**Core JAVA**

**@. Function and Method**

A method is similar to function. In java, a method should be written inside the class only. We do not have functions in java instead of this we have methods. In C++ they are called ‘member functions’ not methods.

**@. Is String class or data type**

String is a class in java.lang package but in Java, all classes are considered as ‘user-defined data types’ so we can take String as a data type also.

**@. Can we call class as data type** -- Yes, we can call class as ‘user-defined data type’ this is becz user can create a class.

**@. Object Reference** SCB -- System Clip Board

An Object Reference is a variable that points to an object and an object can have any number of references. Object Reference is a unique and Object Reference (myDog) is a way to keep memory add info of an **Object** which is stored in SCB. (@**SCB** is a computer memory and it’s nothing but RAM or ROM)

**@. Object**

An instance of a class is called object and object can have its own state, behaviour and identity. Here state represents data (value-5, 6..) of an object and behaviour represents functionality of an object such as deposit, withdraw. An Object can exist physically (that means physical presence of the object in memory). In java **object** cannot be declared as **static**. To access any non-static method of any class, we need to create an object to that class so that, all non-static methods can able to access. An object can have any number of references Dog dg1 = new Dog(); Dog dg2 = new Dog()…

**@. ==(assignment) and equals() while comparing strings. which one is reliable**

**==** is an operator and **equals()** is a method. Both are used to compare to check the equality of two objects. Whenever we create an object using new operator, it will create a new memory location (address) for that object. Here **==** operator is used to check the address of two objects are the same or not. Finally we can use **==** operators for reference (**address**) comparison and equals() method for **content comparison (**comparing values in the objects**)**.

**@. String constant pool**

String constant pool is a separate block of memory and string objects are held by JVM (Java Virtual Machine). When an object is created to a string class (i.e. String s1 = “Hello”), then it is stored in string constant pool.

**@. Declaration, Initialization & Assignment** -- dia

**Declaration**: Declaration is not to declare value to variable here declares the variable to datatype only. **EX**: int i; // dec

**Initialization**: Initialization is the assignment of value to a variable at the time of declaration. **EX**: i = 42; // initialization

**Assignment**: Throwing away the old value of a variable and replacing it with a new one (**or**) Assignment is simply storing the new value to a variable.

**EX**: int[] arr = { 1, 2, 3 }; // declaration with initialization, allows special shorthand syntax for arrays

arr = { 4, 5, 6 }; // doesn't compile, special initializer syntax invalid here

arr = new int[] { 4, 5, 6 }; // simple assignment, compiles fine

**@. 1. String s = ”Hello” 2. String s = new String (“Hello”)**

In the first statement, assignment operator is used to assign the string literal “Hello” to the string variable “s”. In this case, JVM first of all checks whether the same object is already available in the string constant pool. If it is available, then it creates another reference to it. If it is not available, don’t create any other reference and stores it into the string constant pool. In the second statement, new operator is used to create the string object. in this case, JVM always creates a new object without looking the string constant pool.

**@. String and StringBuffer classes**

|  |  |
| --- | --- |
| **String** | **StringBuffer** |
| String class is immutable (once we create object it can’t change) | StringBuffer class is mutable |
| String is slow and consumes more memory while concatenate too many strings because every time it creates a new instance. | StringBuffer is fast and consumes less memory while concatenate too many strings |
| String class Overrides the equals() method of Object class. So, we can compare the contents of two strings by equals() method. | StringBuffer class doesn't Override the equals() method of Object class. |

**@. Are there any other classes whose objects are immutable?** PDT – Primitive datatypes (wrapper classes)

Yes, ‘wrapper classes’ like PDT (boolean, byte, char, short, int, long, float & double) objects are created as ‘immutable’.

**N:** A wrapper class wraps or encapsulate primitive data types into objects. It provides utility methods for performing operations on primitive data types.

**@. float and double ---- float** can rep. up to 7 digits and **double** can rep. up to 16 digits accurately after decimal point.

**@. StringBuffer and StringBuilder classes**

|  |  |
| --- | --- |
| **StringBuffer** | **StringBuilder** |
| SB is synchronized i.e., thread safe. It means two threads can't call the methods of SB simultaneously | SB is non-synchronized i.e., not thread safe. It means two threads can call the methods of SB simultaneously |
| StringBuffer is less efficient | StringBuilder is more efficient |

**@. Class? Class and Object** ----mdcci

Class keyword is reserved in java. Class is a model (Blue print or template) for creating object whereas object is instance of class. Class describes attributes and behaviour of object. Class is a collection of objects. It is a combination of variables and methods. All Java codes are defined inside the class.

A**Variable** is a name of memory location and it acts as a container which holds (store) the value while java prog is executing. Value can assign to variable. There are 2 types of variables in java those are Local and Global variables.

A **Method** is a program module. It is used to perform some operations. It contains a set of statements and instructions to satisfy the particular requirement. A class can contain unlimited number of methods and each method can call unlimited number of times. Method is used to exhibits functionality of an object. There are 2 types of methods in java those are, **Built-in / Pre-defined methods:** Defined by the language and **User-defined methods:** Defined by the user

**@. Private and Final methods in Java**

**Private:** Private methods are not accessible from outside of the class / from child class and these cannot be Overridden.

**Final:** When a method is marked as a final (final keyword before the method name) in the parent class, then any child class cannot override or modify the final method in java.

**N: Constant Variables** are declared as ‘**final’**, so during execution we can’t change their value once they are fixed.

**N:** Java properties file is used to store project configuration data (like environment variables ex: Browser details, username & pass, etc. in key and value pair format) and then initialize this file into setup methods.

**@. for loop and for each loop (Nested / enhanced for loop)**

* These both are used to executes a single stmt or block of stmts repeatedly until a specified expr evaluates to false.
* If certain amount of iteration is known we can proceed with **for** loop.
* **Foreach** loop repeats a block of statements for each element in an array (nothing but object collection).
* **For** loop is more flexible and it does not necessarily involve an array.
* The performance of normal **for** loop is slightly better because there is no function call to each element involved.

**@. Reflection in Java**

Reflection is an API which is used to examine or modify the behaviour of methods, classes or interfaces at runtime. The required classes for reflection can comes under java.lang.Reflect package. Reflection gives us information about the class to which object belongs and also the methods of that class.

**@. Object-oriented approach? OOP languages and OBP languages**

OOP approach is a programming methodology to design computer programs by using classes, interfaces, methods and variables. OOP languages follow all the features of OOP System (OOPS). C++, Java, python, etc. are examples for OOPS languages and these are secure and reusable. Object based programming languages follow all the features of OOPS except Inheritance and Polymorphism concepts. For ex, JavaScript and VBScript (Visual basic).

**N:** Java is not 100% object oriented because datatypes like primitive datatypes (int, float…..) are not objects.

**@. Pair Class in Java**

Pair class can be used to store the values in the form of <Key, Value> pair format by using parameterized constructor provided by the pair class. It is used in [HashMap and TreeMap](https://www.geeksforgeeks.org/hashmap-treemap-java/).

**Methods provided by the javafx.util.Pair class:**

* **Pair(key, value):**Creates a new pair
* **Boolean equals(object obj):**It is used to compare two pair objects. it compares on the basis of <Key, Value>
* **toString():**This method will return the String representation of the Pair.
* **getKey():** It returns key for the pair.
* **getValue():** It returns value for the pair.
* **int hashCode():** It return the hash code for a particular Integer.

**N:** An **API document** is a html file that contains description about all the features of a software or a product or a technology. API document is helpful for the users to understand how to use the software.

**@. #include and import statement**

#include directive makes the compiler go to C/C++ standard library, #include directive copy the entire code from header file contents they are to be compiled. As a result, the program size increases, thus wasting memory and processor’s time. Import statement makes the JVM go to Java standard library, import will paste the compiled output from the header file contents instead of entire code copied. execute the code here and substitute the result into the program. Here, no code is copied so no waste of memory and processor’s time. So, import is efficient mechanism than #include.

**@. print() and println() method**

Both methods are used to display the results on the console. print() method displays the result and then retains the cursor in the same line to the end of the result. println() displays the result and then throws the cursor to the next line.

**@. If ‘String[] args’ is not written in main() method**

When main() method is written without ’String[] args’ i.e., Public static void main() only - The code will compile by the compiler but JVM cannot run the code because it cannot recognize the main() method from where it should start execution of the Java program. Remember JVM always looks for main() method with string type array as parameter.

**N:** If main method is not containing ‘static’ the code will compiled by the Compiler but JVM won’t execute the java prog.

**@. Unicode system**

Unicode system is an encoding standard that provides a unique number for every character no matter on what the platform or programming language using. Unicode uses 2 bytes to represent a single character. For example, Unicode standard defines are UTF-8, UTF-16 & UTF-32.

**@. Control statements and it’s use**

Which alters the flow of execution of program and provide better control to the programmer on the flow of execution. They are useful to write better and complex programs. Control statements are **for, for-each, while** and **do-while**.

**@. Out of do-while and while – – which loop is efficient**

In do-loop, the statements were executed without testing the condition on the first time. From the second time onwards, the condition will observe. In a while-loop, first the condition will test and then only the statements were executed. Hence, while loop is more efficient than do-while loop. Based upon the usage these loops will use.

**@. JAVA** ----ohpc

Java is object oriented, high-level programming language, platform independent and Java is a collection of objects. Java was originally developed by **James Gosling** at Sun Microsystems (later acquired by Oracle) and released as a core component of Sun Microsystems’ Java platform. Lot of applications, websites and Games that are developed using Java. There are three components are available in java those are:

Java SE (Java Standalone /Desktop Edition) **&&** Java EE (Java Enterprise / Web Edition) **&&** Java ME (Java Micro Edition)

**@. Features in JAVA / Java OOPS concepts** ------ IEPA

Java is Object oriented programming language and it has some features like: Variables and data types, Basic operations, Conditional statements (if-else), Loops (for), Arrays, Functions (methods), Garbage collection, Exception Handling, etc.

**OOPS Concepts:** Under OOPS concepts **I**nheritance, **E**ncapsulation, **P**olymorphism and **A**bstraction

* **High Performance:** **JIT** (Just In Time compiler) is a part of JRE. JIT enables high performance in Java. **JIT** runs after the program has started executing on the fly. It accesses runtime information and makes optimizations of the code for better performance. JIT converts the bytecode into machine code at runtime and then JVM starts the execution.
* **Platform independent:** Bcz of this feature a single program can works on different platforms without any modification.
* **Multithreading:** A flow of execution is called Thread and **the process of executing multiple threads simultaneously is known as Multithreading**. Multithreading is also known as Thread-based Multitasking. JVM creates a thread is called ‘main thread’. The user can create multiple threads **By Extending the thread class** or **By Impg Runnable interface**.

**@. Use of multithreading**

The main purpose of multithreading is to provide simultaneous execution of two or more parts of a program that can run concurrently. Generally, a multithreaded program contains two or more parts each part of a program called ‘thread’

**@. Inheritance? Use of inheritance?**

Create a new class from existing class so that the new classes will acquire all the existing properties from parent class to child class with the help of ‘extends’ keyword is called Inheritance. Real time it is applicable in POM design pattern.

**Adv:**

* For Method Overriding (Runtime polymorphism).
* For Code Reusability.
* No Code Duplication.

**@. Encapsulation / Data hiding**

Encapsulation is a mechanism for the process of binding data and corresponding methods together into a single unit*.* for ex, if we take a class, we write the variables and methods inside the class. That class is binding them together so, class is a good example for encapsulation. Encapsulation is mainly used to hide data members with the help of private keyword. To implement Encapsulation, declare the Global variables as private so that this variable cannot be accessed directly by anyone from outside of the class. By providing public non-static (because, we cannot use ‘this’ keyword inside the static content) getter and setter methods in the class to get the values and to set/modify values of the variable/field. So that other methods can access getter & setter and getter & setter will access the private members. If we don’t define the setter methods in the class then the field will act as read-only and if we don’t define the getter methods in the class then the field will act as write-only.

**Adv:** The main purpose of Encapsulation is to prevents the other classes to access the private fields directly for security point of view or hacking prevention point of view.

**Dis-adv:** It increases the length of the code.

**@. Polymorphism**

**In polymorphism** we can perform a single action in different ways. Polymorphism is derived from 2 Greek words: poly and morphs. The word "poly" means many and "morphs" means forms. So, polymorphism means many forms. We can achieve polymorphism by method Overloading and method Overriding. There are 2 types of polymorphism in Java those are Compile-time / Static polymorphism / Early binding / Compile-time binding. Method Overloading is an example for this. When type of object is determined at compile time is known as compile-time polymorphism (i.e., method invocation is determined by the Compiler). **R**untime / Dynamic polymorphism / Late binding / Runtime binding. Method Ove**rr**iding is an example for this. When type of object is determined at run time is known as dynamic polymorphism (i.e., method invocation is determined by the JVM but not by the Compiler). With the help of parameter Compile-time polymorphism itself it can identify. Depends upon the reference we will get the result in Runtime polymorphism. Runtime polymorphism is a process to call an Overridden method through the parent class reference. Binding is nothing but a calling the methods.

**N:** Parent class reference variable refers to the object of child class is called Up-Casting. **Ex:** PC pr = new CC() (both I & E)

**N:** Parent class reference variable refers to the object of parent class as well as Child class reference variable refers to the object of child class is called Down-Casting. **Ex:** PC pr = new PC() as well as CC pr = new CC() (explicitly).

**@. Why goto statements are not available in Java**

goto statements leads confusion for a programmer. Especially in a large program, if several goto statements are used, the programmer will get confuse while understanding the program flow, from where to where the control is jumping.

**@. On which memory, arrays are created & stored in Java**

Arrays are **created** in dynamic memory by JVM. Everything (it’s nothing but Arrays, Variables, Objects ….) is created in dynamic memory only there is no question of static memory in Java

Arrays are **stored** in Heap space, because array is a class so we have to create object to that class, all the objects are stored in heap space and heap space is a dynamic memory.

**Java IDE’s:** An IDE is nothing but a software application which enables users to more easily write and execute the programs. Many IDEs provide some features like syntax highlighting, error displaying, debugging….…etc which help the users to write code more easily. Eclipse, visual studio and NetBeans are the Java IDEs.

**@. Concrete class and Abstract class**

A **Concrete class** can be instantiated (means we can create object) and it requires to implement all the methods.

An **Abstract class** cannot be instantiated and at least one method has not been implemented.

**@. Abstraction**

Hiding the unnecessary data (internal implementation details) from the user and expose only needed data is of interest of the user. The main idea behind abstraction is to reduce complexity and increase the efficiency of code. To achieve abstraction, we have to use Abstract class or Interface.

A good example for Abstraction is a car. Any car has some parts like engine, radiator, mechanical and electrical equipment etc. these are considered as internal implementation parts (details). The user of the car (driver) should know how to drive the car and does not require any knowledge on these parts. i.e., driver is never bothered about how the engine is designed and the internal parts of the engine. This is why, the car manufacturers hide these parts from the driver in a separate panel.

A **Collection** is nothing but a group of elements (like integer values or objects). Examples for collections ‘java.util’ classes like Array, List, Vector……. All the classes and interfaces collections are coming under ‘java.util’ package.

**Collections are used to perform the following operations:** Searching, Sorting, Manipulation, Insertion, Deletion.

**@. Abstract class**

To create an Abstract class using ‘Abstract’ keyword before the class name. It is used to achieve partial abstraction (i.e., 0-99% abstraction). An abstract class can have both Abstract methods and non-abstract methods. In Abstract class at least one method should be in abstract nature. By using extends keyword in child class we can acquire all properties from Abstract class. In Realtime we use this concept in POM design pattern (Here we define all locators and locator identification methods (LIM) in the page objects class, we can use these LIM over test class but we cannot see their implementation of their methods). Rules for Abstract Class: --------- ksbs cvo

* An abstract class must be declared with an abstract keyword.
* If any class having single abstract method, then that class will become abstract class.
* Abstract class can have both abstract methods and non-abstract methods.
* Methods cannot be declared as a static (because we have to Override abstract methods so Overriding is not possible with static methods) in Abstract class and Interface.
* In Abstract class we can define methods and constructors also.
* In Abstract class we can declare **any** kind of variables like static, non-static and final variables.
* Object cannot be created to both Abstract class and Interface

**Abstract method:** Is only prototype that means the method which has only declaration not implementation is called the “Abstract method”. Declarations are ends with semicolon.

**Variables & Constants:** The main difference between variables and constants is that variables can change their value at any time but constants never change their value. (i.e., the constants value is locked for the duration of the program execution). Pi for instance is a good example to declare a constant.

**@. Interface / Why we use Java Interface / How to declare an Interface**

If one class extends more than one class then it is called Multiple inheritance. Multiple inheritance cannot be achieved in java to overcome this problem Interface concept was introduced. An interface is a template and it is a blueprint of class. An interface is declared by using the interface keyword. It is used to achieve full (100%) abstraction. In Interfaces we can declare only static and final variables and abstract methods. It has only method declarations not the method implementation so it cannot have a method body. While implementing Interface no need to write abstract keyword before the method name because interface keyword is used in interface signature so by default it will consider as all the methods in Interface is Abstract nature. By using implements keyword, we can override the abstract methods to child. In real time we use interface concept at the creation of WebDriver instance. (ref: OOPS\_Abstraction\Interface2)

**N:** If we want to specify any implemented method inside the Interface that method should be ‘static‘ or ‘default’. (reff^)

**Adv:** Mainly Interface is used to achieve multiple inheritance, Full abstraction and Loose coupling.

**Loose coupling** means reducing dependencies of a class that use different class directly.

**Tight coupling** means classes and objects are depending on one another.

**#** Dis-adv. of Tightly coupled code is **it takes huge effort** & **testing time** that is reduced by writing loosely coupled code.

**@. Constructor**

Constructor is a block of code similar to method it has the same name as class name. Constructor is called (invoked) by just creating object to the class. Constructors is used to initialize the state of an object and Initialize the elements in POM design pattern. There are two types of constructors those are default and parameterized constructor. Some other constructor properties are: (Ref: API FW api.utility/XLUtility class).

* Constructor doesn’t return any value but does not accept the void in method signature.
* Constructors are always non-static (Because to call a Constructor we have to create object to class)
* Constructor allow public, private, default, protected access modifiers.
* A constructor can Overload but cannot be Overridden.

**Instantiate/Instantiation:** To call any method of any class we need to creates an instance or object of that Class is called ‘Instantiate’. Instantiation allocates initial memory for the object and returns a reference.

**@. Constructor and Method -----** oirdnf

* Constructor is used to initialize the state of an object whereas method is used to expose functionality of an object.
* Constructor is invoked implicitly whereas m**e**thod is invoked **e**xplicitly (i.e., with the obj ref we can access method).
* Constructor doesn’t return any value where the method may or may not return the value.
* In case constructor is not present, if require a default constructor (hidden constructor) is always available. In case of method, no default method is provided.
* Constructor should be the same name as class name. Method name should not be the same name as class name.
* Constructor cannot be marked as a final whereas method can be marked as a final.

**@. Abstract class and Interface** ------ ed mvm pim CC-concrete class, AC – abstract class

|  |  |
| --- | --- |
| **Abstract Class** | **Interface** |
| Abstract class can extend only one CC or one AC at a time | Interface can extend any number of interfaces at a time |
| Abstract class have a default constructor. | Interface doesn’t have any default constructor. |
| It Contains both Abstract and non-Abstract methods. | It Contains only Abstract methods. |
| Abstract Class contains static, non-static and final variables. | The interface contains only static and final variables. |
| The class which implements the Abstract class should not require to implement all the methods, only non-Abstract methods need to be implemented in the concrete subclass. | The class which implements the interface should not require the implement all the methods. |
| Performance wise it is faster than interface ----- ed mvm pim | Performance wise it is slower than Abstract class because in interface if we try to access any method first will check where exactly that particular method is available inside the interface (because in interface method declaration in one class and method implementation in another class) |
| It cannot be instantiated (means object cannot be created) | It cannot be instantiated (means object cannot be created) |
| Class members are private and protected in Abstract class | Class members are public by default in interface |

**@. Types of variables in java**

**Local var’s** are **d**efined inside the method and scope of the variables can exists inside the method itself. EX: int n=90;

**Global variables (Instance & Class variable (static variable))** are **d**efined inside the class and outside the method and scope of this variables can exists throughout the class. EX: String instanceVar = “abcd”;|| public static int staticVar = 90;

**@. Method Overloading** ---- NSR

Inside a class more than one method having the same name with Different parameters or argument list is called Method Overloading. Best example of method overloading is we will use implicit wait to make the page wait for some specific time interval here we can provide different timestamp like SECONDS, MINUTES.…. Another example in selenium is TestNG Assert class i.e., Assert.assert(Boolean\_cond, String\_msg); or Assert.assert(Boolean\_cond); from both method names are same but different parameters. Following are the conditions for Method Overloading:

* Same method name
* Different parameters or argument type (signature)
* Number of arguments is different
* Sequence of arguments is different
* May have different return types also

**Adv:** If we want to perform different operations using same method name so that it will increase the reliability of prog.

**N:** Method Overloading is not possible by changing the return type of method because method name and parameters are same so there will confuse while passing the parameters.

**@. Method Overriding**

Overriding a parent class method in child class and provide its own implementation to an inherited method without modifying the parent class code is called Method Overriding. We can Override Methods but Data members Overriding is not possible. In selenium we use this concept by creating the WebDriver driver = new ChromeDriver(); (RTP concept) then only we can execute the script on any browser. We have to follow some rules to Override a method:

* We have to use exact method declaration as it is in child class (name point of view, static and non-static pov)
* We can override only non-static methods
* Relationship is important (i.e., extends: kw is used to establish an inheritance relationship between classes)

**Adv:** A class can give its own implementation to an inherited method without modifying the parent class code and used to achieve Runtime polymorphism.

**@. Method Visibility in java /** **AMs: Public, Private, Default and Protected** ---- Reff:[**https://youtu.be/dkUSSdUpmyY?si=A0DzFJW1DDZgnIVG**](https://youtu.be/dkUSSdUpmyY?si=A0DzFJW1DDZgnIVG) **--- 30:02**

Methods and variables are known as **members**. MV is nothing but a accessibility of methods from another classes.

**Public:** Public members are **v**isible in the same package as well as the outside package (i.e., other packages).

**Private:** Private members are **v**isible in the same class only and not for the other classes in the same package as well as classes in the outside packages.

**Default:**Members are declared in a class without any AM’s are called ‘default’. These are visible with in the package (include all classes in package) only.

**Protected**: Protected members are visible with in the package (include all classes in package) and outside the package subclasses (of package) only can access.

**@. Multiple inheritance is not supported through class in java, but how it is possible by an interface**

🡪 If one class extends more than one class (there will be compile-time error) then it is called **MI**. Because of ambiguity Java does not allow MI through classes because to reduce complexity and maintain simplify the language and also JVM gets confuse which method or which variable.

🡪 However, it is supported in case of an interface bcz mtd impl is provided by the impl class so, there is no ambiguity

**@. Array and ArrayList / Array and Collection ------** nL his pm

### Array and Collection are somewhat similar regarding storing the references of objects and manipulating the data but they differ in many ways. The main differences between the Array and Collection are defined as:

|  |  |
| --- | --- |
| **Array** | **ArrayList** |
| Arrays can store homogeneous or similar type objects so these are in static nature ------- nL his pm | Collection can store heterogeneous or different type objects so these are in dynamic nature. |
| Arrays are fixed length data structures so we can’t change their size once they are created i.e., Size should be given at the time of array declaration.  **Ex:** String[] name = new String[2] | ArrayList size is automatically increase if we add elements beyond its capability i.e., Size may not be required. It changes the size dynamically.  **Ex:** ArrayList<String> name = new ArrayList<String>(); |
| Arrays can hold both primitive datatypes as well as objects | ArrayList can hold only objects |
| **for** or **for each** loop will use to iterate an array | Iterator will use to iterate an ArrayList |
| Size of Array can check by using **length** attribute | Size of ArrayList can check by using **size()** attribute |
| To put an object into array we need to specify the index. **@Ex:** name[1] = “book” | No need to specify the index instead of this we simply use **add()** method **@Ex:** name.add(“book”) |
| Array is multi-dimensional (Ref: XLUtility class) | ArrayList is single-dimensional |
| Array allow duplicate values | AL allow duplicate values and these are in insertion order |

**N:** Arrays cannot provide any readymade methods for user requirements as searching, sorting, manipulation, insertion, deletion, etc. but Collection includes readymade methods to use.

