**Java & it's Ecosystem**

This lesson introduces the reader to the origins of the Java language.

**Question # 1**

***Tell me a little about the history of Java as a language?***

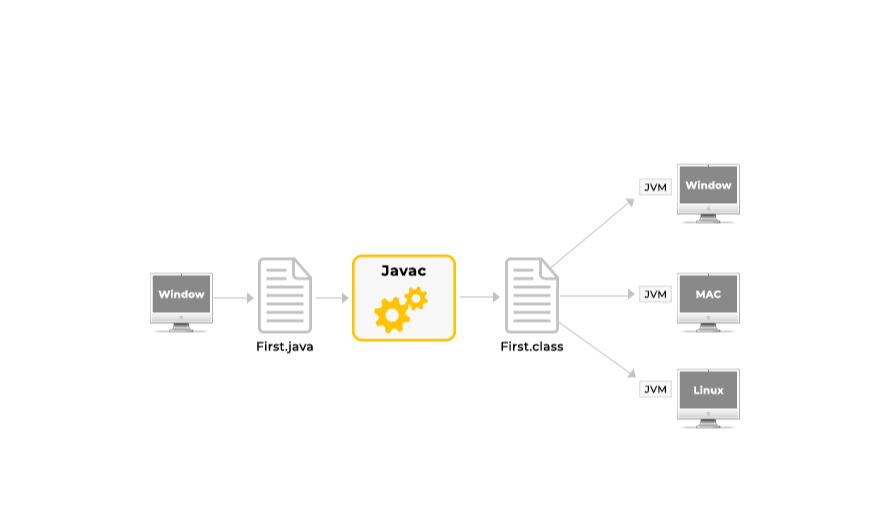
Java was created by James Gosling at Sun Microsystem (later acquired by Oracle) and first appeared in 1991. It is one of the most widely used **general purpose concurrent, class-based and object-oriented** programming languages.

**Question # 2**

***What is meant by the statement Java is platform independent?***

Java works on the principle of ***write once and run anywhere***. Once a Java program is written, it gets compiled into what is known as the ***byte code***, which can then be run on any Java Virtual Machine or JVM for short.

Compilation to bytecode is the magic behind Java's interoperability. Different operating systems and hardware architectures have JVMs custom designed for themselves and all JVMs can run the same bytecode. Therefore, if you write a Java program on Linux, it will run seamlessly on a JVM designed for Windows operating system, making code agnostic to the underlying hardware and OS.



Java's Portability

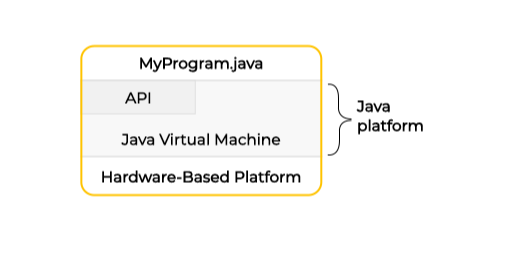
**Question # 3**

***What is meant by the Java platform?***

Java is both a programming language as well as a software platform. The platform consists of:

* Java Virtual Machine (JVM)
* Java Application Programming Interface (Java API)

Oracle's [Java Standard Edition](https://www.oracle.com/technetwork/java/javase/overview/index.html) is an example of the Java platform, which comes in different versions. Similarly, [Java Platform, Enterprise Edition](https://www.oracle.com/technetwork/java/javaee/overview/index.html) is another Java platform targeting enterprise. The platform includes the *Java Language Specification* and the *Java Virtual Machine Specification*. Oracle's corresponding JDKs are implementations of the platforms that can be downloaded and used.



Java Platform

**Question # 4**

***What is the Java language specification?***

In general, **language specification is an official document that gives detailed description of the syntax and semantics of a particular language.** Java publishes Java language specifications and the virtual machine specifications for various editions. Note the following:

* Every specification may not necessarily have an implementation in the JDK (for example JPA, JAX-RS).
* Third party vendors can also participate in implementing the specification.
* An actual implementation of the specification can be a superset of the original specification i.e. it can offer more than the specification but shouldn't contradict the specification.

For example, here is the [*link*](https://docs.oracle.com/javase/specs/) to the Java SE specifications.

**Question # 5**

***What is the Java API?***

Java API is a **large collection of ready-made software components that provide many useful capabilities that comes prepackaged with the Java development kit.** It is grouped into libraries of related classes and interfaces known as packages.

These APIs enable Java programs to access the local file system, the network and other basic functionality which one would otherwise have had to program oneself. These APIs cut down development time.

The standard Java APIs come bundled with the Java Runtime Environment (JRE) or with the Java SDK which also includes a JRE.

**Question # 6**

***What is the Java Runtime Environment?***

The Java Runtime Environment (JRE) includes the **Java Virtual Machine and the standard Java APIs (core classes and supporting files.)**. The JRE contains just enough to execute a Java application, but not to compile it.

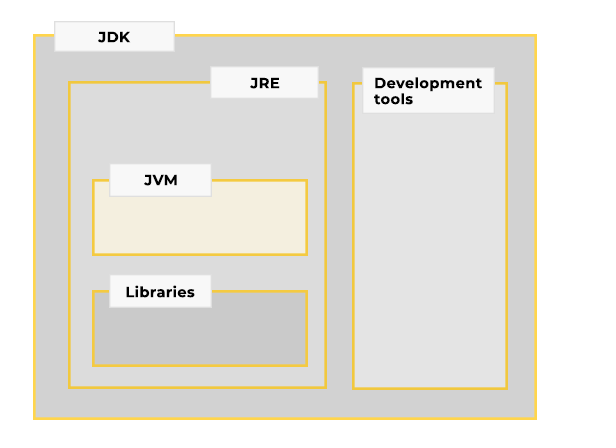
**Question # 7**

***What is the Java Development Kit or JDK?***

The Java Software Development Kit (Java SDK) is **JRE plus the Java compiler, and a set of other tools.**

Java Development Kit (JDK) consists of Java Runtime Environment (JRE) along with tools to compile and debug Java code for developing Java applications. JRE consists of Java platform libraries, Java Virtual Machine (JVM), Java Plugin and Java Web Start to run Java applications. JRE as a stand-alone does not contain compilers and debugging tools.

If you need to develop Java programs you need the full Java SDK. The JRE is not enough for program development. Only the full Java SDK contains the Java compiler which turns your **.java** source files into byte code **.class** files.



JDK vs JRE vs JVM

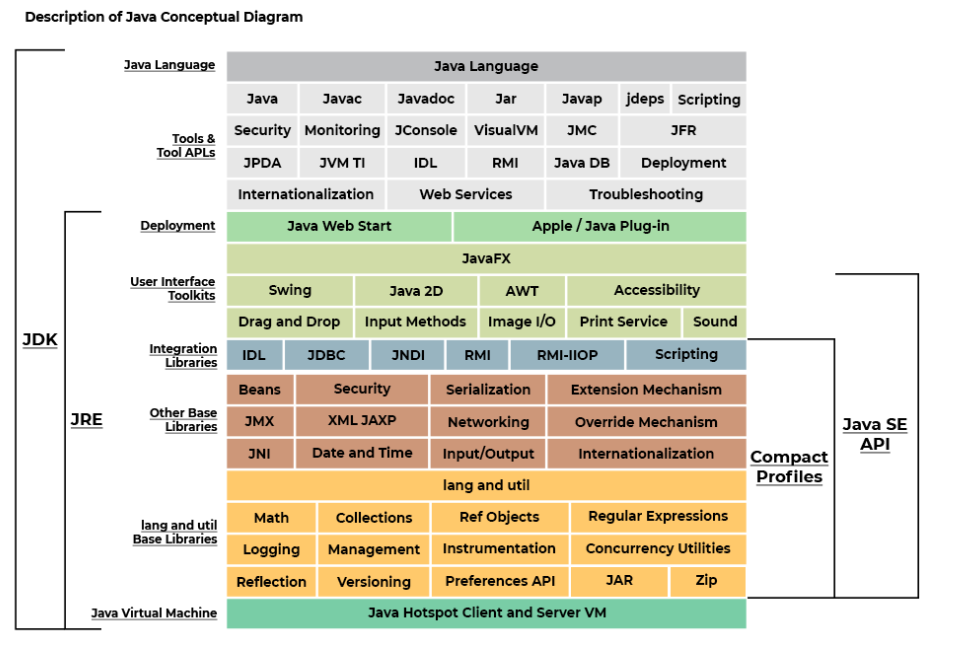
**Question # 8**

***Does Java's platform independence affect its performance?***

As a platform-independent environment, the Java platform can be a bit slower than native code. **Converting byte code to machine code incurs a performance penalty. Additionally, Java is a memory managed language which requires cleaning up of the memory space periodically by the platform, resulting in reduced application throughput.** However, advancements in compiler and virtual machine technologies are bringing performance close to that of native code without threatening portability.

