C:\Users\TISHAN1KA\eclipse\java-2021-12\eclipse\eclipse.exe

If new java version is installed , eclipse gave the error

“rror: A java Runtime Environment (JRE) or Java Development kit (JDK) must be available in order to run Eclipse. No Java virtual machine was found after searching the following locations: D:eclipsejrejavaw.exe javaw.exe in your current PATH.”

For this go to eclipse path.

Open the eclipse configaraion file and change -vm variable

Resources

<https://www.techlistic.com/p/java.html>

Java Notes

Int a[] = new int[5]

Dynamic array

Int a[] = {12,2,3,4,5}

Following is the enhanced loop. When you want to loop the array to read each and every value

for (int i : a)

{

System.out.println(i); // directly prints the value of the array

}

a.length :to get the length of an array

Multi-dimensional array

**int** mdimArray[][] = **new** **int** [3][2];

mdimArray[0][0]=100;

mdimArray[0][1]=200;

mdimArray[1][0]=300;

mdimArray[1][1]=400;

mdimArray[2][0]=500;

mdimArray[2][1]=600;

**int** mdimArray[][] = **new** **int** [3][2];

mdimArray[0][0]=100;

mdimArray[0][1]=200;

mdimArray[1][0]=300;

mdimArray[1][1]=400;

mdimArray[2][0]=500;

mdimArray[2][1]=600;

Method two

int arr[][]= {{100,200}, {300,400}, {500,600} };

System.out.println("No of rows = " +arr.length );

System.out.println("No of columns = "+ arr[0].length );

for (int i =0;i<mdimensional.length;i++)

{

for (int j=0;j<mdimensional[i].length; j++)

{

System.out.print(" " +mdimensional[i][j]);

}

System.out.println(" ");

}

Strings

String s1

//Enhanced for loop

System.out.println("---Enhanced for loop--- ");

for(int i[] :mdimensional )

{

//System.out.println(" "+i);

for(int j : i)

{

System.out.print(" " + j);

}

System.out.println(" ");

}

String s1, s2;

s1=" Welcome ";

s2 = " To Java ";

System.out.println("Length of String =" +s1.length());

System.out.println("Concatenate 2 strings " + s1.concat(s2));

System.out.println("After trimming " +s1.trim().concat(s2).length());

System.out.println("CharAt =" +s1.charAt(5));

System.out.println("Contains " +s1.contains("come"));

System.out.println("Equals " + s1.trim().equals("Welcome"));

System.out.println("EqualsIgnoreCase " + s1.trim().equalsIgnoreCase("welcome"));

System.out.println("Replace " + s1.replace('e', 'a'));

System.out.println("Replace " + s1.replace('e', 'a'));

System.out.println("Replace strings " + s1.concat(s2).replace("Java", "Selenium"));

System.out.println("Substring " + s1.substring(5,7));

System.out.println("toLowercare = " +s1.toLowerCase());

System.out.println("toUppercase = " + s1.toUpperCase() );

System.out.println("indexOf =" + str3.indexOf('@') );

o/p

s1 = Welcome

s2 = To Java

Length of String =9

Concatenate 2 strings =Welcome To Java

After trimming =16

CharAt =m

Contains =true

Equals =false

EqualsIgnoreCase =true

Replace =Walcoma

Replace strings =Welcome To Selenium

Substring =me

toLowercare = welcome

toUppercase = WELCOME

Day-3

----------

Java Control Statements

-----------------

Conditional Statements(Selection Statements)

Loops /Iterative Statements

Jump Statements

Conditional Statements

----------------------

if..else

if(condition)

{

//statements

}

else

{

//statemetns

}

Nested if..else

----------------

if(condition1)

{

statements;

}

else if(condition2)

{

statements;

}

else if(condition3)

{

statements;

}

else

{

Statements;

}

switch case

-----------------

switch(expression)

{

case <condition1>: statements; break;

case <condition2>: statements; break;

case <condition3>: statements; break;

---

----

default: statements;

}

Loop: set of statement/s can be repeated multiple times based on a condition.

while

do..while

for loop

while loop

-------

while(condition)

{

statements;

}

do..while

-------------

do

{

//statements;

}while(condition);

for loop

--------------

initilization

condition

inc/dec

for(initilize;condition; inc/dec)

{

statemetns;

}

Jump Statements

--------

break

continue

Assignments

----------

1) Write a Java program to find a number is positive or negative.

2) Write a Java program to find greatest of 3 numbers.

3) Write a program in Java to display the multiplication table of 5. (for loop)

Expected Output :

num \* i = res

5 X 0 = 0

5 X 1 = 5

5 X 2 = 10

----------

------------

5 X10 = 50

4)Write a Java program count the number of digits of the number.

num=23456

5 digits

-----------------------------------------------------------------

Day-4

--------

Java Arrays & Strings

------------------

int a=10;

a=20;

Array: Array is collection of elements of same data type.

2 types of arrays

----------

1) Single dimensional

2) Two/multi dimensional

Single Dimensional array

------------------

1) Declare an array

2) insert values into array

3) Find size of an array

4) read values from an array

int a[]=new int[5]; //int []a=new int[5]

for(initialization;condition;inc)

{

statemtnes;

}

Advanced foor loop/Enhanced for loop/for each loop

------------------------------

for(initilization)

{

statements;

}

Two/multi dimensional array

----------------------

1) Declare an array

2) insert values into array

3) Find size of an array( rows, columns)

4) read values from an array

int a[][]=new int[3][2]; // 3--> rows 2--> columns

int [][]a=new int[3][2];

String: String is a colection of characters.

String s="welcome"

String methods

---------------------------------------------------------------------------

Day-5

-------

OOP - Object oriented Programming.

class --> collection of variables and methods

object --> object is an instance of a class

method --> block of code which contains a logic

1) main() method can be present in a same class

2) main() method can be present in a separate class.

class varibles

--------

We can assign values to varaibles in 3 ways...

1) By using reference varaible

2) By using method

3) By using constructor

Constructor

--------------

1) Constructor a special type of method.