**Sorted Array:** Array which contains duplicate elements is called sorted array.

**@. HashSet, HashMap, HashTable and TreeSet** ------- Ref: Java\_Examples/Hashset\_HashMap

|  |  |
| --- | --- |
| **HashSet** | **HashMap** |
| HashSet implements Set interface | HashMap implements Map interface |
| HashSet stores the data in the form of objects | HashMap stores the data in the form of key-value pairs |
| HashSet internally uses HashMap to store its elements | HashMap internally uses an array of entry <K, V> objects |
| HashSet doesn’t allow **duplicate** elements | HM doesn’t allow duplicate keys, but allow duplicate values |
| HashSet allow one **null** element | HM allow one <null key, null value> and multiple null values |

**@. Iterator and Enumeration**

Enumeration is older and it is there from JDK1.0 and Iterator was introduced later. Iterator can be used in ArrayList, HashSet and any other collection classes to traverse the objects from collections. Iterator is more secure and safe as compared to Enumeration because it does not allow other thread to modify the collection of objects while some thread is iterating over it, it throws ‘ConcurrentModificationException’.

**PI:** Java has very powerful math functions including **PI**. It is a built-in math function that's part of the overall Math class. Math classes are included in java.lang.Math.\* package.

**@. Classes and Interfaces are available in the collections**

|  |  |
| --- | --- |
| **Interfaces** | **Classes** |
| Map, List, Set, Queue  **Maps:** HashMap, HashTable, TreeMap, LinkedHashMap  **Sets:** HashSet, TreeSet, LinkedHashSet  **Queue:** Priority Queue | ArrayList, Vector, LinkedList |

**Priority Queue / Queue Interface:** It is used to hold the elements in the collection and it follows the **FIFO** (First-In-First-Out) principle to inserting elements at the end of the list and deleting elements from the start of the list.

**@. ArrayList and LinkedList**

An **ArrayList** internally uses a dynamic Array to store the elements and provides fast access on elements using indexes.

A **LinkedList** is implemented from doubly LinkedList (uses a doubly LinkedList) to store elements and provides fast insertion and deletion. Its performance on add and remove is better than ArrayList, but worse on get and set methods.

**N: Vector** is similar to ArrayList but it is synchronized.

**N:** ArrayList is a better choice if our prog. is thread-safe. Vector & ArrayList req. more space when more ele’s are added.

**@. Ordered, Sorted and Contrast in collections**

An **Ordered collection** means the elements of collection have a specific order. The order is independent of the value of the element. **Ex:** [List](https://docs.oracle.com/javase/7/docs/api/java/util/List.html).

A **Sorted collection** means the elements of collection have a specific order. The order is dependent on the value of the element. **Ex:** [Sorted Set](https://docs.oracle.com/javase/8/docs/api/java/util/SortedSet.html).

A **Contrast** means the elements of collection have **without any order**. **Ex:** [Set](http://docs.oracle.com/javase/7/docs/api/java/util/Set.html).

**@. Exception**

An Exception is a problem that can occur during the normal flow of execution. When something wails at runtime the method throws an exception, if couldn’t handle that exception, the execution gets terminated before it completes the task. If we handled the exception, the normal flow gets continued. Exceptions are the subclass of Throwable classes.

**Comparator** is an interface it is used to order(sort) the ele’s in the **collection** in our own way. It gives the ability to decide how the ele’s will be sorted and stored within the **Collection** and **Map**. Comp Interface defines compare() mtd.

**@. Types of Exceptions**

While code compiling time or code executing time there are two types of Exceptions will occur in java those are.

**Checked Exception:** Checked Exceptions are coming under user control that means user has to verify during the coding. These types of exceptions can handle by the Compiler with the help of try and catch blocks.

**Ex:** ClassNotFound Exception, FileNotFoundException ------ Compile time Exceptions

**Unchecked Exception** (Runtime Exceptions)**:** Unchecked Exceptions are not known until they are executed. These types of exceptions can handle by JVM, so we have to correct them programmatically.

**Ex:** ArithmeticExcp, ArrayIndexOutOfBoundsExcp, ClasscastExcp, DivideByZeroExcp ------ Run time Exceptions

**@. Examples for Exceptions / Built-in Exceptions** ---- https://www.geeksforgeeks.org/built-exceptions-java-examples/

There are two categories of exceptions will occur in java those are **Built-in Exceptions** and **User-defined.** AllChecked and Unchecked exceptions are coming under Built-in exceptions.

**ArithmeticException**: It is thrown to indicate that when an exception has occurred in an arithmetic opern.

**ArrayIndexOutOfBoundsException:** It is thrown to indicate that an array has been accessed with an illegal index. i.e., the index is either negative or greater than or equal to the size of the array.

**ClassNotFoundException:** It is thrown when we try to access a class whose definition is not found

**EleNotVisibleExcp**: Although ele is present on the DOM but it is not visible so we are not able to interacted with that ele

**ElementNotSelectableException**: Element is disabled so it is not able to select.

**ElementNotClickableException:** Most of the times by refreshing the page we can handle this exception.

**FileNotFoundException:** It is thrown to indicate that when a file is not accessible or does not open.

**IOException:** It is thrown to indicate that when an input-output operation failed or interrupted

**InterruptedException:** It is thrown when a thread is waiting, sleeping or doing some processing it’s get interrupted.

**IllegalArgumentException:** It is thrown to indicate that when an argument is illegal for Ex Thread.sleep(-1000);

**NoSuchFieldException:** It is thrown to indicate that when a class does not contain the specified field (or variable)

**NoSuchMethodException:** It is thrown to indicate that when accessing a method which is not found.

**NoSuchElementException**: It is thrown to indicate that when findElement() method can’t able to find the element.

**NullPointerException:** This exception is raised when referring to the **members** of a null object. Null rep. nothing

**NumberFormatException:** This exception is raised when a method could not convert a string into a numeric format.

**RuntimeException:** Any exception which occurs during runtime (except **IllegalArgument** above all are RT exception).

**StringIndexOutOfBoundsException:** It is thrown by the String class methods to indicate that an index is either negative than the size of the string.

**StaleElementReferenceException**: It is thrown to indicate that the element is **deleted** but it is showing in DOM.

**N:** The Document Object Model (**DOM**) is a programming API for HTML and XML documents. It defines the logical structure of documents and way of document is accessed and manipulated.

**TimeoutException**: This tells that the execution is failed because of command did not complete in enough time.

**User-Defined / Custom Exceptions**: The following steps are followed to the creation of User-defined Exception.

* First, create a Class that extends **Exception** class and **Exception** class is a sub class of Throwable class.
* Create a parameterized constructor to take string as a parameter to store the exception details and call super class constructor from this and send the string parameter.
* Finally, to raise exception as user-defined type, create an object to our excp class and throw it using throw clause.

**@. Advantages of Exception Handling -----** nct

* If Exception got handled the normal flow of the execution won’t terminated.
* We can identify the problem by using **catch** declaration with the help of **e.printstacktrace()** method.
* Think of situation that means, if we got any exception, we want to print some custom message in our logs so that, it can be understandable by the whole team.

**@. Exception Handling / Exception Handling Keywords / Handle Exception / Ways to Handle Exceptions**

**Exception Handling** is the process of handling the **Exceptions** when a program runs so that the normal flow of the application can be maintained. Java provides object-oriented way to handle the exception scenarios**.**

**throw Keyword:** throw Keyword is used to throw an exception explicitly (create an object to our exception class and throw it using throw clause) from a method. It is used inside the method. It can throw only one exception at a time.

**throws Keyword:** **throws Keyword is used to** throw an exception in runtime and handle it. It is used in method signature. If an exception occurs in a method, the process of creating the exception object and handling it to runtime environment is called **“Throwing the Exception”** and java run time system starts processing to handle them.

**🡪** At the end of the method signature, we declare the Exception type using ‘throws’ keyword. By declaring this, the caller program knows the exceptions is thrown by the method. Here we can declare multiple exceptions in this throws clause and it can be used with main method as well as sub method also.

**By using try-catch:** A method catches an exception using the combination of the **try**and **catch**keywords. try is the start of the block and Catch is at the end of try block to handle the exceptions. A risky code is surrounded by try block and If an exception has occurred it can catch (handling code) by the catch block. try can be followed either by catch (or) finally (or) both. But any one of the blocks is mandatory. Must and should **catch** is followed by try block.

**🡪**A single **try** block can be followed by multiple **catch** blocks for Ex, if there are multiple exceptions **or** we can expect more than one type of exception in a single block of code. There is no restriction on the number of the catch blocks.

**🡪** Working of multiple catch blocks is pretty simple, if an exception occurs in the protected code, the exception is thrown to the first catch block in the list. If the **exception thrown** matches with the **ExceptionType1**, it gets caught there and executes the code which is under the same exception block. If not match, the exception passes down to the second catch statement and goes on like this.

**🡪**In case, the exception does not match with any **Exception type** after falls through all catch blocks, the current method stops the execution and will throw the exception. That’s why it is advisable to include **default exception** at the end so, in case if the exception falls through it, it can be handled by the default one.

**finally:** This is followed either by try block or catch block. Inside of this block statement gets executed regardless of an exception. So generally, clean up codes are provided here.

**@. Explicit and Implicit Exceptions**

|  |  |
| --- | --- |
| Explicit Exceptions are thrown once explicitly checked by JVM **Ex:** ArrayIndexOutofBondExcep (eve Array indexing ope is ex) | Runtime throwing exceptions are called Implicit excp’s **Ex:** NullPointerException & StackOverflowError. |

**@. Exception Propagation**

An exception is first thrown from the method which is at top of the **call stack** if it is not catch, the exception is drops down the call stack to previous method, again if not caught there, the exception again drops down the call stack to previous method and so on until they caught or until they reach to very bottom of the call stack this is called ‘**EP**’

**Call stack** is a mechanism for interpreter (like JavaScrit interpreter in a web browser) to keep track of its place in a script and that calls mul [fun’s](https://developer.mozilla.org/en-US/docs/Glossary/function) to know that what fun is currently being run and what fun’s are called from within that fun, etc.

**@. Final keywords**

A final keyword is used to restrict the modification of classes, methods and variables. It can be applied to classes to preventing the sub classing, methods to preventing overriding and variables to create constants.

**Final variable:** If a variable is declared as final then the value of the variable could not be changed. It’s like a constant.

**Ex:** final int n = 12;

**Final method:** If method is marked as a final (final keyword in method sig), then it cannot be Overridden by subclasses.

**Final class:** A final class cannot be extended by other class.

**@. Thread / To make a thread in Java / Runnable interface / To implement Runnable interface http://www.btechsmartclass.com/java/java-creating-threads.html**

In Java, the flow of execution is called **Thread**. Every java prog has at least one thread called MT. It is created by JVM. The user can create their own threads in 2 ways those are **By** **ETC** (or) **By IRI**. Threads are executed concurrently.

|  |  |
| --- | --- |
| **a) By Extending Thread Class:** Stepsto ETC | **b) By Implementing Runnable Interface:** Steps to IRI |
| * Create a class that extends Thread class * Override the run() method and provide own implementation in this method. This is executed by thread. The run() method must be public while overriding. * Create an obj to main class in the main() mtd. * Call the start() mtd with main class object (c\_n). | * Create a class that implements Runnable interface. * Override the run() method and provide own implementation to this method. This is executed by thread. The run() method must be public while overriding. * Create the object to main class in the main() mtd. * Create the object to Thread class by passing above main class object as parameter to the Thread class constructor. * Call the start() method with ‘Thread Class’ object (Thread). |

**@. join() method.**

A **join()** method is used to join the start of one thread execution to the end of another thread execution so that a thread will not stop running until another thread has ended.

**@. yield () method of the Thread class do**

yield () method moves the currently running thread or thread back to a runnable state and allow other threads for execution. Here thread is not sleep(), wait() or block() so that, the threads have equal priority chance to run. It is a static method and it doesn’t release any lock.

**@. To stop a thread in java / sleep (), wait () and block () methods in a thread**

We can stop a thread in java by using sleep (), wait () and block () methods

**sleep():** sleep() method is used to **sleep** the currently executing thread for the given amount of time. Once the thread is wakeup it moves to runnable state. Ex: **Thread.sleep(2000)**

**wait():** wait() method is used to make the thread to wait in the waiting pool. When wait() method is executed during a thread execution wait() method doesn’t give the lock on the object immediately until the currently executing thread complete its task. after completes, immediately the thread gives the lock on the object and goes to the waiting pool and it is mostly used in synchronization. This thread will wake up after we called through notify() (or) notifyAll() methods.

**notify():** This method is used to send a signal to wake up a single thread in the waiting pool.

**notifyAll():** This method is used to send a signal to wake up all the threads in the waiting pool.

**N:** The major difference is wait() releases the lock and sleep() doesn’t releases any lock while waiting. Generally, wait() is used for inter-thread communication while sleep() is used just to pause the execution.

**Block():** Which blocks the executing thread until their operation finished.

**@. start() and run() method of thread class**

start() method creates new thread and run() method is executed on newly created thread. If we directly call the run() mtd, the new thread is not create and the currently executing thread will continue to execute the code inside run() mtd.

**@. Synchronization in java &&&& Disadvantage of Synchronization**

Synchronization is helps to control the access of multiple threads in java. Disadvantage is Synchronization is not recommended to implement all the methods because of it, if one thread accesses the synchronized code and next thread should have to wait so, it makes slow performance on the other end.

**@. Thread life cycle in Java**

**Thread has the following states:** New, Runnable, Running, Blocked (Non-runnable) and Terminated

[](https://cdn.softwaretestinghelp.com/wp-content/qa/uploads/2018/01/Thread-Life-Cycle-in-Java.jpg)

**New:** In New state the Thread instance has been created but start() method is not yet invoked so, the thread is not considered alive.

**Runnable**: The Thread become runnable state after invoke the start() method but before the run() method is invoked and thread can also return to the runnable state from wait/sleep by yield(). In this state the thread is considered alive.

**Running**: The thread is in running state after it calls the run() method now the thread begins the execution.

**Non-Runnable (Blocked)**: The thread is alive but it is not eligible to run so It will become not in runnable state with the help of sleep(), wait() or block() methods and it will return to runnable state after some time.

**Terminated**: Once the run() method is completed then it is terminated. Now the thread is not alive.

**@. Class and Interface in Java -----** ommk

|  |  |
| --- | --- |
| **Class** | **Interface** |
| Class describes the attributes and behaviours of an object and class is a blue print. Top level class can be created public & default | Interface is a template and it is a blueprint of class |
| Class may contain abstract methods and concrete methods. | Interface contains only abstract methods. |
| Members of a class can be public, private, default or protected. | Members of the interface can be public by default. |
| Extent keyword is used to inherit the other classes | Implements kw is used to implements the interface through class |

**@. Serialization and Deserialization &&&& Methods are used during Serialization and Deserialization process**

|  |  |
| --- | --- |
| **Serialization** | **Deserialization** |
| For security purposes converting the objects in a flat file into byte stream (serial bytes) is known as ‘Serialization’. for this, we need to implement java.io.serializable interface. | Deserialization is the opposite process of serialization where we get the objects back from the byte stream. |
| An object is serialized by writing it on OOS. | An object is deserialized by reading it from OIS. |

ObjectOutputStream.writeObject**🡪** Serialize the object and write the serialized object to a file.

ObjectInputStream.readObject **🡪** Reads the file and deserialize the object.

**N:** To serialize an object must implement the **java.io**.**serializable** interface. If super class implements Serializable then subclass will automatically serializable.

**@. Use of transient keyword (or) Purpose of a transient variables**

**transient** is a variables modifier used in [serialization](http://quiz.geeksforgeeks.org/serialization-in-java/). At the time of serialization, if we don’t want to store value of a particular variable in a file so it ignores original value of the variable and saves with default value of that variable. It is not used with static variables. **Ex:** transient int num = 30;

**@. Static and Non-static variable &&&& method**

|  |  |  |
| --- | --- | --- |
| **Static Variables** | | **Non-static Variables** |
| Static variables are declared as Global variables or Class variables so these are available for all methods | | Non-static variables are declared as Local variables so these are restricted |
| We can access static variables using Class Name | | We can access Non-static variables using reference of Class |
| Static var’s can access by both static & non-static methods | | Non-static var’s can access only by non-static methods. |
| Static variables reduce the amount of memory used by a program and These members are store in java common memory | | Non-static variables do not reduce the amount of memory used by a prog (i.e., to access non-static variables we need to create object so will move all the non-static stuff into this new object) |
| **Static Method** | **Non-static Method** | |
| Static methods are always access with Class Name | Non-static methods are always access with reference of Class | |
| Static var’s can access by both static & non-static mtds | Non-static var’s can access only by non-static methods. | |
| **Static** method uses Compile time / early / static binding. | **Non-static** method uses Runtime / Late / dynamic binding. | |
| Due to early binding these cannot be Override. | These can Override. | |
| **Static** method uses less memory for the execution bcz memory allocated only once at the time of class loading. | **Non-static** method uses much memory for execution bcz memory allocated every time when the method is called. | |

**N:** If we try to access static mtds by using obj reff the warning will show as ‘static field should be accessed in static way’.

**@. Purpose of Volatile Variable**

By using **Volatile variables,** the values are always read from the **main memory** not from **thread's cache memory**. It can use mainly during synchronization and it is applicable only for variables.

**@. Terms are used in Inheritance**

**Sub Class** is a class which inherits the other class it is also called a **c**hild class, **d**erived class or **e**xtended class.

**Super Class** is a class from here the subclass inherits the features. It is also called a **b**ase class or **p**arent class.

**Extends** keyword is used to establish an inheritance relationship between classes

**Adv:**

* **Reusability (i.e.** Functions can reuse**)** is a mechanism which facilitates we to **reuse** the members of existing class by creating a new class.
* Productivity will increase
* Project development time and testing time is reduced

**@. Types of inheritance in java** ----- OOPS\_Inheritance\Types\_Of\_Inheritanc**e**

|  |  |
| --- | --- |
| If one class extends other class is called inheritance and these are 3 types: Single, Multilevel and Hierarchical.  Types of inheritance in Java | If one class inherits multiple classes then it is known as multiple inheritance those are: Multiple and Hybrid  Multiple inheritance in Java |

**@. Source Code and Object /Byte Code**

**Source Code is a collection of computer instructions written in human-readable programming language.**

**Object Code is a sequence of steps in**[machine language](https://www.differencebetween.com/difference-between-machine-language-and-vs-assembly-language/#Machine%20Language) **and it is the output of after** [compiler](https://www.differencebetween.com/difference-between-assembler-and-vs-compiler/)**converts the Source Code.**

**@. Use of toArray () method in java**

**toArray(**array\_obj**)** method is used to get an Array from ArrayList which contains all the elements in ArrayList object in proper sequence (from first to last element).

**@. Exception Hierarchy / Exception and Error**

All the Exceptions and Error types are the sub classes of **Throwable** class it is the base class in hierarchy. **Exceptions are caused by our program only** and these can handle with the help of try-catch blocks. **Errors are caused due to lake of system resources these should not try to catch,** these are thrown by Java run-time system.

**@. How JVM handle an Exception / Default Exception Handling**

If an exception occurred in a method, the method creates an Object is called ‘Exception Object’ and handover it to run-time system (JVM) is called **Throwing an Exception**. The exception object contains a lot of debugging information such as method hierarchy, line number where the exception was occurred, type of exception, name and description of the exception, etc. For default exception handling the following procedure will happen.

* Java run-time system searches the **call stack** (ordered list of the methods) to find the appropriate method that contains block of code this can handle the occurred exception. This block of the code is called “**Exception Handler”**.
* If it finds appropriate handler then it passes the occurred Exception to it. Appropriate handler means the **type of the exception thrown** matches the **type of the exception it can handle**.
* If java run-time system couldn’t find the appropriate handler after searches all the methods in **call stack** then run-time system handover the Exception Object to **Default Exception Handler**, which is part of run-time system. This handler prints the exception information in the following format and terminates the program **abnormally**.

**Ex:** public class ThrowsExecp {

       public static void main(String args[]) {

       String str = null;

         System.out.println(str.length());

        } }

**Output:** Exception in thread "main" java.lang.NullPointerException: Cannot invoke "String.length()" because "str" is null

At pac\_name.class\_name.method\_name(class\_name.java:lineNum)

**@. Java Keywords**

A **Java Keywords** are predefined and these are the reserved terms in java. They have special usage in java prog’g lang. For Ex **KWs** like int, for, class, etc the terms are reserved means that they cannot be used as identifiers for any other prog’g elements including classes, subclasses, variables, mtds and obj’s. They are part of the **Java** prog’g lang syntax.

**@. Maps in java / Can a map can have a Null value / Why and When we use Maps -----** ickud

In Java Map is an interface and it is a part of collections framework. Map interface will works based on key-value pair. It maps unique keys to values. Few characteristics of the Map Interface are:

1. Map doesn’t allow dup keys but allow dup values. It allow one null key and null value like HM and [LinkedHashMap](https://www.geeksforgeeks.org/linkedhashmap-class-java-examples) but some do not like [TreeMap](https://www.geeksforgeeks.org/treemap-in-java/).
2. The order of a map depends on specific implementations **for Ex**: [TreeMap](https://www.geeksforgeeks.org/treemap-in-java/)and [Linked HashMap](https://www.geeksforgeeks.org/linkedhashmap-class-java-examples)have predictable order, while HM does not.

**Adv:** The maps are used to perform lookups by keys or when someone wants to retrieve and update elements by keys. Some examples are: A map of error codes and their descriptions. **&&** A map of zip codes and cities.

**Creating Map Objects:** Because of Map is an interface, objects cannot be created to map. We always need a class that extends this map in order to create an object. After introducing Generics in Java 1.5, it is possible to restrict the type of object that can be stored in the Map. Syn: Map hm = new HashMap();

**@. Methods used in Map Interface --------** <https://www.geeksforgeeks.org/map-interface-java-examples/>

1. .put(key, value): is used to insert elements in Map in the form of <key, value> pair format.
2. .putAll(Map map): Copies all the mappings of the specified map into the new map.
3. .remove(key) | remove(key, value): This method is used to delete an **entry** for specified key.
4. .get(key): is used to return the value for specified key.
5. .getKey() | .getValue(): is used to return the key and value from Map.
6. .containsKey(key | value): is used to check whether the specified key | value is avl in Map and it ret Boolean value.
7. .Entry<String, Integer>: Entry interface enables to work with a map entry
8. keySet(): This method will return all the keys in Map.
9. entrySet(): Creates a set and stores the map elements into them.

**@. Static keyword in java**

In Java, **Static keyword** is mainly used for memory management and static is a non-access modifier. It can be used with variables, methods, blocks or nested classes that is same for every instance of a class.

**@. Data types / Primitive and Non-primitive Data Types**

* **Primitive** data types include Boolean, byte, char, short, int, long, float and double. A data type is primitive means, if we assign value to the variable that variable actually stores that value. These are single values with no special capabilities.
* **Non-primitive / Reference** data types include String, Arrays, Classes, Objects and Interfaces. They don't store the value in memory but stores a reference to that value in memory it is also called address of that value.

**@. JDK, JRE, JVM and JIT**

**JDK** provides the environment to **develop the** Java programs. **JDK**contains JRE along with various Development tools (to provide an environment to develop the java programs) like Java libraries, source compilers, debuggers, etc.

**JRE** is used to run the java applications. It is an installation package that provides the environment by class librariesand other resources to **run** the java programs on any machine. JRE is the part of JDK. **JRE** is an implementation of the JVM.

**JVM** is used to executes java bytecode. It is very important part in both JDK and JRE because it is contained or inbuilt in both. Whatever Java program is run by using **JRE** it goes into JVM. JVM is a type of **Interpreter** and it is responsible for converting the byte code into machine readable code and **executing the java program line by line**. **JVM** is an ACM.

**Interpreter**: Bytecode is not an executable file to execute a bytecode file, we actually need to invoke a **Java Interpreter**.

**N:** An **Abstract Computing Machine** is nothing but a detailed analysis of how the system works.

 

**N:** Compiler converts the**:** source/high level code --> object code --> Machine code/lang (0’s & 1’s) **:** Before program run

Interpreter converts the**:** source/high level code --> Intermediate code --> Mach code/lang (0’s & 1’s) **:** During prog run

**@. Can a class be declared as protected?**

**Classes** and **Interfaces** are cannot be declared as a **protected** but if Variables, methods and constructors are declared as protected in a class these can visible with in the package (include all classes in package) and outside the package subclasses (of package) only can access

**@. Who can access the class member with a private modifier**

If the class members are declared as a **private**, it can access only within the class in which they are declared. Any other class of same package will not able to access these members.

**@. Can I declare class as static or private**

Yes, we can declare a class as static/private inside a top-level class such classes are also known as **Nested** **Classes**. These can create as both static and non-static. **N**on-static **n**ested classes are called I**nn**er classes. If we want to make a top-level class as static/private, then it's not allowed bcz we can’t able to create object to static class. Static nested class doesn’t require the Outer class reference. Non-static nested class/Inner classes only require the Outer class reference.

**@. Can a class be default in java**

A top-level class can declare as public or default (no modifier) but we cannot declare a private or protected.