**Bird's-eye View**

The below image inspired from Oracle's website shows a bird's-eye view of the Java ecosystem.



**Question # 1**

***What is the Java Virtual Machine or JVM?***

**The Java virtual machine is an implementation of a specification, detailing the behavior expected of a JVM.** Any implementation that conforms to the JVM specification should be able to run code compiled into Java bytecode irrespective of the language in which the code was originally written. The Java Virtual Machine is implemented for several different operating systems, like Windows, Mac OS, Linux, IBM mainframes, Solaris etc. Thus, if your Java program can run on a Java Virtual Machine on Windows, it can normally also run on a Java Virtual Machine on Mac OS or Linux. Note that the JVM is a program itself that can be invoked on the command line and instructed to execute a file containing java bytecode.

In the Java programming language, all source code is first written in plain text files ending with the **.java** extension. Those source files are then compiled into **.class** files by the **javac** compiler. A **.class** file does not contain code that is native to your processor; it instead contains bytecodes — the machine language of the Java Virtual Machine. The java launcher tool then runs your application with an instance of the Java Virtual Machine.

The JVM is by definition a virtual machine or an abstract computer, i. e. a software machine that simulates what a real machine does. Like a real machine, it has an instruction set, a virtual computer architecture and an execution model. It is capable of running code written with this virtual instruction set, pretty much like a real machine can run machine code.

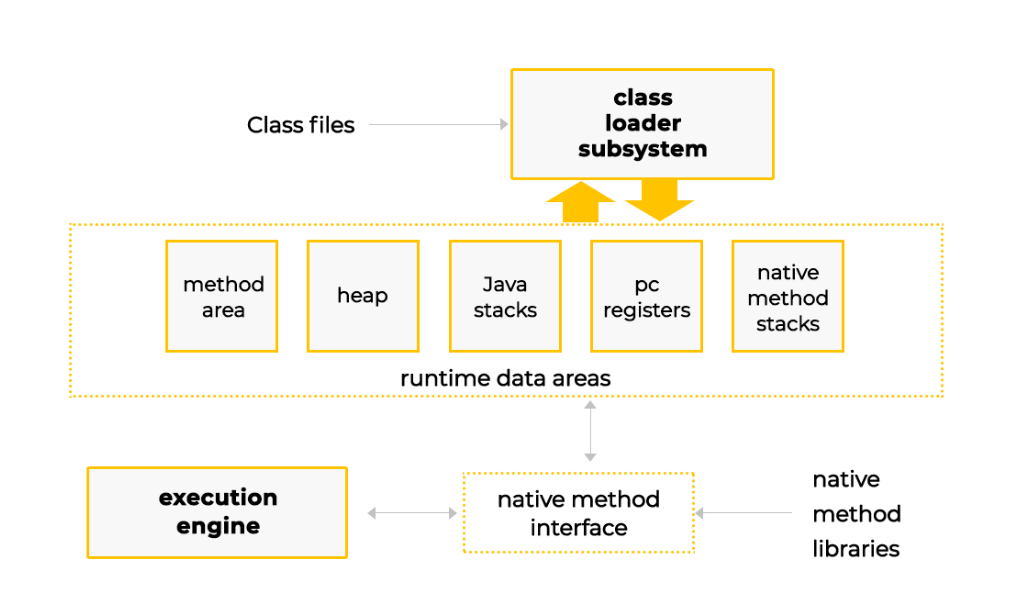
**In practice, JRE is the implementation of the Java Virtual Machine. The JRE contains the JVM and java binaries and other classes to execute any program successfully.**

**Question # 2**

***Describe JVM architecture?***

The Java Virtual Machine consists of three components:

* **Class Loader Subsystem:** The part of a Java virtual machine implementation that takes care of finding and loading types is called the class loader subsystem. The class loader subsystem is responsible for more than just locating and importing the binary data for classes. It must also verify the correctness of imported classes, allocate and initialize memory for class variables, and assist in the resolution of symbolic references. (See a more detailed explanation under the class loader section.)
* **Runtime Data Area:** The memory areas allocated by the JVM are called Runtime Data Area. These consist of method area, heap area, stack, pc registers and native stack. (See a more detailed explanation under the memory management section.)
* **Execution Engine:** The execution is responsible for the actual execution of the bytecode. It consists of three components: interpreter, just-in-time compiler and the garbage collector.



JVM Architecture

**Question # 3**

***If we launch two Java programs on the same machine, how many instances of JVM would be created?***

A runtime instance of the Java virtual machine runs a single Java application. When a Java application starts, a runtime instance is born. When the application completes, the instance dies. **If you start three Java applications at the same time, on the same computer, using the same concrete implementation, you'll get three Java virtual machine instances. Each Java application runs inside its own Java virtual machine.**

**Question # 4**

***Can you give a few examples of JVM implementations?***

A large amount of Java development work takes place on Windows, Solaris, Linux, and FreeBSD, primarily with the Oracle JVMs. In fact, Oracle's **Hotspot** implementation of JVM is used as a reference. Additionally, there are 32 and 64-bit varities of JVM. Some implementations of the JVM have been discontinued by their sponsors and aren't active. Some active implementations of the JVM are listed below:

* [Amazon's Corretto JVM implementation](https://aws.amazon.com/corretto/)
* [CACAO JVM implementation](http://www.cacaojvm.org/)
* [IBM's OpenJ9 JVM implementation](https://www.eclipse.org/openj9/)
* [Azul System's Zulu JVM implementation](https://www.azul.com/downloads/zulu/)

[JRockit](https://en.wikipedia.org/wiki/JRockit) is a discontinued implementation of the JVM. Twitter and SAP also have their implementations of the JVM specifications.

**Question # 5**

***What are JVM languages?***

JVM runs bytecode. The Java compiler converts code written in the Java language to bytecode. Similarly, other languages can take advantage of the Java platform if they have a compiler to convert code written in their respective languages to bytecode. For instance, [**Jython**](http://www.jython.org/) is an implementation of the Python language for the Java platform and a program written in Jython can run on any Java platform. [**JRuby**](https://www.jruby.org/) is another example, which is an implementation of the Ruby programming language atop the JVM. **Such languages that can run on the Java platform are called JVM languages.** Here's a [list](https://en.wikipedia.org/wiki/List_of_JVM_languages) on Wikipedia.

**Question # 6**

***What is Java Hotspot?***

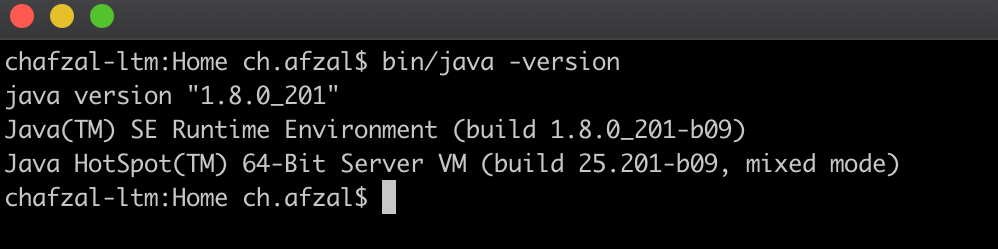
HotSpot is one of the most popular implementations of the JVM concept. It was originally developed by Sun and now is owned by Oracle. There are two editions available:

* Oracle Hotspot
* OpenJDK Hotspot

Sun open sourced and donated the Hotspot JVM source code which became the OpenJDK project. Implementations by OpenJDK serve as reference implementation.

There's not too many differences between the two as Oracle's Hotspot is based on OpenJDK's Hotspot project and comes with additional bells and whistles for paying customers. **The JVM implementation is called HotSpot because it continually analyzes the program's performance for hot spots of code (code paths which are executed repeatedly). The repeating code paths are compiled into very highly optimized native machine code for faster execution.**

You can check the installed JVM version on your machine using the **java -version** command. On my machine the output appears below:



The output shows that the version of the JRE as well as the JVM Hotspot version. Note separate Hotspot JVM implementations exist for server and client environments. In the above screenshot, the JVM identifies itself as the *Server VM*. The Java HotSpot Client VM has been specially tuned to reduce application start-up time and memory footprint, making it particularly well suited for client environments. The Java HotSpot Server VM is similar to the Java HotSpot Client VM, except that it has been specially tuned to maximize peak operating speed. It is intended for running long-running server applications, for which having the fastest possible operating speed is generally more important than having the fastest possible start-up time. These two solutions share the Java HotSpot runtime environment code base but use different compilers that are suited to the distinctly unique performance characteristics of clients and servers. On a 64-bit capable JDK, only the Java Hotspot Server VM is supported.