2) Constructor used for initilizing the class varaibles

3) Constructor Name should be same as class name

4) constructor will not return any value(not even void)

5) constructor will be invoked at the time of object creation.

Method --> Block of code

-----

1)Case1- not taking parameters and also not returned any value

2)Case2 - not taking parameters but returning value

3)Case3 - taking parameters, but not returning any value

4) Case4 - method is taking parameters and also returning a value.

2 Types Constructor

----------------

1) Defualt constructor

2) Parameterized constructor

Day-6

------

Overloading

this keyword

Static variables & static methods

-----------------------

Overloading: crating methods/constructors with the same name with different parameters.

Advantage:

-----

saves memory

saves time

1) Number of parameters

2) data type of parameters

constructor overloading

this keyword

static --> applicable for varaibles and methods.

static varibles

static methods

-------------------------

1) static methods can access only static stuff(directly- without creating an object).

2) static methods can also access non static stuff but through object.

3) Non static methods can access both static & non static stuff directly.

System.out.println()

-------------------------

class Test

{

static String s="welcome";

}

Test.s.length(); --> 7

class System

{

static PrintStream out;

}

System.out.println("testing")

System.out.print("testing")

------------------------------------------------------------------------------------

Day-7

---------

Java Inheritance

Method Overriding

super Keyword

final Keyword

---------------

Inheritance : Aquiring all the properties & behavior from one class to another class is called as inheritance.

Parent/base class/super class

Child class/sub class/derived class

5 TYPES OF INHERITANCE

--------------------

1) Single

2) Multilevel

3) Hierarchical

4) Multiple

5) Hybrid

Method Overriding

--------------------

Rewrite the methods in child classes.

1) method definition should be same

2) body should be changed

super Keyword

----------------

1) super can be used to refer immediate parent class instance variable.

2) super can be used to invoke immediate parent class method.

3) super() can be used to invoke immediate parent class constructor.

final

--------------

variable --> you cannot change the value of the varaible.

method --> method cannot be override in the child classes.

class ---> class cannot be extend into another

Day-8

------

Java Interfaces

Java Packages

Access Modifier’s

-------------------------

Interface

-------------------

An interface in java is a blueprint of a class.

Interface contains final and static variables.

Interface contains abstract methods.

An abstract method is a method contains definition but not body.

Methods in interface are public by default.

Interface supports the functionality of multiple inheritance.

We can define interface with interface keyword.

A class extends another class, an interface extends another interface but a class implements an interface.

We can create Object reference for Interface but we cannot instantiate interface.

package is collection of classes/interfaces/other files.

import

create sub package

2 types of packages

-----

1) user defined packages

2) built-in packages

Access Modifier’s : Define the scope of varaibles and methods

------------------

1) public

2) protected

3) default

4) private

private: The private access modifier is accessible only within class.

default:

If you don't use any modifier, it is treated as default by default. The default modifier is accessible only within package.

protected:

The protected access modifier is accessible within package and outside the package but through inheritance only.

public:

------------

we can access everywhere

Day-9

------------

Exception Handling

----------------

Exception is an abnormal condition.

In java, exception is an event that disrupts the normal flow of the program.

Types of Exceptions

-------------------

1) Checked -> Exceptions checked/identified by the compiler.

Examples:

InterruptedException

IOException

FileNotFoundException etc.

2) Un-checked -> Exceptions whihc are not checked/identified by compiler

Examples:

ArithmeticException

NullPointerException

NumberFormatException

ArrayIndexOutOfBoundsException

String a="abc";

int x=Integer.parseInt(a);

Handling Exceptions

---------------

Syntax1:

--------

try

{

statements;

}

catch(AithmeticException Type)

{

statements;

}

Syntax2

---------

try

{

statements;

}

catch(Exception1)

{

statements;

}

catch(Exception 2)

{

}

---

Syntax3

--------------

try

{

to open a file

}

catch(Exception Type)

{

---

}

finally

{

close

}

one try block can have multiple catch blocks

finally block is always executes....

1) Exception doesn't occur.

2) Exception occurs and not handled.

3) Exception occurs and handled.

Checked Exceptions can be handled in 2 ways

-----------

1) try..catch

2) throws keyword

Day-10

---------

ArrayList

HashMap

JDBC

--------------

Derived Data Types(Collections)

ArrayList

----------

int a[]=new int a[5];

Opearations on ArrayList

--------------------

How to declare array list

how to to add elements/values to array list

Find size of array list

remove elements/values from array list

insert a new element in the middle of array list

read values from arraylist

int a[]=new int[5]

Object a[]=new Object[5];

HashMap

----------

declare HASHMAP

add elements to hashmap

remove elements from hashmap

read pairs from hashmap

JDBC -- Java Database Connectivity

Pre-requisite

--------------

1) Download database driver( .jar file)

2) Add driver jar to your project

Steps to write JDBC program

------------------------

1) Create a connection

2) Create a query/statement

3) Execute statement/query

4) close connection

Day-11

---------

Selenium

---------

Selenium IDE

WebDriver

Grid

Selenium WebDriver

-----------------

1) WebDriver is an Java Interface.

ChromeDriver FirefoxDriver InternetExplorerDriver etc..

2) WebDriver is an API(Application Programming Interface)

3) WebDriver is one of the component of Selenium suite.

4) WebDriver supports multiple languages(Java, C#, Python, ruby etc..)

5) WebDriver automates only web based application(It needs browser)

6) Support multiple browsers(Chrome, Firefox, IE , etc...)

7) Support multiple OS(Windows, MAC, Liunx...)

8) Its open source(free)

9) Selenium can integrate third party tools

AutoIT,Sikuli,Apache poi,TestNG,Extent reports etc...

Limitations

----------

1) Cannot automate desktop applications

2) Cannot automate images/graphs

-> Desktop

-> Web based

-> Mobile

Pre-Requisites

-------------

Java

Eclipse

Configure WebDriver with Eclipse

----------------------------------

1) Download webdriver jars

https://bit.ly/2zm3ZzF

2) Create a new Java project in Eclipse

3) Associate selenium webdriver jars to your java project in Eclipse

Right on Project-->properties-->java build path--> Libraries-->Add External Jars

-->Browse all the jars then click on add.-->Apply-->OK.

