Selenium Training Book

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Chapter 1
Introduction to Selenium WebDriver

History

According to SeleniumHQ, the history of Selenium starts in 2004 at Thoughtworks with Jason Huggins building the core mode as JavaScriptTestRunner. He built the core mode because he did not want to manually step through the same test after every change. Therefore, Jason developed a JavaScript library that permitted him to run test repeatedly against multiple browsers such as Firefox, Google, and Internet Explorer.

Soon after, fellow coworker Paul Hammant saw a demo by Jason and started discussions about making Selenium open source. Open source is free software developed by the community and for the community. The JavaScript library became the core of Selenium that underlines Selenium Remote Control (RC).

Selenium RC is a powerful automation tool that allows an engineer to control the browser. The tool drastically improves productivity by reducing test time and cost. Although powerful, Selenium RC has drawbacks due to its JavaScript based automation engine. The drawback makes certain tasks impossible to carry out.

As a result of the drawbacks, an engineer named Simon Stewart started working on a project in 2006 called WebDriver. The goal of WebDriver was to address Selenium's drawbacks. After WebDriver solved the restrictions of Selenium, both developers decided to merge the two projects. The merge made Selenium WebDriver (also known as Selenium 2) a very robust test automation tool.

Selenium WebDriver released in 2011 and became the successor to Selenium RC. Selenium WebDriver runs on multiple platforms and supported by multiple programming languages. The platforms are Windows, Macintosh, and Linux while the programming languages are C # pronounced as C Sharp, Java, Python, and Ruby.

Chapter 1 provides an overview of this book and introduce the following:

- Java / Object-Oriented Programming
- Unit Test Frameworks
- First Selenium Test Script
- WebDriver and WebElements

Java / Object–Oriented Programming

According to TIOBE, Java is the most popular programming language within the programming community. Therefore, this book will cover Selenium WebDriver from Java's perspective. Java is a language that implements an object-oriented programming (OOP) model (see *Java / Object-Oriented Programming in Chapter 2*). The OOP model centers on objects.

An object is anything visible. Therefore, objects can be a person, place, or thing. All objects share two characteristics: state and behavior. State identifies the object while behavior represent the actions of the object. For example, a dog has a state (name, breed, color) which identifies the dog and behavior (bark, jump, fetch) which represent the dog's actions.

OOP allows an object to contain data and logic. Variables hold data while methods carry out the logic. A variable is a memory location with a name. Methods instruct the program what action to perform and how to perform the action. In addition, a method provides access to data defined by a class. Classes characterize the structure of an object. Objects, methods, and classes are interconnected which serve as the basis of OOP.

Unit Test Frameworks

Unit testing is a development process where developers test the smallest part of an application. Like most processes, unit testing can be time-consuming and tedious. A unit test framework such as JUnit and Test Next Generation (TestNG) facilitates the process (see *JUnit vs TestNG in Chapter 3*). The frameworks execute an individual Test Script, execute a collection of Test Scripts (known as Test Suite), verify expected outcomes (Pass or Fail), and report the results.

Several unit test frameworks belong in the xUnit family. The xUnit family is a collection of unit test frameworks with a common architecture. Each framework has a structure for a specific programming language. For example, JUnit structured for Java and NUnit structured for C#. Both frameworks (JUnit and NUnit) are part of the xUnit family. The following is a list of xUnit test frameworks and their programming languages:

- AsUnit structured for ActionScript
- JUnit structured for Java
- NUnit structured for Microsoft.Net programming languages
- PHPUnit structured for Python

However, not all unit test frameworks are part of xUnit. TestNG is not included in the xUnit family. Although not included in the xUnit family, JUnit inspired TestNG. As a result, TestNG adopted some of JUnit's concepts then added more features for testing an application.

First Selenium Test Script

Many beginners with a desire to learn Selenium start with Selenium Integrated Development Environment (IDE). Selenium IDE does not require knowledge of programming but allows test creation. Therefore, Selenium IDE primarily used to create an automation engineer's first Test Script (see *First Selenium Test Script in Chapter 4*). A test created through its record and replay feature is valuable. The tool interactively records a user's actions and replays those same actions. In addition, the test is replayed any number of times with an ability to compare actual and expected results. Why use Selenium WebDriver if Selenium IDE create and play back Test Scripts? The following screenshot from Selenium HQ describes which Selenium is appropriate for testing:

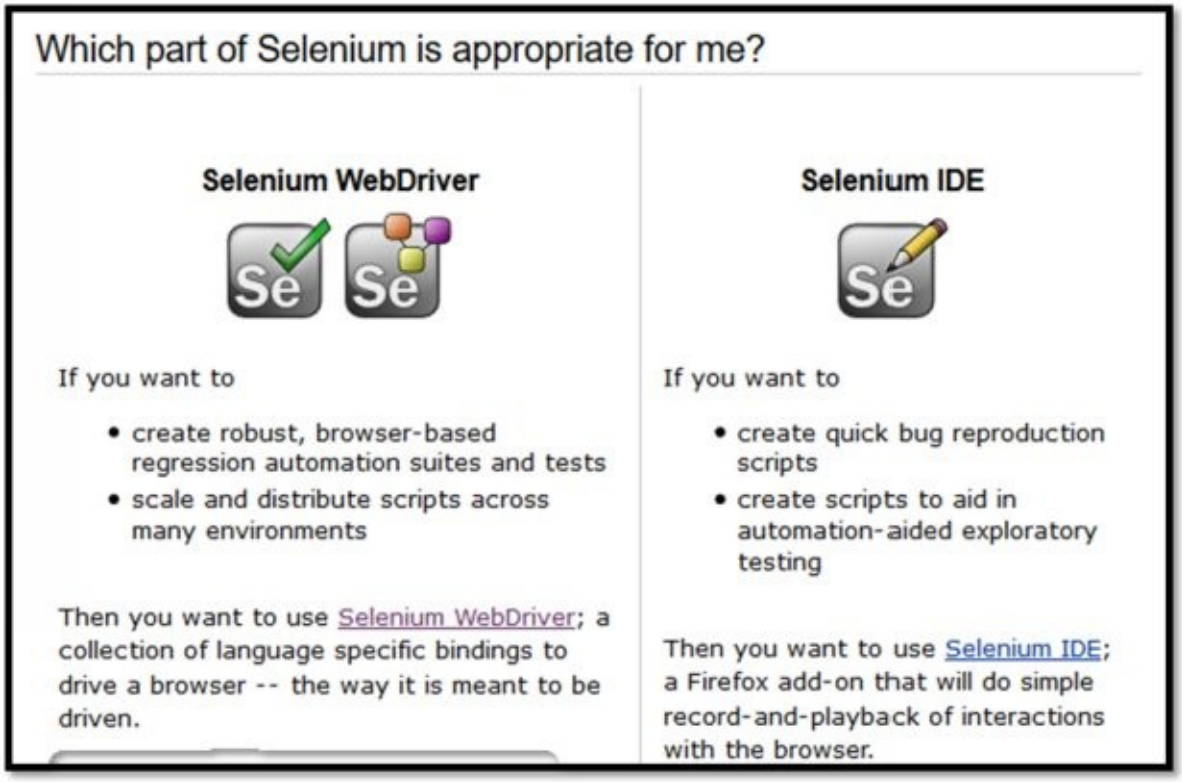


Figure 1. – Difference Between Selenium WebDriver and Selenium IDE

According to Selenium HQ, the difference between Selenium WebDriver and Selenium IDE:

- Selenium WebDriver
  - create robust, browser-based regression automation suites and tests
  - scale and distribute scripts across many environments
- Selenium IDE
  - create quick bug reproduction scripts
  - create scripts to aid in automation-aided exploratory testing

Note: Selenium IDE executes Test Scripts only in Firefox while Selenium WebDriver executes Test Scripts in all major browsers. The record and replay features in Selenium IDE start the automation experience but Selenium WebDriver completes the automation experience.

WebDriver and WebElements

Most software applications are web based applications designed to run on browsers. WebDriver is an interface tool for testing web applications that contain WebElements (see *WebDriver and WebElements in Chapter 5*). WebElements (also known as elements) are buttons, text boxes, checkboxes, drop down menus, and hyperlinks. Identifying an element and performing an action on the element are keys to automating an application. It is important to know that WebDriver identify and perform actions on the elements.

Note: In the field of automation testing, objects or elements describe an entity “i.e., button, text box, etc.”

Installations

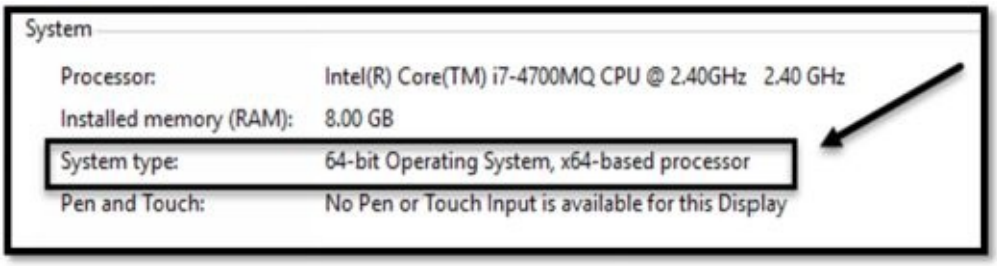
Eclipse requires several installations to execute automation Test Scripts. It is best to provide all of the installation steps in one section rather than listing the steps in different parts of the book. The following is a list of installations to get started with Selenium WebDriver using Java:

Verify The System Type

A verification of the System Type determines the computer's version. Knowledge of the System Type helps when downloading/installing a particular product. All types of errors such as performance issues can occur soon after installing the wrong System Type. The following are steps to verify a computer's System Type:

Steps To Verify The System Type:

1. Go to Start menu
2. Select System
3. System type = "i.e., 64-bit Operating System - Windows 64"



Install Browsers

A browser is a software application used to access the internet. It provides a way to interact with all of the information on the World Wide Web. There are many browser types. However, they contain similar functionalities. Each browser retrieves and presents information via hyperlinks. The most commonly used browsers are Firefox, Google Chrome, and Internet Explorer (IE). An installation of at least one browser is required in order to install the other products. The following are steps to install Firefox, Google Chrome, and Internet Explorer:

Steps To Install Firefox:

1. Go to https://www.mozilla.org/en-US/firefox/new/
2. Click Free Download
3. Click Save then save to a location
4. Click Run
5. Click Yes
6. Click Next
7. Click Install
8. Click Finish

Steps To Install Google Chrome:

1. Go to https://support.google.com/chrome/answer/95346?hl=en
2. Click Download
3. Click Accept and Install
4. Click Run
5. Click Yes

Steps To Install Internet Explorer:

1. Go to https://www.microsoft.com/en-us/download/details.aspx?id=39232
2. Click Download

3. Click Run
4. Click Continue
5. Click Install

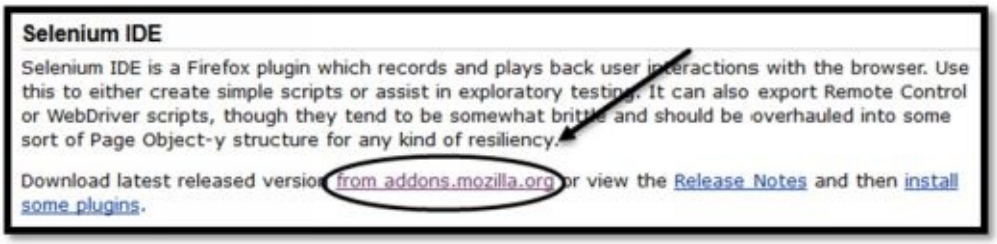
Note: The steps to install each browser are subject to change.

Install Selenium IDE

Selenium IDE is a Firefox extension. The tool records, replays, edits, and debugs a Test Script. Frequently, Selenium IDE is an introduction to automation due to its record and playback features. The tool permits code conversion to a specific language “i.e., Java” and unit test framework “i.e., TestNG”. This technique helps a beginner learn how to read the code before writing the code. The following are steps to install Selenium IDE:

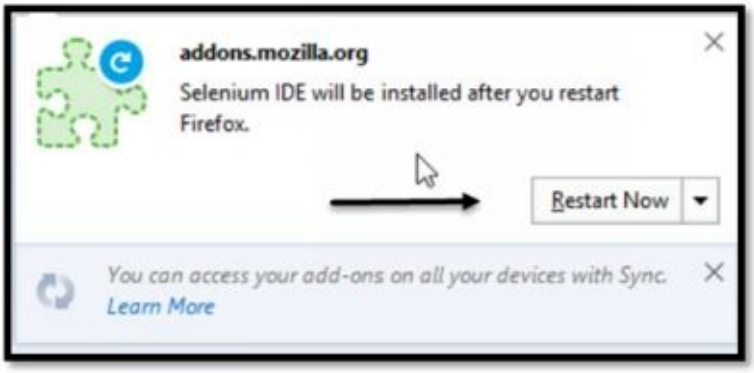
Steps To Install Selenium IDE:

1. Open Firefox browser
2. Go to http://www.seleniumhq.org/download/
3. Select from addons.mozilla.org from Selenium IDE section

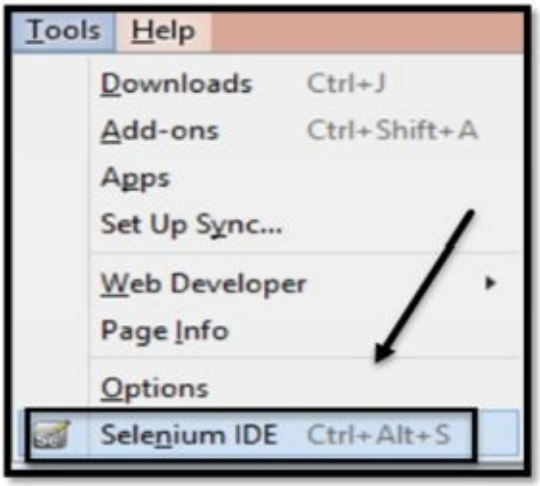


4. Click Add to Firefox

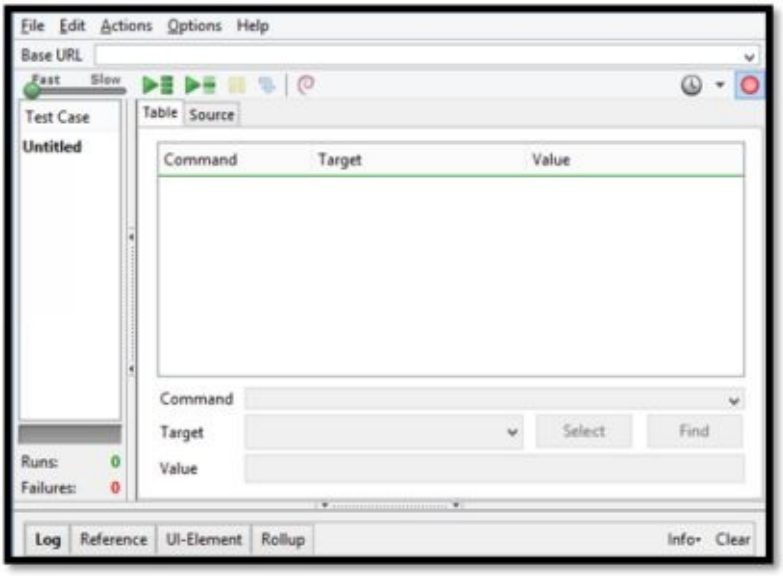
5. Click Restart Now



6. Selenium IDE is installed into Firefox: Tools > Selenium IDE



7. Load Selenium IDE

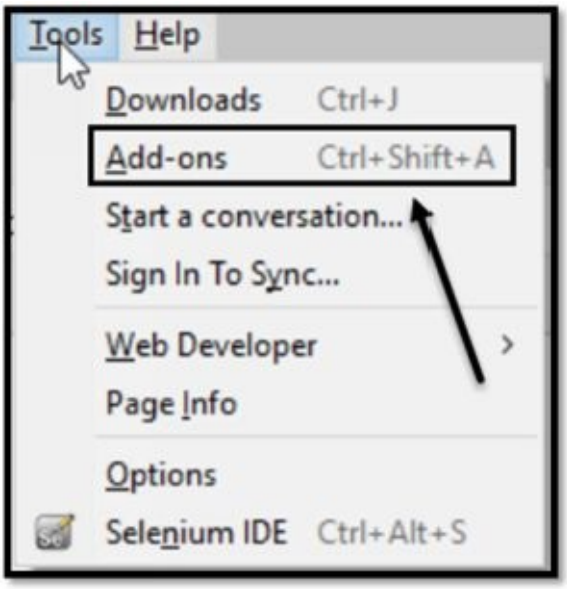


Install Firebug and FirePath

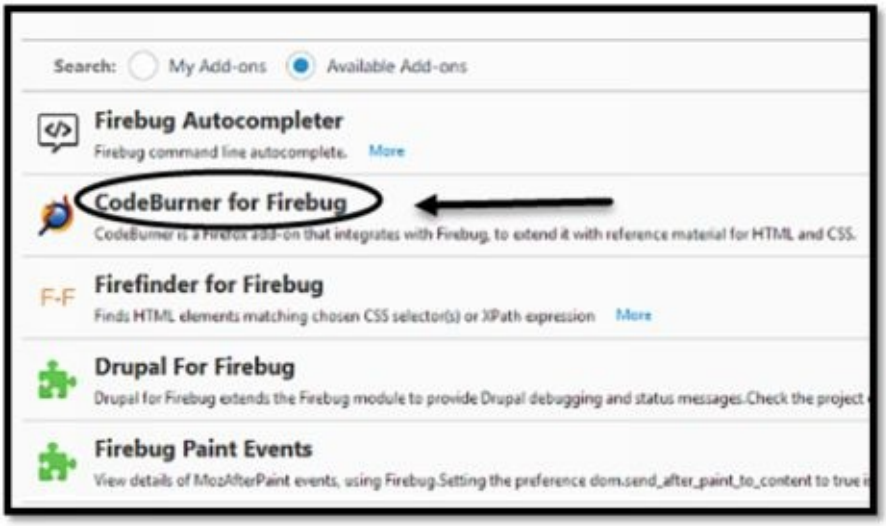
Firebug is an open source Firefox extension that facilitates the process of recognizing WebElements. The Firebug tool allows an element inspection. Element inspection pinpoints a specific element within a web application. Selenium WebDriver provides eight locators to assist with finding an element. Two of the locators (CSS and XPath) must use FirePath to recognize the elements. FirePath is included with Firebug after installation. The following are steps to install Firebug and FirePath:

Steps To Install Firebug and FirePath:

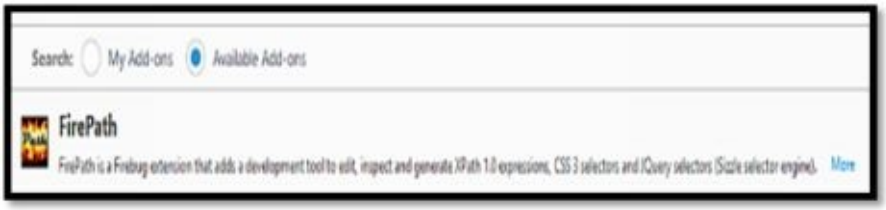
1. Open Firefox browser
2. Navigate to Tools > Add-ons



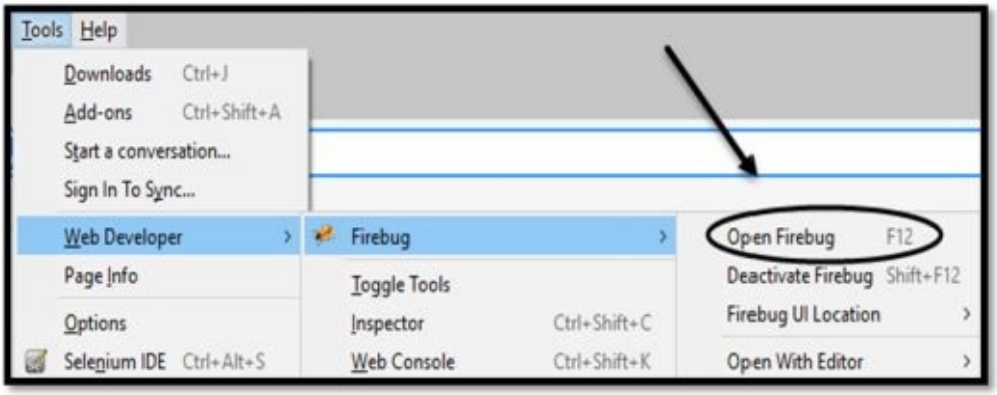
3. Select Add-ons tab if not selected by default
4. Search for Firebug then Install CodeBurner for Firebug



5. Search for FirePath then Click Install for FirePath



6. Click Restart Now
7. Open Firebug: Navigate to Tools > Web Developer > Firebug > Open Firebug



8. FirePath is loaded within Firebug

Install Java Development Kit (JDK)

The Java Development Kit (JDK) is a software development environment used for writing code in Java. It includes many required components for creating and testing applications. Some of the components are Java Runtime Environment (JRE), Java Compiler, Java Interpreter, and Java Archiver (JAR).

- Java Runtime Environment (JRE) – provides the requirements to execute code in a web browser
- Java Compiler – primary program that reads class definitions then compiles it into bytecode class files
- Java Interpreter – primary program that executes bytecode for Java Virtual Machine
- Java Archiver (JAR) – files used to combine Java class files

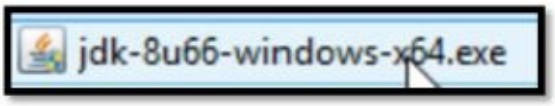
The following are steps to install JDK:

Steps To Install JDK:

1. Go to http://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html
2. Click the JDK Download button

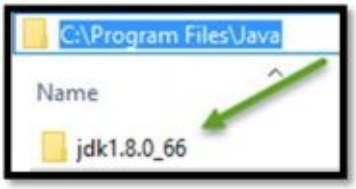
3. Click Accept License Agreement in the Java SE Development Kit 8u66 section
   Note: There may be a more recent version than 8u66

4. Click the Download link for the appropriate System Type “i.e., Windows x64”
5. Go to the Download folder
6. Open the downloaded executable file

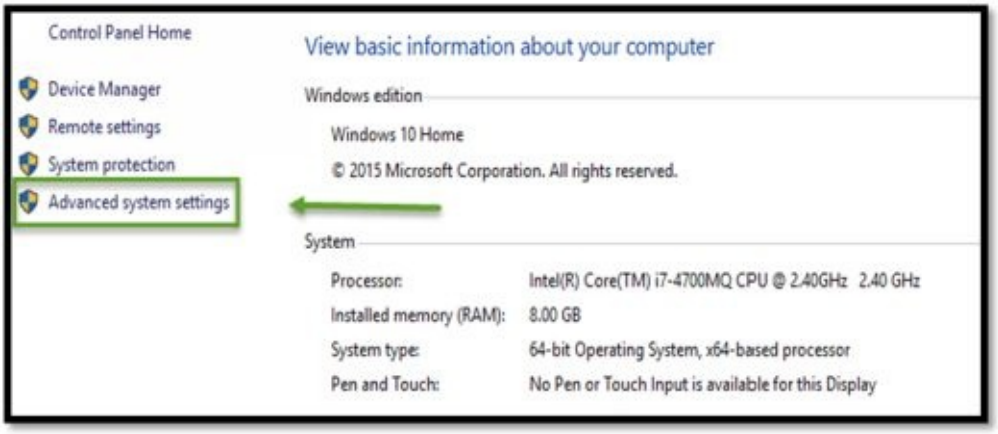


7. Click the Next button to Set Up Java SE Development Kit
8. Click the Next button for Custom Set Up
9. Click the Next button to Install to a specific location “i.e., C:\Program Files\Java”

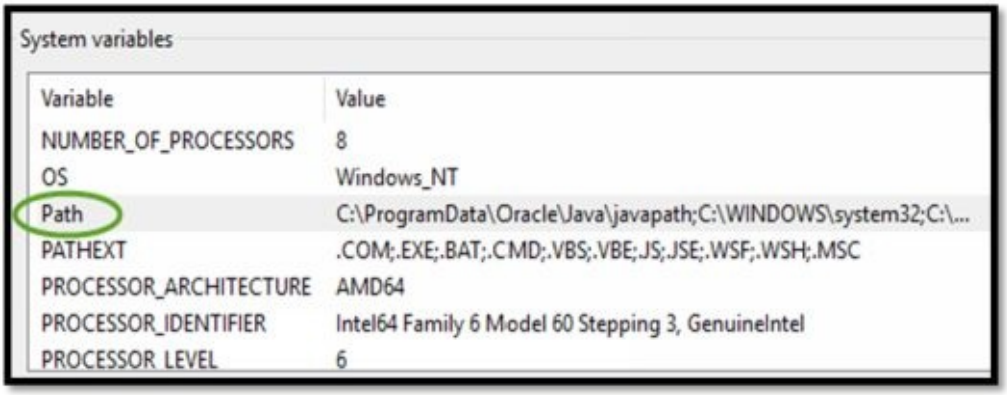
10. Go to the location and Open the jdk folder “i.e., jdk1.8.0_66”



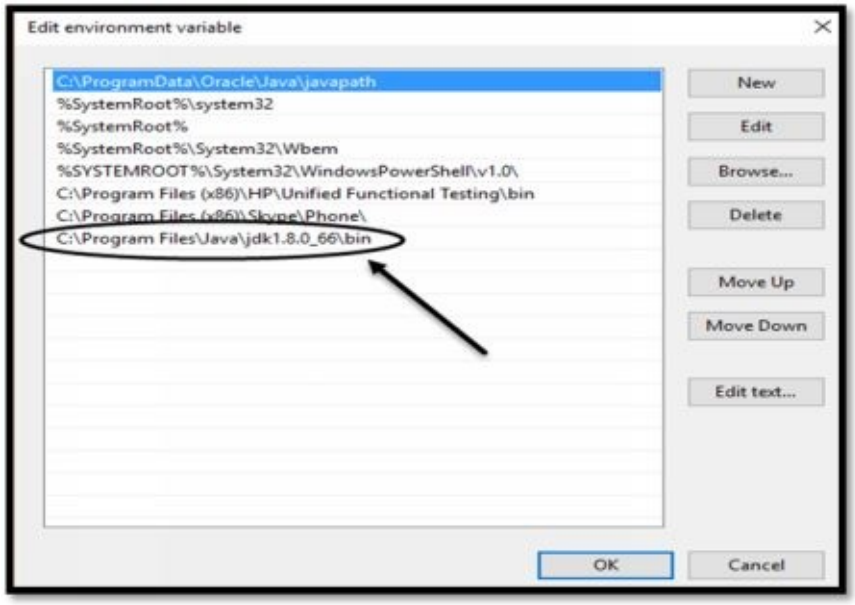
11. Open the bin folder
12. Copy the bin folder’s location “i.e., C:\Program Files\Java\jdk1.8.0_66\bin”
13. Access the Advanced system settings via System



14. Click the Advanced tab
15. Click Environment Variables
16. Go to Path within System variables section



17. Click Edit
18. Paste the bin folder's location "i.e., C:\Program Files\Java\jdk1.8.0_66\bin"



19. Click OK
20. Click Apply
21. Click OK

Note: Steps 10 – 21 are optional but beneficial. Eclipse automatically searches for the path "i.e., C:\Program Files\Java\jdk1.8.0_66\bin" that is placed in the Environment Variables modal.

Install Eclipse IDE

Eclipse is an open source IDE used for developing and testing applications. An IDE is comprehensive whereby it contains many features. The source code editor and debugger are some of the features. A source code editor allows code creation while a debugger examines the created code. Eclipse supports multiple programming languages but mainly used for Java. One of the benefits of Eclipse is the use of plugins. The plugins allow customizations and additional functionalities. The following are steps to install Eclipse IDE:

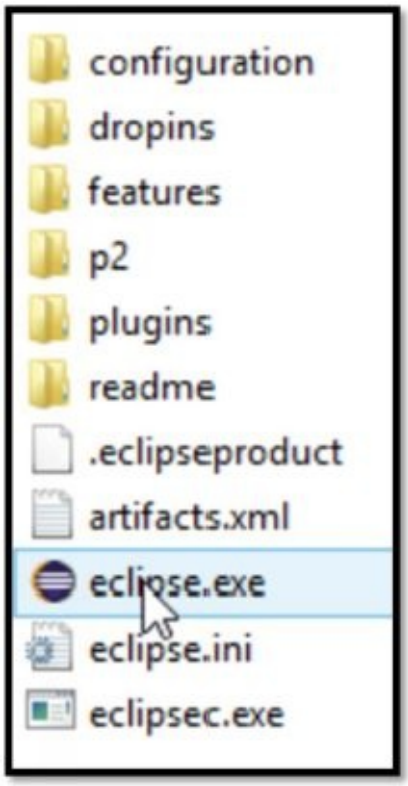
Steps To Install Eclipse:

1. Go to https://eclipse.org/downloads/
2. Select the platform (Windows, Mac OS, or Linux)
3. Click the System Type “i.e., 64 bit” for Eclipse IDE for Java EE Developers

4. Choose a mirror close to you “i.e., Columbia University”

5. Go to Download folder
6. Right click the Eclipse zip file and Extract All files

7. Open the eclipse.exe file to launch Eclipse IDE
    1. Go the extracted folder “i.e., eclipse-jee-mars-1-win32-x86_64”
    2. Open eclipse folder
    3. Right click eclipse.exe and Select Open



8. Load Eclipse IDE

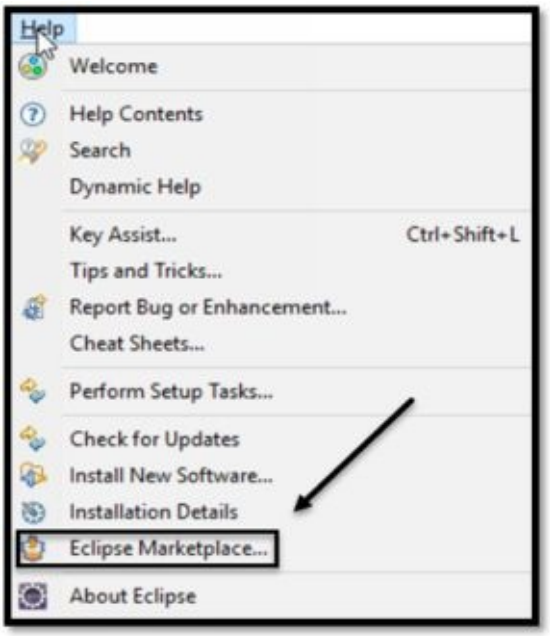

eclipse
MARS.1
Loading org.eclipse.ui.intro.universal

Install TestNG

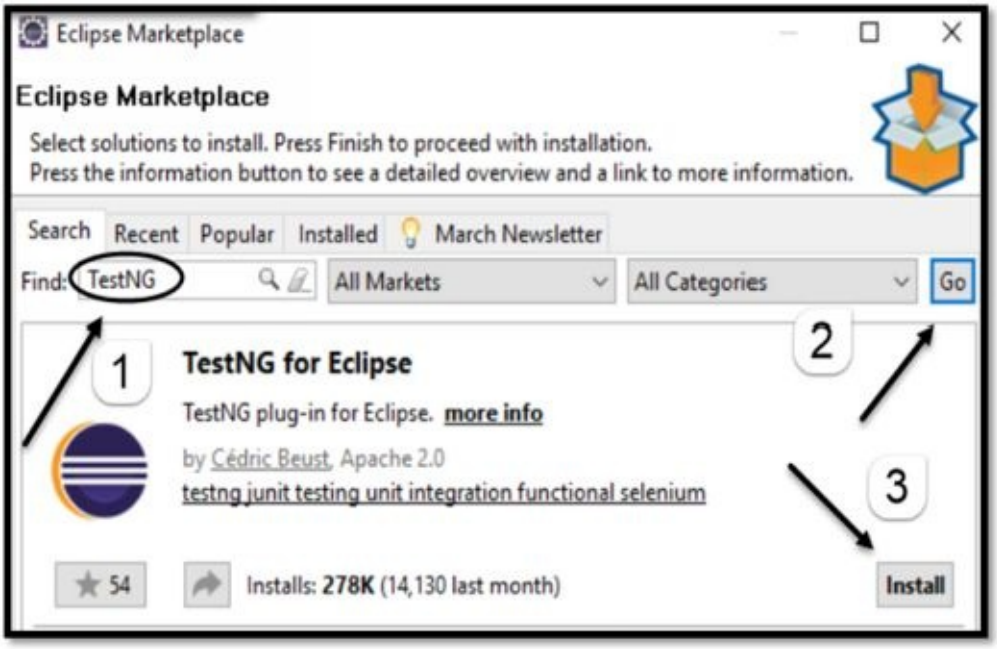
TestNG is a powerful testing framework structured for Java. The framework is designed to cover all types of testing such as unit, regression, functional, end-to-end, and integration. Eclipse requires a TestNG installation to utilize TestNG features. The following are steps to install TestNG:

Steps To Install TestNG:

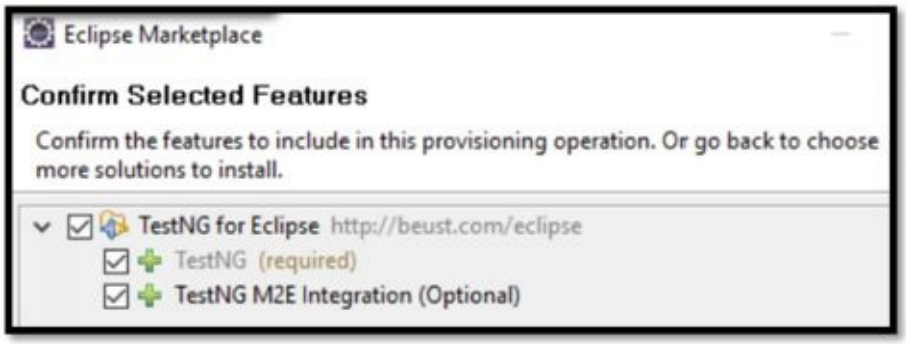
1. Open Eclipse
2. Load a Project “i.e., Hello World”
3. Click Help > Eclipse Marketplace



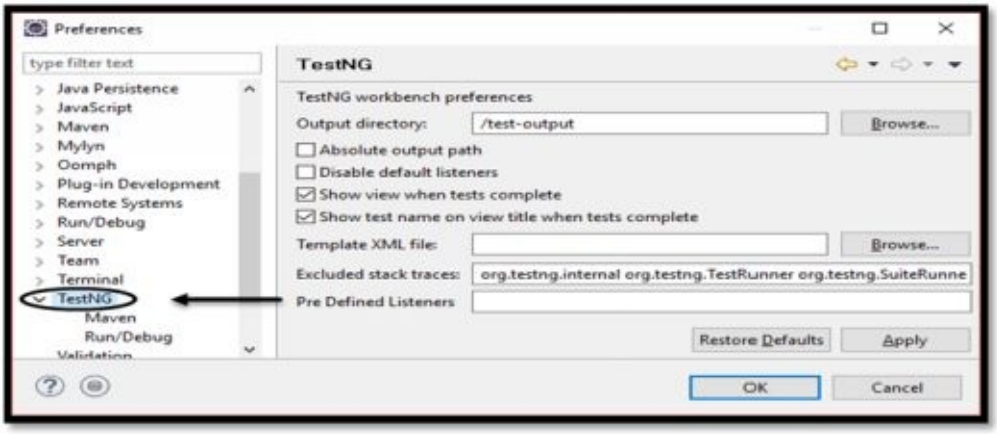
4. Search for TestNG, Click the Go button, then Click the Install button



5. Click the Confirm button to confirm the following features:
    1. TestNG (required)
    2. TestNG M2E Integration (Optional)



6. Click the radio button “I accept the terms of the license agreement”
7. Click the Finish button
8. Click OK if a Security Warning appears in a modal
9. Click Yes to restart Eclipse
10. Verify TestNG has been added
    1. Re-open Eclipse after restart
    2. Click Window
    3. Click Preferences


Preferences
type filter text
Java Persistence
JavaScript
Maven
Mylyn
Oomph
Plug-in Development
Remote Systems
Run/Debug
Server
Team
Terminal
TestNG
Maven
Run/Debug
Validation
TestNG
TestNG workbench preferences
Output directory:
/test-output
Browse...
Absolute output path
Disable default listeners
Show view when tests complete
Show test name on view title when tests complete
Template XML file:
Browse...
Excluded stack traces:
org.testng.internal org.testng.TestRunner org.testng.SuiteRunne
Pre Defined Listeners
Restore Defaults
Apply
OK
Cancel

Configure WebDriver

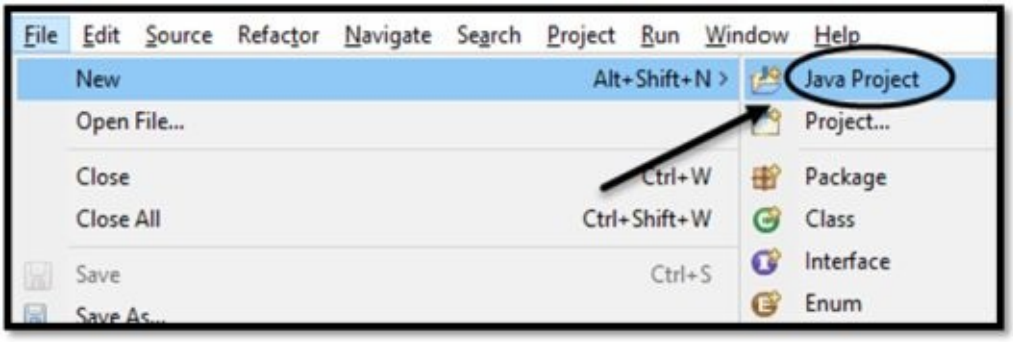
As mentioned earlier, Selenium WebDriver supports multiple programming languages. The programming languages are C#, Java, Python, and Ruby. Download the client driver in order to execute Test Scripts for a particular language. In this case, WebDriver requires a client driver specific to Java. After downloading, configure the client driver in Eclipse by adding JAR files. A JAR file is a collection of multiple Java class files used to distribute Java libraries. Selenium HQ allows a download of the most recent client version for all supported languages. The following are steps to configure a Java client driver:

Steps To Configure A Java Client Driver:

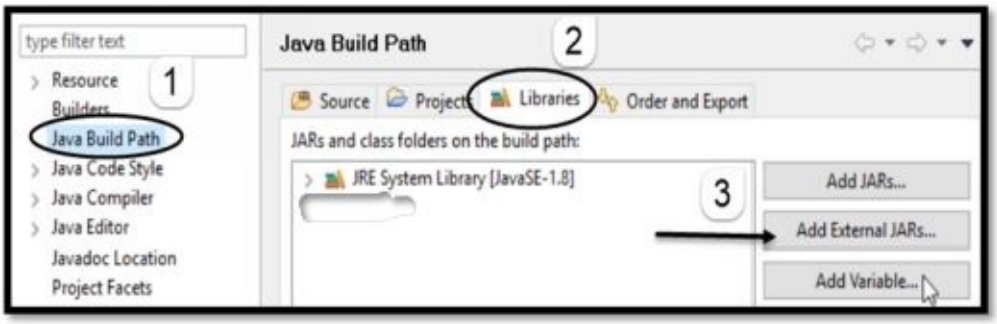
1. Go to http://docs.seleniumhq.org/download/
2. Download client driver for Java

3. Go to Download folder
4. Right click the zip file “i.e., selenium-java-2.48.2.zip” and Extract All “jar files”

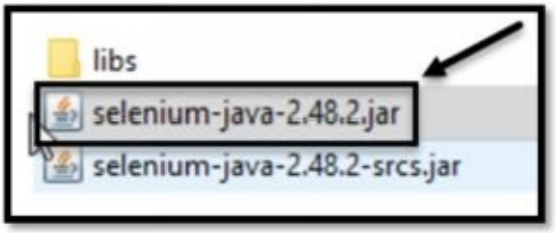
5. Open Eclipse IDE
6. Create New Project:
   Navigate to File > New > Java Project > Project Name “i.e., Hello World” > Finish



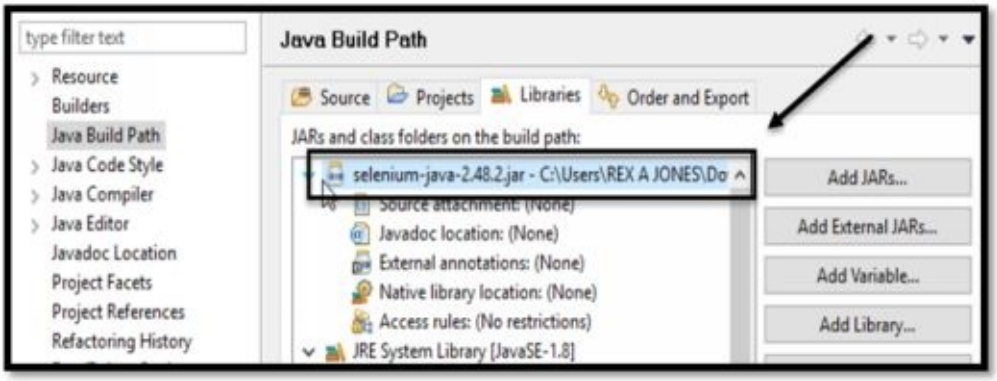
7. Click File > Properties
8. Select Java Build Path > Libraries > Add External JARs



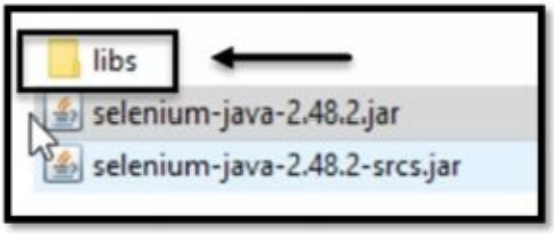
9. Go to the Download folder and Select the extracted jar file “selenium-java-2.48.2.jar”



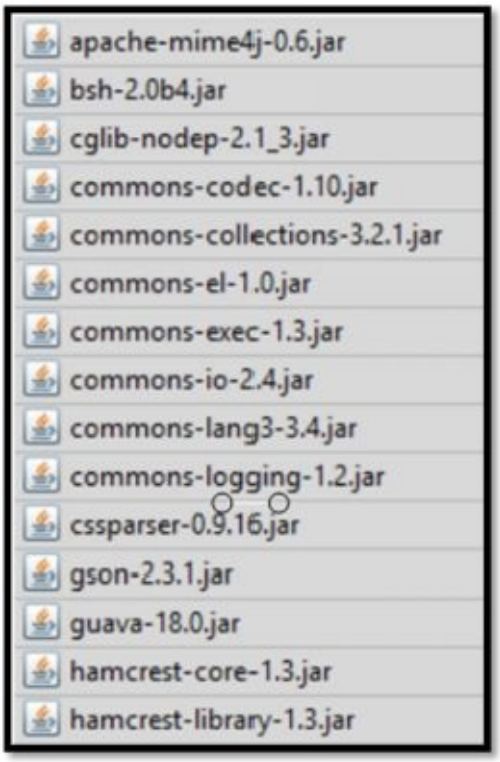
10. Click Open > jar file “i.e., selenium-java-2.48.2.jar” added to the Library