**@. super() and this** ---- Ref: ConstructorConcept/ExOnSuper

**super**() as well as **this** both are used to make constructor call. **super**() is used to invoke (call) Parent class methods, constructors, or variables from child class and **this** is used to invoke (call) current class constructor, methods (impl), or variables. If we don’t mention parameter in super() keyword default constructor will call from parent class and If we mention parameter in super(para) keyword the parameterized constructor will call from parent class. super() is always written inside the child class constructor and It should be the first statement while implementing the function because of this we can call only one function and use only one super keyword in child class.

|  |  |
| --- | --- |
| **Usage of super() Keyword is:** | **Usage of this keyword is:** |
| super() can be used to return the parent class instance var | this can be used to return the current class instance variable |
| super() can passed arguments in the mtd and constr call. | this can be passed as an arg in the method and constr call. |

**@. List and Set**

**List** is a type of ordered collection so elements will maintain in specific order and **Set** is a type of unordered collection so elements will not maintain any order. **List** allows duplicates while **Set** doesn't allow duplicate elements.

**Ex: Set:** Hashset, TreeSet, LinkedHashSet (Set<Setring> st = new HashSet<>())

**List:** ArrayList, Vector, LinkedList (List<String> num = new ArrayList<>())

**@. Static and Final**

|  |  |
| --- | --- |
| **Static** | **final** |
| Static keyword is mainly used for memory management and it is used to **define** class members these can overload and cannot be overridden | Final keyword is used to **declare** constant variables these class members are cannot be override and cannot be inherited. Ex for f**inal class** is **String** |
| **In Modification point of view** Static variables can modify. | Final variables can’t modify |
| Class object is not required to access **static** members | We can create Object to final class. |

**@. Iterator and ListIterator**

|  |  |
| --- | --- |
| **Iterator** | **ListIterator** |
| Iterator travers the elements in forward dir: only | ListIterator travers the ele’s in both forward and backward dir:s |
| Iterator can be used in List, Set and Queue. | **List**Iterator can be used in **List** only. |
| Iterator can only perform remove operation while traversing the collection. | ListIterator can perform add, remove and set operation while traversing the collection. |

**@. Can a Main Method be overridden?**

In Java, A main method can able to **overload** but cannot be **overridden** simply because it is a **static** **method**. Reason for this, Static content will store in java common memory not in new object (because no need to create object for static).

**N:** method hiding is nothing but method won’t overridden by other classes

**@. Base class of all java classes**

Java.lang.object class is the super base class of all Java classes. Every other Java class came from Object class only.

**N:** This concept cannot be generalized to all OOPS lang’s. For instance, in C++ there is no such super class of all classes.

**N:** In java **object** cannot be declared as **static** because static statements are runs as soon as class containing them and class is a model for crating object so it won’t come under static. **N:** static methods cannot be overridden by sub class.

**@. i++ and ++i**

In java increment is performed in two ways those are:

**Post-Inc (i++)**:If we want to use the current value and then increase that value of variable **i** by **1**.

**Pre-Inc (++i)**: If we want to increment the value of variable **i** by **1** and then use it in our statement.

**@. Instance and Object ----** am esc rmd

* **I**nstance means **a**llocating the memory space by JVM and Object means initializing the variables inside the instance.
* Class is a model for creating object and **Instance** is a unique copy of the object (same structure but different data)
* Instance can exist Logically but object can exist Physically (that means physical presence of the object in memory)
* We can’t store an instance but we can store an object
* We can create an instance for both abstract class and interface but we can’t create an object for those (Because if our class is not fully implemented then java will not allow to create the object).
* Instance refers to object reference.
* A single object can have more than one instance.
* Instance will’ve both class definition and object definition whereas object will’ve only the object definition.

**@. VirtualMachineError and AssertionError**

[Java.lang.](https://docs.oracle.com/javase/7/docs/api/java/lang/VirtualMachineError.html)**virtualmachinerrror** is thrown to indicate that an internal error or resource limitation which prevents it from functioning. It is a self-defensive mechanism employed by JVM to prevent the entire application from crashing.

Java.lang.**assertionerror** is thrown while working with Assertion conditions. It’s thrown when an assert statement fails.

**@. Access specifier and Access modifier in java** -----<http://tutorials.jenkov.com/java/access-modifiers.html>

In older languages like C++ public, private, protected, default is considered as Access / Visibility Specifiers. Except this the remaining all like static, etc are considered as Access Modifiers. But in java there is no terminology of specifiers all are by default considered as Modifiers. By Access Modifiers Java provides access right to our code to other classes, fields and methods. It represents whether other classes can access our code or not. For Ex: public, private, default, protected, final, static, abstract, transient, volatile, etc are considered as Access Modifiers.

Proof: If we declare top level class as private will get compile-time error as “modifier private not allowed here”

**N:** In java **Token** is nothing but a smallest unit of our program like keywords, identifiers, objects, literals (where the values are used in the program is nothing but a literal) (inside “ ” of string content, value of int).

**N:** In java main class accepts ----public, default, abstract, interface, final modifiers

**@. Code and Algorithm**

An **Algorithm** is a sequence of steps for computing a task and these are usually executed by computer programs.

A **Code** is a sequence of steps for computing a task and these are usually executed by machines. In many cases, code is composed in a high-level language that is automatically translated into machines understandable code.

**@. equal(), equalsIgnoreCase() and contains()**

Let us consider Actual content as ‘Selenium Project’

equal(Selenium Project) ---- Maintain care sensitive (UpperCase & LowerCase) while comparing string content.

equalsIgnoreCase(SeleNium pRojecT) ---- Ignore care sensitive while comparing string content

contains(Selenium) ---- check only some matching portion of string content

**@. Type Casting** ---- /Java\_WD\_Ex/Java\_Examples2/TypeCasting

Type Casting is nothing but assigning value of one primitive data type to another type. These are two types:

In primitive typecasting **Widening** is nothing but a converting smaller datatype to bigger datatype. It can be done by both implicitly (automatically) and explicitly. And **Narrowing** is wise versa it can do only explicitly (manually).

**WC:** byte -> char -> short -> int -> long -> float -> double **NC:** double -> float -> long -> int -> c -> char -> byte

**N: Break** will use in switch and loop statements to terminate the loop. **Continue** will use in loops only it doesn’t terminate the loop.

**@. Types of Relationships / Associations**

In java two types of associations are possible those are: **IS-A** Relationship (Inheritance) (i.e., where subclass inherits properties from superclass) and **HAS-A** Relationship. Again HAS-A as two types those are: **Aggregation** is nothing but a week relationship (i.e., where class has relationship with another class but not own the other class) and **Composition** is nothing but a strong relationship (i.e., where class has relationship with another class and own the other class for lifecycle).

**@. Call By Value and Call By Reference**

There are two ways to call a method in java those are**“call by value”** and **“call by reference”**. A method can call by the value is called **Call by value**. If there is any change in the value of a variable inside that function, that doesn’t affect the original value of that variable. A method can call by the reference / address is called **Call by reference**. If there is any change in the value of a variable inside that function, that affects the original value of that variable.

**@. To initialize Array of Objects** ---- /Java\_WD\_Ex/Java\_Examples2

Array stores the values of int, Boolean, string, etc., but Array of objects stores class type elements are known as an Array of objects. To initialize Array of objects in 2 ways those are: by using constructor or by using separate member method.

**N: Pointer** is a variable that refers the address (memory) these are unsecure so java does not support.

**N:** In java **Garbage Collector** will collect / deleting the objects that are no longer being used from java heap memory. It helps memory to free during the program execution so that system will faster. Garbage collector is runs automatically and not necessary for programmer to externally call it. Ref: prog.

**N: Ternary operator / condition** is used to replace if-else statement to check the condition.

**N:** Blank / un initialized final variable is called as only Declaration not initialization

**N: toCharArray()** is used to put objects into array. Ref: Java\_Examples\AAA\_EOT.java/Split number

**@. Types of Packages**

A java Package is nothing but group of classes, interfaces and sub-packages. There are 2 types of packages those are:

**Built-in packages** are provided to reduce the program burden Ex: Java.util, Java.io, Java.lang.

**User-defined packages** are created by users. First create a directory myPackage (name should be the same name of the package). Then create myClass inside the directory with the first statement being the package names.

**Jump statements:** Break, Continue and Return

**Operators in java:** Arithmetic operators (+, -, \*, %, /), Logical operators (&&, ||), Relational operators (==, !=, <, >, >=, <=), Bitwise operators (^, |, <<(left shift), >>(right shift), >>>(zero fill right shift)), Assignment operators (+=, \*=, <=, <<=).

**String methods:** charAt(), length(), format(), substring(),contains(), join(),equals().

**@. Can an interface implements another interface**

A class can implements one or multiple interfaces && An interface can extends one or multiple interfaces using extends keyword && An Interface cannot be implements another interface.

**Method Chaining** is a technique where multiple methods are called by an object in a single statement.

**Ex:** obj.method1().method2().method3()…;

**Constructor Chaining** is a process of calling one constructor from another constructor within the same class **or** from a subclass constructor to a superclass constructor. It helps in reusing code and initializing the objects.

**Singleton Class** is a class that allows only one instance to be created and provides a global point of access to that class.

**N:** A **Deep Copy** creates a new copy of an object and copies all of it fields recursively, whereas a **Shallow Copy** creates a new copy of an object but only copies its immediate fields, not the object referenced by it fields.

**Marker Interface** is an interface with no methods or fields. It is used to indicate a special property or behavior to the compiler or runtime environment.

**@. Method Hiding** --- Java\_Examples/MethodHiding

Method Hiding occurs when subclass defines a static method with the same signature as a static method in its superclass. The subclass method hides the superclass method, and the method is resolved at compile-time based on the reference type.

**@. Difference Between Method Overriding and Method Hiding**

* In method overriding both the parent class and child class methods are non-static.
* In method Hiding both the parent class and child class methods are static.
* In method Overriding method resolution is done on the basis of the Object type.
* In method Hiding method resolution is done on the basis of reference type.

end#1

.

**SELENIUM**

**@. Automation? Advantages & Disadvantages of Automation**

The process of converting the manual test cases into test scripts by using any automation tool is known as Automation

|  |  |
| --- | --- |
| **Adv**: ---- frctcabqrr | **Dis-adv:** |
| 1. Fast in execution 2. More reliability 3. More consistence (any time can execute script) 4. It saves time to executing the test cases without manual effort 5. Cost to company (CTC) can save 6. We can maintain accuracy by repeating the same task in same manner 7. Bugs can identify easily and we can report the bugs to the developer 8. We can ensure for quality 9. Automation test scripts are reusable on different versions of applications 10. Automation test scripts are repeatable so we can execute multiple times | 1. Automation tools are expensive 2. Skilled automation test engineers are required 3. While automate with some tools some of the environments or technologies are not possible to automate like MF & Desktop appl’s, captcha reading, OTP verification, Barcode reading, Bitmap comp, GUI, Flex and Flash elements. |

**@. Selenium / and composed of / Different forms of selenium / Components in Selenium**

Primarily selenium was introduced by **Jason Huggins** in **2004**. Selenium is a frontend functional testing robust automation tool and it is a suite of tools and it is used for automating web applications and it is composed of:

**Selenium IDE:**IDE stands for Integrated Development Environment. It is a browser extension to record and play back the user’s actions using existing selenium commands. It supports only HTML language and it is a plugin for Chrome & Firefox. Recorded script can be run against other browsers by using Selenium RC or selenium WebDriver.

**Selenium RC:**  Selenium IDE have some limitations in terms of browser support and language support to overcome that limitations selenium RC was introduced. RC stands for Remote Control. It has 2 components those are Selenium-Server and Client-Libraries. Here Selenium-Server is responsible for launching and killing the browser and run the selenium commands that are sent from test program and Client-Libraries provides an interface between Selenium-Server and programing language.

**Selenium WD / Advanced Selenium:** The functionality of WebDriver is to developing and executing the Automation scripts. It is used for automating web applications by using browsers native support or browser built-in support.

**Selenium Grid:**It is for parallel execution. Here we can launch all the browsers parallelly and scripts can be executed on it parallelly. With the help of the Grid, we can distribute tests on multiple machines so that the test exe time can save.

**@. Why selenium is one API**

Selenium is not a tool and not having any .exe file to install selenium it’s a library. To access selenium, we have to add selenium libraries to our project then only we can able to access all WebDriver methods that is the reason we are getting consider as selenium is an API.

**@. Why should we go for Selenium instead of QTP / How Selenium is diff from commercial browser automation tools**

1. First of all, Selenium is an opensource web application automation tool
2. It supports multiple languages like Java, Ruby, PHP, python, C#, pascal, Perl (scripting language)
3. It supports multiple browsers like Firefox, IE, Google chrome, edge, Safari and Opera
4. It is a platform independent and it supports multiple OSs like Windows, Linux and MacOS
5. It’s supports Web Applications by using browsers native support or browser built-in support.
6. It is very flexible and extendable

**@. Automation testing selection criteria for project -----** rre scrs

1. More releases are expecting
2. More resource requires and time taken by doing manual testing
3. Application environment should support for automation
4. Application should be stable
5. Client accepts in terms of budget
6. Return on investment (ROI)
7. Size of the project (i.e., the application should contain more modules)

**@. Latest version of Selenium available** ---------- Using stable version selenium-java-3.141.59.jars

**@. Locators available in selenium WD** -----id, name, linkText, partialLinkText, className, tagName, XPath & cssSelector

**@. To capture screen shot in WebDriver**

File myFile=((TakesScreenshot)driver).getScreenshotAs(OutputType.FILE); -- To capture screen shot of page (java.io.File)

FileHandler.copy(myFile, new File(“path of file.png”)); ----- To save file in a specific location (selenium.io.FileHandler)

FileUtils.copyFile(myFile, new File("path of file.png"));

**@. Challenges / Difficulties have faced with Selenium -----** mhfptdpp

1. Maintaining synchronization is a challenge in Selenium.
2. Handling with Main Frame, Desktop, captcha reading, OTP verification, GUI, Flex and Flash elements is challenge.
3. Frame tags involved in a page is a challenge.
4. Proving the user defined Results is a challenge
5. Taking the data from the application is a challenge
6. Handling dynamic elements is a challenge
7. Handling with multiple popup windows is a challenge
8. Page load synchronization is a challenge

**@. List out the technical challenges with Selenium / Dis-Advantages of using Selenium as testing tool** --wbrvo

1. Selenium supports only web-based applications it doesn’t supports desktop or window-based applications but it can overcome by using the tools SIKULI or AutoIT or Robot class.
2. Bitmap comparison is not possible with selenium.
3. For any reporting related capabilities, we have to depends upon third party tools like QC, Bugzilla, Jira.
4. There is no vendor support for this tool compared to commercial tools like UFT.
5. By default, in-built object repository concept is not possible with selenium. However, object repositories can be built using the key-value pair approach wherein key refers to the name of the given object and value refers to the properties used to unique identification of an object within the web page.

**N:** Images are stored in series of tiny dots (it’s nothing but pixels) is called **Bitmap** or **raster**. WebDriver does not provide direct any function for **Image comparison** but we can verify images by taking two screenshots of the whole web page, one at **script creation time** and another at **script execution time**. After that these screenshots can compare manually.

**@. SSL (**Secure Sockets Layer**) certificate in selenium**

**SSL** is a standard security protocol for establishing the secure connection between server and client. Browser and server use **SSL Certificate** mechanism to able to establish a secure connection.

**@. Synchronization in selenium**

**Synchronization** is a mechanism which involves two or more components are working parallel with each other. Usually, in automation we have two components such as **Application under test** and **test Automation tool** both of them can have specified speeds and the test scripts should be written in a way such that both these components will work with same speed. This will help to avoid “ElementNotFoundException” otherwise will consume more time to clear off here the synchronization will come for help.

**@. Types of XPaths are avl:** On the basis of node hierarchy XPath can div into 2 types those are Abs XPath & Rel XPath

**@. Categories of Synchronization in test Automation**

**Unconditional Synchronization:** Here only the **timeout** value to be specified so that the tool will wait until the specified time before it proceeding. Where it is not possible to write the condition or check for the condition. The major dis-adv in sometimes, the tool will wait unnecessarily even when the WebElement is ready. **Ex:** Thread.sleep(1000)

**Conditional Synchronization:** Here a **condition** also specified along with **timeout** value because of this the tool will wait to check the condition and will come out if nothing happened. In selenium there are 3 diff types of conditional statements are available to avoid synchronization problems those are **Implicit wait**, **Explicit wait** and **Fluent wait**.

**Implicit Wait** is used to specify some time delay while trying to find out an element or list of elements if they are not readily available. It is applicable to all the WebElements from where it is specified so that the specified amount of time it will try looking for element before throwing the Exception. It throws NoSuchElementExcption.

**N:** The default time for Implicit wait is ‘zero’ and polling frequency is 500 milli.sec.

**Syn:** driver.manage().timeOuts().implicitlywait(Duration.ofSeconds(10));

**Explicit Wait / WD wait:** Here a **condition** also specified along with **timeout** value and it should be satisfied within the specified timeout period. The code will be executed after the specified element is found within the specified time. It is not applicable to all WebElements, applicable only for specified element. It throws ElementNotVisibleException.

**Syn:** WebDriverWait wt = new WebDriverWait(driver, Duration.ofSeconds(10)); ---- selenium.support.ui.WebDriverWait

wt.until(ExpectedConditions.visibility/presence OfElementLocated(By.LN(“LV”))); ---- selenium.support.ui.EC

**Fluent Wait** is an implementation of Wait interface. FluentWait instance is used to define maximum amount of time to wait for a condition (timeout value) as well as the frequency to check the conditions (polling interval). Using this type, certain types of exceptions (such as “NoSuchElementException, StaleElementReferenceException, etc”) can be ignored. It is not applicable to all WebElements, applicable only for specified element.

**Syn:** The wait time is set to a maximum of 30 sec, with a polling interval of 5 sec between each check.

Wait<WebDriver> wait = new FluentWait<WebDriver>(driver)

.withTimeout(Duration.ofSeconds(30))

.pollingEvery(Duration.ofSeconds(5))

.ignoring(NoSuchElementExcp.class, StaleElementReferenceExcp.class, …);

wait.until(ExpectedConditions.visibilityOfElementLocated(By.LN("LV")));

**N:** If we use both imp, exp and sleep() waits at a time it’s not good practice bcz of this our t-script will wait more time.

**@. Single and Double slash in XPath**

|  |  |
| --- | --- |
| **Single slash ( / )** | **Double slash ( // )** |
| Absolute XPath starts with single forward slash ( / ) | Relative XPath starts with double forward slash ( // ) |
| ( / ) starts the selection from the root node or document node | ( // ) start from any middle node that we've selected |
| Single slash ( / ) is always navigate into the tags |  |

**@. Handle Alerts and Confirmation Alerts in WebDriver**

//first we have to navigate to Alert window by using the command -------Alert alert=driver.switchTo().alert()

//To click **OK** or **Cancel** on Alert or Confirmation Alert by using the commands

alert.accept(); — To click OK

alert.dismiss(); — To click Cancel

**N:** If we use both accept and dismiss simultaneously, we get NoAlertPresentException

**@. Handle popups in WebDriver / Is it possible to handle multiple popups in selenium** ----- questionpopup

//To navigate from main window to popup -------- driver.switchTo().window(“popup\_Window\_Name”);

//To navigate from Popup to main window -------- driver.switchTo().window(“Main\_Window\_Name”);

//method 2

Yes, First of all, take all the window names into ‘Set<String>’ **variable** with the help of driver.getWindowHandles(); its return type is String and convert it to **ArrayList**.

Use the Array index to navigate to specific window by using driver.switchTo().window(ArrayList\_Object.get(Index));

**@. How to launch FF, Safari and Opera with WebDriver / How can we launch different browsers in selenium WD**

To launch any browser first we need the supported Driver executable file. It can download from, selenium dev page. After that create System.setProperty(“webdriver.chrome.driver”, “pathofchromedriver.exe”); ----- (key, value)

After that we have to create a driver instance of WebDriver with ChromeDriver object then only we can able to access both WebDriver methods as well as ChromeDriver methods. WebDriver driver = new ChromeDriver(); (--- RP concept ---)

**@. Name an API used for reading and writing data to excel files Significance of Apache POI**

**Apache POI** API is an open-source java library it is used to create, Read, Write and Update excel files.

**@. To capture window name** ---------- **driver.getTitle()** method can be used to capture window name

**@. To select the 2nd item in a List box or drop down** ----selectByIndex(index); index can start from zero

**@. How to maximize the browser in WebDriver** ------- driver.manage().window().maximize();

**N:** **isMultiple()** method will give idea on whether our dropdown having multiple components or not

**N: deselect** method removes the selected item from list (for particular option) and it will work only when our dropdown having multiple components ------- deselectByVisibleText()

**@. To Handle AJAX controls / AJAX calls using selenium (Ex. By typing in search engine how to cap the auto sugg)** AJAX stands for Asynchronous JavaScript And Xml. It allows the web pages to retrieve small amounts of data from the server without reloading the entire page and Ajax means for example when we enter some text in the google textbox, it displays the auto suggested values that means that textbox is under AJAX control.

The **biggest challenge in handling Ajax call is loading time of the web page.**Since the webpage is loading it will last only in fraction of seconds, it is difficult for the tester to test such application through automation tool. For that, Selenium WebDriver has to use different wait methods and waitForCondition to handle Ajax Call. So, by executing this wait command, script will pause until specified timeout period for the expected value.

**@. To take specific cell data from excel(xls) file ------ &&&&& ------ #36b. To take or print data from XML file**

//to take/print data from excel first read the excel file up to the sheet. We can use the syntax like,

FileInputStream fi = new FileInputStream(“Path of the excel file”); ---------// to focus on particular file

XSSFWorkbook wb = new XSSFWorkbook(fi); ------- // to open particular workbook //.Xlsx - Excel 2007 OOXML onwards

XSSFSheet ws = wb.getSheet(“sheet\_name”); ---------// to focus on particular sheet

String cell = ws.getCell(columnID, rowID).getContents(); --------- //to take particular cell data from sheet

**@. To handle Desktop, Flex and Flash objects in Selenium**

We can use SIKULI to support Desktop, Flex and Flash objects and it is an add-on for Selenium. SIKULI is an open-source automation tool and this script can be developed by using JAVA.

|  |  |
| --- | --- |
| **@. To print data from notepad (txt file)** | **#40. To create and write data into txt file** |
| File f = new File(“E:\\data2.txt”); // to focus on parti file  FileReader fr = new FileReader(f);  BufferedReader br = new BufferedReader(fr);  String str;  while((str=br.readLine())! = null) {  system.out.println(str);  } | File f = new File(“E:\\data2.txt”); // to create file on spec loc  FileWriter fw = new FileWriter(f);  BufferedWriter bw = new BufferedWriter(fw);  bw.write(“Name”);  bw.newLine(); --------- // for next line  bw.write(“City”);  bw.close();  fw.close(); |

**Build:** Build is nothing but an executable code. It is a process of converting the source code into software system. There are number of steps to convert the source code to executable code those are,

* 1. Taking the source code from src repository
  2. Preparing a build area
  3. Compiling the source code
  4. Build the compiled code to executable code

1. **@. Ant or Apache Ant / Maven / Ant and Maven** ---- vpfpLr
2. Ant and Maven is Java based build automation management tools. Ant will manage all the steps through **Build.xml** file. Whereas Maven through pom.xml file and Maven is advanced version of Ant.
3. Maven is widely preferred than Ant because Ant is an older tool
4. Ant doesn’t come with formal conventions such as a common project directory and Maven consists of conventions.
5. Ant is procedural it means in Ant, we have to specify the order what should have to be done, whereas as Maven is declarative it means Maven takes care of all the directories once the stored in the pom.xml file.
6. Ant doesn’t have a life cycle whereas Maven has a life cycle.
7. The scripts in Ant are not reusable whereas Maven comes with reusable plugins.

**@. Assertion in Selenium and types of Assertion &&&& Verify and Assert Commands**

Assertion is used for verification that is for comparing the actual result with expected result. Types of assertions are “verify”, “assert” and “waitFor” (waitForTitle, waitForTextPresent, waitForAlert, etc).

**Verify** command will check whether the element is present on the page. If the verified element is not available, verify command will not stop execution of test case. It will log an error and proceed with execution of rest of the test cases. In verification, all the commands are going to run guaranteed even when the test fails. (it Verify the condition true or false)

**Assert** command will check whether the element is present on the page. If the asserted element is not available, assert command will stop execution of test case. It will log an error and not proceed with execution of rest of the test cases. In assert, the test will be terminated at the point where check fails. (it checks the condition)

**@. Selenium RC and WebDriver / Advantages of WebDriver over Selenium Server** ----bss ad

* + 1. With the WebDriver we can access all the latest browsers. Selenium WebDriver makes direct calls to browser by using each **browser native / built-in support** for automation, while using Selenium RC, it’s requires selenium-server to inject JavaScript into the browser while executing the program.
    2. If we are using Selenium-WebDriver, we don’t need the Selenium-Server as it is using totally different technology
    3. WebDriver by default maintains page load synchronization, for page refresh we need to handle it.
    4. WebDriver having auto scroll down action into the application while executing the script.
    5. With the WebDriver we can effectively take the data from application.