=============================================================================

Dowload drivers for browsers

--------------------------------

Firefox : https://github.com/mozilla/geckodriver/releases/download/v0.23.0/geckodriver-v0.23.0-win64.zip

Chrome : https://chromedriver.storage.googleapis.com/2.44/chromedriver\_win32.zip

IE :https://goo.gl/9Cqa4q

=================================================================================

Test Case

-------------

1) Open Web Browser(Chrome/IE/firefox).

2) Open URL https://opensource-demo.orangehrmlive.com/

3) Enter username (Admin).

4) Enter password (admin123).

5) Click on Login.

6) Capture title of the home page.

7) Verify title of the page: OrangeHRM

8) Close browser

Username inputbox

<input name="txtUsername" id="txtUsername" type="text">

Assingment

-------------

1) Open Web Browser(Chrome/IE/firefox).

2) Open URL <http://newtours.demoaut.com/>

Try this

http://demo.guru99.com/test/newtours/register.php

3) Enter username (mercury).

4) Enter password (mercury).

5) Click on Sign-in.

6) Capture title of the page.

7) Verify title of the page: "Find a Flight: Mercury Tours:"

8) Close browser

------------------------------------------------------------------------------------------------------

Day-12

--------

Locators

----------

<input type="text" name="userName" size="10">

tagname

attributes

values

CSS Selector

------------

tag id --> tag#id

tag class --> tag.class

tag attribute ---> tag[attribute=value]

tag class attribute ---> tag.class[attribute=value]

XPath

--------

what is xpath?

how to capture xpath

types of xpath

Diff between absolute xpath & partial xpath

Which xpath is prefer to use in script ? why?

how to write xpath

Xpath functions

How to handle elements those attributes are dynmamically changing - By using xpath functions

following & preceding with xpaths.

what is xpath?

------

XPath is an address of an element.

Ex:

Absolute XPath(Full XPath)

/html/body/div/table/tbody/tr/td[2]/table/tbody/tr[4]/td/table/tbody/tr/td[2]/table/tbody/tr[2]/td[3]/form/table/tbody/tr[4]/td/table/tbody/tr[2]/td[2]/input

Relative XPath(Partial XPath)

//\*[@id="email"]

Firebug & Firepath --> Out dated

ChroPath --> plug in available for Chrome & Firefox browser

We can capture both absolute & relative xpaths

Verify Xpath is right or wrong.

ChroPath links:

------

Chrome: https://chrome.google.com/webstore/detail/chropath/ljngjbnaijcbncmcnjfhigebomdlkcjo?hl=en

Firfox: https://addons.mozilla.org/en-US/firefox/addon/chropath-for-firefox/

/html/body/form/input[3]

Diff between absolute xpath & partial xpath

-----------

1) Absolute xpath starts with ---> /

Relative xpath starts with ---> //

2) Absolute xpath --> we dont use any attribute

Relative xpath --> We use attribute/s

Absolute XPath(Full XPath)

/html/body/div/table/tbody/tr/td[2]/table/tbody/tr[4]/td/table/tbody/tr/td[2]/table/tbody/tr[2]/td[3]/form/table/tbody/tr[4]/td/table/tbody/tr[2]/td[2]/input

Relative XPath(Partial XPath)

//\*[@id="email"]/input/td[1]/......

Xpath functions

-----------

1) text()

2) contains()

3) starts-with()

preceding

---------

//input[@id='u\_0\_v']//preceding::input[4]

driver.findElement(By.xpath("//\*[@id="email"]")).sendkeys()

=======================================================================================

Day-13

--------

URL: https://goo.gl/RVdKM9

get commands

------------------

get() --> opens the URL on the browsers

getTitle() --> returns the page tile

getCurrentURL() -->returns the URL of the page

getPageSource() --> returns HTML code for page

Dropdown/combobox/list box

--------------------------

1) Find how many options present in drop down

dropdown.getOptions().size()

2) Extract all the options and print them

dropdown.getOptions()

3) Select option from the dropdown

dropdown.selectByvisibleText(option)

dropdown.selectByIndex(index)

dropdown.selectByValue(value)

Radio buttons/Checkboxs

----------------

1) Check the status

2) Select option - click()

Conditional Commands (Retirns a boolean value- true/false)

----------------

isDisplayed()

isEnabled()

isSelected() // for radio buttons and check boxes

Navigational commands

-------------------

navigate().to(URL) --> same as driver.get()

navigate.back()

navigate.forward()

navigate.refresh()

browser commands

--------

close() --> close currently open browser(one browser)

quit() --> closes multiple browsers

WebElements coverd

----------

text boxes/input boxes

Drop down

Radio buttons

Check boxes

Links

Commmands

---------

get commands

conditional commands

navigational commands

browser commands

Wait commands

Assingment

-----------------

https://testautomationpractice.blogspot.com/

driver.switchTo().frame(0);

=======================================================================================

Day-14

-------

wait commands

Links

Alerts/popus

Frames/iframes

Synchronization

waits

-----

Thread.sleep(milli seconds)

implicitWait

driver.manage().timeouts().implicitlyWait(5,TimeUnit.SECONDS);

explicitwait

WebDriverWait mywait=new WebDriverWait(driver,10000);

mywait.until(ExpectedConditions.visibilityOfElementLocated(By.name("userName")));

1) Find out total links present in a web page:

total links : 16

case1: locator matches multiple elements, findElement() ----> this can be located single element

case2: locator mathces multiple elements, findElements() --> this can be located multiple elements

case3: locator matches single elemetn, findElements() ---> this can be located singel element

Difference between findElement() & findElements()

Alerts/popus (switch between alerts)

---------------------

https://testautomationpractice.blogspot.com/

https://mail.rediff.com/cgi-bin/login.cgi

driver.switchTo().alert().accept();//closes popup by using OK button

driver.switchTo().alert().dismiss();//closes popup by using Cancel button

Frames/iFrames(switch between frames)