**Question # 7**

***What is the execution engine?***

The execution engine is responsible for executing bytecode. The execution engine is one part of the virtual machines that can vary in different JVM implementations. The most used JVMs have three components of the execution engine:

* Interpreter
* Just in Time Compiler
* Garbage Collector

The simplest kind of execution engine just interprets the bytecodes one at a time.

Another kind of execution engine, one that is faster but requires more memory, comes with a just-in-time compiler. In this scheme, the bytecodes of a method are compiled to native machine code the first time the method is invoked. The native machine code for the method is then cached, so it can be re-used the next time that same method is invoked.

The third type of execution engine is an adaptive optimizer. In this approach, the virtual machine starts by interpreting bytecodes, but monitors the activity of the running program and identifies the most heavily used areas of code. As the program runs, the virtual machine compiles to native and optimizes just these heavily used areas. The rest of the of code, which is not heavily used, remains as bytecodes which the virtual machine continues to interpret.

The garbage collector is discussed at length in the memory management section of the course.

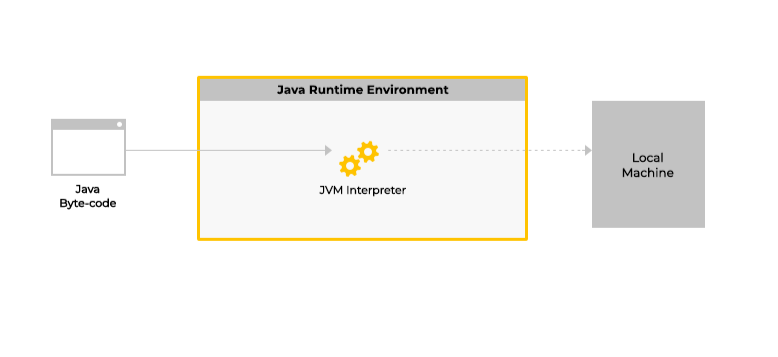
**Question # 8**

***What is the Java interpreter?***

**The Java Interpreter can be thought of as a translator that converts Java bytecode into native machine code. The translation of bytecodes to native machine code is done line by line.**

The Java interpreter is actually a part of the JVM. For each hardware architecture, a different Java bytecode interpreter is needed. When a computer has a Java bytecode interpreter, it can run any Java bytecode program, and the same program can be run on any computer that has such an interpreter.

When Java bytecode is executed by an interpreter, the execution will always be slower than the execution of the same program compiled into native machine language. This problem is mitigated by just-in-time (JIT) compilers for executing Java bytecode.



Java Interpreter

**Question # 9**

***Explain the working of the JIT compiler?***

**A JIT compiler runs after the program has started and compiles the code (usually bytecode or some kind of VM instructions) on the fly (or just-in-time, as it's called) into a form that's usually faster, typically the host CPU's native instruction set. A JIT compiler has access to dynamic runtime information whereas a standard compiler doesn't and can make better optimizations like inlining functions that are used frequently. This is in contrast to a traditional compiler that compiles all the code to machine language before the program is run for the first time.**

Java programs consist of classes, which contain platform-neutral bytecodes that can be interpreted by a JVM on many different computer architectures. **The JIT compiler helps improve the performance of Java programs by compiling bytecodes into native machine code at run time.** The exact behavior of the JIT compiler is hard to predict and documentation is scarce, however, the general theme on which JITs work is presented here. When a method has been compiled, the JVM calls the compiled code of that method directly instead of interpreting it. Theoretically, if the compilation did not require processor time and memory usage, compiling every method could allow the speed of the Java program to approach that of a native application.

JIT compilation does require processor time and memory usage. When the JVM first starts up, thousands of methods are called. Compiling all of these methods can significantly affect startup time, even if the program eventually achieves very good peak performance. In practice, methods are not compiled the first time they are called. For each method, the JVM maintains an invocation count, which starts at a predefined compilation threshold value and is decremented every time the method is called. When the invocation count reaches zero, a just-in-time compilation for the method is triggered. Therefore, often-used methods are compiled soon after the JVM has started, and less-used methods are compiled much later, or not at all. You can disable the JIT compiler, in which case the entire Java program will be interpreted.

JIT is not actually part of the JVM standard, it is, nonetheless, an essential component of Java.

Usually JIT compilers employ a sophisticated, low-cost, sampling-based technique to identify which functions merit optimization. A "sampler thread" wakes up at periodic intervals and checks the status of several application threads. It identifies what each thread is executing and notes some of the execution history. This information is tracked for all the methods and when it is perceived that a method is experiencing heavy use or in other words, becomes *hot* — that method is slated for optimization. Usually, a flurry of such optimization opportunities occurs in the application’s early run stages, with the rate slowing down as execution continues.

# Java Flavors & Processes

This lesson describes the various platform editions of Java. It also touches upon the community and processes around the Java ecosystem.

#### Question # 1

***What is Java SE?***

The *SE* stands for standard edition. We know that the Java platform is a suite of programs that facilitate developing and running programs written in the Java programming language. All Java platforms consist of a Java Virtual Machine (JVM) and an application programming interface (API). Don't confuse the Java programming language with the Java platform. The programming language is *one* part of the Java platform. Since Java is independent of the underlying OS and hardware, there exist different versions of the platform that target specific devices and use-cases.

A Java platform edition is defined by a specification that describes APIs and their interactions. For instance, the Java SE edition specifications can be seen [here](https://docs.oracle.com/javase/specs/). Any vendor is free to implement the specification. For instance, there's one called [Zulu](https://www.azul.com/zulu-enterprise-landing/), which is Java SE 11 compliant. Similarly, Oracle has their own implementation that can be downloaded from [here](https://www.oracle.com/technetwork/java/javase/downloads/index.html).

As a developer or a user, you'll be required to download either a JRE or JDK belonging to the edition you intend to use. The Java Standard Edition contains the basic Java APIs for standalone desktop and command line applications and can be used on desktop PCs, servers, and similar devices.

#### Question # 2

***What is OpenJDK?***

Open Java development kit is a free and open-source implementation of the Java Platform, Standard Edition (Java SE), and the base for the Oracle JDK. OpenJDK is the official reference implementation for Java Standard Edition from Java SE 7. In fact, Oracle JDK’s builds from OpenJDK source code and so do other vendors. There is no major technical difference between Oracle JDK and OpenJDK. Most of the vendors of JDK are written on top of OpenJDK by doing a few tweaks to replace either licensed proprietary parts or more high-performance items that only work on specific OS components.

The OpenJDK project came into being as a result of Sun open sourcing Java

#### Question # 3

***What is Java EE?***

Java EE is a specification describing a collection of technologies and APIs for the Java platform designed to support **enterprise** applications which can generally be classified as large-scale, multi-tiered, distributed, transactional, and highly-available applications for mission-critical business requirements. Technologies implementing and complying with Java EE specification include for instance GlassFish or IBM's WebSphere.

These implementations are the so-called *Java EE Containers*. When you hear people saying that "GlassFish is a Java EE 1.8 implementation" they mean that GlassFish (a Java program written using the Java Standard Edition classes) provides all the features that the Java EE 8 family of specifications define. A Java EE application needs a Java EE compatible server (such as GlassFish or Websphere) in addition to the JVM to run. Note, the Java EE platform is built on top of the Java SE platform and runs on the Java SE runtime i.e. Java SE JRE.

#### Question # 4

***What is Java ME?***

**The *ME* stands for micro edition. The Java ME platform provides an API and a small-footprint virtual machine for running Java programming language applications on small devices, like mobile phones.** The API is a subset of the Java SE API, along with special class libraries useful for small device application development. Java ME applications are often clients of Java EE platform services.

#### Question # 5

***What is Java FX?***

JavaFX is a platform for creating rich internet applications using a lightweight user-interface API. JavaFX applications use hardware-accelerated graphics and media engines to take advantage of higher-performance clients and a modern look-and-feel as well as high-level APIs for connecting to networked data sources. JavaFX applications may be clients of Java EE platform services. It's speculated that the *FX* in the name refers to special "EFF-ECTS".

#### Question # 6

***What is JCP?***

**The Java Community Process (JCP), established in 1998, is a formalized mechanism that allows interested parties to develop standard technical specifications for Java technology.** Anyone can become a JCP Member by filling a form available at the JCP website. JCP membership for organizations and commercial entities requires annual fees but is free for individuals.