**@. Your reporting method**

Bug Reporting is always a manual process. Getting the test report from the automation tool and analyze the report for bugs. If identified bug, report the bugs to the developer by using any Bug reporting tools like QC, Bugzilla or JIRA.

**@. To use selenium for performance testing**

Performance testing comes under non-functional testing. Selenium is a functional testing robust automation tool and it’s not for performa­nce testing but we can generate only the load by using Selenium.

**@. To get all the links in http://google.co.in**

Link means **Anchor tag** is common in any application. First Identify all the links by using **FindElements** and **tagName** attribute and get all the links to **List** variable and take the target link by using **for-loop** and **if** condition.

**@. JUnit and TestNG framework**

1. Both JUnit and TestNGare the open-source Unit testing frameworks supported by selenium.
2. We need to implement all the test methods very independently in Junit and not necessary in TestNG.
3. JUnit contains very limited annotations like @Before, @Test, @After, @Ignore and @RunWith whereas TestNG contains multiple annotations.
4. TestNG provides html result file by default where as in JUnit it won’t provide html result file by default.

**@. If the default port of selenium is busy then which port you use**

Selenium by default uses 4444 port no. If the port is already used by any other server, then we can change it to any other 4-digit no. **Ex:** 5555 or 1234 or 6666

**@. Automation Lifecycle / Approach / Plan**

1. First understand the Functional specifications of the project
2. Execute or Review all the manual TCs to get the func knowledge on appl and to identify the TCs for automation.
3. Choose Automation tool
4. require POC for the project
5. Design the framework (folder structure, what kind of files we have to maintain, etc.)
6. Develop the framework it’s nothing but a:

* Preparing the test scripts for all the identified test cases
* Integrate the scripts with Framework for execution

1. Before executing identify the build changes, if available update the script
2. Execute Test Scripts using different test execution approaches without any Issues. ------follow CV------

**@. Write a program to get all the text boxes in ‘mail.in’ register page using WebDriver**

List<WebElement> str = driver.findElements(By.tagName(“textbox\_tagname”));

for (int i=0; i<str.size()-1; i++) {

System.out.println(str.get(i).getAttribute(“id”));-------- //To print all id values

}

**@. To mouseHover on one element by using WebDriver**

Actions act = new Actions(driver);

WebElement ele = driver.findElement(By.linkText(“About Us”));

act.moveToElement(ele).build().perform();

**@. DesiredCapabilities? How it is useful in terms of Selenium**

The DesiredCapabilities is a series of key-value pairs that stores the browser properties like browser name, browser version, Path of the browser driver in the system (good example ‘System.setProperty()’). And also, to determine the behaviour of the browser at run time. It can useful in terms of Selenium is,

* It is used to configure the driver instance of Selenium WebDriver.
* It is used to handle SSL certification error.
* When we want to run the test cases on different browser with different operating systems and versions.

**@. XPath and CSS selector**

Both XPath and CSS selectors are used to navigate XML document to find the WebElements in web pages. the primary difference between **XPath** and **CSS Selectors** is that, with the **XPath** we can traverse both f**o**rward (d**o**wnwards) and backward (upwards) in the DOM hierarchy by this, with **XPath** we can locate a parent element using child element. Whereas in **CSS selector** we can traverse only in f**o**rward (d**o**wnwards). Although **CSS selector** performance is far better than **XPath**. It has following **Advantages and Dis-Adv over XPath**:

* **XPath engines are different in each browser but CSS is same for all browsers.**
* **XPath tends to become complex and hence make hard to read.**
* XPath not allow the Ends-with method to find the WebElements whereas CSS will allow this.

However, there are some situations, where we need to use XPath like **while searching for a Parent Element** and it is also useful **to identifying the Dynamic Elements**.

**@. How much time we can save with automation testing**

It’s always depending on the **Application** and **complexity of TCs** but on average we can save around 50-60% of the time.

**@. To Scroll down and Scroll up in the browser**

Actions act = new Actions(driver); (Actions class is used to simulate input actions from mouse and KB on specific WE’s)

act.keyDown(Keys.CONTROL).sendKeys(Keys.END).build().perform(); //To scroll down

act.keyDown(Keys.CONTROL).sendKeys(Keys.HOME).build().perform(); //To scroll up

**@. Test types that are supported by Selenium**

Selenium can be used to automate web applications and the test types can be supported into: frontend Functional robust [automation testing](https://www.guru99.com/functional-testing.html), Re-testing, Regression Testing, etc.

**N:** For **post release validation with CI** automation tools could be used: Jenkins, Hudson, Quick Build and Cruise control.

[](https://www.guru99.com/images/SeleniumSuite.png)**@. Selenium 2.0 Selenium 3.0**

Selenium RC and WebDriver are consolidated as a single tool in Selenium 2.0 and Selenium 3.0 is the latest version from Selenium family. It was released in 2 Beta versions with some of the added new features.

**@. To find an element using Selenium**

#### In Selenium every object or control in a web page is treated as element, there are different ways to find an element in a web page by using 8 locator identifying mechanisms.

**@. Advantages or capabilities of Selenium** &&&& **Why testers should option for Selenium and not QTP ------** gLd

* First of all, selenium is open-source tool whereas QTP is a commercial tool.
* It sups mul lang’s like Java, Ruby, PHP, Python, JavaScript, C#, Perl, Groovy, Scala and QTP supports only VB script.
* It supports multiple browsers like FF, CH, IE, edge, safari and opera and QTP supports IE browser.
* It supports different OS like Windows,[Linux](https://www.guru99.com/unix-linux-tutorial.html)& MacOS and QTP supports windows only.
* Handling with multiple frames, popups, alerts and multiple browser windows.
* Page navigation and drag & drop.
* Handling with Ajax based UI elements.
* By using selenium grid component, **Distributed testing** can be carried out on remote machines.
* It has powerful methods to locate elements (methods like XPath, CSS selector).
* Selenium Test scripts can able to develop in various IDEs like Eclipse, Visual studio, NetBeans and IntelliJ………

A **Client**-**server Application** is a piece of software that runs on client computer and makes requests to remote server. Many such applications are written in high-level **visual** programming lang. Most business logic reside in thisapplication.

**@. Same origin policy? How you can avoid same origin policy**

The **“Same Origin Policy”** was introduced for security reason. It ensures the content of any site is never be accessible by a script from another site.  As per this policy, any code loaded within the browser can only operate within that website’s domain. To avoid “Same Origin Policy” **Proxy injection** method is used, in proxy injection mode the Selenium Server acts as a **client configured HTTP proxy**, which sits between the browser and application under test.

**@. sleep() and** **setSpeed() methods**

Both will delay the speed of execution.

**Thread.sleep():** sleep() method is used to sleep the currently executing **java thread** for the given amount of time. It takes a single argument in integer format and it waits only once at the command given at sleep.

**Ex:** thread.sleep(2000) ---- It will wait for 2sec (-----It is also called static wait-----)

**setSpeed():** setSpeed() will stop the execution of every **selenium command** for a given amount of time. It takes a single argument in integer format and runs each command after setSpeed() delay. This command is useful for **demonstration purpose** or if we are using a **slow web application**. **Ex:** selenium.setSpeed(“2000”) ---- It will wait for 2 sec – sel RC cmd

**@. Four parameter we have to pass in Selenium ----------** Host, Port Number, Browser, URL

**@. To submit a form using Selenium**

**submit()** method will use on any element to perform enter activity - ele.submit(); **N:**(instead of click() also we use)

**@. Which attribute should consider throughout the script in frame for “if no frame Id as well as no frame name”**

driver.findElements(By.xpath(“//iframe”)) will return the list of frames and switch to each and every frame and search for locator which we want.

**@. findElement() and findElements()**

**findElement():** It finds the **first** element within the current page using the given “locating mechanism”. It returns a single WebElement. If element is not found it throws NoSuchElementException.

**findElements():** It find **all** the elements within the current page using the given “locating mechanism”. It returns a list of WebElements. If elements are not found it will give empty list.

**@. Data Driven Testing / framework and Keyword Driven framework? How can create those**

**Data Driven Testing / Framework** is a software testing method here test data is stored in spreadsheet format. Input values are read from data files and stored into variables inside test scripts. Execute the Test Cases on multiple times with different set of test data and expect the test output in same table. It is also called Table-driven / Parameterized testing. Input data is stored in single or multiple data sources like .xls, .xml, etc...

**Keyword driven framework** requires the development of data tables and keywords independent of the test automation these keywords representing an action.  In keyword driven test, the functionality of the application under test is documented in a table as well as step by step instructions for each test.

**@. Can login into any site if it’s showing any authentication popup for password and username**

Pass the username and password with URL i.e., <http://username:password@url>

**@. To assert text of webpage using selenium 2.0**

WebElement element = driver.findElement(By.LN(“LV”)) ------ //first we have to create reference to WebElement

String actText = element.getText(); ------ //To get test from element and stored in String variable

String expText = “Selenium WebDriver”;

Assert.assertEquals(**a**ctText, **e**xpText, “if test fails user message will print”); //To assert text from expected

#### **@. Selenium Grid working**

#### [Selenium Grid](https://www.guru99.com/introduction-to-selenium-grid.html) first send tests to the hub and these tests are redirected to Selenium WebDriver, which launch the browser and run the test with entire test suite. **Adv:**

* It allows running test cases in parallel so that the test execution time can save.
* It allows cross-browser testing by running the test on machines having different browsers.
* It allows cross-platform testing by configuring nodes having different operating systems.

**@. Can find Broken Links / images in a page using Selenium WebDriver** (EX49,50) ------- vibuL

Due to existence of broken links, the website reputation gets damaged and there will be a negative impact on business. So, it’s mandatory to find and fix all the broken links before release the application. To find the broken links in a page by using Selenium WebDriver is,

* First Get all the image links in the page by using **findElements()** and **tagName (**img/a**)** and assign to **List** variable.
* Readall the image/link Attribute values with the help of loop condition and **getAttribute(**“src/href”**)**
* Create object to **URL** class.
* openConnection to **HttpURLConnection** class with src/href link.
* Next connect to each and every link.
* get HTTP status code in the target page by using httpurlconnection**.getResponseCode()** method
* And get response message using httpurlconnection**.getResoponseMessage()**

Let’s see some of the HTTP status codes

200 – Valid Link

500 – Internal Error

400 – Bad request

401 – Unauthorized

404 – Link not found/Page not found

**N:** **href** (Hypertext REFerence) is an attribute of anchor tag which is used to identify the sections within the document.

**@. Object Repository**

An Object repository is used to store the WebElements that will be used in the scripts. We can create Object Repository using **Page Object Model** design patterns with **@FindBy** annotation or will use properties file……

**@. While injecting capabilities in WebDriver to perform tests on a browser which is not supported by a WebDriver? Limitation that one can come across** ---Major limitation is that “findElement” command may not work as expected.

**@. Can handle colors in WebDriver / SVG elements**

To handle colors in WD we use getCssValue("background-color ID") fun to get the colors by sending ‘color ID’ as arg.

**@. Using WebDriver how you can store** / **input** / **enter a value to text box / without using sendKeys()**

**sendKeys(“**our\_value**”)** method will used to store a value which is in text box. without using sendKeys() we use **JsE**.

**@. To switch between frames / To move to a particular frame in selenium**

To switch between frames in WD **driver.switchTo().frame()** method can takes one of the three possible arguments

* Select the frame by its index.
* Select a frame by its name or Id attributes (name = String frame name & id = attribute value of id).
* Switch to the frame using WebElements: Use any locator method to locate the frame element --- WebElement frameWebEle = driver.findEelement (By.id("frame-id\_Value")); ---- driver.switchTo().frame(frameWebEle);

**@. 5 different exceptions had faced in Selenium WebDriver**

#### Some of the exceptions will occur while using Selenium WebDriver those are:

* WebDriverException
* NoAlertPresentException
* UnExpectedAlertPresentException
* NoSuchWindow/Element/Frame/AttributeException
* TimeoutException
* InvalidElementStateException: If element is disabled, then we will get this exception.
* IlegalStateExcep: If we don’t write system.setProperty and launching the browser then will get this Exception.

**@. Perform double click**

**Actions act = new Actions (driver);**

**WebEelement ele = diver.findElement(By.LN(“LV”));**

**act.doubleClick(ele).build().perform(); ////// build()---for compile & perform()---for execute**

**@. HTMLUnitDriver ---Or--- Which WebDriver implementation is fastest**

HTMLUnitDriver implementation is fastest unlike other divers (geko, ch...). It is non-GUI and does not execute tests on browser but **plain http request**, which is far quick than launching a browser and executing tests.

**@. To upload a file using Selenium** --- “Robot” class in JAVA or AutoIT will used to make file upload.

**@. To switch back from a frame** ------ driver.switchTo().defaultContent();

**@. getWindowhandles() and getwindowhandle()**

getwindowhandles()is used to return the id’s of the all opened windows and its return type is String.

getwindowhandle()is used to return the id of the current window where the control is there and its return type is String

**N:** In order to display the **value of a variable** / **string** **content** in console we have to use the **system.out.println()** cmd.

**@. To use ‘recovery scenario’ with Selenium**

Recovery scenarios depends upon the programming language which we use.  If we are using Java then we can use **Exception Handling** technique to overcome same by using “**try-catch Block**” within our Selenium WebDriver tests.

**@. Mention in what ways you can customize TestNG report**

There are two ways to customize the TestNG report those are: Using **ITestListener** **Interface** &&&& **IReporter** **Interface**

**@. To insert a break point in Eclipse**

While working with Eclipse IDE to insert and remove Break points we have to follow the same procedures as below:

* By right click on the command where we want to insert break point and click on “Toggle break point” **Or** Focus on particular command and press “ctrl+shift+B” on the keyboard to select the command in Selenium.
* Multiple break points can be set in our IDE

**@. To debug tests in Eclipse**

* First insert the break point at required locations from where we want to execute the script step by step.
* Execute the program by perform context click and select ‘Debug As’
* Give confirmation on ‘Confirm Perspective Switch’ window by click on ‘switch’
* At given break point the execution will be paused.
* To continue with the next statement, click on the ‘**Step Over (F6)**’ button.
* While debugging the script step by step we have to identify the variable values on console.
* Click on the “Run” button to continue the execution of remaining program at a time.

**@. APIs available in selenium to support Browsers / Drivers** ----- HUD-HtmlUnitDriver HU-HtmlUnit

CD for ChB, gD for FFB, SD for SB, HUD for HU headless Browser, Android-Selendroid/Appium, IOS-iosdriver/Appium.

**@. To handle network latency in selenium** ----- driver.manage().timeouts().pageLoadTimeout(Duration.ofSeconds(10));

**@. To retrieve the message in an alert box** -----driver.switchTo().alert().getText()

**@. To generate pdf reports what Java API is required** ----- To generate pdf reports in java, we need **iText** jar files

**@. To verify the specific position of a WebElement** ----- EX55

**@. IntelliJ** ---- It is an IDE that helps to write better and faster code it can be used as option like NetBeans and Eclipse.

**@. To confirms an identified object using selenium**

**isElementPresent(ele)** command is used to confirm an identified object / element using Selenium and it takes a element locator as argument and if found that element, it will returns a Boolean value.

**@. Break points and Start points in selenium**

**Break Points:**When we implement a Break Point in our code, the execution will stop here. This helps to verify that, is our code is working as expected or not.

**Start Points:** Start Point indicates that the point from where the execution should begin. Start Point can be used when we want to run the script from the middle of the code or a breakpoint.

**@. To choose Python over Java in Selenium ----** russ

* Java programs tend to run slower compared to Python programs.
* Java uses traditional braces to start and ends blocks, while Python uses indentations.
* **J**ava employs **s**tatic type checking while Python is dynamically typed.
* Python is simpler and more compact compared to Java.

**N:** Java uses **static type** **checking** to analyse the program during compile time to prove the absence of **typing errors**. The basic idea behind this is to never let bad things happen at runtime.

**N: Indentation** in **Python** refers the **spaces** and **tabs** are used at the beginning of a statement while writing the program

**@.** [**Listeners in TestNG**](https://www.guru99.com/listeners-selenium-webdriver.html)

* **IAnnotationTransformer** is used to modify the content of all the annotations at runtime.
* **IConfigurationListener** is invoked before and after the configuration methods. It triggers only when the configuration methods pass, fail, or skip.
* **IExecutionListener** is invoked at the beginning and end of a test run.
* **IHookableListner** is used to execute any code before and after a test method, test configuration method, or suite.
* **IInvokedMethodListener** is performs some tasks before and after the method execution.
* **IMethodInterceptor** is used to add an interceptor to the test method invocation.
* **ISuiteListener** is invoked before and after a suite is run.
* **ITestListener** is invoked before and after a test is run and on test success or failure.

**@.** [**Listeners in WebDriver**](https://www.guru99.com/listeners-selenium-webdriver.html)

* **WebDriverEventListner** is an interface that contains methods for listening WebDriver events.
* **AbstractWebDriverEventListner** is an abstract class that we can subclass to implement the WDEL interface.
* **EventFiringWebDriverListner** class wraps up a WebDriver instance and enables the firing of WebDriver events
* **WebDriverListnerManager** is a class that manages the registered listeners and notifies them of the events.

**@. Use cases of WebDriver Listeners and TestNG Listeners**

* Taking screenshots of test failure
* Logging test results
* Analysing browser logs
* Capturing performance metrics

**@. For Database Testing in Selenium WebDriver what API is required**

For [Database Testing](https://www.guru99.com/data-testing.html) in Selenium WD, we need JDBC (Java Database Connectivity) API. It allows to execute [SQL](https://www.guru99.com/sql.html)stmt’s

**@. Mention when to use AutoIT**

Selenium is designed to automate web-based applications on different browsers but to handle window based and non-HTML popups in the application we need to use AutoIT.

**@. Do we need Session Handling while working with Selenium**

While working with Selenium WebDriver, we need **Session Handling** this is because, during test execution Selenium WebDriver has interacted with the browser all the time to execute the given commands. At the time of execution, it is also possible that, before the current execution completes, someone else starts execution of another script, in the same machine and in same browser. So, to avoid such situation we need **Session Handling**.

In [Selenium](https://www.codingninjas.com/studio/library/introduction-to-selenium) WebDriver, TestNG framework is used to perform Session Handling. For that in TestNG XML file parallel attribute is added to trigger parallel sessions and thread-count attribute is added to specify the number of threads to be created while executing the tests in parallel mode.

**@. Advantages of Using GitHub for Selenium**

* When multiple people have to work on the same proj, they can update the proj details to other team mem’s simul.
* Jenkins can help to build the project from remote repository regularly and this helps to keep track of failed builds.

**@. XPath / Main features of XPath / XPath syntax** **/ XPath expressions ---** ps

XPath stands for **X**ml **Path** Language. It uses the path expressions to traverse the elements or attributes in an XML document. XPath expressions are care sensitive. XPath specifies seven types of nodes those are:

* Root
* Element
* Text
* Attribute
* Comment
* Processing-Instruction
* Namespace

**@. Types of location paths in XPath? Use of this**

There are two types of location paths are used to specify the location of node in XML documents. Those are **Absolute path** and **Relative path**.

**@. Absolute path in XPath**

Absolute XPath is a way of locating an element using XML expression and it starts from the root node **or** document node. It begins with the single forward slash (/). The main disadvantage of absolute XPath is even a slight change in the UI or any element the hole absolute XPath will get fail and also it is complex to read.

**@. Relative path in XPath**

Relative XPath is a way of locating an element using XML expression and it starts from any middle node that we've selected. It begins with the double forward slash (//). In Relative XPath there are different ways to creating robust XPaths (it is unaffected by changes in other UI elements).

**@. XPath Axes** ---- <https://www.way2tutorial.com/xml/xpath-axes.php> &&& https://www.softwaretestinghelp.com/xpath-axes-tutorial/

XPath Axes are used to identify elements by their relationship like parent, child, sibling, etc. Those are:

**‘Self’ -** is used to find the current node (context node)

* **‘child’ -** is used to get the child of current node.
* **‘descendant’ -** is used to get child and grandchild’s (child-of-child’s) of **current node ---** //\*[@AN=’AV’]//descendant::a
* **‘descendant-or-self’ -** is used to get current node (self), child, child-of-child (grandchild), etc.
* **‘parent’ -** is used to get the parent of current node.
* **‘ancestor’ -** is used to get parent, grandparent’s (parent-of-parent’s) of current node till root node.
* **‘ancestor-or-self’ -** is used to get the current node (self), parent, parent-of-parent (grandparent), etc.

**‘preceding’ (**Before**) -** //\*[@A\_N=’A\_V’]//preceding::tag – (here sibling is not mentioned so it will navigate through tags only). It takes all the elements that come **before** the context node to till end node. It may be the parent or gp node.

**‘following’ (**After**) -** //\*[@A\_N=’A\_V’]//following::tag[1] – (here sibling is not mentioned so it will navigate through tags only). It takes all the elements that come **after** the context node to till root. It may be the child or gc node.

**‘preceding-sibling’ -** Here sibling is mentioned so it will get **before** the context node sibling.

**‘following-sibling’ -** Here sibling is mentioned so it will get **after** the context node sibling.

**@. Types of operators in XPath / Standard functions in XPath**

XPath operators are used to perform some special operations in XML document.

* Athematic Operator
* Boolean Operators
* Comparison Operators
* String Functions / Operators
* Node Functions / Operators
* Number Functions / Operators

**@. XPath Comparison operators** are used to compare one value to another value. Those are: =, !=, <, >, <=, >=

**@. XPath Boolean operators** are used to combine or exclude keywords. Those are: AND, OR, NOT etc.

**@. XPath Number operators** are used to perform mathematical operations on diff. kw’s. Those are: +, -, \*, div, mod(%)

**@. XPath String functions** are used to deal with string content according to our preferences.

**@. XPath nodes / To define relationship among nodes**

There are different types of nodes in XML document. All these nodes are related to each other in the form of **tree structure** based on this structure we can define the relationship among the nodes. These nodes are: Parent, Child, Sibling, etc. The top most node of the tree is called **Root Node**.

**@. To check a checkbox in selenium**

click() mtd is used for clicking btns or radio btns. isSelected() mtd is used to check whether CB or RB is checked or not.

**N: Instead of click()** we can use Keyboard events i.e. **sendKeys(Keys.ENTER)** /**submit()** methods to perform click activity.

**N:** To copy text from user name edit box and paste in password field with the help of **Keyboard Events**.

**@. get() and navigate().to() method**

When we use **get()** method to navigate particular URL, the WebDriver will wait until the page is loaded (i.e. after refreshing the page) and It doesn’t maintains browser history or cookies to navigate back or forward in browser hist. When we use **navigate().to()** method to navigate particular URL, the WebDriver will go to next step in the script to execute irrespective of page is loaded or not (i.e. without refreshing the page) so it may have chance to get exception. It maintains browser history or cookies to navigate back or forward in browser history by using driver.navigate().forward() & driver.navigate().back() methods.

**@. Atomic value in XPath ------** Nodes that has no parent node or child node are called as **Atomic values**.

**@. pom.xml**

**pom**.**xml** is a file which contains project configuration details (such as dependencies, build directory, source directory, test source directory, plugin, goals, etc.) used by Maven to build the project. In normal project development, we have to add libraries manually as required. In **pom** context we call those libraries as **dependency’s**. In **Maven based** development, require **dependency’s** can added to the project using **pom.xml inside the dependency tag** and then save the file then libraries will automatically download and add to our project. just by changing the version number in dependency the libraries will automatically update. Maven reads the file (pom.xml) and executes the goal.

**@. Software Metrics can used in project**

A **software** **metrics** can be used to measuring the software performance, quality, productivity, planning work items, etc. It can be classified into 3 types those are:

* **Product metrics** describe the product char’s such as size, complexity and design features.
* **Process metrics** can be used to improve software development and testing process such as effectiveness of defect removal during development and pattern of testing when defect is arrival.
* **Project metrics** describe the project characteristics such as staffing pattern over software life cycle (number of software developers, Testers are required, etc), cost, schedule and productivity.

**@. To handle Dynamic Elements since the webpage is designed in AngularJS**

Different ways to handle dynamic element and to construct a **Generic XPath**. It is very helpful while handling dynamic elements. In few scenarios, element attribute values change dynamically. **For Ex** let us consider the ‘id’ of a username field is ‘username\_123’ and the XPath will be *//\*[@id='username\_123′]* but when we open the page again the ‘id’ of ‘username’ field might have changed and the attribute value may be changed to ‘username\_234’. In this case, the test will fail because the WebDriver could not find the XPath we have passed earlier as the ‘id’ of the field has changed to some other value. There are many approaches that depending upon the type of problem like If some part of the attribute value changesor If entire value of the attribute changes dynamically:

**1)** XPath with contains --- //\*[contains(@id,'username')] (If some part of the attribute value changes it will work)

**2)** XPath with starts-with --- //\*[starts-with(@id,'username')] (If some part of the attribute value changes it will work)

**N:** ‘contains()’ method checks whether the ‘id’ of the ‘value’ contains the specified substring and starts-with() checks if any attribute value must starts with specified substring.

