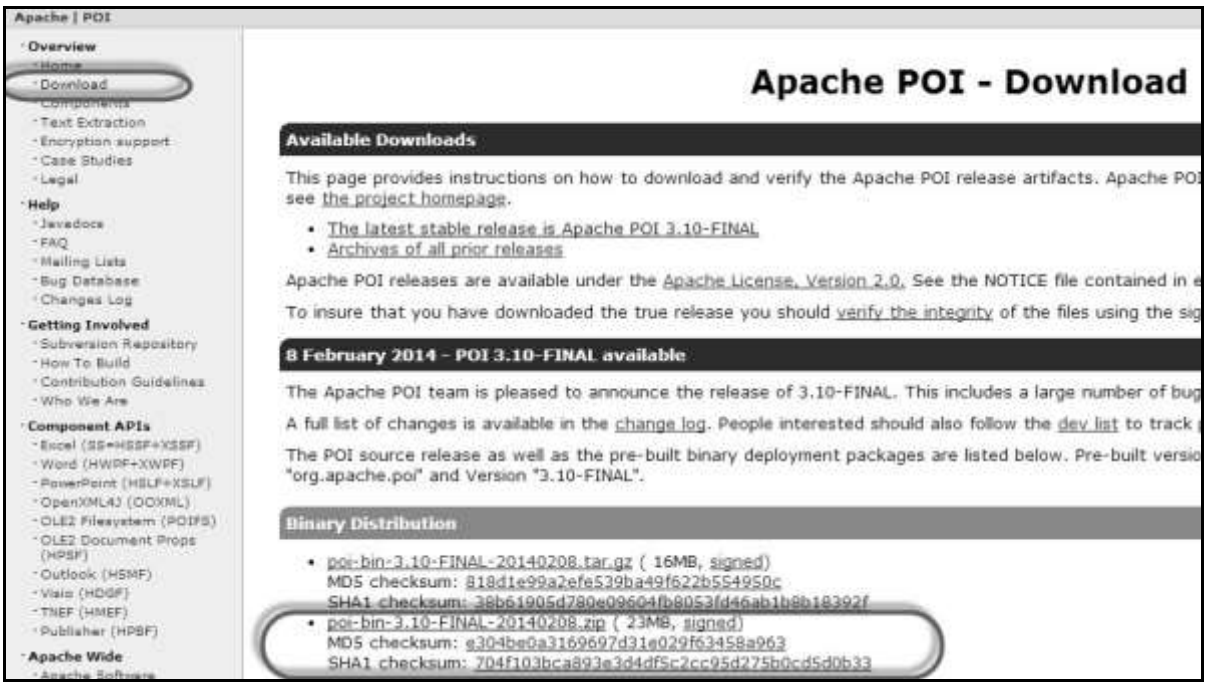


Data Driven using Excel

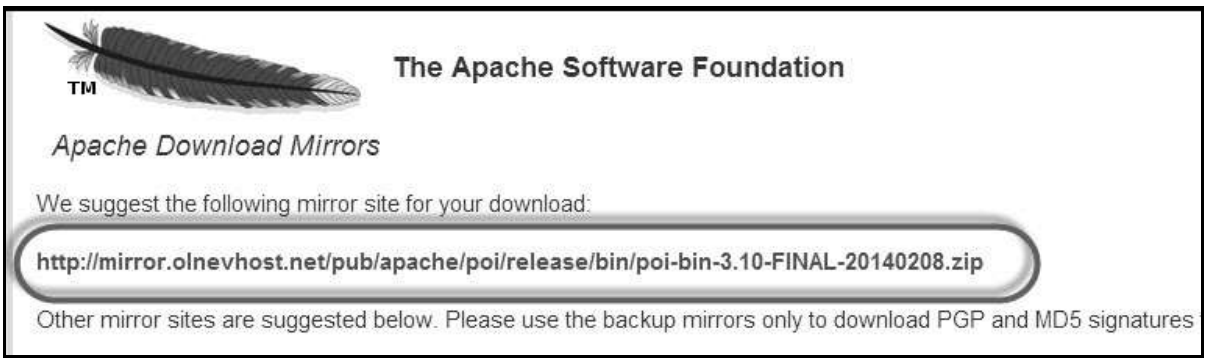
While designing a test, parameterizing the tests is inevitable. We will make use of Apache POI - Excel JAR's to achieve the same. It helps us read and write into Excel.

Download JAR

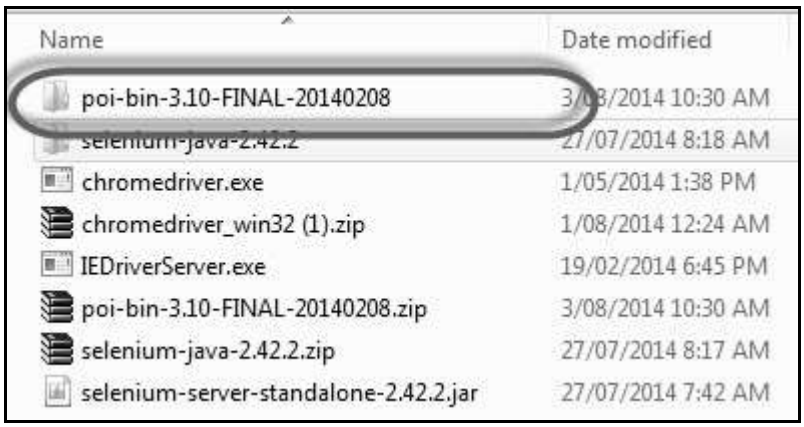
Step 1 : Navigate to the URL – http://poi.apache.org/download.html and download the ZIP format.



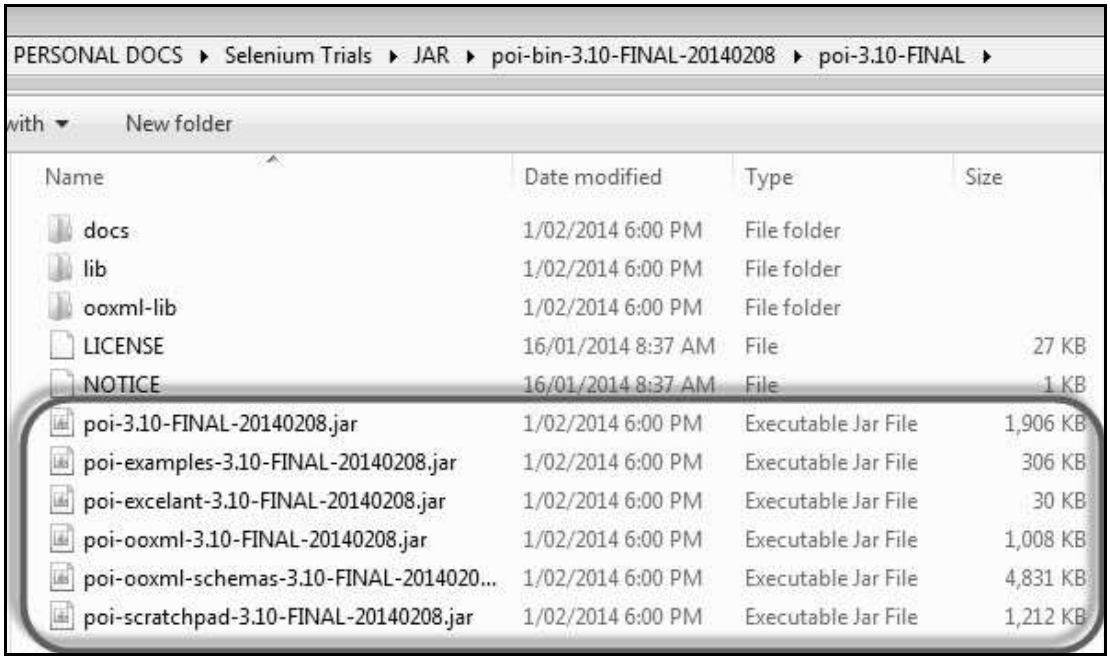
Step 2 : Click on the Mirror Link to download the JAR's.



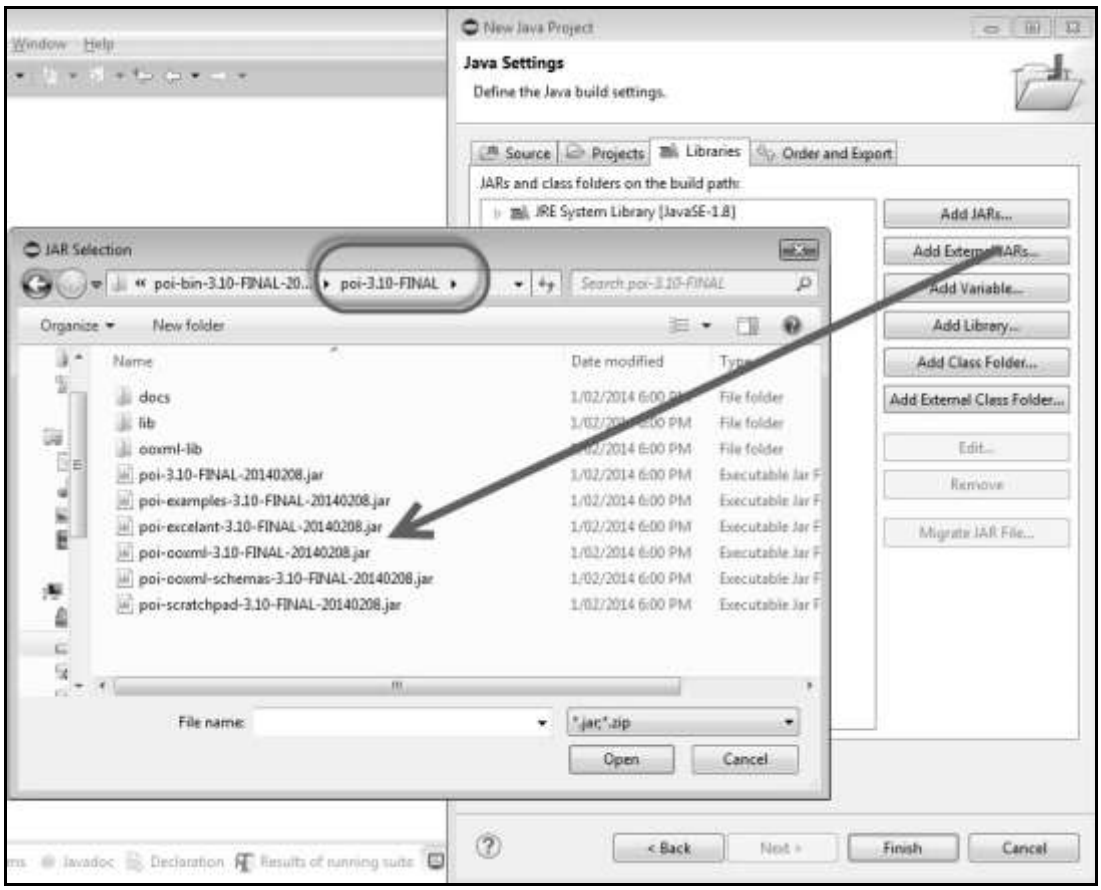
Step 3 : Unzip the contents to a folder.



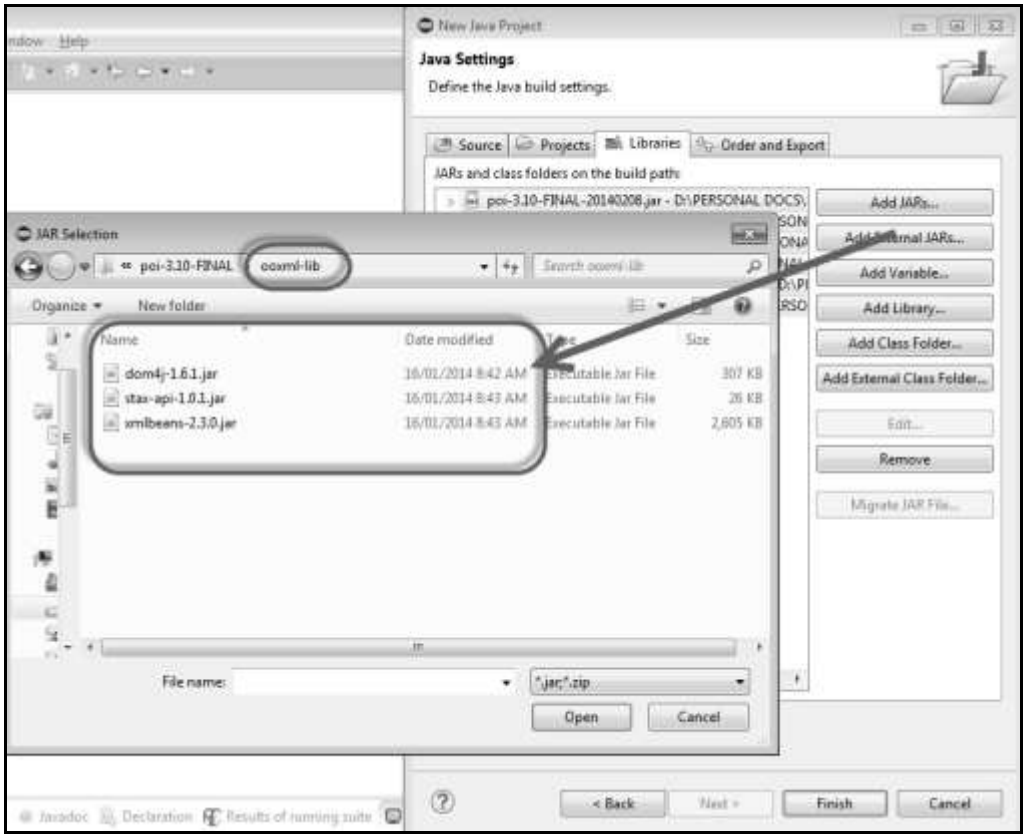
Step 4 : Unzipped contents would be displayed as shown below.



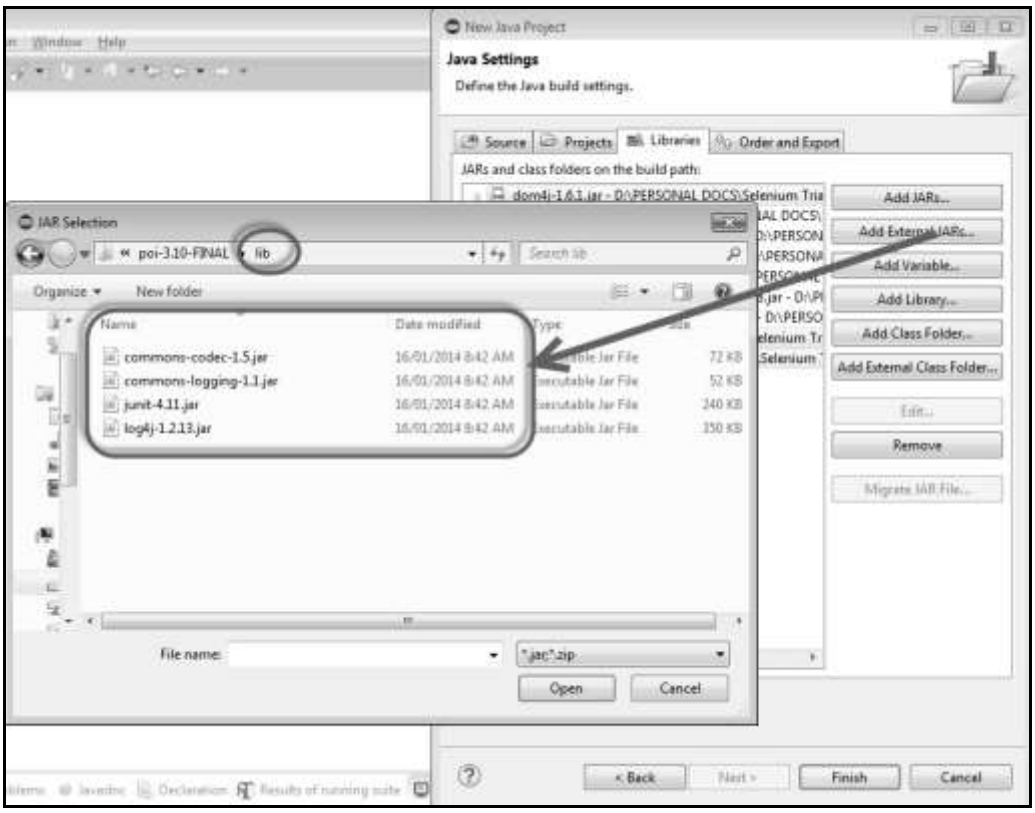
Step 5 : Now create a new project and add all the 'External JARs' under 'poi-3.10.FINAL' folder.



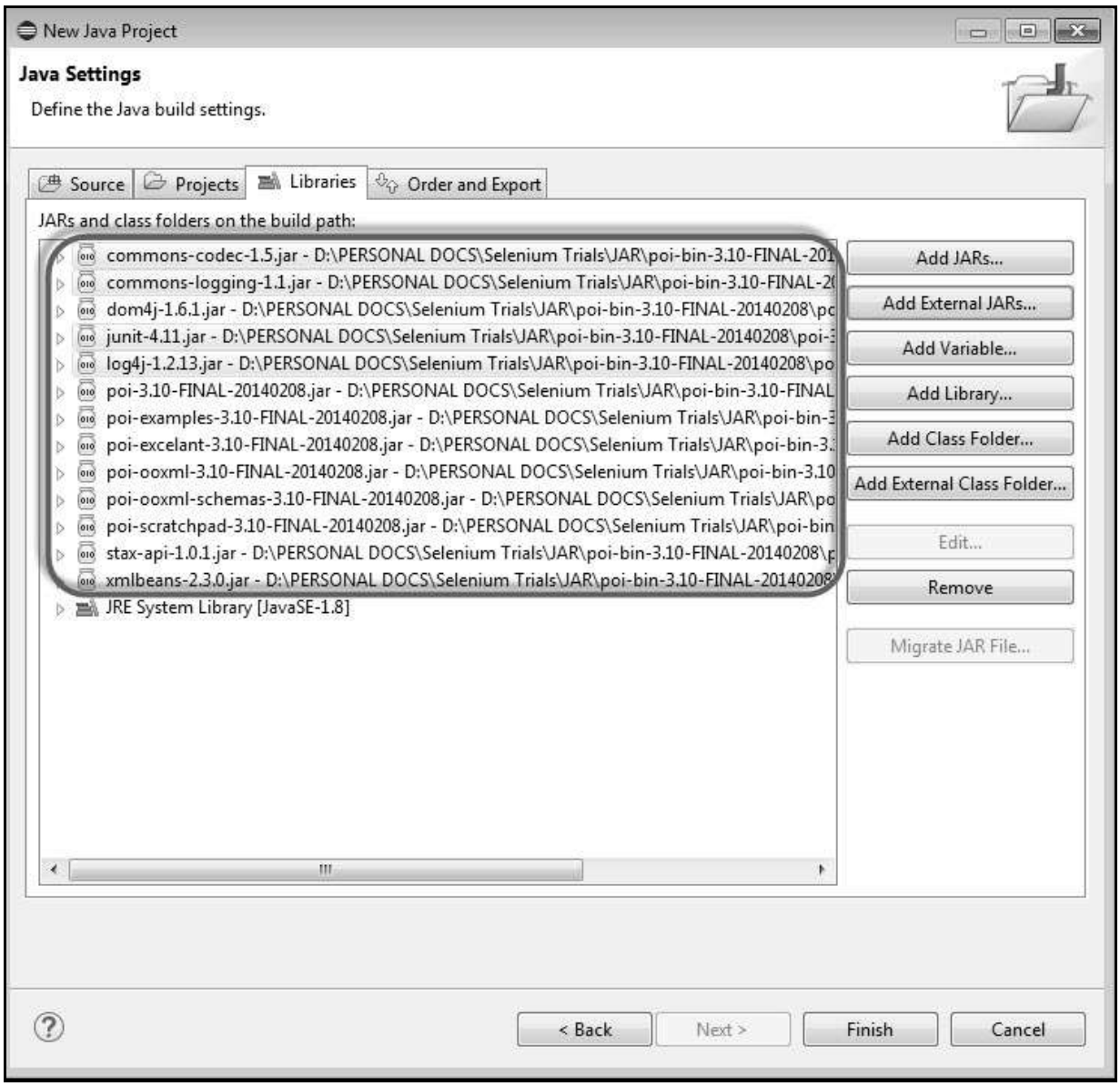
Step 6 : Now add all the 'External JARs' under the 'ooxml-lib' folder.



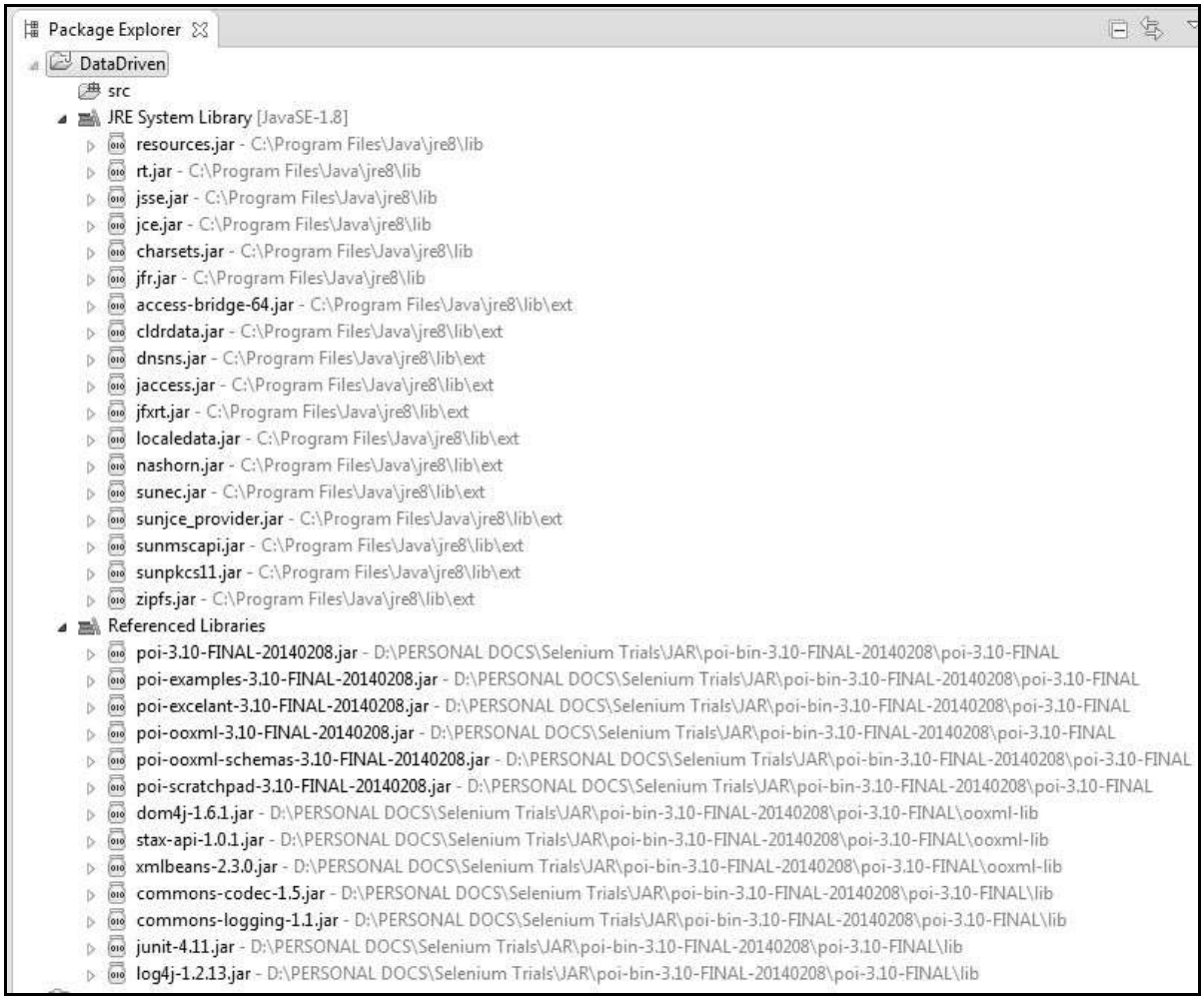
Step 7 : Now add all the 'External JARs' under the 'lib' folder.



Step 8 : The Added JAR is displayed as shown below.



Step 9 : The Package Explorer is displayed as shown below. Apart from that, add 'WebDriver' related JAR's



Parameterization

For demonstration, we will parameterize the percent calculator test.

Step 1 : We will parameterize all the inputs required for percent calculator using Excel. The designed Excel is shown below.