------------------------------------

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

driver.switchTo().frame(name)

driver.switchTo().frame(index)

driver.switchTo().frame(WebElement)

driver.switchTo().defaultContent();

packageListFrame

packageFrame

classFrame

driver.switchTo().frame(0);

Assingment

-----------

switch to frames

http://demo.automationtesting.in/Frames.html

===========================================================================

Day-15

--------

Nested Iframe

Handle browser windows

Date Picker

-----------

driver.switchTo().frame(name)

driver.switchTo().frame(WebELement)

driver.switchTo().frame(0)

Handle browser windows(switch between browser windows)

-----

handle --> an ID for a browser window

driver.getwindowsHandle()

driver.getwindowsHandles()

Date Picker

-----------

https://goo.gl/RVdKM9

Assingment

------------

https://testautomationpractice.blogspot.com/

New Windows

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Day-16

--------

Web Table/HTML Table

-------------

driver.findElement(By.xpath("/html/body/table/tbody/tr")); //only 1 st

driver.findElements(By.xpath("/html/body/table/tbody/tr"));

/html/body/table/tbody/tr[3]/td[2] --> 0002

driver.findElements(By.xpath("//\*[@id="resultTable"]/tbody/tr")).size()

//\*[@id="resultTable"]/tbody/tr[3]/td[5]

http://www.seleniumeasy.com/test/table-pagination-demo.html

Assignment

-----------

1) OrangeHRM

Read all the rows and columns from the table

https://opensource-demo.orangehrmlive.com/

//to be completed

2) https://money.rediff.com/gainers/bsc/daily/groupa

//to be completed

3) Read the data from HTML Table

https://testautomationpractice.blogspot.com/

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Day-17

--------

Mouse Actions

-------

Mouse Hover

Right Click

Double Click

Drag and drop

MouseHover

-----

act.moveToElement(webelement)

Right click

-------

act.contextClick(webelement)

Double click

-----------------

act.doubleClick(Webelement)

Drag and drop

---------------

act.dragAndDrop(source\_element, target\_element)

Resizing/Slider

-----------

act.moveToElement(element).dragAndDropBy(element,400, 0)

Keyboard Actions

---------------------

act.sendKeys(Keys.CONTROL+"a")

Scrolling page

-----------------

3 appraoches...

approach1

----

js.executeScript("window.scrollBy(0,2000)","");

approach2

----

WebElement flag=driver.findElement(By.xpath("//\*[@id=\"content\"]/div[2]/div[2]/table[1]/tbody/tr[86]/td[1]/img"));

js.executeScript("arguments[0].scrollIntoView();",flag);

approach3

------

js.executeScript("window.scrollBy(0,document.body.scrollHeight)");

tooltip

--------------

Assingments

-------------

//to be completed

https://testautomationpractice.blogspot.com/

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Day-18

-------

1) How to upload files

2) How to download files

--------------------------

1) AutoIT

2) Sikuli

How to upload files using WebDriver+Sikuli

------------------------

1) Download Sikuli jar file

https://launchpad.net/sikuli/sikulix/1.1.2/+download/sikulixsetup-1.1.2.jar

2) Add jar file to project build path

Right Click on the project -> Build Path -> Configure Build Path

3) write code for upload file scenario in webdriver.

How to download files

--------------------

Mime types for firefox browser

--------------

https://www.sitepoint.com/mime-types-complete-list/

Assignments

------------

1) Upload File

//to be completed

http://opensource.demo.orangehrmlive.com/

Login(Admin/admin)-->PIM-->Add Employee-->Upload photograph

2) File upload

http://demo.automationtesting.in/FileUpload.html

3) Download all the files from below link( Use chrome & Firefox)

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

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Day-19

-------

Data Driven testing using Excel

-------------------------------

Download Apache poi for Microsoft Excel

---------------

http://www-us.apache.org/dist/poi/release/bin/poi-bin-3.17-20170915.zip

Excel File-->Workbook-->Sheet-->Row-->Cell

FileInputStream

FileOutputStream

1) How to read data from excel file.

2) How to write data into excel

-------------

1) count rows

2) count cells

3) read data from cels

4) write data into cells

XLUtils.java

-----

countingrows()

countingcells()

readcellvalue()

writecellvalue()

https://www.moneycontrol.com/fixed-income/calculator/state-bank-of-india-sbi/fixed-deposit-calculator-SBI-BSB001.html

Assignment

<http://newtours.demoaut.com/mercuryregister.php>

try this

[Welcome: Mercury Tours (guru99.com)](https://demo.guru99.com/test/newtours/)

http://demo.guru99.com/test/newtours/register.php

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Day-20

--------

Data Driven testing(Cont..)

----------------

getAttributeValue('value')

HashMap

-------

key, value

x mercury@mercury

y mercury1@mercury1

z mercury2@mercury2

split()

Database testing with WebDriver

------------

JDBC ---> Java Database connectivity

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

DAY-21

--------

TestNG

--------

TestNG--> New Generation

Open source and Java based Unit testing tool

built-in framework

Similar to Junit.

Advantages

---------

1) HTML reports(Default reports)

2) Manage test suites and test cases

3) Parallel execution

4) uses annotations for executing methods in test cases

5) supports parameterization

6) Test does'nt have main method

TestSuite--->Test cases---> Steps

Package---->Classes---> mehtods

Install TestNG

(Goto Help menu ->eclipse market place->Search TestNG and install it)

Create a new project

Right click project-> properties -> java build path ->class path -> add libraries -> finish

First test case

-----

1. Open URL

2. Login

3.Logout

@Test(priority=1)

3 kinds of output

-----------

1) console

2) Tree mode

3) HTML report

Annotations in TestNG

-------------------------

@Test

@BeforeMethod, @AfterMethod

@BeforeClass, @AfterClass

@BeforeTest, @AfterTest

TC1 (@BeforeMethod, @AfterMethod)

------------

1) Login ---> @BeforeMethod

2) Search --->@Test

3) Logout --> @AfterMethod

4) Login

5) Advanced Search --->@Test

6) Logout

7) Login

8) Recharge --->@Test

9) Logout

TC2 (@BeforeClass, @AfterClass)