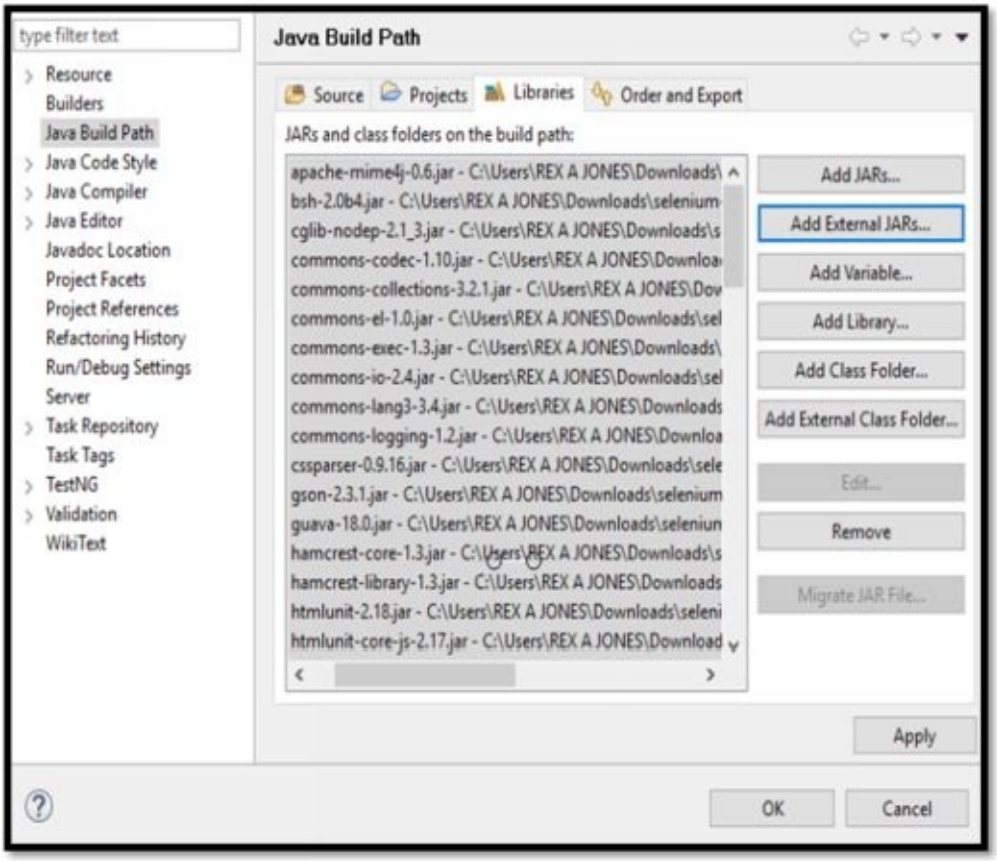
11. Click Add External JARs
12. Select libs in the extracted folder “i.e., selenium-java-2.48.2”



13. Select all of the jar files in libs folder: Ctrl + A



14. All of the jar files are added to the Java Build Path Library > Click OK


type filter text
Resource
Builders
Java Build Path
Java Code Style
Java Compiler
Java Editor
Javadoc Location
Project Facets
Project References
Refactoring History
Run/Debug Settings
Server
Task Repository
Task Tags
TestNG
Validation
WikiText
Java Build Path
Source
Projects
Libraries
Order and Export
JARs and class folders on the build path:
apache-mime4j-0.6.jar - C:\Users\REX A JONES\Downloads\
bsh-2.0b4.jar - C:\Users\REX A JONES\Downloads\selenium
cglib-nodep-2.1_3.jar - C:\Users\REX A JONES\Downloads\s
commons-codec-1.10.jar - C:\Users\REX A JONES\Downloa
commons-collections-3.2.1.jar - C:\Users\REX A JONES\Dov
commons-el-1.0.jar - C:\Users\REX A JONES\Downloads\sel
commons-exec-1.3.jar - C:\Users\REX A JONES\Downloads\
commons-io-2.4.jar - C:\Users\REX A JONES\Downloads\sel
commons-lang3-3.4.jar - C:\Users\REX A JONES\Downloads
commons-logging-1.2.jar - C:\Users\REX A JONES\Downloa
cssparser-0.9.16.jar - C:\Users\REX A JONES\Downloads\sele
gson-2.3.1.jar - C:\Users\REX A JONES\Downloads\selenium
guava-18.0.jar - C:\Users\REX A JONES\Downloads\seleniun
hamcrest-core-1.3.jar - C:\Users\REX A JONES\Downloads\s
hamcrest-library-1.3.jar - C:\Users\REX A JONES\Downloads
htmlunit-2.18.jar - C:\Users\REX A JONES\Downloads\seleni
htmlunit-core-js-2.17.jar - C:\Users\REX A JONES\Download
Add JARs...
Add External JARs...
Add Variable...
Add Library...
Add Class Folder...
Add External Class Folder...
Edit...
Remove
Migrate JAR File...
Apply
OK
Cancel

Download Browser Drivers / Set Up Profiles

According to Selenium HQ, "in order to create scripts that interact with the Selenium Server (Selenium RC, Selenium Remote WebDriver) or create local Selenium WebDriver scripts, you need to make use of language-specific client drivers". The core languages are C#, Java, JavaScript, Python, and Ruby. Most of the drivers execute on Google Chrome, Internet Explorer, and Firefox. A profile is set up in Firefox while Google Chrome and Internet Explorer require client drivers. The following provides steps to download drivers and set up a profile on the most used browsers:

- Google Chrome
- Internet Explorer
- Firefox

Google Chrome

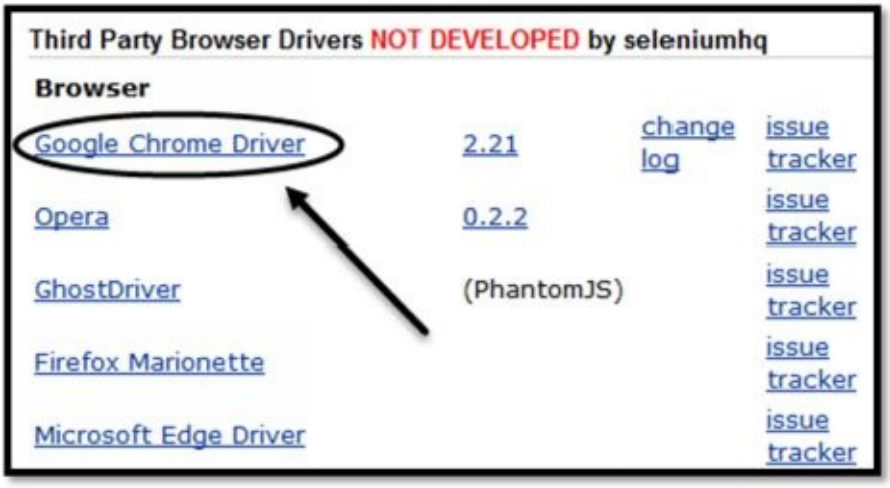
Google Chrome requires a driver called ChromeDriver to run Selenium WebDriver Test Scripts. WebDriver uses ChromeDriver to control testing performed on Google Chrome. An error occurs in Eclipse if there is not a driver download. However, the error provides the following link to download the latest ChromeDriver:

http://chromedriver.storage.googleapis.com/index.html

The following are steps to download ChromeDriver from Selenium HQ:

Steps To Download ChromeDriver:

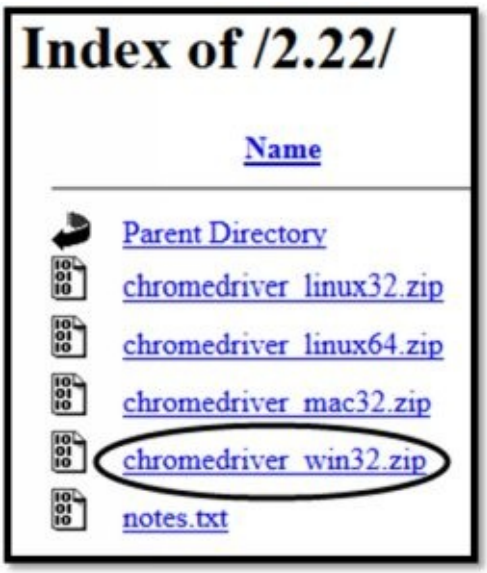
1. Go to http://docs.seleniumhq.org/download/
2. Click the link for Google Chrome Driver in Third Party Browser Drivers section



3. Click the link for the most recent release “i.e., 2.22” via https://sites.google.com/a/chromium.org/chromedriver/

4. Click the link for the most recent release again “i.e., 2.22” via https://sites.google.com/a/chromium.org/chromedriver/downloads

5. Download the system’s zip file “i.e., chromedriver_win 32.zip”

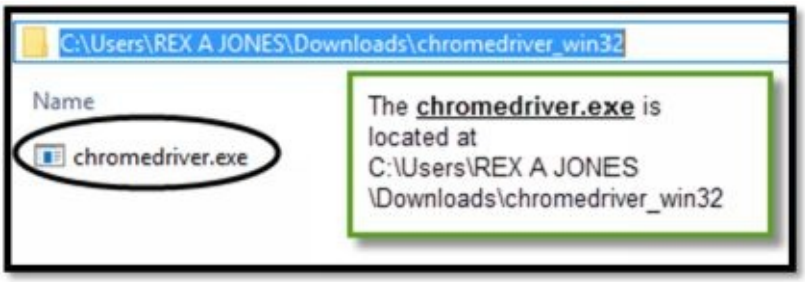


Note: Zip file for Windows 64 is not available. Therefore, the zip file for Windows

32 “chromedriver_win 32.zip” should be downloaded

6. Go to Download folder
7. Right click the zip file “i.e., chromedriver_win32.zip” and Extract All

8. Open the extracted folder “i.e., chromedriver_win32”
9. chromedriver.exe has been downloaded



Note: The chromedriver.exe is located at C:\Users\REX A JONES\Downloads\chromedriver_win32.

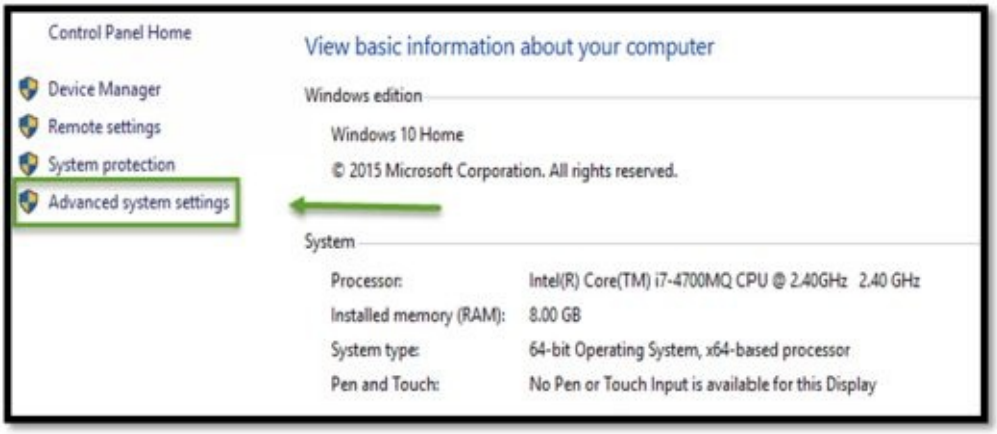
There are two ways to ensure Test Scripts run successfully:

- Add path to Environment Variables – System Variables
- Add path to Selenium WebDriver Test Script. The following is an example of using the chromedriver.exe in a Test Script:

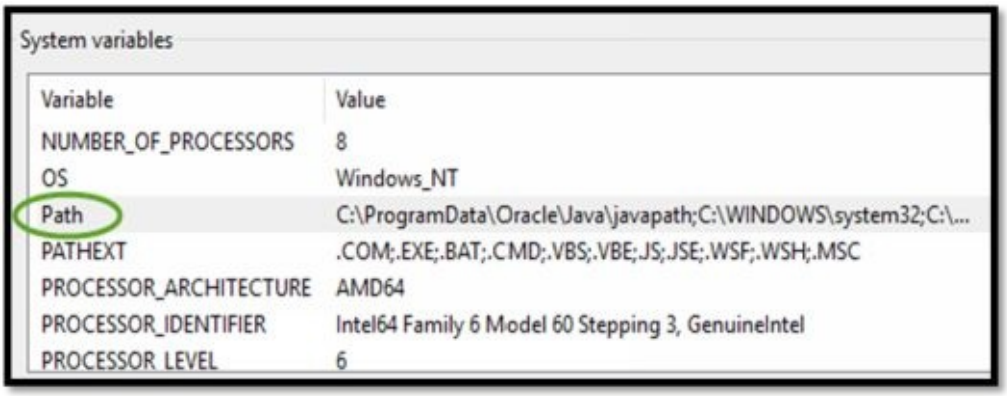
C:\Users\REX A JONES\Downloads\chromedriver_win32\chromedriver.exe”);

The following illustrates how to add the executable file “i.e., chromedriver.exe” path to Environment Variables - System Variables:

10. Copy the path “i.e., C:\Users\REX A JONES\Downloads\chromedriver_win32”
11. Access the Advanced system settings via System

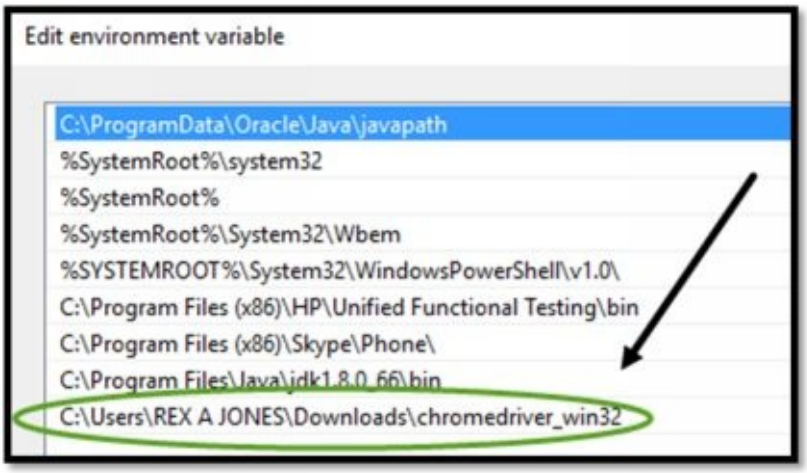


12. Click the Advanced tab
13. Click Environment Variables
14. Go to Path within System variables section



15. Click Edit
16. Paste the ChromeDriver's executable file location

"i.e., C:\Users\REX A JONES\Downloads\chromedriver_win32"



17. Click OK
18. Click Apply
19. Click OK

Note: Most examples in this book include an extra code line via System.set*Property* when executing Test Scripts in Google Chrome. However, the preferred way is to add the path to Environment Variables – System Variables.

Internet Explorer

Internet Explorer requires a driver called IEDriverServer to run Selenium WebDriver Test Scripts. WebDriver uses IEDriverServer to control testing performed on Internet Explorer. An error occurs in Eclipse if there is not a driver download. Selenium HQ contains a section called Internet Explorer Driver Server that allows an IEDriverServer download. Follow the same steps (6 - 9) from Google Chrome's section after downloading IEDriverServer:

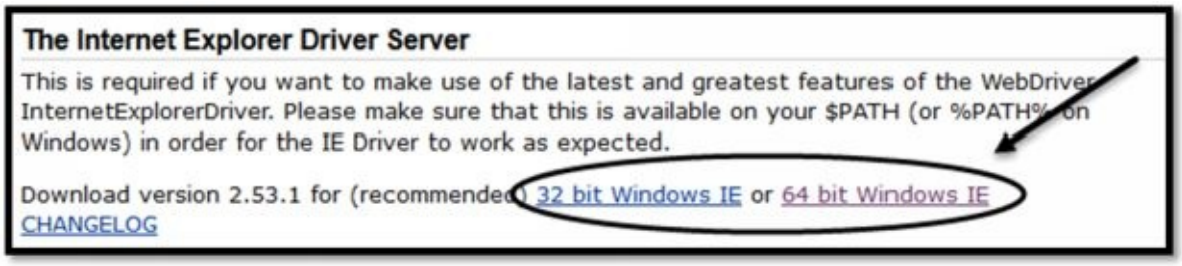
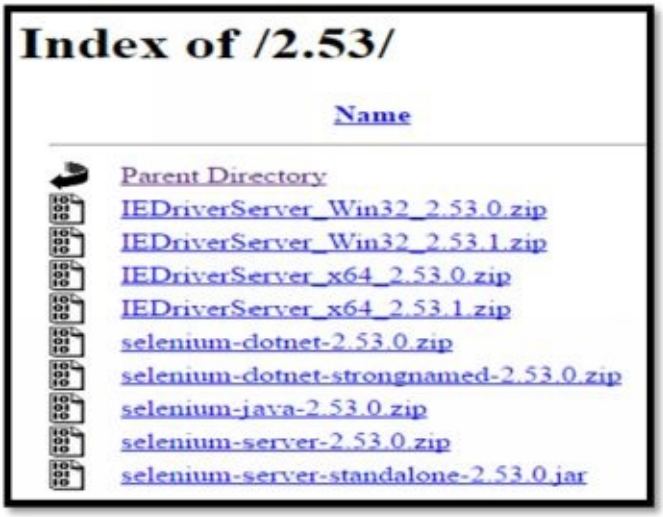


Figure 1.1 – Internet Explorer Driver Server

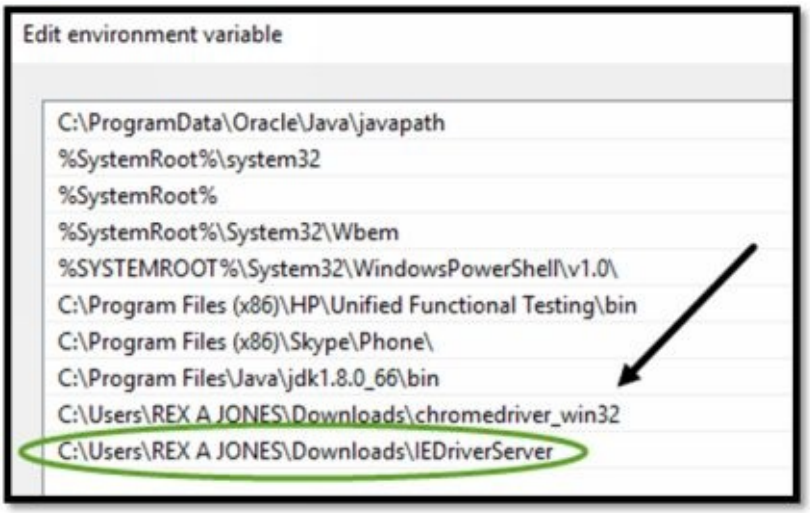
Eclipse provides a link to download IEDriverServer if an error occurs. The following are steps to download IEDriverServer directly from that link:

Steps To Download IEDriverServer:

1. Go to http://selenium-release.storage.googleapis.com/index.html?path=2.53/
2. Download the most recent Internet Explorer driver "i.e., 2.53"



3. Follow the same steps (6 - 19) from Google Chrome's section to execute Test Scripts for Internet Explorer browser.



Note: The security and Firewall exception must be set up / added before running Test Scripts in Internet Explorer.

4. Go to Tools in Internet Explorer
5. Select Internet Options
6. Select Security
7. Confirm the Security Level for all zones (Internet, Local Intranet, Trusted Sites and Restricted Access) are the same
    1. Uncheck or Check the checkbox for Enable Protected Mode
    2. Click Apply
    3. Click OK
    4. Click OK
8. Add Firewall exception by double clicking the IEDriverServer.exe file in its path

"i.e., C:\Users\REX A JONES\Downloads\IEDriverServer"

9. Click Allow Access

Firefox

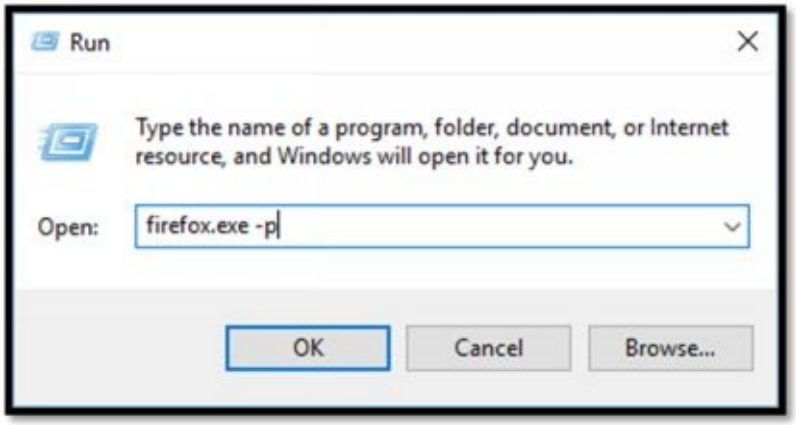
Firefox does not require a separate driver server like Google Chrome and Internet Explorer. Firefox has an in-built server support in Selenium. However, it is beneficial to create a Firefox profile. A Firefox profile is a collection of user preferences, bookmarks, browser settings, extensions, passwords, and history saved into a file. The profile is saved to a separate location from the other Firefox program files. The following are steps to set up a Firefox profile:

Steps To Set Up A Firefox Profile:

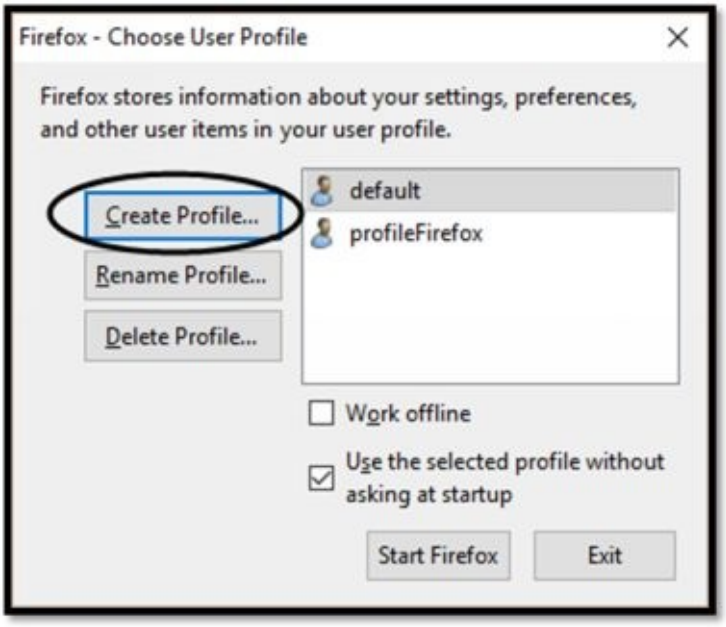
1. Exit Firefox browser (make sure all windows are closed) File > Exit
2. Go to Start menu then Select Run
3. Enter one of the following in the Run dialog
    1. firefox.exe –p
    2. firefox.exe –P
    3. firefox.exe –ProfileManager

Note: Sometimes the Profile Manager does not load after entering the previous information (3a, 3b, 3c). If so, enter the following for a 32-bit Windows system or 64-bit Windows system:

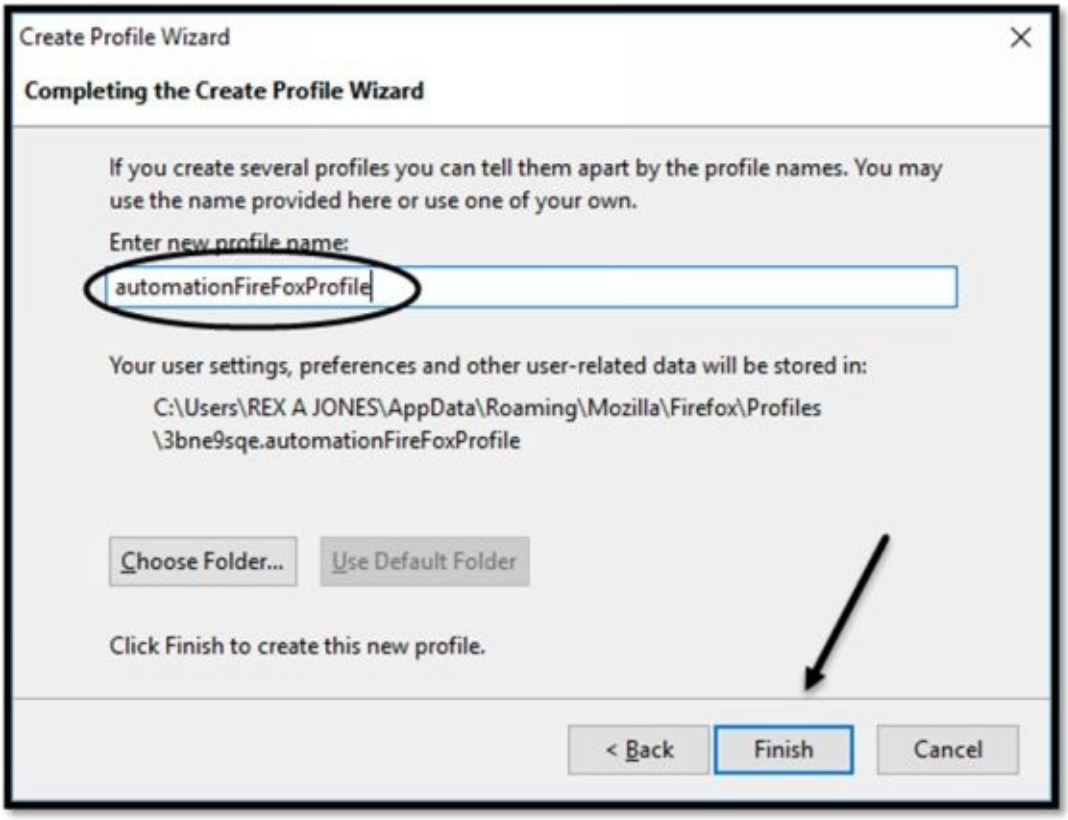
4. 32 bit Windows = "C:\Program Files (x86)\Mozilla Firefox\firefox.exe" –P
5. 64 bit Windows = "C:\Program Files\Mozilla Firefox\firefox.exe" –P



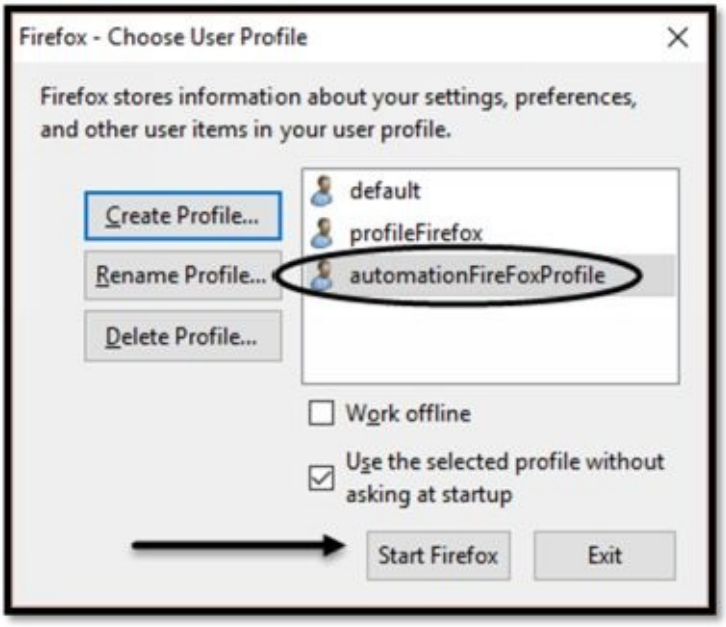
4. Click Create Profile



5. Click Next on the Create Profile Wizard modal
6. Enter Profile Name “i.e., automationFireFoxProfile” > Click Finish



7. Click Start Firefox



Note: Only the tabs will load in the Firefox window. The menu bar (File, Edit, View, etc.) will not be available. Switch profiles back to default in Profile Manager then click Start Firefox to view the menu bar.

Download Notepad ++

Notepad ++ is a free source editor that supports multiple languages. Java uses Notepad ++ and other source editors to view files that end with a .java extension. The following are steps to download Notepad ++:

Steps To Download Notepad ++:

1. Go to https://notepad-plus-plus.org/download/v6.9.2.html
2. Click the Download button

3. Go to Download folder
4. Right click npp.6.9.2.Installer.exe then Select Open

Chapter 1 provided an overview of the upcoming chapters. The subsequent chapters explore Java programming, Unit Test Frameworks (JUnit and TestNG), Selenium IDE, WebDriver, and how to find WebElements. Chapter 2 will explain Java, which is an object-oriented programming language.

Chapter 2
Java / Object-Oriented Programming

The programming languages offered in Selenium WebDriver are Java, C# (pronounced as C Sharp), Python, and Ruby. An understanding of the programming language sets the foundation for automation. That is the main reason for explaining Java at the beginning of this book. According to TIOBE, Java is the most popular programming language within the programming community. It is an object-oriented programming (OOP) language developed by Sun Microsystems. OOP is an approach to programming that revolves around objects. In the real world, an object can be a person, place, or thing. Similarly, in programming, an object is anything that is visible or tangible.

The purpose of this chapter is provide information regarding variables, data types, operators, control structures, classes, objects, methods, access modifiers, inheritance, packages, and interfaces.

A variable contains values that can change depending on information passed throughout the program. Inside a Java program, all variables must include a data type, which dictates the type of value. Operators assign and process values. An operator is a symbol that performs mathematical or logical manipulations on operands. Control structures are features within programming that includes operators. There are two types of control structures: branches and loops. The branch control structures are if branch and switch branch. The loop control structures are for loop, while loop, and do while loop.

A class is a template for creating objects whereby each class includes data and code that operates on the data. Objects are the foundation of Object – Oriented Programming (OOP). The objective of methods is to provide access to data defined by the class. Access modifiers determine access to a class, methods, and variables. Inheritance allows reusable code, which facilitates maintenance. A package is a collection of related classes while an interface contains a collection of related methods.

Chapter 2 will cover the following regarding Core Java:

Variables and Data Types

A variable is a named container or memory location that holds a value. The value of the container or memory location can possibly change during program execution. Each variable has the ability to contain any kind of information, such as text or numbers. As a result, automation engineers are empowered to create flexible programs. Variables represent changeable data rather than hard-coded data. Hard-coded data is unchangeable data entered directly into a program.

All variables possess a name, data type, and value. A variable name uniquely identifies the variable. Data type refers to the type of variable, such as int, double, or boolean stored into a variable. Therefore, data type determines a variable's value. In Java, there are two kinds of data types: primitive and reference. Primitive data type supports eight basic data types while reference data type supported by a class.

Data Types

The primitive data types give an account for the type of data that is stored in a variable. Each data type has a precise range and behavior. Consequently, a data type of int can store numerical data, but a type mismatch error will occur if boolean attempts to store numerical data. Furthermore, certain operations allow values according to the data type. As an example, a math calculation cannot be performed on a boolean data type because boolean cannot contain numbers. The following is a list of all eight primitive data types:

Type	Width in Bits (Bytes)	Description/Range
boolean		True or False values
byte	8-bit (1-byte)	-128 to 127
char	16-bit	Standard character set that can be a letter, control character, number, punctuation, or symbol representing all languages in the world
double	64-bit (8-byte)	-1.7976931348623157E+308 to 1.7976931348623157E+308
float	32-bit (4-byte)	-3.4028235E+38 to 3.4028235E+38
int	32-bit (4-byte)	−2,147,483,648 to 2,147,483,647
long	64-bit (8-byte)	-9,223,372,036,854,775,808 to 9,223,372,036,854,755,807
short	16-bit (2-byte)	-32,768 to 32,767

Figure 2.1 – Eight Primitive Data Types

Variable Names

The name of a variable is significant when identifying the variable in memory. All variable names range anywhere from one character to an unlimited number of characters. Nevertheless, Java has rules to naming variables. One of the rules is to ensure each variable has a unique name. Unique names prevent errors from occurring, such as "Duplicate local variable"— meaning the same variable name has been entered more than one time. The following is a list of rules for naming a variable:

- Can contain case sensitive letters, numbers, dollar sign "$," and underscore "_"
- Can begin with a letter, dollar sign "$," or underscore "_"
- Cannot begin with a number
- Cannot contain a space or special character except dollar sign "$," and underscore "_"
- Cannot contain a reserve keyword. A list of Java's keywords can be found on Oracle's website

The following is a list of suggested conventions for naming a variable:

- Construct descriptive names that describe the variable's purpose
- Compose names utilizing mixed case letters, unless the name is one word
    - If one word, then use all lowercase letters
    - If multiple words, then start the first word with a lowercase letter and each consecutive word with an uppercase letter (e.g., custFirstName)
- Create a name that begins with a letter and not a dollar sign "$" or underscore "_"
- Choose loop control variables that begin with a single lowercase letter (e.g., i, x, y)

Variable Declaration and Initialization

Declaring a variable is stating clearly that a variable exists. All variables are associated with a data type in the event of declaring a variable. Data types guarantee the correct data assigned to a variable.

In general, variables sustain an initial value before the variables are used. The Assignment Operator separates two sides of an equation. There is a left and right side of every equation. The left side displays a variable name while the right side displays a value. The following is the syntax along with an example of declaring and initializing a variable:

Syntax
variableType variableName;

Syntax Details

Argument	Description
variableType	Data type of variable being declared
variableName	Name of variable being declared
;	Semi-colon completes the declaration statement

Figure 2.2 – Variable Declaration Syntax Details

The following is a variable declaration and initialization example:

```
import org.testng.annotations.Test;

public class DeclareInitializeVariables
{
    @Test
    public void testDeclareInitialize ()
    {
            int x;
            int y;
```

```
        x = 10;
        y = 15;

        System.out.println("The values of x and y are: " + x + " and " + y);
    }
}
```

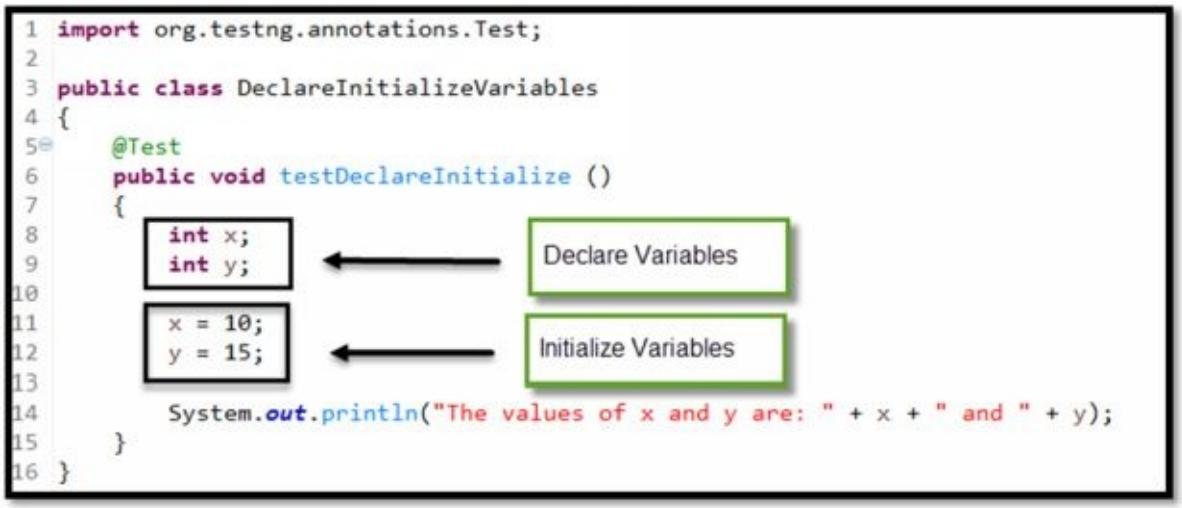


Figure 2.3 – Variable Declaration

Program Output:

The values of x and y are: 10 and 15

- Line 1 is a required import statement to utilize the annotation "@Test" at line 5. All annotations are imported if the word "Test" in line 1 is replaced with an asterisk (*):

  import org.testng.annotations.*; (see *JUnit vs TestNG in Chapter 3*)

- Lines 8 and 9 declare variables "x" and "y" with an int data type. Notice how each declaration ends with a semi-colon. The semi-colon completes the declaration statement.

- Lines 11 and 12 initialize the variables "x" and "y" with a value determined by the int data type. Variable "x" initialized to 10 and variable "y" initialized to 15.

Note: It is possible to declare multiple variables on the same line if the variable has the same data type. The following is a declaration example of multiple variables separated by a comma:

```
int x, y;
```

In like manner, it is possible to declare and initialize a variable or variables on the same line. The following is an example of declaring and initializing a variable(s) on the same line:

```
int x = 10;
int y = 15;
```

or

```
int x = 10, y = 15;
```

Variable Type, Scope, and Lifetime

Java allows a variable to be declared anywhere in a program. For that reason, it is valid to declare a variable within a class, within a method, or within a method as a parameter. The scope of a variable relates to its declaration inside a program. Lifetime is how long the variable exists in the program. The following are four types of variables, their scope, and lifetime:

1. Local Variables
2. Parameter Variables
3. Instance Variables
4. **Class Variables**

Local Variables

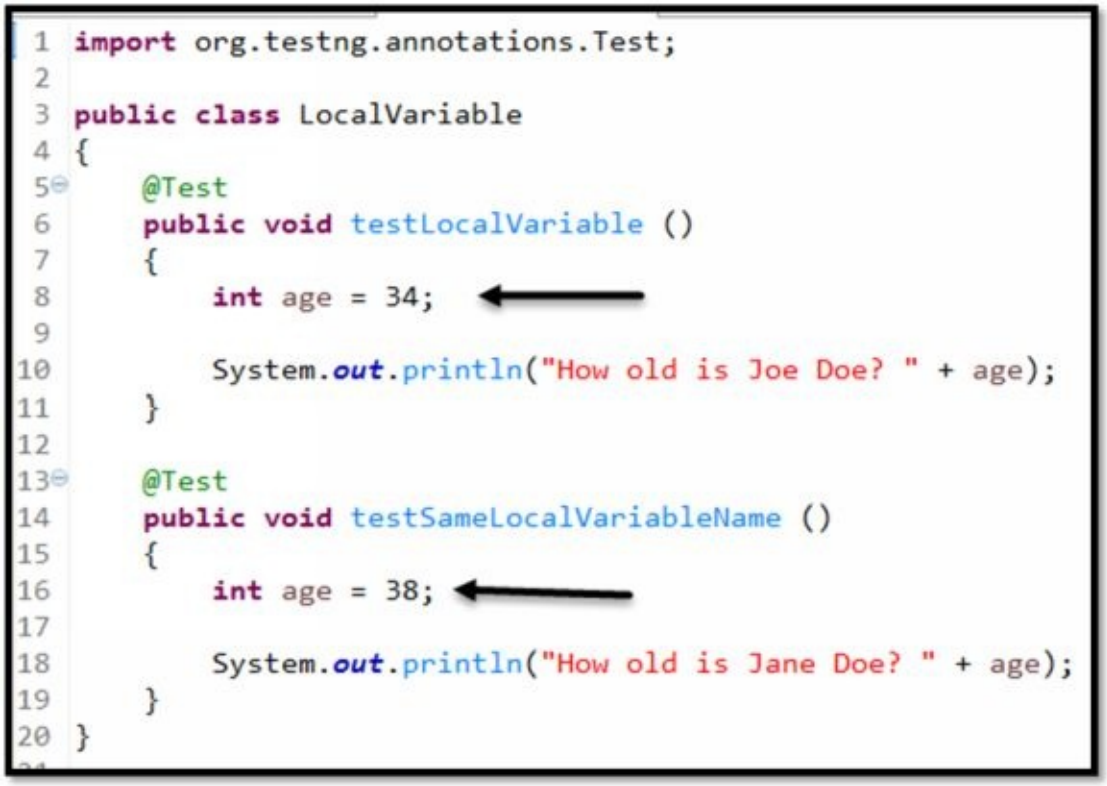
Local variables are declared inside a method. Individual methods can have the same variable name as another method. Local variables are only visible inside its method. The following is a local variable example:

```
import org.testng.annotations.Test;

public class LocalVariable
{
    @Test
    public void testLocalVariable ()
    {
            int age = 34;

            System.out.println("How old is Joe Doe? " + age);
    }
    @Test
    public void testSameLocalVariableName ()
    {
            int age = 38;

            System.out.println("How old is Jane Doe? " + age);
    }
}
```



```
1  import org.testng.annotations.Test;
2
3  public class LocalVariable
4  {
5      @Test
6      public void testLocalVariable ()
7      {
8          int age = 34;
9
10         System.out.println("How old is Joe Doe? " + age);
11     }
12
13     @Test
14     public void testSameLocalVariableName ()
15     {
16         int age = 38;
17
18         System.out.println("How old is Jane Doe? " + age);
19     }
20 }
```

Figure 2.4 – Local Variable

Program Output:

How old is Joe Doe? 34

How old is Jane Doe? 38

- Lines 8 and 16 display a local variable “age” that is local to methods “testLocalVariable and testSameLocalVariableName.”
- An error will not occur because each variable is unique to its method. However, the same variable name cannot be declared multiple times within the same method. The scope and lifetime of a local variable is limited to the block/curly braces in which it is declared.

Parameter Variables

Parameter variables are declared in the parenthesis “()” of a method. After a parameter variable is declared, it works like a local variable. Therefore, a local variable and parameter variable cannot have the same name. Eclipse displays “duplicate local variable” if a local variable and parameter variable contain the same name. The following is a parameter variable example:

```
import org.testng.annotations.Test;
```

```
public class ParameterVariable
{
    @Test
    public void testParameterVariable (int age)
    {
            System.out.println("Jane Doe is " + age + " years old");
    }
    @Test
    public void passAgeArgument ()
    {
            ParameterVariable objAge = new ParameterVariable ();

            objAge.testParameterVariable (43);
    }
}
```

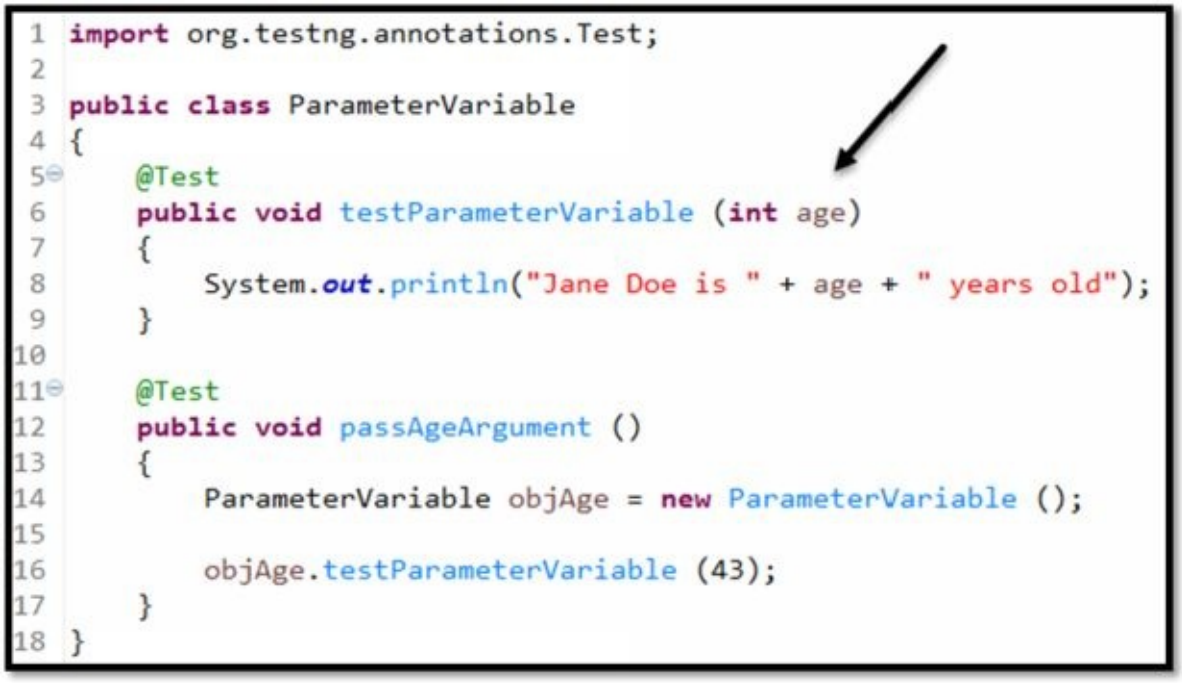


Figure 2.5 – Parameter Variables

Program Output:

Jane Doe is 43 years old

- Line 16 pass an argument "43" into parameter variable "age" within method "testParameterVariable."