#### Question # 7

***What is JSR?***

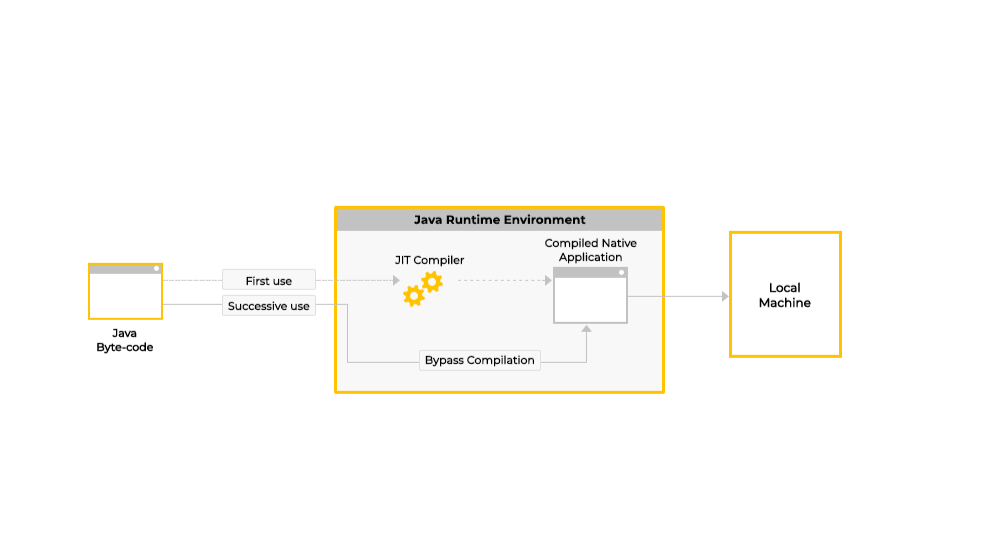
The JCP involves the use of **Java Specification Requests (JSRs) – the formal documents that describe proposed specifications and technologies for adding to the Java platform.** Formal public reviews of JSRs take place before a JSR becomes final and the JCP Executive Committee votes on it. A final JSR provides a reference implementation that is a free implementation of the technology in source code form and a Technology Compatibility Kit to verify the API specification.

#### Question # 8

***What is TCK?***

**A Technology Compatibility Kit (TCK) is a suite of tests that nominally checks if a claimed implementation of a Java Specification Request (JSR) is compliant.** The Technology Compatibility Kit for a particular Java platform is called Java Compatibility Kit (JCK). It is an extensive test suite used by Oracle and licensees to ensure compatible implementations of the platform.

Under the JCP process, release of a new or revised technology specification must contain three primary components:

* **Specification:** A written specification of technology. There are different kinds of specifications, for example platform editions, profiles and optional packages.
* **Reference Implementation (RI):** The prototype or proof of concept implementation of the specification. The RI is required to pass the TCK.
* **Technology Compatibility Kit (TCK):** A test kit that Java technology implementors can use to ensure that their work is conformant with the technology specification. The TCK must test all aspects of a specification that impact how conformant an implementation of that specification would be, such as the public API and all elements of the specification. A vendor's implementation of a specification is only considered conformant if the implementation passes the TCK.
* 

# Java Tools & Files

Common file types and tools used in Java development.

#### Question # 1

***What files do we write Java code in?***

Java code is written in files with the extension **.java**

#### Question # 2

***What are .class files?***

***or***

***What is Java bytecode?***

The java compiler compiles the **.java** files into **.class** files. The **.class** files contain what is known as the ***java bytecode***. Then the bytecode can be run by the JVM. **Java bytecode is the instruction set of the Java virtual machine.**

#### Question # 3

***What are .jar files?***

A JAR (Java Archive) is a package file format used to aggregate many Java class files and associated metadata and resources (text, images, etc.) into one file for distribution. A jar file is built on the ZIP format and typically has a .jar file extension. The jar tool can be used to create **.jar** file.

#### Question # 4

***What is a fat jar?***

***Fat jar,* or *uber jar,* is a jar which contains all project class files and classes from all the libraries, on which the project depends.**

#### Question # 5

***What is JCL?***

JCL stands for Java Class Library. It is a set of dynamically loadable libraries that Java applications can call at run time. JCL includes fundamental classes such as **java.lang.String**, **java.lang.Thread**, **java.util.ArrayList** and all the other classes from Java API. Almost all of JCL is stored in a single Java archive file called **rt.jar** (classes.jar on mac) runtime jar for short, which is provided with JRE and JDK distributions. Starting from Java 9 the **rt.jar** file has been broken into several smaller modules.

#### Question # 6

***What is a .hprof file?***

HProf is a tool built into JDK for profiling the CPU and heap usage within a JVM. A Java process crash may produce an **.hprof** file containing a heap dump of the process at the time of the failure.

#### Commonly Used Java Tools

|  |  |
| --- | --- |
| Name | Used For |
| **java** | Launches a java application. |
| **javac** | The Java programming language compiler, javac, reads source files written in the Java programming language, and compiles them into bytecode class files. |
| **javadoc** | Javadoc is a tool that parses the declarations and documentation comments in a set of source files and produces a set of HTML pages describing the classes, interfaces, constructors, methods, and fields. |
| **jar** | combines multiple files into a single JAR archive file. The combined files could include **.class** files, image and sound files etc. |
| **javap** | The javap command disassembles one or more class files. For instance, it can be used to view public, protected and private members of a class. |
| **JPDA** | The Java Platform Debugger Architecture is a collection of APIs to debug Java code. |
| **jConsole** | JConsole is a graphical monitoring tool to monitor Java Virtual Machine and Java applications both on a local or remote machine. |
| **Java VisualVM** | VisualVM is a tool that provides a visual interface for viewing detailed information about Java applications while they are running on a Java Virtual Machine. It helps in troubleshooting and profiling these applications. |
| **jcmd** | It is a comprehensive JDK tool for troubleshooting JVM applications. It can be used to get heap dumps, stack traces, retrieving garbage collector statistics etc. |
| **jmap** | map is a tool to print statistics about the memory in a running JVM. We can use it for local or remote processes. It can also be used to generate heap dumps. |
| **jstack** | This tool can be used to retrieve stack traces of all Java threads running within a target JVM. |
| **jstat** | This tool is used to monitor JVM statistics, which can also be observed using the visual tools. |
| **jinfo** | This tool prints Java configuration information for a given Java process or core file or a remote debug server. Configuration information includes Java System properties and Java virtual machine command line flags. |

# Variable Argument Passing

This lesson explains how variable number of arguments can be passed to methods.

#### Question # 1

***How can we pass multiple or variable number of arguments to a method on each invocation call?***

We can pass variable number of arguments to a method using varargs feature. Below is an example of passing multiple arguments of the same type to a method.

##### Varargs Example

**public void childrenNames(String... names) {  
        for (int i = 0; i < names.length; i++)  
            System.out.println(names[i]);  
    }**

Note:

* The type name is followed by three dots, a space, and then the variable name.
* The varargs variable is treated like an array.
* The varargs variable must appear at the last in the method signature.
* As a consequence of the above, there can only be a single varargs in a method signature.

The above method can be invoked as follows:

##### Invoking Varargs Method

**childrenNames();  
        childrenNames("jane");          
        childrenNames("jane", "tom", "peter");**

**Varargs method can also be invoked without any arguments.**

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class Demonstration {

    public static void main( String args[] ) {

        childrenNames();

        childrenNames("tom", "nancy");

        childrenNames("trump", "obama", "modi");

    }

    public static void childrenNames(String... names) {

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

            System.out.println(names[i]);

    }

}





RUN

SAVERESET

# Pass by Value

This lesson explains how Java works as pass by value.

#### Question # 1

***Is Java both pass by reference and pass by value?***

**Q**

**A)**

True

Your Answer

**B)**

False

Explanation

Java is pass by value only. Even reference data types are passed by value.

#### Great, you got it right!

Retake Quiz

#### Question # 2

***Give an example of pass by value?***

When primitive data types are passed to methods, their values are copied and sent over. Any changes made within the receiving method to the received values don't affect or change the original values. Consider the below snippet

##### Pass By Value Example

    void passByValue() {  
        float gravity = 9.8f;  
        receiveByVale(gravity);  
        System.out.println("Gravity acceleration = " + gravity);  
    }  
   
    void receiveByVale(float gravity) {  
        // Attempt to change gravity  
        gravity = 10f;  
    }

The above code will not change the value of the variable **gravity** in the method **passByValue**

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class PassByValueExample {

    public static void main( String args[] ) {

      (new PassByValueExample()).passByValue();

    }

    void passByValue() {

        float gravity = 9.8f;

        receiveByVale(gravity);

        System.out.println("Gravity acceleration = " + gravity);

    }

    void receiveByVale(float gravity) {

        // Attempt to change gravity

        gravity = 10f;

    }

}





RUN

SAVERESET

**Remember Java's method passing always work as pass by value!**

**Pass by Reference**

This lesson explains the concept of pass by reference.

**Question # 1**

***What is passing by reference?***

**Passing by reference doesn't apply to Java!** Reference data type parameters, such as objects, are also passed into methods by value. This means that when the method returns, *the passed-in reference still references the same object as before*.