	A	B	C	D
1	**Test Name**	**Num1**	**Num2**	**Expected Result**
2	Percent Calculator	10.25	50.56	5.1824
3	Percent Calculator	20.55	40.66	8.35563
4	Percent Calculator	30	200.5	60.15
5	Percent Calculator	103.5	500	517.5
6				

Step 2 : Execute all the percent calculator functions for all the specified parameters.

Step 3 : Let us create generic methods to access the Excel file using the imported JARs. These methods help us get a particular cell data or to set a particular cell data, etc.

```
import java.io.*;
import org.apache.poi.xssf.usermodel.*;

public class excelutils
{
   private XSSFSheet ExcelWSheet;
   private XSSFWorkbook ExcelWBook;

   //Constructor to connect to the Excel with sheetname and Path
   public excelutils(String Path, String SheetName) throws Exception
   {
       try
       {
           // Open the Excel file
           FileInputStream ExcelFile = new FileInputStream(Path);

           // Access the required test data sheet
           ExcelWBook = new XSSFWorkbook(ExcelFile);
           ExcelWSheet = ExcelWBook.getSheet(SheetName);
       }
       catch (Exception e)
       {
          throw (e);
       }
   }

    // This method is to set the rowcount of the excel.
    public int excel_get_rows() throws Exception
    {
       try
       {
```

```
            return ExcelWSheet.getPhysicalNumberOfRows();
        }
        catch (Exception e)
        {
            throw (e);

        }
    }


    // This method to get the data and get the value as strings.
    public String getCellDataasstring(int RowNum, int ColNum) throws Exception
    {
        try
        {
            String CellData =
            ExcelWSheet.getRow(RowNum).getCell(ColNum).getStringCellValue();
            System.out.println("The value of CellData " + CellData);
            return CellData;
        }
        catch (Exception e)
        {
             return "Errors in Getting Cell Data";
        }
     }

     // This method to get the data and get the value as number.
     public double getCellDataasnumber(int RowNum, int ColNum) throws Exception
     {
        try
        {
          double CellData =
          ExcelWSheet.getRow(RowNum).getCell(ColNum).getNumericCellValue();
```

```
            System.out.println("The value of CellData " + CellData);
            return CellData;
            }

            catch (Exception e)
            {
                return 000.00;
            }
        }
}
```

Step 4 : Now add a main method which will access the Excel methods that we have developed.

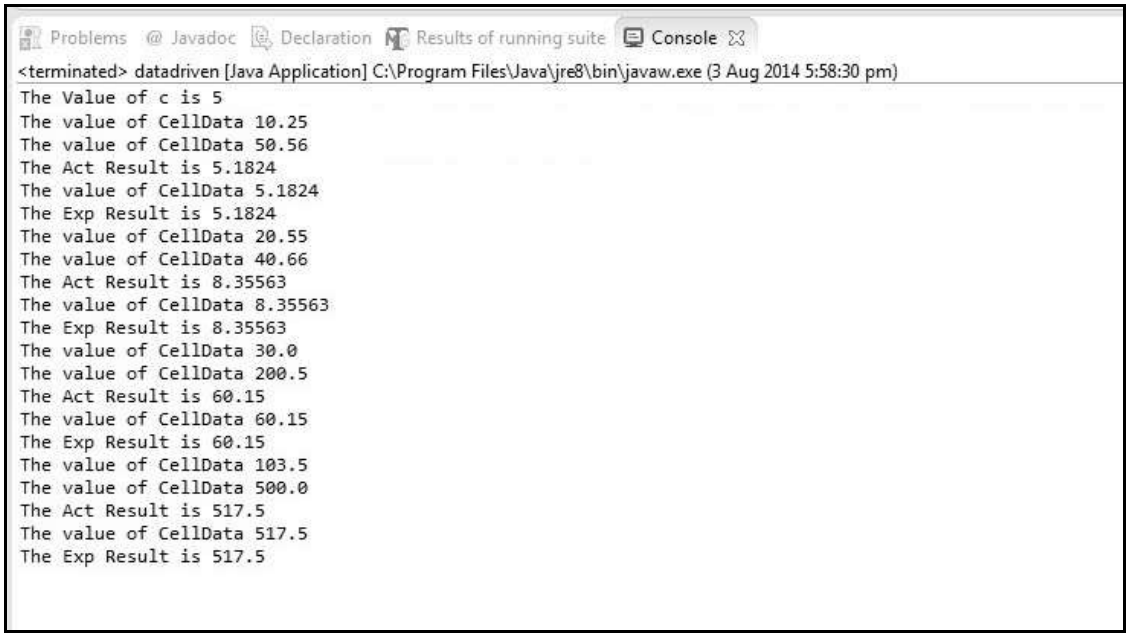
```
import java.io.*;
import org.apache.poi.xssf.usermodel.*;

public class excelutils
{
   private XSSFSheet ExcelWSheet;
   private XSSFWorkbook ExcelWBook;

   //Constructor to connect to the Excel with sheetname and Path
   public excelutils(String Path, String SheetName) throws Exception
   {
       try
       {
           // Open the Excel file
           FileInputStream ExcelFile = new FileInputStream(Path);
           // Access the required test data sheet
           ExcelWBook = new XSSFWorkbook(ExcelFile);
           ExcelWSheet = ExcelWBook.getSheet(SheetName);

        }
        catch (Exception e)
```

```
        {
            throw (e);
        }
    }

    // This method is to set the rowcount of the excel.
    public int excel_get_rows() throws Exception
    {
        try
        {
            return ExcelWSheet.getPhysicalNumberOfRows();
        }

        catch (Exception e)
        {
            throw (e);
        }
    }

    // This method to get the data and get the value as strings.
    public String getCellDataasstring(int RowNum, int ColNum) throws Exception
    {
        try
        {
            String CellData =
            ExcelWSheet.getRow(RowNum).getCell(ColNum).getStringCellValue();
            // Cell = ExcelWSheet.getRow(RowNum).getCell(ColNum);
            // String CellData = Cell.getStringCellValue();
            System.out.println("The value of CellData " + CellData);
            return CellData;
        }
        catch (Exception e)
        {
```

```
            return "Errors in Getting Cell Data";
        }
    }

     // This method to get the data and get the value as number.
     public double getCellDataasnumber(int RowNum, int ColNum) throws Exception
    {
        try
        {
            double CellData =
            ExcelWSheet.getRow(RowNum).getCell(ColNum).getNumericCellValue();
            // Cell = ExcelWSheet.getRow(RowNum).getCell(ColNum);
            // String CellData = Cell.getStringCellValue();
            System.out.println("The value of CellData " + CellData);
            return CellData;
        }
        catch (Exception e)
        {
            return 000.00;
        }
    }
}
```

Output

Upon executing the script, the output is displayed in the console as shown below.



Log4j Logging

Log4j is an audit logging framework that gives information about what has happened during execution. It offers the following advantages:

- Enables us to understand the application run.
- Log output can be saved that can be analyzed later.
- Helps in debugging, in case of test automation failures.
- Can also be used for auditing purposes to look at the application's health.

Components

1. Instance of Logger class.

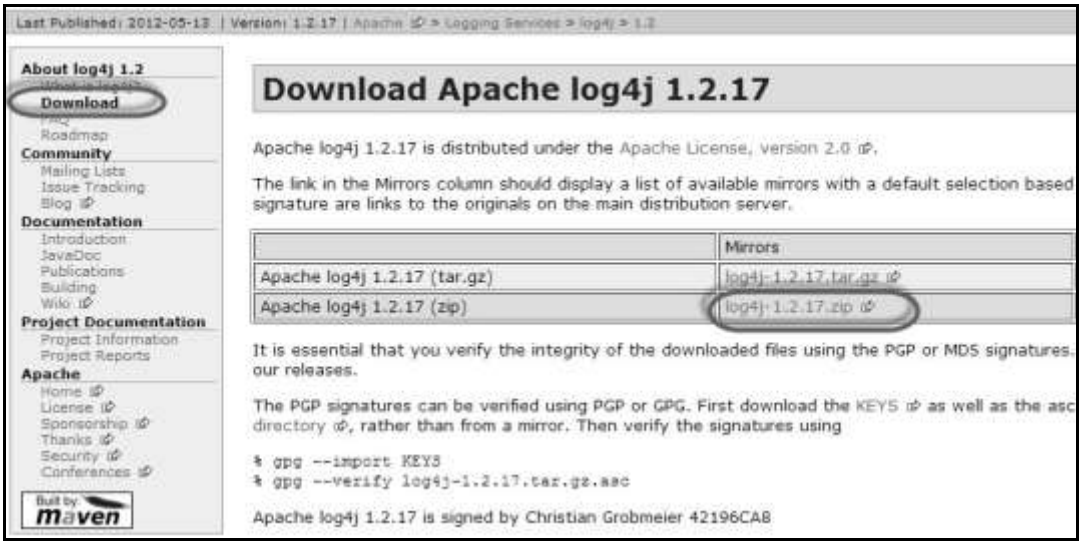
2. Log level methods used for logging the messages as one of the following:

- error
- warn
- info
- debug
- log

Example

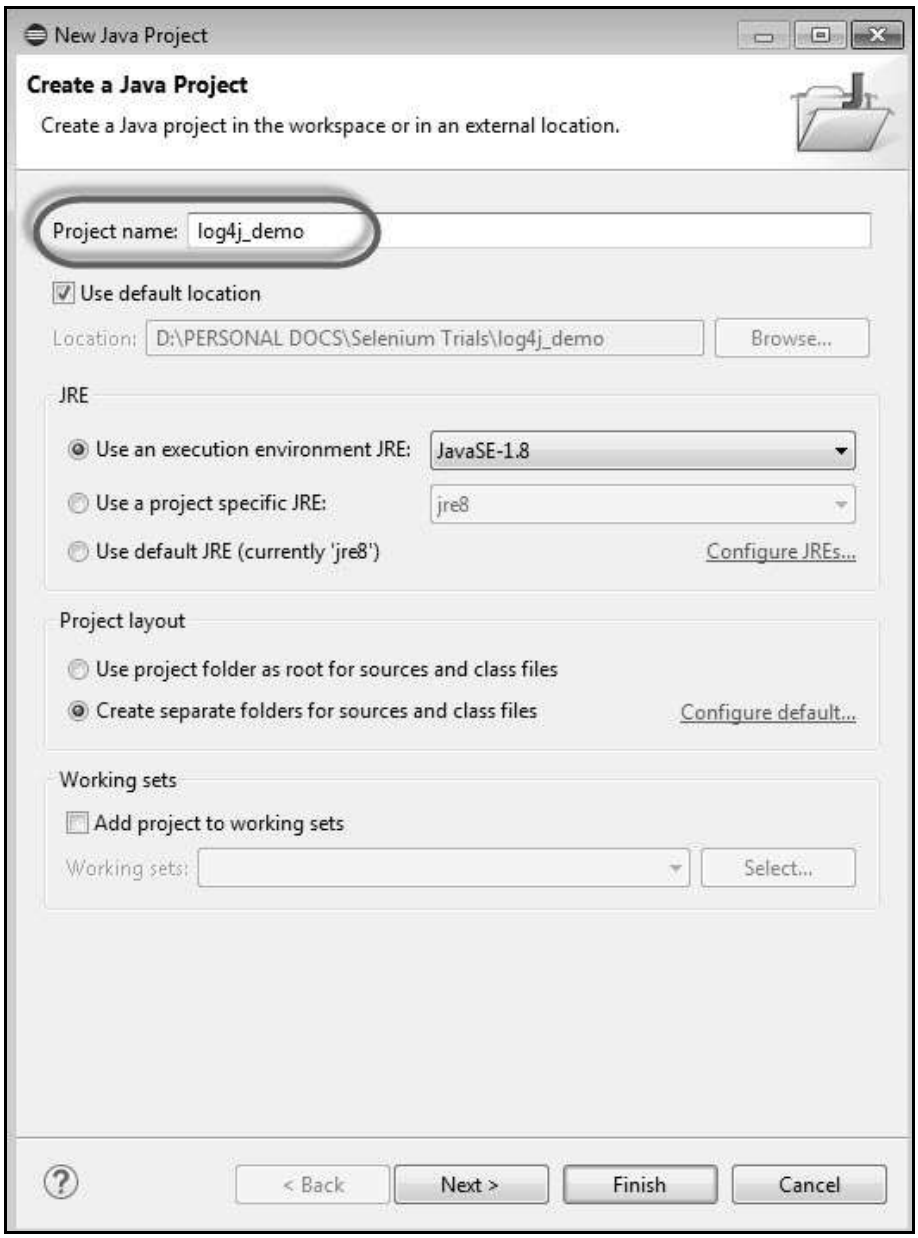
Let us use the same percent calculator for this demo.

Step 1 : Download log4j JAR file from https://logging.apache.org/log4j/1.2/download.html and download the Zipped format of the JAR file.

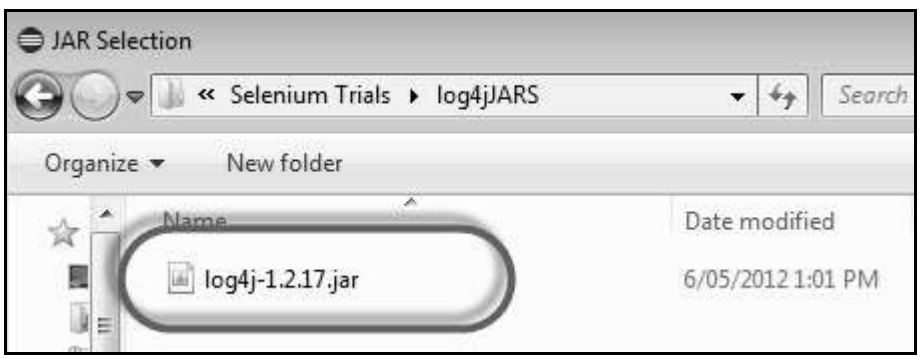


Step 2 : Create 'New Java Project' by navigating to the File menu.

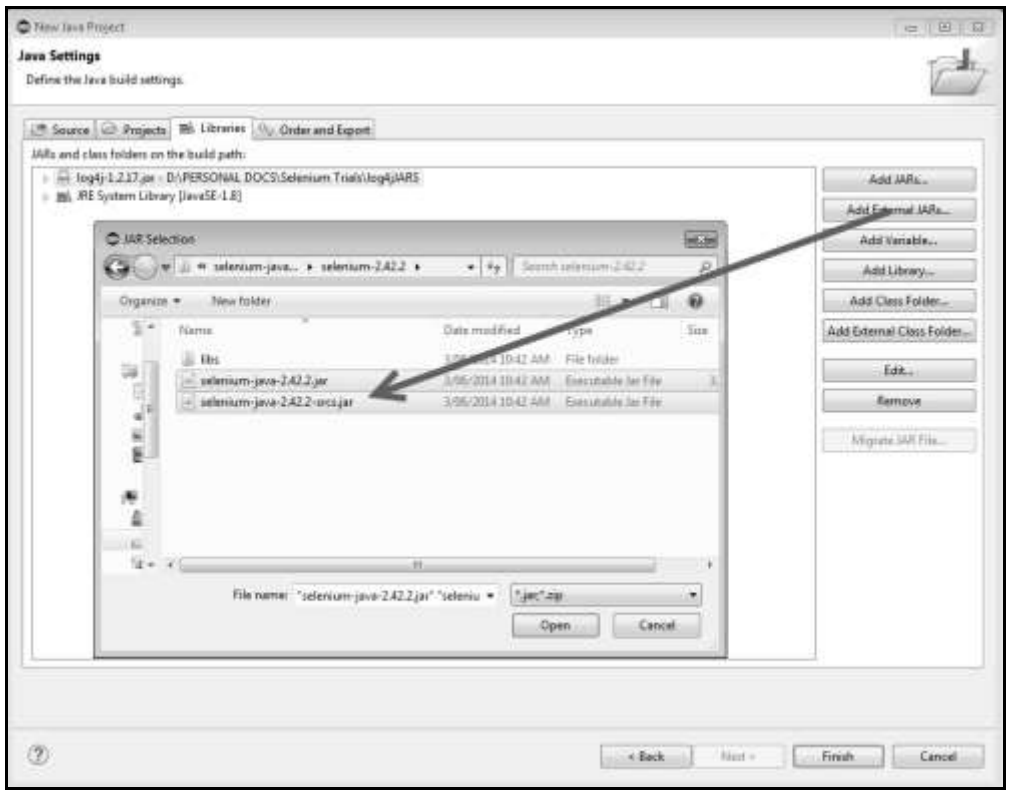
Step 3 : Enter the name of the project as 'log4j_demo' and click 'Next'.



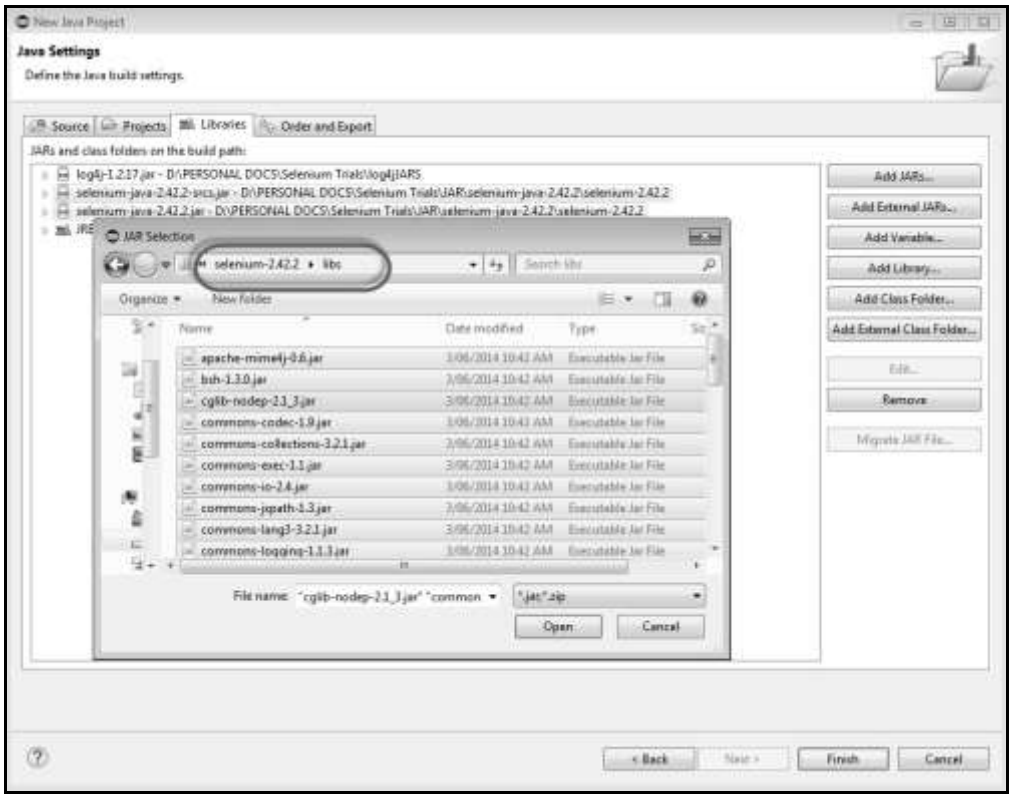
Step 4 : Click Add External Jar and add 'Log4j-1.2.17.jar'.



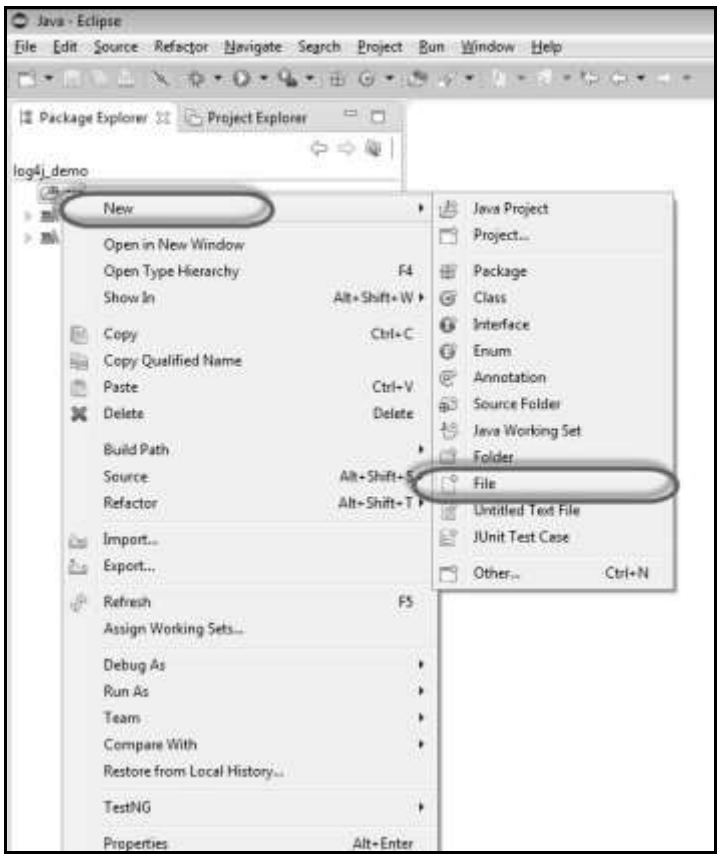
Step 5 : Click Add External Jar and add Selenium WebDriver Libraries.



Step 6 : Click Add External Jar and add Selenium WebDriver JAR's located in the Libs folder.



Step 7 : Add a New XML file using which we can specify the Log4j properties.



Step 8 : Enter the Logfile name as 'Log4j.xml'.

Step 9 : The final folder structure is shown below.

Step 10 : Now add the properties of Log4j which would be picked up during execution.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE log4j:configuration SYSTEM "log4j.dtd">
<log4j:configuration xmlns:log4j="http://jakarta.apache.org/log4j/"
debug="false">
     <appender name="fileAppender"
     class="org.apache.log4j.FileAppender">
         <param name="Threshold" value="INFO" />
         <param name="File" value="percent_calculator.log"/>
              <layout class="org.apache.log4j.PatternLayout">
              <param name="ConversionPattern" value="%d{yyyy-MM-dd
              HH:mm:ss}  [%c] (%t:%x) %m%n" />
              </layout>
     </appender>
     <root>
           <level value="INFO"/>
           <appender-ref ref="fileAppender"/>
     </root>
</log4j:configuration>
```

Step 11 : Now for demonstration purpose, we will incorporate log4j in the same test that we have been performing (percent calculator). Add a class file in the 'Main' function.

```
package log4j_demo;
import org.apache.log4j.LogManager;
import org.apache.log4j.Logger;
import org.apache.log4j.xml.DOMConfigurator;
```

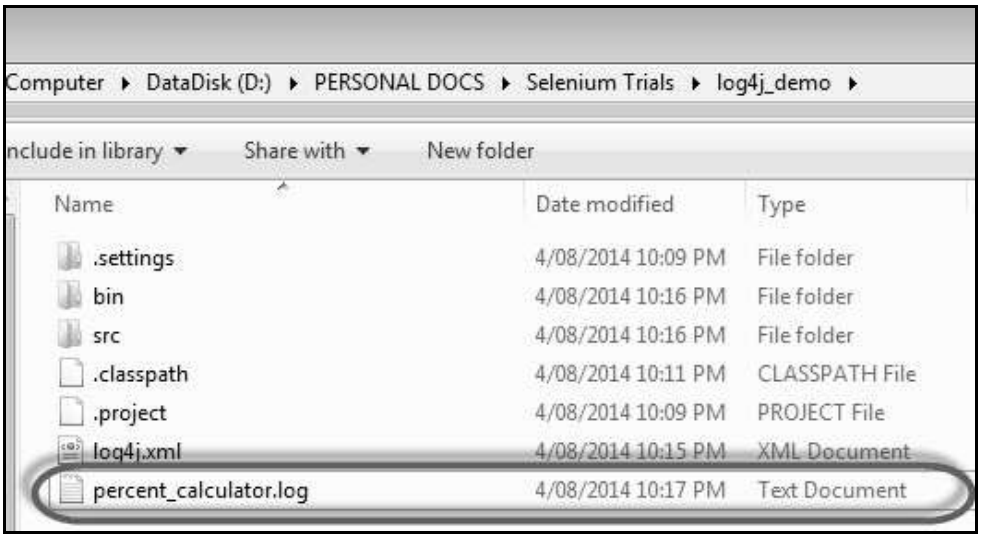
```
import java.util.concurrent.TimeUnit;
import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;

public class log4j_demo
{

    static final Logger logger =
    LogManager.getLogger(log4j_demo.class.getName());

    public static void main(String[] args)
    {
    DOMConfigurator.configure("log4j.xml");

    logger.info("# # # # # # # # # # # # # # # # # # # # # # # # # # # # # ");
    logger.info("TEST Has Started");

    WebDriver driver = new FirefoxDriver();

    // Puts an Implicit wait, Will wait for 10 seconds
    // before throwing exception
    driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);

    // Launch website
    driver.navigate().to("http://www.calculator.net/");
    logger.info("Open Calc Application");

    // Maximize the browser
    driver.manage().window().maximize();

    // Click on Math Calculators
    driver.findElement(By.xpath(".//*[@id='menu']/div[3]/a")).click();
```

```
logger.info("Clicked Math Calculator Link");

// Click on Percent Calculators
driver.findElement(By.xpath(".//*[@id='menu']/div[4]/div[3]/a"))
.click(); logger.info("Clicked Percent Calculator Link");

// Enter value 10 in the first number of the percent Calculator
driver.findElement(By.id("cpar1")).sendKeys("10");
logger.info("Entered Value into First Text Box");



// Enter value 50 in the second number of the percent Calculator
driver.findElement(By.id("cpar2")).sendKeys("50");
logger.info("Entered Value into Second Text Box");

// Click Calculate Button
driver.findElement(By.xpath(".//*[@id='content']/table
/tbody/tr/td[2]/input")).click();
logger.info("Click Calculate Button");

// Get the Result Text based on its xpath
String result =
driver.findElement(By.xpath(".//*[@id='content']
/p[2]/span/font/b")).getText();
logger.info("Get Text Value");

// Print a Log In message to the screen
logger.info(" The Result is " + result);

if(result.equals("5"))
{
    logger.info("The Result is Pass");
```

```
    }
    else
    {
        logger.error("TEST FAILED. NEEDS INVESTIGATION");
    }

    logger.info("# # # # # # # # # # # # # # # # # # # # # # # # # # # # ");

    // Close the Browser.
    driver.close();
  }
}
```

Execution

Upon execution, the log file is created on the root folder as shown below. You CANNOT locate the file in Eclipse. You should open 'Windows Explorer' to show the same.



The contents of the file is shown below.