- The scope of a parameter variable is a method's header inside the parenthesis while the lifetime is a method's body within the curly brackets.

Instance Variables

Instance variables (also known as Global Variables) are declared inside a class but outside of a method. They can be declared before or after it is initialized with visibility to all methods in a class. The following is an instance variable example:

```
import org.testng.annotations.Test;

public class InstanceVariable
{
    int age = 18;
    @Test
    public void testInstanceVariable ()
    {
            System.out.println("Most people graduate from high school at " +
                        age + " years old");
    }
    @Test
    public void testInstanceVariableAgain ()
    {
            System.out.println("Some places state " + age + " years old" +
                        " is the legal age for adulthoold");
    }
}
```

```
1  import org.testng.annotations.Test;
2
3  public class InstanceVariable
4  {
5      int age = 18;
6
7      @Test
8      public void testInstanceVariable ()
9      {
10         System.out.println("Most people graduate from high school at " +
11                 age + " years old");
12     }
13
14     @Test
15     public void testInstanceVariableAgain ()
16     {
17         System.out.println("Some places state " + age + " years old" +
18                 " is the legal age for adulthoold");
19     }
20 }
```

Figure 2.6 – Instance Variable

Program Output:

Most people graduate from high school at 18 years old

Some places state 18 years old is the legal age for adulthoold

- Line 5 declares the instance variable “age” within the class “InstanceVariable,” but outside of methods “testInstanceVariable and testInstanceVariableAgain”.
- The instance variable is accessed in lines 11 and 17 because instance variables are visible to all methods. Therefore, the lifetime of the variable exists as long as there is a reference.

Note: Some automation engineers’ call instance variables global variables. Therefore, an instance variable can be accessed directly using the instance variable name or object reference.

Class Variables

Class Variables (known as Static Variables) are declared in a class but not in a method. This type of variable is declared using keyword static. The keyword static announces to the compiler that only one copy of a particular variable exists, but shared by all instances of an object. When a member is declared as static, the member can be accessed prior to creating an object. However to access a static member, it is best to precede the static member with a class name and dot operator. Accessing a static member using a class name

separates class variables from instance variables. The following is a class variable example:

```
import org.testng.annotations.Test;

public class ClassStaticVariable
{
    static int age = 18;
    @Test
    public void testInstanceVariable ()
    {
            System.out.println("Most people graduate from high school at " +
                    ClassStaticVariable.age + " years old");
    }
    @Test
    public void testInstanceVariableAgain ()
    {
            System.out.println("Some places state " + ClassStaticVariable.age +
                    " years old is the legal age for adulthoold");
    }
}
```

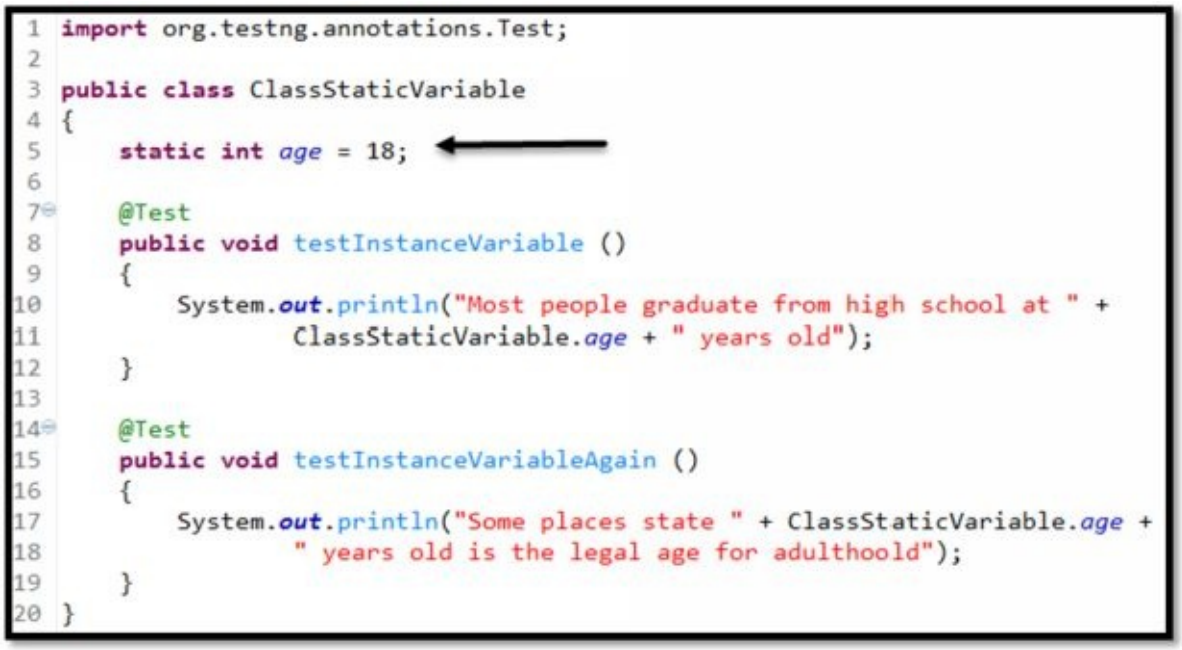


Figure 2.7 – Class Variable

Program Output:

Most people graduate from high school at 18 years old

Some places state 18 years old is the legal age for adulthood

- Line 5 declares the Class Variable “age” within the class “ClassStaticVariable” but outside of methods “testInstanceVariable and testInstanceVariableAgain”.
- The scope of a class variable is inside the block/curly braces of class and outside the block/curly braces of all methods. Therefore, the lifetime of the variable continues throughout execution of the program.

Note: A class variable can be accessed via class name, object reference, or directly using the class variable name. However, it is recommended to using the class name to access the class variable.

Operators

Operators are symbols that perform mathematical or logical manipulations on one or more operands. An operand is anything that can be changed or manipulated. The most common type of operand is a variable. In Java, there are four types of operators: Arithmetic, Bitwise, Logical, and Relational. However, Arithmetic, Logical, and Relational operators are the most used operators in Selenium.

Arithmetic Operators

Arithmetic operators implement mathematical operations on numerical values. Therefore, the arithmetic operators apply to any data type involving numbers. The following is a list of arithmetic operators:

Symbol	Name	Description
+	Addition	Adds a value on both sides of the (+) operator Used for joining strings which is known as string concatenation
-	Subtraction	Subtracts right operand from left operand
*	Multiplication	Multiplies values on both sides of the (*) operand
/	Division	Divides left operand by right operand
%	Modulus	Divides left operand by right operand then returns the remainder
++	Increment	Increases the operand's value by one
—	Decrement	Decreases the operand's value by one

Figure 2.8 – Arithmetic Operators

Note: The Division Operator (/) truncates the remainder while the Modulus Operator (%) returns the remainder. For instance, 10/3 only returns three and truncates the remainder, which is one. On the other hand, 10%3 only returns the remainder of one. The following example demonstrates a Multiplication (*) Operator:

```
import org.testng.annotations.Test;

public class OperatorArithmetic
{
    @Test
    public void testMultiplication ()
    {
            int total;
```

```
        total = 4 * 5;
        System.out.println("What is 4 times 5? " + total);
    }
}
```

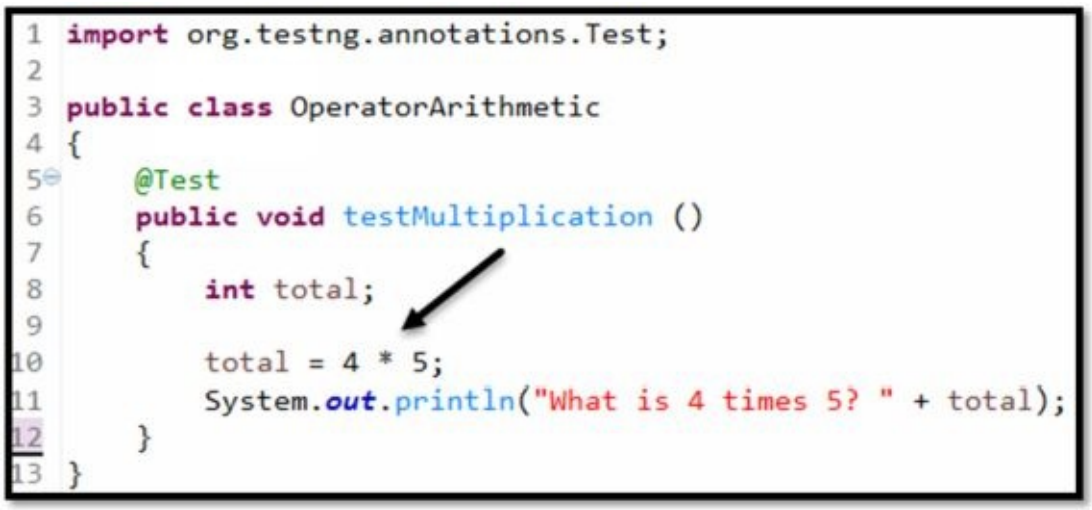


Figure 2.9 – Operator and Operands

Program Output:

What is 4 times 5? 20

- The multiplication operator (*) is used at line 10
- 4 and 5 are the operands

Logical Operators

Logical Operators (known as Conditional Operators) return a boolean value based on one or more expressions. Therefore, the Logical Operator's data type must be boolean. The following is a list of logical operators:

Symbol	Name	Description
&&	Logical AND	Returns true if both operands are true Returns false if one operand or both operands are false
||	Logical OR	Returns true if one operand or both operands are true Returns false if both operands are false
^	Logical Exclusive OR (XOR)	Returns true if only one operand is true Returns false if both operands are false and if both operands are true
!	Logical NOT	Returns the opposite value of the operand Returns true if the operand is false and return false if the operand is true

Figure 2.10 – Logical Operators

Note: The Bitwise Operators and Logical Operators perform some of the same functions. The following are examples:

```
import org.testng.annotations.Test;

public class OperatorLogicalBitwise
{
    @Test
    public void testLogicalBitwise ()
    {
            boolean x = 100 > 99, y = 99 > 100;

            // Logical AND '&&' operator
            System.out.println("What is the result of 100 > 99 && 99 > 100? " + (x && y));
```

```
        // Bitwise AND '&' operator
        System.out.println("What is the result of 100 > 99 & 99 > 100? " + (x & y));

        // Logical OR '||' operator
        System.out.println("What is the result of 100 > 99 || 99 > 100? " + (x || y));

        // Bitwise OR '|' operator
        System.out.println("What is the result of 100 > 99 | 99 > 100? " + (x | y));

        // Logical XOR '^' operator
        System.out.println("What is the result of 100 > 99 ^ 99 > 100? " + (x ^ y));

        // Logical NOT '!' operator
        System.out.println("What is the result of Not 100 > 99? " + (!x));

        // Logical NOT '!' operator (parenthesis is optional surrounding this operator and operand)
        System.out.println("What is the result of Not 99 > 100? " + !y);
    }
}
```

```
1  import org.testng.annotations.Test;
2
3  public class OperatorLogicalBitwise
4  {
5      @Test
6      public void testLogicalBitwise ()
7      {
8          boolean x = 100 > 99, y = 99 > 100;
9
10         // Logical AND '&&' operator
11         System.out.println("What is the result of 100 > 99 && 99 > 100? " + (x && y));
12
13         // Bitwise AND '&' operator
14         System.out.println("What is the result of 100 > 99 & 99 > 100? " + (x & y));
15
16         // Logical OR '||' operator
17         System.out.println("What is the result of 100 > 99 || 99 > 100? " + (x || y));
18
19         // Bitwise OR '|' operator
20         System.out.println("What is the result of 100 > 99 | 99 > 100? " + (x | y));
21
22         // Logical XOR '^' operator
23         System.out.println("What is the result of 100 > 99 ^ 99 > 100? " + (x ^ y));
24
25         // Logical NOT '!' operator
26         System.out.println("What is the result of Not 100 > 99? " + (!x));
27
28         // Logical NOT '!' operator (parenthesis is optional surrounding this operator and operand)
29         System.out.println("What is the result of Not 99 > 100? " + !y);
30     }
31 }
```

Figure 2.11 – Logical and Bitwise Operator Examples

Program Output:

What is the result of 100 > 99 && 99 > 100? false

What is the result of 100 > 99 & 99 > 100? false

What is the result of 100 > 99 || 99 > 100? true

What is the result of 100 > 99 | 99 > 100? true

What is the result of 100 > 99 ^ 99 > 100? true

What is the result of Not 100 > 99? false

What is the result of Not 99 > 100? True

In this example, line 8 declares and initializes the variables. Both variables “x and y” are assigned boolean expressions. Variable “x” assigned a true expression (100 > 99) while “y” assigned a false expression (99 > 100). A && (Logical AND) operator in line 11 and & (Bitwise AND) operator in line 14 compares the operands “x and y” then returns a “false” value. False is returned because one operand “x” is true while the other operand “y” is false. A similar process is performed for all examples in Figure 2.11 using different Logical and Bitwise Operators.

Relational Operators

Relational Operators return a boolean value after comparing operands. Normally, all of the Relational Operators apply to operands that are numbers. If the relationship between two operands is Yes, then true is returned. For example, if 34 equals 34, then the output returns true. The following is a list of Relational Operators:

Symbol	Name	Description
==	Equal To	Verifies if both operands are equal.
!=	Not Equal To	Verifies if both operands are not equal.
>	Greater Than	Verifies if the left operand is greater than the right operand
>=	Greater Than or Equal To	Verifies if the left operand is greater than or equal to the right operand
<	Less Than	Verifies if the left operand is less than the right operand
<=	Less Than or Equal To	Verifies if the left operand is less than or equal to the right operand

Figure 2.12 – Relational Operators

The following are examples of each relational operator:

```
import org.testng.annotations.Test;

public class OperatorRelational
{
    @Test
    public void testRelational ()
    {
            int x = 25, y = 50;

            // = = Equal To operator
            System.out.println("Is 25 equal to 50? " + (x == y));
```

```
        // ! = Not Equal To operator
        System.out.println("Is 25 not equal to 50? " + (x != y));

        // > Greater Than operator
        System.out.println("Is 25 greater than 50? " + (x > y));

        // > = Greater Than or Equal To operator
        System.out.println("Is 25 greater than or equal to 50? " + (x >= y));

        // <  Less Than operator
        System.out.println("Is 25 less than 50? " + (x < y));

        // < =  Less Than or Equal To operator
        System.out.println("Is 25 less than or equal to 50? " + (x <= y));
    }
}
```

```
1  import org.testng.annotations.Test;
2
3  public class OperatorRelational
4  {
5      @Test
6      public void testRelational ()
7      {
8          int x = 25, y = 50;
9
10         // = = Equal To operator
11         System.out.println("Is 25 equal to 50? " + (x == y));
12
13         // ! = Not Equal To operator
14         System.out.println("Is 25 not equal to 50? " + (x != y));
15
16         // > Greater Than operator
17         System.out.println("Is 25 greater than 50? " + (x > y));
18
19         // > = Greater Than or Equal To operator
20         System.out.println("Is 25 greater than or equal to 50? " + (x >= y));
21
22         // <  Less Than operator
23         System.out.println("Is 25 less than 50? " + (x < y));
24
25         // < =  Less Than or Equal To operator
26         System.out.println("Is 25 less than or equal to 50? " + (x <= y));
27     }
28 }
```

Figure 2.13 – Relational Operator Examples

Program Output:

Is 25 equal to 50? false

Is 25 not equal to 50? true

Is 25 greater than 50? false

Is 25 greater than or equal to 50? false

Is 25 less than 50? true

Is 25 less than or equal to 50? True

In this example, line 8 declares and initializes the variables. Variable “x” assigned 25 while “y” assigned 50. An == (Equal To) operator determines if both variables (x == y) equals each other on line 11. The values 25 and 50 are not equal so the program returns false. A similar process is performed for all examples in Figure 2.13 using a different Relational Operator according to Figure 2.12.

Assignment Operator

An Assignment Operator (=) is positioned between a variable and value / expression. The purpose is to assign values to variables. Therefore, the value on the right side transferred to the variable name on the left side. The following is an assignment operator syntax:

Syntax
variableName = expression;

Syntax Details

Argument	Description
variableName	Name of variable that was declared
expression	Value that is assigned to the variable name
;	Semi-colon completes the initialization statement

Figure 2.14 – Assignment Operator Syntax Details

The following is an Assignment Operator example:

```
import org.testng.annotations.Test;

public class OperatorAssignment
{
    @Test
    public void testAssignmentOperator ()
    {
            int j;

            j = 34;
            System.out.println("The value " + j + " has been assigned to j");
    }
}
```

```
1  import org.testng.annotations.Test;
2
3  public class OperatorAssignment
4  {
5      @Test
6      public void testAssignmentOperator ()
7      {
8          int j;
9
10         j = 34;
11         System.out.println("The value " + j + " has been assigned to j");
12     }
13 }
```

Figure 2.15 – Assignment Operator Example

Program Output:

The value 34 has been assigned to j

- Line 10 assigns a value “34” to variable “j”
- The value is printed via line 11

Control Structures

Control structures are the process of using logic to force the program to skip statements while looping other statements. Forcing the program to skip statements is known as branching and looping specific statements is carried out via loops. The two types of branches are if branch and switch branch. The three types of loops are for loop, while loop, and do while loop.

If Branch

The if branch executes a statement when a condition is true. In other words, a specific statement executes if a condition is met. An if branch is a greatly utilized and considered an indispensable control structure. The following is the syntax for the if branch:

Syntax

```
if (condition)
{
  statement(s);
}
```

Syntax Details

Argument	Description
if	Keyword that starts the if branch
condition	Boolean expression which results in a true or false result
{	An opening curly bracket
statement(s)	Statement that will be executed if the condition is true
;	Semi-colon completes the true statement
}	A closing curly bracket

Figure 2.16 – If Branch Syntax Details

The following example displays a message if the customer brings three or more extra customers to a sporting event:

```
import org.testng.annotations.*;

public class IfBranch
{
    @Test
    public void testIfBranch ()
    {
```

```
        int extraCustomers = 4;

        if (extraCustomers >= 3)
        {
            System.out.println("Customer receives a discount");
        }
    }
}
```

```
1  import org.testng.annotations.*;
2
3  public class IfBranch
4  {
5      @Test
6      public void testIfBranch ()
7      {
8          int extraCustomers = 4;
9
10         if (extraCustomers >= 3)
11         {
12             System.out.println("Customer receives a discount");
13         }
14     }
15 }
```

Figure 2.17 – If Branch

Program Output:

Customer receives a discount

Line 8 assigns "4" to the variable "extraCustomers". Line 10 displays keyword "if" followed by a parenthesis. Inside the parenthesis is a condition (extraCustomers >= 3) that returns true. True is returned because four is greater than three. The statement at line 12 (inside the curly brackets) executes after the true evaluation.

Note: The program would not execute the statement if the condition returned false. However, there are two variations of the if branch that can be executed when a condition is false:

1. If Else
2. If Else-If

If Else Branch

An optional else keyword extends the if branch just in case the condition returns false. Therefore, the statements following keyword “if” and the condition executes when a condition is true. Otherwise, the statement following keyword else, is executed when a condition is false. The following is the syntax for the if-else branch:

Syntax

```
if (condition)
{
  statement(s);
}
else
{
  statement(s);
}
```

The following example displays a message when the customer does not bring three or more extra customers to a sporting event:

```
import org.testng.annotations.*;

public class IfElseBranch
{
    @Test
    public void testIfElseBranch ()
    {
            int extraCustomers = 2;

            if (extraCustomers >= 3)
            {
                    System.out.println(“Customer receives a discount”);
            }
            else
            {
                    System.out.println(“Customer does not receive a discount”);
            }
    }
}
```

```
1  import org.testng.annotations.*;
2
3  public class IfElseBranch
4  {
5      @Test
6      public void testIfElseBranch ()
7      {
8          int extraCustomers = 2;
9
10         if (extraCustomers >= 3)
11         {
12             System.out.println("Customer receives a discount");
13         }
14         else
15         {
16             System.out.println("Customer does not receive a discount");
17         }
18     }
19 }
```

Figure 2.18 – If Else Branch

Program Output:

Customer does not receive a discount

Line 8 assigns “2” to the variable “extraCustomers”. Line 10 displays keyword “if” followed by a parenthesis. Inside the parenthesis is a condition (extraCustomers >= 3) that returns false. False is returned because two is not greater than or equal to three. Therefore, the program bypasses the statement at line 12 and executes the statement at line 16.

If Else-if Branch

The first if keyword can optionally be followed by one or more if keywords. However, each subsequent if keyword must be preceded by a required else keyword. The else-if branch is only executed when the first if branch is false. All else-if branches are followed by a condition and one or more statements. The following is the syntax for the else if branch:

Syntax

```
if (condition)
{
   statement(s);
}
else if (condition)
{
   statement(s);
}
else if (condition)
{
   statement(s);
}
else
{
   statement(s);
}
```

The following example displays a message when the customer brings less than three extra customers to a sporting event:

```
import org.testng.annotations.Test;

public class ElseIfBranch
{
    @Test
    public void testElseIfBranch ()
    {
            int extraCustomers = 2;

            if (extraCustomers >= 3)
            {
```

```
                System.out.println("Customer receives a discount");
        }
        else if (extraCustomers <= 3)
        {
                System.out.println("No Discount: Customer count less than or equal to 3");
        }
        else
        {
                System.out.println("Error: Not a valid customer count");
        }
    }
}
```

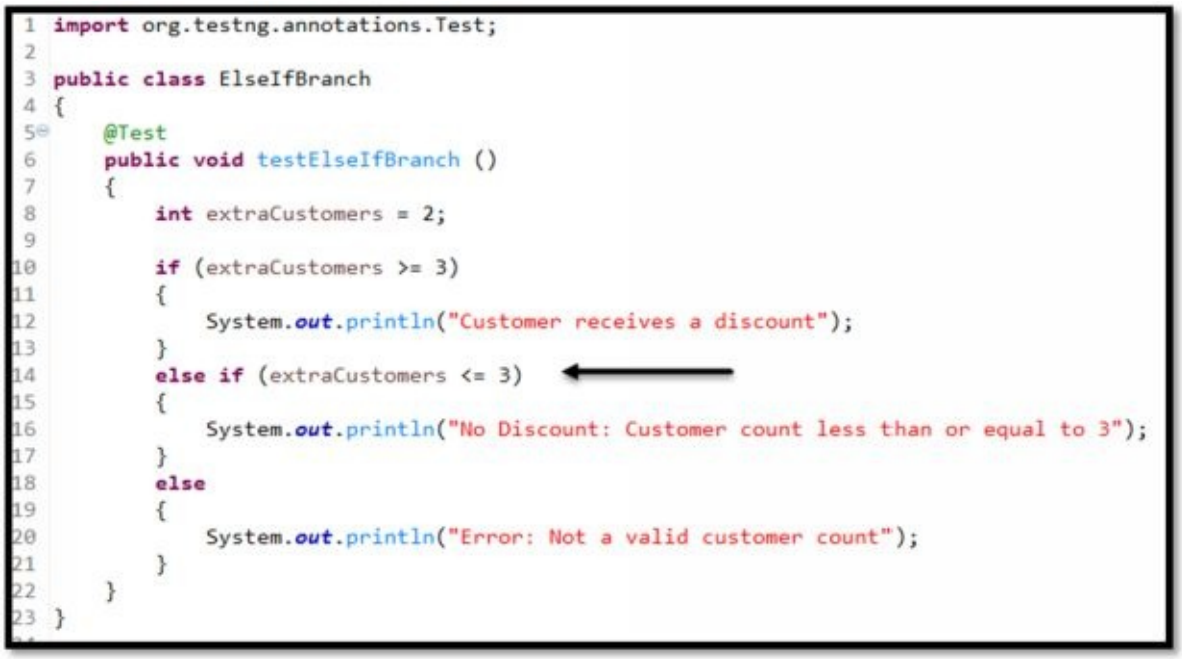


Figure 2.19 – Else If Branch

Program Output:

No Discount: Customer count less than or equal to 3

Line 8 assigns “2” to the variable “extraCustomers”. Line 14 displays keywords “else” and “if” followed by a parenthesis. Inside the parenthesis is a condition (extraCustomers <= 3) that returns true. True is returned because two is less than or equal to three. The second condition (line 14) only executes after the first condition (line 10) returns false.

Note: Several else-if branches can be added to the if branch. On the other hand, line 20 executes if variable “extraCustomers” assigned an invalid value such as characters. The program output would have printed “Error: Not a valid customer count”.

Switch Branch

The switch branch evaluates a single variable then executes a statement according to the variable's value. Primitive data types byte, short, char, and int are evaluated along with String. The switch and if branches have similar functionality. There are situations where either branch is suitable. However, the switch branch is most efficient when dealing with a specific number of values, such as days of the week. Otherwise, it is best to implement an if branch when handling an infinite number of values. The following is the syntax for the switch branch:

Syntax

```
switch (variableName)
{
case constant1:
   statement(s);
   break;
case constant2:
   statement(s);
   break;
case constant3:
   statement(s);
   break;
.
.
.
default:
   statement;
}
```

The following is a switch branch example:

```
import org.testng.annotations.Test;

public class BranchSwitch
{
    @Test
    public void testSwitchBranch ()
    {
            int day = 6;
```

```
        switch (day)
        {
        case 1:
                System.out.println("Sunday is the 1st day of the week");
                break;
        case 2:
                System.out.println("Monday is the 2nd day of the week");
                break;
        case 3:
                System.out.println("Tuesday is the 3rd day of the week");
                break;
        case 4:
                System.out.println("Wednesday is the 4th day of the week");
                break;
        case 5:
                System.out.println("Thursday is the 5th day of the week");
                break;
        case 6:
                System.out.println("Friday is the 6th day of the week");
                break;
        case 7:
                System.out.println("Saturday is the 7th day of the week");
                break;
        default:
                System.out.println("Not valid: There are only 7 days in a week");
        }
    }
}
```

```
1  import org.testng.annotations.Test;
2
3  public class BranchSwitch
4  {
5      @Test
6      public void testSwitchBranch ()
7      {
8          int day = 6;
9
10         switch (day)
11         {
12         case 1:
13             System.out.println("Sunday is the 1st day of the week");
14             break;
15         case 2:
16             System.out.println("Monday is the 2nd day of the week");
17             break;
18         case 3:
19             System.out.println("Tuesday is the 3rd day of the week");
20             break;
21         case 4:
22             System.out.println("Wednesday is the 4th day of the week");
23             break;
24         case 5:
25             System.out.println("Thursday is the 5th day of the week");
26             break;
27         case 6:
28             System.out.println("Friday is the 6th day of the week");
29             break;
30         case 7:
31             System.out.println("Saturday is the 7th day of the week");
32             break;
33         default:
34             System.out.println("Not valid: There are only 7 days in a week");
35         }
36     }
37 }
```

Figure 2.20 – Switch Branch Example

Program Output:

Friday is the 6th day of the week

Line 8 assigns the variable “day” the value of “6.” Then the keyword “switch” starts the branch at line 10 by checking the variable’s value. Keyword “case” at line 27 matches the variable’s value “6”, and then executes the statement at line 28. The keyword “break” at line 32 is necessary to prevent case 7 (line 30) and default (line 33) from executing.

Note: All statements following a match will execute due to switch branches executing sequentially utilizing a top-down approach. Therefore, the keyword “break” must be used to jump out of the switch branch after a match is found.

For Loop

The for loop executes a block of code for a certain number of iterations. In other words, a statement executes as long as a condition is met. One of the benefits allows statements to execute without writing code repeatedly. The following is the for loop syntax:

Syntax

```
for (initialization; condition; iteration)
{
  statement(s);
}
```

Syntax Details

Argument	Description
for	Keyword that starts the for loop
initialization	Assignment that sets the loop control initial value
;	Semi-colon completes the initialization
condition	A boolean expression that determines if the loop will or will not repeat
;	Semi-colon completes the condition
iteration	Indicates how the loop control variable will change after each variation
{	An opening curly bracket
statement(s)	Statement(s) that will execute after the condition is met
;	Semi-colon completes the statement
}	A closing curly bracket

Figure 2.21 – For Loop Syntax Details

The initialization component declares a data type and assigns an initial value via loop control variable. Usually, the loop control variable is a single character variable name (e.g., i) that controls the entire loop. The condition is a boolean expression that specifies a maximum value for the loop control variable. All for loops continue executing while the condition is true. Execution continues on the statement immediately following the for loop when the condition becomes false. Most automation engineers use an increment (++) or decrement (—) operator as the iteration expression. The increment operator increases the loop control variable value by one, while the decrement operator decreases the value by one. An executable statement is placed between the optional curly brackets. Although, the curly brackets are optional, it is recommended to use the brackets to improve code readability. The following is a for loop example:

```
import org.testng.annotations.Test;

public class LoopFor
{
    @Test
    public void testForLoop ()
    {
            for (int i = 0; i < 5; i++ )
            {
                    System.out.println("The loop control variable value is " + i);
            }
    }
}
```

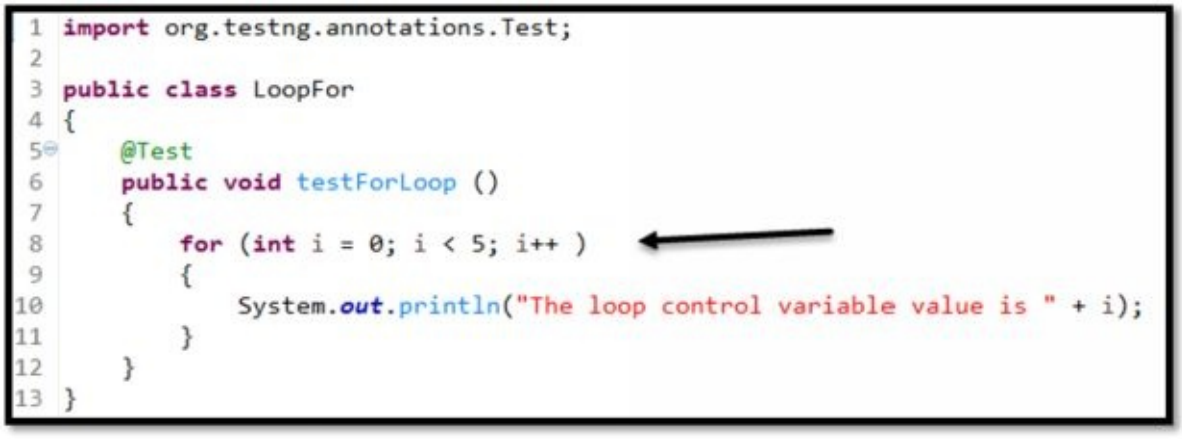


Figure 2.22 – For Loop Example

Program Output:

The loop control variable value is 0

The loop control variable value is 1

The loop control variable value is 2

The loop control variable value is 3

The loop control variable value is 4

Line 8 starts the for loop with keyword “for” followed by three arguments (initialization, condition, and iteration). Initialization (int i = 0;) assigns zero as the starting value. Condition (i < 5) sets less than five as the stopping point for the loop control variable. Increment (i++) increases the loop control variable by one. The statement prints the loop control variable via line 10.

It is important to use harmonious values in the for loop. The values lead to an infinite loop if the values are not created in agreement. An infinite loop is a loop that never stops. For example, the following for loop will repeat indefinitely because of the initial value, maximum value, and iteration expression:

for (int i = 3; i > 1; i++)

The initial value “3” starts at a greater value than the maximum value of “1,” while the iterator “++” increases after each loop. This example continues indefinitely since the condition always true. To correct this infinite loop, the initialization value “3” must decrease to less than the conditional value “1”; the conditional value “1” must increase to more than the initialization “3”; or the iterator must change from increasing “++” to decreasing “—” after each loop.

Note: Routinely, a condition using a greater than operator (>) implements a decrement operator (—), while a condition using a less than operator (<) implements an increment operator (++).

While Loop

The while loop repeats a statement while a condition is true. Conditions are boolean expressions that is checked prior to executing the statement. In addition, the variable name initialized before the loop and evaluated as part of the condition. When executing the statement, the while loop continues until the condition becomes false. The following is the syntax of a while loop.

Syntax

```
while (condition)
{
  statement(s);
}
```

Syntax Details

Argument	Description
while	Keyword that starts the loop
condition	A boolean expression that determines if the loop will or will not repeat
{	An opening curly bracket
statement(s)	Statement(s) that will execute after the condition is met
;	Semi-colon that completes the statement
}	A closing curly bracket

Figure 2.23 – While Loop Syntax Details

The following is a while loop example:

```
import org.testng.annotations.Test;

public class LoopWhile
```

```
{
    @Test
    public void testWhileLoop ()
    {
            int i = 0;

            while (i < 5)
            {
                    System.out.println("The variables value is " + i);
                    i++;
            }
    }
}
```

```
1  import org.testng.annotations.Test;
2
3  public class LoopWhile
4  {
5      @Test
6      public void testWhileLoop ()
7      {
8          int i = 0;
9
10         while (i < 5)
11         {
12             System.out.println("The variables value is " + i);
13             i++;
14         }
15     }
16 }
```

Figure 2.24 – While Loop Example

Program Output:

The variables value is 0

The variables value is 1

The variables value is 2

The variables value is 3

The variables value is 4

Line 8 initializes the variable “i” to zero “0”. The variable will be evaluated at line 10 as part of the condition (i < 5) after keyword “while”. A value for the variable “i” prints repeatedly via line 12 while the condition is true. Notice the increment operator at line 13. It is important to know that the while loop never stops without an increment operator. Therefore, the loop would continue indefinitely, generating an infinite loop. In addition, the while loop becomes indefinite if the initialization and conditional variable values are not set in agreement.

Do While Loop

The do while loop evaluates a condition at the bottom of the loop. Therefore, the loop will execute the statement within the loop then evaluate the condition. As a result, the do while loop always executes a statement at least one iteration and continues as long as the condition is true. The following is the syntax for a do while loop:

Syntax

```
do
{
  statement(s);
}
while (condition);
```

Syntax Details

Argument	Description
do	Keyword that starts the loop
{	An opening curly bracket
statement(s)	Statement(s) that will execute at least once
;	Semi-colon that completes the statement
}	A closing curly bracket
while	Keyword that determines if the loop's condition will repeat
condition	A boolean expression that determines if the loop will or will not repeat
;	Semi-colon that completes the condition

Figure 2.25 – Do While Loop Syntax Details

The following is a do while loop example:

```
import org.testng.annotations.Test;

public class LoopDoWhile
{
    @Test
    public void testDoWhileLoop ()
    {
            int i = 0;

            do
            {
                System.out.println("The variables value is " + i);
                i++;
            }
            while (i < 5);
    }
}
```

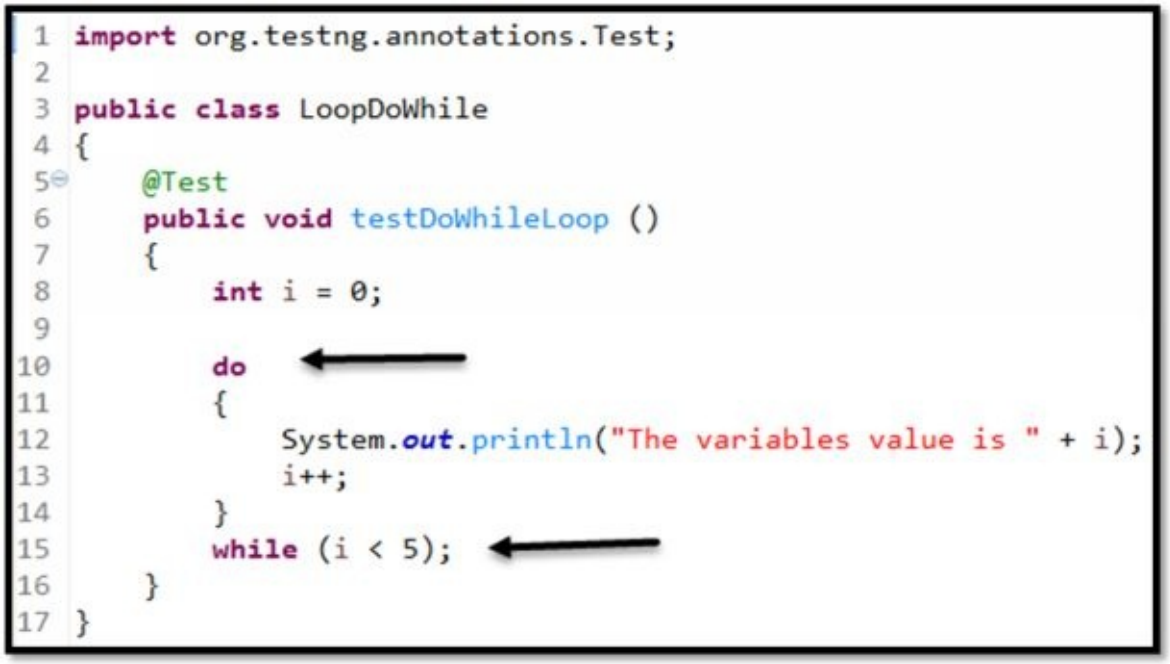


Figure 2.26 – Do While Loop Example

Program Output:

The variables value is 0

The variables value is 1

The variables value is 2

The variables value is 3

The variables value is 4

Line 8 initializes the variable “i” to zero “0”. The keyword “do” starts the do while loop followed by two statements surrounded by curly brackets. A value for the variable “i” prints repeatedly via line 12 while the condition (i < 5) is true. Coincidentally, the condition is evaluated after the statement at line 15. Like the while loop, an infinite loop would have occurred if the increment operator (++) was not added at line 13. The initialization and conditional values also create an infinite loop if not set correctly. In this example, the statements repeated multiple iterations because the condition started with a true result. The following shows what happens when the condition starts with a false result:

```
import org.testng.annotations.Test;

public class LoopDoWhile
{
    @Test
    public void testDoWhileLoopFalse ()
    {
            int i = 0;

            do
            {
                    System.out.println(“The variables value is “ + i);
                    i++;
            }
            while (i > 5);
    }
}
```

```
1  import org.testng.annotations.Test;
2
3  public class LoopDoWhile
4  {
5      @Test
6      public void testDoWhileLoopFalse ()
7      {
8          int i = 0;
9
10         do
11         {
12             System.out.println("The variables value is " + i);
13             i++;
14         }
15         while (i > 5);
16     }
17 }
```

Figure 2.27 – Do While Loop Example (Start With False Condition)

Program Output:

The variables value is 0

Line 8 initializes the variable “i” to zero “0”. Therefore, the condition (i > 5) at line 15 is false due to zero being less than five. The do while loop executed the statement because statements are executed prior to evaluating the condition.

Note: The loops (for, while, and do while) are similar in functionality. A rule of thumb when deciding which loop to implement is:

- Implement a for loop when executing a specific number of iterations
- Implement a while loop when the loop will repeat an uncertain number of iterations
- Implement a do while loop when a loop needs to be executed at least one iteration

Classes, Objects, and Methods

Object-Oriented Programming (OOP) is an approach to programming that centers around objects. As a result, identifying objects is one of the most essential principles in OOP. An object is anything that can be seen or perceived. Objects serve as the foundation for OOP while methods perform actions. Both objects and methods are located inside of a class. The following is an example of an English Course using a class, object, and method:

```
import org.testng.annotations.Test;

public class EnglishCourse
{
    int students;
    int weeks;
    int days;

    @Test
    public void testEnglishCourse ()
    {
            EnglishCourse ENG101 = new EnglishCourse ();
            int totalDays;

            ENG101.students = 10;
            ENG101.weeks = 4;
            ENG101.days = 3;

            totalDays = ENG101.weeks * ENG101.days;
            System.out.println("The English 101 course is a total of " + totalDays + " days");
    }
}
```

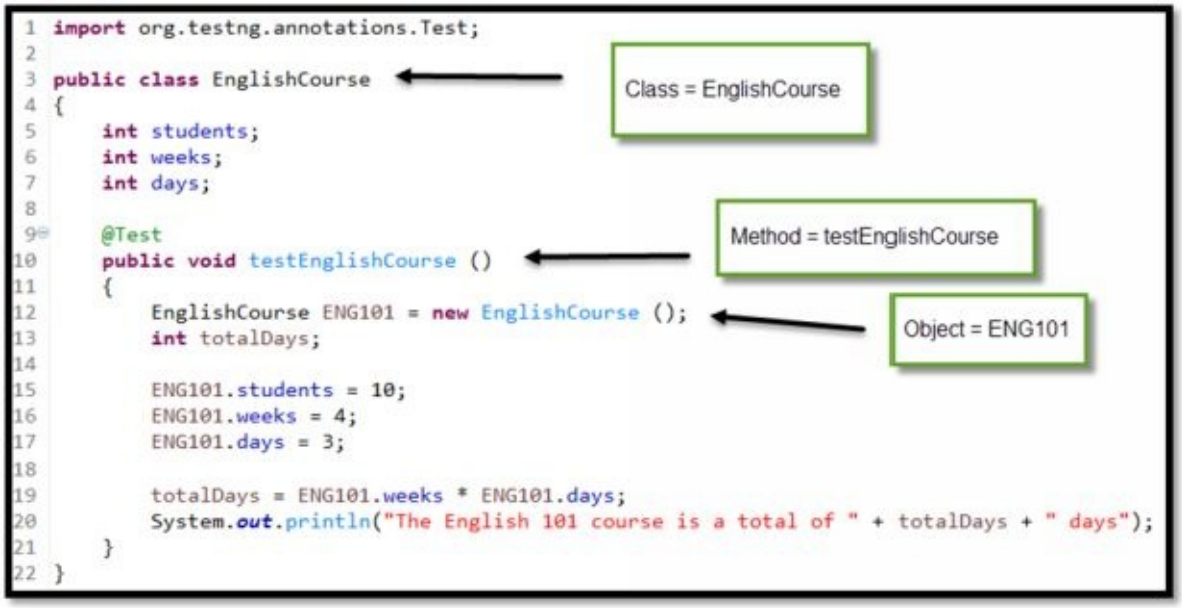


Figure 2.28 – Class, Object, and Method

Program Output:

The English 101 course is a total of 12 days

- Line 3 defines the class called “EnglishCourse”
- Line 10 defines the method called “testEnglishCourse”
- Line 12 creates a new object (EnglishCourse ENG101 = **new** EnglishCourse ();) by combining two steps. According to Java A Beginner’s Guide Sixth Edition (2014), the two steps combined can be rewritten like the following to show each step individually (page 106):

1. **EnglishCourse ENG101;** - The left side of the assignment declares a variable called ENG101 of class type EnglishCourse
2. **ENG101 = new EnglishCourse ();** - The right side of the assignment creates a copy of the object and give ENG101 a reference to the object

ENG101 is a creation (known as instance) of EnglishCourse after creating the new object. Lines 15 – 17 assign values to the instance variables by accessing the variables using the dot (.) operator.

Class

A class is a blueprint for creating an object. Classes include data and code that operate on the data. Hence, a class is a template that defines the structure of an object. Therefore, the structure of a class must be precise. Classes formed with one logical entity makes the class complete. It is important to define classes with information that is logically connected. For example, a class that contains information about an English Course would not contain unrelated information about the school zone speed limit.

Note: A convention for naming classes is to use an UpperCamelCase where each word in the class name begins with a capital letter (i.e., EnglishCourse).

Objects

Objects serve as the cornerstone for OOP. All objects have two characteristics: state and behavior. State identifies the object and behavior represent actions of the object. For example, a dog has a state (name, breed, color) which identifies the dog and behavior (bark, jump, fetch) which represent the dog's actions. Objects are created using the keyword "new".

Note: A convention for naming an object is similar to naming a variable.

Methods

A method executes a job for the object. The state of an object is supported by variables while behavior is implemented through methods. A method is a block of code surrounded by curly brackets. The purpose is to manipulate and provide access to data defined by the class. In other words, a method's responsibility is to instruct the program what task/action to perform and how to perform the task/action.