To understand the concept of passing by reference, we'll go through an example. Consider the below code snippet.

**public class SuperList {  
   
    // Constructor  
    public SuperList(int n) {  
1.       List<Integer> superList;  
2.       allocate(superList, n);  
    }  
   
    // Method that does initialization  
    void allocate(List<Integer> list, int n) {  
3.       list = new ArrayList<>(n);  
    }  
}**

What should happen when we initialize an object of class **SuperList**? It will be null, which may seem counterintuitive.

* Consider **superList** to be a holder that will hold a value of null on line 1.
* On line 2, we are passing a value of null and not the variable **superList** itself. This is a very important distinction to realize.
* When program control, reaches line 3, the **list** variable is not the variable **superList**. In fact, it's a brand-new variable (holder) which receives a value of null.
* Line 3 also initializes the **list** variable to an object of **ArrayList** and the **list** variable will hold the reference or the address of the **ArrayList** object in the memory(heap).
* When the program control returns to line 2, **superList** is still null because it was never passed in and assigned the **ArrayList** object.

In Java, we are *copying* the reference or the address the reference data type variable holds and passing it, and not the actual variable.

Consider the below diagram for further clarity.

Note that objects are always created in heap memory and the program *variables* are only references or addresses to them. So, when we pass a reference data type, the address of the object in the heap memory is copied and passed along. The receiving method can use the reference or the address to manipulate the object in the heap.

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import java.util.\*;

class Demonstration {

    public static void main( String args[] ) {

        SuperList obj = new SuperList(5);

        System.out.println("superList = " + obj.sList);

    }

}

class SuperList {

    public List<Integer> sList;

    public SuperList(int n) {

      List<Integer> superList = null;

      allocate(superList, n);

      sList = superList;

    }

    void allocate(List<Integer> list, int n) {

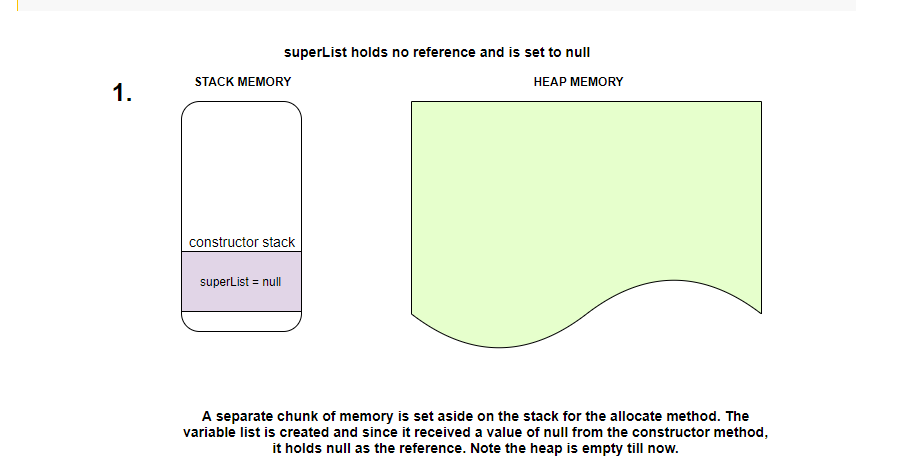
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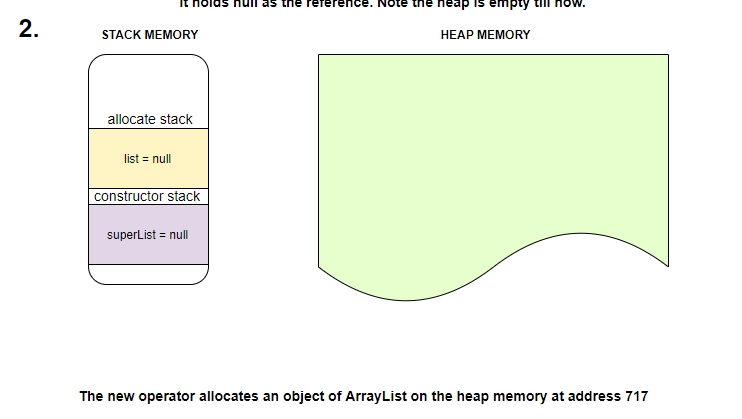
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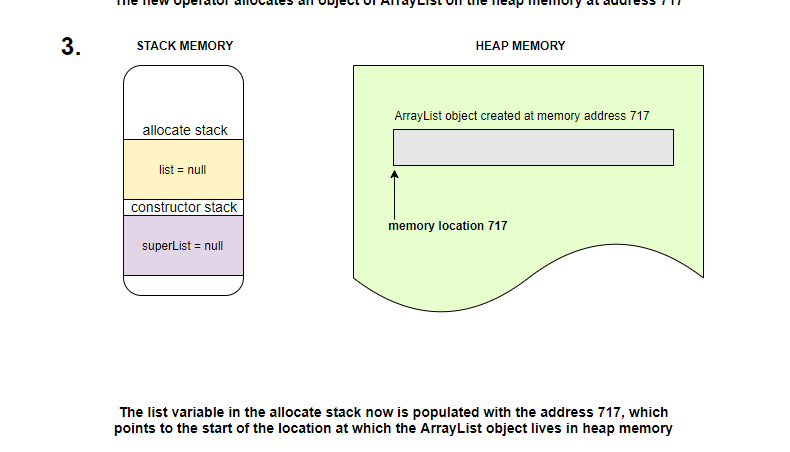


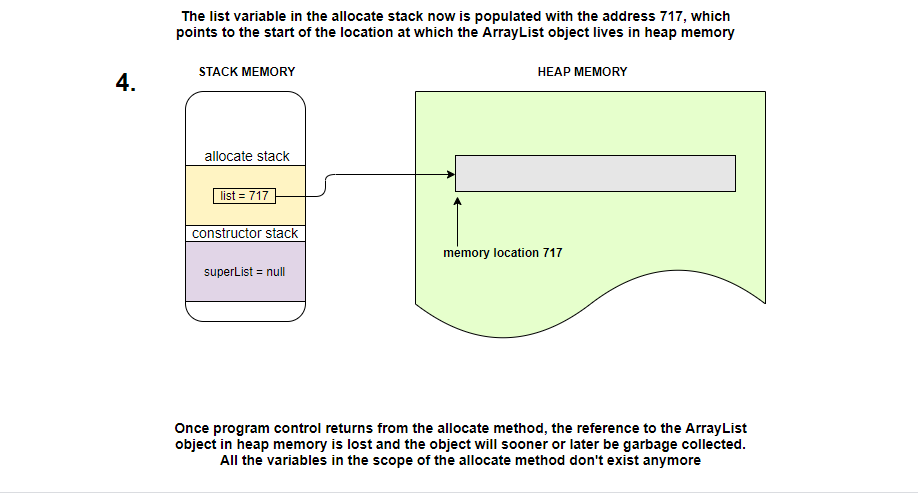


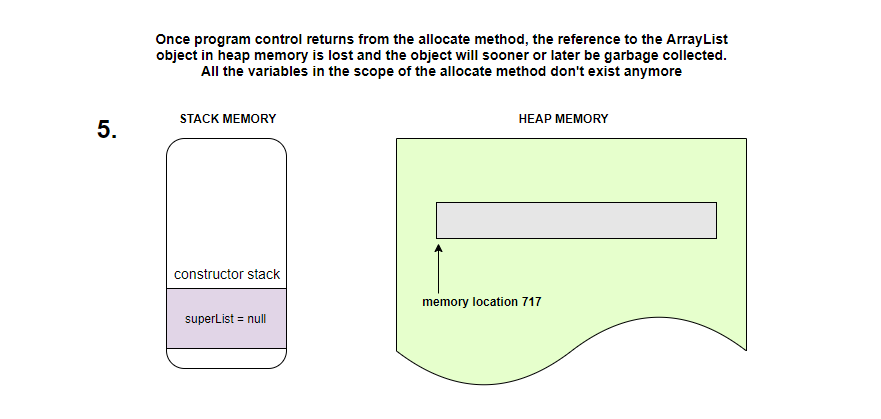
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**Question # 2**

***What will be the output of the run method for the IntegerSwap class below?***

**public class IntegerSwap {  
   
    public void run() {  
        Integer x = 5;  
        Integer y = 9;  
        System.out.println("Before Swap x: " + x + " y: " + y);  
        swap(x, y);  
        System.out.println("After Swap x: " + x + " y: " + y);  
    }  
   
    private void swap(Integer a, Integer b) {  
        Integer temp = a;  
        a = b;  
        b = temp;  
    }  
}**

The output for the two print statements will exactly be the same, i.e. there will be no swapping. Follow the diagram below to understand why.