**3)** XPath with OR/AND --- //\*[@A\_N=’A\_V’ OR/AND @A\_N=’A\_V’]

**4)** We can create generic XPath with the help of **XPath Axis** also.

**For Ex**: If id of ‘login’ field changes dynamically and there is no constant value to use **contains()** & **starts-with()** methods.

**Solution**: Selenium provides diff mtds to use **sendKeys()** mtdwith **fun keys** like TAB key, ENTER key and KB Events…….

**@. Elements in pom.xml (Elements inside Dependency’s tag)**

For creating a simple pom.xml file, we need some elements those are:

|  |  |
| --- | --- |
| **Element** | **Description** |
| **Project** | It is the root element of pom.xml file |
| **modelVersion** | It specifies the parent POM version and by default it should be 4.0.0 |
| **groupId** | It specifies the id for the project group. |
| **artifactId** | It specifies the id for the project artifact (i.e., proj name). An artifact is something either produced or used by a project. Ex’s of Maven produced artifacts are: JARs, source, binary distributions and WARs. |
| **Version** | It specifies the version of the artifact under given group. By default, it should be 0.0.1-SNAPSHOT |
| **Packaging** | defines packaging type such as jar, war etc. |
| **Name** | defines name of the maven project |
| **url** | defines URL of the maven official website |
| **Description** | It is a simple description regarding project |
| **Dependencies** | define dependencies for this project |
| **Dependency** | define dependency for this project and it can keep inside dependencies tag |
| **Scope** | define scope of the maven project. It can be provided, compile, runtime, test and system. |

**@. To build the maven project / To add dependency’s in pom.xml**

Maven is java-based build automation management tool that allows to import dependencies into our projects. If we create a maven project by default pom.xml file will create. Using this pom.xml as a template, we need to add **tags** inside pom.xml file. In order to use Maven, it is necessary to explicitly add required dependencies to **pom.xml** file and save the file then that dependencies will automatically download, add and update.

1. Download **Apache Maven** ([apache-maven-3.8.1-bin.zip](https://mirrors.estointernet.in/apache/maven/maven-3/3.8.1/binaries/apache-maven-3.8.1-bin.zip))from internet and un-zip it.
2. Set Environment variables in local system.

* M2\_HOME --- RC on This PC 🡪 Properties 🡪 Adv Sys Settings 🡪 Env var’s 🡪 click on ‘New’ under ’Sys Vars’ 🡪 set “**variable name**” as “**M2\_HOME**” and “**variable value**” as “Location of folder where the maven is”
* MAVEN\_HOME --- again click on ‘New’ under ’Sys Vars’ 🡪 same as above

N: some programs look for try to find M2\_HOME or MAVEN\_HOME that’s why I added both the variables

* Path --- select ‘path’ under Sys Vars 🡪 Edit 🡪 New 🡪 add **.bin** path 🡪 OK

1. To check installation was done or not 🡪 go to CMD and check maven version by using “mvn -version”
2. Install maven plugin (i.e., Maven Integration for Eclipse (Luna/Mars) 1.2.0) in Eclipse.

## Create Maven project: File 🡪 New 🡪 Project 🡪 Maven 🡪 Maven Project 🡪 Next 🡪 Give workspace location 🡪 Next 🡪 Catalog (Internal) and Select an Archetype i.e., ‘maven-archetype-quickstart 1.1’ 🡪 [Next]

## Specify the archetype parameters those are GroupID and ArtifactID (Proj name) by giving these by default version (0.0.1-SNAPSHOT) and ‘package (GroupID.ArtifactID) under src/test/java folder’ will show and click on [Finish]

1. There are two folders will create by default **src/main/java** (maintain utilities like Test Data configuration files those are excel file, properties files...etc) and **src/test/java** (this folder is used to create automation test scripts)
2. Add necessary dependencies by copying it from ‘mvnrepository.com’ and paste inside the dependencies tag and save pom.xml file then only the jars will download and added to proj it can see in “Maven Dependencies” folder.
3. Prepare the script.
4. Before executing the script, we have to import “maven-surefire-plugin” and “maven-compiler-plugin” from ‘https://maven.apache.org/’. These are helpful to run our tests through pom.xml file and these can keep inside <build> tag. Without ‘maven-surefire-plugin’ we can’t able to execute our script through pom.xml file.
5. testing.xml will specify along with maven-sure-fire plugin tag because maven-compiler-plugin is for compilation purpose and maven-surefire-plugin is responsible to execute our script through pom.xml. pom.xml will control our test execution by testing.xml file by specifying testing.xml file inside <build>

* Browser 🡪 search for ‘Maven Surefire Plugin’ 🡪 click on ‘usage’ under OVERVIEW 🡪 copy <build>..</build> tag only 🡪 paste above the ‘dependencies tag’ (below the ‘</properties>’)
* While running through pom.xml our Test Execution is completely depending upon the testing.xml because we specified testing.xml file is kept inside <suiteXmlFiles>

1. To execute the script RC on pom.xml (Run As 🡪 8 Maven test)
2. If we get error regarding “Source option 5 is no longer supported. use 7 or later” or “Target option 5 is no longer supported. use 7 or later” to overcome these errors add two tags inside <properties> those are <maven.compiler.source>7</maven.compiler.source> and <maven.compiler.target>7</maven.compiler.target> and then save pom.xml
3. Execute the script

**Adv:** Maven is used to build the project and download, add, update libraries to project. Compile and execute the project without using eclipse. We can able to run the script through CMD, batch file, pom.xml file and Jenkins, etc.

**Maven commands:** Toexecute maven proj through cmd / powerShell win must need to install maven on local machine.

**N:** To Run test cases from powerShell window

Goto proj directory 🡪 Shift+RC on mouse 🡪 select "open PowerShell window" 🡪 "mvn clean install / test" 🡪 Enter

**==>** **mvn clean** will clean maven artifacts that was created by previous maven builds

## N: To compile the project

Goto proj dir 🡪 open dir (copy path) 🡪 open CMD 🡪 f: 🡪 **E** 🡪 cd paste\_copied\_path 🡪 **E** 🡪 mvn clean compile 🡪 **E**.

**N:** To Run test cases from command prompt

Goto proj dir 🡪 open dir (copy path) 🡪 open CMD 🡪 f: 🡪 **E** 🡪 cd paste\_copied\_path 🡪 **E** 🡪 mvn test 🡪 **E**.

**N:** To Run test cases from .bat file

🡪 Open notepad 🡪 f: 🡪 Save As with extension .bat 🡪 double click on .bat file

cd paste\_copied\_path

mvn test

**Repositories in maven:** Maven repository holds the dependencies and build artifacts (jars, war, plugins…...). There are two types of repositories in maven those are: **Local** and **Remote**:

**Local:** It will get generate in our local machine (**.m2** directory) by executing maven command.

**Remote:** It is a custom repository it will create by organisations for those need.

**Maven Plugins:** There are two types of maven plugins are available. Those are:

**Build plugins** will be executed during the build. These plugins are declared inside <build> in pom.xml file.

**Reporting plu** will be executed during the site generation. These plugins are declared inside <reporting> in pom.xml file.

**Core Plugins:** A list of maven core plugins are --- ccd fir ssv

|  |  |
| --- | --- |
| Clean | Clean up after build (clean the artifacts that was generated by the previous builds). |
| Compiler | Compiles java source code. |
| Deploy | Deploy the build artifact into remote repository. |
| Failsafe | Runs the JUnit **integration tests** in an isolated classloader. |
| Install | Install the build artifact into local repository. |
| Resources | Copies the resources to the output directory including JAR. |
| Site | Generate a site for the current project |
| Surefire | Run the JUnit **unit tests** in an isolated classloader. It used to run our tests through pom.xml file |
| Verifier | Verifies the existence of certain conditions. It is useful for integration tests. |

1. **Maven Build Phases / Lifecycle**: Maven build lifecycle goes through a set of stages, they are called build phases. For example, the default lifecycle is made up of the following phases.

|  |  |
| --- | --- |
| Validation ph | Validate all the precondition information to trigger the build |
| Compile ph | Compiles the java source code. |
| * Test | Execute the build |
| * Package | Jar, war, etc |
| Verifier | Verifies the existence of certain conditions. It is useful for integration tests. |
| Install | Install the build artifact in local repository. |
| Deploy | Deploys the build artifact into remote repository. |

**@. Test cases can be automated per day**

The efficiency of our tests is always Depends upon the **Application** and **Complexity**. It includes 1. Analyzing test cases 2. Developing the script 3. Executing and Debug the script 4. Stabilizing the script.

**@. To estimate the time to automate a scenario**

Various factors should consider to estimate the time for Selenium specific project those are:

1. **Scope of the project**
2. **Complexity of application**
3. **Use of supporting tools/technologies**
4. **Environment setup**
5. **Implementing the Framework**
6. **Scripting and Reviewing**
7. Capability and experience of the testing team (i.e., Experience with testing tools, frameworks and environments).

**@. If the element is not present, how will print the Element is not present message**

WebElement element = driver.findElement(By.LN(LV));

Assert.assertFalse(element.isDisplayed()); **(or)** Assert.assertNull(element);

**isElementPresent()** will checks that if element is exists on the page DOM page. It returns Boolean value.

**isDisplayed()** will checks that if certain element is present and displayed on web page (UI). It returns Boolean value.

**@. To check the Actual vs Expected Result**

Comparison Testing is helpful to determine whether test cases result is pass/fail. After performing the test, tester will get Actual Result (Actual Outcome). It is always documented along with the test case during the test execution phase. This Actual Result is compared with the Expected Result and the deviations are noted. If any deviation then we log as **defect** and that defect goes through the defect life cycle. After getting the Actual Result only we can mark whether the scenario is pass or fail. Comparison test tools enables to mark the date and time stamp in result.

**Comparing Automated Testing Tools:**Selenium WebDriver, Katalon Studio and Unified Functional Testing (UFT).

**@. URL and a URI**

**URI** stands for Uniform Resource Identifier and **URL** stands for Uniform Resource Locator. **URI** is name and address / Locator for online resource whereas **URL** is just address / **L**ocator for online resource. **URL** is a subset of **URI**.

**@. 'Defect Triage' / Need of 'Defect Triage'**

Defect triage is a process here each bug is prioritize based on its severity, risk, etc. It is used to define the severity and priority of defects, make changes as per need and assign resources. Mainly it is useful in agile project management.

**@. Mandatory and other participants of 'Defect Triage'**

**Mandatory Participants:** Project Manager, Technical Lead/Development Lead, Test Lead

**Optional Participants:** Developers, Testers, Business Analyst

**@. Roles and Responsibilities of participants during 'Defect Triage' / What happens during DTM / outcome of DTM**

* During the defect triage meeting, each defect is analysed to see whether right **Priority** & **Severity** was assigned to it.
* If needed re-assign the priorities and discuss the reason with each attendee so that other members can understand the **Root Cause** of defect.
* Updates will capture in bug tracking system.

**@. TestNG Annotation**

TestNG Annotation is used to control the flow of execution (like sequence and priority) of test methods. These are inserted inside the program. Which allows to execute our code before and after certain points.

**Hierarchy of the TestNG Annotations:**

* @BeforeSuite: under this annotation method will execute before the execution of <suite> (this is at suite level)
* @BeforeTest: under this annotation method will execute before the execution of <test> (this is at test level)
* @BeforeClass: under this annotation method will execute before execution of class
* @BeforeMethod: under this annotation method will execute before each and every @Test annotation
* @Test: @Test annotation identifies that this particular method is in test environment
* @AfterMethod: under this annotation method will execute after the execution of each and every @Test ann.
* @AfterClass: under this annotation method will execute after the execution of class
* @AfterTest: under this annotation method will execute after the execution of <test> in xml
* @AfterSuite: under this annotation method will execute after the execution of <suite>

**@. How many Sprints have worked and how often will get Sprints**

My current organisation sprint structure is around 3 weeks of development and 4th week allows us to show the progress to the client, deploy it for testers, eliminate bugs and discuss about the next sprint.

**@. POM design pattern / Advantages / important parts in POM / Lazy Initialization Technique**

POM helps to create the page objects while implement the framework. Here element identification code (WebElements identification methods belongs to the page) and validation codes are kept separated. For each page of the application a class is created. Here each WebElement returns the identification value. Test scripts are maintained in separate class and methods of the page object files are call from the test scripts file to perform operations. In selenium-java POM is implemented, with the help of **@FindBy** and **PageFactory** annotations. There are 3 steps in POM those are Identification (Identifying the elements with @FindBy annotation), Initialization (using PageFactory annotation we can initialize the elements inside constructor), Declaration (creating action methods to WebElements and utilize these methods). If element is not found in POM we will get **StaleElementRefferenceExcp** and if PageFactory is not used to initialize WebElements we will get **NullPointerExcp**.

**Adv:**

* We can create an Object Repository using POM design pattern.
* For any change in UI (r WebElements) only page object files are need to be updated leaving test files are unchanged.
* It makes code reusable and maintainable.
* To avoid duplication of code.

**@. Framework / Advantages**

A FW is a structure with set of assumptions and rules must need to follow while automating the appl

**Adv: -- crm**

* Provide consistency in testing
* Readability
* Increase Reusability of script
* Maintainability (Less maint)

**@. Cookies / delete cookies in selenium**

Cookies are the small text files that are stored by a website in our computer to keep track of information about our browsing on that site.

* With the help of **driver.get(“**url**”)** command to launch URL and to delete cookies.
* Click on Logout link is mandatory to our application sometimes this will delete session cookies.
* By using **driver.manage().deleteCookieNamed(**arg0**)** / **deleteCookie(spe\_cookie)** / **deleteAllCookies()** methods

**@. To get cookies in selenium**

* With the help of **driver.navigate().to(“**url**”)** command to launch URL and to get cookies.
* Read the cookie information by using **driver.manage().getCookieNamed(**arg0**)** / **getCookies()** methods
* Store the cookie information by using **FileWriter** Class (to write streams of characters) and **BufferedWriter** class (to write the text into a file and to create as .txt file) i.e., Cookies data.

**Return Type:** Methods can return a value and it can possible without **void** in method signature. If the **void** is mentioned in method signature, that means method doesn’t return any value. If method is returning a value, then must specify the type of the value it can return.

**Parameter:** A parameter is an argument which is passed to a method to perform some specific operations.

**@. Various commands / functions provided by Selenium WebDriver**

Selenium WebDriver commands can broadly classify into 3 categories those are:

1. Browser interaction commands
2. [Navigation Commands](https://www.javatpoint.com/selenium-webdriver-navigation-commands)
3. [WebElement Commands](https://www.javatpoint.com/selenium-webdriver-webelement-commands)

**1. Fetching a webpage:** **get()** and **navigate().to()** methods are used to fetch particular web page

**2. Locating forms** and **sending user inputs:** driver.findElement(By.LN("LV")) method is used to locate forms and sendKeys("javatpoint tutorials") method for sending user inputs.

**3. Clearing User inputs:** clear() method is used to clear the user inputs from text box or edit box.

**4. Fetching data over any WebElement:** Sometimes we need to fetch the text written over a WebElement to performing some Assertions operations for this we use **getText()** method. It will return the text in string format.

**6. getAttribute():** is used to capture values (inner HTML text) of different attributes like name, class, id of an element and Its return type is string.

**7. Performing click() & submit() events:** click() method is used to perform click activity on any web element whereas submit() method is used to perform enter activity.

**8. Navigating backward & forward in browser history:** driver.navigate().back(); **&&&** driver.navigate().forward();

**10. Refresh / Reload a web page:** driver.navigate().refresh();

Dis-adv: The moment we refresh sometimes it will give the StaleElementExcep because the DOM will get loading again.

**11. Closing Browser:** We can use two methods for this

* **close():** driver.close(); ---- (To close current focusing window in browser associated with driver)
* **quit():** driver.**q**uit(); ---- (To close all other opened windows in browser associated with driver)

**12. Moving between Windows:** driver.switchTo().window("windowName");

**13. Moving between Frames:** driver.switchTo().frame("frameName");

**14. Drag and Drop:** Drag and Drop operation is performed using the Action class.

WebElement elementSource = driver.findElement(By.name("source"));

WebElement elementTarget = driver.findElement(By.name("target"));

Actions act = new Actions(driver));

Act.dragAndDrop(elementSource, elementTarget ).build().perform();

Some other commands like: getPageSource(), getCurrentUrl(), getLocation(), getFistSelectedOption() and getOptions()

**@. Can we test APIs or web services using selenium WebDriver**

No, selenium WebDriver always interact with browser by using the **browser’s native support** to automate the web applications so API testing is not possible using selenium WebDriver because APIs do not run-on browser. for API testing we can use Postman or SoapUI and Web services testing tools are RestAssured.

**@. To inspect the WebElement attributes in order to use them in different locators**

Using developer tools (CH) / Toggle Tools (FF) (ctrl+shift+c) to inspect the specific web elements and also chropath and SelectorsHub are the plugins for both chrome and Firefox that provides various development tools. These are used specially for inspecting web elements in order to use their attributes like id, class, name, etc. in different locators.

**@. To move the parent of an element using XPath https://www.quorcom/How-can-we-move-to-parent-of-an-element-using-XPath**

**//div[@id=”childid”]/..** or **//div[@id=”childid”]/parent::parent\_tagName** cmd will locate the **Pr** ele with **ch** attribute.

**@. To locate an element by only partially matching the value of its attribute in XPath**

We can use **contains()** method to locate an element while partially matching its attributes value. This is particularly helpful in scenarios where the attributes have dynamic values with certain constant parts. Whereas in Links, we can use locator as **partialLinkText(“LV”)** method.

**@. To move nth-child element using XPath** -----https://www.tutorialspoint.com/how-to-identify-the-nth-sub-element-using-xpath

There are two ways to navigating the nth element using XPath

* Using **square brackets** with **index** EX: div[3] 🡪 It will find the third div element
* Using **position()** mtd EX: div[position()=3] / div[‘position()=3’] / div[‘position=3’] 🡪 It will find the 3rd div element

**@. To move nth-child element using CSS Selector** -----https://www.swtestacademy.com/css-selenium/

**tag:nth-child(n)** will locate the nth-child element EX: div:nth-child(2) it will locate 2nd child element (i.e. div).

|  |  |  |
| --- | --- | --- |
| **Description** | **XPath** | **CSS Path** |
| Direct Child | //div/a | div > a |
| Child or child-of-child | //div//a | div a |
| Id | //div[@id=’idValue’] | div#idValue |
| Class | //div[@class=’classValue’] | div.classValue a (remove the spaces) |
| following-sibling | //ul/li[@class=’first’]/following-sibling::div[1] | ul>li.first + li (ul>li – pr, first + li – ch) |
| Attribute | //form/input[@name=’username’] | form input[name=’username’] |
| Multiple Attributes | //input[@name=email and @type=’button’] | input[name=’continue’][type=’button’] |
| nth Child | //ul[@id=’list’]/li[4] | ul#list li:nth-child(4(index)) |
| First Child | //ul[@id=’list’]/li[1] | ul#list li:first-child (ul#list - pr, li - ch) |
| Last Child | //ul[@id=’list’]/li[last()] | ul#list li:last-child (ul#list - pr, li - ch) |
| Attribute Contains | //div[contains(@title,’Title’)] | div[title\*=”Title”] |
| Attribute Starts-With | //input[starts-with(@name,’user’)] | input[name^=”user”] |
| Attribute Ends-With | //input[ends-with(@name,’user’)] | input[name$=”user”] |
| Element with Attribute | //div[@title] | div[title] |

**@. To locate elements using their text in XPath** ----- //\*[text()=’text content’]

**N:** CSS syntax in general ----- cssSelector(“tag[A\_N=’A\_V’]”) Ex: cssSelector(“div[class=’A\_V’]”)

**N:** To find matching elements through DOM console**:** $x(“XPath”) | $$(“cssSelector”). To clear console: ctrl+L

**@. To switch between multiple windows in selenium**

**Set<String>**, **Iterator<String>**, **driver.getWindowHandles()** and **driver.switchTo().window(“**whn**”)** commands allow to work with multiple windows. Here **getWindowHandles()** command returns the list of id’s corresponding to each window and by passing a particular window handle to **driver.switchTo().window(“**whn**”)** will switch to specific window.

**@. Is there a way to refresh the browser using selenium**

* Using **driver.navigate().refresh()** command to refresh the current page
* Using **driver.get(“URL”)** to navigate into URL
* Using **sendKeys(Keys.F5)** method to refresh the textbox on the webpage

**@. To find the value of different Attributes (Attribute\_Values) for name, class, id of an element**

**Ex:** String attributeValue = driver.findElement(By.LN(“LV”).getAttribute(“name/id”); // it will return A\_V of name

**@. Some expected conditions that can be used in Explicit Waits**

.elementToBeClickable(WebElement element)

.stalenessOf(WebElement element)

.visibilityOf(WebElement element)

.visibilityOfElementLocated(By.LN(LV))

.invisibilityOfTheElementLocated(By.LN(LV))

.presenceOfElementLocated(By.LN(LV))

.attributeContains(WebElement element, String attribute, String value)

.titleContains(String title)

.titles(String title)

.alertIsPresent()

.textToBePresentInElementLocated(By String)

**@. Keyboard Operators**

actns.keyDown(Keys.***CONTROL***).sendKeys("a").keyUp(Keys.***CONTROL***).build().perform();

sendKeys(“sequence of character”) – Used for passing character sequence to an input or textbox element

keyPress(KeyEvent.***VK\_CONTROL***) – Used for press keys like control keys, function keys, etc. those are non-text

keyRelease(KeyEvent.***VK\_CONTROL***) – Used in conjunction with **keyPress** event to releasing a key from KB event.

**@. Mouse Actions**

Click(WebElement element)

doubleClick(WebElement element)

ContextClick(WebElement element)

mouseUp(WebElement element)

mouseDown(WebElement element)

mouseMove(WebElement element)

moveToElement(WebElement element)

**@. To fetch the current URL in selenium** ---- driver.getCurrentUrl()

**@. To fetch the title in selenium** ---- driver.getTitle()

**@. To fetch the page source in selenium** - driver.getPageSource(); This method returns a string containing PS

**@. To check if an element is enabled for interaction on a web page** – isEnabled()

**@. To locate a link using its text in selenium / To click on Hyper Links using selenium**

**linkText()** and **partialLinkText()** methods are used to locate links. Difference between this two is **linkText()** method matches complete string passed as a parameter to the **linkText**. Whereas **partialLinkText()** method matches some portion of string passed as a parameter to the **partialLinkText**.

**@. To check which option in the dropdown is selected**

Select countriesDD = new Select(driver.findElement(By.id(“countries”))); ---- arg – dd parent element

countriesDD.selctByVisibleText(“India”); ------- // to select DD option ‘india’

boolean elePresent = driver.findElement(By.xpath("xpath")).isSelected(); **(or)**

System.out.println(driver.findElemnt(By.id(“India”))).isSelected(); -------- // It returns the Boolean value in console

**@. To handle window UI elements and Popups using selenium**

Selenium is used for automating web-based applications only. For handling window GUI elements, we can use AutoIT. It is a freeware used for automating window UI. AutoIT scripts follow simple BASIC language (syntax) and these can easily integrate with selenium tests.

**@. Robot API**

It is generally used to perform **KB** & **Mouse Events** and to upload files in the server while executing selenium scripts.

**@. To handle hidden elements in selenium WebDriver**

Where elements are not interactable because of hidden problem in those situations we use JsE. i.e.,

JavasrcriptExecutor js = (JavasrcriptExecutor)driver;

js.executeScript(“window.document.getElementByClassName(LV)”).click();

**N: PageFactory** is used to initialize the WebElements inside the constructor defined with @FindBy annotation i.e., **PageFactory.initElements()**

**N:** **Hybrid framework** is a combination of one or more frameworks. Normally it is associated with POM Design Pattern, DD and TestNG frameworks.

**N:** Hub is a server or central point in the selenium grid that controls the entire test execution on different machines.

**@. Node on Selenium Grid**

Nodes are called different machines (like diff OS with diff environment (different browsers, browser versions, java versions, etc)) these are attached to hub and hub controls all the nodes. There are multiple nodes in Selenium Grid.

**Dis-adv‘s of Grid:** We need to maintain multiple nodes in multiple VMs because I node = to 1VM (nothing but physical machine) we need to add these VMs to central Hub server. (for ex VM1 contain windows OS and this having all browsers, VM2 contain mac OS and this having all browsers, VM3 contain Linux OS and this having all browser. Suppose if we want to run our script on Linux OS & chrome browser grid will choose VM3 or if we want to run our script on mac OS & chrome browser grid will choose VM2 or if we want to run our script on windows OS & ff browser grid will choose VM1, etc). In Selenium Grid all the entire thing (nodes (VMs), Hubs) is present in different VMs machines.