```
2014-08-04 22:17:22  [log4j_demo.log4j_demo] (main:) # # # # # # # # # # # # # # # # # # # # # # # # # # # #
2014-08-04 22:17:22  [log4j_demo.log4j_demo] (main:) TEST Has Started
2014-08-04 22:17:31  [log4j_demo.log4j_demo] (main:) Open Calc Application
2014-08-04 22:17:33  [log4j_demo.log4j_demo] (main:) Clicked Math Calculator Link
2014-08-04 22:17:33  [log4j_demo.log4j_demo] (main:) Clicked Percent Calculator Link
2014-08-04 22:17:34  [log4j_demo.log4j_demo] (main:) Entered Value into First Text Box
2014-08-04 22:17:35  [log4j_demo.log4j_demo] (main:) Entered Value into Second Text Box
2014-08-04 22:17:35  [log4j_demo.log4j_demo] (main:) Click Calculate Button
2014-08-04 22:17:36  [log4j_demo.log4j_demo] (main:) Get Text Value
2014-08-04 22:17:36  [log4j_demo.log4j_demo] (main:)  The Result is 5
2014-08-04 22:17:36  [log4j_demo.log4j_demo] (main:) The Result is Pass
2014-08-04 22:17:36  [log4j_demo.log4j_demo] (main:) # # # # # # # # # # # # # # # # # # # # # # # # # # # #
```

Exception Handling

When we are developing tests, we should ensure that the scripts can continue their execution even if the test fails. An unexpected exception would be thrown if the worst case scenarios are not handled properly.

If an exception occurs due to an element not found or if the expected result doesn't match with actuals, we should catch that exception and end the test in a logical way rather than terminating the script abruptly.

Syntax

The actual code should be placed in the try block and the action after exception should be placed in the catch block. Note that the 'finally' block executes regardless of whether the script had thrown an exception or NOT.

```
try
{
   // Perform Action
}
catch(ExceptionType1 exp1)
{
   // Catch block 1
}
catch(ExceptionType2 exp2)
{
   // Catch block 2
}
catch(ExceptionType3 exp3)
{
   // Catch block 3
}
finally
{
   // The finally block always executes.
}
```

Example

If an element is not found (due to some reason), we should step out of the function smoothly. So we always need to have a try-catch block if we want to exit smoothly from a function.

```
public static WebElement lnk_percent_calc(WebDriver driver)throws Exception
{
  try
  {
     element =
     driver.findElement(By.xpath(".//*[@id='menu']/div[4]/div[3]/a"));
     return element;
  }
  catch (Exception e1)
  {
     // Add a message to your Log File to capture the error
     Logger.error("Link is not found.");

     // Take a screenshot which will be helpful for analysis.
     File screenshot =
     ((TakesScreenshot)driver).getScreenshotAs(OutputType.FILE);

     FileUtils.copyFile(screenshot, new
     File("D:\\framework\\screenshots.jpg"));

     throw(e1);
  }
}
```

Multi Browser Testing

Users can execute scripts in multiple browsers simultaneously. For demonstration, we will use the same scenario that we had taken for Selenium Grid. In the Selenium Grid example, we had executed the scripts remotely; here we will execute the scripts locally.

First of all, ensure that you have appropriate drivers downloaded. Please refer the chapter "Selenium Grid" for downloading IE and Chrome drivers.

Example

For demonstration, we will perform percent calculator in all the browsers simultaneously.

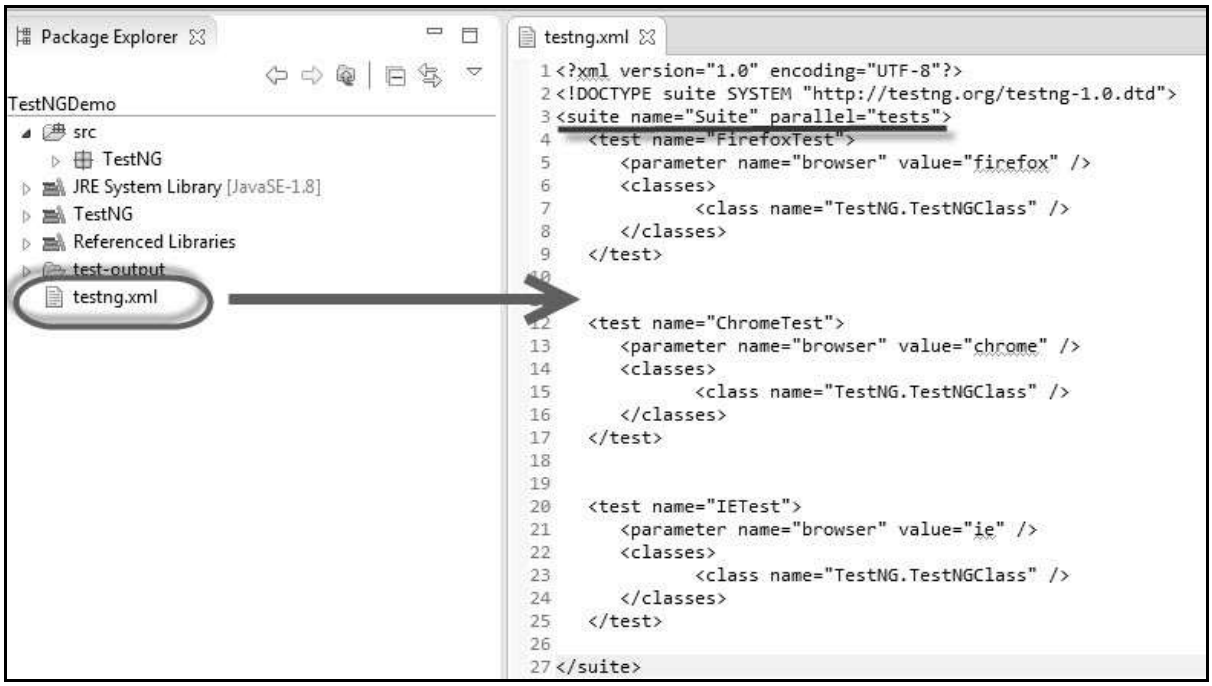
```
package TestNG;

import org.openqa.selenium.chrome.ChromeDriver;
import org.openqa.selenium.firefox.FirefoxDriver;
import org.openqa.selenium.ie.InternetExplorerDriver;
import java.util.concurrent.TimeUnit;
import org.openqa.selenium.*;
import org.testng.annotations.*;

public class TestNGClass
{
  private WebDriver driver;
  private String URL = "http://www.calculator.net";

  @Parameters("browser")
  @BeforeTest
  public void launchapp(String browser)
  {

   if (browser.equalsIgnoreCase("firefox"))
   {
      System.out.println(" Executing on FireFox");
      driver = new FirefoxDriver();
      driver.get(URL);
      driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);
      driver.manage().window().maximize();
   }
   else if (browser.equalsIgnoreCase("chrome"))
```

```
   {
      System.out.println(" Executing on CHROME");
      System.out.println("Executing on IE");
      System.setProperty("webdriver.chrome.driver",
      "D:\\chromedriver.exe");
      driver = new ChromeDriver();
      driver.get(URL);
      driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);
      driver.manage().window().maximize();
   }
   else if (browser.equalsIgnoreCase("ie"))
   {
      System.out.println("Executing on IE");
      System.setProperty("webdriver.ie.driver",
      "D:\\IEDriverServer.exe");
      driver = new InternetExplorerDriver();
      driver.get(URL);
      driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);
      driver.manage().window().maximize();
   }
   else
   {
       throw new IllegalArgumentException("The Browser Type is Undefined");
   }
}

 @Test
 public void calculatepercent()
 {
    // Click on Math Calculators
    driver.findElement(By.xpath(".//*[@id='menu']/div[3]/a")).click();

    // Click on Percent Calculators
    driver.findElement(By.xpath(".//*[@id='menu']/div[4]/div[3]/a")).click();
```

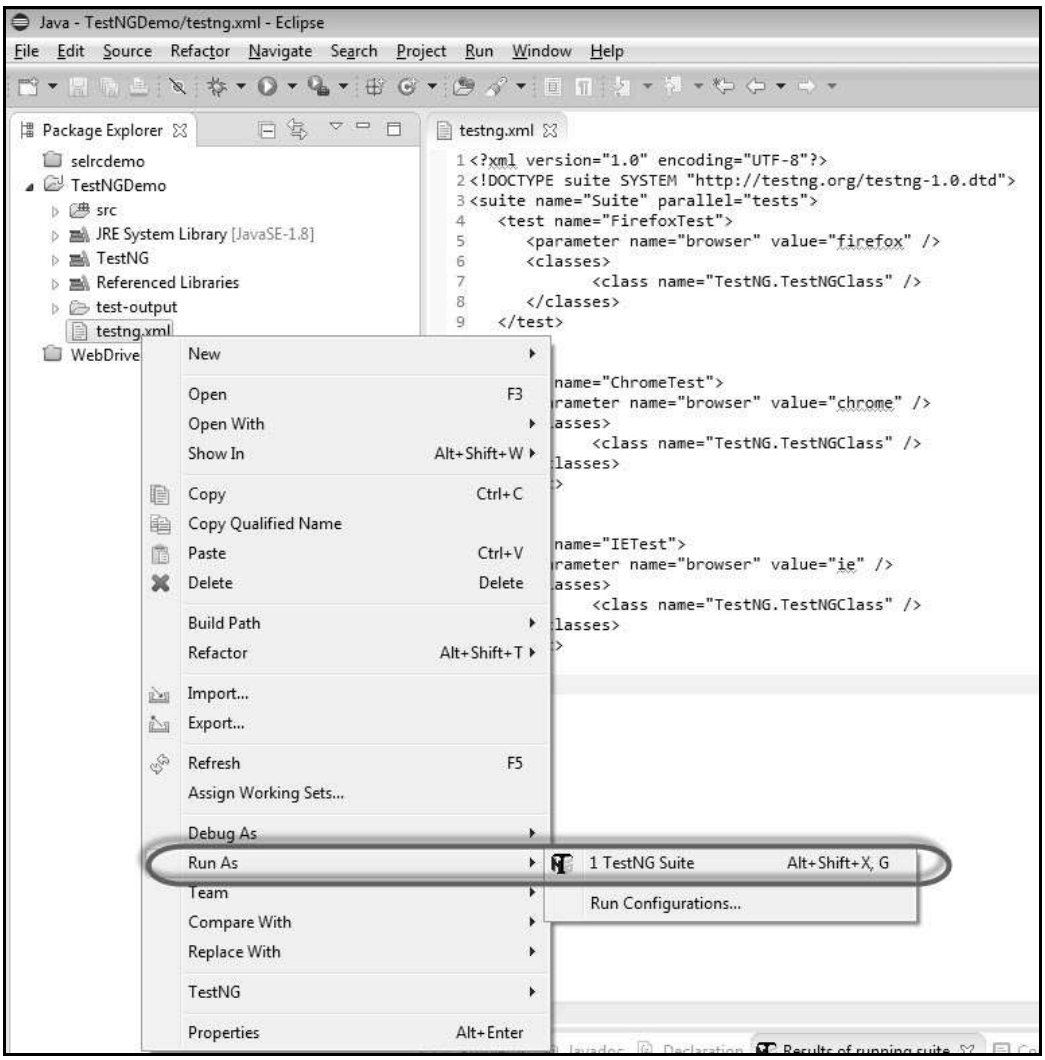
```
    // Enter value 10 in the first number of the percent Calculator
    driver.findElement(By.id("cpar1")).sendKeys("10");

    // Enter value 50 in the second number of the percent Calculator
    driver.findElement(By.id("cpar2")).sendKeys("50");

    // Click Calculate Button
    driver.findElement(By.xpath(".//*[@id='content']/table/tbody/
    tr/td[2]/input")).click();

    // Get the Result Text based on its xpath
    String result =
    driver.findElement(By.xpath(".//*[@id='content']/p[2]/span
    /font/b")).getText();

    // Print a Log In message to the screen
    System.out.println(" The Result is " + result);

    if(result.equals("5"))
    {
          System.out.println(" The Result is Pass");
    }
    else
    {
    System.out.println(" The Result is Fail");
    }
}

@AfterTest
public void closeBrowser()
{
      driver.close();
```

```
   }
}
```

Create an XML which will help us in parameterizing the browser name and don't forget to mention parallel="tests" in order to execute in all the browsers simultaneously.



Execute the script by performing right-click on the XML file and select 'Run As' >> 'TestNG' Suite as shown below.



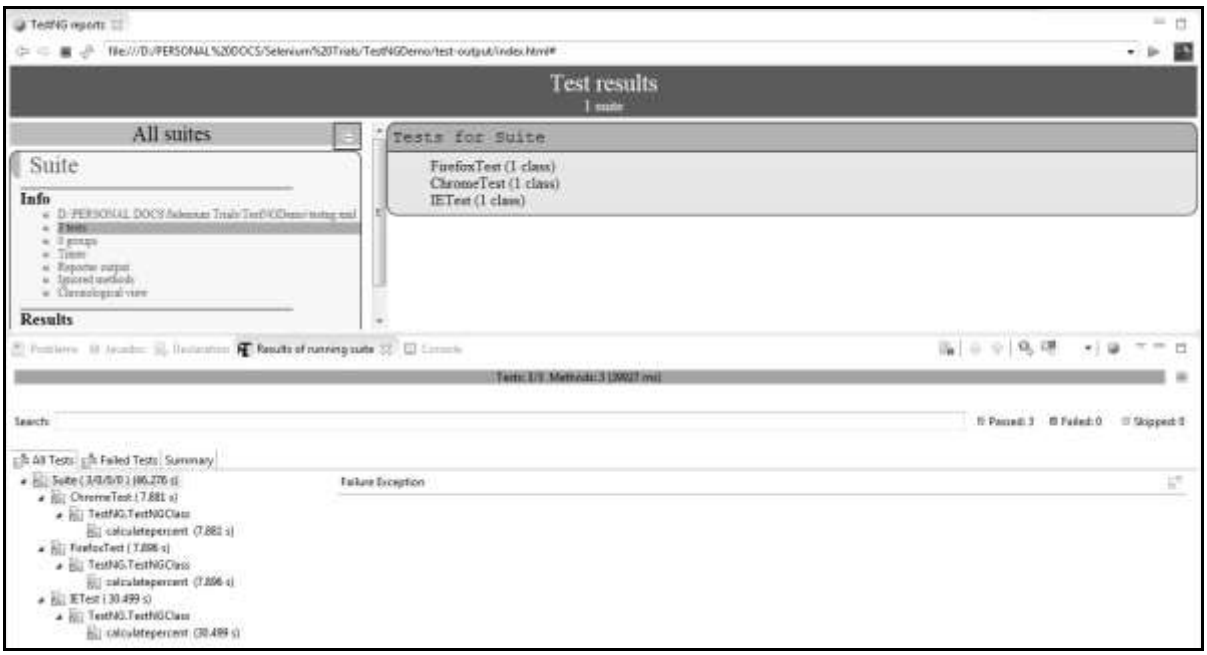
Output

All the browsers would be launched simultaneously and the result would be printed in the console.

Note : To execute on IE successfully, ensure that the check box 'Enable Protected Mode' under the security tab of 'IE Option' is either checked or unchecked across all zones.

```
Problems  @ Javadoc  Declaration  Results of running suite  Console
<terminated> testng.xml [TestNG] C:\Program Files\Java\jre8\bin\javaw.exe (5 Aug 2014 12:56:29 am)
[TestNG] Running:
  D:\PERSONAL DOCS\Selenium Trials\TestNGDemo\testng.xml

 Executing on CHROME
Executing on IE
Executing on IE
 Executing on FireFox
Starting ChromeDriver (v2.10.267521) on port 37977
Only local connections are allowed.
Started InternetExplorerDriver server (64-bit)
2.40.0.0
Listening on port 15717
 The Result is 5
 The Result is Pass
 The Result is 5
 The Result is Pass
 The Result is 5
 The Result is Pass

===============================================
Suite
Total tests run: 3, Failures: 0, Skips: 0
===============================================
```

TestNG results can be viewed in HTML format for detailed analysis.



Capture Screenshots

This functionality helps to grab screenshots at runtime when required, in particularly when a failure happens. With the help of screenshots and log messages, we will be able to analyze the results better.

Screenshots are configured differently for local executions and Selenium Grid (remote) executions. Let us take a look at each one them with an example.

Localhost Execution

In the following example, we will take a screenshot after calculating the percentage. Ensure that you give a valid path to save the screenshot.

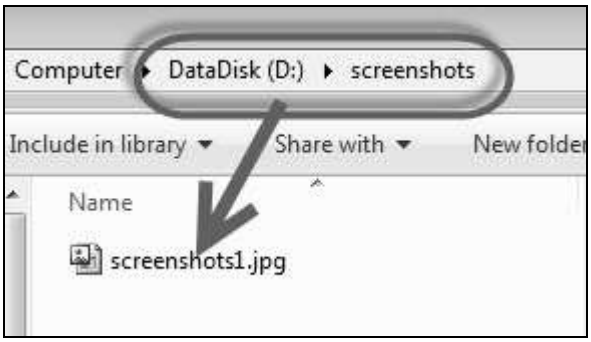
```
import java.io.File;
import java.io.IOException;
import java.util.concurrent.TimeUnit;

import org.apache.commons.io.FileUtils;
import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;

public class webdriverdemo
{
  public static void main(String[] args) throws IOException
  {
     WebDriver driver = new FirefoxDriver();

     // Puts an Implicit wait, Will wait for 10 seconds
     // before throwing exception
     driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);

     // Launch website
     driver.navigate().to("http://www.calculator.net/");

     // Maximize the browser
     driver.manage().window().maximize();
```

```
    // Click on Math Calculators
    driver.findElement(By.xpath(".//*[@id='menu']/div[3]/a")).click();

    // Click on Percent Calculators
    driver.findElement(By.xpath(".//*[@id='menu']/div[4]/div[3]/a")).click();

    // Enter value 10 in the first number of the percent Calculator
    driver.findElement(By.id("cpar1")).sendKeys("10");

    // Enter value 50 in the second number of the percent Calculator
    driver.findElement(By.id("cpar2")).sendKeys("50");

    // Click Calculate Button
    driver.findElement(By.xpath(".//*[@id='content']/table
    /tbody/tr/td[2]/input")).click();

    // Get the Result Text based on its xpath
    String result =
    driver.findElement(By.xpath(".//*[@id='content']/p[2]
    /span/font/b")).getText();

    File screenshot =
    ((TakesScreenshot)driver).getScreenshotAs(OutputType.FILE);

    FileUtils.copyFile(screenshot, new
    File("D:\\screenshots\\screenshots1.jpg"));

    // Print a Log In message to the screen
    System.out.println(" The Result is " + result);

    // Close the Browser.
    driver.close();
}
```

```
}
```

Output

Upon executing the script, the screenshot is saved in the 'D:\screenshots' folder with the name 'screenshots1.jpg' as shown below.



Selenium Grid – Screenshot Capture

While working with Selenium Grids, we should ensure that we are taking the screenshots correctly from the remote system. We will use augmented driver.

Example

We will execute the script on a Firefox node attached to a hub. For more on configuring hub and nodes, please refer the **Selenium Grids** chapter.

```
package TestNG;


import org.openqa.selenium.remote.Augmenter;
import org.openqa.selenium.remote.DesiredCapabilities;
import org.openqa.selenium.TakesScreenshot;
import java.util.concurrent.TimeUnit;
import org.openqa.selenium.*;
import org.testng.annotations.AfterTest;
import org.testng.annotations.BeforeTest;
import org.testng.annotations.Parameters;
import org.testng.annotations.Test;
import java.io.File;
import java.net.URL;
import java.net.MalformedURLException;
import org.apache.commons.io.FileUtils;
```

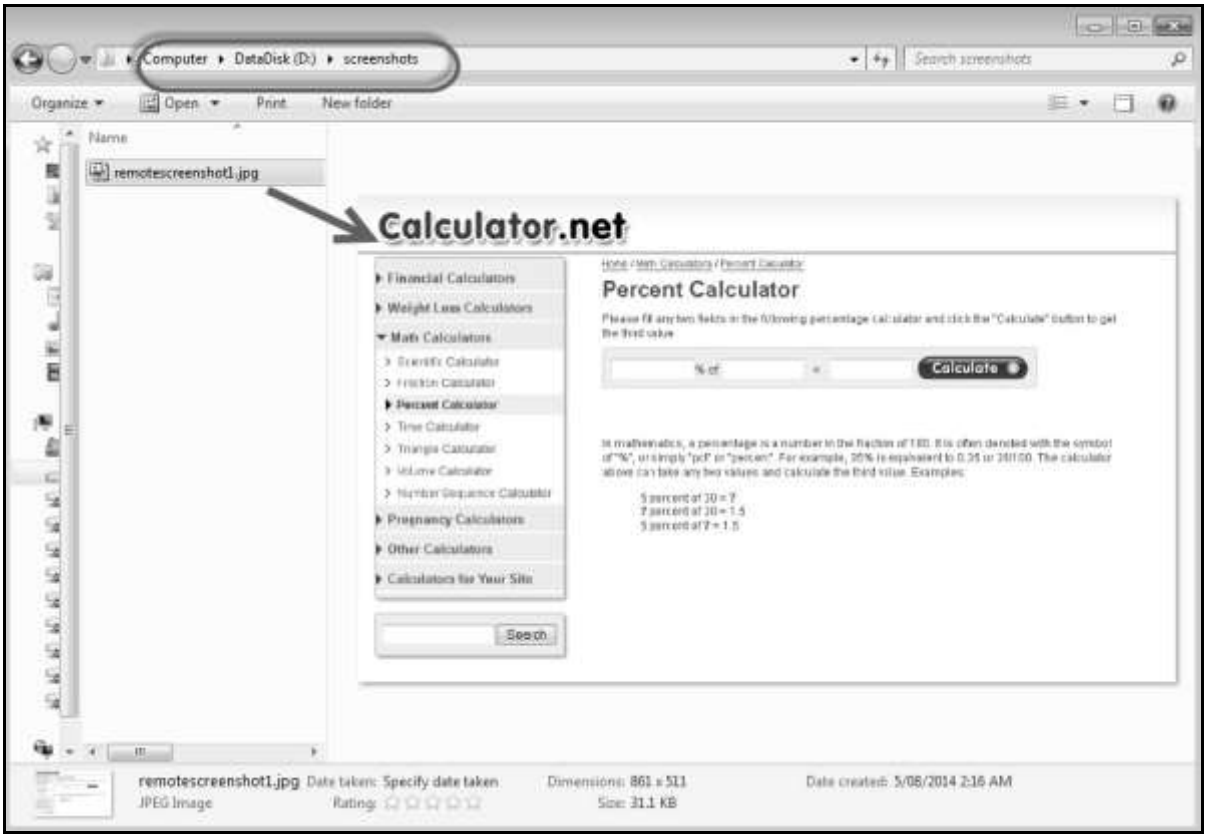
```
import org.openqa.selenium.remote.RemoteWebDriver;
import java.io.IOException;

public class TestNGClass
{
  public WebDriver driver;
  public String URL, Node;
  protected ThreadLocal<RemoteWebDriver> threadDriver = null;

  @Parameters("browser")
  @BeforeTest
  public void launchapp(String browser) throws MalformedURLException
  {
   String URL = "http://www.calculator.net";
   if (browser.equalsIgnoreCase("firefox"))
   {
      System.out.println(" Executing on FireFox");
      String Node = "http://10.112.66.52:5555/wd/hub";
      DesiredCapabilities cap = DesiredCapabilities.firefox();
      cap.setBrowserName("firefox");

      driver = new RemoteWebDriver(new URL(Node), cap);
      // Puts an Implicit wait, Will wait for 10 seconds
      // before throwing exception
      driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);

      // Launch website
      driver.navigate().to(URL);
      driver.manage().window().maximize();
   }
   else
   {
     throw new IllegalArgumentException("The Browser Type is
```

```
    Undefined");
   }
}


 @Test
 public void calculatepercent() throws IOException
 {
    // Click on Math Calculators
    driver.findElement(By.xpath(".//*[@id='menu']/div[3]/a")).click();

    // Click on Percent Calculators
    driver.findElement(By.xpath(".//*[@id='menu']/div[4]/div[3]/a")).click();

    // Make use of augmented Driver to capture Screenshots.
    WebDriver augmentedDriver = new Augmenter().augment(driver);
    File screenshot =
    ((TakesScreenshot)augmentedDriver).getScreenshotAs(OutputType.FILE);

    FileUtils.copyFile(screenshot, new
    File("D:\\screenshots\\remotescreenshot1.jpg"));

    // Screenshot would be saved on the system where the script is
    // executed and NOT on remote machine.