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class IntegerSwap {

    public static void main( String args[] ) {

        (new IntegerSwap()).run();

    }

    public void run() {

        Integer x = 5;

        Integer y = 9;

        System.out.println("Before Swap x: " + x + " y: " + y);

        swap(x, y);

        System.out.println("After Swap x: " + x + " y: " + y);

    }

    private void swap(Integer a, Integer b) {

        Integer temp = a;

        a = b;

        b = temp;

    }

}

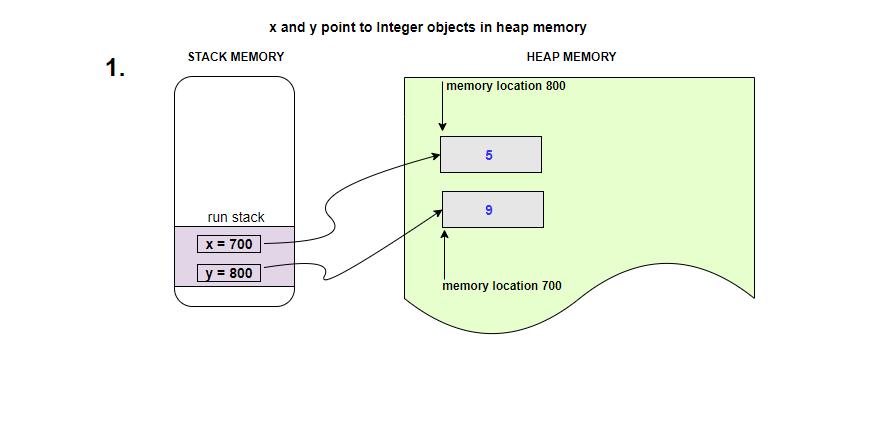


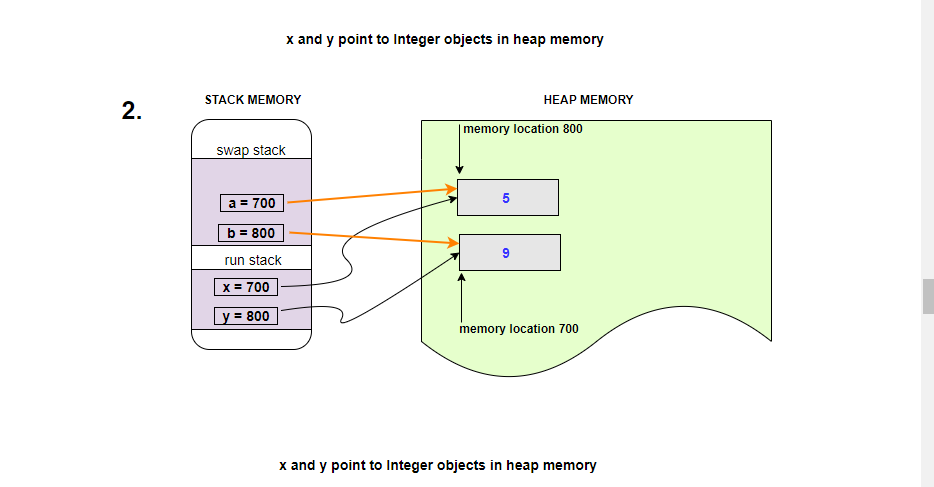


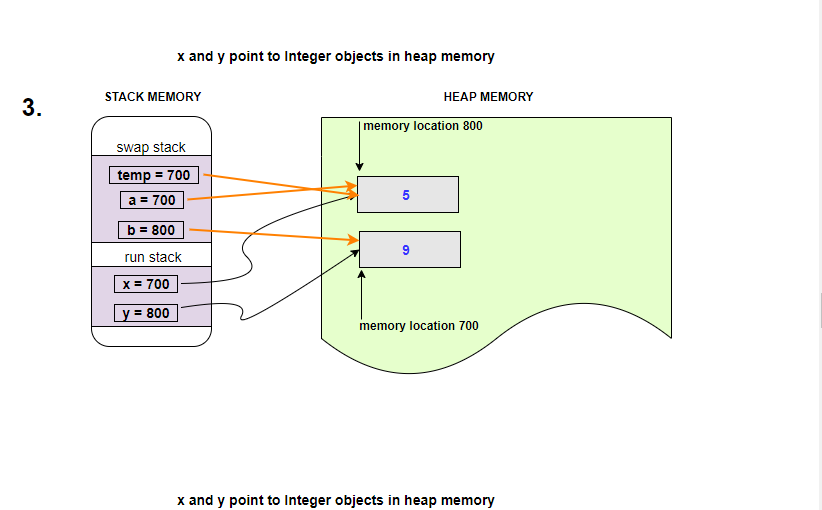
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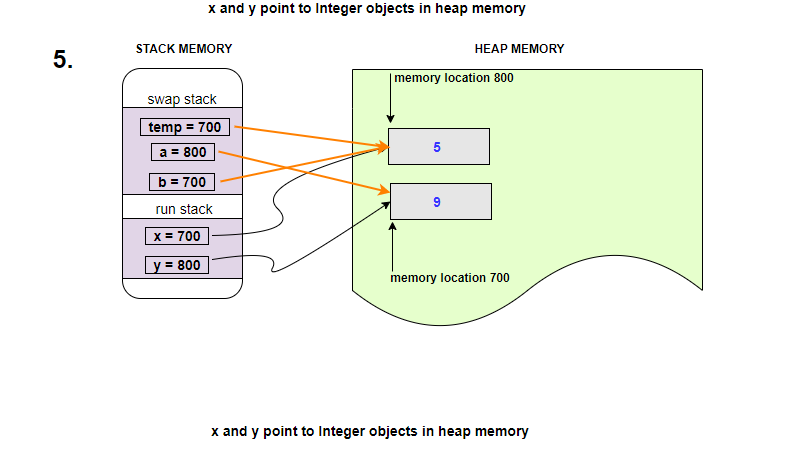
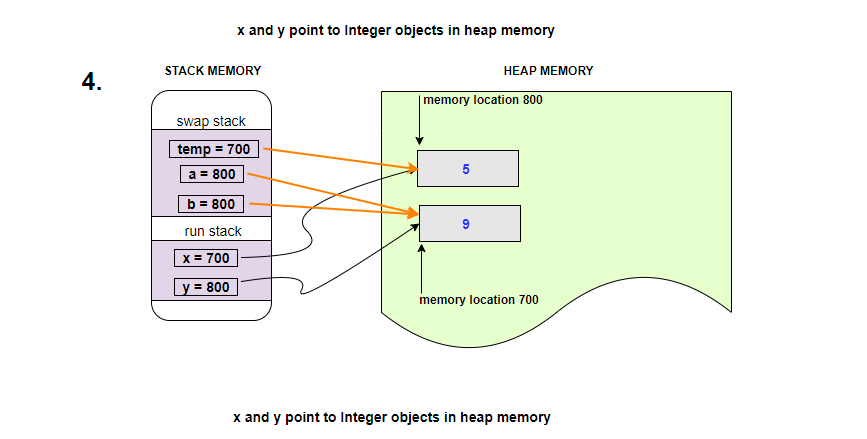
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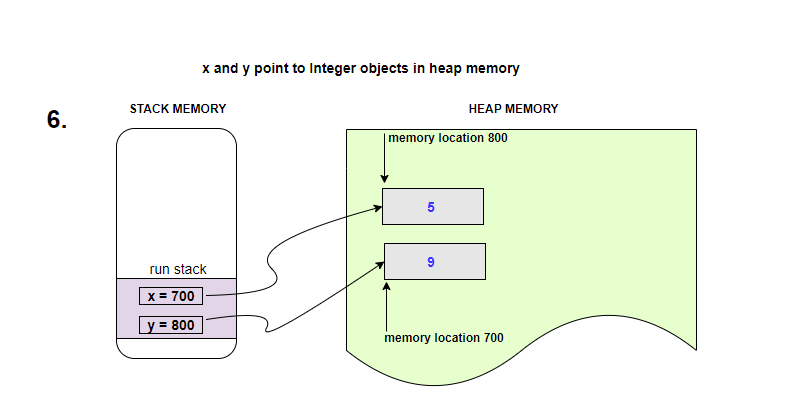
As you can see from the diagram, *a* and *b* appear as stack variables holding addresses of integer object locations. Once the program control returns back to the run method, the *x* and *y* keep pointing to the same integer objects in heap because they passed in the *references* or the *addresses* of the integer objects and not themselves.











**Question # 3**

***What value will be printed from the following snippet?***

**String[] students = new String[10];  
        String studentName = "You are an awesome developer";  
        students[0] = studentName;  
        studentName = null;  
        System.out.println(students[0]);**

**Q**

**A)**

You are an awesome developer

**B)**

null

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**1 of 1**

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class Demonstration {

    public static void main( String args[] ) {

        String[] students = new String[10];

        String studentName = "You are an awesome developer";

        students[0] = studentName;

        studentName = null;

        System.out.println(students[0]);

    }

}





RUN

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**Method Overloading**

Discusses method overloading in Java.