In case of docker every node is considered as a container instead of maintaining physical machines (VMs) we can just pull different containers based upon different configuration (like OSs, Browsers, etc). These containers will associate with one single SeleniumHub container and based upon the desired capabilities it will choose proper container (that means proper OS, Browser, etc). In docker all the entire thing (containers, Hubs) is present in single machine.

**@. Explain the line of code WebDriver driver = new Firefoxdriver(); and purpose of ‘driver’ instance**

In the line of code **‘**WebDriver driver = new Firefoxdriver();**’** **WebDriver** is an interface so we can’t able create object to that interface directly so we are creating the WebDriver instance to the object of FirefoxDriver class (i.e., **new Firefoxdriver()**) then only we can able to access all the methods of both WebDriver and FirefoxDriver and also able to execute script on different machines. This entire concept is known as Runtime polymorphism.

**@. TestNG / Features of TestNG / list out some of the functionality in TestNG which makes it more effective**

TestNG standards for Test Next Generation and it is a Built-in unit testing framework. TestNG makes the automated test scripts are more structured, readable, maintainable and user-friendly. It can easily integrate with our automation scripts to perform multiple operations. It can be introduced to overcome the dis-advantages of JUnit. With TestNG we can perform end-to-end testing easily. ------adff hxpp adgp

**Features / Functionalities / Adv:** The following functionalities which makes it efficient testing framework those are

* Supports multiple Annotations.
* Allows **Data Driven** **Testing** (basically it is a combination of XLUtility along with DataProvider).

**@DataProvider** will get the data from the Excel sheet and store the entire data in the 2-D array. This method is responsible for proving the data to all test methods.

* Flexible test configuration
* Ability to Re-execute failed test cases
* Provide html reports
* With testing.xml we can control the execution of our test scripts.
* **Parameterizing** test cases by using @parameters annotation. ---- adff hxpp agdp
* It provides **Parallel** execution of test methods.
* TestNG provides different **Assertions** that helps to comparing the actual results with expected results.
* We can define the **Dependency** of one test method over other methods in TestNG.
* It allows **Grouping** the test methods into test groups.
* We can assign **Priority** to test methods in selenium.

**@. Use of testing.xml file**

testing.xml file is used to configure and triggering the test suite. In testing.xml file, we can create a test suite, grouping testcases, mark tests for parallel execution, execution methods can control, allows to create cross browser testing, add listeners and pass parameters to test scripts.

**@. Listeners in Selenium / Use of Listeners in TestNG**

In Selenium, Listeners "listen" the event defined in the script and behave accordingly. Listeners are used to allows customizing TestNG reports or to generate logs to provide some details about our test. There are two type of listeners in selenium those are WebDriver listener and TestNG Listener: WebDriver listeners are particularly useful where we need to capture and process events emitted by the WebDriver. TestNG listeners are particularly useful where we need to perform operations before and after a test method is executed. One of the most widely used TestNG listener is **@ITestListner** interface and it has methods like onStart, onTestSuccess, onTestFailure, onTestSkipped, onFinish etc. these are overridden methods. We need to implement this **@ITestListner** interface in created listener class itself. onStart() Will execute only once before starting all the tests and remaining all methods are responsible to create entries in the report (either fail or pass or skip etc). Best Ex is **@ITestListner** concept is used as in ExtentReporterManager class (Ref: API FW). To generate extent report by executing Tests only through testing.xml (bcz we are integrating **Test class** and **ExtentReportManager class** in textng.xml) then only report will generate. Before <test> we need to add <Listners>.

**@. @Factory and @DataProvider**

**@Factory** is used to **run a set of tests with different data values**. To achieve this, we define a separate set of tests inside a suite in the testng.xml. **The problem with this approach is if we get an extra set of data, we need to add more tests.**

**@DataProvider** is bound to individual test methods and execute the individual method multiple times.

**@. Some common assertions provided by TestNG**

assertEquals(Actual String, Expected String, “to pass String message in console”) //if script fail then only print Error msg

assertNotEquals(double data1, double data2, “to pass String message in console”)

assertNull(Object bject)

assertNotNull(Object bject)

assertFalse(Boolean condition, “to pass String message in console”)

assertTrue(Boolean condition, “to pass String message in console” )

fail(Boolean condition, “to pass String message in console”)

true(String message)

**@. To run test cases in parallel using TestNG**

In order to run the tests in parallel we just need to add these two key-value pairs to our test suite

* Parallel= ”methods/classes/tests”
* Thread-count= ”number of threads / max parallel executions we want to run simultaneously”

**Syntax:** < suite name="suite\_name" thread-count="5" parallel="classes" >

**@. Name an API used for logging? in java Use of logging**

Log4j is open-source API widely used for logging while script is executing. Log4j can configure with the help of Log4j.xml or Log4j.properties file. It supports multiple levels of logging those are – ALL, TRACE, DEBUG, INFO, WARN, ERROR, FATAL, OFF and FAIL.

**Use of logging in automation:** Logging helps to debugging the tests when required and also provides test’s runtime behaviour with date and time stamp.

**@. Selenium runs**

1. First create WebDriver instance.
2. Launch browser
3. Enter URL to navigate to webpage.
4. Locate an HTML elements on the webpage.
5. Perform require actions on that HTML element with the WebDriver commands.
6. Anticipate the browser response to that action.
7. Record test results using a test framework.
8. Conclude the test.

**@. To Run testng.xml through the command prompt ---** https://youtu.be/Dc1yvMdhF2U

Perform the following steps for running testng.xml through the command prompt:

1. Create a java project with test cases and generate testing.xml file (RC on class 🡪 TestNG 🡪 Convert to TestNG).
2. Go to project directory 🡪 copy bin path 🡪 back 🡪 search CMD
3. set classpath=F:\LT eclipse-workspace\RunFromCMD\bin; F:\LT eclipse-workspace\RunFromCMD\lib\\*

F:\LT eclipse-workspace\RunFromCMD\bin **--->** Project path from eclipse (after open ‘bin’ folder)

F:\LT eclipse-workspace\RunFromCMD\lib **--->** Here I kept whatever jars require for project in new folder

1. E 🡪 java org.testng.TestNG testng.xml 🡪 E

**@. To Run selenium WebDriver script from command prompt**

1. Add JAR files to project
2. RC on class 🡪 Export 🡪 in Export window ‘Expand ‘java folder’’ 🡪 click on runnable JAR File 🡪 Next 🡪 Under ‘Launch Configuration edit box’ 🡪 select particular project with class 🡪 Brows to select location of Exporting jars 🡪 save 🡪 Finish 🡪 ok 🡪 ok
3. Open downloaded jars folder (Resultant JAR is single JAR) 🡪 select on that jar and type CMD on folder navigation edit box 🡪 E 🡪 java -jar TestOne.jar #(TestOne --- Exported JAR name) 🡪 Enter

**@. Selenium WebDriver Architecture**



Interaction of the Selenium client library with the real browser

Selenium client library is available in multiple programming languages including JAVA, C#, Python, JavaScript, etc. These client libraries interact with the browser driver executable files using JSON wired protocol over HTTP which passes the actions and arguments to initiate the user actions, which will simulate with the real browsers by creating **WebDriver driver = new ChromeDriver();** here one section id will get create and this will happening at server side.

**N:** After driver.quit() we cannot use driver once again because section id will going to ‘null’ and in case of driver.close() it will depends on other window. If multiple windows present the section id is not null and only single window present the section id will going to null.

**N:** In case of multiple windows if one window is closed but we try to run getWindowHandles() method we will get section I'd is null so it throws NoSuchSectionExcep.

**@. Assert, Hard Assert and Soft Assert**

|  |  |
| --- | --- |
| **Hard Assert** | **Soft Assert** |
| When an assert statement is fails Hard Assert will throw an assert exception immediately and the test will not continue | When an assert statement is fails Soft Assert won’t throw any assert exception immediately but it will collect all errors and show at the end and test will continue with the next test |

**N:** If we click on one link if it is not open then we go to click other link without script fails for that situation we use SA.

**N:** While working with SA, If we want to know about the exceptions **softassertobj.assertAll()** method will use and it will placed as a last step in the test.

**@. TDD and BDD**

Both TDD and BDD are the software development techniques.

|  |  |
| --- | --- |
| **TDD (**Test Driven Development**)** | **BDD (**Behaviour driven development**)** |
| TDD is for Unit testing (here will test each method) | BDD is for E2E testing (here will test each scenario) |
| It is achieved by using Junit and TestNG | It is achieved by using Cucumber and SpecFlow |
| In TDD more focus on functional test cases | In BDD more focus on Acceptance test cases (these are provided by product owner) |
| It can understand only who can have programming knowledge | Everyone can understand this framework |
| - In TDD test the certain piece of functionality using prog lang’s  - Running the test to make them fail  - And then write the code to make the test pass  - Repeat the process  TDD is also called as Test First Development because in which here testing the code while developing it. | - In BDD test scripts are designed by describing the behaviour of an application appear to the end user in plain English language using Gherkin keywords.  - In BDD the process starts by writing a scenario as per the expected behaviour. |

**N:** In case of 100TCs we can execute 50TCs with the help of **@Test(enabled=false)** and in .xml use method incl and excl.

**invocationCount** allow to execute any method multiple times. It allows to set int value i.e., **@Test(invocationCount = 5)**

**threadPoolSize** defines the number of threads to be used while running a test method.

**N:** JSON is not programming language it’s for storing and executing data.

**@. Jenkins**

Jenkins is an open-source build automation tool and it is mostly used by the DevOps team to automate the build and to deploy the build. Here will know whether the new code is breaking something in the software or not. Gherkins programming language used by Jenkins. For this create pipe lines in multiple stages those are:

1. Automation code will get from GitHub repository by URL and creates the environment for execution.
2. Find some defects and those defects will logged into test management tools
3. Reports will get generated
4. DevOps team create a pipeline.

**@. Need to done before start automation testing**

* At least one cycle of manual testing complete
* Application should be stable

**@. If a particular testcase does not get executed with in the specified time then how to mark the testcase is fail and move forward how will achieve this using TestNG**

In TestNG we have a **timeOut** attribute and it allows the integer value. If the testcase does not get executed within the timeOut value then it will fail with the TimeOutException. **@Test(timeOut=90)**

**N:** In TestNG timeOut parameter represents that the max time a method can wait for execution. This parameter can use if we want to complete the automation with in the specified time.

**@. When selenium server requires to run Tests in selenium WD? Is selenium server require to run WD scripts**

* When we are using remote or virtual machine to run WD scripts if that specific browser is not in our local machine.
* When we are using selenium grid to distribute our test case Execution on different Remote or virtual machines.

**@. Verification points in selenium**

In selenium WebDriver there is no built-in features for verification points. It’s totally depending upon our coding style. Some of the verification points are: To check for Page Title, to check for certain Text, to check for certain element (Text box, Dropdown, button...…)

**@. Super interface of WebDriver** ----- SearchContext

**@. Use of creating the reference variable of type WebDriver (i.e., WebDriver driver)**

By creating the reference variable for WebDriver, we can use this same reference variable to work with any browser.

**N:** The **Optional Parameters** will useful when there are no other parameters define in the test case methods.

**@. To create feature file in cucumber**

RC on package 🡪 new 🡪 others 🡪 select ‘file’ under General folder and save with .feature extension

**@. Selenium is now W3C complaint**

* JSON wire protocol was used to communicate between the Selenium WebDriver and the browser native APIs.
* With W3C compliance, the communication happens directly without any encoding and decoding required.
* Any software following W3C standard protocol can be integrated with selenium with no compatibility issues.
* All the major browsers chrome, firefox and safari are already W3C complaint.

**@. Selenium 4 New Features**

1. Enhanced Selenium Grid

2. Upgraded Selenium IDE

3. Relative Locators in Selenium 4

4. Improved Documentation

5. Support for Chrome Debugging Protocol

6. Better Window/Tab Management in Selenium 4

7. Deprecation of Desired Capabilities

8. Modifications in the Actions Class

* WebElements are locate nearby elements by specifying directions using Relative Locators. Those are: above, below, toLeftOf, toRightOf, near
* Better window/tab management

Work with multiple windows or tabs in the same session.

We can open multiple windows/tabs without creating new driver object.

* Introduced new APIs for CDP (Chrome DevTools Protocol).

**Selenium 3:** inspect Elements in DOM, Mock faster/slower N/W speeds, Mock geolocations of the user, etc. **Selenium 4:** Capture and monitor N/W traffic, simulate N/W conditions, perform geolocation testing, etc

* Modification in the Actions class

Click on WebElement: moveToElement(onElement).click() 🡪 click(WebElement)

Click on element without releasing click: moveToElement(onElement).clickAndHold() 🡪 clickAndHold(WebElement)

Right click: moveToElement(onElement).contextClick() 🡪 contextClick(WebElement)

release() function is now part of the Actions class

* Some updates in Selenium IDE.

Now Selenium IDE is acts as a add-on for FF, CH, MS Edge browsers (Older it is limited to FF only).

**@. To resolve merge conflict Git** ---- **https://docs.github.com/en/pull-requests/collaborating-with-pull-requests/addressing-merge-conflicts/resolving-a-merge-conflict-on-github**

When people make different changes to the same line of the same file on different branches in Git repository. We can only resolve the merge conflict only on GitHub using the conflict editor or on CMD line. Steps to resolve GMC: Pull requests 🡪 Resolve Conflicts 🡪 Our conflict code will show in ‘conflict editor’ 🡪

Decide that we want to keep only our branch's changes, keep only the other branch's changes, or make a brand-new change, which may incorporate changes from both branches. Delete the conflict markers <<<<<<<, =======, >>>>>>>  and make the changes you want in the final merge.

If we have more than one merge conflict in our file, scroll down to the next set of conflict markers and repeat steps to resolve your merge conflict.

click **Mark as resolved** 🡪 click **Commit merge** 🡪 click **Create branch and update my pull request** or **I understand, continue updating BRANCH** 🡪 click **Merge pull request**.

Plugins require for IDE – Cucumber Eclipse plugin & Natural 0.9 plugin

https://cucumber.io/docs/cucumber/api/?lang=java

cucumber-junit

cucumber-java

cucumber-core

gherkin

cucumber-jvm

cucumber-jvm-deps

cucumber-picocontainer

junit

Shortcut for keywords in feature file: ctrl+space

Create feature file and the run the future file Run as ‘Cucumber feature’ all un implemented methods will generate in console

We can use JUnit to run Cucumber tests. To run JUnit, add the cucumber-junit dependency to your project. If you're using JUnit 5, add the junit-vintage-engine dependency as well.

Cucumber-JVM allows parallel execution across multiple threads since [version 4.0.0.](https://cucumber.io/blog/announcing-cucumber-jvm-4-0-0/)

Cucumber can be executed in parallel using JUnit and Maven test execution plugins. In JUnit the feature files are run in parallel rather than scenarios, which means all the scenarios in a feature file will be executed by the same thread.

**Order of execution:** Feature file contain number of steps and to implement feature file we need step definition file and this file internally call the Page Objects class.

To execute unimplemented methods must execute feature file not the TestRunner file

@Test(AlwaysRun=true) - that method will get execute always. In case of fail above any method

Cloning in Jira: if want to clone particular testcase and if we want to add them to the different test cycle then we can do that.

**Colour indicators in Jira**

Green: no prob with particular user story i.e., clean without any defect

Orange: there is non-blocker issue

Blue: means not completed but not having any defects

Red: it has so many non-blocker issues going to reject

Managers will use these colour indicators QA engineers will not use

**Conflict will occur** mainly two reasons those are:

There are two separate branches got changes into the same line in the file

When a particular file is deleted in one of the branches but it has got modified in another branch

**N:** Pre-requisites for protractor: Selenium WebDriver should require and download protractor package.

Feature file contain multiple features and each feature contain multiple scenarios and each scenario contain multiple steps and these steps will write in gherkin keywords

After creation of feature file every scenario and steps we need to create a step definition file. It is just java class. In step definition file we write the corresponding methods of each steps in feature file it's nothing but all the steps implementing in the step definition file. And run this particular step definition file.

If we have single feature file or specific scenario that can run directly. Suppose if you have multiple feature files then you have to create one test runner class (JUnit class) (main class). This test runner file will connect to feature file and this feature file and feature file steps will be read and these steps will again use in step definition file.

Feature file (nothing but folder) with .feature extension will create anywhere like project level, test level .......

step definition class and test runner class (JUnit class) will create under java folder

**N:** In eclipse we can’t run the Scenario alone but it possible in IntelliJ IDE

**N:** Always folders will create at project level

**149. Write code to click on the Check box which is inside the Dynamic Table ----** Ex: date field <https://www.guru99.com/handling-dynamic-selenium-webdriver.html>

**101. How can you prepare customized html report using TestNG in hybrid framework**

**N:** Git status commands is used to show the difference between the working directory and the index

**Git Commands:**

go to project directory

RC --> open 'Git Bash Here'

git init - to initialize repository (It will create a local empty repository) -------- 1time activity

git config --global user.name "BalakrishnaAratipamula" (GitHub UserName) -------- 1time activity

git config --global user.email "balakrishnmvn@gmail.com" (GitHub repo email) -------- 1time activity

git status - it will show what are all the folders ready to commit

* untracked files - are not part of staging area and these are ready to add staging area or git repository (will show in Red colour)
* tracked files - are already part of tracked files or git repository

git add -A - -A represents add all files to staging area / If we want to commit specific file use git add file\_name command

git status – this time status is green colour.

git commit -m "must write some comment msg" - commit all files into local git repository (staging area to local Git repo) (((((stagging to Git repo))))) 🡪 Enter 🡪 all files will show in white colour

git status – nothing to commit

**::** Create on empty rep in GitHub (rep name is normally the same name of our project in eclipse) 🡪 copy this **Repo URL**

git remote add origin "https://github.com/BalakrishnaAratipamula/CucumberDemoProject.git (**Repo URL**)" - to integrate Git with GitHub (provide connection bn Git and GitHub) ((((working dir to staging area)))) -------- 1time activity

git push -u origin master / git push origin branch\_name - send all the files from git to GitHub repository ((((((git to GitHub repo))))) 🡪 100% complete

------ Go to remote repository and refresh URL

Eclipse activity:

git clone GitHub\_Project\_URL - clone project into working directory which are not available in working directory

file --> Import --> General --> Existing projects into work space --> Next --> Browse --> Select project (which project we want to export) --> Next/Finish

copy work space location "F:\LT eclipse-workspace\CucumberA"

go to project directory

open 'Git Bash Here'

git pull origin master - remote repository to local system

clear - to clear

cd repo\_name – to focus that particular repository

git branch branch\_name – to create branch in repository

git branch – it will show all the existing branches in repository

git checkout branch\_name – to focus that particular branch

**N:** if we want create file in GitHub Add File --> create new File --> give extension .java if it is class --> commit new file

**N:** To disconnect Git connect RC on proj --> Team --> Disconnect

<https://www.guru99.com/top-100-selenium-interview-questions-answers.html>

**MANUAL**

**@. Software Testing**

Software Testing is a process of identifying the bugs in the software product. Here Test engineer will check whether the software product was developed as per the client’s requirements or not. Here we can ensure for quality. There are two types of testing those are**:** Structural or WBT (done by Developer) **&&&** Functional or BBT (done by Tester).

**@. SDLC / Phases available in SDLC / Project Execution Flow (SDLC)**

SDLC is a process of developing various quality software’s. It is a process for project execution flow. To develop and deliver any software product SDLC process can be followed. It describes the development process of software product to fulfil the client requirements within the specified cost and time. Which contains various phases like:

* Requirements capturing
* Analysis
* Design
* Coding
* Testing
* Deployment / Implementation / Live Environment / Production
* Delivery / Maintenance / Support

**@. Error, Defect, Bug, failure and Issue**

**Error:** Mistake in a coding is called ‘Error’ it’s like syntax error or logical error.

**Defect:** If software misses some features or functionalities from their requirements is called “Defect” **Or** The deviation between expected to actual results in AUT (Application Under Test).

**Bug:** Defect which is suspected by the development team is called Bug.

**Failure:** A deviation from the specified or expected behavior that is visible to End-users is called “failure”

**Issue:** TL/TM/PM/Client point of view Bug, Defect, Error, failure all are considered as issues.

**@. Re-testing and Regression testing**

**Retesting:** Re-testing the application to verify whether the defects have been fixed or not.

**Regression:** Re-executing some or all test cases in each build. Whenever new build is release, we have to verify that fixes or changes or added new features may have not introduced new errors. Regression testing is done in 3 situations.

1. After fixing the bugs
2. If a new change request will come from client
3. When environment changes

**@. Smoke and Sanity Testing**

**Smoke testing/BVT/TAT:** It is a first level of testing on any newly released build to check the **main functionalities** of the application. Smoke testing is done once the build is ready from the development environment before releasing it to the testing environment to make sure that **most basic** and **crucial functions** of software are working fine. The resultant of this testing is used to decide whether the build is ready for further testing or not.

**Sanity testing:** Sanity testing is done once the build is released to the testing environment. It is done when the build is Relatively stable. The main purpose of sanity test is **not to break the test execution** and to make sure that end-user requirements are met or not that means to verify the newly added functionalities etc. are working fine.

**@. Performance, Load and Stress Testing**

**Performance testing:** Performance testing is the process of checking whether the application is maintaining the targeted response time for the specific load. These are two types those are: Load testing and Stress testing.

**Load Testing:** Load means number of users. The process of increasing the load within the limits (for ex if application limit is 100 users, we will test from 1, 10, …. Up to 99) on the application and performance test engineer will check the response time of the application is known as **Load Testing**.

**Stress Testing:** The process of increasing the load beyond the limits (for ex if application limit is 100 users, we will test from 101, 110….) on the application and performance test engineer will check the response time of the application and at what point (load & time) the application is taking **more time** to process the request is known as **Stress Testing.**

**@. Usability testing**

Usability means easy to use and learnability of a human made objects. Here Test Engineer will check whether the application is maintaining user friendliness with the End users or not is known as **Usability Testing**.

**N:** **Accessibility testing** is the sub set of Usability testing here will validate the amount of ease to use application.

**@. AUT** stands for Application Under Test. The application which we are testing is known as AUT.

**@. Showstopper Defect** ------- A defect which is not permitting to continue further testing is called **SSD**.

**@. UAT**

UAT stands for User Acceptance Testing and it is also known as **Client Acceptance Testing**. UAT is done to check whether the application is working as per client requirements or not. Basically, UAT will conduct when the application is before going to production.

As per software testing standards once the application is stable, the client will provide some UA Test Cases to the testing team. The test engineer has to execute all the test cases. If all the Test Cases are passed, then only the client will accept the build and that build will be deliver to the client. UAT is two types those are:

**1. Alpha Testing:** UA Test Cases will be executed in Test environment by testing team.

**2. Beta Testing:** UA Test Cases will be executed in Client’s environment by testing team / client’s team / third-party TE’s.

**N:** Before proceeding build to UAT we make sure that the business flow is working perfectly or not by mapping the req’s

**@. TC Design techniques / ECP, BVA and Error guessing**

**Error guessing:** Based on our testing experience we know that particular thing is not working properly this will know only if we already worked on such type. It’s nothing but guessing defects which was there in the software.

**ECP:** ECP stands for Equivalence Class Partition. This technique is used to deriving the Test Data where it is not possible to develop the Test Data with all the positive and negative flows. Equivalence class Partition drastically cuts down the number of test cases required to test a system reasonably. We will use ECP as**:**

* + First divide the test data equally into valid and invalid partitions.
  + Test the field with valid data so that the field should accept it.
  + Test the field with invalid data so that the field should not accept it.

**BVA:** BVA stands for Boundary Value Analysis. This technique is used to deriving the Test Data to search the boundary conditions have a higher probability of detecting error for ex, when we are planning to test the range like 0-100 or 0-1000 or 1Lac to 2Lac etc., It is very difficult to test the field with all the values and even to write the Test data for all the positive and negative flows. The following are the reasons to introduce BVA:

* + Verify faults at near boundaries
  + Faults tend to around near boundaries
  + Test values on both sides of boundaries
  + Good place to look for faults

We will use BVA as**:** test the field with min, min+1, middle, max-1 and max values. If the field is accepting, then we can conclude that the test has been passed.

And test the field with min-1 and max+1 value. If the field is not accepting, then we can conclude that it is accepting only the range.

**@. System testing**

System testing includes functional and non-functional testing. Here will check overall functionality and performance of a complete and fully integrated software. It tests whether the system meets the specified requirements or not and also if it is suitable for delivery to the end-users. This type of testing is performed after the Integration testing and before the Acceptance testing.

**N:** **Response time** is the time taken between the request and response.

**@. Client Server Application testing and Web Application testing**

In **Client Server Application testing**, there are two different components to test. Those are application is loaded on the server machine and application .exe is installed on every client machine. Testing is done broadly in categories like GUI, func, non-func on both sides, Client-Server interaction and backend testing. Most of the CSA’s are Intranet networks.