    // Enter value 10 in the first number of the percent Calculator
    driver.findElement(By.id("cpar1")).sendKeys("10");

    // Enter value 50 in the second number of the percent Calculator
    driver.findElement(By.id("cpar2")).sendKeys("50");

    // Click Calculate Button
    driver.findElement(By.xpath(".//*[@id='content']/table/tbody
    /tr/td[2]/input")).click();
```

```
    // Get the Result Text based on its xpath
    String result =
    driver.findElement(By.xpath(".//*[@id='content']/p[2]
    /span/font/b")).getText();

    // Print a Log In message to the screen
    System.out.println(" The Result is " + result);

    if(result.equals("5"))
    {
          System.out.println(" The Result is Pass");
    }
    else
    {
          System.out.println(" The Result is Fail");
    }
  }

  @AfterTest
  public void closeBrowser()
  {
     driver.quit();
  }
}
```

Output

Upon executing the script, the screenshot is captured and saved in the specified location as shown below.



Capturing Videos

Sometimes we may not be able to analyze the failures just with the help of a log file or a screenshot. At times, it helps to capture the complete execution as a video. Let us understand how to capture videos.

We will make use of Monte Media Library to perform this operation.

Configuration

Step 1 : Navigate to the URL - http://www.randelshofer.ch/monte/index.html and download the screen recorder JAR as shown below.

Monte Media Library

The Monte Media Library is a Java library for processing media data. Supported media formats include still images, video, audio and meta-data.

This is an *experimental* library for my personal studies!

This library has some overlap in functionality with the Java Media Framework (JMF). For some codecs, the Monte Media Library provides wrappers, which allow to use them with JMF. However, in general, Monte Media is not compatible with JMF.

Demo Applications

Most demos consist of an executable JAR file which also includes the source code. On some platforms, you can double click the JAR file to execute the demo, on others, you can start it with the command `java -jar nameofdemo.jar`

To get the source code, rename the file to `nameofdemo.zip` and unzip it.

Screen Recorder

Creates a screen recording with audio and stores it in a movie file.

The demo code is located in the package org.monte.screenrecorder

MonteScreenRecorder.jar

Click the launch button to start the recorder:

Launch

Movie Converter

Converts a movie from one file format into another.

This advanced demo demonstrates the use of codec chains, and the ability for processing stereo videos created with the Fujifilm Real 3D W1 camera.

Click the launch button to start the demo:

Launch

Movie Maker

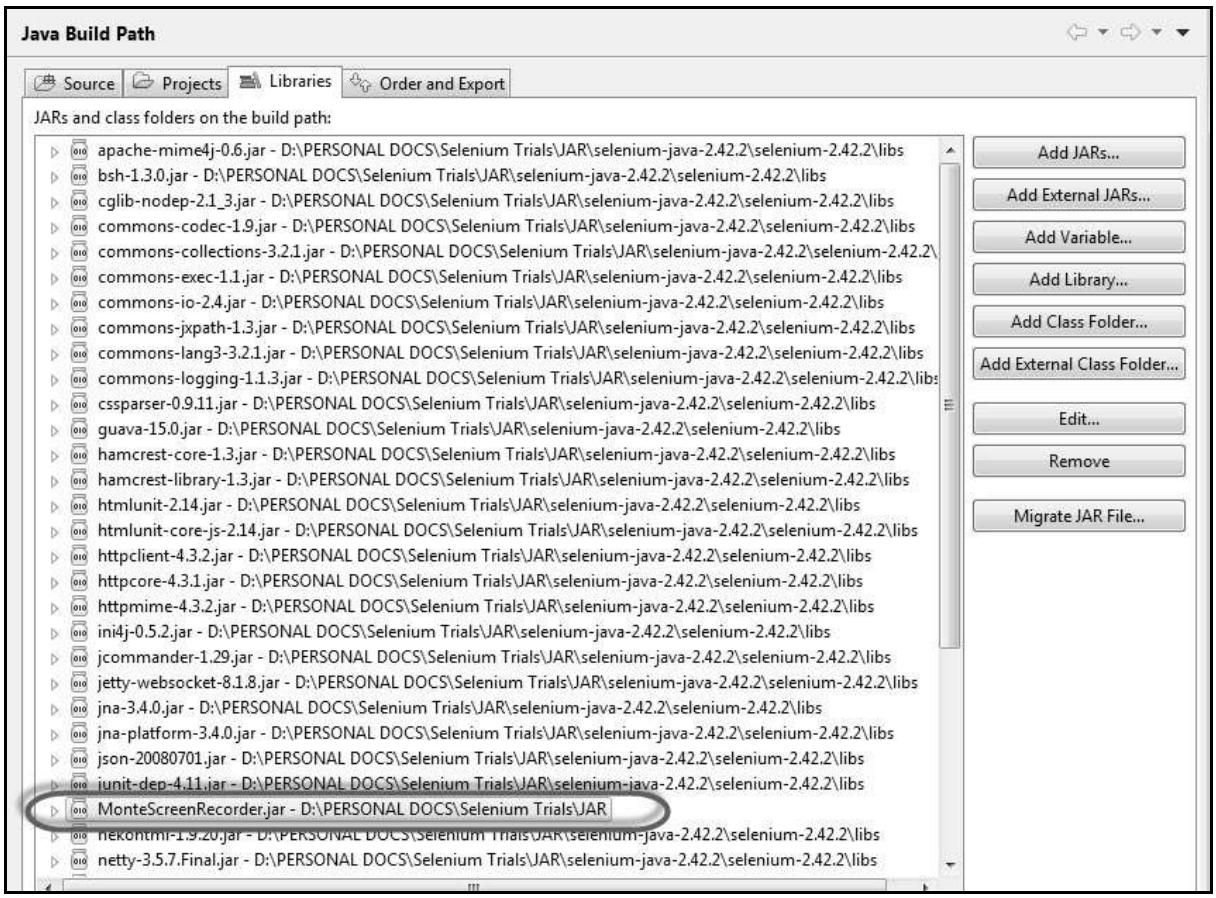
This demo creates a QuickTime movie from a folder with image files and an audio file.

The movie is written with the QuickTimeWriter class.

The demo code is located in the class org.monte.moviemaker.MovieMakerMain

MovieMaker.jar

Step 2 : After downloading, add the JAR file to the Libraries of the current project.



Step 3 : We will use Java's AWT package to initialize the graphics configuration.

```
GraphicsConfiguration gc = GraphicsEnvironment
  .getLocalGraphicsEnvironment()
  .getDefaultScreenDevice()
  .getDefaultConfiguration();
```

Step 4 : An instance of ScreenRecorder is created which takes the following parameters.

Parameter	Description
GraphicsConfiguration	Provides information about the display screen such as size and resolution.

Video and compression format	The output format (AVI) of the movie with number of frames/sec.
Color of the mouse cursor and refresh rate	Specifies the mouse cursor color and refresh rate.
Audio format	If 'NULL', audio will NOT be recorded.

Example

We will capture a video of the simple test execution - percent calculation.

```
import java.io.File;
import java.io.IOException;
import java.util.concurrent.TimeUnit;

import org.apache.commons.io.FileUtils;

import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;
import org.openqa.selenium.WebDriver;
import org.openqa.selenium.By;

import org.monte.media.math.Rational;
import org.monte.media.Format;
import org.monte.screenrecorder.ScreenRecorder;

import static org.monte.media.AudioFormatKeys.*;
import static org.monte.media.VideoFormatKeys.*;
import java.awt.*;

public class webdriverdemo
{
```

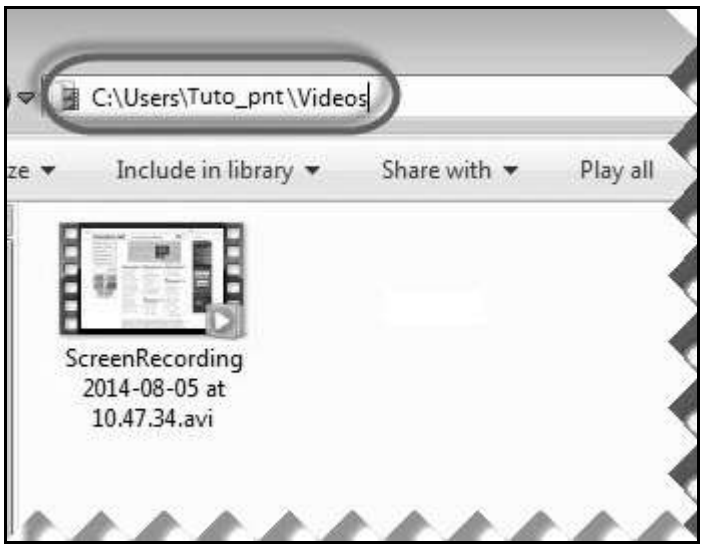
```
private static ScreenRecorder screenRecorder;
public static void main(String[] args) throws IOException, AWTException
{
     GraphicsConfiguration gconfig = GraphicsEnvironment
          .getLocalGraphicsEnvironment()
          .getDefaultScreenDevice()
          .getDefaultConfiguration();

     screenRecorder = new ScreenRecorder(gconfig,
          new Format(MediaTypeKey, MediaType.FILE, MimeTypeKey,
          MIME_AVI),
          new Format(MediaTypeKey, MediaType.VIDEO, EncodingKey,
          ENCODING_AVI_TECHSMITH_SCREEN_CAPTURE,
          CompressorNameKey, ENCODING_AVI_TECHSMITH_SCREEN_CAPTURE,
          DepthKey, (int)24, FrameRateKey, Rational.valueOf(15),
          QualityKey, 1.0f,
          KeyFrameIntervalKey, (int) (15 * 60)),
          new Format(MediaTypeKey, MediaType.VIDEO,
          EncodingKey,"black",
          FrameRateKey, Rational.valueOf(30)), null);

     WebDriver driver = new FirefoxDriver();

     // Start Capturing the Video
     screenRecorder.start();

     // Puts an Implicit wait, Will wait for 10 seconds
     // before throwing exception
     driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);

    // Launch website
     driver.navigate().to("http://www.calculator.net/");
```

```
// Maximize the browser
driver.manage().window().maximize();

// Click on Math Calculators
driver.findElement(By.xpath(".//*[@id='menu']/div[3]/a")).click();

// Click on Percent Calculators
driver.findElement(By.xpath(".//*[@id='menu']/div[4]/div[3]/a"))
.Click();

// Enter value 10 in the first number of the percent Calculator
driver.findElement(By.id("cpar1")).sendKeys("10");

// Enter value 50 in the second number of the percent Calculator
driver.findElement(By.id("cpar2")).sendKeys("50");

// Click Calculate Button
driver.findElement(By.xpath(".//*[@id='content']/table
/tbody/tr/td[2]/input")).click();

// Get the Result Text based on its xpath
String result =
driver.findElement(By.xpath(".//*[@id='content']
/p[2]/span/font/b")).getText();

File screenshot =
((TakesScreenshot)driver).getScreenshotAs(OutputType.FILE);

FileUtils.copyFile(screenshot, new
File("D:\\screenshots\\screenshots1.jpg"));
```

```
        // Print a Log In message to the screen
        System.out.println(" The Result is " + result);

        // Close the Browser.
        driver.close();