A method performs actions on the data. It is best for all methods to carry out a single task. For example, a good method will only perform a single task of adding numbers but not adding numbers and saving data to a file. The program may become difficult to read and understand if a method carries out more than one task. The following is the syntax for a method:

Syntax

```
methodType methodName (parameter-list)
{
   // Method Body
}
```

Methods consist of a header and body. The method's header includes a method type and a method name. The convention for method name is similar to a variable name, which consist of a lowerCamelCase style. Each word begins with a capital letter except the first word. Succeeding the method name is a required pair of parenthesis that sets apart variables from methods.

A good technique to employ for naming a method is verb-noun combinations, such as "getOrder or addNumbers". Method body executes code to carry out a task. The parameter list contains variables that receive arguments passed to the method. If the method has no parameters then the parameter list must remain empty. The method type (known as return type) determines the data type returned by the method. A programmer is forced to use keyword "void" for the method type if no values are returned.

Access Modifiers

Access modifiers are helpful features of object-oriented programming. They are helpful because of the access limitation it places on every class and class members (variables and methods). One of the access modifiers “public” has been used throughout this chapter. In Java, there are four kinds of access modifiers:

1. public – indicates a member can be accessed by all classes
2. protected – indicates a member can be accessed by all classes and subclasses within its own package
3. no modifier – indicates a member can be accessed by all classes within its own package
4. private – indicates a member can be accessed within its own class

	public	protected	no modifier	private
Class	Yes	Yes	Yes	Yes
Package	Yes	Yes	Yes	No
Subclass	Yes	Yes	No	No
World	Yes	No	No	No

Figure 2.29 – Access Modifier Levels

Inheritance

Inheritance is a hierarchical concept that allows code and objects to be reused. Each class allows other classes to inherit its code. As a result, the relationship between the classes are superclass and subclass. Superclass is the parent class and subclass is the child class. The classes maintain common data while holding unique characteristics. In order for the subclass to inherit the superclass, the keyword “extends” must be used in the class declaration. Keyword “extends” means the subclass will add to the superclass. The following is the syntax for a subclass inheriting a superclass:

Syntax

```
class SubClassName extends SuperClassName
{
   //Class Body
}
```

The following is an example for a subclass inheriting a superclass:

Figure 2.30 – Subclass Extends Superclass Example

Program Output:

My elementary school is Bishop Heights

The principal name is Joe Doe

There are 10 teachers and 130 students

Therefore the total of teachers and students is 140

- Line 1 displays superclass “School”
- Line 11 uses the keyword “extends” to create subclass “ElementarySchool” which inherits superclass “School”
- Line 17 utilize variables “numTeachers and numStudents” of the superclass
- Lines 29 and 30 display two objects “BishopHeights and AltaMesa”
- Lines 32 and 33 assign values “10 and 130” to variables “numTeachers and numStudents” which are inherited from superclass “School”
- Line 34 assign a value “Joe Doe” to variable “principalName” which is a member of subclass “Elementary School”

The subclass “ElementarySchool” is a unique type of superclass “School”. More subclasses such as HighSchool, University, etc. can inherit superclass “School”. The “ElementarySchool“ class inherits all of the “School“ class members then add a variable “principalName” and two methods “totalTeacherStudents () and displayPrincipal ()”. Notice how line 30 creates an object that was not utilized. This shows that more Elementary School objects can be created to access members of the superclass “School”.

Note: Objects from the superclass do not have knowledge of the subclass. Therefore, the superclass objects cannot access the subclass.

Packages

A package is a collection of related classes. The package is comparable to a folder and classes are similar to files within the folder. Each class within the package is accessed by the package name. It is important to know that Java requires a package import if a class wants to use members from a different class. A Java package is imported by using the keyword “import”. After importing a package, the members of the package are used directly without any additional syntax. The following is the syntax for importing a package:

Syntax

importpackagename.ClassName;

The following screenshot shows a package “examplepackage” and class “PackageTest” that will be imported into a different class “PackageOne”.

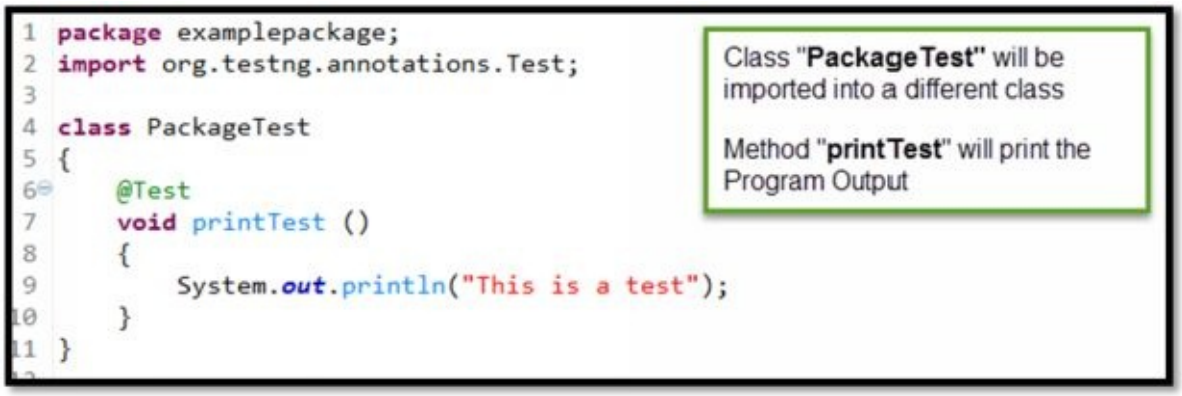


Figure 2.31 – Class PackageTest

The following screenshot shows an import of class “PackageTest” into class “PackageOne” from the same package “examplepackage”:

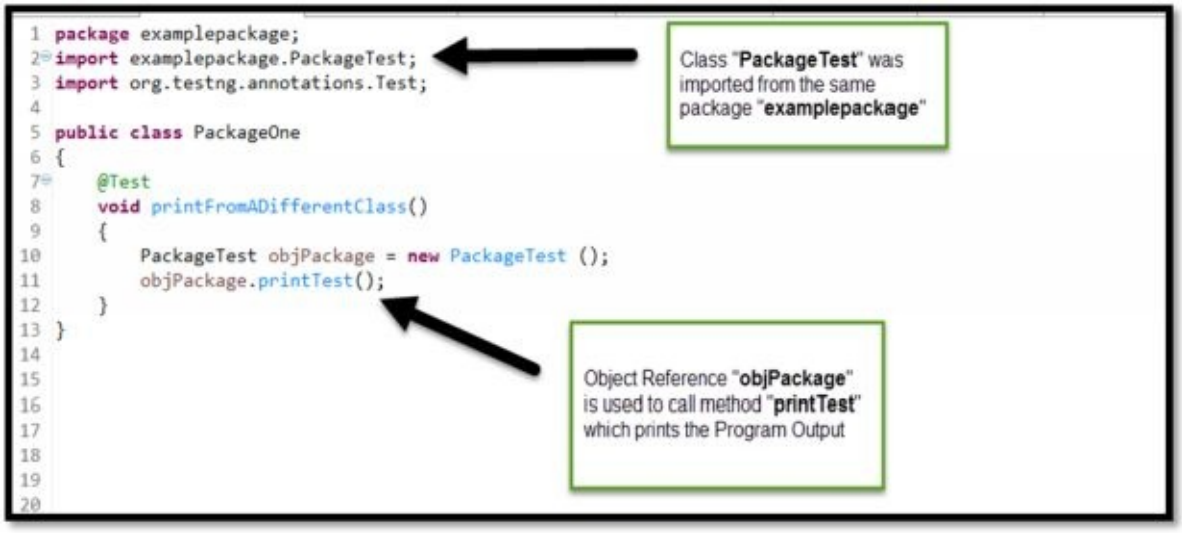


Figure 2.32 – Package Import

Program Output:

This is a test

- Line 1 contains the package statement "**package** examplepackage;". The package statement reveals the package name which is examplepackage
- Line 2 contains the import statement "**import** examplepackage.PackageTest;". The package name is "examplepackage" and class name is "PackageTest" which is located in a different file
- Line 3 imports the @Test annotation on line 7
- Line 5 begins the class declaration "**public class** PackageOne"
- Line 7 contains the @Test annotation
- Line 10 creates an object "objPackage" using the imported class "PackageTest"
- Line 11 calls the method "printTest();" which is located in a different class "PackageTest". The method prints the Program Output "This is a test"

Note: All of the classes from a different package or same package "i.e., examplepackage" are imported using the package name and an asterisk: **import** packagename.*;

The following screenshot is the Package Directory for package "examplepackage" and classes "PackageTest and PackageOne". It resembles a folder "examplepackage" that contains files "PackageTest and PackageOne":

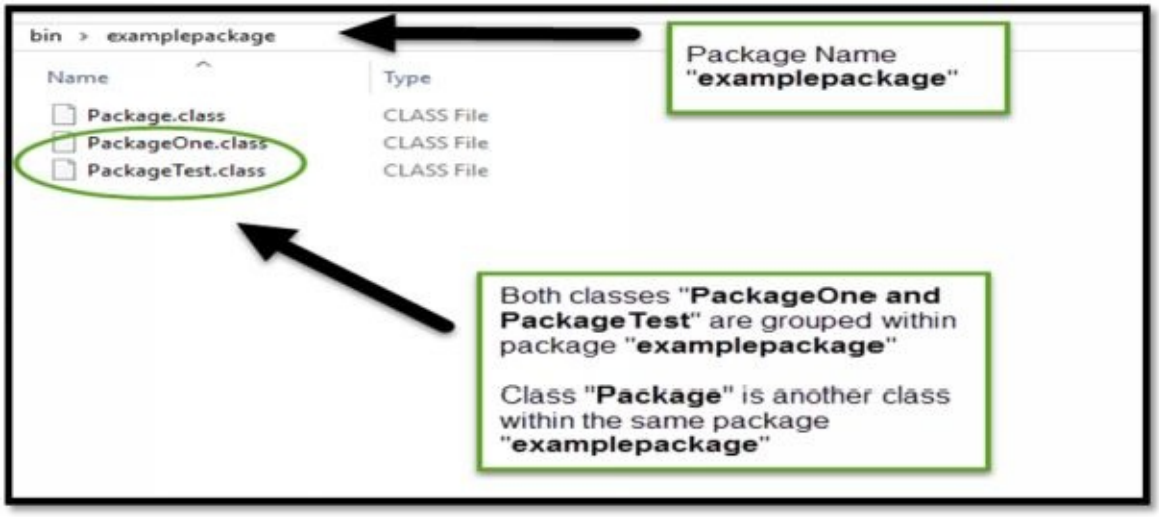


Figure 2.33 – Package Directory Screenshot

Interfaces

An interface is a collection of related methods. Generally, most interfaces do not include the body of a method. Therefore an interface method reveals what action to perform but not how to perform the action. This concept allows a class to implement the interface method and decide how to perform the action. Each class has the ability to implement a different action for the same interface method. Interfaces optionally extend one or more interfaces similar to a subclass extending a superclass. The following is the syntax for an interface:

Syntax

accessmodifier **interface** interfaceName **extends** interfaceName1, interfaceName2, interfaceNameN

```
{
    variableType variableName1;
    variableType variableName2;
    variableType variableNameN;
    methodType methodName1 (parameter-list);
    methodType methodName2 (parameter-list);
    methodType methodNameN (parameter-list);
}
```

Syntax Details

Argument	Description
accessmodifier	Can be public or no access modifier. A public declaration indicates the interface can be used by any code. A no access modifier is the default which indicates the interface is only available to members of its package
interface	A keyword used to declare an interface
interfaceName	The name of an interface

extends	An optional keyword that extends one or more interfaces
interfaceName1, 2, N	One or more interfaces separated by a comma that will be extended
variableType variableName1, 2, N;	One or more interface variables
methodType methodName1 (parameter-list);	One or more interface methods

Figure 2.34 – Interface Syntax Details

The following is an interface example:

```
1 package InterfaceTesting;
2
3 public interface InterfaceTest
4 {
5     public void methodOne();
6     public void methodTwo();
7 }
```

Figure 2.35 – Interface Example

- Line 3 declares an interface by using the keyword “interface” with a “public” access modifier. Therefore, any class within any package can implement the code. The interface name is InterfaceTest.
- Lines 5 and 6 are void methods “methodOne and methodTwo”. Notice the semi-colon at the end of each method. The semi-colon is placed at the end of the methods because there is no body/implementation.

- Arrays
- Strings
- Errors
- Exceptions
- Debugging
- File Input/Output

Chapter 2 provided an overview of Core Java (Variables, Data Types, Operators, Control Structures, Classes, Objects, Methods, Access Modifiers, Inheritance, Packages, and Interfaces). Chapter 3 will discuss JUnit and TestNG, which are Unit Test Frameworks. JUnit inspired TestNG then TestNG added more features for testing applications.

Chapter 3
JUnit vs TestNG

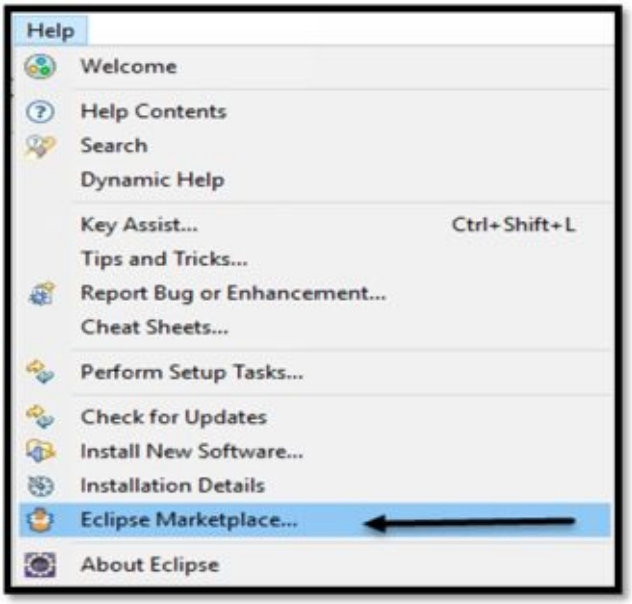
JUnit and Test Next Generation (known as TestNG) are unit test frameworks structured for Java. Both frameworks support testing in Eclipse. JUnit is part of a unit testing framework family called xUnit. The xUnit family is a collection of unit test frameworks with a common architecture.

TestNG is not part of the xUnit family but influenced by JUnit. Consequently, TestNG added new more powerful test features, which includes unit, integration, end-to-end (E2E), acceptance, and functional testing.

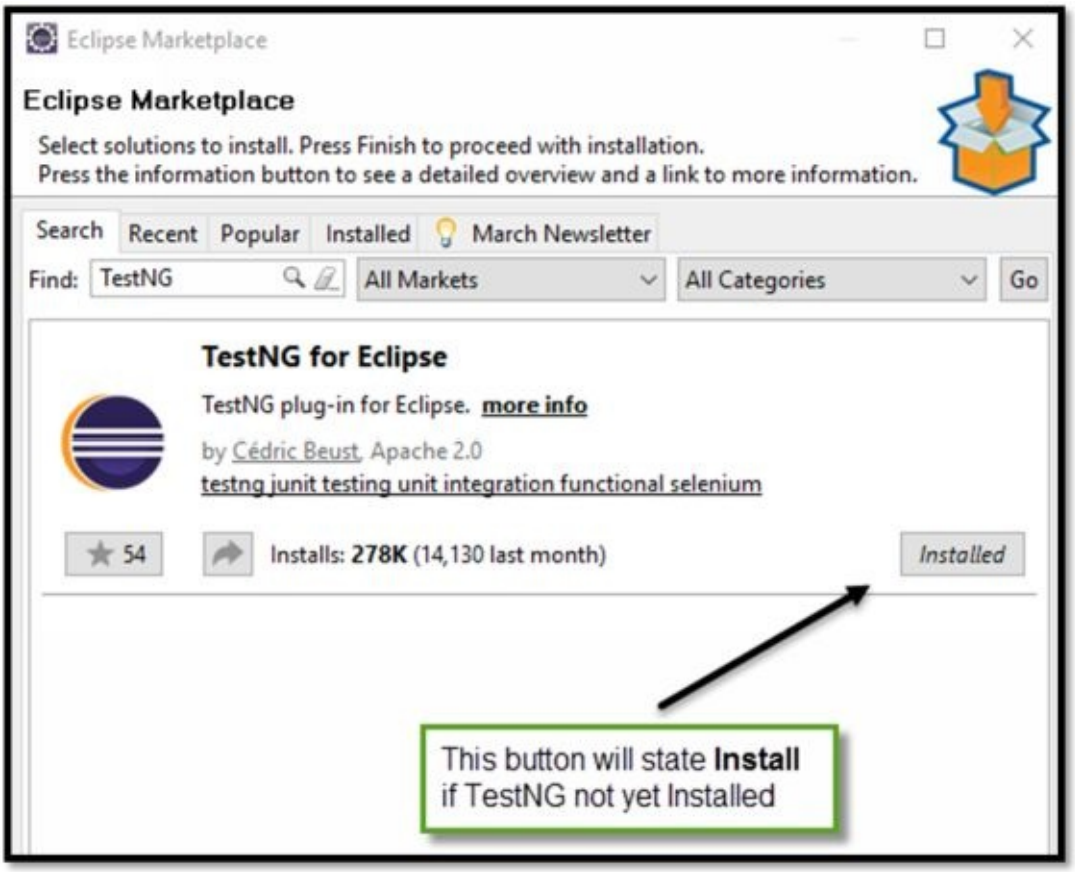
In spite of TestNG containing more features, JUnit is more popular than TestNG. A lot of mainstream IDE's are automatically furnished with JUnit. On the other hand, TestNG must be installed as a plugin to the IDE's. The following illustrates one of the ways to install TestNG into Eclipse IDE:

Install TestNG via Marketplace:

1. Open Eclipse
2. Click Help
3. Click Eclipse Marketplace…



4. Enter TestNG in the Find text field



5. Click Go
6. Click Install

The following are core functions of TestNG and JUnit testing frameworks:

- Create Test Scripts via Selenium WebDriver
- Generate Test Reports
- Generate Logs
- Read / Write Data in Excel

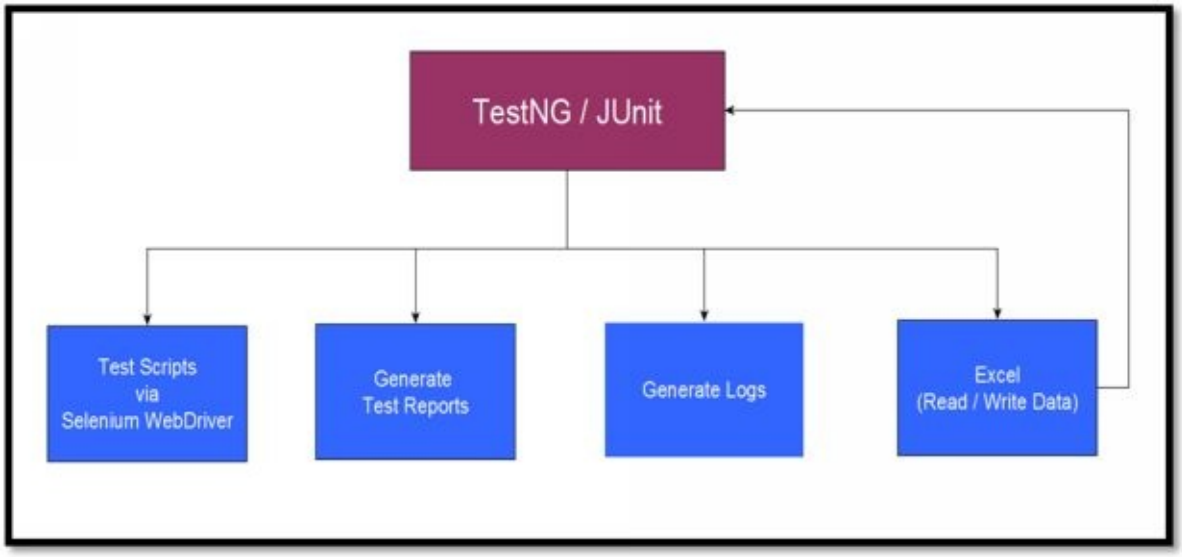


Figure 3.1 – TestNG and JUnit Core Test Functions

Chapter 3 will focus on the following TestNG features although both frameworks perform similar functions:

- What Are Annotations
- Import Annotations
- Create Annotations
- Execute Annotations

What Are Annotations

Annotations provide metadata to the compiler. Metadata is data that describes data. All annotations start with an at "@" symbol followed by the annotation name. The goal of annotations is to specify the purpose of a class, method, or test. Annotations have the ability to receive parameters like methods. The following is a list of annotations and their descriptions according to testng.org.

- @BeforeSuite – The annotated method will run before all tests in this suite have run.
- @AfterSuite – The annotated method will run after all tests in this suite have run.
- @BeforeTest – The annotated method will run before any test method belonging to the classes inside the <test> tag runs.
- @AfterTest – The annotated method will run after all the test methods belonging to the classes inside the <test> tag runs.
- @BeforeGroups – The list of groups that this configuration method will run before. This method is guaranteed to run before the first test method that belongs to any of these groups is called/invoked.
- @AfterGroups – The list of groups that this configuration method will run after. This method is guaranteed to run after the last test method that belongs to any of these groups is called/invoked.
- @BeforeClass – The annotated method will run before the first test method in the current class is called/invoked.
- @AfterClass – The annotated method will run after all the test methods in the current class runs.
- @BeforeMethod – The annotated method will run before each test method.
- @AfterMethod – The annotated method will run after each test method.
- @DataProvider – Marks a method as providing 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.

Note: Annotations are case-sensitive so the compiler will generate an error if they are not written with the correct syntax.

Import Annotations

Importing a package is a feature that allow a class to access members of another class (see *Chapter 5 in (Part 2) Java 4 Selenium WebDriver*). In the case of annotations, there are packages that contain annotation classes. The annotation classes must be imported for another class to use a specific annotation. An error occurs if the correct class is not imported. The following is an example of several TestNG annotation imports:

```
import org.testng.annotations.Test;
import org.testng.annotations.BeforeMethod;
import org.testng.annotations.AfterMethod;
import org.testng.annotations.DataProvider;
import org.testng.annotations.BeforeClass;
import org.testng.annotations.AfterClass;
import org.testng.annotations.BeforeTest;
import org.testng.annotations.AfterTest;
import org.testng.annotations.BeforeSuite;
import org.testng.annotations.AfterSuite;
```

Figure 3.2 – TestNG Annotation Import

Note: An automation engineer can use an asterisk (*) or enter the shortcut (Ctrl + Shift + O) to import all classes. The following is an example of using an asterisk to import all required annotation classes.

```
import org.testng.annotations.*;
```

Create Annotations

Annotations are created to identify test methods. As a result, an annotation is placed one line prior to the test method. Annotations have a syntax that must be followed but test methods can be any name. The annotations are selected via New TestNG class modal or entered by the automation engineer.

How To Add Annotations via New TestNG Class

In Eclipse, a New TestNG class modal is accessed multiple ways. The following are steps to access the TestNG class modal via project:

1. Right click the project name “e.g., Chapter_3”
2. Select TestNG
3. Select Create TestNG class
4. Select / Enter Source folder, Package name, and Class name
5. Check one or more the annotations
6. Click Finish

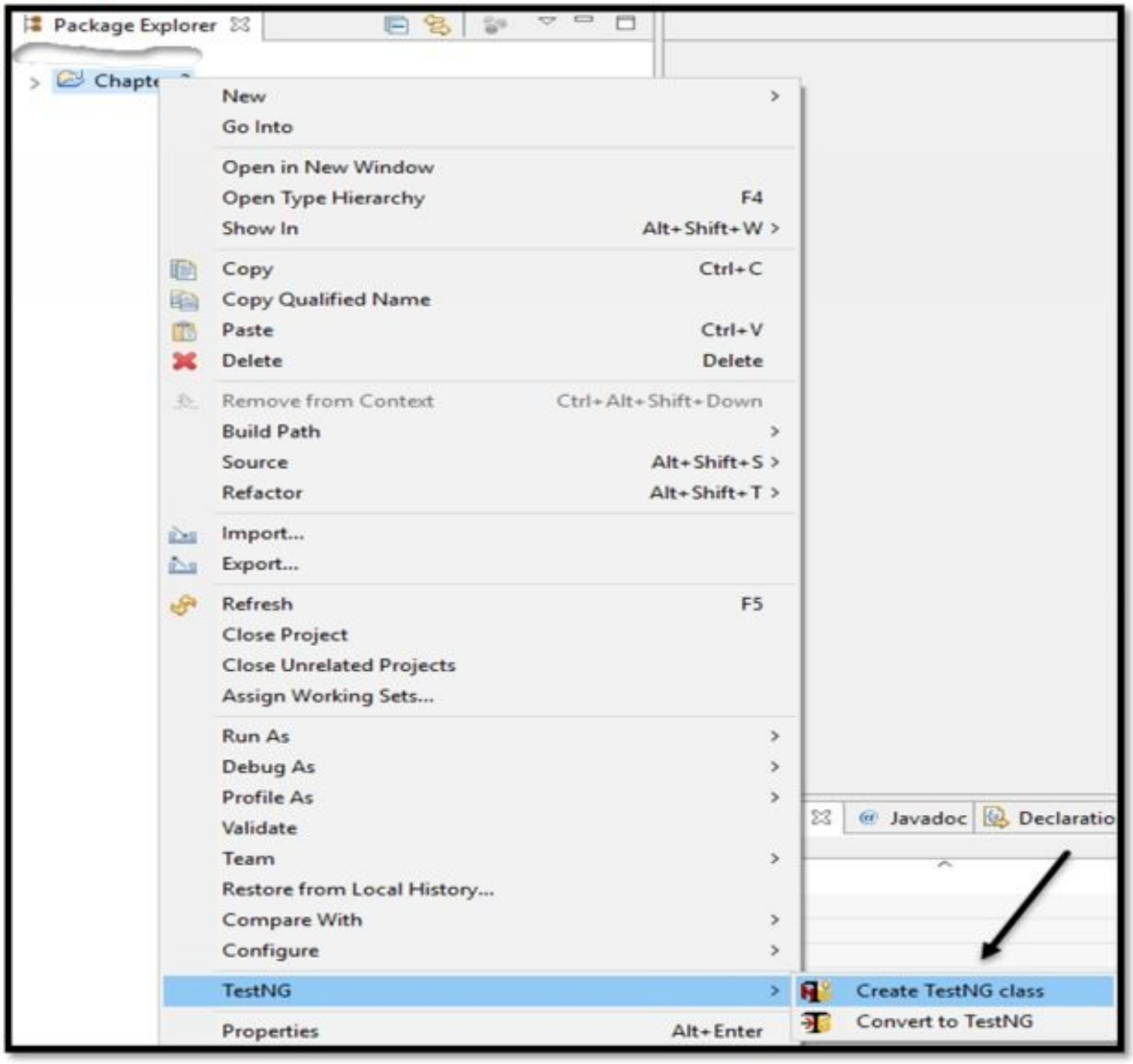


Figure 3.3 – Steps To Access New TestNG Class Modal

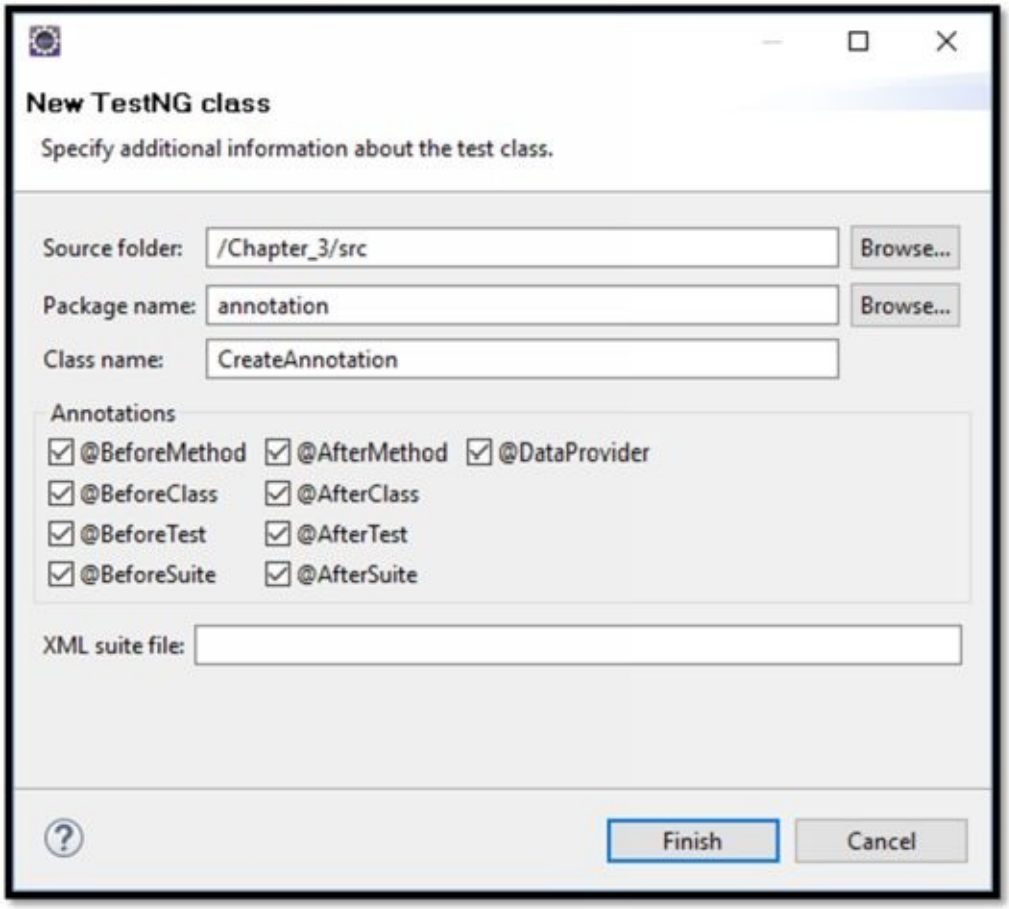


Figure 3.4 – New TestNG Class Modal

Note: The annotations and imports are automatically created in the program after clicking the Finish button. The following is an example of annotations after checking the annotations from New TestNG Class modal:

```
package annotation;

import org.testng.annotations.Test;
import org.testng.annotations.BeforeMethod;
import org.testng.annotations.AfterMethod;
import org.testng.annotations.DataProvider;
import org.testng.annotations.BeforeClass;
import org.testng.annotations.AfterClass;
import org.testng.annotations.BeforeTest;
import org.testng.annotations.AfterTest;
import org.testng.annotations.BeforeSuite;
import org.testng.annotations.AfterSuite;

public class CreateAnnotationsAutomatically
{
```

```
@Test(dataProvider = “dp”)
public void f(Integer n, String s) {
}

@BeforeMethod
public void beforeMethod() {
}

@AfterMethod
public void afterMethod() {
}

@DataProvider
public Object[][] dp() {
   return new Object[][] {
   new Object[] { 1, “a” },
   new Object[] { 2, “b” },
   };
}
@BeforeClass
public void beforeClass() {
}

@AfterClass
public void afterClass() {
}

@BeforeTest
public void beforeTest() {
}

@AfterTest
public void afterTest() {
}

@BeforeSuite
public void beforeSuite() {
}
```

```
  @AfterSuite
  public void afterSuite() {
  }

}
```

Figure 3.5 – Automatically Created Annotations From New TestNG Class Modal

Note: Lines 3 – 12 have imports. However, lines 4 – 12 are minimized so all of the imports are not visible. The remaining lines similar to Figure 3.2 – TestNG Annotation Import are shown by clicking the plus icon (+) next to line 3.

How Automation Engineers Write Annotations

In the previous example, all of the annotations were checked in the New TestNG Class modal. Generally, all annotations are not checked or written by an automation engineer. Only the annotations necessary for testing is utilized. An automation engineer can write any of the annotations from the list of annotations. The following is a Test annotation "@Test" example:

```
package annotation;

public class WriteAnnotations
{
    @Test
    public void testFirstScript ()
    {
            System.out.println("This is the first test script");
    }
}
```

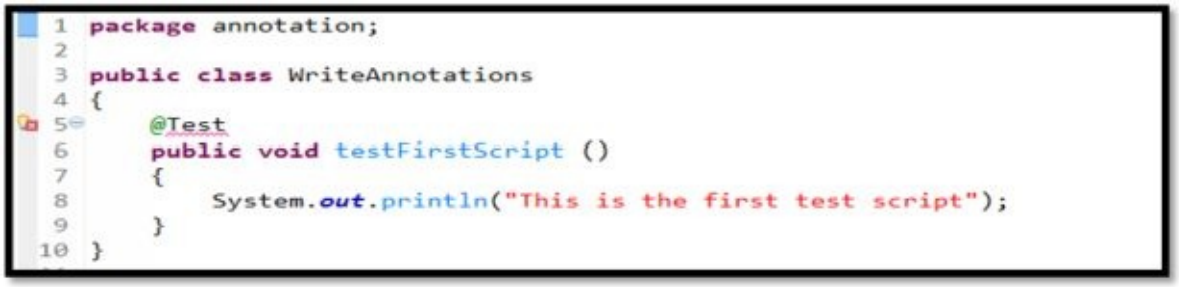


Figure 3.6 - @Test Annotation

Notice, the error at line 5 for the Test annotation "@Test". A TestNG library and test annotation import must be added to resolve the error. Eclipse displays several solutions by hovering over the error. The following shows how to add an import.

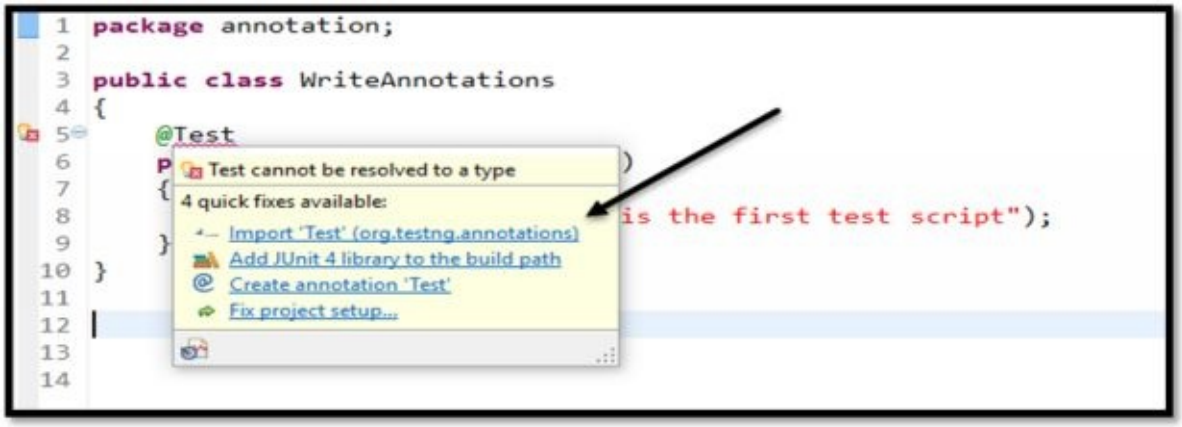


Figure 3.7 – Import Test Annotation

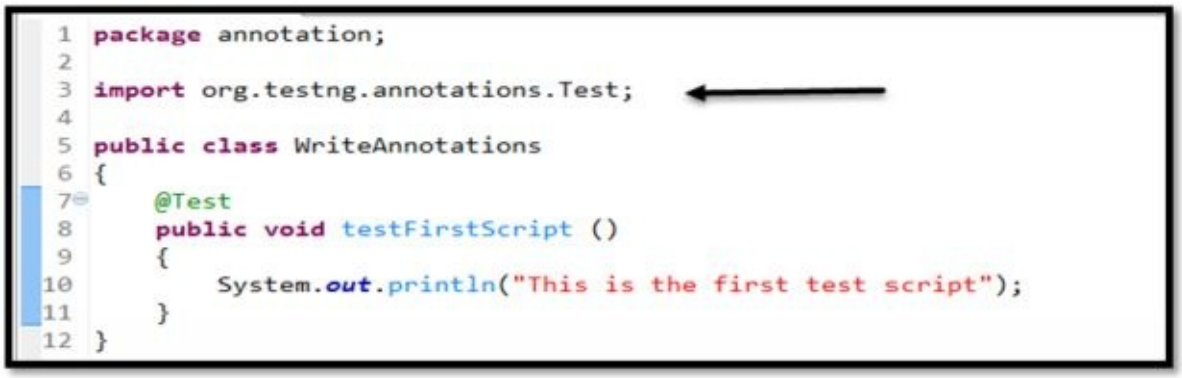


Figure 3.8 – Test Annotation Imported

- The option “Import ‘Test’ (org.testng.annotations)” was selected to import the Test annotation
- Line 3 automatically populates the program with an import to resolve the error

Note: In this example, TestNG was added as a library to the Project Explorer before importing the Test annotation. The following is a screenshot of the TestNG library:

Figure 3.9 – TestNG Library Added To The Project Explorer

Execute Annotations

Annotations are executed in a predefined order. The annotations can be located anywhere in the program and still execute according to the predefined order. TestNG contains an in-built mechanism for executing annotations. According to Next Generation Java ™ Testing TestNG and Advanced Concepts, every time a method is annotated with one of these annotations, it will run at the following time (page 20):

- @BeforeSuite / @AfterSuite – before a suite starts / after all the test methods in a certain suite have been run
- @BeforeTest / @AfterTest – before a test starts / after all the test methods in a certain test have been run
- @BeforeClass / @AfterClass – before a test class starts / after all the test methods in a certain class have been run
- @BeforeMethod / @AfterMethod – before a test method is run / after a test method has been run

The following is an example illustrating an annotation execution order:

```
package annotation;

import org.testng.annotations.*;

public class AnnotationExecutionOrder
{
 @Test // This is a test method
 public void testMethod ()
 {
     System.out.println("@Test - This is a test method");
 }

 @BeforeMethod // Executes before each test
 public void beforeMethod()
 {
     System.out.println("@BeforeMethod - Executes before each test method");
 }
```

```
@AfterMethod
public void afterMethod()
{
    System.out.println("@AfterMethod - Executes after each test method");
}

@BeforeClass
public void beforeClass()
{
    System.out.println("@BeforeClass - Executes first in the class");
}

@AfterClass
public void afterClass()
{
    System.out.println("@AfterClass - Executes last in the class");
}

@BeforeTest
public void beforeTest()
{
    System.out.println("@BeforeTest - Executes before all test methods");
}

@AfterTest
public void afterTest()
{
    System.out.println("@AfterTest - Executes after all test methods");
}

@BeforeSuite
public void beforeSuite()
{
    System.out.println("@BeforeSuite - Executes first in the suite");
}

@AfterSuite
public void afterSuite()
```

```
 {
     System.out.println("@AfterSuite - Executes last in the suite");
 }
}
```

```java
@Test // This is a test method
public void testMethod ()
{
    System.out.println("@Test - This is a test method");
}

@BeforeMethod // Executes before each test
public void beforeMethod()
{
    System.out.println("@BeforeMethod - Executes before each test method");
}

@AfterMethod
public void afterMethod()
{
    System.out.println("@AfterMethod - Executes after each test method");
}

@BeforeClass
public void beforeClass()
{
    System.out.println("@BeforeClass - Executes first in the class");
}

@AfterClass
public void afterClass()
{
    System.out.println("@AfterClass - Executes last in the class");
}

@BeforeTest
public void beforeTest()
{
    System.out.println("@BeforeTest - Executes before all test methods");
}

@AfterTest
public void afterTest()
{
    System.out.println("@AfterTest - Executes after all test methods");
}

@BeforeSuite
public void beforeSuite()
{
    System.out.println("@BeforeSuite - Executes first in the suite");
}

@AfterSuite
public void afterSuite()
{
    System.out.println("@AfterSuite - Executes last in the suite");
}
```

Figure 3.10 – TestNG Annotations And A Single Test Annotation

Program Output:

@BeforeSuite - Executes first in the suite

@BeforeTest - Executes before all test methods

@BeforeClass - Executes first in the class

@BeforeMethod - Executes before each test method

@Test - This is a test method

@AfterMethod - Executes after each test method

@AfterClass - Executes last in the class

@AfterTest - Executes after all test methods
@AfterSuite - Executes last in the suite

- Lines 7, 13, 19, 25, 31, 37, 43, 49, and 55 contain TestNG annotations
- The program displays the annotations in the following order: @Test, @BeforeMethod, @AfterMethod, @BeforeClass, @AfterClass, @BeforeTest, @AfterTest, @BeforeSuite, @AfterSuite
- The annotations execute in the following predefined order: @BeforeSuite, @BeforeTest, @BeforeClass, @BeforeMethod, @Test, @AfterMethod, @AfterClass, @AfterTest, @AfterSuite

The test annotations “@Test” do not execute in a predefined order if multiple Test annotations are created in a program. The following is an example execution of multiple Test annotations in a single program.

```
package annotation;

import org.testng.annotations.*;

public class ExecuteTestAnnotations
{
    @Test
    public void testInternetExplorer ()
    {
            System.out.println(“Test Script 3 - Cross Browser Testing in Internet Explorer”);
    }
    @Test
    public void testFirefox ()
    {
            System.out.println(“Test Script 1 - Cross Browser Testing in Firefox”);
    }
    @Test
    public void testGoogle ()
    {
            System.out.println(“Test Script 2 - Cross Browser Testing in Google”);
    }
}
```

```
1  package annotation;
2
3  import org.testng.annotations.*;
4
5  public class ExecuteTestAnnotations
6  {
7      @Test
8      public void testInternetExplorer ()
9      {
10         System.out.println("Test Script 3 - Cross Browser Testing in Internet Explorer");
11     }
12
13     @Test
14     public void testFirefox ()
15     {
16         System.out.println("Test Script 1 - Cross Browser Testing in Firefox");
17     }
18
19     @Test
20     public void testGoogle ()
21     {
22         System.out.println("Test Script 2 - Cross Browser Testing in Google");
23     }
24 }
```

Figure 3.11 – Test Annotations

Program Output:

Test Script 1 - Cross Browser Testing in Firefox

Test Script 2 - Cross Browser Testing in Google

Test Script 3 - Cross Browser Testing in Internet Explorer

- Lines 7, 13, and 19 display multiple Test annotations "@Test" which identify test methods at lines 8, 14, and 20
- The program displays the test methods in the following order: testInternetExplorer, testFirefox, and testGoogle
- The test methods execute in the following order: testFirefox, testGoogle, then testInternetExplorer

Note: The test methods were executed in alphabetical order according to method name. However, it is best to pass a priority parameter to each test annotation. The following is an example using a priority parameter to specify an execution order:

```
package annotation;

import org.testng.annotations.*;

public class OrderTestAnnotations
```

```
{
    @Test (priority = 2)
    public void testInternetExplorer ()
    {
            System.out.println("Test Script 3 - Cross Browser Testing in Internet Explorer");
    }
    @Test (priority = 3)
    public void testFirefox ()
    {
            System.out.println("Test Script 1 - Cross Browser Testing in Firefox");
    }
    @Test (priority = 1)
    public void testGoogle ()
    {
            System.out.println("Test Script 2 - Cross Browser Testing in Google");
    }
}
```

Figure 3.12 – Test Annotation With Priority Parameter

Program Output:

Test Script 2 - Cross Browser Testing in Google

Test Script 3 - Cross Browser Testing in Internet Explorer

Test Script 1 - Cross Browser Testing in Firefox

- Lines 7, 13, and 19 include a priority parameter within the Test annotations. The priority parameter sets the precedence for each test method on lines 8, 14, and 20

- Execution order for the test methods are testGoogle (line 20), testInternetExplorer (line 8), then testFirefox (line 14). As a result, the Program Output displays Test Script 2, Test Script 3, and Test Script 1

The following is an example displaying the execution order for multiple TestNG annotations:

```
package annotation;

import org.testng.annotations.*;

public class ExecuteMostAnnotations
{
    @BeforeMethod // Execute before each test (i.e., @Test)
    public void openBrowser()
    {
            System.out.println("Open Browser");
    }

    @AfterMethod // Execute after each test (i.e., @Test)
    public void closeBrowser()
    {
            System.out.println("Close Browser \n");
    }

    @BeforeTest // Before all test scripts are executed
    public void connectDataBase()
    {
      System.out.println("Connect to a Database \n");
    }

    @AfterTest // After all test scripts are executed
    public void disconnectDataBase()
    {
```

```
        System.out.println("Disconnect from the Database");
    }
    @Test (priority = 1)
    public void testFirefox ()
    {
        System.out.println("Test Script 1 - Cross Browser Testing in Firefox");
    }
    @Test (priority = 2)
    public void testGoogle ()
    {
        System.out.println("Test Script 2 - Cross Browser Testing in Google");
    }
    @Test (priority = 3)
    public void testInternetExplorer ()
    {
        System.out.println("Test Script 3 - Cross Browser Testing in Internet Explorer");
    }
}
```

```java
package annotation;

import org.testng.annotations.*;

public class ExecuteMostAnnotations
{
    @BeforeMethod // Execute before each test (i.e., @Test)
    public void openBrowser()
    {
        System.out.println("Open Browser");
    }

    @AfterMethod // Execute after each test (i.e., @Test)
    public void closeBrowser()
    {
        System.out.println("Close Browser \n");
    }

    @BeforeTest // Before all test scripts are executed
    public void connectDataBase()
    {
      System.out.println("Connect to a Database \n");
    }

    @AfterTest // After all test scripts are executed
    public void disconnectDataBase()
    {
        System.out.println("Disconnect from the Database");
    }

    @Test (priority = 1)
    public void testFirefox ()
    {
        System.out.println("Test Script 1 - Cross Browser Testing in Firefox");
    }

    @Test (priority = 2)
    public void testGoogle ()
    {
        System.out.println("Test Script 2 - Cross Browser Testing in Google");
    }

    @Test (priority = 3)
    public void testInternetExplorer ()
    {
        System.out.println("Test Script 3 - Cross Browser Testing in Internet Explorer");
    }
}
```

Figure 3.13 – TestNG Annotations And Multiple Test Annotations

Program Output:

Connect to a Database

Open Browser
Test Script 1 - Cross Browser Testing in Firefox
Close Browser

Open Browser
Test Script 2 - Cross Browser Testing in Google
Close Browser

Open Browser
Test Script 3 - Cross Browser Testing in Internet Explorer

Close Browser

Disconnect from the Database

- Lines 7, 13, 19, 25, 31, 37, and 43 contain multiple TestNG annotations. Lines 31, 37, and 43 are the test annotations
- The annotations execute in the following order:
  - **Line 9**
  @BeforeTest
  - **Line 7, Line 31, Line 13**
  @BeforeMethod, @Test – testFirefox, @AfterTest
  - **Line 7, Line 37, Line 13**
  @BeforeMethod, @Test – testGoogle, @AfterTest
  - **Line 7, Line 43, Line 13**
  @BeforeMethod, @Test – testInternetExplorer, @AfterTest
  - **Line 43**
  @AfterTest

Note: Some additional powerful features of TestNG include the following:

- Automatically identify and run JUnit test
- Generate reports in HTML and XML
- Trace code that handles exceptions
- Group test methods and specify groups that contain other groups

Chapter 3 discussed JUnit and TestNG frameworks. JUnit is part of the xUnit family, which is a collection of unit test frameworks with a common architecture. TestNG and JUnit are similar due to JUnit influencing TestNG. Chapter 4 introduces Selenium IDE, which is a good automation tool for creating Selenium's first Test Script.