-------

1) Login ---> @BeforeClass

2) Search ---> @Test

3) AdvSearch ---> @Test

4) Recharge ---> @Test

5) Logout--> @AfterClass

TC1, TC2 --->@BeforeTest, @AfterTest

HTML report for your test cases

------------------

You need to run u r test cases using xml file

2 ways of creating xml files

----------

1) Manually

2) Automatically Generate

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Day-22

---------

Asert commands in TestNG(Assertions)

-------------------------------------

Assert.assertTrue(true or false);

Assert.assertEquals(String1, String 2) ---> true/false

Assert.fail()

Dependency methods

--------------------------

@Test(priority=1, dependsOnMethods={"method1","method2"...}

Disable test methods in testNG

---------------

@Test(priority=1,enabled=false)

Parameterization

-------------------

Passing parameters/data to the test methods

1) Through xml --> can be used for cross browser and parallel testing

2) Through method --> @DataProvider

XML structure

--------------

<suite name="testsute"

<test name="test">

<classes>

<class name="package.testcasename" />

</classes>

</test>

</suite>

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Day-23

--------

TestNG Listeners

Extent reports

-----------------

TestNG Listeners : We can define post actions after execution of test cases based on status(pass, fail, skipped).

TestListenerAdapter : This pre defined class present in TestNG

onTestStart()

onTestSuccess()

onTestFailure()

onTestTestSkipped()

How to implement ExtentReports

------------------

Third Party reports

Setup

-----

1) we need to download extent reports jars along with extent-config.xml

https://drive.google.com/open?id=1EXYQHO-QFUgUo10KnxPAjBYe1i3M6y9b

2) add all the jars to your project build path and copy the extent-config.xml file in to project home directory.

3) Create test case/s

4) Implement listener class ( Written teh code for generating extent report)

5) Integrate them in to testng xml file

6) Execute test xml file which will generate extent report

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Day-24

---------

Log4j

Page Object Model

How to implement Logging to your automation (Log4J)

---------------------------------------------------

Step1: Downlaod log4j.Jar file and add to project build path

http://www-us.apache.org/dist/logging/log4j/1.2.17/log4j-1.2.17.zip

Step2: Copy log4j.properties file in project home directory

Step3: Add logging messages into your test case

Logger logger=Logger.getLogger("Log4jdemo"); // Provide test ase name/class name as a parameter

PropertyConfigurator.configure("Log4j.properties");

logger.info(message);

Page Object Model ( Mange Page objects)

-------------------------

1) Re-usability

2) Reduce our stuff.

test case includes

--------

--> Test Method : Ex: Login()

--> Object Identification method Ex : driver.findElemnt()

--> Action method Ex: sendKeys(), click()...

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Day-25

Selenium Grid

-------------

Grid is a component of Selenium used for executing test cases remotly.

Hub(Master) ---> One hub

Node(Slave) ---> Many number of nodes

Pre-requisites

----------

1) We Should have drivers & browsers on Local & remote systems.

2) Make local system as HUB server , then register all the VM's(nodes) with Hub

Download Selenium Standalone Server jar

https://goo.gl/4g538W

\* we sholud have same jar on all the Nodes

Convert your local system as hubserver

----------

java -jar selenium-server-standalone-3.9.1.jar -role hub

Nodes should register to http://192.168.13.1:4444/grid/register/

Clients should connect to http://192.168.13.1:4444/wd/hub

Check Hub is running or not (check this in the browser)

----

http://localhost:4444/grid/console

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

By default Maven is present with eclipse

To verify go to Menu File ->new -> other (check MVEN FOLDER IS PRESENT)

If not present

Go to Menu Help -> eclipse market place -> search for Maven and get install

To create new project

Go to file New-> Other -> Maven -> Maven project

Add dependencing in pom.xml

MVNrepositories search for (Core java, apache commons io, apache log4j, apache lang 3, testing,

Create pageObject package

testcase package

utilities package

Create Driver folder (Select project ->right click ->create folder)

Next copy the all the browser .exe file to the drivers folder

Copy log4j.properties file to the the project dir

Create a new folder “configuration” under the project

Create a file config.properties under configuration. And now add the variable that you need to access ex username, pwd, driver path

Under the projutilities folder create a class ReadConfig to read the property file

If u have 6 variable in properties file. U need to create 6 methods in ReadConfig class

Now from Base class call the readConfig and initialize all the variables.

In tha base class make changes for browser selection by passing browser parameter

Using the @Parameter annotation

Create TestNG.xml file (right click project -> new-> other -> xml)

Add the necessary tags

Add parameter tag

Add <test> tags 3 time to run for 3 different browser

Next

Jars – add extent report dependency in pom.xml

extent-config.xml –copy this file to your project directory

listener(Reporting.java) – write necessary code to the listner classs( OnTestSuccess, OnTestFailure, OnFinish)

Integrate class to the test

Add <Listener> tag to the testNG.xml file

In pom.xml add apache maven plugin and apache surefire plugin

(now you can execute the project thro pom.xml in eclipse. ) but when you come out of eclipse you cannot execute it from cmd prompt. So we need to make following settings

**To execute the test case through command prompt**

Dowmload and Copy apache-maven folder from google and place it in c:

Add maven to the path

Right click This PC -> Advanced system settings -> environment variables -> select path variable -> add the C:\apache-maven-3.8.4\bin

(And add %MAVEN\_HOME% entry) -this may not be required please check and verify

Next create Maven\_Home system variable and add the path C:\apache-maven-3.8.4\

Verify if maven is configured

Goto command prompt

>mvn -version

If the path is set it shows the details.