        // Stop the ScreenRecorder
        screenRecorder.stop();
    }
}
```

Output

The recorded video is saved in the "C:\users\<<UserName>>\Videos" folder as shown below.



10. TestNG

What is TestNG?

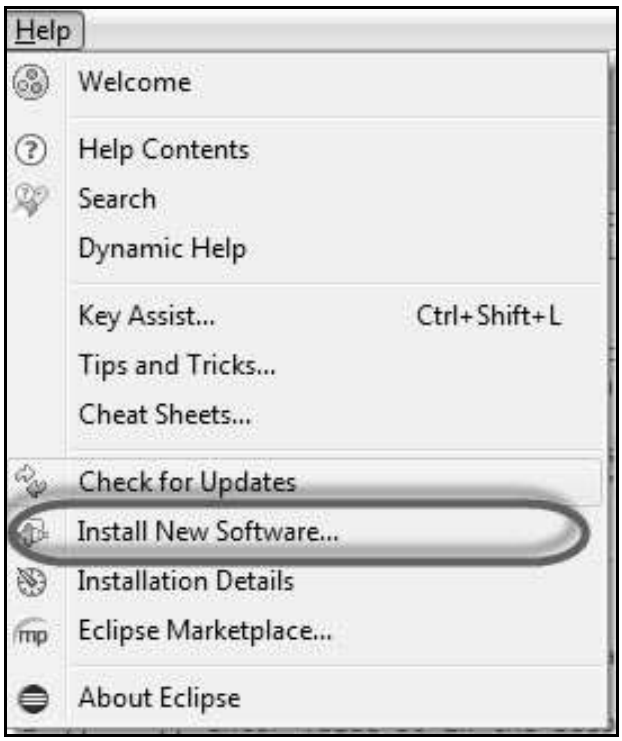
TestNG is a powerful testing framework, an enhanced version of JUnit which was in use for a long time before TestNG came into existence. NG stands for 'Next Generation'.

TestNG framework provides the following features:

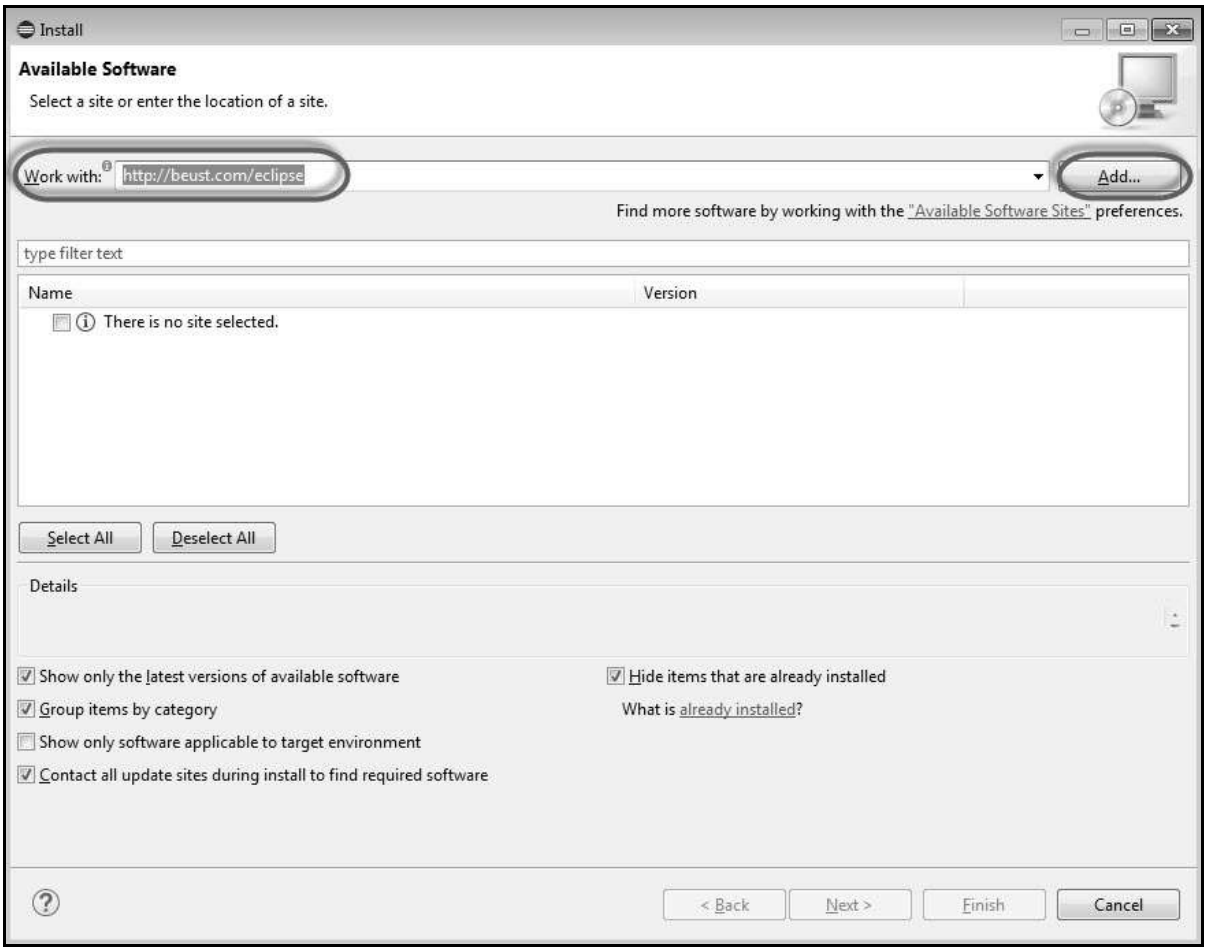
- Annotations help us organize the tests easily.
- Flexible test configuration.
- Test cases can be grouped more easily.
- Parallelization of tests can be achieved using TestNG.
- Support for data-driven testing.
- Inbuilt reporting

Installing TestNG for Eclipse

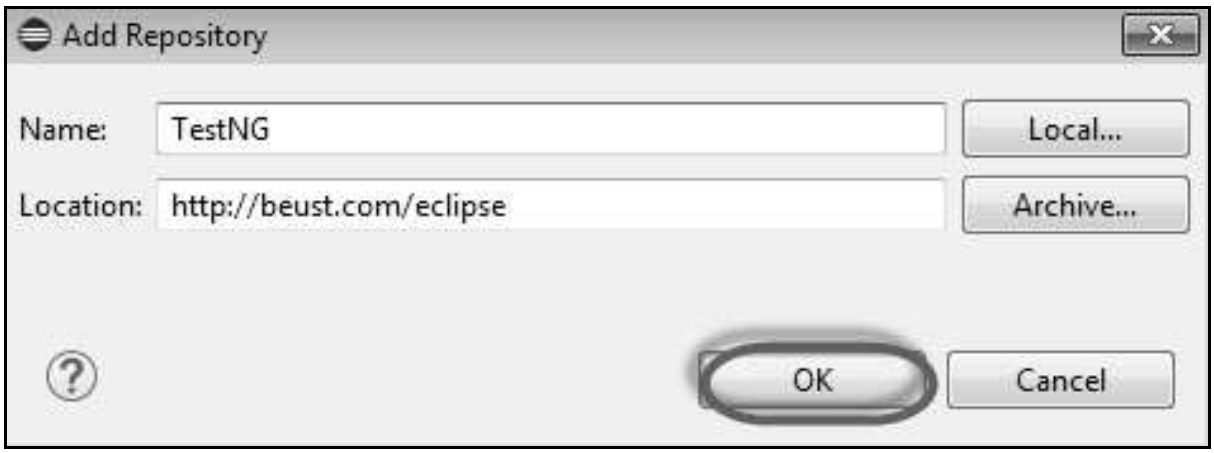
Step 1 : Launch Eclipse and select 'Install New Software'.



Step 2 : Enter the URL as 'http://beust.com/eclipse' and click 'Add'.

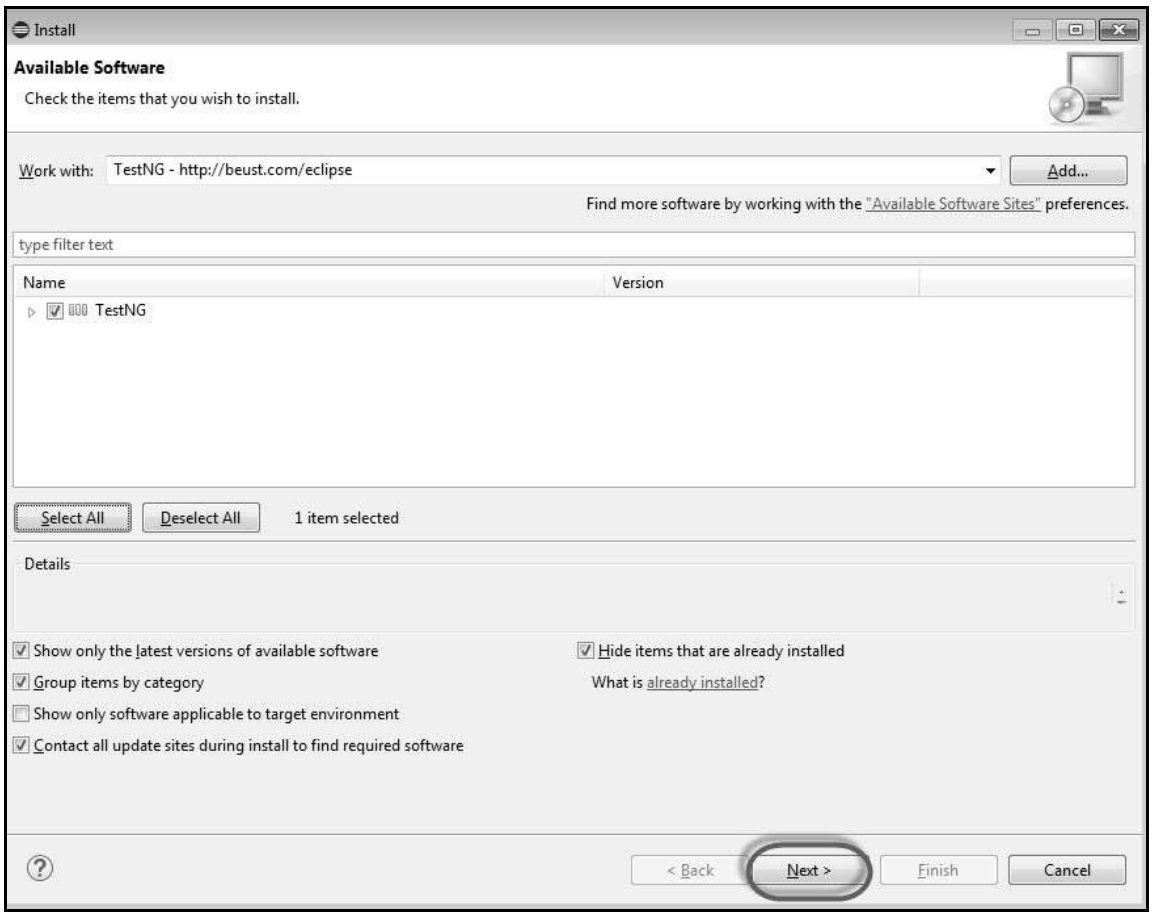


Step 3 : The dialog box 'Add Repository' opens. Enter the name as 'TestNG' and click 'OK'

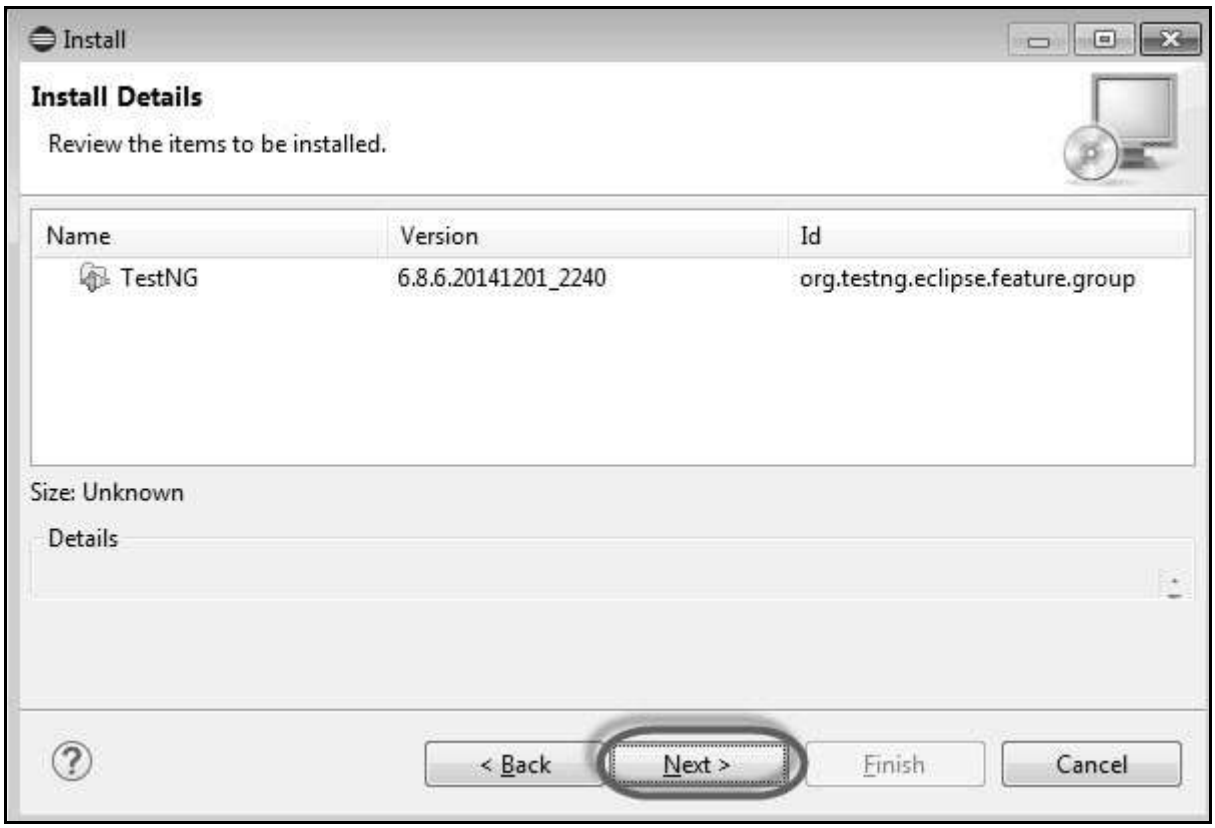


Step 4 : Click 'Select All' and 'TestNG' would be selected as shown in the figure.

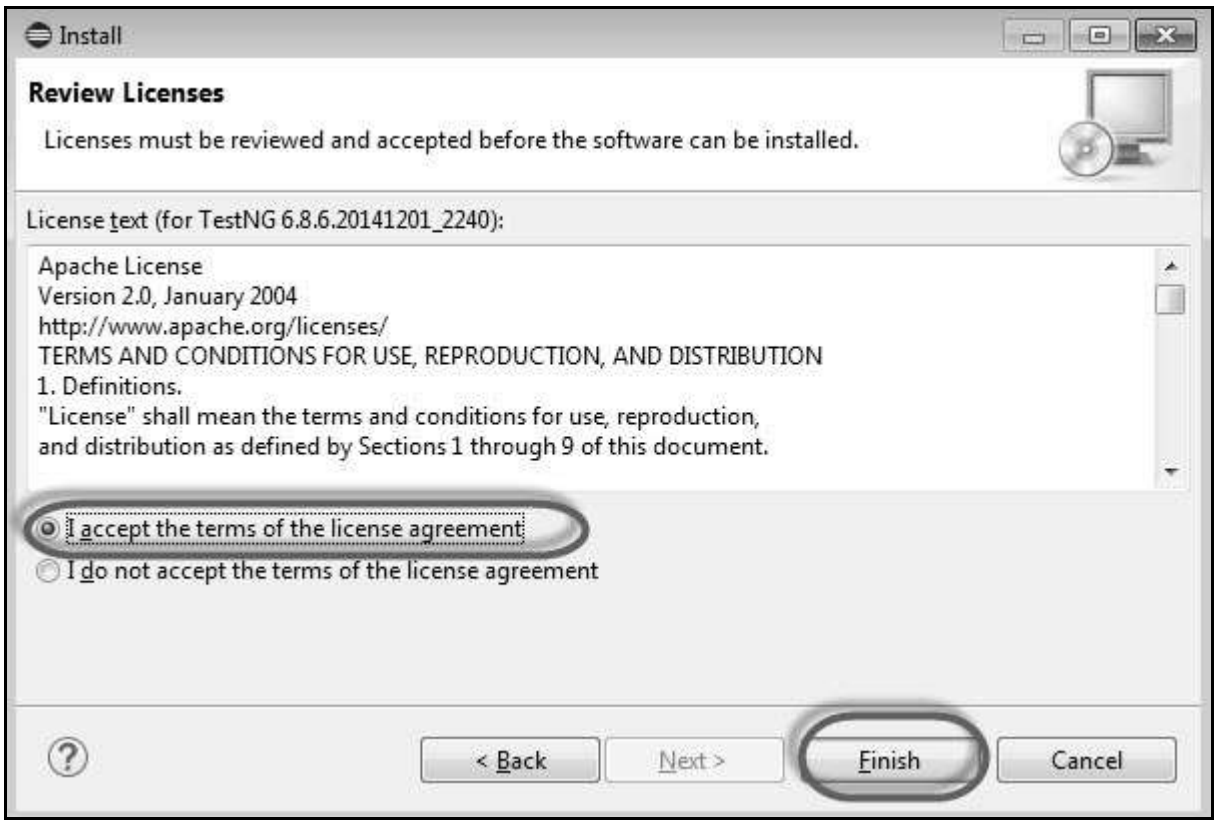
Step 5 : Click 'Next' to continue.



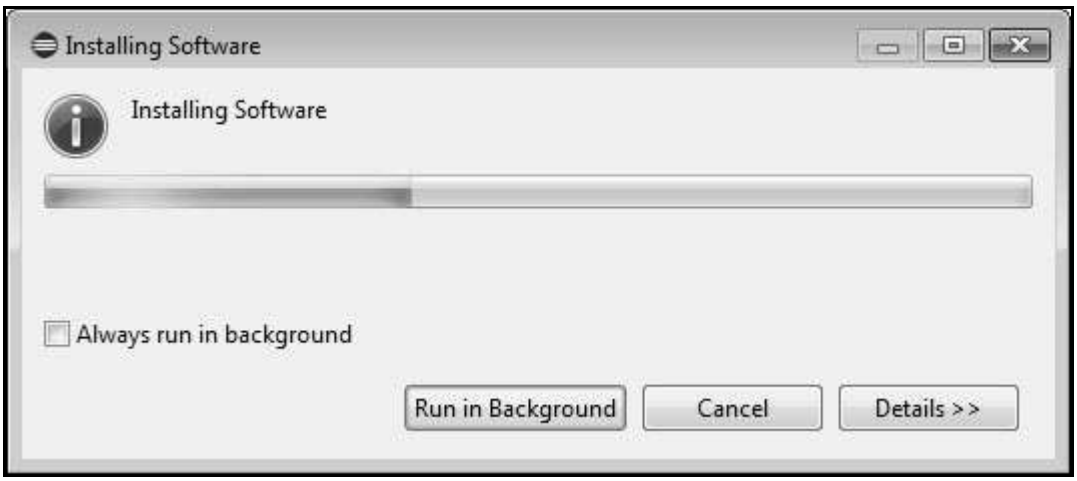
Step 6 : Review the items that are selected and click 'Next'.



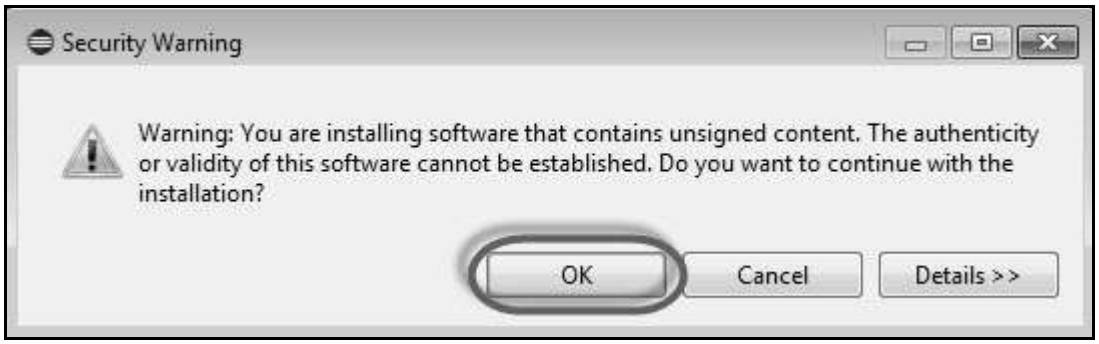
Step 7 : "Accept the License Agreement" and click 'Finish'.



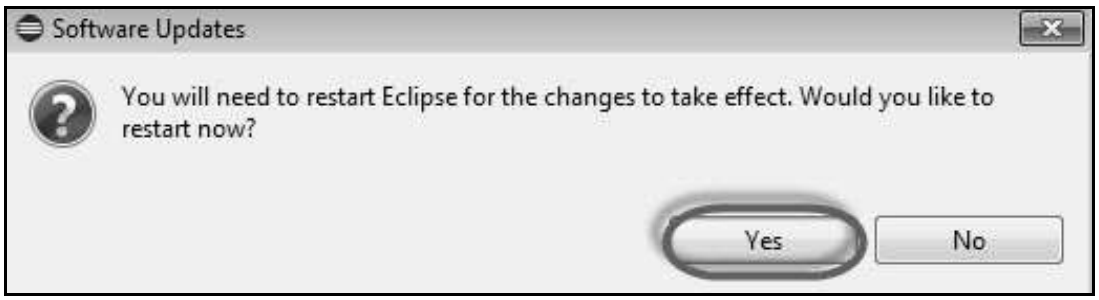
Step 8 : TestNG starts installing and the progress would be shown follows.



Step 9 : Security Warning pops up as the validity of the software cannot be established. Click 'Ok'.



Step 10 : The Installer prompts to restart Eclipse for the changes to take effect. Click 'Yes'.



Annotations in TestNG

Annotations were formally added to the Java language in JDK 5 and TestNG made the choice to use annotations to annotate test classes. Following are some of the benefits of using annotations. More about TestNG can be found here.

- TestNG identifies the methods it is interested in by looking up annotations. Hence, method names are not restricted to any pattern or format.

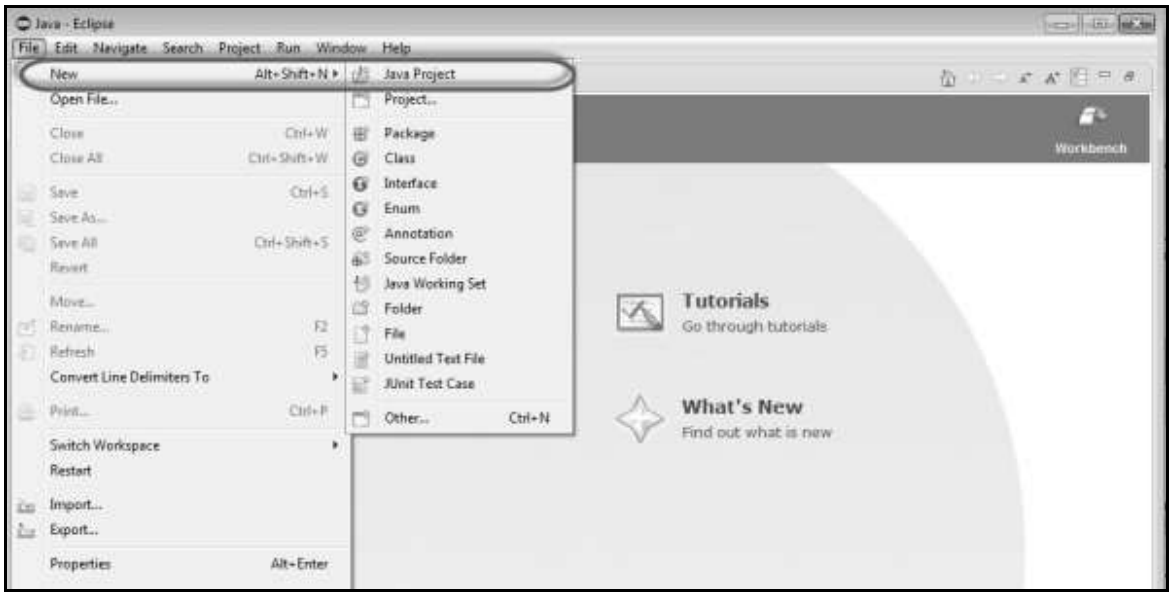
- We can pass additional parameters to annotations.
- Annotations are strongly typed, so the compiler will flag any mistakes right away.
- Test classes no longer need to extend anything (such as TestCase, for JUnit 3).

Annotation	Description
@BeforeSuite	The annotated method will be run only once before all the tests in this suite have run.
@AfterSuite	The annotated method will be run only once after all the tests in this suite have run.
@BeforeClass	The annotated method will be run only once before the first test method in the current class is invoked.
@AfterClass	The annotated method will be run only once after all the test methods in the current class have run.
@BeforeTest	The annotated method will be run before any test method belonging to the classes inside the <test> tag is run.
@AfterTest	The annotated method will be run after all the test methods belonging to the classes inside the <test> tag have run.
@BeforeGroups	The list of groups that this configuration method will run before. This method is guaranteed to run shortly before the first test method that belongs to any of these groups is invoked.
@AfterGroups	The list of groups that this configuration method will run

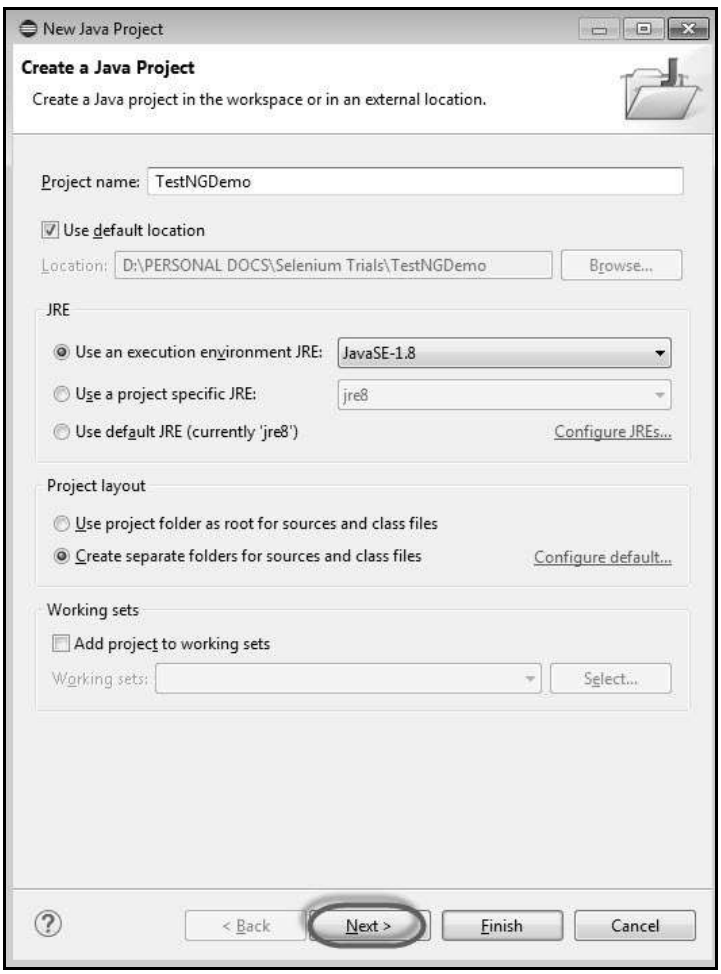
	after. This method is guaranteed to run shortly after the last test method that belongs to any of these groups is invoked.
@BeforeMethod	The annotated method will be run before each test method.
@AfterMethod	The annotated method will be run after each test method.
@DataProvider	Marks a method as supplying data for a test method. The annotated method must return an Object[ ][ ] where each Object[ ] can be assigned the parameter list of the test method. The @Test method that wants to receive data from this DataProvider needs to use a dataProvider name equals to the name of this annotation.
@Factory	Marks a method as a factory that returns objects that will be used by TestNG as Test classes. The method must return Object[ ].
@Listeners	Defines listeners on a test class.
@Parameters	Describes how to pass parameters to a @Test method.
@Test	Marks a class or a method as part of the test.

TestNG-Eclipse Setup

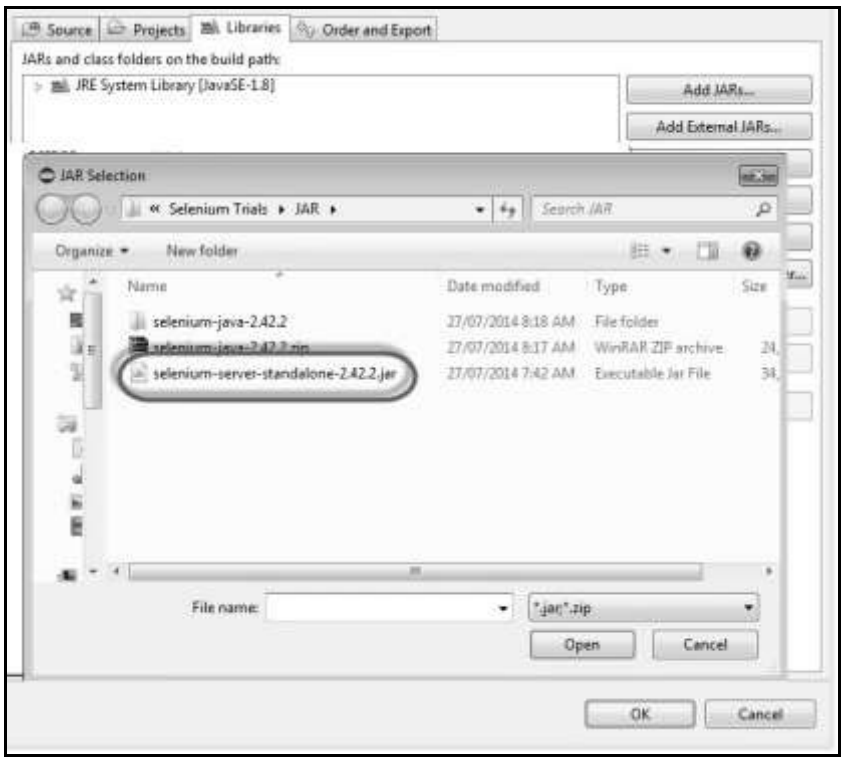
Step 1 : Launch Eclipse and create a 'New Java Project' as shown below.



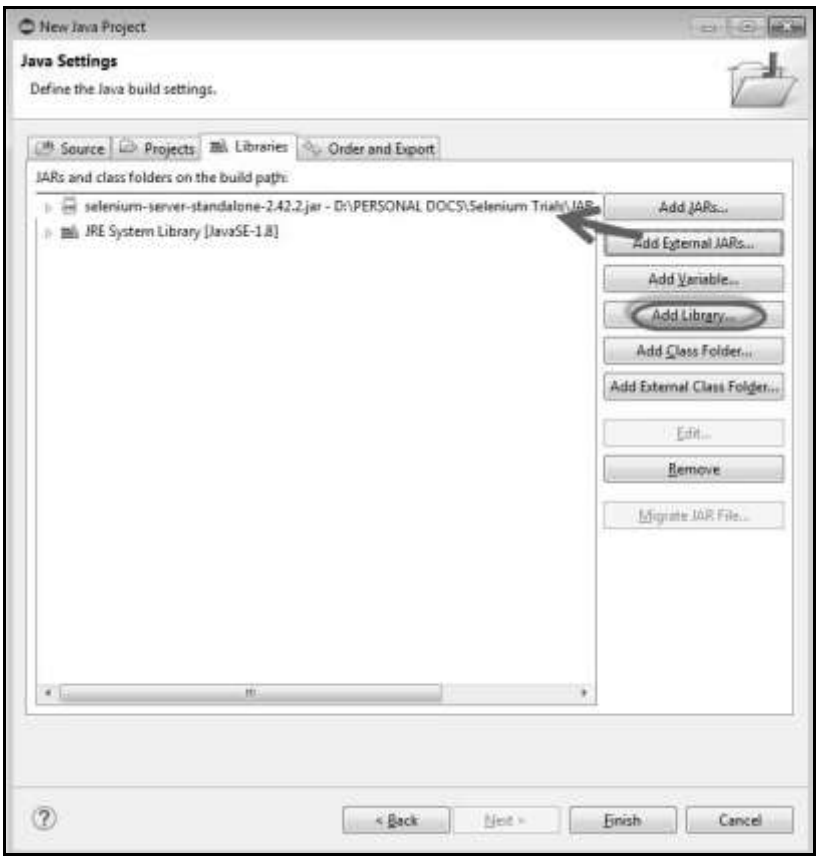
Step 2 : Enter the project name and click 'Next'.



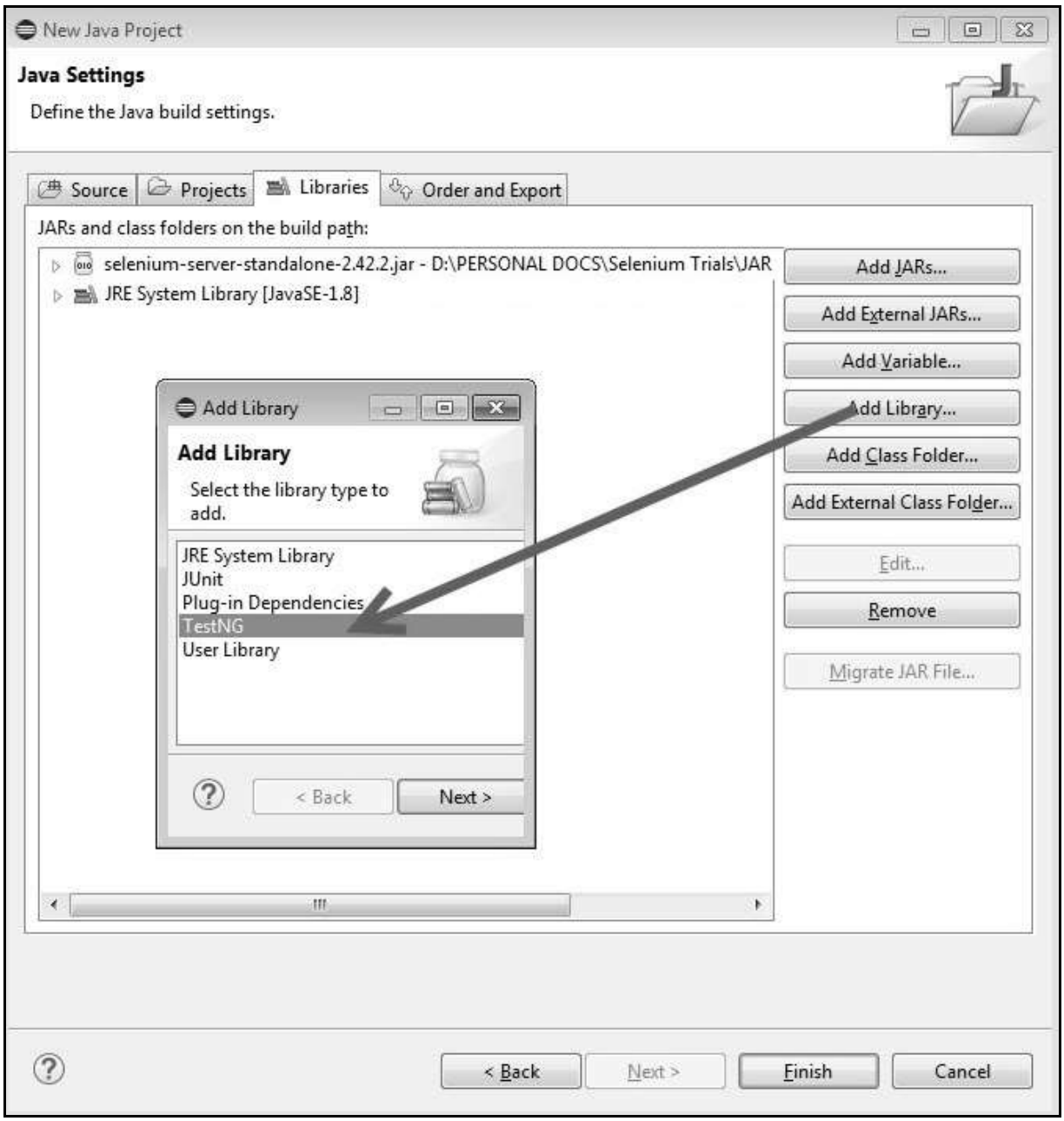
Step 3 : Navigate to "Libraries" Tab and add the Selenium Remote Control Server JAR file by clicking on "Add External JAR's" as shown below.



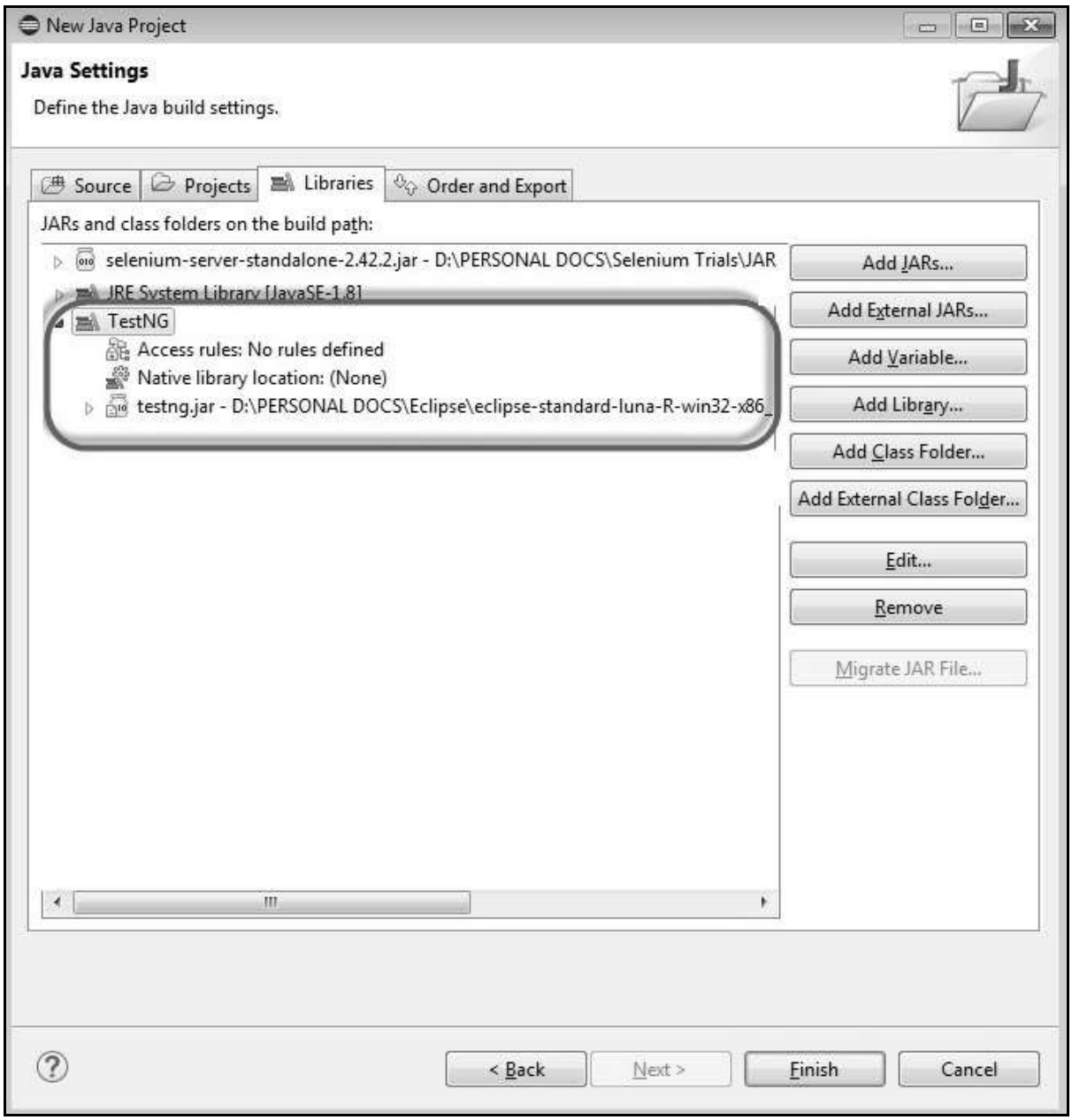
Step 4 : The added JAR file is shown here. Click 'Add Library'.



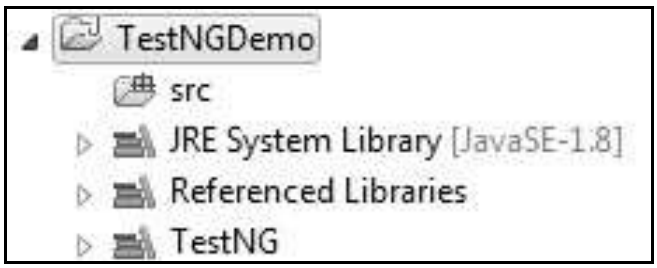
Step 5 : The 'Add Library' dialog opens. Select 'TestNG' and click 'Next' in the 'Add Library' dialog box.



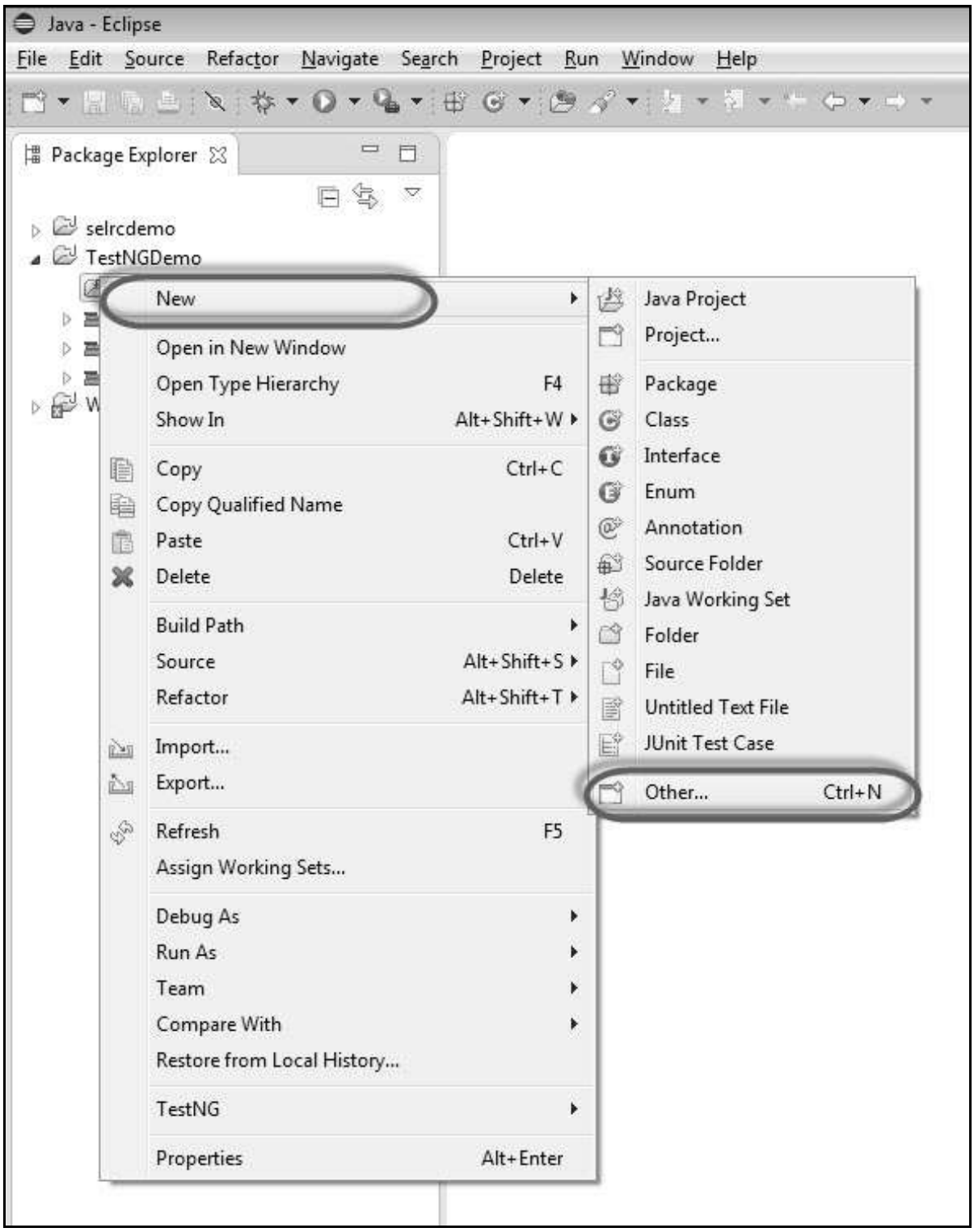
Step 6 : The added 'TestNG' Library is added and it is displayed as shown below.



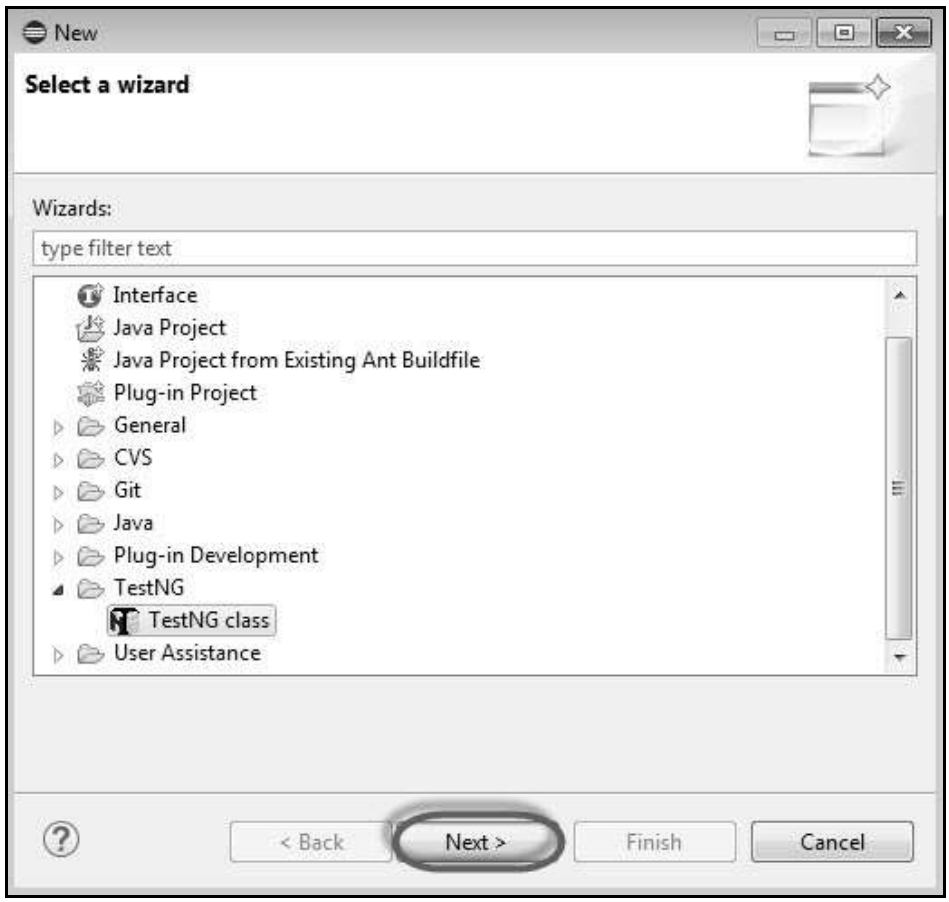
Step 7 : Upon creating the project, the structure of the project would be as shown below.



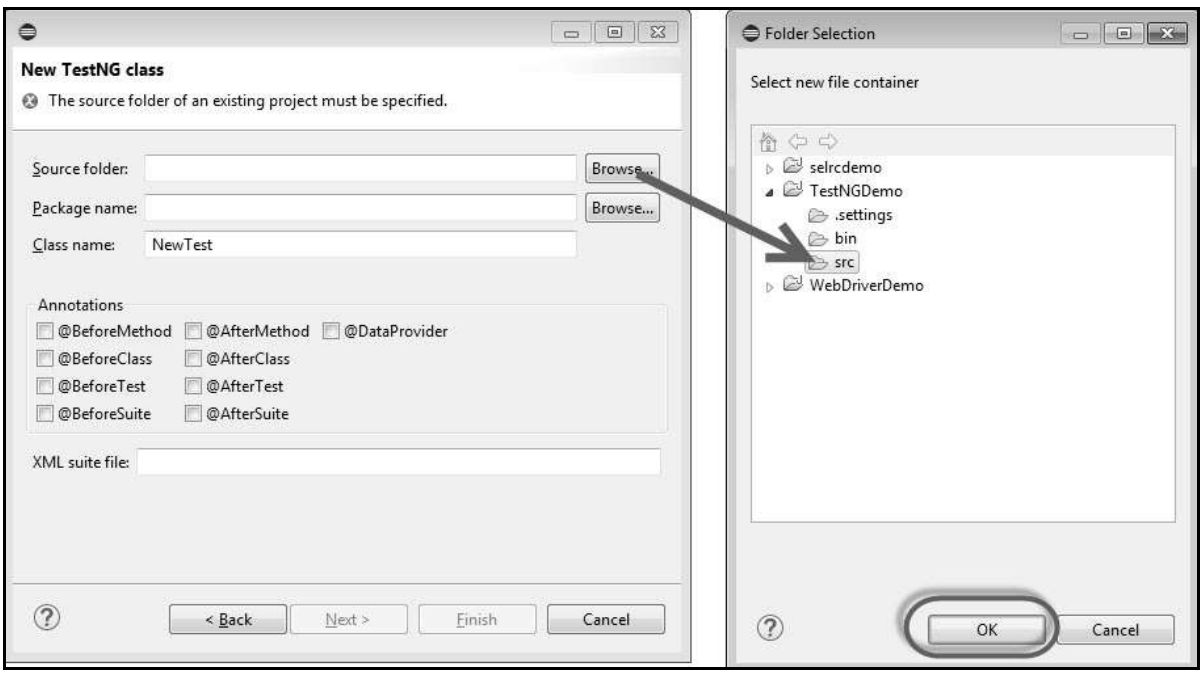
Step 8 : Right-click on 'src' folder and select New >> Other.



Step 9 : Select 'TestNG' and click 'Next'.

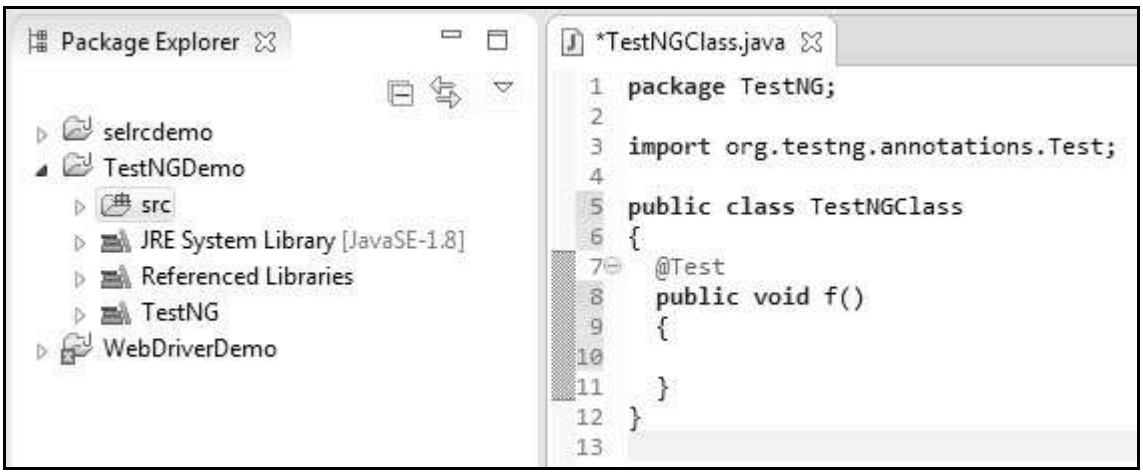


Step 10 : Select the 'Source Folder' name and click 'Ok'.



Step 11 : Select the 'Package name', the 'class name', and click 'Finish'.

Step 12 : The Package explorer and the created class would be displayed.



First Test in TestNG

Now let us start scripting using TestNG. Let us script for the same example that we used for understanding the WebDriver. We will use the demo application, www.calculator.net, and perform percent calculator.

In the following test, you will notice that there is NO main method, as testNG will drive the program execution flow. After initializing the driver, it will execute the '@BeforeTest' method followed by '@Test' and then '@AfterTest'. Please note that there can be any number of '@Test' annotation in a class but '@BeforeTest' and '@AfterTest' can appear only once.

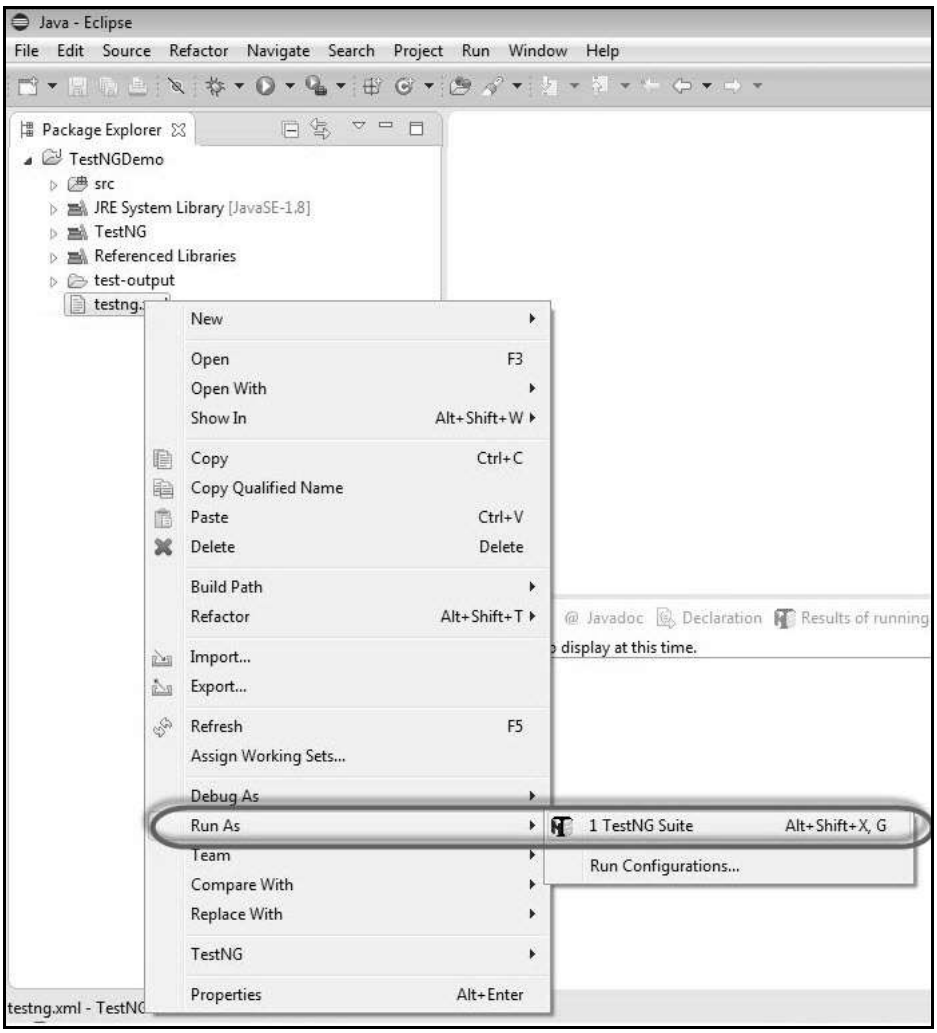
```
package TestNG;
import java.util.concurrent.TimeUnit;
import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;
import org.testng.annotations.AfterTest;
import org.testng.annotations.BeforeTest;
import org.testng.annotations.Test;