**Question # 1**

***Consider the following overloaded methods and determine which method will be invoked for the call myOverloadedMethod(5)?***

**void myOverloadedMethod(long arg) {  
        System.out.println("Method with long invoked");  
    }  
   
    void myOverloadedMethod(int arg) {  
        System.out.println("Method with int invoked");  
    }**

**Q**

**A)**

Method with **int** invoked

**B)**

Method with **long** invoked

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class Demonstration {

    public static void main( String args[] ) {

        myOverloadedMethod(5);

    }

    static void myOverloadedMethod(long arg) {

        System.out.println("Method with long invoked");

    }

    static void myOverloadedMethod(int arg) {

        System.out.println("Method with int invoked");

    }

}





RUN

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**Question # 2**

***How does method overloading match work in Java?***

Methods of a class can be overloaded in Java by:

* Changing the number of parameters
* Changing the type of the parameters passed into the methods

Note that methods can't be overloaded by changing the return types of the methods, as it may cause ambiguity. While overloading has nothing to do with polymorphism, Java programmers also refer to method overloading as Compile Time Polymorphism because the method that is going to get called will be decided at compile time.

**The compiler uses the name of the method and the types of the argument expressions to locate methods that are both accessible and applicable. There may be more than one such method, in which case the *most specific one is chosen*.** Typically, varargs methods are the last chosen, if they compete with other candidate methods because they are considered less specific than the ones receiving the same parameter type.

**Question # 3**

***Can the main method be overloaded?***

Yes, the static **main** method can be overloaded. But only **public static void main(String[] args)** will be used when your class is launched by the JVM even if you specify one or two command-line arguments. However, programmatically one can invoke the overloaded versions of the **main** method.

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class Demonstration {

    public static void main( String args[] ) {

        System.out.println( "Traditional main method" );

    }

    public static void main( String singleArg) {

        System.out.println( "Method with single arg" );

    }

    public static void main( ) {

        System.out.println( "Method with no args" );

    }

}





RUN

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# Accessibility

This lesson discusses the various accessibility levels in Java.

#### Question # 1

***How can access to classes, class variables and methods be controlled?***

Access level modifiers determine whether other classes can use a particular field or invoke a particular method in another class. There are two levels of access control, the top level and the member level.

#### Question # 2

***List the access modifiers in Java?***

**There are four accessibility levels in Java.** They are listed below in order of increasing restrictiveness:

* public
* package private
* protected
* private

#### Question # 3

***What are the top-level access modifiers?***

The top-level access modifiers apply to top level classes. **Classes can be marked either public or package private**.

* A public class is accessible across different packages.
* A package private class is only visible to other classes within the same package.

All the four access modifiers can be applied at member level.

#### Question # 4

***Explain the public modifier***

The **public** modifier is the least restrictive modifier. Any class marked public or class member marked public would be accessible everywhere.

#### Question # 5

***How can we mark an entity package private in Java?***

There's no explicit modifier for package private. **In the absence of any modifier the class or member variables are package private. A member marked package private is only visible within its own package.** Consider the class below.

##### Package Private Example

// class can be accessed by other classes within the same  
// package but not outside of it.  
class IamPackagePrivateClass {  
   
    int IamPackagePrivate;  
    private int IamPrivate;  
   
    public IamPackagePrivate(int a, int b) {  
        this.IamPackagePrivate = a;  
        this.IamPrivate = b;  
    }  
}

Package private is a slightly wider form of private. One nice thing about package-private is that you can use it to give access to methods you would otherwise consider private to unit test classes. So, if you use helper classes which have no other use but to help your public classes do something clients need, it makes sense to make them package private as you want to keep things as simple as possible for users of the library.

#### Question # 6

***Explain the protected access modifier?***

The **protected** modifier specifies that a member can only be accessed within its own package (as with package-private) and, in addition, by a subclass of its class in another or the same package.

#### Question # 7

***Explain the private modifier?***

The **private** modifier specifies that the member can only be accessed in its own class. Note that top level classes can't be marked private or protected but nested ones can be.

#### Question # 8

***Is it a good idea to make classes and fields public?***

If other programmers use your class, you want to ensure that errors from misuse cannot happen. Access levels can help you do this.

* Use the most restrictive access level that makes sense for a particular member.
* Use private unless you have a good reason not to.
* Avoid public fields except for constants.
* Note public fields tend to link you to a particular implementation and limit your flexibility in changing your code.

#### Access Modifier Table

The table below, lists how the different access modifiers affect visibility within different entities in Java.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Marked with Modifier** | **Visible Within Class** | **Visible within Package** | **Visible within Subclass** | **Visible within World** |
| **public** | yes | yes | yes | yes |
| **protected** | yes | yes | yes | no |
| **package private** | yes | yes | no | no |
| **private** | yes | no | no | no |

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# The Object Class

This lesson discusses the root class of all objects in Java.

#### Question # 1

***What is the Object class?***

**The Object class is the superclass directly or indirectly of every other class in Java. The Object class itself doesn't have any superclass.** In the absence of any other explicit superclass, every class is implicitly a subclass of Object.

##### Implicit Object Superclass

**// Class is implicity a derived class  
// of the Object class  
public class ObjectSubclass {  
   
}  
   
(new ObjectSubclass()) instanceof Object // Prints true**

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class HelloWorld {

    public static void main( String args[] ) {

        System.out.println((new ObjectSubclass()) instanceof Object);

    }

}

class ObjectSubclass {

}





RUN

SAVERESET

#### Question # 2

***What are the methods defined in the Object class?***

The methods defined in the **Object** class include:

* **clone()**
* **equals()**
* **hashCode()**
* **finalize()**
* **getClass()**
* **toString()**

#### Question # 3

***What is the output of the below snippet?***

**String obj1 = new String("abc");  
    String obj2 = new String("abc");  
    System.out.println(obj1 == obj2);**

**1**

Your Answer

**A)**

false

Explanation

These are two different String objects in the heap memory. When the addresses get compared, they aren’t equal.

**B)**

true

**2**

What will be the output of this snippet?

**String myStr = "abc";  
System.out.println(myStr == "abc");**

**A)**

false

**B)**

true

Your Answer

**C)**

evaluation result depends on compiler optimizations

**3**

**System.out.println(new Integer(5) == new Integer(5));**

will return?

Your Answer

**A)**

false

**B)**

true

**4**

**System.out.println(new Integer(5) == 5);**

will return?

**A)**

false

Your Answer

**B)**

true

**SUMMARY**

**Correct4**

**Incorrect0**

#### Awesome! you got all 4 correct!

Retake Quiz

The **equals()** method provided in the Object class uses the identity operator **==** to determine whether two objects are equal. For primitive data types, this gives the correct result. For objects, however, it does not. **The equals() method provided by Object tests whether the object references are equal — that is, if the object references are pointing to the same address in memory. This is the reason the statement new Integer(5) == new Integer(5) will output false because the two integer objects have different memory addresses even though their *values* are the same.**

The case of **String** class is a little tricky. Compiler optimization can cause string literals to point to a single string object if the same literal is repeated many times in the code. Therefore, a snippet like below can result in true or false depending on how the program is compiled.

String myStr = "abc";  
System.out.println(myStr == "abc");

Always use the **equals()** method when comparing strings!

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class Demonstration {

    public static void main( String args[] ) {

        question1();

        question2();

        question3();

        question4();

    }

    static void question1() {

        String obj1 = new String("abc");

        String obj2 = new String("abc");

        System.out.println(obj1 == obj2);

    }

    static void question2() {

        String myStr = "abc";

        System.out.println( myStr == "abc");

    }

    static void question3() {

        System.out.println( new Integer(5) == new Integer(5));

    }

    static void question4() {

        System.out.println( 5 == new Integer(5));

    }

}





RUN

SAVERESET

#### Question # 4

***What is wrong with the BadCloneExample class shown below?***

**public class BadCloneExample {  
   
    List<Integer> seen = new ArrayList<>();  
    int current = -1;  
   
    public void add(int newCurrent) {  
        seen.add(current);  
        current = newCurrent;  
    }  
   
    public void clearHistory() {  
        seen.clear();  
    }  
   
    public BadCloneExample clone() {  
        BadCloneExample clone = new BadCloneExample();  
        clone.current = current;  
        clone.seen = seen;  
        return clone;  
    }  
}**

The **Object** class's **clone()** method can be overridden by classes in Java. However, the most common mistake is to copy reference variables. In the given code snippet, the **clone** method copies the reference to the list field **seen**. This makes two objects point to the same list field. Look at the snippet below:

**BadCloneExample bce = new BadCloneExample();  
     bce.add(5);  
     bce.add(6);  
     BadCloneExample prev = bce.clone();  
     // will print [-1, 5]  
     System.out.println(prev.seen);  
     // clears out the list field  
     bce.clearHistory();  
     // user sees [] but expects [-1,5]  
     System.out.println(prev.seen);**

The two objects point to the same field and operations by the original object cascade to the clone.