If you get error

No compiler is provided in this environment. Perhaps you are running on a JRE rather than jdk

For this you need to copy jdk path

For this go to your jdk path

C:\Program Files\Java\jdk-17.0.2 (copy this path)

Right click This PC -> properties-> advanced setting ->environment variables -> New -> create a new variable variable name =“JAVA\_HOME”

Variable value = “C:\Program Files\Java\jdk-17.0.2”

Lets test this

Go to project right click -> properties-> get the project path

Now go th file browser to the project path

Invoke command prompdt from the path ->cmd

Dir = to see all the files

(if you are in other dir, then navigate to your project dir)

Now execute the following to rum your test cases

* mvn clean install

if its successful you get “BUILD SUCCESS”

**To run the test case using batch file (run.bat)**

Navigate to your project

Create a text file and name it run.bat (you can choose any other name. in unix name it as .sh)

Now edit the run.bat file add the following lines

cd C:\Users\TISHAN1KA\eclipse-workspace\nopCommerceV2

mvn clean install

Save as run.bat and close the file. ( make sure its type is Windows batch file)

Double click to execute the test cases

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Saturday 12 February 2022

Extent report not getting generated

-------------------------------------------------------------------

Day-26

---------

Framework

-----------------

Framework is used for organiziong project related files in properr order.

-> Re-usuability

-> Maintainability

Types of frameworks

-------------------

1) Pre-defined frameworks

Junit, TestNG,Nunit etc...

2) User defined frameworks/customized frameworks

Data Driven framework

Keyword Driven

Hybrid frameworks

----------------

Selenium webdriver

TestNG

Maven

pache poi

Sikuli

Log4j

extents reports

etc....

3 Phases

-----------

1) Implementation

2) Execution

3) Maintanace

Implementation

---------------

Maven: Build tool

1-> pom.xml ( dependencies)

You will get all the dependencies from...

https://mvnrepository.com

Application URL:http://admin-demo.nopcommerce.com/

Admin email: admin@yourstore.com

Admin password: admin

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Day-27

---------

Kick start Atomation framework.

---------

Creating Maven project

Updating pom.xml with required dependencies

Creating folder structure

Create basic test case(Login)

Add logs to tet case

Read Common values from Properties file

Execute Test case on desired browsers

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Day-28

---------

Extent reports

--------

jars

extent-config.xml

listener(Reporting.java)

Test Case---> Excel file

Test Case

----

@DataProvider

Data Driven testing

---------------------

Apache poi

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Day-29

----------

1) Implementation

2) Execution

3) Maintanance

Executing test cases:

-----------------------

1) Run test cases using pom.xml within eclipse

2) Run test cases using command prompt(without using eclipse)

3) Run test cases using run.bat

4) Run test cases using Jenkins

1) Run test cases using pom.xml within eclipse

------------------------------------------

dependencies --> Downlaod jars

plugins --> used to run your Maven project

maven-compiler-plugin

maven-surefire-plugin

2) Run test cases using command prompt(without using eclipse)

Install Maven on windows:

Downlaod link: http://mirrors.wuchna.com/apachemirror/maven/maven-3/3.6.0/binaries/apache-maven-3.6.0-bin.zip

You will get zip file

Maven Home: C:\apache-maven-3.5.4\bin

Add entry in path varaible: C:\apache-maven-3.5.4\bin

Create new varaibles under System varaibles section...

MAVEN\_HOME =C:\apache-maven-3.5.4\

cd C:\Users\admin\myworkspace\nopCommerceV2

mvn clean install

3) Run test cases using run.bat

------------------------------

Create run.bat file contain following commands

--------

cd C:\Users\admin\myworkspace\nopCommerceV2

mvn clean install

4) Run test cases using Jenkins

--------------

Downlaod jenkins from URL: https://jenkins.io/download/

1) Execute project using free style project(run.bat)

2) Execute project using Maven(pom.xml)

cd C:\Users\admin\myworkspace\nopCommerceV2

run.bat

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Day-29

----------

1) Implementation

2) Execution

3) Maintanance

Executing test cases:

-----------------------

1) Run test cases using pom.xml within eclipse

2) Run test cases using command prompt(without using eclipse)

3) Run test cases using run.bat

4) Run test cases using Jenkins

1) Run test cases using pom.xml within eclipse

------------------------------------------

dependencies --> Downlaod jars

plugins --> used to run your Maven project

maven-compiler-plugin

maven-surefire-plugin

2) Run test cases using command prompt(without using eclipse)

Install Maven on windows:

Downlaod link: http://mirrors.wuchna.com/apachemirror/maven/maven-3/3.6.0/binaries/apache-maven-3.6.0-bin.zip

You will get zip file

Maven Home: C:\apache-maven-3.5.4\bin

Add entry in path varaible: C:\apache-maven-3.5.4\bin

Create new varaibles under System varaibles section...

MAVEN\_HOME =C:\apache-maven-3.5.4\

cd C:\Users\admin\myworkspace\nopCommerceV2

mvn clean install

3) Run test cases using run.bat

------------------------------

Create run.bat file contain following commands

--------

cd C:\Users\admin\myworkspace\nopCommerceV2

mvn clean install

4) Run test cases using Jenkins

--------------

Downlaod jenkins from URL: https://jenkins.io/download/

1) Execute project using free style project(run.bat)

2) Execute project using Maven(pom.xml)

cd C:\Users\admin\myworkspace\nopCommerceV2

run.bat

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Day-30

git - local repository

github - remote repository

pre-requsites

step 1 create new account in github

step 2: create a new repository in github

https://github.com/Santi2020/nopCommerceV2.git

get/copy the URL of repository here

step 3 : in local system install git software

Git issue tracker

file:///C:/Program%20Files/Git/ReleaseNotes.html

Git commands

1st time you need to execute many extra commands

1. git init : creates an empty git repository (local repository) (one time command/ needs to be executed 1st time only for each project)

2. git remote add origin "https://github.com/Santi2020/nopCommerceV2.git" (one time command/ needs to be executed 1st time only for each proj)

3. git status

4. git add -A (adds files to the staging area i,e local git)

Following two command a executed before doining the commit for the 1st time

-----------------------------------------

5. git config --global user.name "santoshi" (one time for eacj project)

6. git config --global user.email "tambe.santoshi@gmail.com" (one time for eacj project)

-----------------------------------------

7. git commit -m "This is my 1st commit"

8. git push -u origin master (to push files from git to github .asks for usrname and pwd OR a popup window will appear provide the code and click on credential manager)

(next i created a testing123.txt file in repository and executed the foll cmd. )

9. git pull origin master (pull the files from github repository to git)