public class TestNGClass
{
  WebDriver driver = new FirefoxDriver();

  @BeforeTest
  public void launchapp()
  {
     //Puts an Implicit wait, Will wait for 10 seconds
     // before throwing exception
     driver.manage().timeouts().implicitlyWait(10, TimeUnit.SECONDS);
     //Launch website
     driver.navigate().to("http://www.calculator.net");
     driver.manage().window().maximize();
  }

  @Test
  public void calculatepercent()
```

```
{
   // Click on Math Calculators
   driver.findElement(By.xpath(".//*[@id='menu']/div[3]/a")).click();

   // Click on Percent Calculators
   driver.findElement(By.xpath(".//*[@id='menu']/div[4]/div[3]/a")).click();

   // Enter value 10 in the first number of the percent Calculator
   driver.findElement(By.id("cpar1")).sendKeys("10");

   // Enter value 50 in the second number of the percent Calculator

   driver.findElement(By.id("cpar2")).sendKeys("50");

   // Click Calculate Button
   driver.findElement(By.xpath(".//*[@id='content']/table
   /tbody/tr/td[2]/input")).click();

   // Get the Result Text based on its xpath
   String result =
   driver.findElement(By.xpath(".//*[@id='content']/p[2]
   /span/font/b")).getText();

   // Print a Log In message to the screen
   System.out.println(" The Result is " + result);


   if(result.equals("5"))
   {
         System.out.println(" The Result is Pass");
   }
   else
   {
         System.out.println(" The Result is Fail");
```

```
    }
  }

  @AfterTest
  public void terminatetest()
  {
    driver.close();
  }
}
```

Execution

To execute, right-click on the created XML and select "Run As" >> "TestNG Suite"



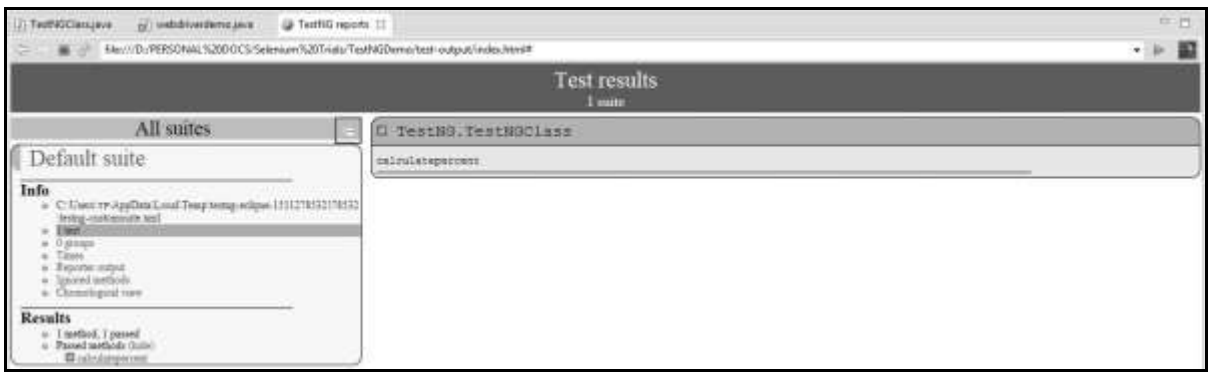
Result Analysis

The output is thrown to the console and it would appear as shown below. The console output also has an execution summary.