Chapter 4
First Selenium Test Script

Most books and videos create the first Selenium test script via Selenium IDE. A Selenium test script is a set of instructions executed on the Application Under Test (AUT). Selenium IDE is a record and replay automation tool integrated within the Firefox browser. The tool generates Selenium test scripts by extracting locators from the web application. Locators help find and match WebElements. WebElements are buttons, radio buttons, text boxes, checkboxes, drop down menus, and hyperlinks (also known as links) located on a web application.

The record and replay feature is a good introduction for testers starting to learn automation testing. However, Selenium IDE has limitations such as cross browser testing. Therefore, it cannot test across multiple browsers (i.e., Google Chrome, Internet Explorer, etc.) because it is a Firefox extension.

Although Selenium IDE is limited, the record and replay feature is the main reason for discussing Selenium's first test script. The record feature captures a user's interaction with the AUT then provides an ability to playback the interactions. For example, Selenium IDE can record then playback the following interactions (also known as steps):

1. Enter User Name
2. Enter Password
3. Click Login

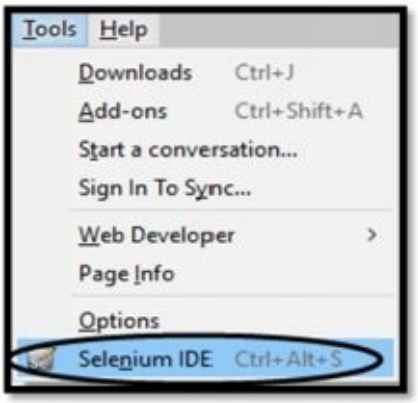
Chapter 4 will cover the following regarding Selenium's First Test Script:

How To Access Selenium IDE

Selenium IDE must be installed as a Firefox extension before it can be accessed. Steps for installing Selenium IDE are located in Chapter 1 – Install Selenium IDE section. The following are steps to access Selenium IDE:

Steps To Access Selenium IDE: (Shortcut = Ctrl + Alt + S)

1. Open the Firefox browser
2. Click Tools
3. Click Selenium IDE



Result: The Selenium IDE automation tool opens.

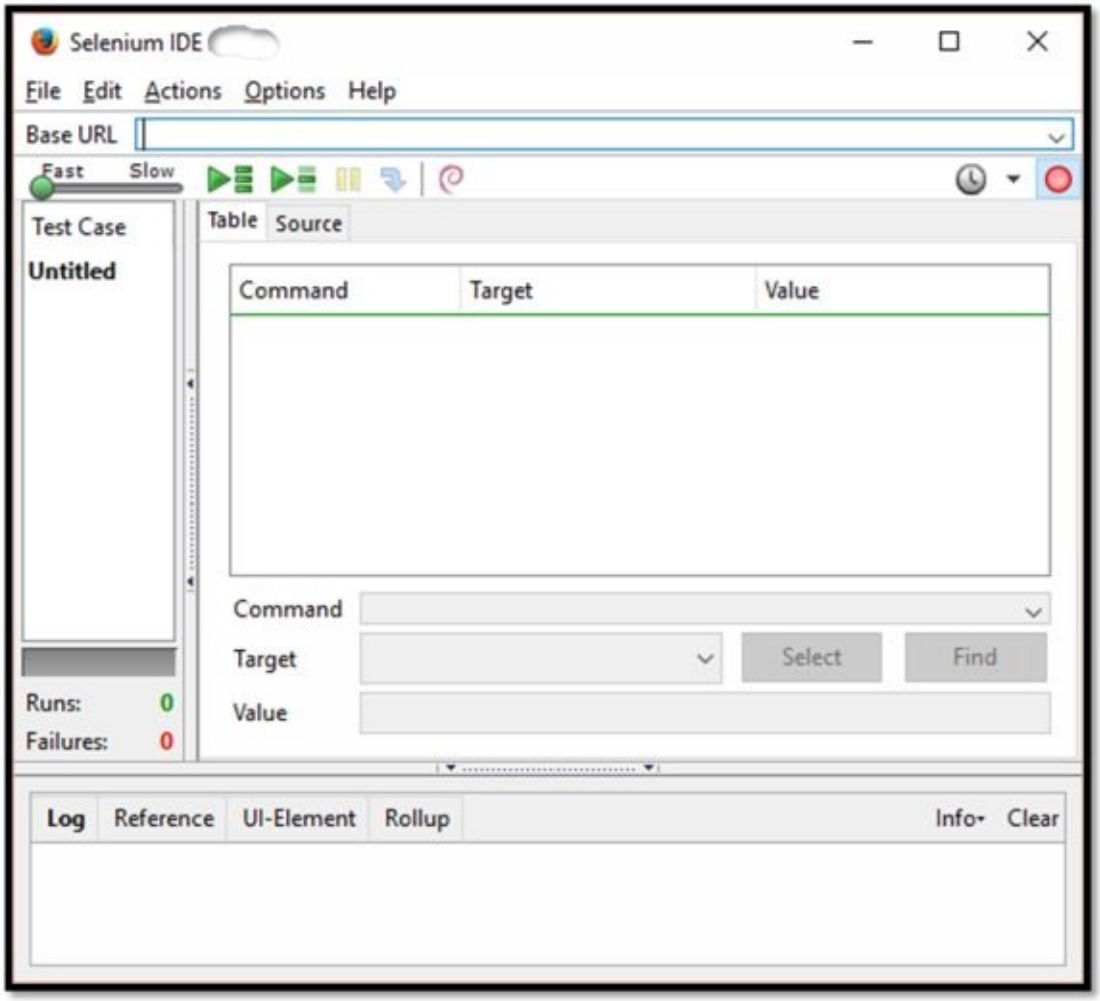


Figure 4.1 – Selenium IDE Screenshot

Selenium IDE User Interface

The Selenium IDE testing tool comes equipped with a Menu Bar and Tool Bar. Both bars form the User Interface (UI), which makes Selenium IDE more than a record and replay tool. The Menu Bar consist of a File menu, Edit menu, Actions menu, Options menus, and Help menu.

Figure 4.2 – Selenium IDE Menu Bar Screenshot

- **File menu** - allows a Test Script and Test Suite to be added, opened, saved, and exported
- **Edit menu** - allows Test Script commands to be copied, pasted, and deleted
- **Actions menu** - allows a Test Script to be recorded, played, and debugged
- **Options menu** - allows a change in the Selenium IDE settings
- **Help menu** - contains information about Selenium's UI/Elements, website, and blog

The following is a screenshot of Selenium IDE Tool Bar:

Figure 4.3 – Selenium IDE Tool Bar Screenshot

- **Speed Control** – controls how slow/fast the test script runs
- **Play Entire Test Suite** – plays the entire Test Suite when multiple Test Scripts are loaded
- **Play Current Test Script** – plays the current loaded Test Script
- **Pause/Resume Test Script** – allows the loaded Test Script to pause and resume
- **Step Through The Test Script** – allows a Test Script to get debugged one command at a time
- **Apply Rollup Rules** – allows one or more Selenium commands to be grouped into one command
- **Turn Test Scheduler On/Off** – allows a Test Suite to be scheduled
- **Record Button** – records the user's interactions with the web browser

Note: There is a difference between a Test Script and Test Case although used

interchangeably. Selenium IDE mislabels a Test Script by calling it a Test Case. In reality, a Test Script refers to steps from an automation perspective while Test Case refers to steps from a manual testing perspective.

The following is a list of Selenium IDE features that is not visible on the Menu Bar or Tool Bar:

- Add comments to a test script
- Store information in variables
- Work with multiple windows such as pop up windows
- Work with AJAX applications
- Parameterize the test scripts
- Prioritize the locators

Record Selenium's First Test Script

Most first time automation engineers utilize the record feature in Selenium IDE. After recording the interactions, a set of Test Scripts is hardcoded into Selenium IDE. Commands, targets, and values form the Test Scripts. Command shows the actions performed by the user. Target shows the element that received an action from the user. Value is the data entered by the user.

A web application called "Welcome to the Internet" powered by Elemental Selenium will be used to record Selenium's first Test Script. Dave Haeffner is the writer of Elemental Selenium which provides a free, once a week email on how to use Selenium like a Pro. The following is a set of manual Test Case steps simulating a user logging into a web application.

Test Case Steps:

1. Open Firefox
2. Access Selenium IDE
3. Click the red button if recording is not turned on by default
4. Enter URL for the website "http://the-internet.herokuapp.com/"
5. Click the Form Authentication link
6. Enter Username "tomsmith"
7. Enter Password "SuperSecretPassword!"
8. Click the Login button

The following screenshot shows the recorded Test Scripts in Selenium IDE:

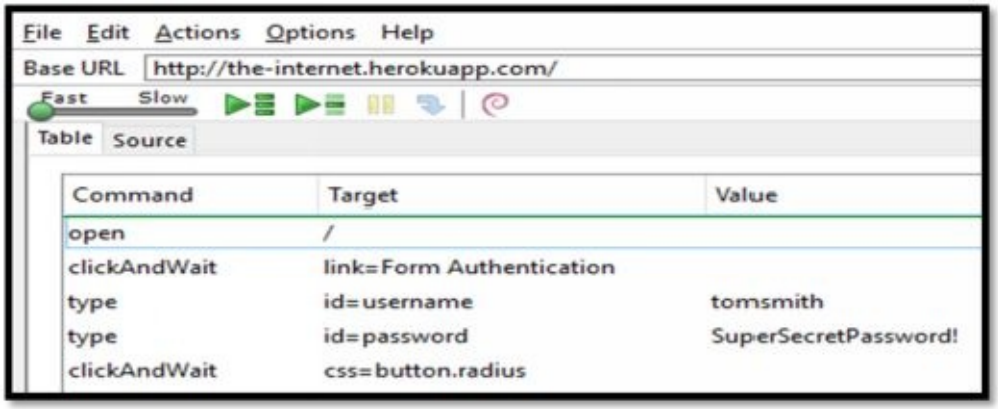


Figure 4.4 – Selenium IDE Recorded Test Script

All of the manual Test Case steps (4 - 8) recorded as a single Test Script. The following

explains Base URL along with columns Command, Target, and Value:

- **Base URL**: web application loaded by the user

- **Command**: represents the action performed by the user
  - **open** – opens the Base URL
  - **clickAndWait** – clicks on a hyperlink, button, checkbox, or radio button
  - **type** – sets the value of a text field (also known as input field)

- **Target**: represents the element that received an action from the user
  - **link=Form Authentication** – element Form Authentication received an action from the user
  - **id=username** – element Username received an action from the user
  - **id=password** – element Password received an action from the user
  - **css=button.radius** - element Login received an action from the user

  Note: The attributes (link and id) and attribute value (radius) are derived from HTML and will be explained in Locate WebElements via HTML.

- **Value**: represents the data entered by the user
  - **tomsmith** – data entered in the Username text field
  - **SuperSecretPassword**! – data entered in the Password text field

The following screenshots illustrate loading the website, clicking the Form Authentication link, entering the Username, entering the Password, and clicking the Login button:

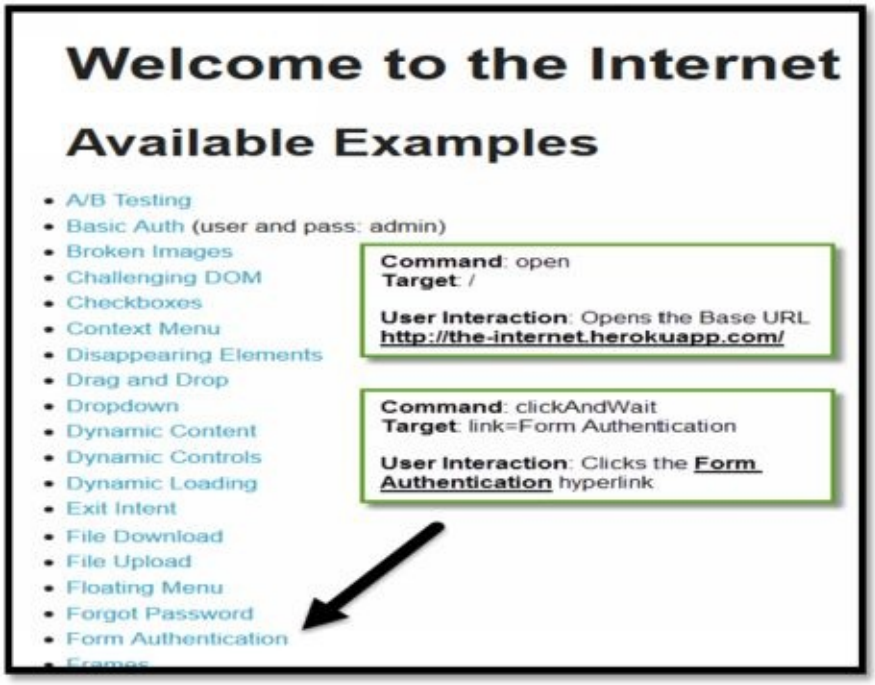


Figure 4.5 – Clicks The Form Authentication Link

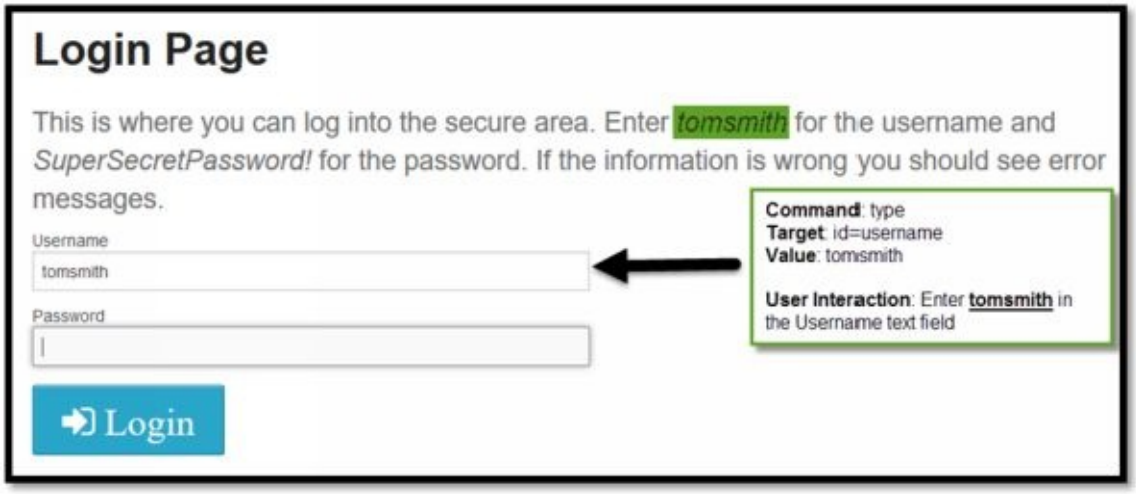


Figure 4.6 – Enter Username In The Text Field

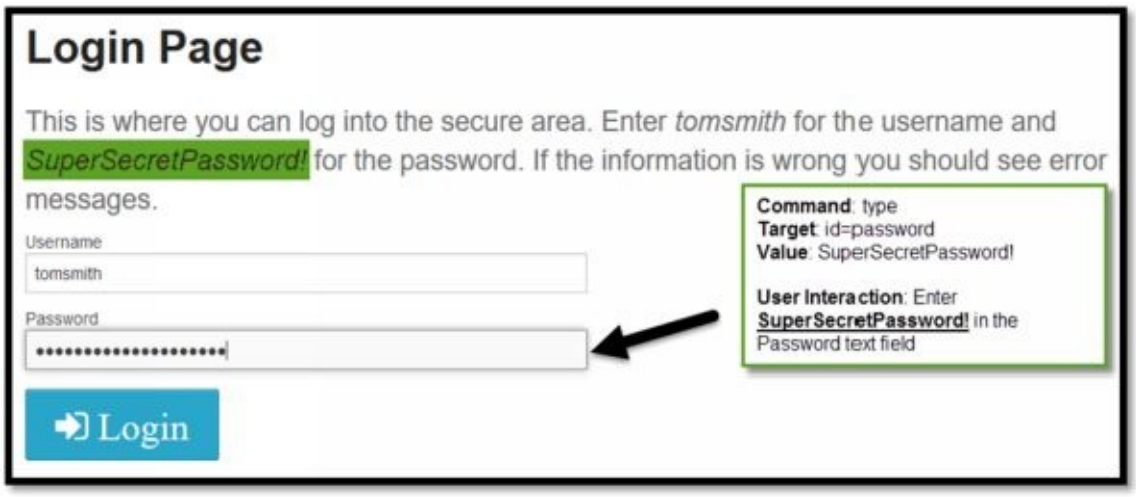


Figure 4.7 – Enter Password In The Text Field

Figure 4.8 – Clicks The Login Button

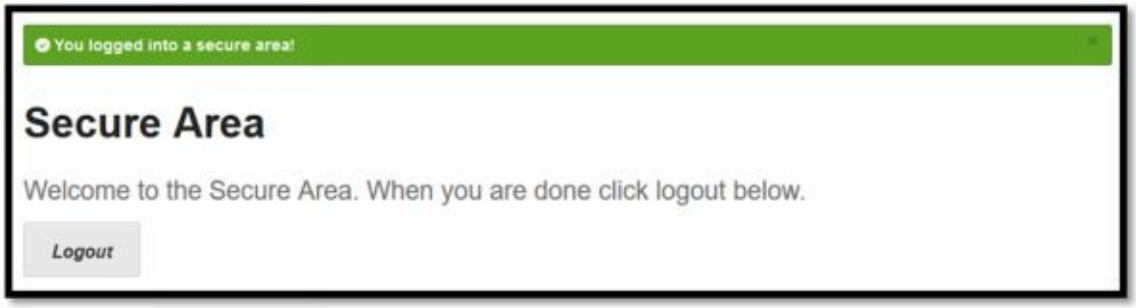


Figure 4.9 – Successful Login

Save and Playback Selenium's First Test Script

All Test Scripts in Selenium IDE can be saved and played back. It is best to save the Test Script before replaying the Test Script. Replaying a Test Script allows the user to see every recorded action.

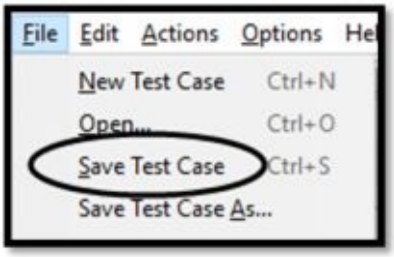
As mentioned in "Record Selenium's First Test Script", the Test Scripts are formed by commands, targets, and values. However, their terminology is different when recording the Test Script and replaying the Test Script. Recording the Test Script represents actions performed by the user. Replaying the Test Script are instructions to Selenium IDE. The following is terminology for command, target, and value while replaying a Test Script:

- **Command**: instructs Selenium IDE what action to perform
- **Target**: instructs Selenium IDE what element to locate
- **Value**: instructs Selenium IDE what data to enter

The following are steps to save and playback an automation Test Script:

Steps To Save The Test Script:

1. Click File from the Menu Bar
2. Click Save Test Case

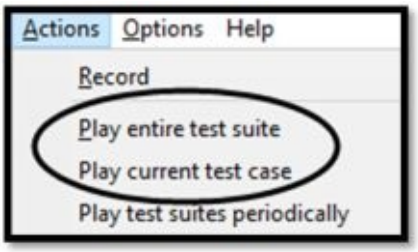


3. Name the Test Script "i.e., Enter Username – Password (Form Authentication)"

Steps To Playback The Test Script

1. Click the icon for Play Entire Test Suite or Play Current Test Case
    or  or

2. Click Actions from the Menu Bar
3. Select Play Entire Test Suite or Play Current Test Case



Note: Playing the entire Test Suite is suitable for replaying one Test Script or multiple Test Scripts.

Selenium IDE stores information (Commands, Targets, Values) about WebElements in Test Scripts while recording. Then uses the information to identify each WebElement for replaying the Test Scripts. For example, when the user enters a value in the Username text field, enters a value in the Password text field, and clicks the Login button. Selenium IDE stores the Commands, Targets, and Values then uses the information to replay the Test Script. Therefore, Selenium IDE will enter the same value in the text fields and click the Login button.

Replaying a Test Script offers useful information in the bottom pane of Selenium IDE. The bottom pane includes four tabs (Log, Reference, UI-Element, and Rollup). Two of the tabs (UI-Element and Rollup) are advanced features that are not relevant for this chapter. However, more information about both tabs is covered in the UI-Element Documentation located in Selenium's Help menu. Log reveals all steps and whether the Test Script Passed or Failed. Reference allows an automation engineer to investigate a specific step in the Test Script by displaying information regarding the command. The following are Log and Reference screenshots covering Figure 4.4.

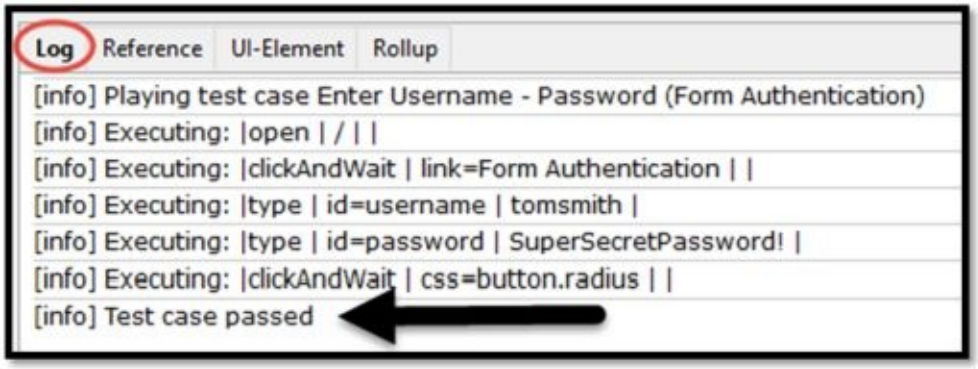


Figure 4.10 – Log Tab

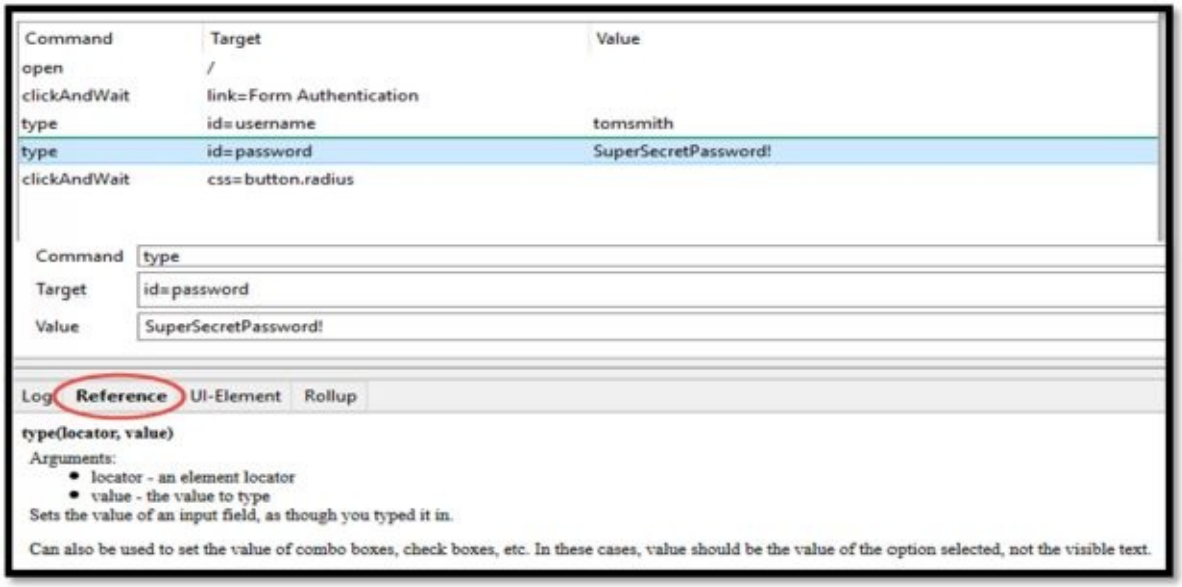


Figure 4.11 – Reference Tab

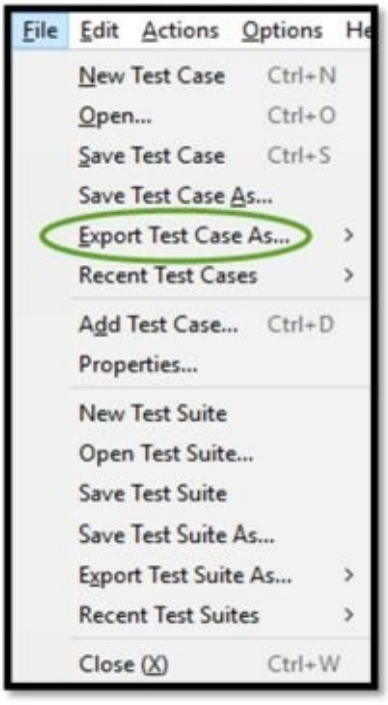
Export From Selenium IDE To Selenium WebDriver

After recording a Test Script, the Test Script can be exported from Selenium IDE to Selenium WebDriver in different formats. Selenium IDE provides bindings for the available programming languages in Selenium WebDriver. The available languages are C# (pronounced C Sharp), Java, Python, and Ruby.

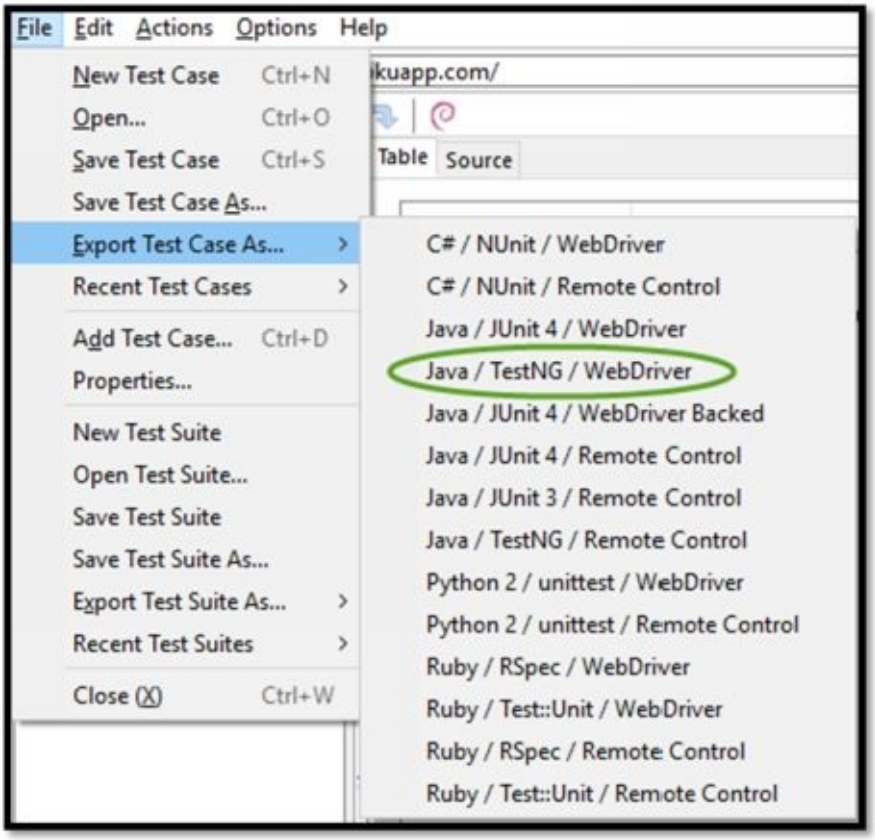
In addition, the testing framework such as JUnit and TestNG are exported along with the programming language. This section exports code for Java / TestNG / WebDriver since Java, TestNG, and WebDriver are the book's focal point. The following are steps for exporting code from Selenium IDE to Selenium WebDriver:

Steps For Exporting Code From Selenium IDE:

1. Click File from the Menu Bar
2. Select Export Test Case As



3. Select Java / TestNG / WebDriver



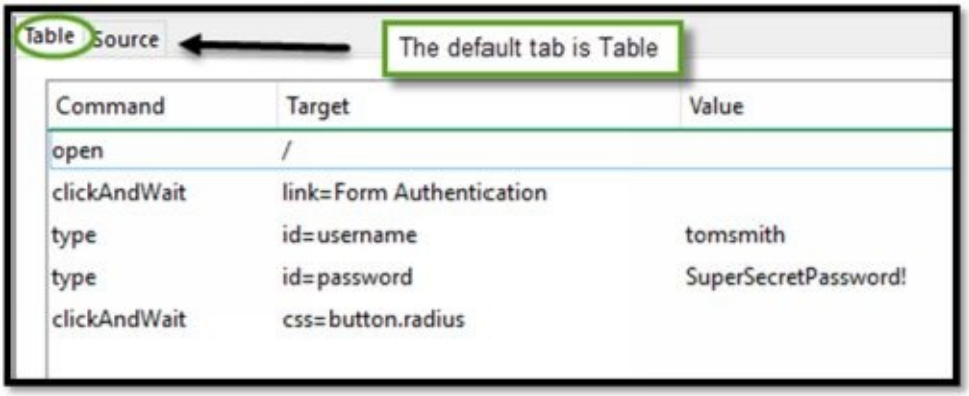
4. Save the file "i.e., **First Selenium Test Script**". The file will be saved with a .java extension "i.e., **First Selenium Test Script.java**"
5. Open the file with a text editor such as Notepad ++. Chapter 1 – Download Notepad ++ provides information for downloading Notepad ++:

Result: The Test Script is available in Java / TestNG / WebDriver format.

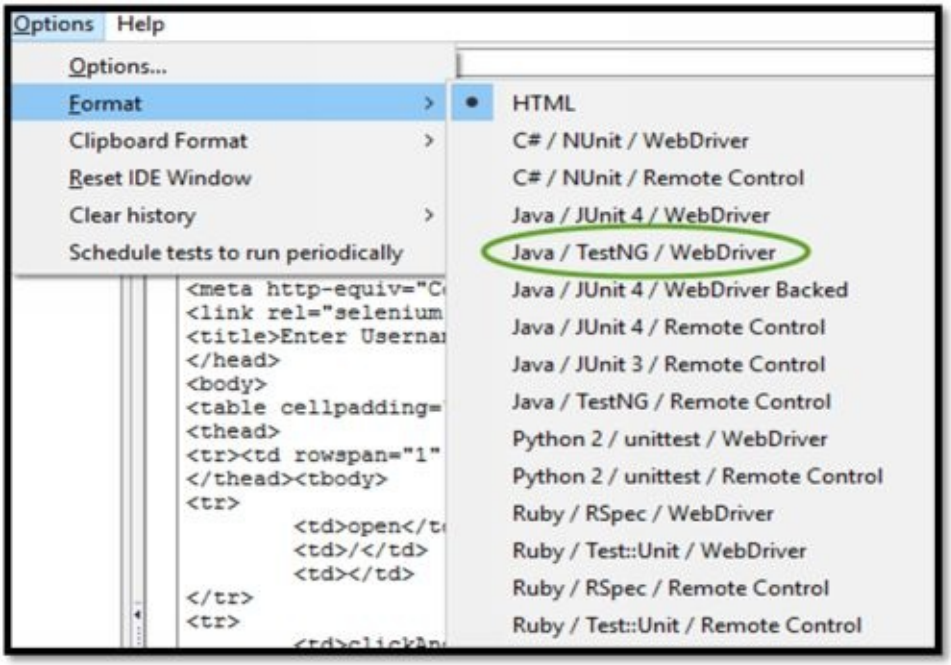
Selenium IDE has a Source feature similar to the Export feature that reveals the code in any language and test framework. Therefore, the Java / TestNG / WebDriver format can be seen without Notepad ++. However, the difference between the Source feature and Notepad ++ is the code's color. Notepad ++ displays some of the code with colors while the Source feature only displays black and white colors. The following are steps for utilizing the Source feature in Selenium IDE:

Steps For Viewing Code Within Selenium IDE:

1. Select the Source tab (The Table tab is selected by default)



2. Click Options from the Menu Bar
3. Check the Enable experimental features checkbox
4. Click OK
5. Click Options from the Menu Bar
6. Click Format
7. Select Java / TestNG / WebDriver



8. Click OK on the JavaScript Application modal

Result: The Test Script is available in Java / TestNG / WebDriver format.

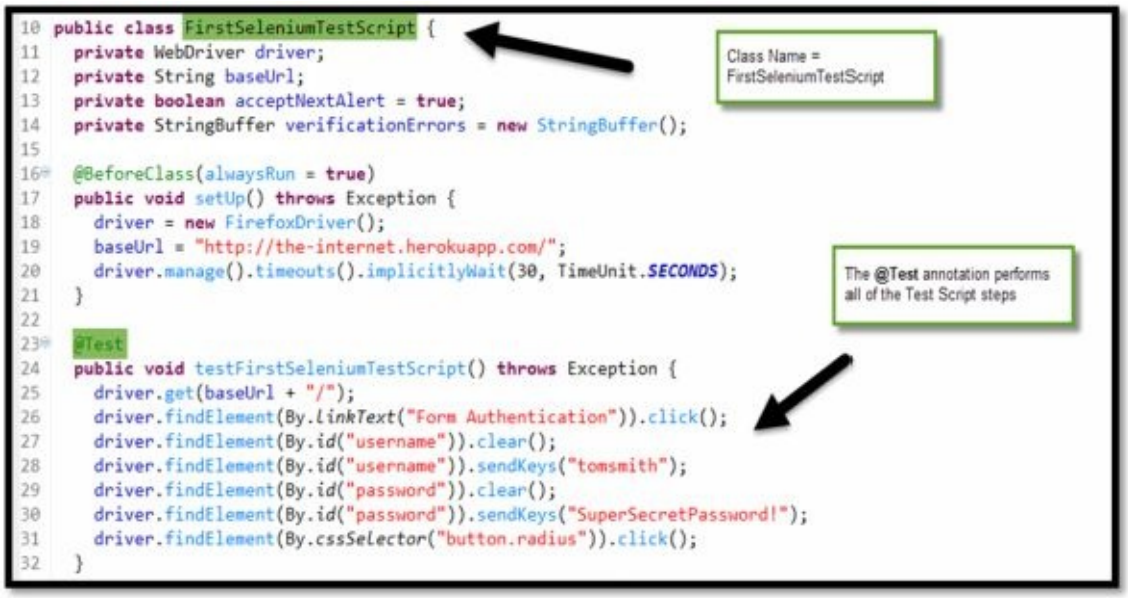
After viewing the code, it can be copied from the Source tab or text editor “i.e., Notepad ++”, pasted into Eclipse, then executed like all Selenium WebDriver Test Scripts. The following is a portion of the Test Script from Eclipse.

```
public class FirstSeleniumTestScript {
  private WebDriver driver;
  private String baseUrl;
  private boolean acceptNextAlert = true;
  private StringBuffer verificationErrors = new StringBuffer();

  @BeforeClass(alwaysRun = true)
  public void setUp() throws Exception {
    driver = new FirefoxDriver();
    baseUrl = “http://the-internet.herokuapp.com/”;
    driver.manage().timeouts().implicitlyWait(30, TimeUnit.SECONDS);
  }

  @Test
  public void testFirstSeleniumTestScript() throws Exception {
```

```
    driver.get(baseUrl + "/");
    driver.findElement(By.linkText("Form Authentication")).click();
    driver.findElement(By.id("username")).clear();
    driver.findElement(By.id("username")).sendKeys("tomsmith");
    driver.findElement(By.id("password")).clear();
    driver.findElement(By.id("password")).sendKeys("SuperSecretPassword!");
    driver.findElement(By.cssSelector("button.radius")).click();
}
```




```
10 public class FirstSeleniumTestScript {
11   private WebDriver driver;
12   private String baseUrl;
13   private boolean acceptNextAlert = true;
14   private StringBuffer verificationErrors = new StringBuffer();
15
16   @BeforeClass(alwaysRun = true)
17   public void setUp() throws Exception {
18     driver = new FirefoxDriver();
19     baseUrl = "http://the-internet.herokuapp.com/";
20     driver.manage().timeouts().implicitlyWait(30, TimeUnit.SECONDS);
21   }
22
23   @Test
24   public void testFirstSeleniumTestScript() throws Exception {
25     driver.get(baseUrl + "/");
26     driver.findElement(By.linkText("Form Authentication")).click();
27     driver.findElement(By.id("username")).clear();
28     driver.findElement(By.id("username")).sendKeys("tomsmith");
29     driver.findElement(By.id("password")).clear();
30     driver.findElement(By.id("password")).sendKeys("SuperSecretPassword!");
31     driver.findElement(By.cssSelector("button.radius")).click();
32   }
```

Figure 4.12 – First Selenium Test Script

- Line 10 displays the Class Name "FirstSeleniumTestScript" which is the same name as the saved file "First Selenium Test Script" from Selenium IDE
- Line 23 "@Test" identifies the method as a test method and performs all of the Test Script steps (lines 25 - 31)
- Line 25 gets the baseUrl, which is http://the-internet.herokuapp.com/. A new page loads "Welcome to the Internet" in the browser window
- Line 26 clicks the Form Authentication hyperlink
- Line 28 types the Username "tomsmith" into the text field
- Line 30 types the Password "SuperSecretPassword!" into the text field
- Line 31 clicks the Login button

Note: The WebDriver Methods "i.e., findElement", Locator Types "i.e., id", and methods that perform an action "i.e., click" are explained in Chapter 5 – WebDriver and WebElements.

Locate WebElements via HTML

All web applications and browsers contain WebElements “i.e., buttons, links, etc.” The WebElements are derived from HTML (Hyper Text Markup Language). HTML is the standard markup language for creating web applications. Furthermore, each browser reads an HTML document to display the browser pages.

A great deal of HTML markup tags includes an opening (also known as starting) tag, a closing (also known as ending) tag, and at least one attribute. In regards to web applications and browsers, the markup tags determine the characteristics of a WebElement. Attributes provide additional information about the WebElement. It is important to know that attributes are defined in the opening tag.

Both tags have the same name surrounded by angle brackets (< >). However, the difference between an opening and closing tag is the forward slash (/). Closing tags must include a forward slash before the tag name. Unlike the tags, an attribute contains a name/value pair. The following is the syntax for an opening tag, closing tag, and attribute name/value pair.

Syntax

<Opening AttributeName=”AttributeValue”>
Content placed in between the tags
</Closing>

Note: Some elements do not contain a closing tag.

Recall three of the Targets (Username, Password, Login) from Figure 4.4 - Selenium IDE Recorded Test Script displayed the following information:

- id=username
  - id is the AttributeName
  - username is the AttributeValue
- id=password
  - id is the AttributeName
  - password is the AttributeValue

- css=button.radius
  - css is the Locator Type (see *Chapter 9 – Find WebElement by CSS Selector*)
  - button is the opening/closing tag name
  - radius is the AttributeValue

The following screenshot provides an illustration of TagNames, AttributeNames, and AttributeValues using HTML's source code for Username, Password, and Login:

Figure 4.13 – HTML For The-Internet.Herokuapp.com/Login

Understanding The HTML Document Object Model (DOM)

The Document Object Model (DOM) represents an HTML document as a tree. The tree consists of parent-child relationship nodes. A parent can have one child node or many children nodes. Everything is considered a node in the HTML DOM. All of the HTML elements/tags are element nodes and all attributes are attribute nodes. Thus, the HTML document is a document node.

The HTML document becomes a document object when loaded into a browser. As a result, the top level is the owner of all nodes that contains children nodes. The parent node is labeled HTML while the two children nodes are labeled head and body. The following screenshot shows the parent node “HTML” along with its two children nodes “head and body”.