(the newly created file is pulled into the workspace. Verify in thr folder and eclipse)

in eclipse createed new file testingabc.txt

2nd round onwards

-------------------------------

git status

git add -A (adds files to the staging area i,e local git)

git commit -m "This is 2nd commit"

git push -u origin master

------------------------------------------------------------------------------------------------------------------------

Next login to Jenkins

http://localhost:8080

provide username and password

Session details

30. continous integration

timestamp 44.30

------------------------------------

In jenkins

click new item -> maven project(since no path hard coding)

Give meaning project name

clicl ok

Source code management

-> Git -> provide github repo URL

Build

->Root POM = pom.xml

->Goals and options = clean install

Apply and save

In the project dashboard

Select the project

Click build now

click on the blinking ball to go to console

------------------------------------------------------------------------------------------------------------------------

output

TISHAN1KA@DESKTOP-1QBSVOI MINGW64 ~/eclipse-workspace/nopCommerceV2 (master)

$ git init

Initialized empty Git repository in C:/Users/TISHAN1KA/eclipse-workspace/nopCommerceV2/.git/

TISHAN1KA@DESKTOP-1QBSVOI MINGW64 ~/eclipse-workspace (master)

$ git remote add origin "https://github.com/Santi2020/nopCommerceV2.git"

$ git status

On branch master

No commits yet

Untracked files:

(use "git add <file>..." to include in what will be committed)

.classpath

.project

.settings/

Drivers/

Screenshots/

TestNG.xml

configuration/

extent-config.xml

log/

log4j.properties

pom.xml

run.\_my.bat

src/

target/

test-output/

nothing added to commit but untracked files present (use "git add" to track)

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

$ git add -A

warning: LF will be replaced by CRLF in TestNG.xml.

The file will have its original line endings in your working directory

warning: LF will be replaced by CRLF in target/maven-status/maven-compiler-plugin/testCompile/default-testCompile/createdFiles.lst.

The file will have its original line endings in your working directory

warning: LF will be replaced by CRLF in target/maven-status/maven-compiler-plugin/testCompile/default-testCompile/inputFiles.lst.

The file will have its original line endings in your working directory

warning: LF will be replaced by CRLF in target/surefire-reports/index.html.

The file will have its original line endings in your working directory

warning: LF will be replaced by CRLF in target/surefire-reports/jquery.min.js.

The file will have its original line endings in your working directory

warning: LF will be replaced by CRLF in target/surefire-reports/junitreports/TEST-com.nopcommerce.testCases.TC\_AddCustomerTest\_003.xml.

The file will have its original line endings in your working directory

warning: LF will be replaced by CRLF in target/surefire-reports/nopCommerceSuite/Test1.html.

The file will have its original line endings in your working directory

warning: LF will be replaced by CRLF in target/surefire-reports/nopCommerceSuite/Test1.xml.

The file will have its original line endings in your working directory

warning: LF will be replaced by CRLF in target/surefire-reports/old/index.html.

The file will have its original line endings in your working directory

warning: LF will be replaced by CRLF in target/surefire-reports/old/nopCommerceSuite/classes.html.

----------------------------------------------------------------------------------

TISHAN1KA@DESKTOP-1QBSVOI MINGW64 ~/eclipse-workspace/nopCommerceV2 (master)

$ git config --global user.name "santoshi"

----------------------------------------------------------------------------------

TISHAN1KA@DESKTOP-1QBSVOI MINGW64 ~/eclipse-workspace/nopCommerceV2 (master)

$ git config --global user.email "tambe.santoshi@gmail.com"

----------------------------------------------------------------------------------

git commit -m "This is my 1st commit"

----------------------------------------------------------------------------------

TISHAN1KA@DESKTOP-1QBSVOI MINGW64 ~/eclipse-workspace/nopCommerceV2 (master)

$ git push -u origin master

Enumerating objects: 160, done.

Counting objects: 100% (160/160), done.

Delta compression using up to 4 threads

Compressing objects: 100% (142/142), done.

Writing objects: 100% (160/160), 15.41 MiB | 1.88 MiB/s, done.

Total 160 (delta 42), reused 0 (delta 0), pack-reused 0

remote: Resolving deltas: 100% (42/42), done.

To https://github.com/Santi2020/nopCommerceV2.git

\* [new branch] master -> master

branch 'master' set up to track 'origin/master'.

----------------------------------------------------------------------------------

After modifying existing file and creating a new file in eclipse

TISHAN1KA@DESKTOP-1QBSVOI MINGW64 ~/eclipse-workspace/nopCommerceV2 (master)

$ git status

On branch master

Your branch is up to date with 'origin/master'.

Changes not staged for commit:

(use "git add <file>..." to update what will be committed)

(use "git restore <file>..." to discard changes in working directory)

modified: testing123.txt

Untracked files:

(use "git add <file>..." to include in what will be committed)

testingabc.txt

no changes added to commit (use "git add" and/or "git commit -a")

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Day 31

Cucumber

Session-1

---------------

Pre-defined frameworks

JUNit (TDD --> Test Driven Framework)

TestNG (TDD --> Test Driven Framework)

Cucumber (BDD -->Behavior Driven Framework)

User defined frameworks

Data Driven Frameowrk

Keyword Driven framework

Hybrid Driven frmaework

Install Cucumber plug-in for Ecipse

------------------------

Eclipse Market Place -->Search for cucmber -->Install

Feature File

-----------

Feature file contains all the features of an application,

Appliation: ebanking

Features:

login --> Steps

add customer -->Steps

Edit customer --> Steps

------

----

My comment

-------------------------------------------start

File ->New-> project ->Maven ->project 🡪 filter = “maven-archetype-quickstart” ->next

Provide groupid, artifactid ->finish

Expand the newly created project

Open pom.xml file

In browser go to maven repository and search for info-cukes

Add the following dependencies

Cucumber-core

Cucumber-java

Cucumber-junit

cucumber-jvm-deps

info.cukes/gherkin

<!-- https://mvnrepository.com/artifact/net.masterthought/cucumber-reporting -->

<!-- https://mvnrepository.com/artifact/org.mockito/mockito-all -->

<!-- https://mvnrepository.com/artifact/net.sourceforge.cobertura/cobertura -->

<!-- https://mvnrepository.com/artifact/org.seleniumhq.selenium/selenium-java -->