```
Problems  @ Javadoc  Declaration  Console  Results of running class TestNGClass
<terminated> TestNGClass [TestNG] C:\Program Files\Java\jre8\bin\javaw.exe (31 Jul 2014 8:18:51 am)
[TestNG] Running:
  C:\Users\TP\AppData\Local\Temp\testng-eclipse-1511278532\testng-customsuite.xml

 The Result is 5
 The Result is Pass
PASSED: calculatepercent

===============================================
    Default test
    Tests run: 1, Failures: 0, Skips: 0
===============================================


===============================================
Default suite
Total tests run: 1, Failures: 0, Skips: 0
===============================================

[TestNG] Time taken by org.testng.reporters.JUnitReportReporter@626b2d4a: 9 ms
[TestNG] Time taken by org.testng.reporters.SuiteHTMLReporter@73a8dfcc: 66 ms
[TestNG] Time taken by org.testng.reporters.EmailableReporter2@6f2b958e: 4 ms
[TestNG] Time taken by [FailedReporter passed=0 failed=0 skipped=0]: 1 ms
[TestNG] Time taken by org.testng.reporters.jq.Main@aec6354: 34 ms
[TestNG] Time taken by org.testng.reporters.XMLReporter@c2e1f26: 6 ms
```

The result of TestNG can also be seen in a different tab. Click on 'HTML Report View' button as shown below.

The HTML result would be displayed as shown below.



11. SELENIUM GRID

Selenium Grid is a tool that distributes the tests across multiple physical or virtual machines so that we can execute scripts in parallel (simultaneously). It dramatically accelerates the testing process across browsers and across platforms by giving us quick and accurate feedback.

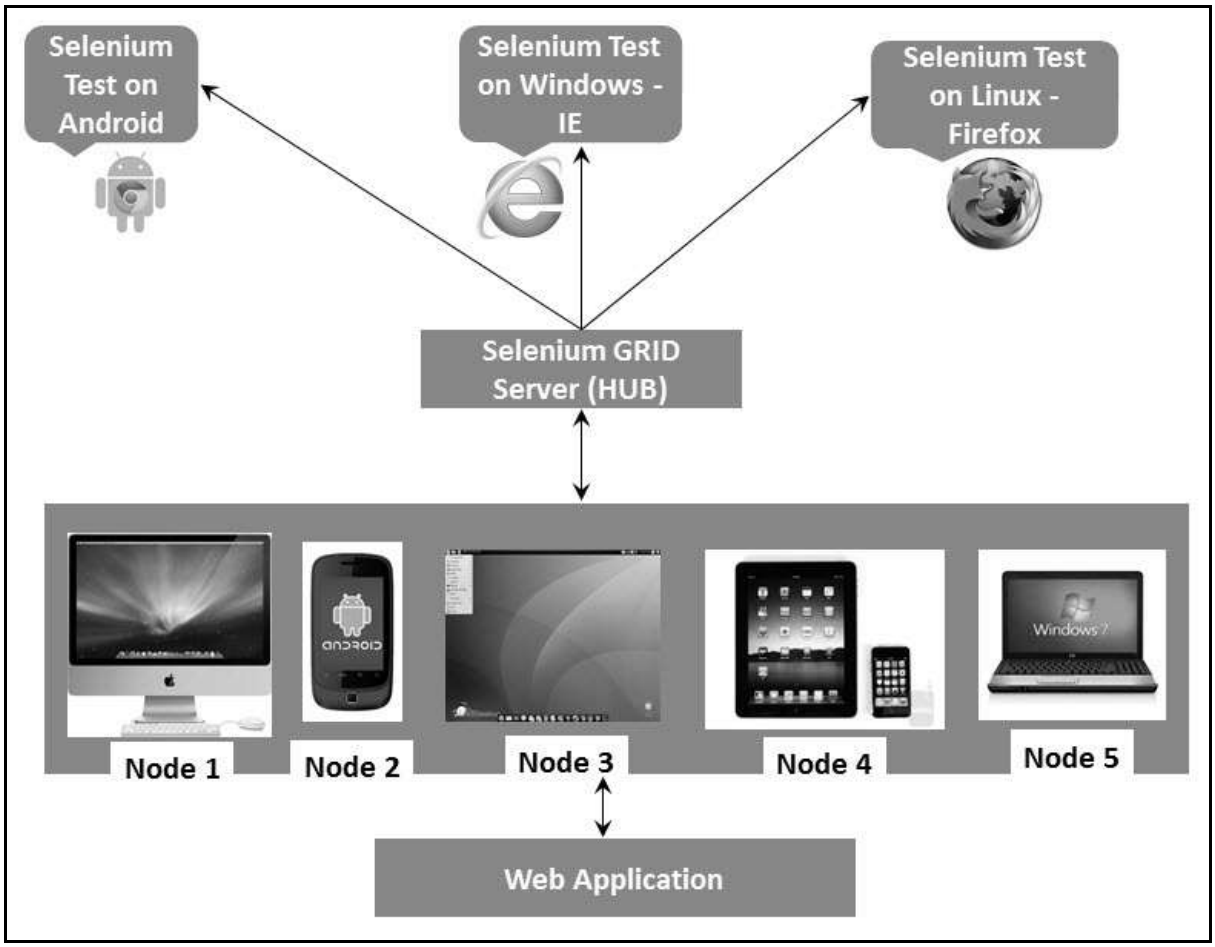
Selenium Grid allows us to execute multiple instances of WebDriver or Selenium Remote Control tests in parallel which uses the same code base, hence the code need NOT be present on the system they execute. The selenium-server-standalone package includes Hub, WebDriver, and Selenium RC to execute the scripts in grid.

Selenium Grid has a Hub and a Node.

- **Hub** - The hub can also be understood as a server which acts as the central point where the tests would be triggered. A Selenium Grid has only one Hub and it is launched on a single machine once.
- **Node** - Nodes are the Selenium instances that are attached to the Hub which execute the tests. There can be one or more nodes in a grid which can be of any OS and can contain any of the Selenium supported browsers.

Architecture

The following diagram shows the architecture of Selenium Grid.



Working with Grid

In order to work with the Grid, we need to follow certain protocols. Listed below are the major steps involved in this process:

- Configuring the Hub
- Configuring the Nodes
- Develop the Script and Prepare the XML File
- Test Execution
- Result Analysis

Let us discuss each of these steps in detail.

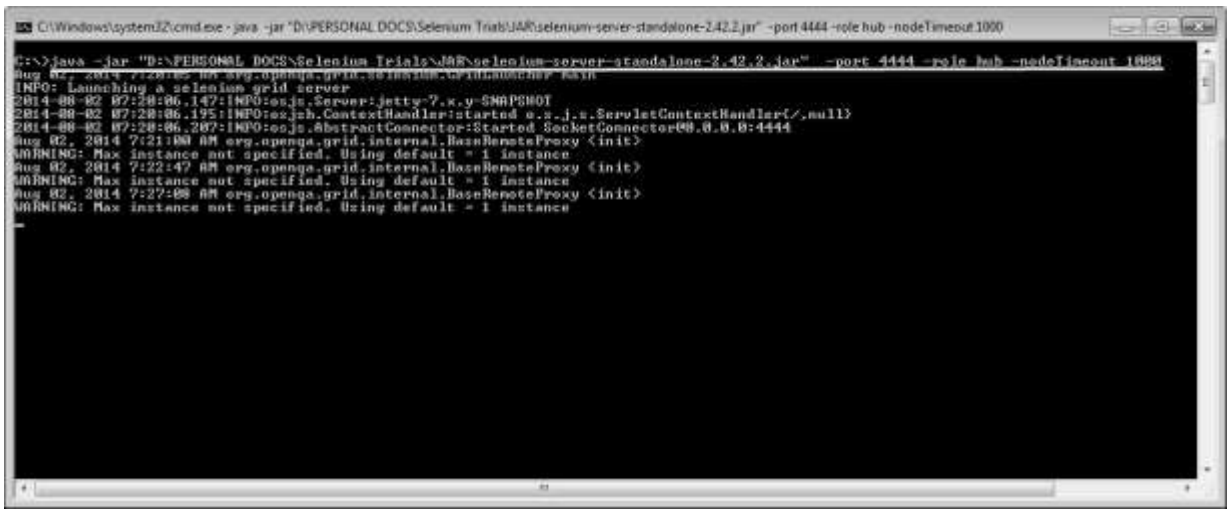
Configuring the Hub

Step 1 : Download the latest Selenium Server standalone JAR file from http://docs.seleniumhq.org/download/. Download it by clicking on the version as shown below.

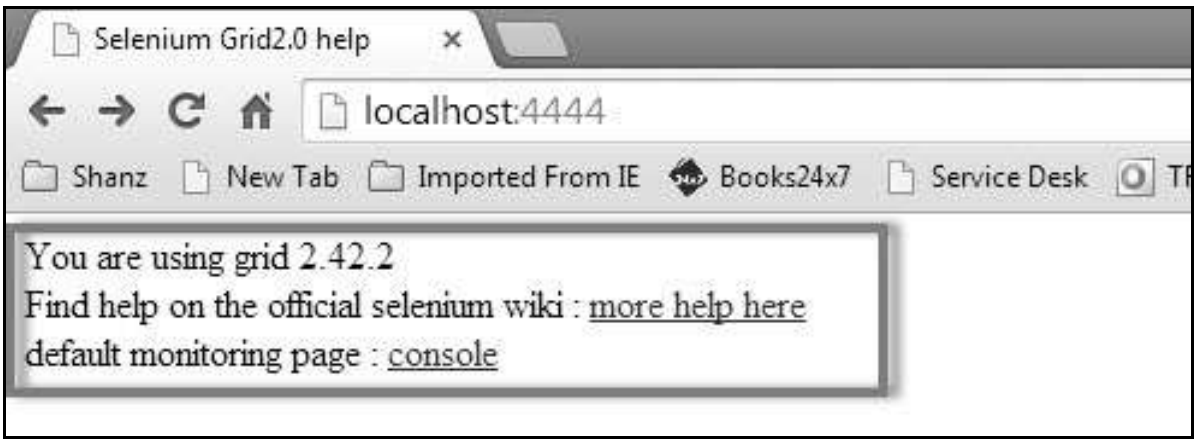
Step 2 : Start the Hub by launching the Selenium Server using the following command. Now we will use the port '4444' to start the hub.

Note : Ensure that there are no other applications that are running on port# 4444.

```
java -jar selenium-server-standalone-2.25.0.jar -port 4444 -role hub -
nodeTimeout 1000
```



Step 3 : Now open the browser and navigate to the URL http//localhost:4444 from the Hub (The system where you have executed Step#2).



Step 4 : Now click on the 'console' link and click 'view config'. The config of the hub would be displayed as follows. As of now, we haven't got any nodes, hence we will not be able to see the details.

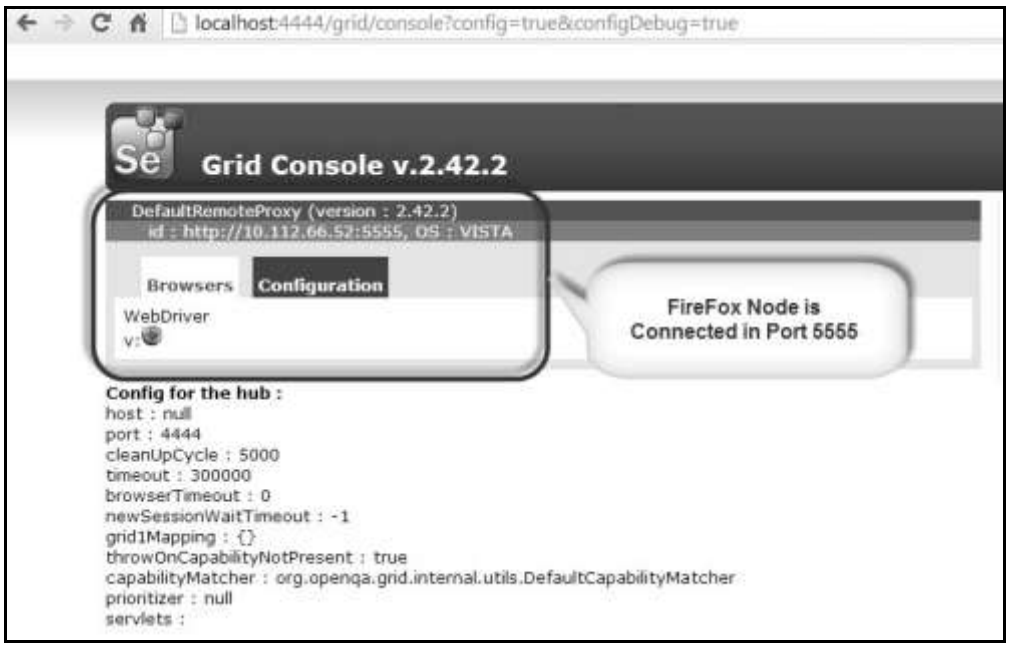
Configuring the Nodes

Step 1 : Logon to the node (where you would like to execute the scripts) and place the 'selenium-server-standalone-2.42.2' in a folder. We need to point to the selenium-server-standalone JAR while launching the nodes.

Step 2 : Launch FireFox Node using the following command.

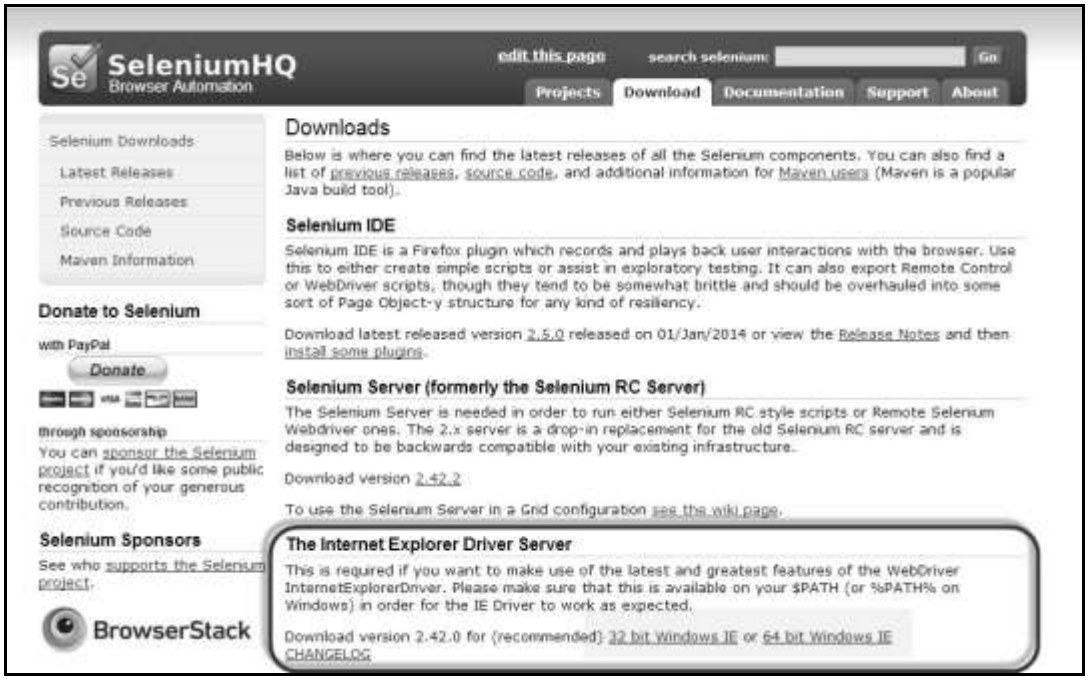
```
java -jar D:\JAR\selenium-server-standalone-2.42.2.jar -role node -hub
http://10.30.217.157:4444/grid/register -browser browserName=firefox -
port 5555


Where,

D:\JAR\selenium-server-standalone-2.42.2.jar = Location of the Selenium
Server Standalone Jar File(on the Node Machine)

http://10.30.217.157:4444 = IP Address of the Hub and 4444 is the port
of the Hub

browserName = firefox (Parameter to specify the Browser name on Nodes)

5555 = Port on which Firefox Node would be up and running.
```

Step 3 : After executing the command, come back to the Hub. Navigate to the URL - http://10.30.217.157:4444 and the Hub would now display the node attached to it.



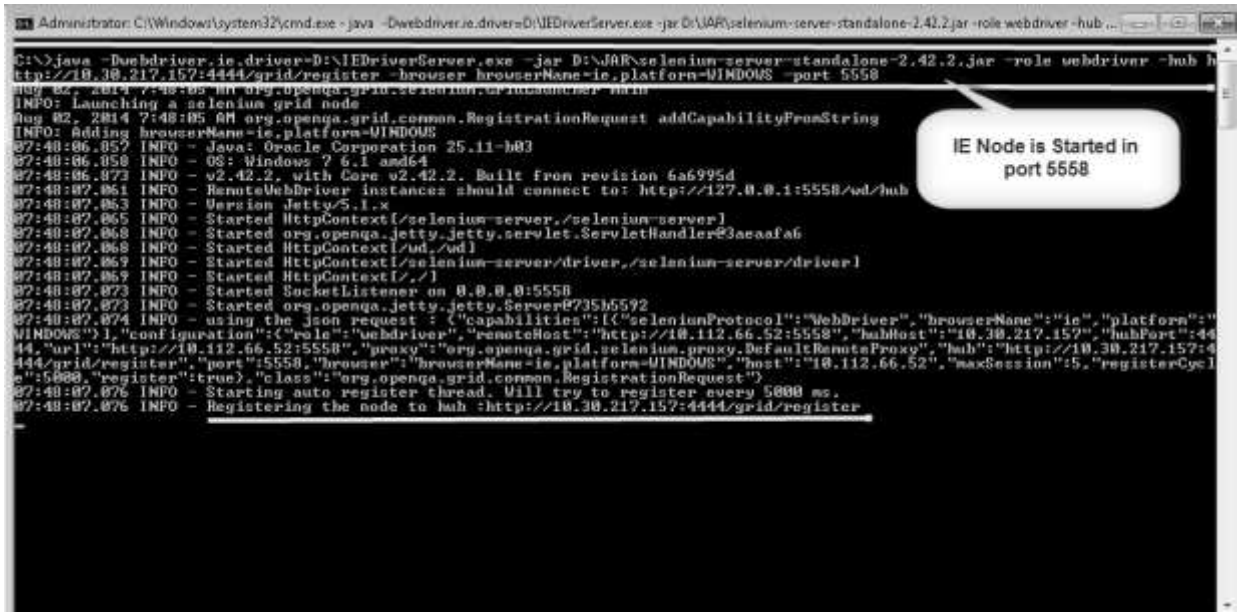
Step 4 : Now let us launch the Internet Explorer Node. For launching the IE Node, we need to have the Internet Explorer driver downloaded on the node machine.

Step 5 : To download the Internet Explorer driver, navigate to http://docs.seleniumhq.org/download/ and download the appropriate file based on the architecture of your OS. After you have downloaded, unzip the exe file and place it in a folder which has to be referred while launching IE nodes.



Step 6 : Launch IE using the following command.

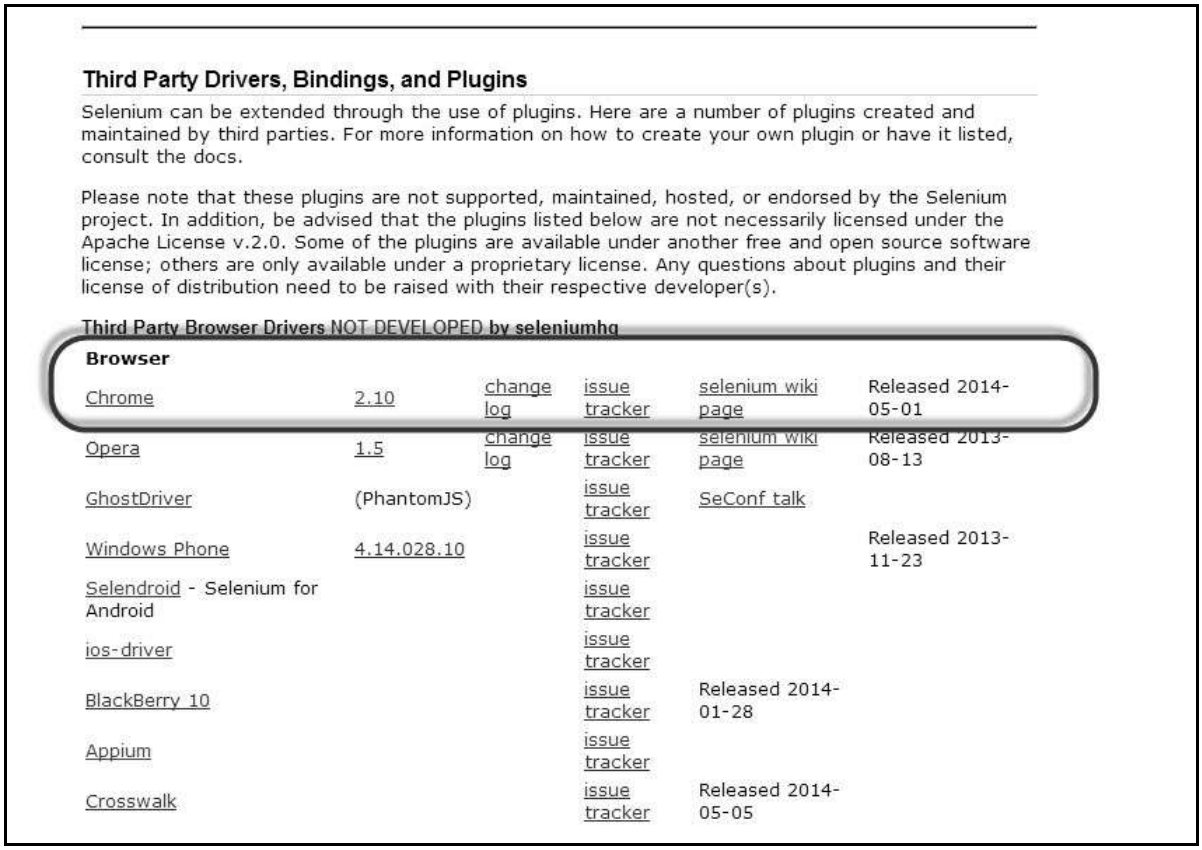
```
C:\>java -Dwebdriver.ie.driver=D:\IEDriverServer.exe -jar
D:\JAR\selenium-server-standalone-2.42.2.jar -role webdriver -hub
http://10.30.217.157:4444/grid/register -browser
browserName=ie,platform=WINDOWS -port 5558


Where,

D:\IEDriverServer.exe = The location of the downloaded the IE Driver(on
the Node Machine)

D:\JAR\selenium-server-standalone-2.42.2.jar = Location of the Selenium
Server Standalone Jar File(on the Node Machine)

http://10.30.217.157:4444 = IP Address of the Hub and 4444 is the port
of the Hub

browserName = ie (Parameter to specify the Browser name on Nodes)

5558 = Port on which IE Node would be up and running.
```



Step 7 : After executing the command, come back to the Hub. Navigate to the URL - http://10.30.217.157:4444 and the Hub would now display the IE node attached to it.

Step 8 : Let us now launch the Chrome Node. For launching the Chrome Node, we need to have the Chrome driver downloaded on the node machine.

Step 9 : To download the Chrome Driver, navigate to http://docs.seleniumhq.org/download/ and then navigate to Third Party Browser Drivers area and click on the version number '2.10' as shown below.



Third Party Drivers, Bindings, and Plugins

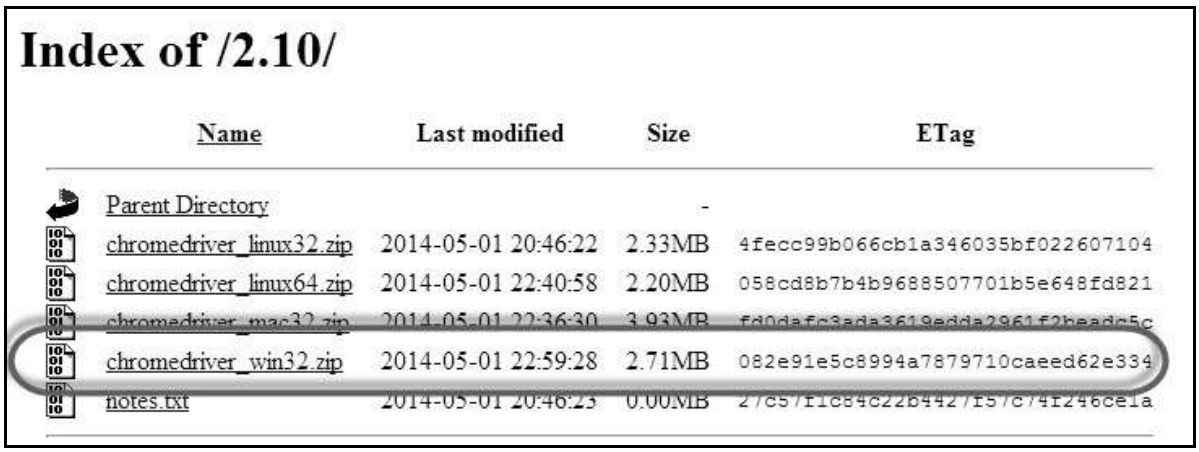
Selenium can be extended through the use of plugins. Here are a number of plugins created and maintained by third parties. For more information on how to create your own plugin or have it listed, consult the docs.

Please note that these plugins are not supported, maintained, hosted, or endorsed by the Selenium project. In addition, be advised that the plugins listed below are not necessarily licensed under the Apache License v.2.0. Some of the plugins are available under another free and open source software license; others are only available under a proprietary license. Any questions about plugins and their license of distribution need to be raised with their respective developer(s).

Third Party Browser Drivers NOT DEVELOPED by seleniumhq

Browser					
Chrome	2.10	change log	issue tracker	selenium wiki page	Released 2014-05-01
Opera	1.5	change log	issue tracker	selenium wiki page	Released 2013-08-13
GhostDriver	(PhantomJS)		issue tracker	SeConf talk	
Windows Phone	4.14.028.10		issue tracker		Released 2013-11-23
Selendroid - Selenium for Android			issue tracker		
ios-driver			issue tracker		
BlackBerry 10			issue tracker	Released 2014-01-28	
Appium			issue tracker		
Crosswalk			issue tracker	Released 2014-05-05	

Step 10 : Download the driver based on the type of your OS. We will execute it on Windows environment, hence we will download the Windows Chrome Driver. After you have downloaded, unzip the exe file and place it in a folder which has to be referred while launching chrome nodes.



Index of /2.10/

Name	Last modified	Size	ETag
Parent Directory		-	
chromedriver_linux32.zip	2014-05-01 20:46:22	2.33MB	4fecc99b066cb1a346035bf022607104
chromedriver_linux64.zip	2014-05-01 22:40:58	2.20MB	058cd8b7b4b9688507701b5e648fd821
chromedriver_mac32.zip	2014-05-01 22:36:30	3.93MB	fd0dafc3ada3619edda2961f2beadc5c
chromedriver_win32.zip	2014-05-01 22:59:28	2.71MB	082e91e5c8994a7879710caeed62e334
notes.txt	2014-05-01 20:46:23	0.00MB	27c57f1c84c22b4427f57c74f246ce1a

Step 11 : Launch Chrome using the following command.