In **Web Application testing**, the application is loaded on the server machine and no .exe is installed on the client machine. Web Applications can test on different browsers and OS platforms. It is tested mainly for browser and OS compatibility, GUI, functional, non-functional and backend testing, etc.

**Intranet network:** An **intranet network** is a **private network** that uses Internet Protocol technologies to securely share any part of an organization's information or system operations within that organization.

**@. Integration testing? different type of Integration testing**

Integration means combining once all the modules are developed by the developers, the developer will combine all the modules in a hierarchical order is known as **Integration**. **Integration Testing** means here will check whether the data flow between one module to other module is navigating properly or not and also verify data communication, co-existence relation between modules is called “**Integration testing**”. There are 4 different type of Integration testing are there those are:

**Big bang Int Testing:** Here testing will start after integration of all the modules.

**Top-down Int Testing:** Here testing will start from top-level modules to lower-level module in the hierarchy.

**Bottom-up Int Testing:** Here testing will start from lower-level modules to top-level module in the hierarchy.

**Hybrid Int Testing:** Here testing will start from the middle layer and testing is carried out in both the direction.

**@. Use Case, Test Case and Test Scenario** --wdt

**Use Case** is a graphical representation of actions, that describes the behaviour of a system to do a particular task.

**Test Case** consists of set of test data, input values, preconditions, postconditions, Actual results, Expected Results are developed to cover certain test Condition. A Test Case is executed to verify the functionality of our application using this a test engineer can determine whether a software product is functioning as per the client requirements or not.

**Test Scenario:** Scenario means a flow or story. Requirement will be divided into multiple scenarios to test the application with all possible flows. A Scenario is defined to identify all possible areas to be tested. It gives high-level idea on what we need to test. Which describes End-to-End functionality to be tested.

|  |  |
| --- | --- |
| **Test Scenario** | **Test Case** |
| It focuses on more "what to test" **than** "how to test". | It focuses on both "what to test" **and** "how to test.". |
| Test scenarios are derived from test artefacts like FRS. | Test Case is mostly derived from Test Scenarios. Multiple Test Cases can be derived from a single Test Scenario |
| Comparatively less time and less resources are required for creating and documentation of Scenarios. | More time and more resources are required for creating, documentation and execution of Test Cases. |

**@. QA and QC ----** ippc

|  |  |
| --- | --- |
| **QA** (Tester) | **QC** |
| Identify the standards and guidelines | Implement the standards and guidelines |
| Process oriented | Product oriented |
| Preventing problem | Detecting problem |
| Continuous improvement | Final check point before delivery |
| Goal of QA is to improve development and testing processes so that defects will not arise when the product is being developed | Goal of QC is to Detecting defects after a product is developed and before it’s released |
| Verification is an example of QA | Validation is an example of QC |

**@. In the software defects, how Priority and Severity defined / priority say in Test Case document**

**Severity**: Severity defines the importance of defect with respect to application functionality point of view. Responsibility of testing team. Each and every defect will have the severity and classification could be.

**CRITICAL / Fatal Defect / Blocker Defect:** A major functionality is failed so testing cannot continue **Ex:** login func fails.

**MAJOR:** A major issue in functionality of system component is not working but testing can continue **Ex:** Internal links or buttons are not working.

**MODERATE:** A minor issue in functionality of system component is not working that imposes some loss of functionality but testing can proceed without interruption **Ex:** Slight deviation in Button and Edit box positions.

**MINIMAL:** Under this will comes usability and UI issues **Ex:** spelling mistake, slight change in image / logo colors.

**Priority:** Priority defines the importance of functionality w. r. to client business needs that means how soon it should fix. Responsibility of developing team. Each and every bug will have priority and it describes the importance of the Test Cases. Based on the severity the priority will be assigned. Priority defines in which order the defect has been fixed by the developer. The classification could be P1-HIGH, P2-MEDIUM, P3-LOW.

**P1 (HIGH):** The Test Case describes about the main functionality.

**P2 (MEDIUM):** The Test Case describes about the field level.

**P3 (LOW):** All the GUI issues.

**@. Test Plan / What will write in Test Plan**

Software Test Plan is a strategic document which describes how to perform the testing in effective and efficient manner and also describes the scope, approach, resources planning, schedule of testing activities, identifies test items, features to be tested, testing tasks who will be doing and any risks, etc. It will be prepared by the Test Lead / Test Manager.

**@. Installation testing**

Install and uninstall the application using various operating systems and browsers (preferably it’s based on user env.)

**@. Ad hoc Testing**

Ad hoc Testing doesn’t follow any structured way while testing the application. It will do testing randomly on any part of application. The main aim of this testing is to find defects by random checking. Ad hoc testing can be achieved with the **Error Guessing Technique.**

**@. Compatibility Testing**

Testing the application in multiple environments like multiple browsers and multiple operating systems and check whether the application is working as expected in all the environments or not is known as **Compatibility Testing**. This kind of testing is very useful for Internet based applications like Facebook, G-mail, etc.

**@. End-to-End testing**

Test engineer has to identify the end user using scenarios in the application and execute all these scenarios and check that whether the application is fulfilling the end user’s requirements or not is known as **E2E testing**.

**@. Localization Testing**

Test engineer will test the application in all the local languages like Hindi, Bengali, Telugu, Tamil etc., and check that whether the application is working as expected or not is known as **Localization Testing** and it is also called as **L10N** testing, and here 10 is the number between **L** and **n** in the Localization word. @**Ex:** google.com avl in all the Local lang’s.

**@. Internationalization / Globalization Testing**

Test Engineer will test the application in all the international languages like Spanish, Chinese, Japanese etc. and check that whether the application is working as expected or not is known as **Internationalization testing**. and it is also called as **I18N** testing, and here 18 is the number between **I** and **n** in the Internationalizationword. @**Ex:** gmail.com available in all the Internationalization languages.

**@. Monkey Testing (or Gorilla Testing)**

Monkey Testing means testing the application by performing abnormal actions like: continuously click on any field for a longer period of time and check that whether the application is throwing any error or not. It’s nothing but enter the invalid data and check whether the application is crashing or not.

**@. Bug which is High Severity and Low priority**

High severity bugs will be having high priority. But if the bug is not related to the current release, then the priority of the bug will become low priority. The development lead having the permissions to change the priority.

**Ex:** If some crash is happening in the application but that particular module release to customer after some time.

**@. Bug which is Low Severity and High priority**

Low severity bugs will be having low priority. But if the bug is related to the current release, then the priority of the bug will become high priority. The development lead having the permissions to change the priority.

**Ex:** Slight change in logo colour or spelling mistake in About / Help page.

**@. Low Severity and Low priority** ----A spelling mistake in a page and that page is not frequently navigatin by users.

**@. High priority and High severity** ---- Issue with login functionality.

**@. Endurance Testing (or Soak Testing) and Volume Testing**

Both will come under Performance Testing.

|  |  |
| --- | --- |
| **Endurance Testing (or Soak Testing)** | **Volume Testing** |
| Testing the application with minimum load for 1 to 2hrs and check that whether the application is maintaining the targeted Response time or not is known as **Soak Testing**. | Testing the application with maximum load for 1 to 2hrs and check that whether the application is maintaining the targeted response time or not is known as **Volume Testing.** |

**@. Unit Testing / Component Testing**

Validating individual components within the system is called **Unit Testing** or **Component Testing**. Deliverable of this Unit Testing is: software unit is ready for testing with other system component. Unit testing tools are Junit and TestNG.

**@. Defect Age**

**Defect Age** is the difference in time between the current date (if the defect is still open) or Defect fixed date to the Defect Detection Date **for Ex**: If a defect was detected on 01/01/2009 10:00:00 AM and closed on 01/04/2009 12:00:00 PM, the Defect Age is 74 hours.**@@@**Defect Age = Current Date (or Defect Fixed Date) – Defect Detection Date

**Masked defect** is commonly known as **defect** that hides the other **defects** in the system so that the **defect** is not detected at a given point of time.

**@. Bug Release and Bug Leakage**

**Bug Release:** When a specific version of the software is released into market with some known bugs is known as Bug Release. These will get fixed in the later versions. These are low priority Bugs and this will mention in the software release note documents and sharing with end-users.

**Bug Leakage:** When the tested software is released into the market and the end-user finds bugs in it is known as Bug Leakage. During the test execution phase testing team missed to test these bugs. Bug Leakage will occur due to tester followed the wrong requirements, Developer developed the code with wrong requirements, Reviewing the TCs was not proper, client requirements not updated correctly. Generally, we perform UAT before release application into production to find defects which are not identified or which are moved to next phase. Bug Leakage is not part of Software Release Note documents because these bugs are missed by tester.

**@. GUI and UI Testing**

UI testing is mostly GUI testing. GUI testing is a subset of UI testing. **GUI** Testing focuses will on the software's graphical user interface (GUI) by testing elements such as icons, buttons, menus and text boxes are functionating correctly and also the logo colours. **UI** testing refers to the broader category of testing the interface (graphical, voice and touch) through which users interact with a website or an application.

**@. Defect Density ----** Ref for Ex: https://economictimes.indiatimes.com/definition/defect-density

Defect Density is the number of confirmed bugs (Defect count) in a software application or a module during the period of development, divided by the size of the software. It enables to decide if a piece of software is ready to release. Defect density is counted per thousand lines of code, also known as **KLOC**. **@@**DD = Defect count/ LOC of the release

**@. Latent defect ----** Defect which is identified in later stage due to hidden problem.

**Test Set** is a group of tests derived from the internal structure of a component in order to achieve 100% coverage of specific criteria. For Ex: **Tests** that focus on a certain part of the application such as GUI or Database and **Tests** that belong to a certain task such as Regression or Sanity.

**@. SDLC and STLC ----** rfp ntgp

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| --- | --- |
| **SDLC** | **STLC** |
| SDLC is mainly related to software development. | STLC is mainly related to Software Testing. |
| It focuses on both Development and Testing the software. | It focuses only on Testing the software application. |
| SDLC involves some phases like req capturing, analysis..... | STLC involves some phases like unds the req, TP, RTM..... |
| In SDLC, more number of developers are required for the whole process. | In STLC, comparing to developers less number of testers are required for the whole process. |
| In SDLC, Development team makes the plans and decisions. | In STLC, Testing team makes the plans and decisions. |
| Goal of SDLC is to developing a good quality software. | Goal of STLC is to testing the s/w product more effectively. |
| SDLC phases are completed before the STLC phases. | STLC phases are performed after SDLC phases. |

**@. Iterative process**

An iterative process is a process for calculating the desired result (expected results) by repeated cycle of operations. If number of iterations increase, it should come closer to desired result.

**@. Sprint**

In Agile methodology **sprint** is a **s**et **p**eriod of **t**ime during which, a specific work has to be complete and made ready for review. Each **sprint** begins with a planning and meeting. Traditionally, a **sprint** lasts 2-4 weeks.

**@. Static Testing and Dynamic Testing----** cop ctc cv

|  |  |
| --- | --- |
| ST checks the requirements, design documents and code for errors | DT checks the functionality of a software system such as memory usage and overall system performance |
| Objective is to discover verity of bugs and to prevent the bugs in software without executing the code | Objective is to find and fix the bugs in software by executing the code |
| It is performed at early stage of software development | It is performed later stage of software development |
| ST is less costly | DT is highly costly |
| ST generally takes shorter time | DT generally takes LT (bcz it involves running several TCs) |
| ST involves checklist for testing process | DT involves TCs for testing process |
| Includes informal reviews, technical reviews, code reviews, walkthrough and inspections | Involves functional and non-functional testing |
| It is a verification process | It is a validation process |

**@. WBT and BBT ----** icp hmsc

|  |  |
| --- | --- |
| **Blackbox Testing (Testers)** | **Whitebox Testing (Developers)** |
| Blackbox Testing is a [Software testing method](https://www.softwaretestingclass.com/what-is-software-testing/) which is used to test the application without knowing the internal structure of code. **----** icp hmsc | Whitebox Testing is a software testing method which is used to test the application by knowing the internal structure of code. |
| This type of testing is carried out by Testers. | This type of testing is carried out by Developers. |
| Implementation / Programming knowledge is not required to carry out Blackbox Testing. | Implementation / Programming knowledge is required to carry out Whitebox Testing. |
| Testing is applicable on higher levels of testing like System testing, Acceptance testing. | Testing is applicable on lower level of testing like Unit testing, Integration testing. |
| Black box testing means Functional Testing | White Box testing means Structural / Interior Testing. |
| Black Box testing can be started based on Requirement Specifications documents | White Box testing can be started based on Detailed Design documents. |
| Functional testing, Behaviour testing, Close box testing is carried out under Black Box testing, so there is no programming knowledge required. | Path testing, Logic testing, Loop testing, Code coverage testing, Structural testing, Open box testing is carried out under White Box testing, so compulsory programming knowledge require. ----- plcs |

**Entry Criteria** define the **pre-requisite** items that must be complete before **testing can begin.**

**Exit Criteria** defines the **post-requisite** items that must be complete before **testing can be concluded.**

**@. Dynamic Testing**

Testing the dynamic behaviour of code / elements is called **Dynamic Testing** or **Dynamic** **Analysis**. It refers the physical response from the system to variables are not constant and these are change with time.

**@. Positive and Negative Testing**

**Positive Testing:** Testing the application by providing the **valid data** **as input and** checks whether an application behaves as expected with positive inputs. This test is done to check the application response if it is supposed to do. For Ex.

**Negative Testing: Testing the application** by providing the **invalid data as input** and checks whether an application behaves as expected with the negative inputs. This test is done to check the appl response if it is supposed to do. For Ex.

[](https://www.guru99.com/images/p1(1).png)[](https://www.guru99.com/images/p2(1).png)

**@. Test Cases you have written in a project -------** Around 250 to 300 Test cases I written for my modules

**@. Techniques are followed to write test cases -----** In BBT we use techniques like ECP, BVA and Error Guessing

**@. Domain knowledge ----** Banking,Capital market, ERP,E-comers, Finance, Health care, Insurance, Telecom & Travel

**@. Testing Levels -----** Unit level testing, Integration testing**,** System testing and UAT

**@. Requirement Traceability Matrix (RTM)**

It captures all the requirements proposed by the client or software development team and their traceability in a single document that delivered at the conclusion of SDLC. It maps all the requirements with the Test Cases to check no functionality is unchecked during Software testing. Components in RTM**:** Req ID, TSs, TC ID/Name, TC Description. RTM helps to ensure 100% test coverage.

**@. How will provide priority for a Test Case / Advantage of priority**

We can assign priority to a test case based on importance of the functionality w. r. to client business needs. DL/TL can provide priority to a test case

**Adv:** Based on priority order the developer can fix the bugs and we can select test cases for execution when there is no time to execute all the test cases.

**@. Approach to write Test Cases**

* + First Study the Requirement Doc or Use Cases
  + Prepare test scenarios
  + Develop test cases for the particular scenarios

**@. Test Cases will write / prepare in a day**

It always depends on the project and requirements. But an average we can prepare 5 to 6 test cases per day. It means we are taking around 50 mins to prepare 1 test case it’s include review and analyse the requirement and to update it in test case template.

**@. Test Cases can be executed manually per day**

It’s always depending on the project and req’s but also depends upon below 2 approaches it may vary. Those are:

1. If we have written the test cases then we will know the functional knowledge of the application. So, we can execute 10 to 11 test cases per day.

2. If we not written the test cases, for example client has given the test cases. In this situation we can execute 7 to 8 test cases per day.

**@. Responsibilities of TE -----** ufs cpe iLr tsm aerc

* + Understanding the requirements and functional specifications of the applications
  + follow the standards and guidelines of project while testing the application
  + Identify the require Test Scenarios for project
  + Design and prepare Test cases and Test Data for identified scenarios
  + Participate in peer reviews
  + Execute the Test Cases to validate the application without any issue
  + Identify the defects and maintain the bug reports for defect tracking
  + Logging and tracking the defect
  + Re-test the fixed defects on previous builds ----- ufs cpe iLr tsm aerc
  + Perform various types of testing assigned by TL (functional, usability, system, UI, compatibility, Regression, etc.)
  + Prepare daily status report, daily defect report, weekly status report, monthly status report, Re-testing report and any other assigned tasks.
  + Participate in regular team meetings conducted by Team Lead
  + Preparing automation test scripts for Re-testing and Regression Testing
  + Based on end-user perspective providing enhancements (improvements) to the project
  + Provide recommendations whether the application or system is ready for production or not
  + Maintain good communication with hole team members

**@. Status reporting in organisation**

In my organisation all Test Engineers have to report status to Test Lead but sometimes may also report to Project Manager that depends on resource availability in the project so, team may report to TL or PM

**@. To share or sent a file (size-50MB) in the organization**

If the file size is more, then we can’t send it through a mail so, in my organizations we having “Common Repository”. so, copy the file and paste it in the Common Repository so any one can access it.

**@. Software Testing Process (STLC) (Testing Lifecycle)**

Software testing is a process that helps to make quality software and to find defects in the software. STLC process using as a testing process in my organisation. There are seven steps involved in this testing process those are:

**1) Test planning:** Here will write the test plan, which includes the activities that will be carried out throughout the test process. Product that will deliver as part of Test plan. Test plan will prepare by the Test Lead or Test Manager.

**2) Test monitoring & control:** Here will compare the progress with what is stated in the Test Plan. If there is a deviation between what was planned and what is actually done, we perform control activities to resolve this deviation. In test monitoring & control we may write a “Test progress report” that is used by stakeholders to monitor the progress of testing and decide whether the software is ready to be delivered or not.

**3) Test analysis:** Preparing Test Scenarios by reviewing the requirements, user stories, or design doc.

**4) Test design:** Preparing the Test Cases from Test Scenarios. Test Cases are more detailed than Test Scenarios and take more time to write. In some projects, we just use test scenarios, and in some other projects, we skip the test scenario writing step and just write test cases.

* 1. Test Initiation O/p 🡪 Test Strategy document is the O/P for Test Initiation
  2. Test Planning O/p 🡪 Test Plan document is the O/P for Test Planning

**Components in TP:** Some of the components will comes under test plan those are.

1. **TC Design:** We can design Test case as below
   * + 1. We can design Test case with the help of Use case and Test Scenario’s
       2. Using Test case design techniques like ECP, BVA and Error Guessing technique
       3. Using Test case Template
2. **Test Execution:** Test Execution can do with two documents those are
   * 1. Software Release Note Document (SRN): It describes about build details like Build version number, Build location, Modules changed, Installation steps, known issues and Bug fixes
     2. Deployment Document (DD): It describes how to install/deploy the application before testing and how-to setup the Test environment
3. **Defect Reporting:** Some of the components will require for defect reporting those are

-Defect Template

-Knowledge to assign Severity and Priority

-Bug Life Cycle (BLC)

5) Test implementation

In test implementation, we ask ourselves the question “Are we ready to execute our tests?”, and if the answer is no, we begin to work on turning this “No” into a “Yes”. Test implementation includes many activities like setting up the test environment that we will execute our tests on.

6) Test execution

In test execution, we execute our test scenarios or test cases. When defects are found, we write defect reports and report them to developers.

7) Test completion

In test completion, we make sure that all defects are fixed and we write test summary reports which summarize all testing activities that happened during the test process.

**72. When do you prefer Driver how it will work**

When main module is under construction **driver** will provide connection to sub modules it is also called as **“Calling Program”**

**73. When do you prefer Stub how it will work**

When **s**ub module is under construction **Stub** will return control back to main module with some temporary result is also called as "**Called Program**".

**75. What is Agile Methodology / Agile process / How agile methodology diff from traditional methodologies**

AGILE methodology promotes **continuous iteration** of development & testing throughout the Software Development Life Cycle of the project. In this both development and testing activities are concurrent unlike the Waterfall model.

* It is an iterative and incremental framework to develop applications ------ idcc pst hmet
* This model allows rapid dynamic changes in requirements
* Customer satisfaction by rapid delivery of working software frequently (weeks rather than months)
* Close and daily cooperation between business professionals and developers
* In Agile model project is divided into various sprints
* Each sprint contains highest-priority requirements
* A time period for sprint is typically 2 to 4 weeks
* Here will have scrum teams, scrum master and product owner
* In agile model, will conduct daily scrum meeting with team members to share status and potential issues
* Each sprint is released to customers
* It can be used for time-critical applications

The agile model software development mainly contains two core values those are: --- ir

* Individual and team interactions over processes and tools
* Responding to change over following a plan

**N:** Agile methodology define the process like we have to follow these particular principles. Whereas scrum is how to follow them and how to implement them.

**76. Explain difference between Verification and Validation**

Software testing is a combination of both verification and validation. These are the basic ingredients of SQA activities

**Verification:** It is a process to check Are we **developing** system right or not

Hence, Verification techniques can be used in Peer review, code walkthrough, Inspection, etc.

**Validation:** It is a process to check Are we **developed** system right or not

Hence, Validation techniques can be used in unit testing, integration testing, system testing, etc.

**77. What is meeting point in V-model ---- Coding** is the meeting point in V-model

**78. Which activity will be perf. to check project is acceptable or not to develop** -- Feasibility Study or Kick off meeting

**74. What is optimal testing -------** Validating the application with **best possible** test cases is called **optimal testing**

**81. What is Dynamic changes in Req’s -------** If client continuously sending changes in req’s while developing the appln.

**84. When defects will arise while developing appln ------** mistakes in Design **&&** mistakes in Coding **&&** incorrect req’s

**79. When do you think testing activities should start in software development process why**

Testing activities should start parallelly with development activities because early stages identified defects will take less time and less cost to solve those defects compare to later stages identified defects.

**80. What is prototype how it will helpful for TE**

Prototype is a model of the application or blue print of application. Based on approved SRS, software architect will design model of the project and it will help to foresee the future implementation of application.

**82. What type of skill set required for a TE**

-knowledge on Manual testing

-knowledge on any one of the automation tools like selenium, UFT, etc

-knowledge on any one of the automation tools supporting programming language (i.e., coding knowledge)

-knowledge on any one of the defect reporting tools like QC, Bugzilla, JIRA, etc

-knowledge on database (how to retrieve data from a database)

-Basic knowledge on different Domain applications

**83. Why do we perform software testing / Explain advantages of software testing -------** rmsb

-to deliver reliable product to customer

-to reduce maintenance cost of a project

-to stay in business

-to deliver bug free application

**85. What is Burndown chart in Agile**

A **Burndown chart** is a graphical representation of **work left to do** versus **time**. The o**u**tstanding work (or backlog) is represented on the **v**ertical axis along with time on horizontal axis. Basically, it is a clear representation about how much work completed and how much work is pending by the team.

**86. Difference between Test Plan and Test Strategy ----** dpc cid

|  |  |
| --- | --- |
| **TEST PLAN** | **TEST STRATEGY** |
| It is derived from SRS | It is derived from BRS |
| It is prepared by the Test lead or Test manager. | It is developed by the PM or the Business analyst. |
| Test plan id, test techniques, testing tasks, features to be tested, features pass or fail criteria, test deliverables, responsibilities, T schedule, etc. are the components of TP. | Objectives and scope, documentation formats, testing processes, team reporting structure, client communication strategy, etc. are the components of test strategy. |
| If there is a new feature or a change in the requirement need to update the test plan document. | Test strategy maintains the standards while preparing the document so it is also called as **static document**. |
| We can prepare the test plan individually for diff projects | We can use Test strategy to multiple projects. |
| It describes what to test, how to test, who will test and when to test. | It describes what type of testing technique can follow and which module to test. |

**87. Difference between Test Case and Test Script-----** stdd

|  |  |
| --- | --- |
| **Test Case** | **Test Script** |
| It is a step-by-step procedure to test an application | It is a set of instructions to test an application automatically. |
| The term Test Case is used in the manual testing env. | The term Test Script is used in automation testing env. |
| It is done manually. | It is done by scripting format. |
| It is developed in the form of templates and Test case template includes Test case ID, Test Data, Test procedure, Actual results, Expected results etc | It is developed in the form of scripting. Here will use different commands to develop the Test Script |

**92. Why performance testing required**

* It helps in checking the reliability of application to provide correct and consistent output
* It helps in evaluating the scalability of application (conduct performance tests with different number of concurrent users, we can check if the application is capable of scaling up to a higher number of users)
* It helps in checking the robustness of application (with stress testing, we can check the robustness of application).