Figure 4.14 – HTML Parent Node And Two Children Nodes

As mentioned earlier, everything is considered a node in HTML DOM. Therefore, the html opening/closing tag and two attribute name/value pairs are nodes. The minus icon (-) next to html tag discloses the child nodes “head and body”. An automation engineer can click the plus icon (+) to view all children nodes within a specific parent node. In our example website “Welcome to the Internet”, the body node contains three div tags. The second div tag holds the Username text field, Password text field, and Login button. The following screenshots show each div tag and how the WebElements appear within the second div tag:

Figure 4.15 – Multiple Div Tags Within Body Node

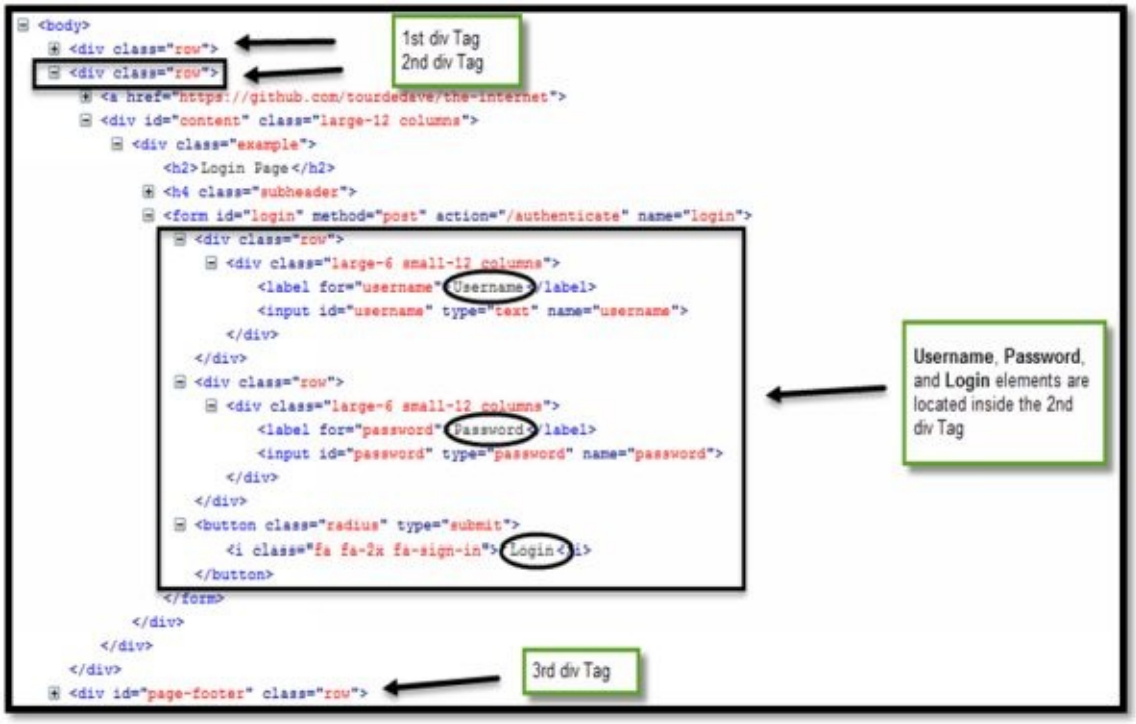


Figure 4.16 – Username, Password, and Login WebElements Inside 2nd Div Tag

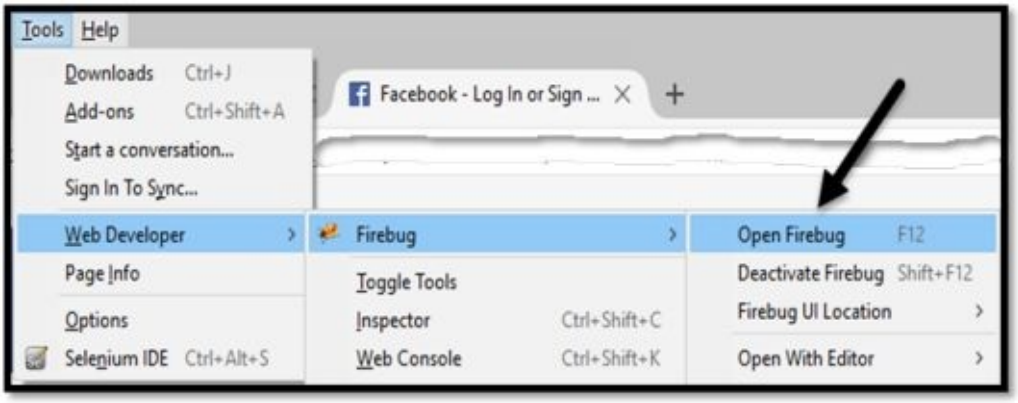
Note: The WebElements "Username, Password, and Login" are located within the 2nd div tag. However, there are several nodes between the 2nd div tag and each WebElement.

How To Locate A WebElement

A WebElement is located utilizing the tag name of an opening/closing tag, attribute name, and/or attribute value. They are located depending on how the extractors find and match the elements. Each element is extracted from HTML's source code into Selenium IDE. Firebug is one of many tools used to read HTML's source code. Steps for installing Firebug are located in Chapter 1 – Install Firebug and FirePath. The following are steps for locating a WebElement.

Steps for locating a WebElement:

1. Open Firefox browser
2. Load a web application "i.e., Welcome to the Internet"
3. Click shortcut "F12" or Tools > Web Developer > Firebug > Open Firebug



4. Navigate to the HTML tab within Firebug

5. Click the WebElement Inspector

6. Select the WebElement “i.e., Username”

Result: The WebElement is highlighted in the web application and HTML’s source code.

Figure 4.17 – WebElement In The Web Application And HTML Source Code

Chapter 4 explained Selenium IDE and HTML. Selenium IDE primarily used for recording and replaying Test Scripts. HTML is the standard markup language used for creating web applications. Web applications contain WebElements identified by tags and attributes within HTML. The Test Scripts from Selenium IDE can be exported to Selenium WebDriver. Chapter 5 will describe WebDriver, how to find WebElements via WebDriver, and how to perform actions on WebElements via WebDriver.

Chapter 5
WebDriver and WebElements

The starting point for testing all web applications begins with a browser. Selenium WebDriver provides support for major browsers such as Firefox, Google Chrome, Internet Explorer, Safari, and Opera. Calls are directed to the browser by using the browser's native support for automation. Common calls such as performing actions on WebElements are executed through a WebDriver. WebDriver is an interface tool used for testing web applications.

As mentioned in Chapter 4, WebElements are buttons, text boxes, checkboxes, drop down menus, and hyperlinks. The building blocks of Selenium WebDriver is locating a WebElement and performing an action on the WebElement. Therefore, if an automation engineer identifies the element then an appropriate action can be determined for the element.

Chapter 5 will discuss the following regarding WebDriver and WebElements:

- WebDriver Packages and Classes
- WebDriver Object and Methods
- Find and Perform Actions On WebElements

Note: A configuration for WebDriver is required before importing its packages. The driver object and methods are put to use after a WebDriver package import. Chapter 1 – Configure WebDriver provides details for configuring WebDriver.

WebDriver Packages and Classes

The WebDriver interface contains several classes. Each class utilized through an imported package. In order to use WebDriver, the appropriate package must be imported to execute specific commands. As an example, package “org.openqa.selenium.chrome” must be imported to use class “ChromeDriver” to execute a command such as load the Google Chrome browser.

As mentioned in Chapter 3 (see *Import Annotations*), importing a package is a feature that allows a class to access members of another class. Per the example, a separate class accesses the “ChromeDriver” class in order to load Google Chrome. The following is an example of importing a package for a Firefox driver:

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

WebDriver Object and Methods

Executions of the WebDriver commands are carried out through the driver object. The driver object is the main WebDriver component, which assist with locating and performing actions on WebElements. Like objects in Java programming, the driver object must be instantiated "created" before it is used. The following is an example of instantiating a Firefox driver object:

```
WebDriver driver = new FirefoxDriver();
```

After creating a driver object, the WebDriver methods are available to perform actions on WebElements. An automation engineer can type the word "driver" followed by the dot operator (.) to view the methods. The following is a screenshot of the WebDriver methods:

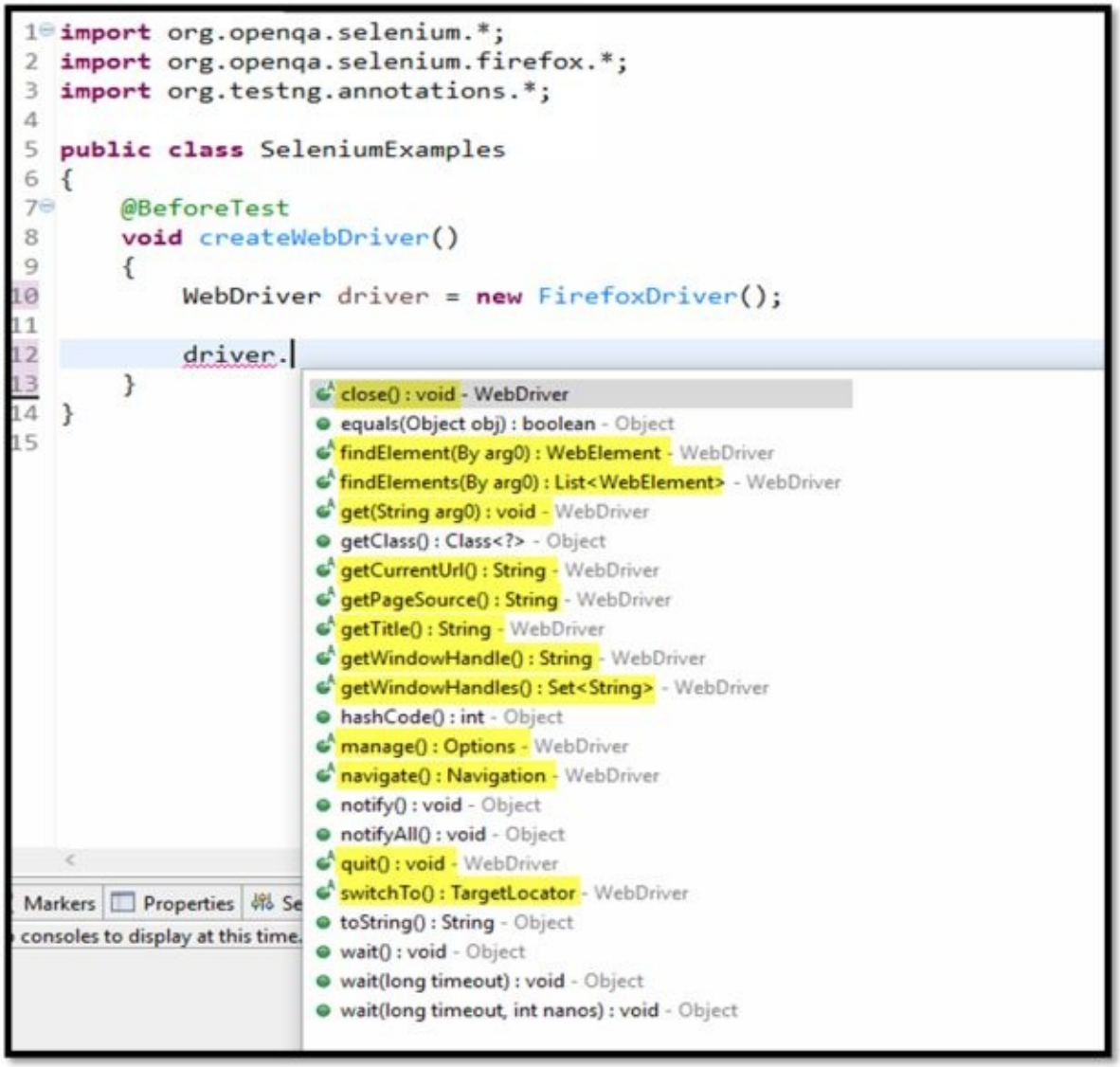


Figure 5.1 – WebDriver Methods

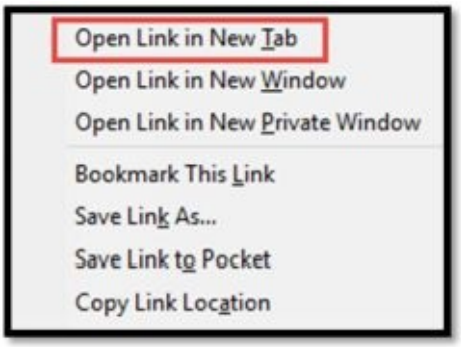
The WebDriver methods either return a value or return no value. A method “i.e., **close() : void**” with a return value of “void” indicates a value will not be returned. On the other hand, a method “i.e., **findElement(By arg0) : WebElement**” with a return value of “WebElement” indicates a WebElement will be returned.

Notice a description of the highlighted WebDriver method “**close() : void**” is not available. Eclipse has a feature that allows documentation to be imported from SeleniumHQ. After importing the documentation, a description of the WebDriver methods will be available. The following are steps to add documentation from SeleniumHQ:

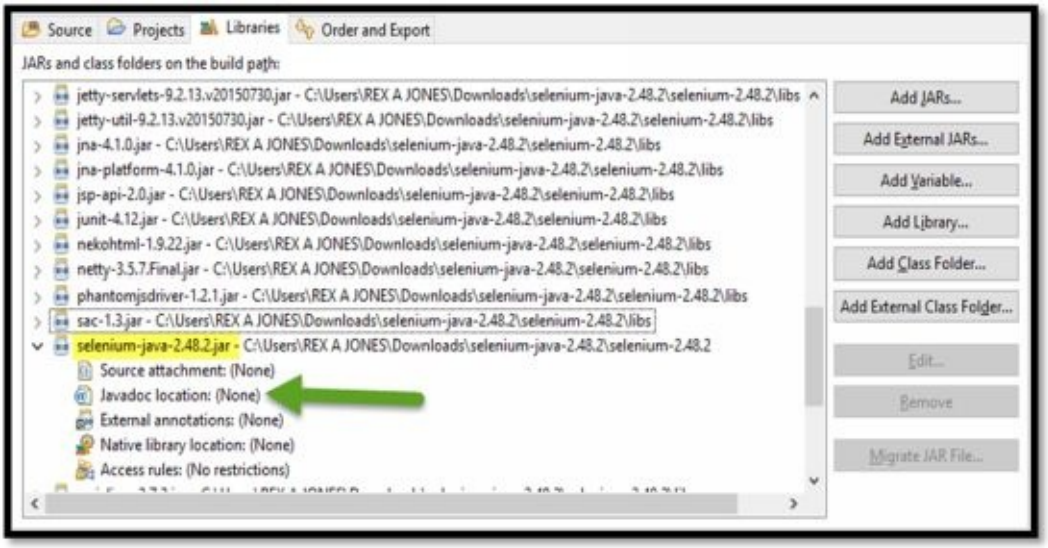
Steps to import documentation from Selenium HQ:

1. Navigate to http://www.seleniumhq.org/download/
2. Right click Javadoc

3. Select Open Link in New Tab

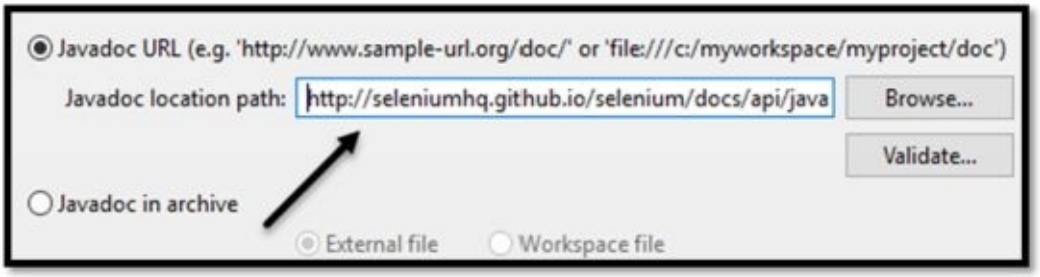


4. Open Eclipse IDE
5. Right click on the project “i.e., Chapter_5”
6. Select Build Path => Configure Build Path
7. Search for Selenium jar files “i.e., selenium-java-2.48.2.jar”
8. Select Javadoc location: None



9. Click the Edit button
10. Paste the Javadoc URL into Javadoc location path

    http://seleniumhq.github.io/selenium/docs/api/java/index.html



11. Remove index.html from the end of the location path
    http://seleniumhq.github.io/selenium/docs/api/java/index
12. Click OK => Apply
13. Javadoc is successfully imported into Eclipse

Figure 5.2 – Import Javadoc Into Eclipse

A description of the WebDriver methods is available after importing the Javadoc. Descriptions are valuable if an automation engineer lacks knowledge about a method. The following is a screenshot of the previous example but with a WebDriver description:

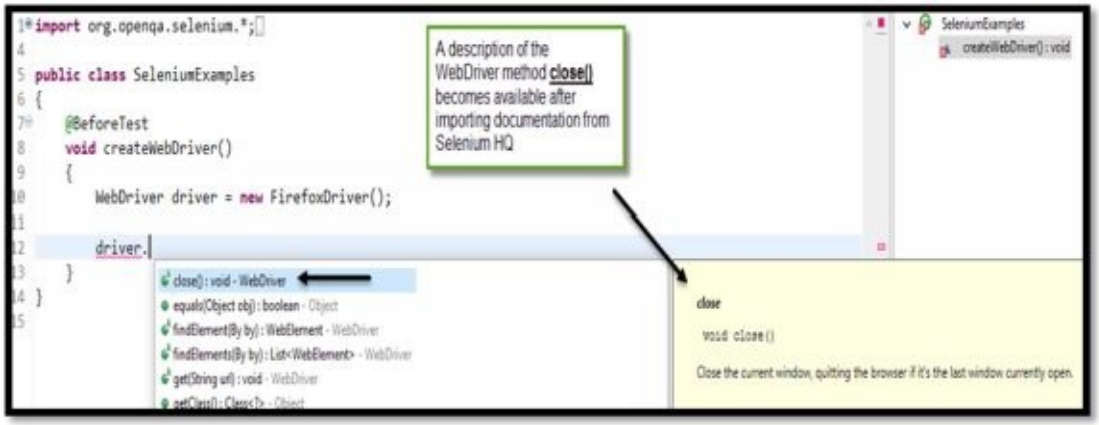


Figure 5.3 – WebDriver Methods With A Description

The following describes each WebDriver method:

WebDriver Method	Description
close()	Closes the current active window if there are

	multiple windows. The browser quits if only one window is active
findElement()	Find the first WebElement based on the locator type
findElements()	Find all elements within the current page based on the locator type
get()	Loads a new web page in the current browser window
getCurrentUrl()	Gets a string defining the current web page URL
getPageSource()	Gets the complete page source of the loaded web page.
getTitle()	Gets the current page title
getWindowHandle()	Handles a browser after switching a specific window
getWindowHandles()	Handles all browser windows and permits the user to switch control between the parent window and child window
manage()	Receives the option interface
navigate()	Navigates to a specific URL
quit()	Stops/Quits the driver instance and close all open browser windows
switchTo()	Switch from one browser window to another browser window

Figure 5.4 – WebDriver Methods and Descriptions

Find And Perform Actions On WebElements

WebDriver methods findElement() and findElements() are used to find WebElements. The difference between both methods are returned number of WebElements. WebDriver method findElement() returns one element while findElements() return multiple elements. If no elements are found then findElement() throws an exception "NoSuchElementException" but findElements() returns an empty list.

It is important to know a driver object must be created before searching for a WebElement. After creating a driver object, the driver object connects to one of the WebDriver methods via dot operator. The WebDriver method is followed by an open parenthesis, a By object, dot operator, and a locator type. The following is the syntax for findElement() and findElements():

Syntax for findElement()

```
driver.findElement(By.locatorType("value"));
// or
WebElement element = driver.findElement(By.id("value"));
```

Syntax for findElements()

```
driver.findElements(By.locatorType("value"));
// or
List <WebElement> elements = element.findElements(By.id("value"));
```

Note: Package "java.util.List" must be imported to write the last syntax which starts with "List <WebElement> …".

The object "By" is used to help locate WebElements. However, the object must be used in conjunction with a locator type. A locator type is the main component for finding and matching WebElelments. There are eight locator types to find WebElements within an application. The following is a screenshot of all locator types in Eclipse after writing

```
driver.findElement(By.
// or
```

driver.findElements(By.

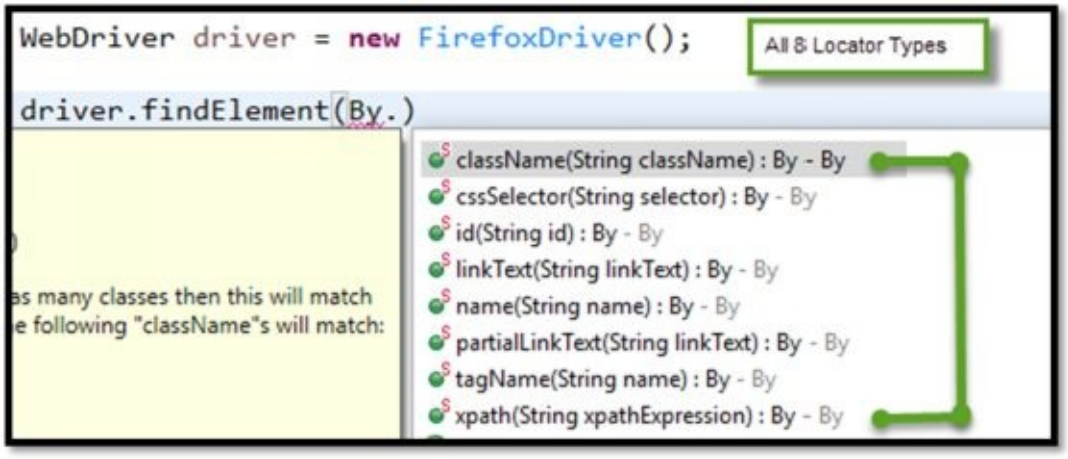


Figure 5.5 – Screenshot of All Locator Types

The following is a description of each locator type in alphabetical order:

Locator Type	Description
*By.**className***	Find WebElements by the value of its Class attribute
*By.**cssSelector***	Find WebElements by the CSS Selector's engine
*By.**id***	Find WebElements by the value of its ID attribute
*By.**linkText***	Find hyperlink WebElements by its complete text
*By.**name***	Find WebElements by the value of its Name attribute
*By.**partialLinkText***	Find hyperlink WebElements by partial text contained within the complete text
*By.**tagName***	Find WebElements by its tag name
*By.**xpath***	Find WebElements by its XPath

Figure 5.6 – Eight Locator Types

The following chapters describe each findElement by locator type:

- Chapter 6 – Find WebElement By ID

- Chapter 7 – Find WebElement By Name
- Chapter 8 – Find WebElement By XPath
- Chapter 9 – Find WebElement By CSS Selector
- Chapter 10 – Find WebElement By Link Text
- Chapter 11 – Find WebElement By Partial Link Text
- Chapter 12 – Find WebElement By Tag Name
- Chapter 13 – Find WebElement By Class

An element can be located using a locator type if the HTML property (e.g., ID, Name, etc.) is present. Each locator type provides interaction between Selenium WebDriver and the web application. However, there is a precedence regarding which locator type is used to find a specific WebElement. The following is prioritization of the locator types:

1. By.***id***
2. By.***name***

An automation engineer should search for a WebElement starting with an ID attribute. If the ID attribute is not available then the next attribute is Name. CSS Selector and XPath locator types are the next priority locators behind ID and Name. Some automation engineers use CSS Selector as the third priority while others use XPath. As you will see in Chapter 8 - *Find WebElements by XPath* and Chapter 9 - *Find WebElements by CSS Selector*, the XPath and CSS Selector locators are very similar.

After finding a WebElement, an action such as enter value is performed on the WebElement. The following is a screenshot of available actions / methods in Eclipse after writing

driver.findElement(By.id(“value”)).

// or

WebElement element = driver.findElement(By.*id*(“value”));

element.

Note: Both statements end with a dot operator (.).

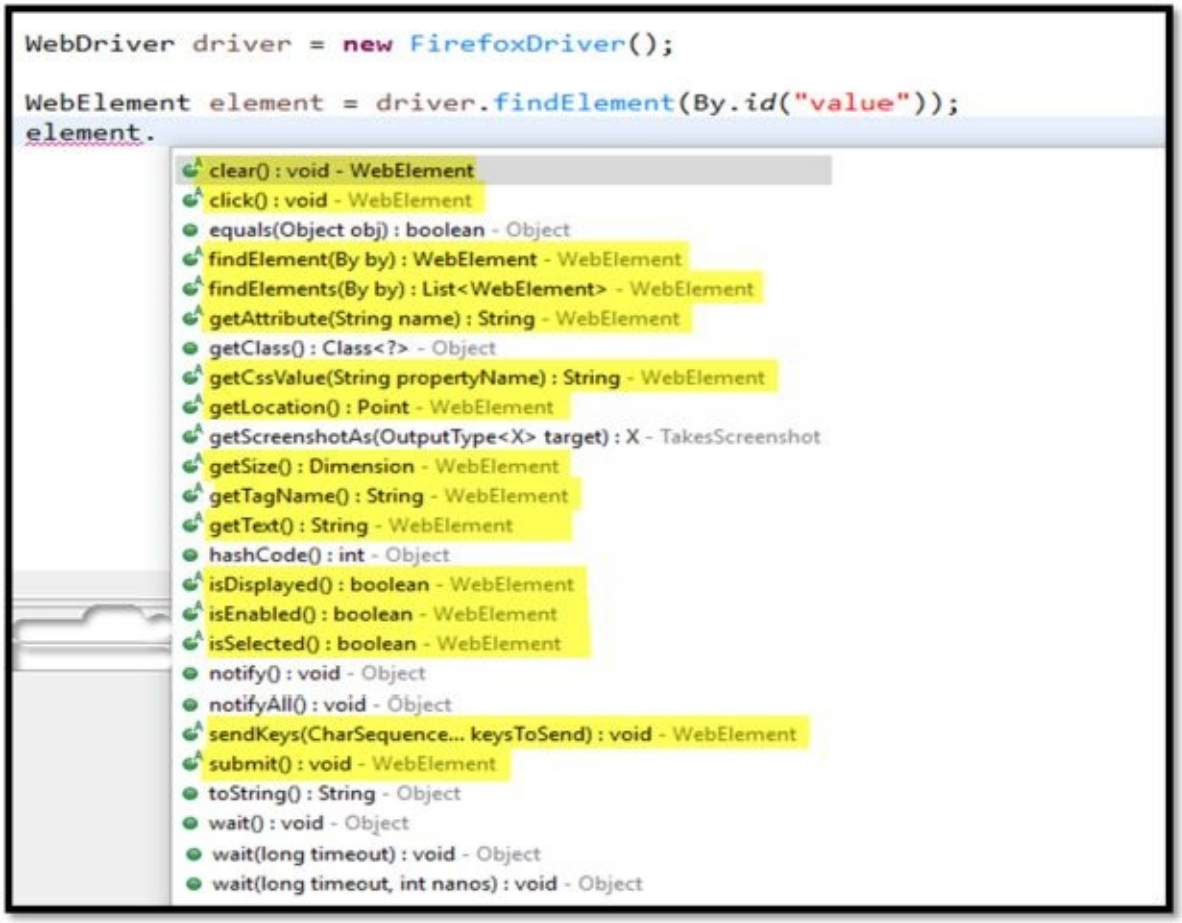


Figure 5.7 – Available Actions After Finding A WebElement

The following describes each method that performs an action:

Action/Method	Description
clear()	Clear or erase a value in a text field
click()	Clicks a link, button, checkbox, or radio button
findElement()	Find the first WebElement based on the locator type
findElements()	Find all elements within the current page based on the locator type
getAttribute()	Get the value of a specified WebElement attribute
getCssValue()	Returns the value of CSS properties
getLocation()	Returns the x and y coordinates with the top left corner of an element as the point
getSize()	Returns the width and height of a rendered element

getTagName()	Get the tag name of a specified WebElement
getText()	Get the visible innerText attribute of a WebElement
isDisplayed()	Verifies if a WebElement is present on a page
isEnabled()	Verifies if a WebElement is enabled on a page
isSelected()	Verifies if a WebElement is selected on a page
sendKeys()	Insert or type text in a text field
submit()	Operates like the click () method if the WebElement is a form or within a form

Figure 5.8 - Methods That Perform Actions On WebElements

Chapter 5 discussed WebDriver and WebElements. WebDriver is a tool used for testing web applications. All web applications contain WebElements. WebElements are buttons, text boxes, checkboxes, drop down menus, and hyperlinks. The key to testing a web application is finding the WebElement then performing an action on the WebElement. Chapters 6 through 13 explain how to find a WebElement by each locator type and provide examples for performing an action:

- Chapter 6 – Find WebElement By ID
- Chapter 7 – Find WebElement By Name
- Chapter 8 – Find WebElement By XPath
- Chapter 9 – Find WebElement By CSS Selector
- Chapter 10 – Find WebElement By Link Text
- Chapter 11 – Find WebElement By Partial Link Text
- Chapter 12 – Find WebElement By Tag Name
- Chapter 13 – Find WebElement By Class

Chapter 6
Find WebElement By ID

Finding an element by ID is the first priority of all locator types. According to W3C, id attributes are unique on a web page. Therefore, the id attribute is extremely safe when locating an element within HTML. It is possible the developer will not change the ID when modifying a web page. The following is a screenshot of LinkedIn and its HTML markup tags for a User's First Name:

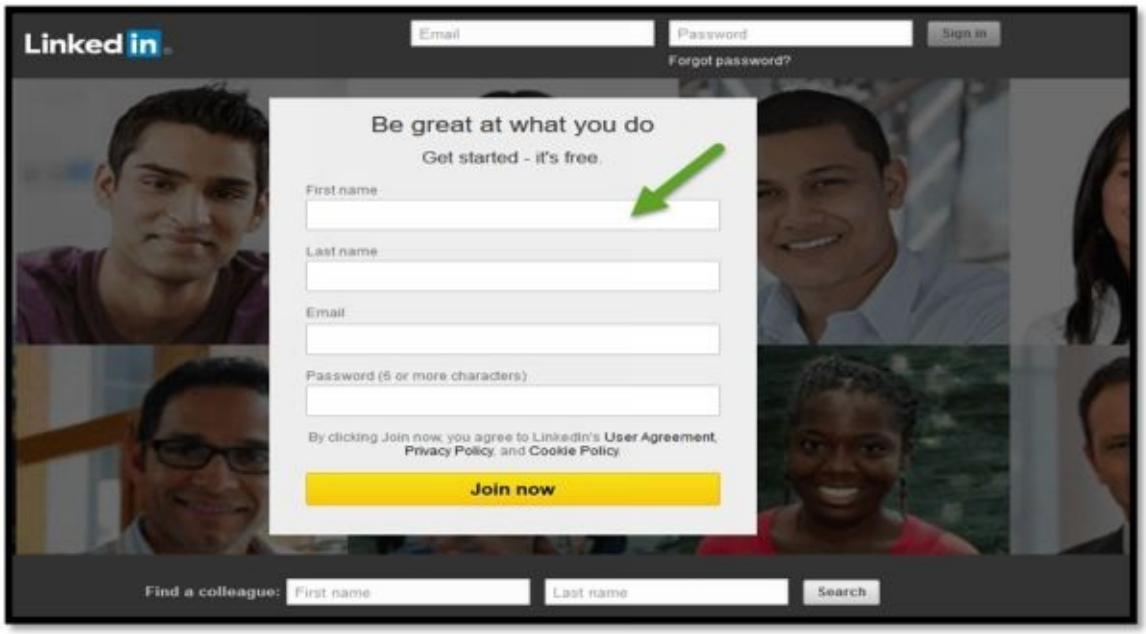


Figure 6.1 – LinkedIn's Home Screen (User's First Name)

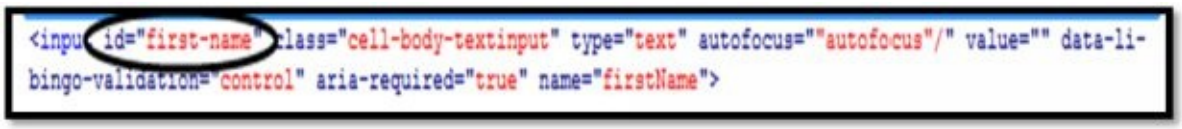


Figure 6.2 – HTML For LinkedIn's User First Name

The following is an example of finding LinkedIn's User First Name using the HTML id attribute:

```
driver.findElement(By.id("first-name"));

// or
```

WebElement userFirstName = driver.findElement(By.*id*(“first-name”));

Enter Text In The User’s First Name Text Field

The following is code for entering text in LinkedIn’s User First Name text field via id attribute:

```
package LinkedInHomePage;
import org.openqa.selenium.*;
import org.openqa.selenium.firefox.FirefoxDriver;
import org.testng.annotations.*;

public class JoinLinkedIn1
{
    WebDriver driver;
    @BeforeTest
    public void setUp() throws Exception
    {
       driver = new FirefoxDriver();

       // Go to LinkedIn’s Home Page
       driver.get(“https://www.linkedin.com/”);
    }
    @AfterTest
    public void tearDown() throws Exception
    {
            driver.quit();
    }
    @Test
    void joinLinkedIn_1()
    {
       // Find first name via ID locator type
       // Enter first name via send keys
            driver.findElement(By.id(“first-name”)).sendKeys(“Test First Name”);
    }
}
```

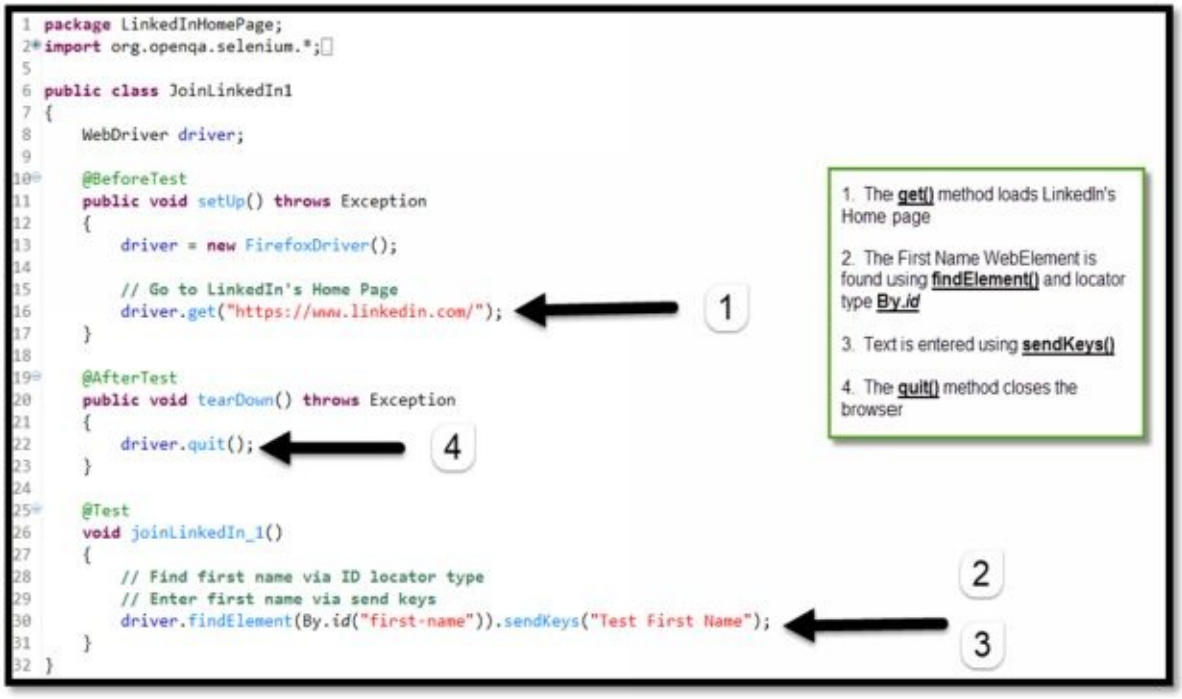


Figure 6.3 – Perform Actions On The User's First Name Text Field (1)

- Line 8 "WebDriver driver" is the interface for driving the browser. Currently, the object reference variable "driver" points to nothing but will point to a FirefoxDriver object in a subsequent line "driver = **new** FirefoxDriver()".

- Line 13 "driver = **new** FirefoxDriver()" is an implementation of the WebDriver interface. The object reference variable "driver" is pointing to new FirefoxDriver() which means testing is controlled on the Firefox browser.

- Line 16 "driver.get("https://www.linkedin.com/")" loads a new LinkedIn Home page in the current browser window

- Line 22 "driver.quit()" quits the driver instance and closes the open browser window

- Line 30 "driver.findElement(By.*id*("first-name")).sendKeys("Test First Name")":
    - driver – WebDriver object reference variable that assist with finding a WebElement
    - findElement – a WebDriver method that finds the text field WebElement "First name" on LinkedIn's Home page
    - (By.*id*("first-name")) – By and *id* are parameters of the findElement WebDriver method. By is an object which locate elements and id is the locator type. The id locator type accepts a string parameter "first-name" which is the value of the HTML id attribute
    - sendKeys("Test First Name") – types the text "Test First Name" in the First Name text field

Note: An exception is an error that occurs at runtime. Lines 11 and 20 define an exception via **throws** Exception. It is used to explicitly identify an exception that the setUp() and tearDown() methods might come across at runtime. See Errors, Exceptions, and Debugging in Chapter 7 of "(Part 2) Java 4 Selenium WebDriver".

The following is a screenshot of LinkedIn's Home page after entering text in the User's First Name text field:

Figure 6.4 – Enter Text In The User's First Name Text Field

In some cases, an extra tab opens with a problem while running Test Scripts in Firefox. Although there is a problem, the automation Test Scripts still run successfully. The following is a screenshot of two tabs opening up while running Test Scripts in Firefox:

Figure 6.5 – Problem Loading A Tab In Firefox

The problem with Firefox loading an extra tab does not happen every time. However, prevent the problem by creating a Firefox profile then access the profile from Selenium WebDriver.

Enter the following code lines in Selenium WebDriver to access the profile:

```
ProfilesIni profile = new ProfilesIni();
FirefoxProfile autoProfile = profile.getProfile("automationFireFoxProfile");
WebDriver driver = new FirefoxDriver(autoProfile);
```

The new profile "i.e., automationFireFoxProfile" reflects where the file is stored. Steps for creating a Firefox profile are located in Chapter 1 – Download Browser Drivers / Set Up Profiles section. The following screenshot is an example of how to access / get the Firefox profile (lines 10, 11, and 18) using Selenium WebDriver:

```
8  public class JoinLinkedIn1
9  {
10     ProfilesIni profile = new ProfilesIni();
11     FirefoxProfile autoProfile = profile.getProfile("automationFireFoxProfile");
12
13     WebDriver driver;
14
15     @BeforeTest
16     public void setUp() throws Exception
17     {
18         driver = new FirefoxDriver(autoProfile);
19
20         // Go to LinkedIn's Home Page
21         driver.get("https://www.linkedin.com/");
22     }
```

Figure 6.6 – Screenshot of Code To Prevent A Tab Loading Problem

The following is a screenshot of a successful run after accessing the Firefox profile:

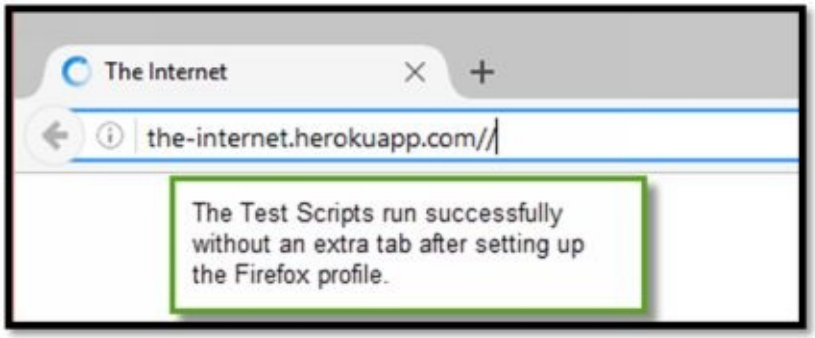


Figure 6.7 – Successful Run After Adding Code Lines In Selenium WebDriver

Enter and Clear Text In The User's First Name Text Field

The following is code for entering and clearing text in LinkedIn's User First Name text field via id attribute:

```
package LinkedInHomePage;
import org.openqa.selenium.*;
import org.openqa.selenium.chrome.ChromeDriver;
import org.testng.annotations.*;

public class JoinLinkedIn2
{
    WebDriver driver;
    @BeforeTest
    public void setUp() throws Exception
    {
       driver = new ChromeDriver();

       // Go to LinkedIn's Home Page
       driver.get("https://www.linkedin.com/");
    }
    @AfterTest
    public void tearDown() throws Exception
    {
              driver.quit();
    }
    @Test
    void enter_clearFirstName()
    {
       // Find first name via ID locator type
       WebElement userFirstName = driver.findElement(By.id("first-name"));

       // Enter first name via send keys
       userFirstName.sendKeys("Test First Name");

      // Clear first name via clear
      userFirstName.clear();
    }
}
```

```
1  package LinkedInHomePage;
2  import org.openqa.selenium.*;
5
6  public class JoinLinkedIn2
7  {
8      WebDriver driver;
9
10     @BeforeTest
11     public void setUp() throws Exception
12     {
13         driver = new ChromeDriver();
14
15         // Go to LinkedIn's Home Page
16         driver.get("https://www.linkedin.com/");
17     }
18
19     @AfterTest
20     public void tearDown() throws Exception
21     {
22         driver.quit();
23     }
24
25     @Test
26     void enter_clearFirstName()
27     {
28         // Find first name via ID locator type
29         WebElement userFirstName = driver.findElement(By.id("first-name"));
30
31         // Enter first name via send keys
32         userFirstName.sendKeys("Test First Name");
33
34        // Clear first name via clear
35        userFirstName.clear();
36     }
37 }
```

1. The **get()** method loads LinkedIn's Home page
2. A **WebElement** object "userFirstName" is created then the first name WebElement is found using **findElement()** and locator type **By.id**
3. Text is entered using **sendKeys()**
4. Text is cleared using **clear()**
5. The **quit()** method closes the browser

Figure 6.8 – Perform Actions On The User's First Name Text Field (2)

- Line 8 "WebDriver driver" is the interface for driving the browser. Currently, the object reference variable "driver" points to nothing but will point to a Chrome Driver object in a subsequent line "driver = new ChromeDriver()".

- Note: The System.*setProperty*() method was not used in this example since the ChromeDriver path was placed in Environment Variables – System Variables. However, the subsequent examples will contain an extra code line for System.*setProperty*() method:

```
System.setProperty("webdriver.chrome.driver","C:\\Users\\REX A JONES\\Downloads\\chromedriver_win32\\chromedriver.exe");
```

Figure 6.9 – System.set*Property* () Prevents An Exception For Google Chrome

- The following are parameters for System.*setProperty*:
  - **key** = webdriver.chrome.driver
  - **value** = C:\Users\REX A JONES\Downloads\chromedriver_win32\chromedriver.exe

- Line 13 "driver = **new** ChromeDriver()" is an implementation of the WebDriver interface. The object reference variable "driver" is pointing to new ChromeDriver() which means testing is controlled on the Chrome browser.

- Line 16 “driver.get(“https://www.linkedin.com/”)” loads a new LinkedIn Home page in the current browser window

- Line 22 “driver.quit()” quits the driver instance and closes the open browser window

- Line 29 “WebElement userFirstName = driver.findElement(By.*id*(“first-name”)):
  - WebElement userFirstName – creates an object reference variable called userFirstName that refers or points to a WebElement
  - driver – WebDriver object reference variable that assist with finding the WebElement
  - findElement – a WebDriver method that finds the text field WebElement “First name” on LinkedIn’s Home page
  - (By.*id*(“first-name”)) – By and *id* are parameters of the findElement WebDriver method. By is an object which locate elements and id is the locator type. The id locator type accepts a string parameter “first-name” which is the value of the HTML id attribute

- Line 32 “userFirstName.sendKeys(“Test First Name”)” types the text “Test First Name” in the First Name text field via object reference variable “userFirstName”

- Line 35 “userFirstName.clear()” clears the text “Test First Name” from the First Name text field via object reference variable “userFirstName”

Note: This example was an illustration for clear() method. However, it is useful to create a WebElement object like userFirstName if multiple actions (i.e., enter text and clear text) are performed on the same WebElement (i.e., First Name text field).