<!-- https://mvnrepository.com/artifact/com.google.guava/guava -->

-------------------------------------------end

To specify steps in feature file we need to use special language called Gherkins

Feature

Scenario

Given

When

And

Then

Given

Pre-requisites

When/And

Steps

Then

Expected

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

-----------------------------------------------------------------------------------------------------------

Session 23 : working with selenium grid timestamp = 32:25

Commands executed by me in my local ( to convert local system as hub server)

Java -jar C:\Drivers\selenium-server-standalone-jar-3.141.59\selenium-server-standalone-jar-3.141.59\package\jar -role hub

java -jar C:\Drivers\selenium-server-standalone-jar-3.141.59\selenium-server-standalone-jar-3.141.59\package\jar\selenium-server-standalone-3.141.59.jar -role hub

15:14:34.860 INFO [Hub.start] - Selenium Grid hub is up and running

15:14:34.860 INFO [Hub.start] - Nodes should register to http://10.0.0.125:4444/grid/register/

15:14:34.860 INFO [Hub.start] - Clients should connect to http://10.0.0.125:4444/wd/hub

To register the node to the hub

C:\Drivers\selenium-server-standalone-jar-3.141.59\selenium-server-standalone-jar-3.141.59\package\jar>java -Dwebdriver.chrome.driver="C:\Drivers\chromedriver\_win32\chromedriver.exe" -jar selenium-server-standalone-3.141.59.jar -role node -hub http://10.0.0.125:4444/grid/register/

------------------------------------------------------------------------------------------------------------

Register node with Hub server

------------------

java -Dwebdriver.chrome.driver="C:\Drivers\chromedriver\_win32\chromedriver.exe" -jar selenium-server-standalone-3.9.1.jar -role node -hub http://192.168.13.1:4444/grid/register/

3) Write test case then execute on Remote systems

Scenarios

----------------

1) Windows(Hub)--------->Windows(Chrome) // I'm using same machine as Hub and Node

2) Windows(Hub)---------->Linux(Firefox)

Register Linux node with Hub server

------------------

java -Dwebdriver.gecko.driver="/home/pavan/Drivers/geckodriver" -jar selenium-server-standalone-3.9.1.jar -role node -hub http://192.168.13.1:4444/grid/register/

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

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SAMPLE EXAMPLE

System.setProperty(“webdriver.chrome.driver”,”path\exe”);

WebDriver driver = new chromeDriver();

driver.get(URL);

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

driver.findElement(By.id(“txtUserName”).sendKeys(); ---------text box

driver.findElement(By.name(“Submit”).click() ---------------buttons

Notes:

While capturing the screenshots

Downloaded commons-io jar

Session 23

=============================================================================

Doubts

The following is not working for radio buttons. After executiong the click(). isSelected returns false

WebElement rad\_male =driver.findElement(By.xpath("//\*[@id=\"q26\"]/table/tbody/tr[1]/td/label"));

System.out.println("Radio button Male is Selected " +rad\_male.isSelected());

rad\_male.click();

Thread.sleep(5000);

System.out.println("After clicking Radio button Male is Selected " +rad\_male.isSelected());

Checkboc isSelected() is returning false everytime

Keyboard action select all is not working

Try this(project =nopCommerce class= AddCustomer.java session 28 Timestamp = 1.19)

JavascriptExecutor js = (JavascriptExecutor) lDriver;

js.executeScript("argument[0].click();" , listItem);

Actions act = new Actions(driver);

act.sendKeys(Keys.CONTROL+"a").build().perform();

+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

Unable to create manual xml file

Session : 22

Timestamp 40:12

Right click package -> new -> other -> XML ( xml folder is missing)

+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

Session 23

Ch: TestNG Listners & extent reports 3

How to download extent report jar files

Extent-config.xml

=============================================================

Session 25 :working with selenium grid

Package name = grid

Class = LoginTestOnWindowsUsingChrome

DesiredCapabilities cap = DesiredCapabilities.chrome() ; // not working

===============================================

What is POM

It is not a java file. It is maven configuration file. What is a POM? A Project Object Model or POM is the fundamental unit of work in Maven. It is an XML file that contains information about the project and configuration details used by Maven to build the project.

Maven pom.xml file

POM is an acronym for Project Object Model. The pom.xml file contains information of project and configuration information for the maven to build the project such as dependencies, build directory, source directory, test source directory, plugin, goals etc.

Maven reads the pom.xml file, then executes the goal.

Apache Maven plugin

Maven is - at its heart - a plugin execution framework; all work is done by plugins. Looking for a specific goal to execute? This page lists the core plugins and others. There are the build and the reporting plugins:

Build plugins will be executed during the build and they should be configured in the <build/> element from the POM.

Reporting plugins will be executed during the site generation and they should be configured in the <reporting/> element from the POM. Because the result of a Reporting plugin is part of the generated site, Reporting plugins should be both internationalized and localized. You can read more about the localization of our plugins and how you can help.

Apache Maven surefire plugin

Maven surefire plugin is used to run the project tests. It also allows us to configure which XML suites to execute when we build our project. ... xml and test\_parameters. xml test suite files.

string objects are immutable:

In java, string objects are immutable. Immutable simply means unmodifiable or unchangeable. Once string object is created its data or state can't be changed but a new string object is created.

Questions

Class variables vs instance variables

What is static variable

What is encapsulation

Private variables

Abstraction

String is immutablility (interview quest google it)

(very important topic)

Data structures: Array, Stack, queue, linked list, tree, graph

Stack: Last in first out,

Push()

Pop()

Size()

Top()

Queue : First in first out.

Is empty()

getFront()

dequeue()

Linked list: is quick insertion and quick deletion, but slow search

Tree:

Inorder()

Preorder()

Postorder()

StringBuffer is mutable

StringBuilder

Synchronized

What is a data structure?

Java novice -- Websites