**@. Software testing principles -----** teedp ta

**Adv:** There are seven principles in software testing to maintain uniform and consistency in output those are:

* **Testing shows presence of defects:** The defects could be present in software so we can’t go with an assumption that software is bug free
* **Exhaustive testing is not possible:** Testing all feature and functionalities with all inputs and outputs is impossible
* **Early testing:** Early stage identified defects will take less time and less cost to fix compare to later stage id defects
* **Defect clustering:** It’s nothing but a small module might contain most of the bugs.
* **Pesticide paradox:** if try to test google form for that we written 10 TCs in the 1st we get some bugs and 2nd also we get some bugs… those repeated usage of the same TCs without modifying it won’t give the bugs.
* **Testing is context dependent:** ecommerce app can test in own way and financial app will test in own way. Thinking in way of focus.
* **Absence of errors fallacy**

**@. Test Scenario and Test Condition ----** pig ur

**Test Scenario:** It is a process to test an application with all possible ways. These are the input for creation of testcases. It contains single or group of test cases. By writing scenario, we can understand the functionality of application. It reduces complexity.

**Test Condition:** It should be followed static rules to test an application. It makes system bug free.

**89. Difference between Test Procedure and Test Suite ----** coc

|  |  |
| --- | --- |
| **TEST PROCEDURE** | **TEST SUITE** |
| It is a combination of test cases to test an application. | It is a group of test cases to test an application. |
| Here order of execution is fixed. | Here order of execution may not important. |
| Test procedure contains end to end test cases. | Test suite contains all new features and regression test cases. |

**100. Explain about scrum events**

**Sprint planning:** Sprint planning is the detailed discussion of what work to be performed in the sprint. scrum master is responsible for making this and participants can understand its purpose.

**Sprint review:** Sprint review is conducted at the end of the sprint. Here will discuss about implementation of month-long sprint.

**Daily scrum:** daily scrum is time-box to 15 min to discuss development team’s activities for the next 24hrs and it also includes discussions regarding the what work performed in last 24hrs.

**Sprint retrospective:** The **sprint** **retrospective** is nothing but a meeting and that can be facilitated by the **Scrum** **Master**. Here team will discussion on just-concluded sprint and also determines what could be change in the next sprint to make sprint is more productive. It often helpful to management to get feedback from the team about the progress work.

**101. What can be delivered in the sprint How the work gets done**

The product owner discusses the goal of the sprint. Items from product backlog will be selected and included in the sprint backlog. Based on sprint backlog, the team needs to decide how it will work towards developing a usable increment

**N:** Suppose we r taken the user story for current sprint and dev and tester no able to complete that pert story that story points will go to backlog and these story points will add in next sprint.

**102. What is random testing**

It is one of the black box software testing techniques here the application is tested by different random dat

**103. What is Exploratory Testing**

**Exploratory Testing** is a type of software testing where Test cases are not created in advance but testers check system on the fly. They may note down ideas about what to test before test execution. The focus of exploratory testing is more on testing as a “thinking” activity. Exploratory Testing is widely used in Agile models and is all about discovery, investigation, and learning.

**104. Is testing depends on TCs or Testing types**

If any Build came first will done sanity test to know whether the build is acceptable or not (Let us assume there are chances that in a day we can expect there are 5 to 10 builds from developer side each time we will not test manually all those sanity TCs. We will automate the TCs that make we to accept the build or not)

**N:** Template means process document to prepare TC’s or TS’s ……..

**N:** In service-based companies’ client / client-side person will work as scrum master and in product-based companies we can expect all the employees from company itself.

**105. Difference between functional and non-functional testing**

|  |  |
| --- | --- |
| **Functional Testing** | **Non-functional Testing** |
| Testing the functional components in the application | Testing the non-functionalities of the application |
| Under the fun testing will come smoke, sanity, regression.... | Under the NF testing will come Load, stress, performance…. |
| Functional test data will be as per the requirement | Non-functional test data like testing with 5, 10, 20 users…… |
| Here will check the customer requ’s are meet or not | Here will check the stability and response time of the appl |

**106. Why any company has to do bug release --** If a bug is high priority bug the operation will get stop in prod time.

**237. What is mean by Reliability testing**

Reliability testing is carried out in order to confirm does the software displays reliable output for longer period of time irrespective of the operating system, browser should show the reliable output.

**238. What is mean by complains testing**

It is a non-functional test that’s actually validates does the software designed meets all the specified standards.

**239. What is mean by data Migration testing**

To make sure that the migrating data (nothing but data loss) from one version to other version should be minimal so that the production will not getting effected.

**240. What is mean by data Fuzz testing**

It is automation testing technique here will test whenever invalid or random data was given, we check what kind of exceptions are coming like software getting crashed or memory leakage happening.

**245. How to perform Debugging in manual testing**

For ex a company having two kind of servers one is production server(production people will use) and other is QA server. Testters using qa server and all the req's will go to qa server. What we need to do login to app go to directory where the logs are present (logs are nothing but human understanding readable lang). Which api is called and response of that api in case that api is breaking what excp I'm getting and also get new logs with what api is breaking with what error. Share those logs to developer is called debugging

**N:** Error seeding is the process of adding known bugs in a software to check the quality of the tester how can he manage

**N:** To create sprint take task from product backlog if scrum master will try to create new print but product backlog is over, he will take task from bug bucket of p0 priority bugs and assign to developer we re-test again......

**N:** Peer Review is also called as technical review.

**246. If lot of changes made in a build by dev and less time to finish what u do / What do in impact analysis meeting**

I will conduct the impact analysis meeting with the developer and the product manager to ask what changes u done and which module going to impact due to these changes. And I will test that particular thing only.

**N:** Impact analysis meeting helps to decide ‘How much regression testing should be done’.

**247. If click on end BTN in zoom it's not working what ur approach**

If button is not clickable on any web based applications We could see that netro page has could come In console will get all the ui calls getting captured Based on thus we know whether ui getting call or not so can find its ui issue or not

2nd way is check in network calls whether api is called or not if api working check application logs

**248. When should stop testing**

* All the bug fixes have done
* One complete cycle of all the Testcases have been executed
* All the Defects like Critical, major, blocker defects are resolved.
* Based on automation code coverage value.
* Based on Mean Time Between Failure (MTBF) – MTBF is the time interval between two inherent failures. Based on stakeholder’s decisions, if the MTBF is quite a large one can stop the testing phase.
* Once the testing deadline is met – Testing can be stopped after deadlines get met with no high priority issues left in the system.

**248. What is a Test Bed and Test Harness**

**Test bed:** It is a test environment used for testing an application. A test bed configuration can consist of the hardware and software requirement of the application under.

**Test Harness:** It is a collection of test scripts and test data that is usually associated with unit and integration testing.

**249. What is Defect Cascading**

Defect cascading is the triggering of a defect by another defect. It happens when a defect is not caught by the testing team and it gives rise to another defect.

**N:** Recovery testing is to test how Quickly the application recover from the failure or from sys crash or from the hardware failure to original state

**N:** On what basis u will calculate the story points Based on complexity it means how much time it will take for execution

**N:** Product owner is responsible for preparing user story. Product owner will define the features of the software in the form of user story

**250. Difference between scrum and agile**

Scrum is a framework through which we build the software product by following agile principles

**Continuous integration:** Continuous integration is a software development process in which the changes are made in software that are integrated into the main code. Here will be having one main branch in which all the code will be checked it and simultaneously other dev’s who are regularly creating new code or working on new features this code will put and integrate into the main code whenever this patch will be ready it will build, tested, deployed and monitor.

**Continuous delivery:** Continuous delivery is nothing but we are delivering the changes which are happening in the CI.

**Continuous deployment:** Whenever the CI changes are there, those are deployed into the target environment

**N:** Product manager is responsible for writing the epics and stories these will get from the customer

**URL**

Git Install - <https://youtu.be/E6-YSidPCu0>

Git from CDM to capture file - <https://youtu.be/9FOuyNt0V8I>

Git from CDM to capture code - <https://youtu.be/NJPkHtvyAIQ>

Git from IDE to capture code and merge - <https://youtu.be/HCeBd5GKNO8>

**SQL**

**1. What is SQL and when SQL was appeared**

SQL stands for Structured Query Language it is a declarative language used to communicate the DBMS. SQL was developed by IBM in 1974 later acquired by oracle. SQL is ANSI (American National Standards Institute) language for accessing Databases.SQL syntax is not care sensitive.

**2. What is SQL Process**

When we are executing SQL commands for any DBMs, the system determines the best way to carry out our request and SQL engine identifies how to interpret the task. There are various components included in this process. These components are Query Dispatcher, Optimization engines, Classic Query Engine and SQL query engine etc. Classic query engine handles all non-SQL queries and SQL query engine handle only SQL queries won't handle logical files.

**3. Is SQL supports Programming**

No, SQL doesn’t have any Conditional and Loop statements. Using SQL Commands, we can access the Databases only.

**4. What is MS Access**

MS Access is entry-level Database management software it was launched in 1992 by Microsoft Corporation as part of MS Office. It is not only an inexpensive and also powerful database for small-scale projects. MS Access comes with the professional edition of MS Office package and it is a user-friendly Data Base Management System.

**5. What is Oracle**

Oracle is a RDBMS developed by Oracle Corporation and launched in 1977. Oracle supports all major Operating Systems includes MS Windows, NetWare and most UNIX flavours.

**6. What is MS SQL Server**

MS SQL Server is a RDBMS, developed by Microsoft. Its primary query languages are T-SQL and ANSI SQL.

**7. What is Sybase**

Sybase is a name of computer software company and their primary product is Sybase RDBMS, it is a RDBMS based upon structured query language.

**8. What is MySQL Q: Teradata**  
MySQL is open-source RDBMS, developed by Swedish company. It is used for developing web applications

* MySQL Supports many different platforms including MS Windows, Linux distributions and Mac OS.
* MySQL has free and paid versions depending on its usage and features.
* MySQL comes with a very fast, multi-threaded and multi-user SQL database server.

**9. What is DB2** --------- DATABASE2 is a relational database product developed by IBM. in 1983  
**10. What is DB/400** -- DB/400 is a relational database product developed by IBM. It is one of the flavours of IBM DB2  
  
**11. What are Arithmetic operators in SQL**

|  |  |
| --- | --- |
| **Operator** | **Description** |
| + (Addition) | Add values |
| - (Subtraction) | Subtracts the Right-side value from Left side value |
| \* (Multiplication) | Multiplies values on either side of the operator |
| / (Division) | Divides left hand operand by right hand operand and returns co-efficient |
| % (Modulus) | Divides left hand operand by right hand operand and returns remainder |

**12. What are Comparison operators in SQL ----- or ----- Which Operators used in SELECT statements**  
 Let us assume x = 1 and y= 2  
**Operator    Example**  
=              (x = y) is False  
!=            (x!=y) is True.   
<>           (x <> y) is true.   
>             (x > y) is False  
<             (x < y) is True          
>=           (x >= y) is False  
<=           (x <= y) is True  
!<            (x! < y) is False  
!>            (x! > y) is True.

BETWEEN: Between an inclusive range LIKE Search for a pattern  
**N:** Comparison Operators are always return Boolean Results  
 **13. What are Logical operators in SQL**    
**Operator    Description   
AND**          Returns TRUE if both component conditions are TRUE **&&** Returns FALSE if either is FALSE.  
**OR**          Returns TRUE if either component condition is TRUE **&&** Returns FALSE if both are FALSE.

**NOT**           Returns TRUE if the condition is FALSE **&&** Returns FALSE if it is TRUE

**14. What is Data Relationship and What are they**

Database Relationship is nothing but a connection between the tables in a DB. There are 4 types of relationships:

* One to One Relationship, One to Many Relationship, Many to One Relationship and Many to Many Relationship

**15. What are the Important Data Types in SQL**

Char(x), varchar(x), int, smallInt, float(p), numeric(p,s), decimal(p,s), Date, Time, bit(x) and Real

**16. How to Select / Activate / focus particular existing Database in SQL** ------ **SQL>** USE db\_name;  
**17. How to view all existing Databases list** ------ **SQL>** SHOW DATABASES;

**18. How to fetch data from a Database Table**  
Using ‘SELECT’ Statement we can fetch (view table info) data from a Database Table  
**SQL>** SELECT column1, column2…..columnN FROM table\_name; **---OR---** SELECT \* FROM table\_name;

**19. Give a usage for BETWEEN ... AND**

SELECT emp\_name FROM table\_name WHERE age BETWEEN value1 AND value2 -- (the values can be numbers / dates)

**20. What is the use of CASCADE CONSTRAINTS** --- <https://www.techonthenet.com/sql_server/foreign_keys/foreign_delete.php>

When this **clause** is used with the **DROP** command i.e., a parent table can be dropped even when a child table exists.

**21. Why does the following command give a compilation error** --- **DROP TABLE &table\_name;**  
Variable names should start with an alphabet but here the table name starts with an '&' symbol.

**22. Which system tables contain information on privileges granted and privileges obtained**  
USER\_TAB\_PRIVS\_MADE **&&&&** USER\_TAB\_PRIVS\_RECD

**23. What is the advantage when specifying with GRANT option in the GRANT command**

Grant option gives the user permissions to grant the privileges to other users. Privileges**:** select, insert, update, delete

**24. What does the following query do SELECT SAL + NVL(COMM,0) FROM EMP;**

This displays the total salary of all employees. The null values in the commission column will be replaced by 0 and added to salary.

**25. Which system table contains info on constraints on all the tables created obtained** ------ USER\_CONSTRAINTS

**26. State true or false. EXISTS, SOME, ANY are operators in SQL** ------- True

**27. Which command executes the contents of a specified file** ------ START or @

**28. Which command displays the SQL command in the SQL buffer and then executes it** ------- RUN

**29. Which command is used to get back the privileges offered by the GRANT command** ------- REVOKE

**30. What operator performs pattern matching** ------ LIKE operator

**31. What is the use of DESC in SQL**

DESC has two purposes. It is used to describe a schema as well as to retrieve rows from table in DESCending order.  
**Ex:** SELECT \* FROM emp\_order BY emp\_name DESC; will display the output sorted on emp\_name in descending order.

**32. What command is used to create a table by copying the structure of another table**

To copy only the structure, the WHERE clause of the AS SELECT command should contain a FALSE statement with CREATE TABLE command can be use as: CREATE TABLE new\_t\_name AS SELECT \* FROM existing\_t\_name WHERE 1=2;

If the WHERE condition is true, then all the rows or rows satisfying the condition will be copied to new table.

**33. What are the wildcards used for pattern matching** \_ for single char substitution **&…&** % for multichar substitution

**34. What is an SQL injection**

When form data contains an SQL escape sequence and injects a new SQL query to be run is called **SQL injection.**

**35. Difference between TRUNCATE & DELETE**

|  |  |
| --- | --- |
| **TRUNCATE** | **DELETE** |
| TRUNCATE allows deleting entire table and TRUNCATED records cannot rolled back | DELETE allows the **f**iltered deletion so Deleted records can rolled back |
| Database triggers do not fire on TRUNCATE | Database triggers **f**ire on DELETE |

**36. What is the use of the DROP option in the ALTER TABLE command** ----- To drop constraints specified on the table

**37. What operator tests column for the absence of data** --------- IS NULL operator

**38. What are the privileges that can be granted on a table by a user to others**

select**,** Insert, update, delete, alter, references, index, execute, all.

**39. Which function is used to find the largest integer less than or equal to a specific value** ------- FLOOR

**40. Which subset of SQL commands is used to manipulate Oracle Database structures, including tables** ---- DDL

**41. What is the output of the following query SELECT TRUNC (1234.5678, -2) FROM DUAL;** ------- 1200

**42. What is the sub-query --** Sub-query is a query which return values are used in filtering conditions of the main query

**43. What is a join Explain the different types of joins**

The join clause is used to combine or retrieves records from 2 or more tables in a Database. Type of joins are:

* INNER JOIN - An inner join is used to return the matched records from both tables
* LEFT(OUTER) JOIN: Returns all records from the left table and the matched records from the right table
* RIGHT(OUTER) JOIN: Returns all records from the right table, and the matched records from the left table
* FULL(OUTER) JOIN: Returns all records when there is a match in either left and right table

****   

**44. What is correlated sub-query** ------ Correlated sub-query is a sub-query which reference to the main query.

**45. Explain CONNECT BY PRIOR** ------ Retrieves rows in hierarchical order for Ex, Select e\_no, e\_name from emp\_table;

**Hierarchical Queries:** If a table contains hierarchical data, then we can select rows in a hierarchical order by using the hierarchical query clause.

**46. Difference between INSTR and SUBSTR**

The **INSTR** function returns a character position in a pattern of string

**Ex:** INSTR(‘Dot-Net-Funda’,’-’,2) ----- O/P: **8**(i.e., 2nd occurrence of ‘-‘)

The **SUBSTR** function returns a specific portion of string

**Ex:** SUBSTR(‘DotNetFunda’,6) ----- O/P: DotNet

**47. Explain about INTERSECT, MINUS, UNION and UNION ALL**  
INTERSECT - returns all distinct rows selected by both queries.  
MINUS - returns all distinct rows selected by the first query but not by the second query.  
UNION - returns all distinct rows selected by either query  
UNION ALL - returns all rows selected by either query, including all duplicates.

**48. What is ROWID**

**ROWID** is a pseudo-column attached to each row of a table and that uniquely defines a single row in a database table. The pseudo-column is used to refer ROWID in the WHERE clauses of a query as we would refer to a column stored in our database. the difference is we cannot insert, update or delete ROWID values.

**Pseudo-column:** A **pseudo**-**column** behaves like a table **column** but values are not actually stored in the table. We can select values from pseudo-columns but we cannot insert, update or delete their values. A pseudo-column is also similar to a function without arguments.

**49. What is the fastest way of accessing a row in a table** ------- By using ROWID CONSTRAINTS

**50. What is an integrity constraint** ------- Integrity constraint is a rule that restricts values to a column in a table

**51. What is referential integrity constraint**

Maintaining data integrity through a set of rules, that restrict the values of one or more columns of the tables based on the values of primary key or unique key of the referenced table.

**52. Difference between primary key and unique key**

This concept can use to make the relation between tables.

|  |  |
| --- | --- |
| **Primary key** | **Unique key** |
| Primary key doesn’t accept duplicate values and null vals | Unique key not accept duplicate values but accept null vals |
| Only one primary key present in a table | Multiple Unique keys present in a table |

**API Testing**

**1. What are the important operations will do in API testing What are HTTP Requests**

**GET:** It will get the record/data from the server by passing URL

**POST:** It will go and create a new resource(record) in the server. POST require to pass Request body/ Request Payload. Use of Request Payload is when we create a post request, we need to specify what kind of record going to create in the server. There are two kind of POST requests 1st one is going to create a new record In database and 2nd one is going to validate some data in the database.

**PUT:** If we want to update the record, we need to use PUT request. PUT require to pass Request body/ Request Payload. Use of Request Payload is when we update a PUT request, we need to specify what kind of record going to update in the server.

**DELETE:** It will delete the record/data from server by passing URL

**N:** Every request will get response in the JSON format. RESTapi supports multiple formats (HTML, XML, JSON) but SOAP supports only XML

Once we get the response there are certain things we need to focus those are: Response Body (Body), HTTP status code (200, 201 are successful status codes ‘OK’ other than these codes our request is not processed properly because of some reasons), how much time it is taken (Time), how much data we got (size), along with these every response will have some headers (Header), Cookies

Add validation points under Test tab

**2. Difference between query parameter and path parameter is**

Query parameter will filter the data whereas path parameter will get data from the server based on path we specify.

For finding paths ---- json path finder

API documentation --- https://reqres.in/ (different type of requests will available username and pass copy from here for POST)

**Scenario Based Qns**

**1. In case Yesterday code executed properly but today not working**

Network issue, Server issue (because of this page not loading prop), Browser updated

**2. In production yesterday code worked properly and today not working properly getting very slow what is your root cause analysis.**

First check the load

Code breakage in existing code

Users side may be internet issues are there

Yesterday browser version is 72 and night updated to 74 which is not compatible by the website got deployed

May be browser changed

**N:** Whenever root cause analysis term came give answer like this: I will refer the log files

**3. Development env application working fine and in production env application facing some issues**

1. Proper deployment maybe not done in the production env

2. Production database not updated properly after each and every run

**1. What is Software Testing**

Software Testing is a process of identifying the bugs in the software product. Here Test engineer will check whether the software product was developed as per the client’s requirements or not. Here we can ensure for quality. there are two types of testing those are**:** Structural or WBT **&&&** Functional or BBT

**83. Why do we perform software testing / Explain advantages of software testing -------** rmsb

-to deliver reliable product to customer

-to reduce maintenance cost of a project

-to stay in business

-to deliver bug free application

Cost effective, security point, quality, customer satisfaction

**92. What are the software testing principles -----** teedp ta

**Adv:** There are seven principles in software testing to maintain uniform and consistency in output those are:

* Testing shows presence of defects: The defects could be present in software so we can’t go with an assumption that software is bug free
* Exhaustive testing is not possible: Testing all feature and functionalities with all inputs and outputs is impossible
* Early testing: Early stage identified defects will take less time and less cost to fix compare to later stage id defects
* Defect clustering: It’s nothing but a small module might contain most of the bugs
* Pesticide paradox: if try to test google form for that we written 10 TCs in the 1st we get some bugs and 2nd also we get some bugs… those repeated usage of the same TCs without modifying it won’t give the bugs.
* Testing is context dependent: ecommerce app can test in own way and financial app will test in own way

Absence of errors fallacy

**40. Explain difference between SDLC to STLC ----** rfp ntgp

|  |  |
| --- | --- |
| **SDLC** | **STLC** |
| SDLC is mainly related to software development. | STLC is mainly related to software testing. |
| It focuses on both Development and testing the software. | It focuses only on testing the software application. |
| SDLC involves some phases like req capturing, analysis..... | STLC involves some phases like unds the req, TP, RTM..... |
| In SDLC, more number of developers are required for the whole process. | In STLC, comparing to developers less number of testers are required for the whole process. |
| In SDLC, Development team makes the plans and decisions. | In STLC, Testing team makes the plans and decisions. |
| Goal of SDLC is to developing a good quality software. | Goal of STLC is to testing the s/w product more effectively. |
| SDLC phases are completed before the STLC phases. | STLC phases are performed after SDLC phases. |

**86. Difference between Test Plan and Test Strategy ----** dpc cid

|  |  |
| --- | --- |
| **TEST PLAN** | **TEST STRATEGY** |
| It is derived from SRS | It is derived from BRS |
| It is prepared by the Test lead or Test manager. | It is developed by the PM or the Business analyst. |
| Test plan id, test techniques, testing tasks, features to be tested, features pass or fail criteria, test deliverables, responsibilities, T schedule, etc. are the components of TP. | Objectives and scope, documentation formats, testing processes, team reporting structure, client communication strategy, etc. are the components of test strategy. |
| If there is a new feature or a change in the requirement need to update the test plan document. | Test strategy maintains the standards while preparing the document so it is also called as **static document**. |
| We can prepare the test plan individually for diff projects | We can use Test strategy to multiple projects. |
| It describes what to test, how to test, who will test and when to test. | It describes what type of testing technique can follow and which module to test. |

**Test Case:** Test case consists of set of test data, input values, preconditions, postconditions, actual results, expected Results are developed to cover certain test Condition. A set of actions are executed to verify a particular feature or functionality of our application. A test case includes specific variables or conditions, using which a test engineer can determine whether a software product is functioning as per the client requirements or not.

**19. What is Test Plan And What do you write in a test plan**

Software Test Plan is a strategic document which describes how to perform the testing in effective and efficient manner and also describes the scope, approach, resources, schedule of testing activities, it identifies test items, features to be tested, testing tasks who will be doing and any risks, etc. It will be prepared by the Test lead / Test manager.

**63. What is Requirement traceability matrix (RTM)**

It captures all the requ’s proposed by the client or software development team and their traceability in a single document that delivered at the conclusion of the lifecycle. In other words, it is a doc that maps and traces user req with TCs. Components in RTM**:** Requ ID, TSs, TC ID/Name, TC Description. RTM helps to ensure 100% test coverage.

**15. Explain the difference between Use case, test case and test scenario --** dt

**UC:** It is a collection of corresponding information on several items, which enables a test to be executed **(or)** Use case is a list of actions or event steps typically defining the interactions b/n the role (user) and a system to achieve the goal.

**Test Case:** Test case consists of set of test data, input values, preconditions, postconditions, actual results, expected Results are developed to cover certain test Condition. A set of actions are executed to verify a particular feature or functionality of our application. A test case includes specific variables or conditions, using which a test engineer can determine whether a software product is functioning as per the client requirements or not.

**Test Scenario**: Scenario means a flow or story. Requirement will be divided into multiple scenarios to test the application with all possible flows. A Test Scenario is defined to identify all possible areas to be tested. It gives high-level idea on what we need to test. Which describes end-to-end functionality to be tested.

|  |  |
| --- | --- |
| **Test Scenario** | **Test Case** |
| It focuses on more "what to test" **than** "how to test". | It focuses on both "what to test" **and** "how to test.". |
| Test scenarios are derived from test artefacts like FRS. | Test case is mostly derived from test scenarios. Multiple Test case can be derived from a single Test Scenario |
| Comparatively less time and less resources are required for creating and documentation using scenarios. | More time and more resources are required for creating, documentation and execution of test cases. |