The following is a screenshot of LinkedIn’s Home page after clearing the User’s First Name:

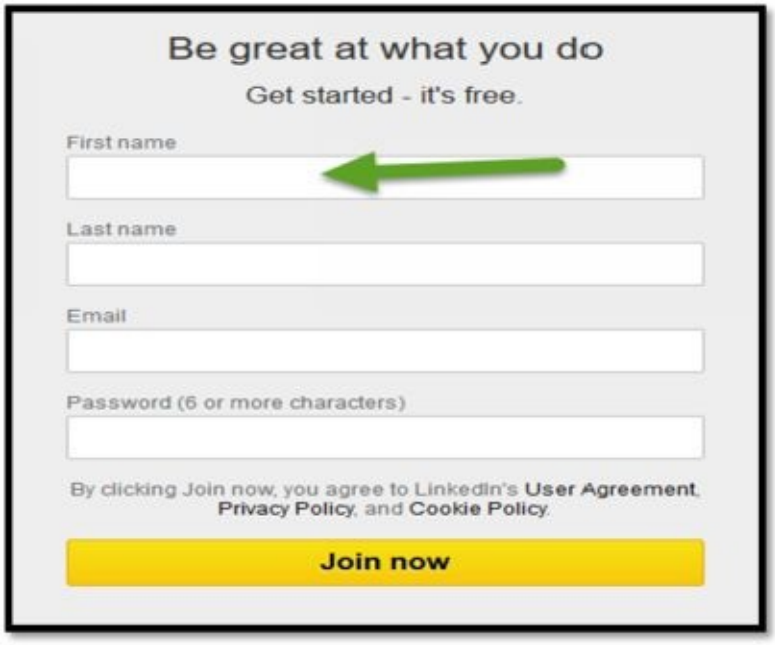


Figure 6.10 – Enter And Clear Text In The User's First Name Text Field

Chapter 7
Find WebElement By Name

There are times when a web page may not contain an id attribute. If so, then an automation engineer should search for the value of a name attribute. Finding an element by name is the second priority behind the ID locator type. Usually, the name attribute is located in WebElements such as text fields and buttons. However, unlike the id attribute, which contains a unique value, the name attribute can contain the same value within HTML's source code. The following is a screenshot of LinkedIn and its HTML markup tags for a Colleague's First and Last Name:

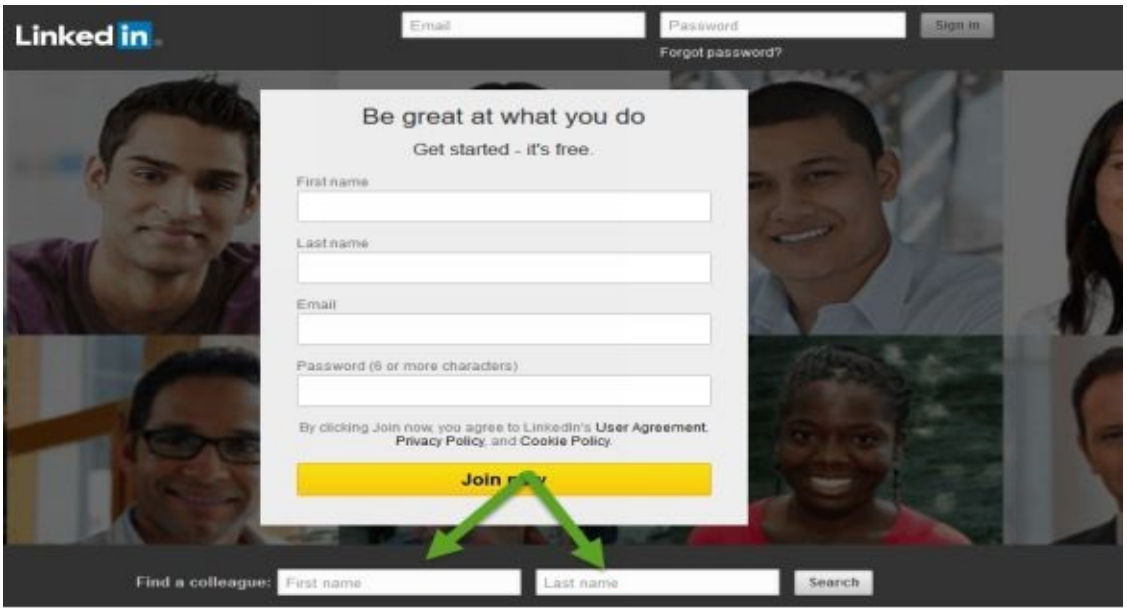


Figure 7.1 – LinkedIn's Home Screen (Colleague's First and Last Name)

```
<h3>Find a colleague:</h3>
<input type="text" placeholder="First name" name="first">
<input type="text" placeholder="Last name" name="last">
<input type="submit" value="Search" name="search">
```

Figure 7.2 – HTML For LinkedIn's Colleague First and Last Name

Note: The HTML markup tags do not contain an id attribute for Colleague's First or Last Name:

Enter Text In The Colleague's First and Last Name Text Fields

The following is code for entering text in LinkedIn's Colleague First and Last Name text

fields via name attribute:

```
package LinkedInHomePage;
import org.openqa.selenium.*;
import org.openqa.selenium.chrome.ChromeDriver;
import org.testng.annotations.*;

public class FindColleague
{
    WebDriver driver;

    @BeforeTest
    public void setUp() throws Exception
    {
            System.setProperty("webdriver.chrome.driver", "C:\Users\REX A
JONES\Downloads\chromedriver_win32\chromedriver.exe");
            driver = new ChromeDriver();

       driver.get("https://www.linkedin.com/");
    }
    @AfterTest
    public void tearDown() throws Exception
    {
            driver.quit();
    }
    @Test
    public void enterColleagueName()
    {
            driver.findElement(By.name("first")).sendKeys("Rex");
            driver.findElement(By.name("last")).sendKeys("Jones");
    }
}
```

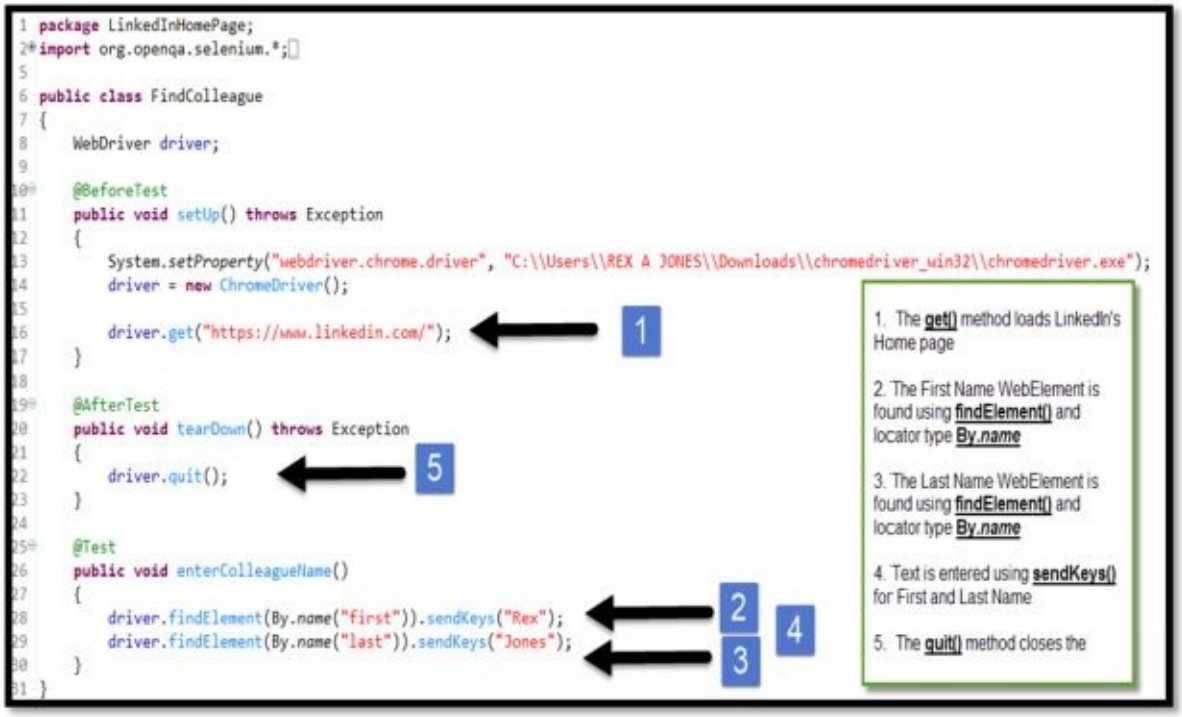


Figure 7.3 – Perform Actions On The Colleague's First Name Text Field

- Line 8 "WebDriver driver" is the interface for driving the browser. Currently, the object reference variable "driver" points to nothing but will point to a Chrome Driver object in a subsequent line "driver = new ChromeDriver()".

- Line 13 tells Selenium where the executable file for Chrome driver is located via System.*setProperty.* The executable file operates like a bridge between Selenium and the browser. All browsers except Firefox require an executable file. Steps for downloading the executable file are located in Chapter 1 – Download Browser Drivers / Set Up Profiles section. The following are parameters for System.*setProperty*:

  - **key** = webdriver.chrome.driver
  - **value** = C:\Users\REX A JONES\Downloads\chromedriver_win32\chromedriver.exe

  Note**:** Value is the path location of the executable file

- Line 14 "driver = **new** ChromeDriver()" is an implementation of the WebDriver interface. The object reference variable "driver" is pointing to new ChromeDriver() which means testing is controlled on the Chrome browser.

- Line 16 "driver.get("https://www.linkedin.com/")" loads a new LinkedIn Home page in the current browser window

- Line 22 “driver.quit()” quits the driver instance and closes the open browser window

- Line 28 “driver.findElement(By.*name*(“first”)).sendKeys(“Rex”)”:
  - driver – WebDriver object reference variable that assist with finding a WebElement
  - findElement – a WebDriver method that finds the text field WebElement “First name” on LinkedIn’s Home page
  - (By.*name*(“first”)) – By and *name* are parameters of the findElement WebDriver method. By is an object which locate elements and name is the locator type. The name locator type accepts a string parameter “first” which is the value of the HTML name attribute
  - sendKeys(“Rex”) – types the text “Rex” in the Colleague’s First Name text field

- Line 29 “driver.findElement(By.*name*(“last”)).sendKeys(“Jones”)”:
  - driver – WebDriver object reference variable that assist with finding a WebElement
  - findElement – a WebDriver method that finds the text field WebElement “First name” on LinkedIn’s Home page
  - (By.*name*(“last”)) – By.name are parameters of the findElement WebDriver method. By is an object which locate elements and name is the locator type. The name locator type accepts a string parameter “last” that is the value of the HTML name attribute
  - sendKeys(“Jones”) – types the text “Jones” in the Colleague’s Last Name text field

The following is a screenshot of LinkedIn’s Home page after entering text in the Colleague’s First and Last Name field:

Figure 7.4 – Enter Text In The Colleague’s First and Last Name Text Field

Chapter 8
Find WebElement By XPath

XML Path Language “XPath” is a powerful method for finding WebElements. The XPath locator type refers to a specific node in the DOM tree. It is important to know that most WebElements can be located using the XPath locator type. The XPath locator accepts two types of parameter strings to find a WebElement.

1. Absolute XPath – generates a complete XPath starting from the <html> tag or single forward slash (/)
2. Relative XPath – generates a shortened version of the XPath starting with double forward slashes (//)

An automation engineer can manually create an XPath using the web page’s HTML or a tool that generates the XPath. FirePath is a tool that generates an absolute and relative XPath. Steps for installing FirePath are located in Chapter 1 – Install Firebug and FirePath section. The following is a screenshot of FirePath within Firebug:

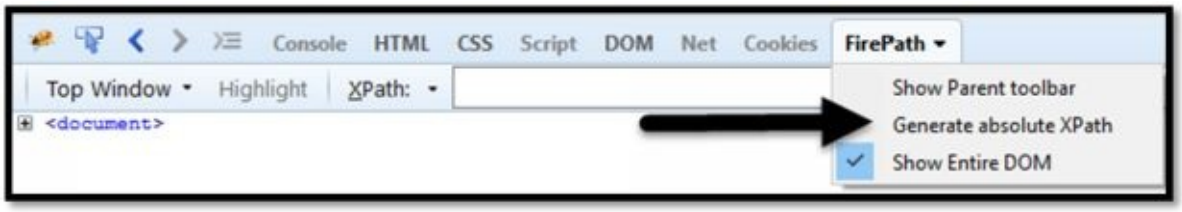


Figure 8.1 – FirePath / XPath Screenshot

The option labeled “Generate absolute XPath” determines whether FirePath generates an absolute or relative XPath. Below are screenshots of Facebook’s Sign Up page, its markup tags for radio buttons “Female and Male”, followed by steps to generate an absolute and relative XPath:

Figure 8.2 – Facebook's Sign Up Page / Female and Male Radio Buttons

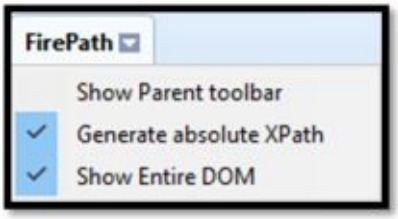
```
<span id="u_0_h" class="_5k_3" data-name="gender_wrapper" data-type="radio">
 <span class="_5k_2 _5dba">
      <input id="u_0_e" type="radio" value="1" name="sex"/>
      <label class="_58mt" for="u_0_e">Female</label>
   </span>
 <span class="_5k_2 _5dba">
      <input id="u_0_f" type="radio" value="2" name="sex"/>
      <label class="_58mt" for="u_0_f">Male</label>
   </span>
</span>
```

Figure 8.3 – HTML For Female and Male Radio Buttons On Facebook's Sign Up Page (1)

Steps For Generating An Absolute XPath:

1. Open Firefox browser
2. Load a web application “i.e., Facebook”
3. Right click the WebElement “i.e., radio button”
4. Select Inspect in FirePath

5. Click the drop down for FirePath
6. Check the option “Generate absolute XPath”



Result: The XPath text box displays a string parameter for absolute XPath.

Figure 8.4 – Absolute XPath For The Female Radio Button

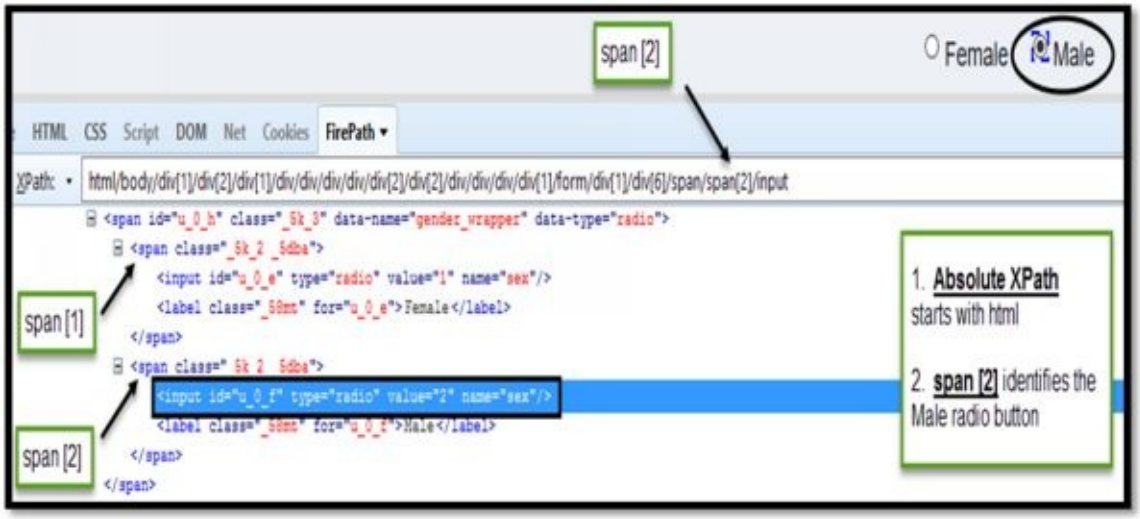
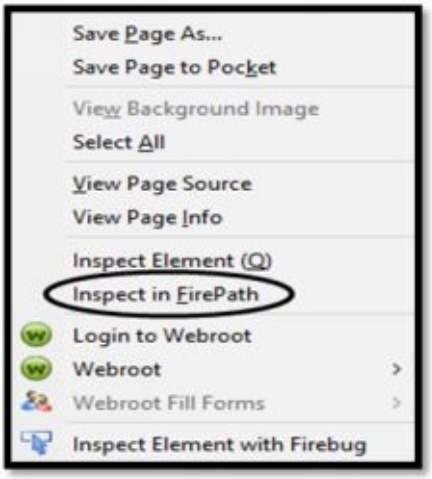


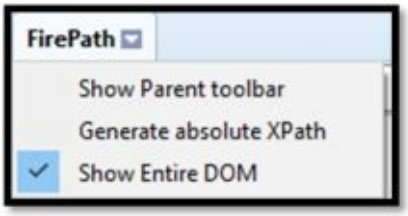
Figure 8.5 – Absolute XPath For The Male Radio Button

Steps For Generating A Relative XPath:

1. Open Firefox browser
2. Load a web application “i.e., Facebook”
3. Right click the WebElement “i.e., radio button”
4. Select Inspect in FirePath



5. Uncheck the option “Generate absolute XPath”



Result: The XPath text box displays a string parameter for relative XPath.

Figure 8.6 – Relative XPath For The Female Radio Button

Figure 8.7 – Relative XPath For The Male Radio Button

Note: FirePath can also be accessed via Firefox > F12 or Tools > Firebug > Open Firebug then navigate to the FirePath tab.

The relative XPath finds the nearest id attribute for the chosen WebElement. In this case, the value for Female id attribute is u_0_e and Male id attribute is u_0_f. However, the id attribute value of "u_0_h" would have been chosen as the relative XPath if the radio buttons "Female & Male" did not contain an id attribute.

It is recommended to use the relative XPath rather than the absolute XPath. Both XPaths are valuable but the absolute XPath is more vulnerable to an HTML code change. The chosen WebElement "i.e., radio button" becomes invalid if a developer adds or removes a tag prior to the WebElement. For example, the Test Script will not be functional if a developer modifies the HTML code "i.e., div tag" prior to span[1] in Figure 8.4.

Select A Radio Button via Relative XPath

The following is code for selecting the Female radio button on Facebook's Sign Up Page via XPath locator type:

```
package FacebookSignUpPage;
import org.openqa.selenium.By;
import org.openqa.selenium.WebDriver;
import org.openqa.selenium.chrome.ChromeDriver;
import org.testng.annotations.*;

public class SelectRadioButton
{
```

```
    WebDriver driver;
    @BeforeTest
    public void setUp () throws Exception
    {
            System.setProperty("webdriver.chrome.driver", "C:\Users\REX A
JONES\Downloads\chromedriver_win32\chromedriver.exe");
            driver = new ChromeDriver ();

            driver.get("https://www.facebook.com/");
    }
    @AfterTest
    public void tearDown () throws Exception
    {
            driver.quit();
    }
    @Test
    public void selectGender ()
    {
            driver.findElement(By.xpath("//*[@id='u_0_e']")).click();
    }
}
```

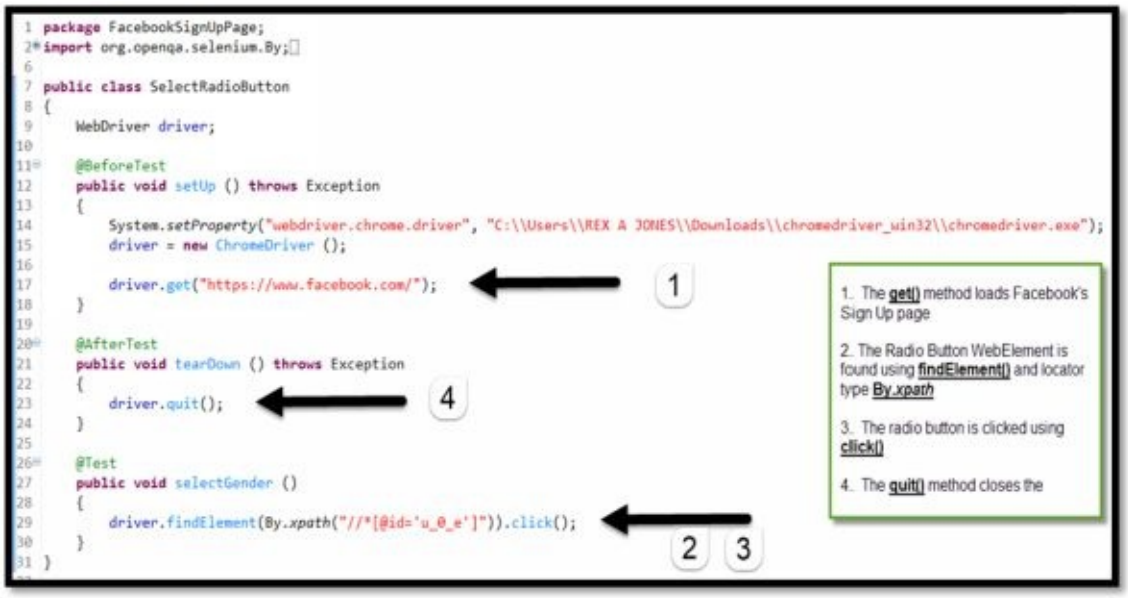


Figure 8.8 – Perform Actions On The Radio Button

- Line 9 "WebDriver driver" is the interface for driving the browser. Currently, the object reference variable "driver" points to nothing but will point to a Chrome Driver object in a subsequent line "driver = new ChromeDriver()".

- Line 14 tells Selenium where the executable file for Chrome driver is located via System.*setProperty.* The executable file operates like a bridge between Selenium and the browser. All browsers except Firefox require an executable file. Steps for downloading the executable file are located in Chapter 1 – Download Browser Drivers / Set Up Profiles section. The following are parameters for System.*setProperty*:

  - **key** = webdriver.chrome.driver
  - **value** = C:\Users\REX A JONES\Downloads\chromedriver_win32\chromedriver.exe

  Note**:** Value is the path location of the executable file

- Line 15 "driver = **new** ChromeDriver()" is an implementation of the WebDriver interface. The object reference variable "driver" is pointing to new ChromeDriver() which means testing is controlled on the Chrome browser.

- Line 17 "driver.get("https://www.facebook.com/")" loads a new Facebook page in the current browser window

- Line 23 "driver.quit()" quits the driver instance and closes the open browser window

- Line 29 "driver.findElement(By.*xpath*("//*[@id='u_0_e']")).click()":
  - driver – WebDriver object reference variable that assist with finding a WebElement
  - findElement – a WebDriver method that finds the radio button WebElement "Female" on Facebook's Sign Up page
  - (By.*xpath*("//*[@id='u_0_e']")) – By and *xpath* are parameters of the findElement WebDriver method. By is an object which locate elements and xpath is the locator type. The XPath locator type accepts a string parameter "//*[@id='u_0_e']" which is the relative XPath for the Female radio button.
  - click() – clicks the Female radio button

Note: The dot (.) operator which is the first character in FirePath's relative XPath must be removed before executing the test script.

- FirePath's relative XPath contains the dot operator "**.//*[@id='u_0_e']**"
- Test Script removes the dot operator (By.*xpath*("//*[@id='u_0_e']"))

The following is a screenshot of Facebook's Sign Up page after selecting the Female radio button:

Figure 8.9 – Select The Female Radio Button

Relative XPath Alternatives To FirePath

The following HTML screenshot of Facebook's Female and Male radio buttons will be used to explain alternatives for executing relative XPath:

Figure 8.10 – HTML For Female and Male Radio Buttons On Facebooks's Sign Up Page (2)

The relative xpath's locator (By.*xpath*("//*[@id='u_0_e']")) was used to click the Female radio button. An asterisk (*) in the relative XPath represents any tag within the HTML code. Therefore, an automation engineer can choose to be more specific and replace the asterisk with a tag name. The following is the syntax for finding a WebElement by relative XPath:

Syntax

//TagName[@AttributeName='AttributeValue']

The following code shows how input is a suitable tag name for clicking the radio button.

(By.*xpath*("//input[@id='u_0_e']"))

According to the syntax, the attribute "id" can be replaced with any attribute. An attribute such as name or type that identifies the WebElement is suitable. However, there are attributes/values that are duplicated within HTML's source code. If duplicate attributes/values exist for a WebElement then an automation engineer can use multiple attributes. Multiple attributes are beneficial if it is difficult find a unique attribute/value. The following are examples for utilizing a single attribute and multiple attributes:

- (By.*xpath*("//*[@for='u_0_e']"))

- (By.*xpath*(“//label[@for=‘u_0_e’]”))
- (By.*xpath*(“//*[@type=‘radio’ and @value=‘1’]”))
- (By.*xpath*(“//input[@type=‘radio’ and @name=‘sex’ and @value=‘1’]”))

Working With Dynamic WebElements Using XPath

There are situations when a web application may contain dynamic WebElements. A dynamic WebElement is when the value on an application changes at runtime. For example, the time will change every second/minute on an application during runtime.

In addition, a dynamic WebElement manifests when the value of an attribute changes upon reloading the web application. The Home page of Yahoo is a perfect example of a dynamic WebElement. All of the list box WebElements change when the page reloads. A user has to search for information, select an option from the list of options, and then return to Yahoo's Home page. The following screenshots show how the same set of options contains a different value for ID attribute:

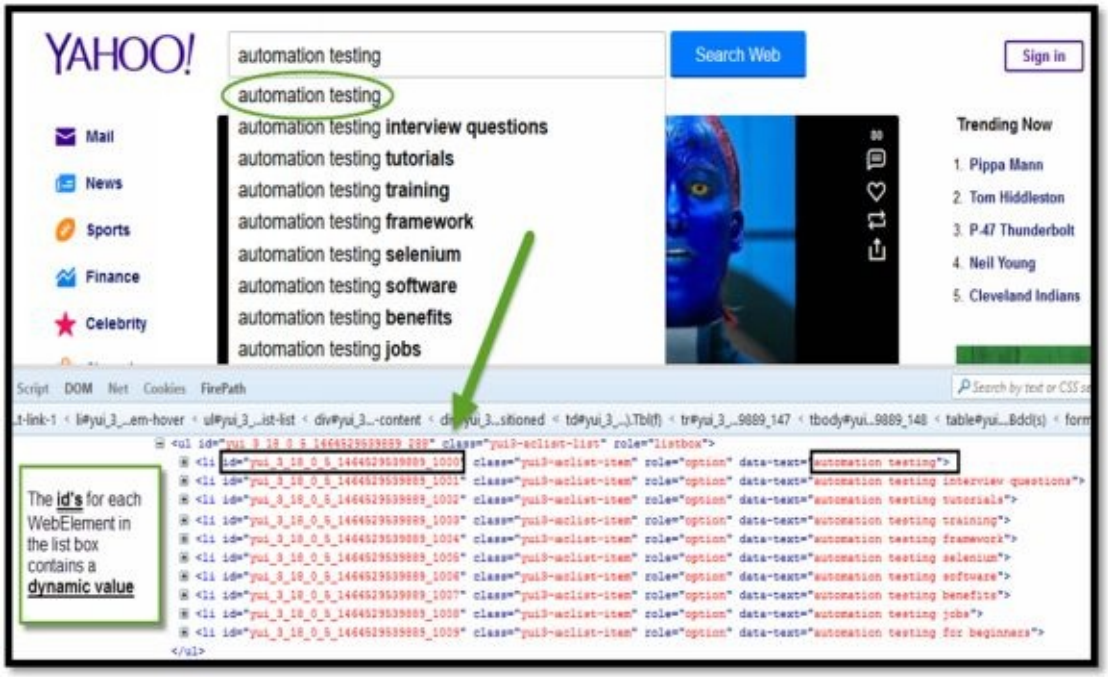


Figure 8.11 – HTML For Yahoo's Home Page Listbox (1)

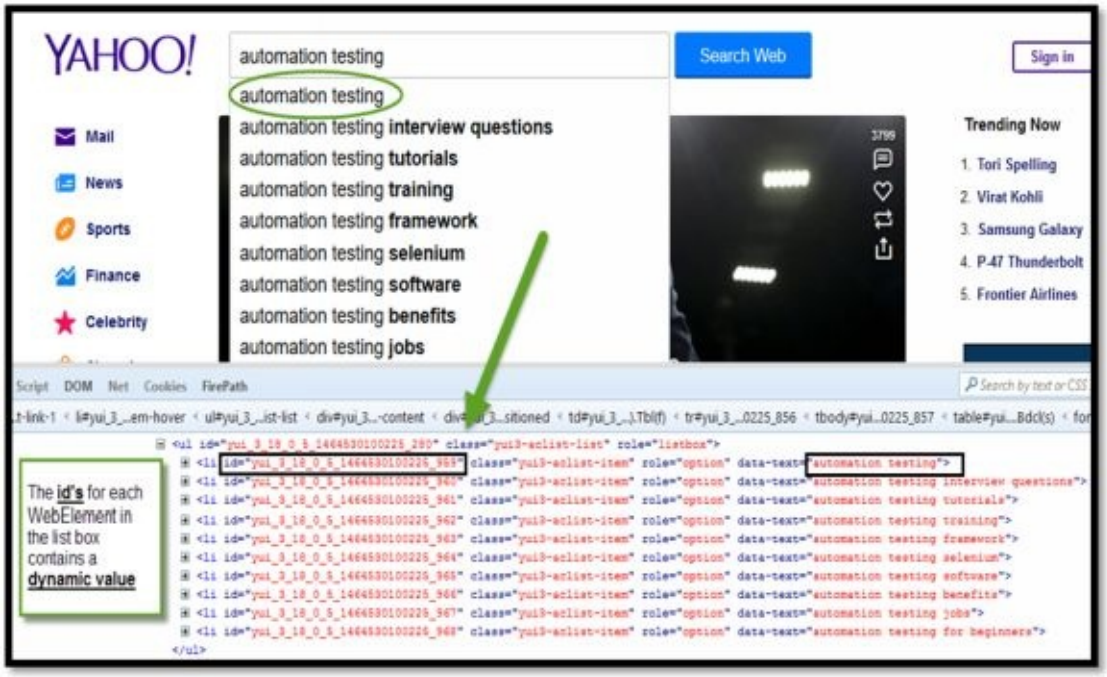


Figure 8.12 – HTML For Yahoo's Home Page Listbox (2)

The screenshots display a dynamic value for ID attribute. In particular, the ID changes for list box option "automation testing" from "yui_3_18_0_5_1464529539889_1000" to "yui_3_18_0_5_1464530100225_959".

An exception occurs if the locator attempts to find a dynamic element. The Test Script will not find the element because the value changed. Nevertheless, the Relative XPath can find dynamic WebElements utilizing a partial pattern match. A partial pattern match locates a WebElement based on part of the value. The following is the syntax for using a partial pattern match via relative XPath:

Syntax

[PartialPatternMatch(@AttributeName,'AttributeValue')]

Assume the value for an ID attribute changes from "Test123" to "Test456", "123Test" to "456Test", and "123Test456" to "789Test123". The constant value in each example is Test. As a result, an automation engineer can manually write a partial pattern match to find the dynamic WebElement. The following are three partial pattern match types that assist with dynamic values: starts-with, ends-with, contains

1. **starts-with** – finds a WebElement if the value starts with a constant string value "Test123" and "Test456"

```
driver.findElement.(By.xpath("//[starts-with(@id,'Test')]"))
```

2. **ends-with** – finds a WebElement if the value ends with a constant string value "123Test" and "456Test"

```
driver.findElement.(By.xpath("//[ends-with(@id,'Test')]"))
```

3. **contains** – finds a WebElement if the value contains a constant string value "123Test456" and "789Test123"

```
driver.findElement.(By.xpath("//[contains(@id,'Test')]"))
```

Chapter 9
Find WebElement By CSS Selector

Cascade Style Sheet “CSS” Selector is a robust method for finding WebElements. This locator type is very similar to the XPath locator type. An automation engineer can manually create a CSS Selector from the web page’s HTML or use FirePath. Steps for installing FirePath are located in Chapter 1 – Install Firebug and FirePath section. The following is a screenshot “How To Select CSS” from FirePath:

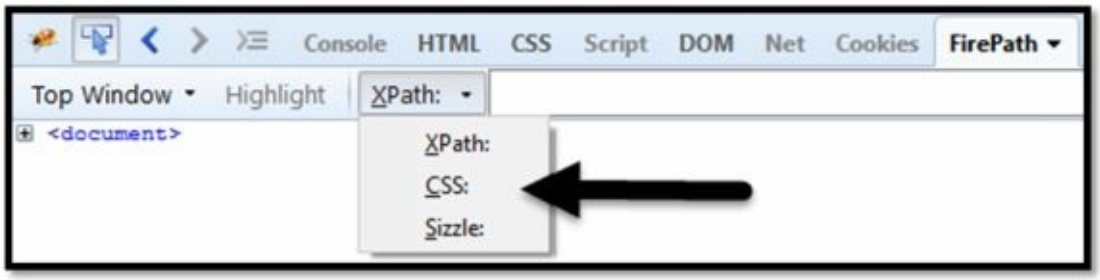


Figure 9.1 – FirePath / CSS Selector Screenshot

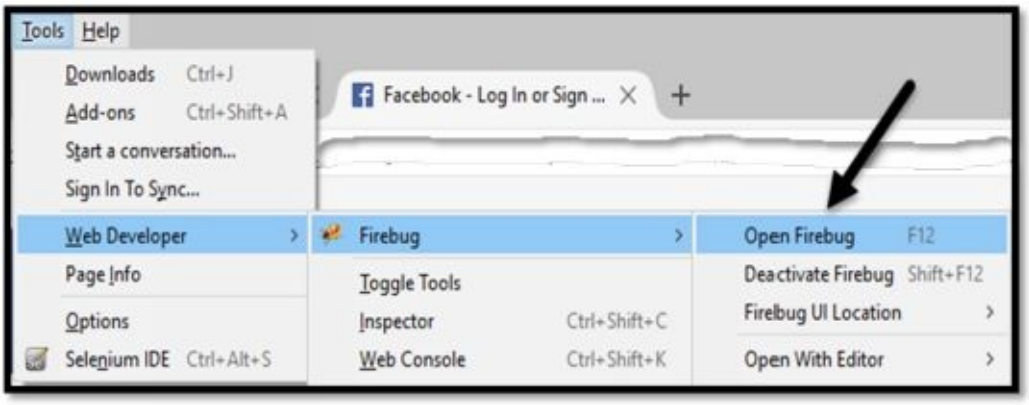
The CSS feature within FirePath provides an ability to retrieve a string parameter for CSS Selector locator. Below are screenshots of Facebook’s Sign Up page, its markup tags for radio buttons “Female and Male”, followed by steps to generate a CSS Selector string parameter:

Figure 9.2 – Facebook’s Sign Up Page / Female and Male Radio Buttons

Figure 9.3 – HTML For Female and Male Radio Buttons On Facebook's Sign Up Page

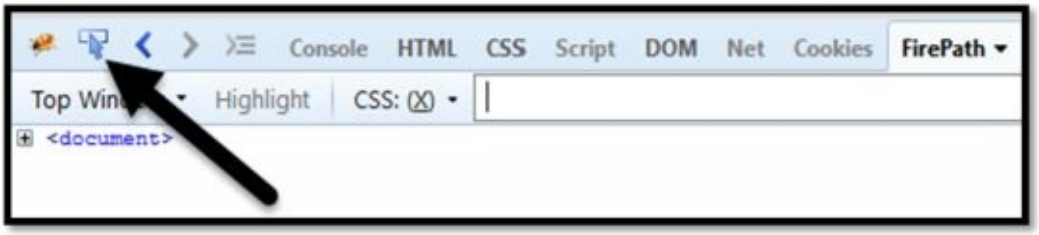
Steps for generating a CSS Selector:

1. Open Firefox browser
2. Load a web application “i.e., Facebook”
3. Click shortcut “F12” or Tools > Web Developer > Firebug > Open Firebug



4. Navigate to the FirePath tab within Firebug
5. Click the drop down for XPath
6. Select CSS:

7. Click the WebElement Inspector



8. Select the WebElement “i.e., radio button”

Result: The CSS text box displays a string parameter for CSS Selector.

Figure 9.4 – CSS Selector For The Female Radio Button

Figure 9.5 – CSS Selector For The Male Radio Button

Select A Radio Button via CSS Selector

The following is code for selecting the Male radio button on Facebook's Sign Up Page via CSS Selector locator type:

```
package FacebookSignUpPage;
import org.openqa.selenium.By;
import org.openqa.selenium.WebDriver;
import org.openqa.selenium.chrome.ChromeDriver;
import org.testng.annotations.*;

public class SelectRadioButton2
{
    WebDriver driver;
    @BeforeTest
```

```
    public void setUp () throws Exception
    {
            System.setProperty("webdriver.chrome.driver", "C:\Users\REX A
JONES\Downloads\chromedriver_win32\chromedriver.exe");
            driver = new ChromeDriver ();

            driver.get("https://www.facebook.com/");
    }
    @AfterTest
    public void tearDown () throws Exception
    {
            driver.quit();
    }
    @Test
    public void selectGender ()
    {
            driver.findElement(By.cssSelector("#u_0_f")).click();
    }
}
```

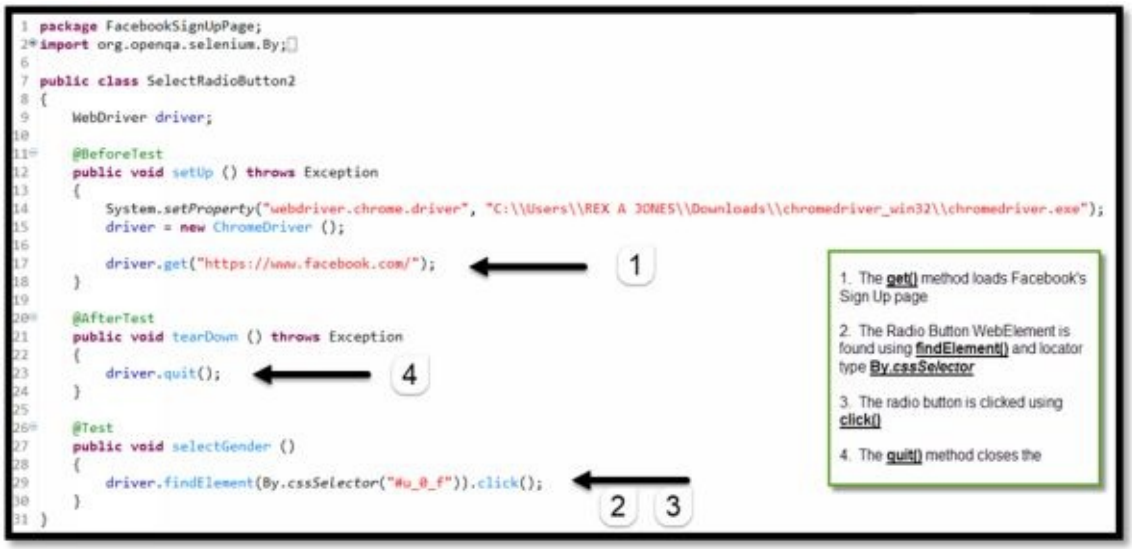


Figure 9.6 – Perform Actions On The Radio Button

- Line 9 "WebDriver driver" is the interface for driving the browser. Currently, the reference "driver" points to nothing but will point to a Chrome Driver object in a subsequent line "driver = new ChromeDriver()".

- Line 14 tells Selenium where the executable file for Chrome driver is located via System.*setProperty*. The executable file operates like a bridge between Selenium

and the browser. All browsers except Firefox require an executable file. Steps for downloading the executable file are located in Chapter 1 – Download Browser Drivers / Set Up Profiles section. The following are parameters for System.*setProperty*:

- **key** = webdriver.chrome.driver
- **value** = C:\Users\REX A JONES\Downloads\chromedriver_win32\chromedriver.exe

Note**:** Value is the path location of the executable file

- Line 15 "driver = **new** ChromeDriver()" is an implementation of the WebDriver interface. The reference "driver" is pointing to new ChromeDriver() which means testing is controlled on the Chrome browser.