```
C:\>java -Dwebdriver.chrome.driver=D:\chromedriver.exe -jar
D:\JAR\selenium-server-standalone-2.42.2.jar -role webdriver -hub
http://10.30.217.157:4444/grid/register -browser
browserName=chrome,platform=WINDOWS -port 5557
```

Where,

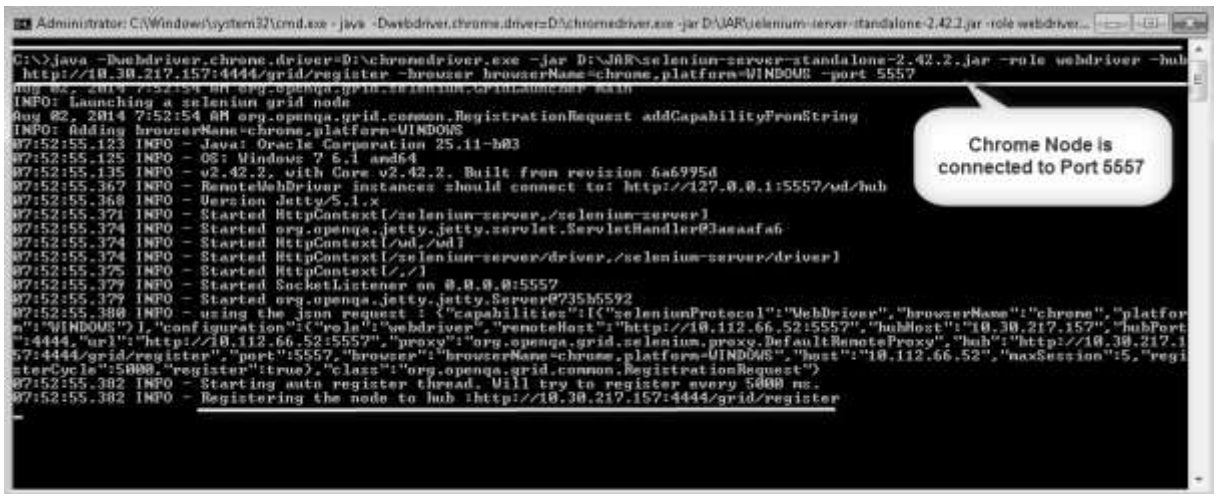
D:\chromedriver.exe = The location of the downloaded the chrome Driver(on the Node Machine)

D:\JAR\selenium-server-standalone-2.42.2.jar = Location of the Selenium Server Standalone Jar File(on the Node Machine)

http://10.30.217.157:4444 = IP Address of the Hub and 4444 is the port of the Hub

browserName = chrome (Parameter to specify the Browser name on Nodes)

5557 = Port on which chrome Node would be up and running.



Step 12 : After executing the command, come back to the Hub. Navigate to the URL - http://10.30.217.157:4444 and the Hub would now display the chrome node attached to it.

Develop the Script and Prepare the XML File

Step 1 : We will develop a test using TestNG. In the following example, we will launch each one of those browsers using remote WebDriver. It can pass on their capabilities to the driver so that the driver has all the information to execute on Nodes.

The Browser Parameter would be passed from the "XML" file.

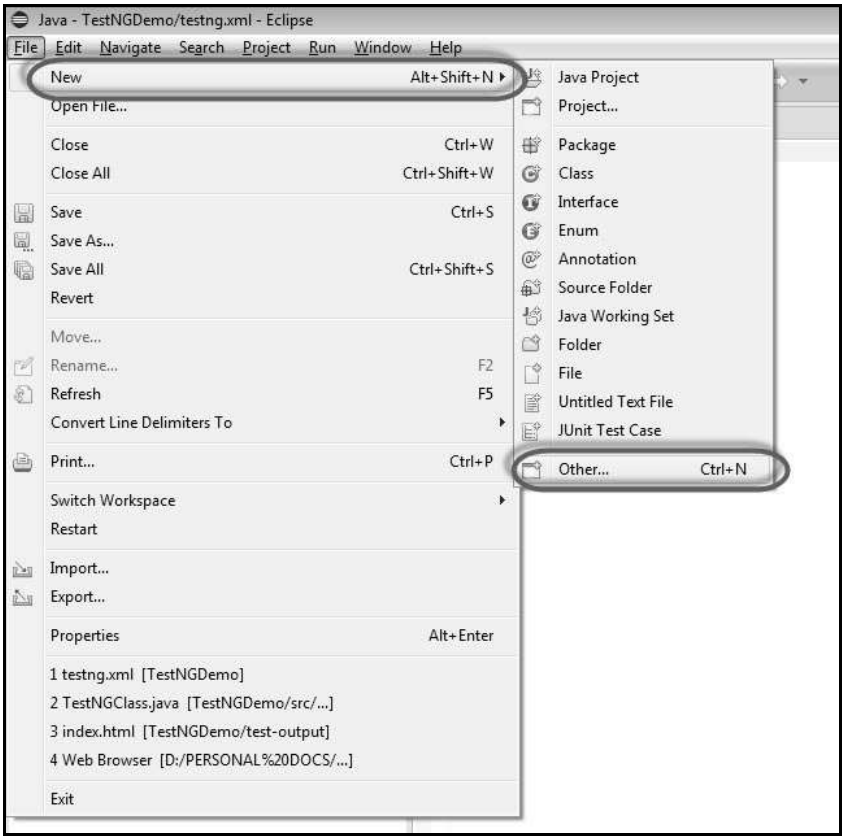
```
package TestNG;

import org.openqa.selenium.remote.DesiredCapabilities;
import java.util.concurrent.TimeUnit;
import org.openqa.selenium.*;
import org.testng.annotations.AfterTest;
import org.testng.annotations.BeforeTest;
import org.testng.annotations.Parameters;
import org.testng.annotations.Test;
import java.net.URL;
import java.net.MalformedURLException;

import org.openqa.selenium.remote.RemoteWebDriver;

public class TestNGClass
{
    public WebDriver driver;
    public String URL, Node;
    protected ThreadLocal<RemoteWebDriver> threadDriver = null;

    @Parameters("browser")
    @BeforeTest
    public void launchapp(String browser) throws MalformedURLException
    {
         String URL = "http://www.calculator.net";
         if (browser.equalsIgnoreCase("firefox"))
         {
              System.out.println(" Executing on FireFox");
              String Node = "http://10.112.66.52:5555/wd/hub";
              DesiredCapabilities cap = DesiredCapabilities.firefox();
              cap.setBrowserName("firefox");
```

```
            driver = new RemoteWebDriver(new URL(Node), cap);
            // Puts an Implicit wait, Will wait for 10 seconds
            // before throwing exception
            driver.manage().timeouts()
            .implicitlyWait(10, TimeUnit.SECONDS);

            // Launch website
            driver.navigate().to(URL);
            driver.manage().window().maximize();
        }
        else if (browser.equalsIgnoreCase("chrome"))
        {
            System.out.println(" Executing on CHROME");
            DesiredCapabilities cap = DesiredCapabilities.chrome();
            cap.setBrowserName("chrome");
            String Node = "http://10.112.66.52:5557/wd/hub";
            driver = new RemoteWebDriver(new URL(Node), cap);
            driver.manage().timeouts()
            .implicitlyWait(10, TimeUnit.SECONDS);

            //Launch website
            driver.navigate().to(URL);
            driver.manage().window().maximize();
        }
        else if (browser.equalsIgnoreCase("ie"))
        {
            System.out.println(" Executing on IE");
            DesiredCapabilities cap = DesiredCapabilities.chrome();
            cap.setBrowserName("ie");
            String Node = "http://10.112.66.52:5558/wd/hub";
            driver = new RemoteWebDriver(new URL(Node), cap);
            driver.manage().timeouts()
            .implicitlyWait(10, TimeUnit.SECONDS);
```

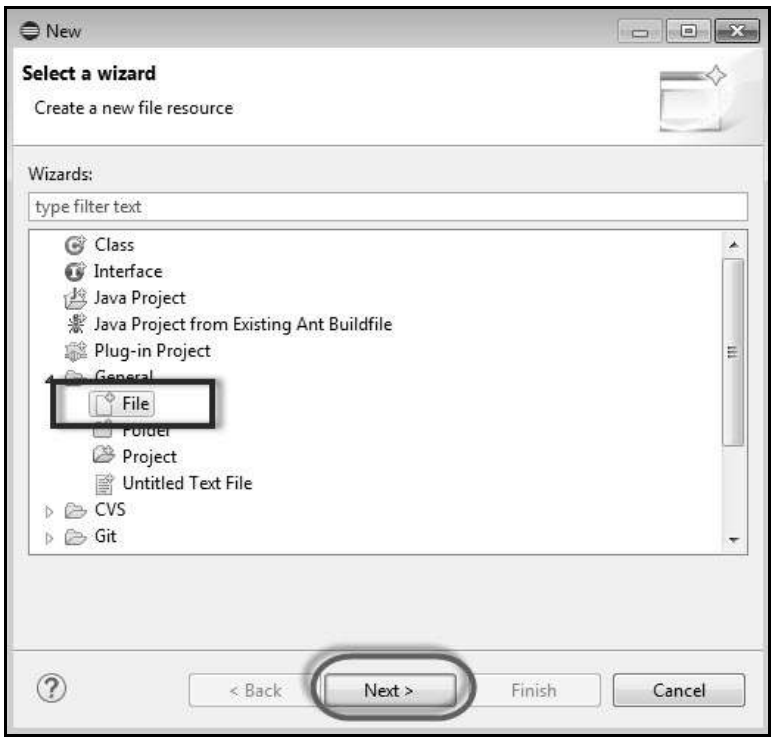
```
            //Launch website
            driver.navigate().to(URL);
            driver.manage().window().maximize();
        }
        else
        {
            throw new IllegalArgumentException
            ("The Browser Type is Undefined");
        }
}

@Test
public void calculatepercent()
{
  // Click on Math Calculators
  driver.findElement(By.xpath(".//*[@id='menu']/div[3]/a")).click();

  // Click on Percent Calculators
  driver.findElement(By.xpath(".//*[@id='menu']/div[4]/div[3]/a")).click();

  // Enter value 10 in the first number of the percent Calculator
  driver.findElement(By.id("cpar1")).sendKeys("10");

  // Enter value 50 in the second number of the percent Calculator
  driver.findElement(By.id("cpar2")).sendKeys("50");

  // Click Calculate Button
  driver.findElement(By.xpath(".//*[@id='content']/table/tbody
  /tr/td[2]/input")).click();

  // Get the Result Text based on its xpath
  String result =
  driver.findElement(By.xpath(".//*[@id='content']/p[2]
```

```
    /span/font/b")).getText();
    // Print a Log In message to the screen
    System.out.println(" The Result is " + result);


    if(result.equals("5"))
    {
         System.out.println(" The Result is Pass");
    }
    else
    {
         System.out.println(" The Result is Fail");
    }
 }

 @AfterTest
 public void closeBrowser()
    {
       driver.quit();
    }
}
```

Step 2 : The Browser parameter will be passed using XML. Create an XML under the project folder.

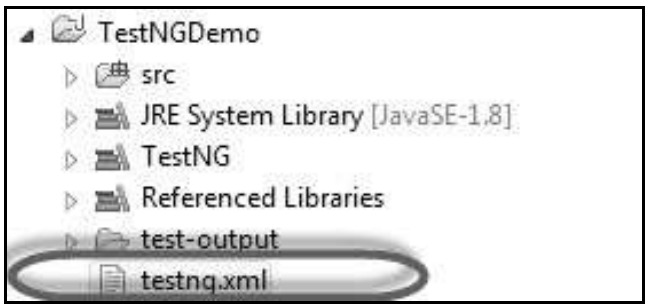


Step 3 : Select 'File' from 'General' and click 'Next'.



Step 4 : Enter the name of the file and click 'Finish'.

Step 5 : TestNg.XML is created under the project folder as shown below.



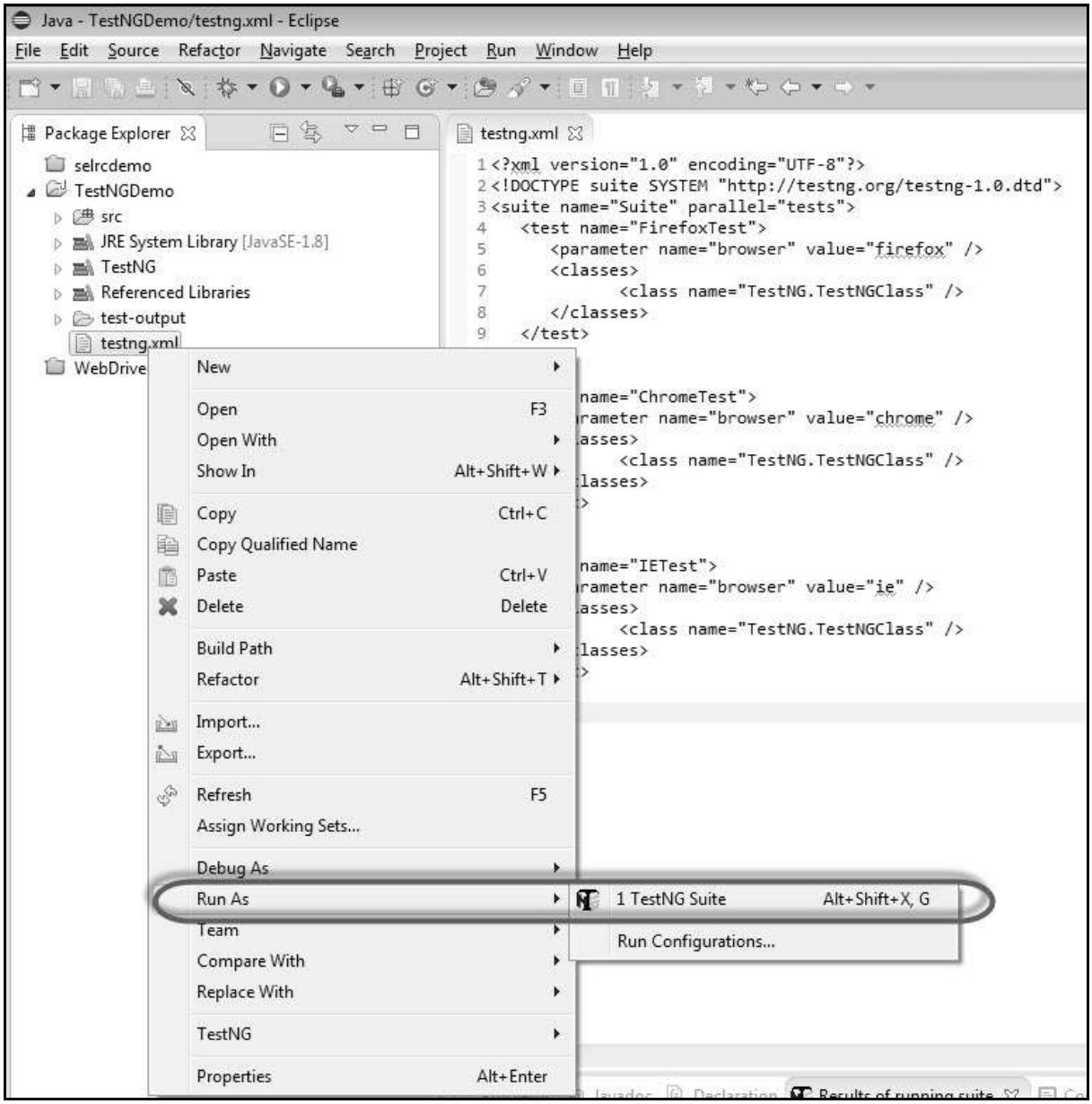
Step 6 : The contents of the XML file are shown below. We create 3 tests and put them in a suite and mention parallel="tests" so that all the tests would be executed in parallel.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE suite SYSTEM "http://testng.org/testng-1.0.dtd">
<suite name="Suite" parallel="tests">
   <test name="FirefoxTest">
      <parameter name="browser" value="firefox" />
      <classes>
            <class name="TestNG.TestNGClass" />
```

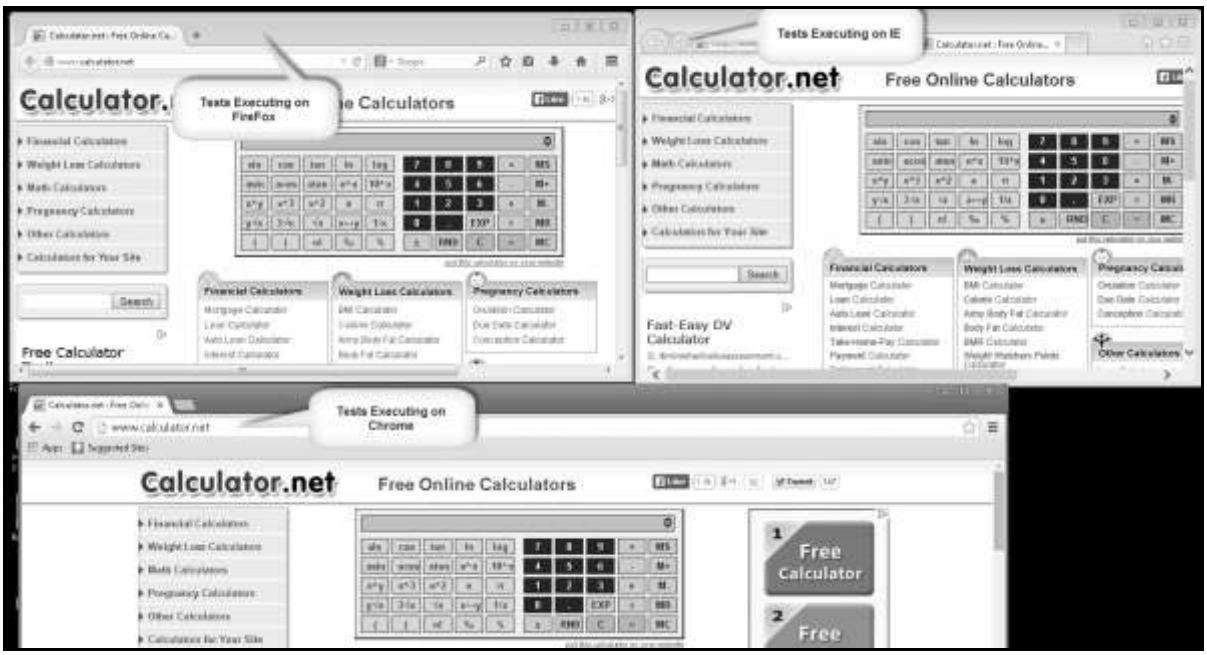
```
      </classes>
   </test>

   <test name="ChromeTest">
      <parameter name="browser" value="chrome" />
      <classes>
             <class name="TestNG.TestNGClass" />
      </classes>
   </test>

   <test name="IETest">
      <parameter name="browser" value="ie" />
      <classes>
             <class name="TestNG.TestNGClass" />
      </classes>
   </test>
</suite>
```

Test Execution

Step 1 : Select the created XML; right-click and choose 'Run As' >> 'TestNG Suite'.

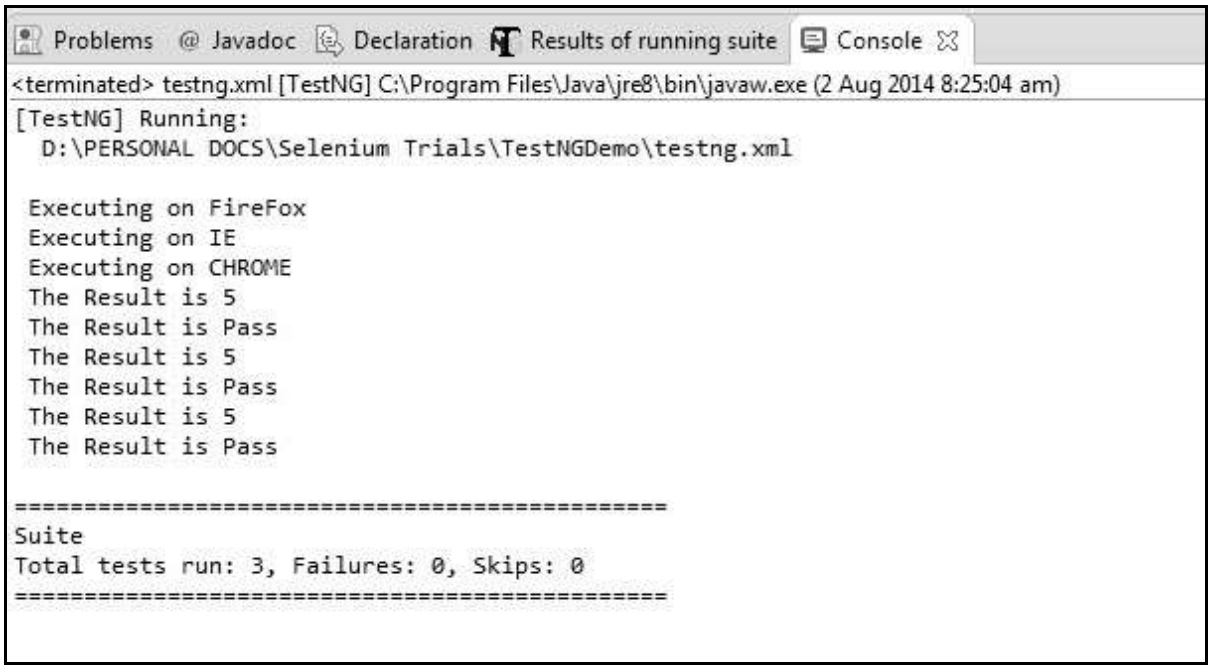

Java - TestNGDemo/testng.xml - Eclipse
File Edit Source Refactor Navigate Search Project Run Window Help
Package Explorer
selrcdemo
TestNGDemo
src
JRE System Library [JavaSE-1.8]
TestNG
Referenced Libraries
test-output
testng.xml
WebDrive
testng.xml
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE suite SYSTEM "http://testng.org/testng-1.0.dtd">
<suite name="Suite" parallel="tests">
<test name="FirefoxTest">
<parameter name="browser" value="firefox" />
<classes>
<class name="TestNG.TestNGClass" />
</classes>
</test>
New
Open F3
Open With
Show In Alt+Shift+W
Copy Ctrl+C
Copy Qualified Name
Paste Ctrl+V
Delete Delete
Build Path
Refactor Alt+Shift+T
Import...
Export...
Refresh F5
Assign Working Sets...
Debug As
Run As
Team
Compare With
Replace With
TestNG
Properties Alt+Enter
1 TestNG Suite Alt+Shift+X, G
Run Configurations...

Step 2 : Now open the Node, where we have launched all the browser nodes. You will see all the three browsers in execution simultaneously.

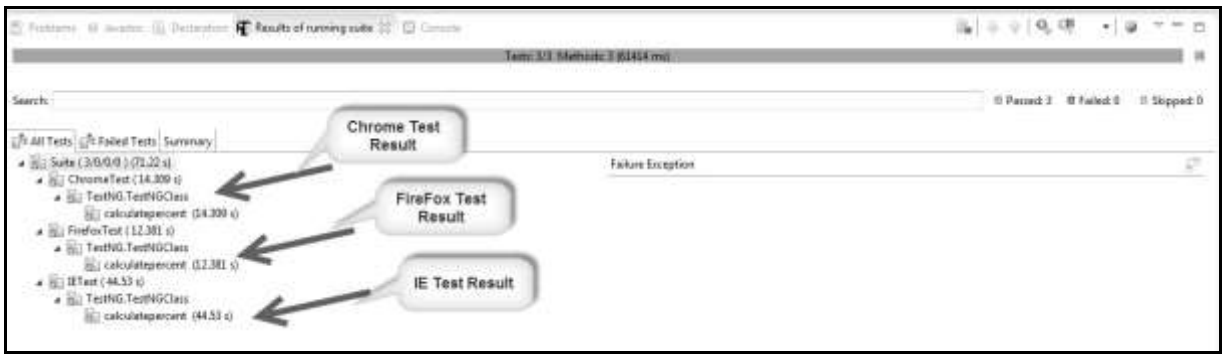


Result Analysis

Step 1 : Upon completing the execution, we can analyze the result like any other execution. The result summary is printed in the console as shown in the following snapshot.



Step 2 : Navigate to the 'Results of Running Suite' Tab and TestNG would display the result summary as shown below.



Step 3 : Upon generating the HTML, we will be able to see the test results in HTML format.