- Line 17 "driver.get("https://www.facebook.com/")" loads a new Facebook page in the current browser window

- Line 23 "driver.quit()" quits the driver instance and closes the open browser window

- Line 29 "driver.findElement(By.*cssSelector*("#u_0_f")).click();":
  - driver – WebDriver object which assist with finding a WebElement
  - findElement – a WebDriver method that finds the WebElement "Male" radio button on Facebook's Sign Up page
  - (By.*cssSelector*("#u_0_f")) – By and *cssSelector* are parameters of the findElement WebDriver method. By is an object which locate elements and *cssSelector* is the locator type. The CSS Selector locator type accepts a string parameter "#u_0_f" which is the CSS Selector for the Male radio button.
  - click() – clicks the Male radio button

The following is a screenshot of Facebook's Sign Up page after selecting the Male radio button:

Figure 9.7 – Select The Male Radio Button

CSS Selector Alternatives To FirePath

The number “#” (also known as pound or hashtag) symbol starts a CSS Selector representing an ID attribute. In the previous example, CSS Selector (By.*cssSelector*(“#u_0_f”)) means the ID attribute’s value is “u_0_f” for Male radio button. However, the dot (.) operator is a symbol that represents the Class attribute. The following is the syntax for identifying all elements using class if the class name is Automation:

Syntax

(By.*cssSelector*(“.Automation”))

The following is the syntax for identifying an element using class if the tag type is Test and class name is Automation:

Syntax

(By.*cssSelector*(“Test.Automation”))

The first syntax only used a dot operator with the class name (Automation). Therefore, all elements are identified if the class name is Automation. The second syntax used the tag name (Test), dot operator (.), and class name (Automation). A specific element will be identified since the Test Script contains a tag name and class name. CSS Selector has a syntax similar to relative XPath that identify WebElements. The difference between the CSS Selector and relative XPath is the two forward slashes and the at symbol “@” before attribute name:

CSS Selector Syntax

TagName[AttributeName=’AttributeValue’]

Relative XPath

//TagName[@AttributeName=’AttributeValue’]

The following is a screenshot of WordPress and its HTML markup tags for Remember Me checkbox:

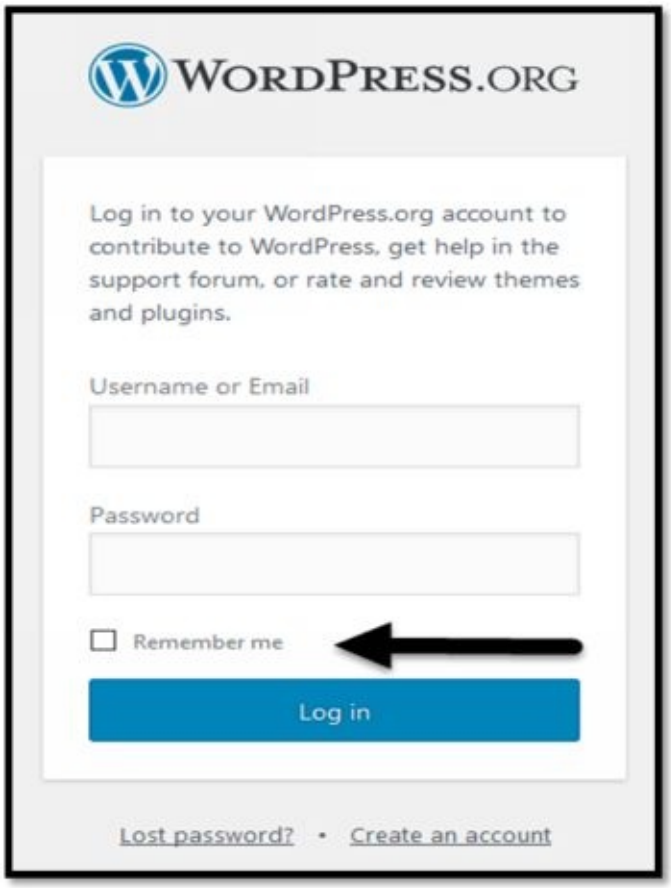


Figure 9.8 – WordPress Remember Me Checkbox

```
<p class="login-remember">
 <label>
      <input id="rememberme" type="checkbox" value="forever" name="rememberme">
     Remember me
   </label>
</p>
```

Figure 9.9 – HTML For The Remember Me Checkbox On WordPress Log In Page

The following table compares CSS Selector and relative XPath using the ID attribute for Remember Me checkbox:

CSS Selector	XPath
*[id='rememberme']	//*[@id='rememberme']
input[id='rememberme']	//input[@id='rememberme']

Figure 9.10 – Similarities Between CSS Selector and Relative XPath

Working With Dynamic WebElements Using CSS Selector

As mentioned earlier, a dynamic WebElement manifests when the value on an application changes or the value of an HTML attribute changes. The WebElement can be found although the value changes at runtime or after a page reloads. CSS Selector has three pattern matching symbols (^, $, *) that assist with finding dynamic WebElements. The following is the syntax for finding dynamic WebElements via CSS Selector:

Syntax

TagName[AttributeName Symbol='AttributeValue']

Assume the value for an ID attribute changes from "Hello123" to "Hello456", "123Hello" to "456Hello", and "123Hello456" to "789Hello123". The constant value in each example is Hello. As a result, an automation engineer can insert a symbol (^, $, *) to find the dynamic WebElement. The following are three CSS Selector pattern matching symbols that find dynamic values:

1. ^ (caret) – finds a WebElement if the value starts with a constant string value "Hello123" and "Hello456"

2. driver.findElement.(By.*cssSelector*("*[id ^='Hello']"))

3. **$** (dollar sign) – finds a WebElement if the value ends with a constant string value "123Hello" and "456Hello"

   driver.findElement.(By.*cssSelector*("*[id $='Hello']"))

4. ***** (asterisk) – finds a WebElement if the value contains a constant string value "123Hello456" and "789Hello123"

   driver.findElement.(By.*cssSelector*("*[id *='Hello']"))

Chapter 10
Find WebElement By Link Text

Finding an element by Link Text is carried out via the hyperlink's text name. Using a hyperlink's text name is the best way to click a hyperlink. The entire hyperlink's text name is used as the string parameter for the Link Text locator type. It is important to know that the hyperlink's text name is placed within HTML's anchor 'a' tags and after the href attribute/value. The following is a screenshot of LinkedIn and its HTML markup tags for the Forgot Password hyperlink:

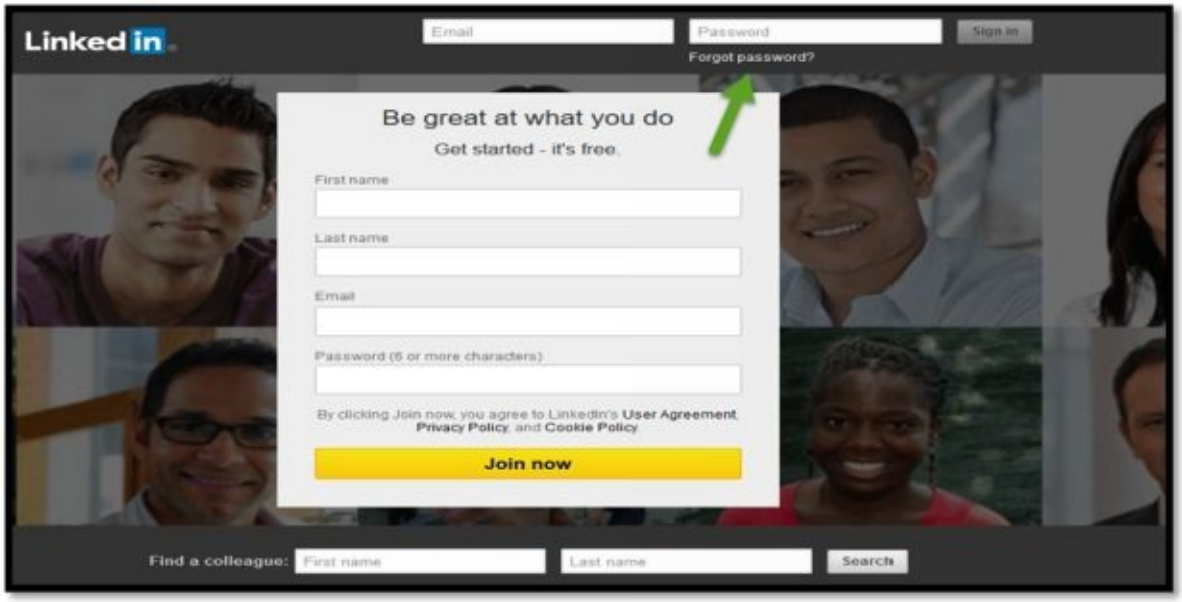


Figure 10.1 – LinkedIn's Home Screen (Forgot Password?)

Figure 10.2 – HTML For The Forgot Password Hyperlink On LinkedIn's Home Page

Click The Hyperlink For Forgot Password (Link Text)

The following is code for clicking the Forgot Password hyperlink on LinkedIn's Home Page via linkText locator type:

```
package LinkedInHomePage;
import org.openqa.selenium.*;
```

```
import org.openqa.selenium.chrome.ChromeDriver;
import org.testng.annotations.*;

public class ForgotPassword
{
    WebDriver driver;
    @BeforeTest
    public void setUp() throws Exception
    {
            System.setProperty("webdriver.chrome.driver", "C:\Users\REX A
JONES\Downloads\chromedriver_win32\chromedriver.exe");
            driver = new ChromeDriver();

       // Go to LinkedIn's Home Page
       driver.get("https://www.linkedin.com/");
    }
    @AfterTest
    public void tearDown() throws Exception
    {
            driver.quit();
    }
    @Test
    public void clickForgotPassword()
    {
            driver.findElement(By.linkText("Forgot password?")).click();
    }
}
```

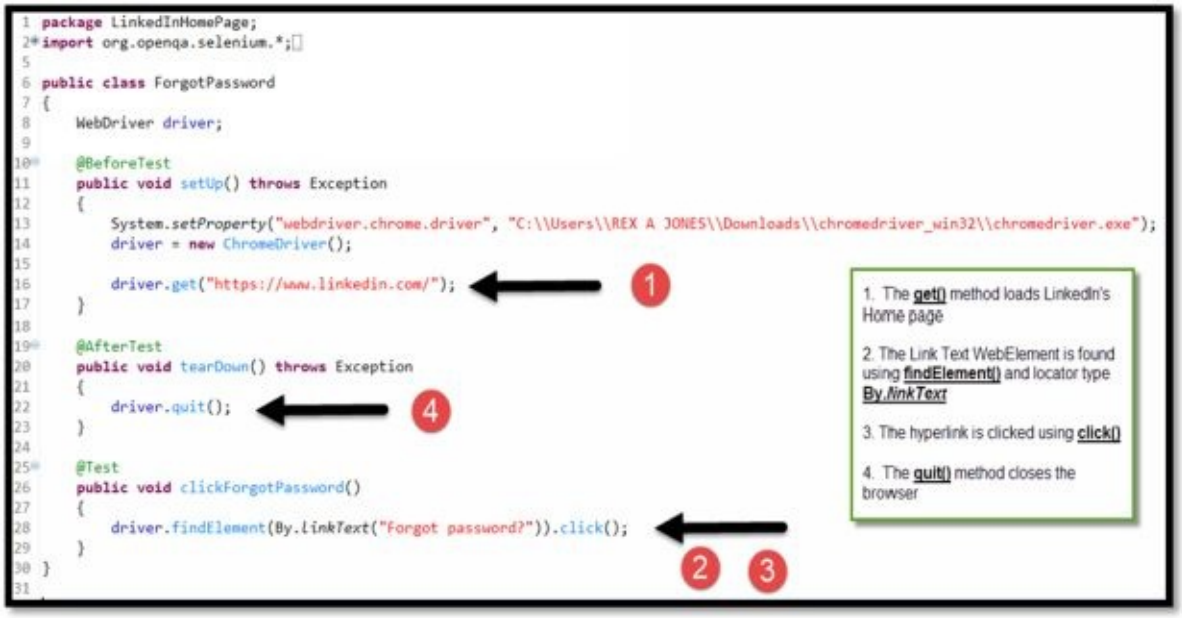


Figure 10.3 – Perform Actions On The Forgot Password Hyperlink

- Line 8 "WebDriver driver" is the interface for driving the browser. Currently, the object reference variable "driver" points to nothing but will point to a Chrome Driver object in a subsequent line "driver = new ChromeDriver()".

- Line 13 tells Selenium where the executable file for Chrome driver is located via System.*setProperty.* The executable file operates like a bridge between Selenium and the browser. All browsers except Firefox require an executable file. Steps for downloading the executable file are located in Chapter 1 – Download Browser Drivers / Set Up Profiles section. The following are parameters for System.*setProperty*:

  - **key** = webdriver.chrome.driver
  - **value** = C:\Users\REX A JONES\Downloads\chromedriver_win32\chromedriver.exe

  Note**:** Value is the path location of the executable file

- Line 14 "driver = **new** ChromeDriver()" is an implementation of the WebDriver interface. The object reference variable "driver" is pointing to new ChromeDriver() which means testing is controlled on the Chrome browser.

- Line 16 "driver.get("https://www.linkedin.com/")" loads a new LinkedIn Home page in the current browser window

- Line 22 "driver.quit()" quits the driver instance and closes the open browser

window

- Line 28 “driver.findElement(By.*linkText*(“Forgot password?”)).click()”:
  - driver – WebDriver object reference variable that assist with finding a WebElement
  - findElement – a WebDriver method that finds the hyperlink WebElement “Forgot Password” on LinkedIn’s Home page
  - (By.*linkText*(“Forgot password”)) – By and *linkText* are parameters of the findElement WebDriver method. By is an object which locate elements and linkText is the locator type. The Link Text locator type accepts a string parameter “Forgot password” which is the text name of the hyperlink
  - click() – clicks the Forgot Password hyperlink

Note: The submit() method can also be used to click the Forgot Password hyperlink.

The following is a screenshot of LinkedIn’s Home page after clicking the Forgot Password hyperlink:

Figure 10.4 – Change Your Password

Chapter 11
Find WebElement By Partial Link Text

Finding an element by Partial Link Text is carried out similar to Link Text. Both techniques only works for clicking hyperlinks. However, the difference between Partial Link Text and Link Text is hyperlink's text name. Part of the hyperlink's text name is suitable for the Partial Link Text locator type. For example, an automation engineer can enter "Password" and the "Forgot Password" link is clicked. The following is a screenshot of LinkedIn and its HTML markup tags for the Forgot Password hyperlink:

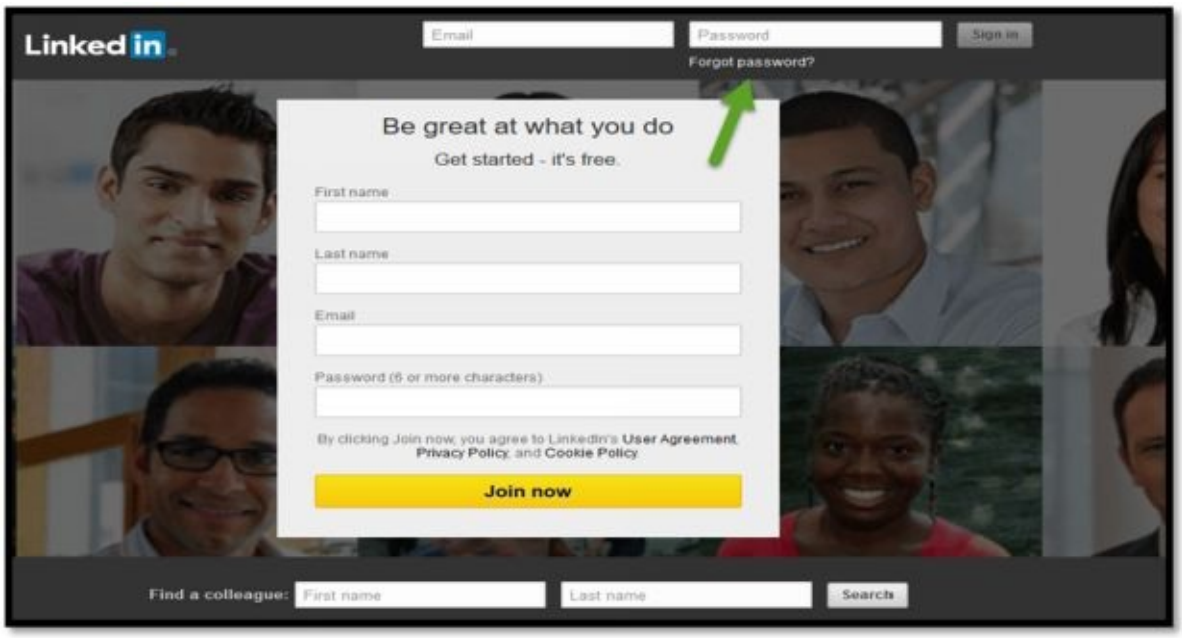


Figure 11.1 – LinkedIn's Home Screen (Forgot Password?)

Figure 11.2 – HTML For The Forgot Password Hyperlink On LinkedIn's Home Page (2)

Click The Hyperlink For Forgot Password (Partial Link Text)

The following is code for clicking the Forgot Password hyperlink on LinkedIn's Home Page via partialLinkText locator type:

```
package LinkedInHomePage;
```

```
import org.openqa.selenium.*;
import org.openqa.selenium.chrome.ChromeDriver;
import org.testng.annotations.*;

public class ForgotPassword2
{
    WebDriver driver;
    @BeforeTest
    public void setUp() throws Exception
    {
            System.setProperty("webdriver.chrome.driver", "C:\Users\REX A
JONES\Downloads\chromedriver_win32\chromedriver.exe");
            driver = new ChromeDriver();

            driver.get("https://www.linkedin.com/");
    }
    @AfterTest
    public void tearDown() throws Exception
    {
            driver.quit();
    }
    @Test
    public void clickForgotPassword()
    {
            driver.findElement(By.partialLinkText("Forgot")).click();
    }
}
```

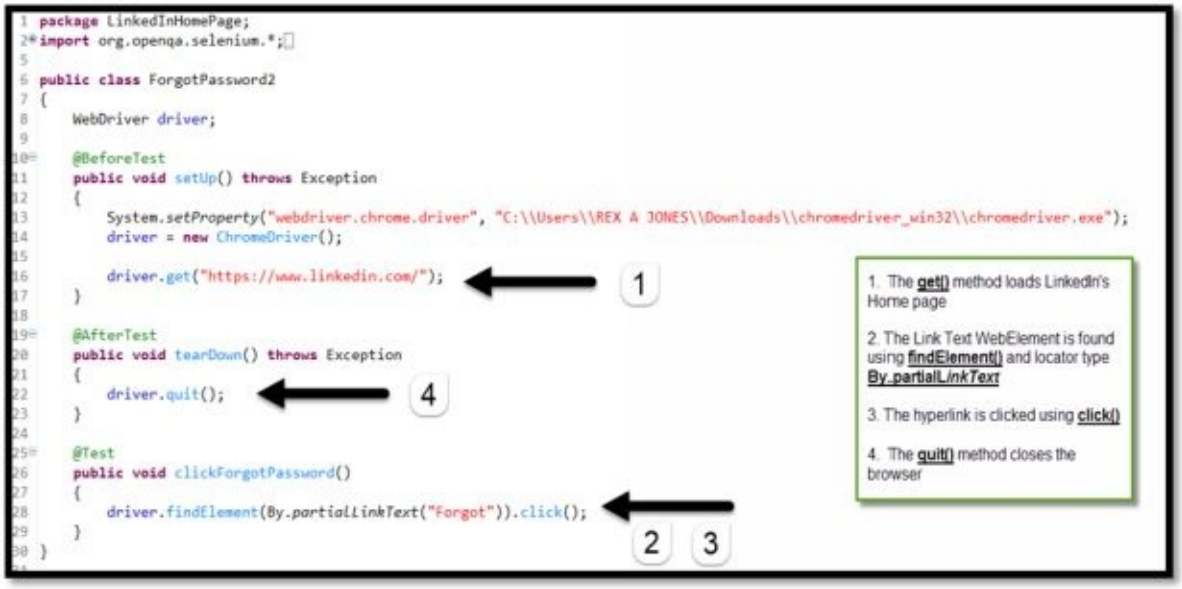


Figure 11.3 – Perform Actions On The Forgot Password Hyperlink

- Line 8 "WebDriver driver" is the interface for driving the browser. Currently, the object reference variable "driver" points to nothing but will point to a Chrome Driver object in a subsequent line "driver = new ChromeDriver()".

- Line 13 tells Selenium where the executable file for Chrome driver is located via System.*setProperty.* The executable file operates like a bridge between Selenium and the browser. All browsers except Firefox require an executable file. Steps for downloading the executable file are located in Chapter 1 – Download Browser Drivers / Set Up Profiles section. The following are parameters for System.*setProperty*:

  - **key** = webdriver.chrome.driver
  - **value** = C:\Users\REX A JONES\Downloads\chromedriver_win32\chromedriver.exe

  Note**:** Value is the path location of the executable file

- Line 14 "driver = **new** ChromeDriver()" is an implementation of the WebDriver interface. The object reference variable "driver" is pointing to new ChromeDriver() which means testing is controlled on the Chrome browser.

- Line 16 "driver.get("https://www.linkedin.com/")" loads a new LinkedIn Home page in the current browser window

- Line 22 "driver.quit()" quits the driver instance and closes the open browser window

- Line 28 “driver.findElement(By.*partialLinkText*(“Forgot”)).click()”:
  - driver – WebDriver object reference variable that assist with finding a WebElement
  - findElement – a WebDriver method that finds the hyperlink WebElement “Forgot Password” on LinkedIn’s Home page
  - (By.*partialLinkText*(“Forgot”)) – By and *partialLinkText* are parameters of the findElement WebDriver method. By is an object which locate elements and partialLinkText is the locator type. The Partial Link Text locator type accepts a string parameter “Forgot” which is part of the hyperlink’s text name..
  - click() – clicks the Forgot Password hyperlink

Note: The submit() method can also be used to click the Forgot Password hyperlink.

The following is a screenshot of LinkedIn’s Home page after clicking the Forgot Password hyperlink:

Figure 11.4 – Change Your Password

Chapter 12
Find WebElement By Tag Name

In HTML, multiple elements share the same Tag Name. Therefore finding an element by Tag Name is limited. It is best to use another locator type in conjunction with the Tag Name locator type to identify an element. The following is a screenshot of LinkedIn and its HTML markup tags for the Join Now button:

Figure 12.1 – LinkedIn's Join Now Button

Figure 12.2 – HTML For The Join Now Button On LinkedIn's Home Page

Click The Join Now Button

The following is code for clicking the Join Now button on LinkedIn's Home Page via tagname locator type:

```
package LinkedInHomePage;
import org.openqa.selenium.*;
import org.openqa.selenium.chrome.ChromeDriver;
```

```
import org.testng.annotations.*;


public class JoinNow
{
    WebDriver driver;
    @BeforeTest
    public void setUp() throws Exception
    {
            System.setProperty("webdriver.chrome.driver", "C:\Users\REX A
JONES\Downloads\chromedriver_win32\chromedriver.exe");
            driver = new ChromeDriver();


            driver.get("https://www.linkedin.com/");
    }
    @AfterTest
    public void tearDown() throws Exception
    {
            driver.quit();
    }
    @Test
    public void clickJoinNowButton ()
    {
            // This button can be clicked using submit() or click()
            driver.findElement(By.tagName("button")).submit();
    }
}
```

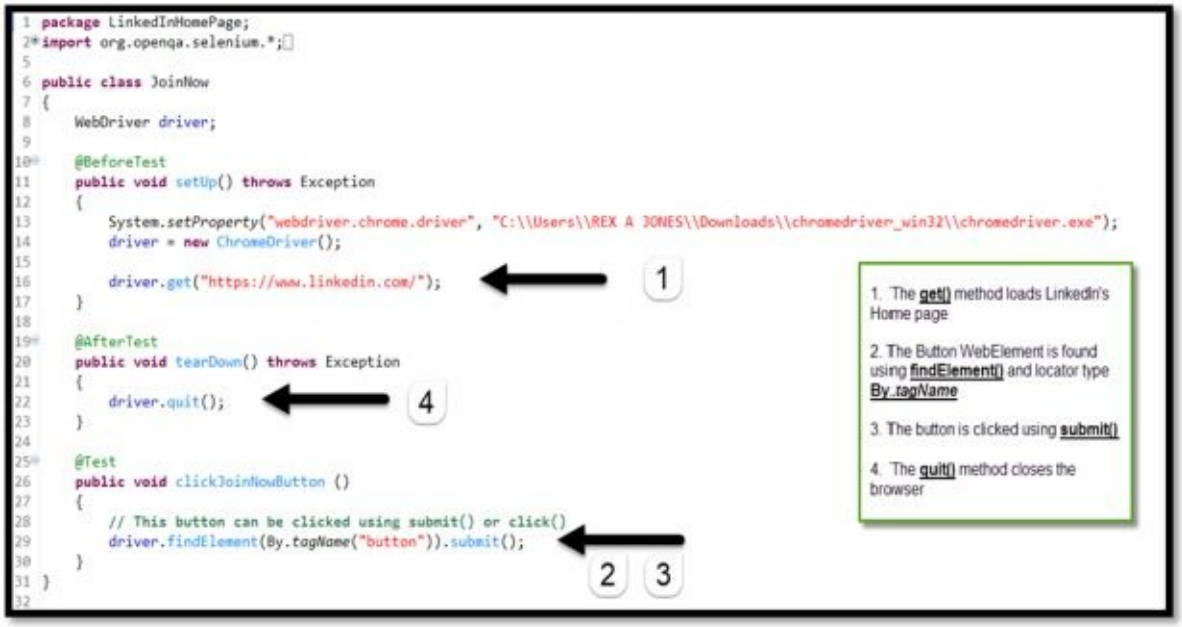


Figure 12.3 – Perform Actions On The Join Now Button

- Line 8 "WebDriver driver" is the interface for driving the browser. Currently, the object reference variable "driver" points to nothing but will point to a Chrome Driver object in a subsequent line "driver = new ChromeDriver()".

- Line 13 tells Selenium where the executable file for Chrome driver is located via System.*setProperty*. The executable file operates like a bridge between Selenium and the browser. All browsers except Firefox require an executable file. Steps for downloading the executable file are located in Chapter 1 – Download Browser Drivers / Set Up Profiles section. The following are parameters for System.*setProperty*:

  - **key** = webdriver.chrome.driver
  - **value** = C:\Users\REX A JONES\Downloads\chromedriver_win32\chromedriver.exe

  Note**:** Value is the path location of the executable file

- Line 14 "driver = **new** ChromeDriver()" is an implementation of the WebDriver interface. The object reference variable "driver" is pointing to new ChromeDriver() which means testing is controlled on the Chrome browser.

- Line 16 "driver.get("https://www.linkedin.com/")" loads a new LinkedIn Home page in the current browser window

- Line 22 "driver.quit()" quits the driver instance and closes the open browser

window

- Line 29 “driver.findElement(By.*tagName*(“button”)).submit()”:
  - driver – WebDriver object reference variable that assist with finding a WebElement
  - findElement – a WebDriver method that finds the button WebElement “Join Now” on LinkedIn’s Home page
  - (By.*tagName*(“button”)) – By and *tagName* are parameters of the findElement WebDriver method. By is an object which locate elements and tagName is the locator type. The Tag Name locator type accepts a string parameter “button” which is the tag name for the Join Now button.
  - submit() – clicks the Join Now button

Note: The click() method can also be used to click the Join Now button. There is only one button on LinkedIn’s Home page. Therefore, the Tag Name locator type is used by itself because multiple elements do not share the same Tag Name “button”.

The following is a screenshot of LinkedIn’s Home page after clicking the Join Now button without entering required fields:

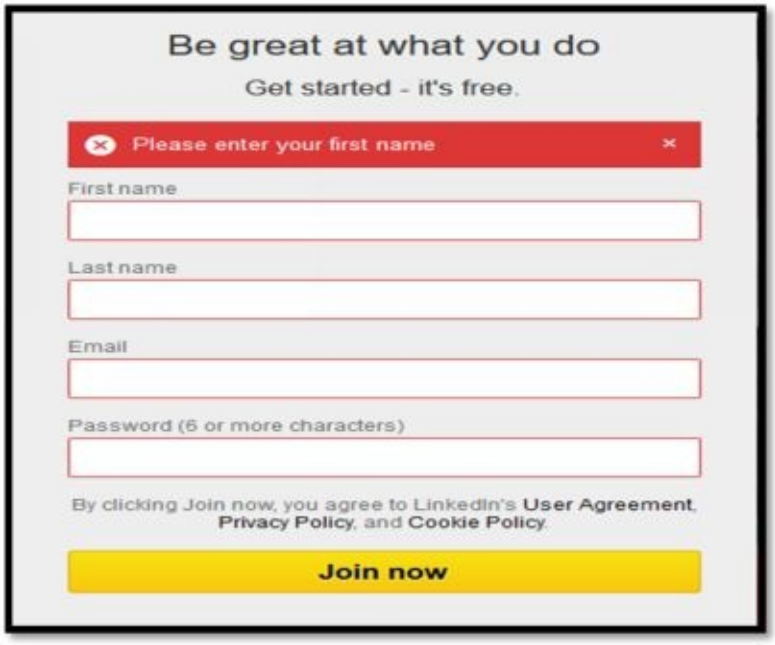


Figure 12.4 – Click The Join Now Button Without Entering Required Fields

Chapter 13
Find WebElement By Class

Finding a WebElement by Class is unique from most locator types. A specific WebElement may contain multiple class attributes. On the other hand, there may be multiple WebElements within the same class attribute. If the latter scenario occurs then the first WebElement will be returned if the WebElement is not identified with another locator type. The following is a screenshot of LinkedIn and its HTML markup tags for the Email text box, Password text box, and Sign In button:

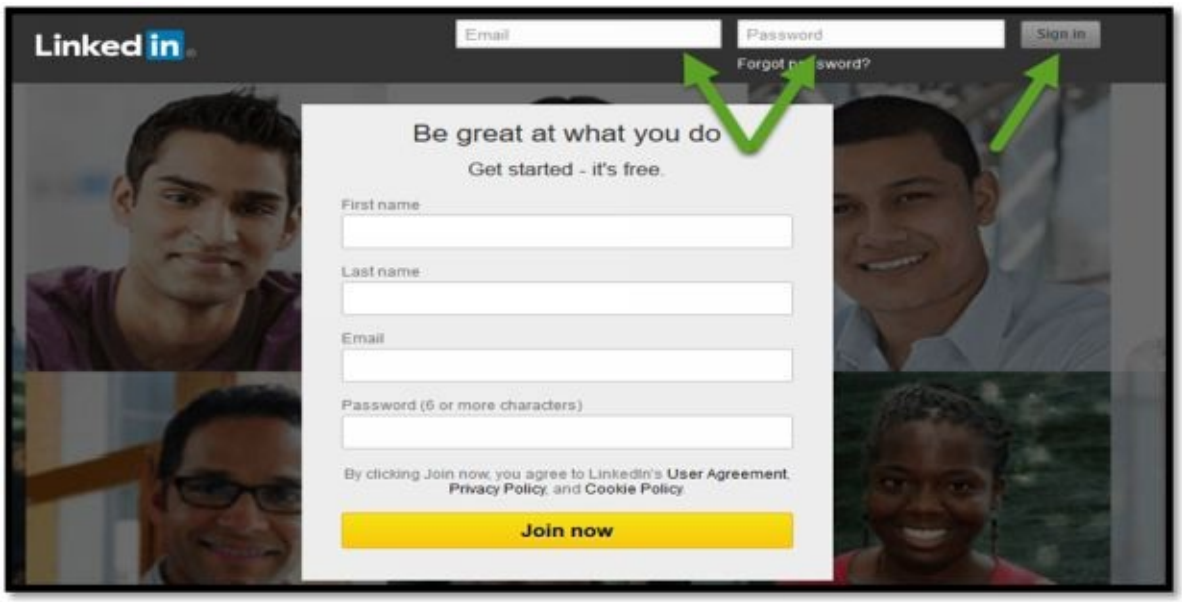


Figure 13.1 – LinkedIn's Email Text Field, Password Text Field, And Sign In Button

Figure 13.2 – HTML For The Email Text Field, Password Text Field, And Sign In Button

Enter Email, Password, and Click The Sign In Button

The following is code for entering an email, password, and clicking the Sign In button on LinkedIn's Home Page via classname locator type:

```
package LinkedInHomePage;
import org.openqa.selenium.*;
import org.openqa.selenium.chrome.ChromeDriver;
import org.testng.annotations.*;

public class CaptureErrorMessage
{
    WebDriver driver;
    @BeforeTest
    public void setUp() throws Exception
    {
            System.setProperty("webdriver.chrome.driver", "C:\Users\REX A
JONES\Downloads\chromedriver_win32\chromedriver.exe");
            driver = new ChromeDriver();

            driver.get("https://www.linkedin.com/");
    }
    @AfterTest
    public void tearDown() throws Exception
    {
            driver.quit();
    }

    @Test
    public void captureSignInErrorMessage()
    {
            WebElement parentSignIn = driver.findElement(By.className("login-form"));

            WebElement childEmail = parentSignIn.findElement(By.id("login-email"));
            WebElement childPassword = parentSignIn.findElement(By.id("login-password"));
            WebElement childSignInButton = parentSignIn.findElement(By.name("submit"));

            // Enter Email and Password then Click the Sign In button
            childEmail.sendKeys("Rex.Jones@Test4Success.org");
            childPassword.sendKeys("34Tester");
            childSignInButton.click();
```

```
            // Capture the error messages
            String firstSignInErrorMessage = driver.findElement(By.className("alert")).getText();
            System.out.println(firstSignInErrorMessage);
    }
}
```

Figure 13.3 – Perform Actions On Email, Password, And Sign In

Program Output:

There were one or more errors in your submission. Please correct the marked fields below.

- Line 8 "WebDriver driver" is the interface for driving the browser. Currently, the object reference variable "driver" points to nothing but will point to a Chrome Driver object in a subsequent line "driver = new ChromeDriver()".

- Line 13 tells Selenium where the executable file for Chrome driver is located via System.*setProperty.* The executable file operates like a bridge between Selenium and the browser. All browsers except Firefox require an executable file. Steps for downloading the executable file are located in Chapter 1 – Download Browser Drivers / Set Up Profiles section. The following are parameters for System.*setProperty*:

- **key** = webdriver.chrome.driver
- **value** = C:\Users\REX A JONES\Downloads\chromedriver_win32\chromedriver.exe

Note**:** Value is the path location of the executable file

- Line 14 "driver = **new** ChromeDriver()" is an implementation of the WebDriver interface. The object reference variable "driver" is pointing to new ChromeDriver() which means testing is controlled on the Chrome browser.

- Line 16 "driver.get("https://www.linkedin.com/")" loads a new LinkedIn Home page in the current browser window

- Line 22 "driver.quit()" quits the driver instance and closes the open browser window

- Line 29
  "WebElement parentSignIn = driver.findElement(By.*className*("login-form"))":
  - WebElement parentSignIn - creates an object reference variable called parentSignIn that refers or points to a WebElement. Subsequent lines for Email, Password, and Sign In will point to the same form WebElement via parentSignIn.
  - driver – WebDriver object reference variable that assist with finding the WebElement
  - findElement – a WebDriver method that finds the form WebElement on LinkedIn's Home page. The form includes an email text box, password text box, Sign In button, and a Forgot Password hyperlink
  - (By.*className*("login-form")) – By and *className* are parameters of the findElement WebDriver method. By is an object which locate elements and className is the locator type. The Class Name locator type accepts a string parameter "login-form" which is the value of the HTML class attribute.

- Line 31
  "WebElement childEmail = parentSignIn.findElement(By.*id*("login-email"))":
  - WebElement childEmail = creates an object reference variable called childEmail that refers or points to a WebElement
  - parentSignIn – object reference variable that assist with finding the WebElement by pointing to the same form WebElement from line 29
  - findElement – a WebDriver method that finds the text box WebElement "Email" on LinkedIn's Home page.
  - (By.*id*("login-email")) – By and *id* are parameters of the findElement WebDriver method. By is an object which locate elements and id is the locator type. The ID locator type accepts a string parameter "login-email"

which is the value of the HTML id attribute.

- Line 32
  "WebElement childPassword = parentSignIn.findElement(By.*id*("login-password"))":
  - WebElement childPassword = creates an object reference variable called childPassword that refers or points to a WebElement
  - parentSignIn – object reference variable that assist with finding the WebElement by pointing to the same form WebElement from line 29
  - findElement – a WebDriver method that finds the text box WebElement "Password" on LinkedIn's Home page.
  - (By.*id*("login-password")) – By and *id* are parameters of the findElement WebDriver method. By is an object which locate elements and id is the locator type. The ID locator type accepts a string parameter "login-password" which is the value of the HTML id attribute.

- Line 33
  "WebElement childSignInButton = parentSignIn.findElement(By.*name*("submit"))":
  - WebElement childSignInButton = creates an object reference variable called childSignInButton that refers or points to a WebElement
  - parentSignIn – object reference variable that assist with finding the WebElement by pointing to the same form WebElement from line 29
  - findElement – a WebDriver method that finds the button WebElement "Sign In" on LinkedIn's Home page.
  - (By.*name*("submit")) – By and *name* are parameters of the findElement WebDriver method. By is an object which locate elements and name is the locator type. The Name locator type accepts a string parameter "submit" which is the value of the HTML name attribute.

- Line 36 "childEmail.sendKeys("Rex.Jones@Test4Success.org)" types the text "Rex.Jones@Test4Success.org" in the Email text field via object reference childEmail

- Line 37 "childPassword.sendKeys("34Tester)" types the text "34Tester" in the Password text field via object reference childPassword

- Line 38 "childSignInButton.click()" clicks the Sign In button via object reference childSignInButton

Note: The submit() method can also be used to click the Sign In button.

- Line 41

"String firstSignInErrorMessage = driver.findElement(By.*className*("alert")).getText()"

- String firstSignInErrorMessage = creates an object reference variable called firstSignInErrorMessage that refers or points to a string
  - driver – WebDriver object reference variable that assist with finding a WebElement
  - findElement – a WebDriver method that finds the WebElement string "error message" on LinkedIn's Sign In page
  - (By.*className*("alert")) – By and *className* are parameters of the findElement WebDriver method. By is an object which locate elements and className is the locator type. The Class Name locator type accepts a string parameter "alert" which is the value of the HTML class attribute
  - getText() – gets the WebElement string

- Line 42 "System.***out***.println(firstSignInErrorMessage)" prints the WebElement string "error message". View the error message (Class's Program Output and/or Figure 13.4 – Sign In Page After Entering Invalid Credentials)

Note: In this example scenario, Email, Password, and Sign In contained unique attribute/values within HTML's source code. However, the Class locator type is beneficial if there are multiple WebElements with the same attribute/value. The WebElement with a duplicate attribute/value should be located first by finding the value for its class attribute followed by attributes ID, Name, etc. This explains why object reference "parentSignIn" was created for the form followed by Email "childEmail", Password "childPassword", and Sign In "childSignInButton".

Lines 29 – 38 could have been created without references. The following code also enters an email, password, and clicks the Sign In button:

```
driver.findElement(By.id("login-email")).sendKeys("Rex.Jones@Test4Success.org");
driver.findElement(By.id("login-password")).sendKeys("34Tester");
driver.findElement(By.name("submit")).click();
```

The following is a screenshot of LinkedIn's Sign In page after entering invalid credentials:

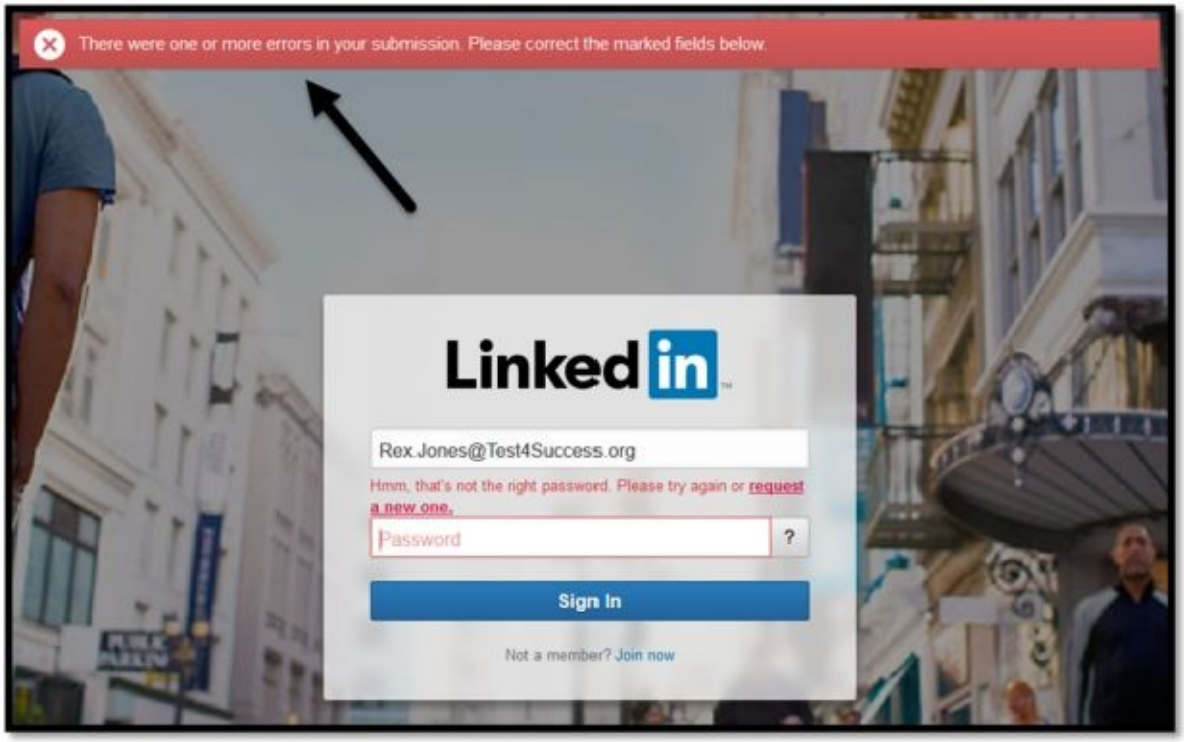


Figure 13.4 – Sign In Page After Entering Invalid Credentials

Conclusion

Selenium WebDriver is a very popular open source automation tool in the Software QA/Testing industry. The goal of "*(Part 1) Selenium WebDriver for Functional Automation Testing*" was to provide a foundation for beginners. An automation engineer is effective when learning how to program, how to apply a unit test framework, and understand two automation principles. The two automation principles encompass finding a WebElement then deciding what action to perform on the WebElement. Automation engineers build on top of that foundation with knowledge of classes, methods, and annotations within Java, TestNG, and Selenium WebDriver. The following are take-away topics from this book:

Java

Java is one of the programming languages supported by Selenium WebDriver. An automation engineer can transition to a different language (C#, Python, Ruby) after understanding the fundamentals of programming. One of the fundamentals is to learn the syntax for that desired programming language. The following are several concepts regarding Core Java:

- Variables: A location that holds data
- Data Types: Refers to the type of variable
- Operators: A symbol that performs mathematical or logical operations
- Control Structures: Refers to the process of using logic to force the program to skip or loop statements

- Class: A template for objects which contains data and code that operates on the data

- Objects: Objects are the foundation to object-oriented programming (OOP). It consists of two characteristics: state and behavior. State identifies the object and behavior represent actions of the object

- Methods: A method is a block of code that perform a specific task / action

- Access Modifiers: Determines access to a class and all of the class members (variables and methods)

- Inheritance: Inheritance is a hierarchical concept which allows reusable code and objects to be extended

- Packages: A package is a collection of related classes

- Interfaces: An interface is a collection of related methods

TestNG

TestNG is a unit test framework influenced by JUnit. JUnit comes equipped with Eclipse but TestNG must be installed as a plugin. Both frameworks contain annotations that are required for testing an application. However, TestNG added more features that facilitate unit, integration, end-to-end (E2E), acceptance, and functional testing. The following are some of the annotations within TestNG:

- @BeforeSuite / @AfterSuite – before a suite starts / after all the test methods in a certain suite have run
- @BeforeTest / @AfterTest – before a test starts / after all the test methods in a certain test have run
- @BeforeClass / @AfterClass – before a test class starts / after all the test methods in a certain class have run
- @BeforeMethod / @AfterMethod – before a test method runs / after a test method has run
- @Test - Marks a class or a method as part of the test

Selenium WebDriver

Selenium WebDriver is an automation tool used for testing web applications. The tool generates a call to a browser utilizing each browser's native support for automation. It is important to know that all web applications and browsers contain WebElements "i.e., buttons, links, etc." The WebElements are derived from HTML, which is an acronym for Hyper Text Markup Language.

HTML is the standard language for creating web applications. As a result, the key to automating an application is to first find the WebElement via HTML. After locating the WebElement, an automation engineer decides the appropriate action to perform on the WebElement. Finding the WebElement and performing an action on the WebElement are building blocks to test automation. A WebElement is found using the following eight locator types:

1. ID - Find WebElements by the value of its ID attribute
2. Name - Find WebElements by the value of its Name attribute
3. XPath - Find WebElements by its XPath
4. CSS Selector - Find WebElements by the CSS Selector's engine
5. Link Text - Find hyperlink WebElements by its complete text
6. Partial Link Text - Find hyperlink WebElements by partial text contained within the complete text
7. Tag Name - Find WebElements by its tag name
8. Class Name - Find WebElements by the value of its Class attribute

Resources

1. Selenium HQ

http://www.seleniumhq.org/
http://www.seleniumhq.org/about/history.jsp
http://www.seleniumhq.org/download/
https://seleniumhq.github.io/selenium/docs/api/java/index.html?
org/openqa/selenium/WebDriver.html

2. TIOBE

http://www.tiobe.com/tiobe_index

3. ORACLE Java Documentation
The Java ™ Tutorials

https://docs.oracle.com/javase/tutorial/java/nutsandbolts/_keywords.html

4. Java A Beginner's Guide Sixth Edition
Create, Compile, and Run Java Programs Today
Herbert Schildt

5. TestNG

http://testng.org/doc/documentation-main.html#annotations

6. Next Generation Java ™ Testing
TestNG and Advanced Concepts_
Cédric Beust | Hani Suleiman

7. W3C

http://www.w3.org/TR/WCAG20-TECHS/H93.html

8. LinkedIn

https://www.linkedin.com/

9. Facebook

https://www.facebook.com/

10. Yahoo

https://www.yahoo.com/

11. WordPress

https://login.wordpress.org/

12. Welcome to the Internet

http://the-internet.herokuapp.com/

The following resources are links to the installations in Chapter 1. Some links duplicate the previous 12 resources:

13. Install Selenium IDE via Selenium HQ

http://www.seleniumhq.org/download/

14. Install Java Development Kit (JDK) via Oracle

http://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html

15. Install Eclipse IDE via Eclipse

https://eclipse.org/downloads/

16. Install Java Client Driver via Selenium HQ

http://docs.seleniumhq.org/download/

17. Install ChromeDriver via Selenium HQ or Google Sites

http://docs.seleniumhq.org/download/
https://sites.google.com/a/chromium.org/chromedriver/downloads

18. Install IEDriverServer via Selenium HQ or Selenium Server

http://docs.seleniumhq.org/download/
http://selenium-release.storage.googleapis.com/index.html?path=2.53/

19. Install Notepad ++

https://notepad-plus-plus.org/download/v6.9.2.html