#### Question # 5

***Answer the question based on the following snippet:***

**public class Employees {  
   
    List<Person> list = new ArrayList<>();  
   
    public Employees() {  
   
    }  
   
    public void add(String name) {  
        list.add(new Person(name));  
    }  
   
    public Employees clone() {  
        Employees clone = new Employees();  
        for (Person person : list) {  
            clone.list.add(person);  
        }  
        return clone;  
    }  
}  
   
class Person {  
   
    String name;  
   
    public Person(String name) {  
        this.name = name;  
    }  
}**

**Q**

What will be the output of the following snippet?

**Employees apple = new Employees();  
        apple.add("Tim Cook");  
        Employees microsoft = apple.clone();  
        microsoft.list.get(0).name = "Satya Nadella";  
   
        System.out.println(apple.list.get(0).name);**

**A)**

Tim Cook

Your Answer

**B)**

Satya Nadella

**C)**

CloneNotSupportedException exception is thrown

Check Answers

**The purpose of the above question is to drive home the fact that correct implementation of the clone method, requires appropriately copying nested reference variables.**

#### Question # 6

***Answer the question based on the following setup:***

**public class Celebrity {  
   
    String name;  
    int age;  
   
    public Celebrity(String name, int age) {  
        this.name = name;  
        this.age = age;  
    }  
   
    public boolean equals(Object obj) {  
        if (this == obj)  
            return true;  
   
        if (!(obj instanceof Celebrity) || obj == null)  
            return false;  
   
        Celebrity otherCeleb = (Celebrity) obj;  
        return name.equals(otherCeleb.name);  
    }  
}**

**1**

What will be the output of the below snippet:

**Celebrity realKardashian = new Celebrity("Kim", 17);  
        Celebrity kardashianClone = new Celebrity("Kim", 17);  
        System.out.println(realKardashian.equals(kardashianClone));**

Your Answer

**A)**

false

Correct Answer

**B)**

true

**2**

What will be the output of this snippet?

        HashSet<Celebrity> set = new HashSet();  
        Celebrity realKardashian = new Celebrity("Kim", 17);  
        Celebrity kardashianClone = new Celebrity("Kim", 17);  
        set.add(realKardashian);  
   
        if (set.contains(kardashianClone)) {  
            System.out.println("Kim is a celebrity");  
        } else {  
            System.out.println("Can't find Kim");  
        }

Your Answer

**A)**

Can’t find Kim

**B)**

Kim is a celebrity

**SUMMARY**

**Correct1**

**Incorrect1**

Retake Quiz

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        } else {

            System.out.println("Can't find Kim");

        }

        System.out.println(realKardashian.equals(kardashianClone));

        System.out.println(realKardashian.hashCode() + " " +kardashianClone.hashCode());

    }

}

class Celebrity {

    String name;

    int age;

    public Celebrity(String name, int age) {

        this.name = name;

        this.age = age;

    }

    public boolean equals(Object obj) {

        if (this == obj)

            return true;

        if (!(obj instanceof Celebrity) || obj == null)

            return false;

        Celebrity otherCeleb = (Celebrity) obj;

        return name.equals(otherCeleb.name);

    }

}





RUN

SAVERESET

The above questions explain why one needs to override the **hashCode()** method whenever we override the **equals()** method for a class. The vice-versa is not necessary that is if you override the hashCode method it is not a must to override the equals method. Let's try to understand why that is so. Whenever, we use a hash-based collection, it uses:

* **hashCode()** method to find the right bucket
* **equals()** method to match the object we are looking for

In the example snippet in the quiz above, the two celebrity objects are equal but when we search for the second object in the hash set we are unable to find it because it has a different hashcode than the first celebrity object that has been added to the set. The value returned by **hashCode()** is the object's hash code, which is the object's memory address in hexadecimal. By definition, if two objects are equal, their hash code must also be equal. If you override the **equals()** method, you change the way two objects are equated and **Object**'s implementation of **hashCode()** is no longer valid. **Therefore, if you override the equals() method, you must also override the hashCode() method as well**.

#### Question # 7

***Explain the finalize() method in the Object class?***

The **Object** class provides a callback method, **finalize()**, that may be invoked on an object when it becomes garbage. Object's implementation of **finalize()** does nothing — you can override **finalize()** to do cleanup, such as freeing up resources.

The **finalize()** method may be called automatically by the system, *but when it is called, or even if it is called, is uncertain*. **Therefore, you should not rely on this method to do your cleanup for you**. For example, if you don't close file descriptors in your code after performing I/O and you expect **finalize()** to close them for you, you may run out of file descriptors.

#### Question # 8

***Consider the snippet below:***

**void myMethod(Object input) {  
        // Your awesome code here      
    }  
   
    myMethod("123")  
    myMethod(new Integer(5))**

***Is there a way your method can find out if the object passed in is an integer or a string?***

Yes, the **getClass()** method returns a **Class** object, which has methods you can use to get information about the class, such as its name **getSimpleName()**, its superclass **getSuperclass()**, and the interfaces it implements **getInterfaces()**. **The getClass() method is final and can't be overridden**.

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class Demonstration {

    public static void main( String args[] ) {

        myMethod(new Integer(5));

        myMethod("abc");

    }

    static void myMethod(Object input) {

        System.out.println("class name: " + input.getClass().getSimpleName());

        System.out.println("super class name: " + input.getClass().getSuperclass().getSimpleName());

        System.out.println("# of interfaces implemented: " + input.getClass().getSuperclass().getInterfaces().length);

        System.out.println();

    }

}





RUN

SAVERESET

#### Question # 9

***What will be the output of the following snippet of code? Can you explain the result?***

**Integer.valueOf(1).equals(Long.valueOf(1))**

**The output will be false.** Even though the values are the same, i.e. one, but the objects are of different types. One is of type **Integer** and other is of type **Long**.

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**Constructors**

This lesson discusses constructors in Java.

**Question # 1**

***There's no constructor for the class in the snippet below, how can instances of it be instantiated then?***

**public class Celebrity {  
    String Name;  
    int age;  
}**

Even though the class doesn't define a constructor, **a default no-argument constructor is provided** by the compiler. In this case the string variable will be initialized to null and the age variable would be initialized to zero. *Remember that you can also provide a no-argument constructor for a class.*

**Question # 2**

***What will be printed on the console, if we create an object of the following class and invoke it's print method?***

**public class SpecialPerson {  
   
    String fullName = init();  
    String name = "batman";  
   
    public SpecialPerson() {  
        name = "superMan";  
    }  
   
    private String init() {  
        return name;  
    }  
   
    public void print() {  
        System.out.println(fullName);  
    }  
}**

**Q**

Correct Answer

**A)**

null

Your Answer

**B)**

superman

**C)**

batman

?????

**Oops, you got that wrong. Want to try again?**

Retake Quiz

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class Demonstration {

    public static void main( String args[] ) {

        (new SpecialPerson()).print();

    }

}

class SpecialPerson {

    String fullName = init();

    String name = "batman";

    public SpecialPerson() {

        name = "superMan";

    }

    private String init() {

        return name;

    }

    public void print() {

        System.out.println(fullName);

    }

}





RUN

SAVERESET

**Question # 3**

***Can a class have a static constructor to initialize static fields?***

**Q**

Correct Answer

**A)**

No

Explanation

There’s no such thing as a static constructor in java. A constructor only exists in the context of creating a new instance or object of a class. Static fields of a class can be initialized in the *static block*.

Your Answer

**B)**

Yes

?????

**Oops, you got that wrong. Want to try again?**

Retake Quiz

**Question # 4**

***Consider the following parent child classes.***

**public class ParentClass {  
   
    protected int counter;  
   
    public ParentClass(int val) {  
        this.counter = val;  
    }  
}  
   
public class EmptyChildClass extends ParentClass {  
   
    public EmptyChildClass() {  
   
    }  
}**

**Q**

What is missing in the above code snippet?

Your Answer

**A)**

Everything looks good

**B)**

Derived class doesn’t override any methods from super class

Correct Answer

**C)**

Parent class doesn’t have a default no-argument constructor

Explanation

The above code will not compile because the parent class doesn’t define a no-argument default constructor. We could either invoke the parent’s one parameter constructor within the child’s constructor or add a default constructor to the parent. Also note that if the parent defined no constructor at all, the snippet would compile because the compiler would supply a no-argument constructor in the absence of any user-defined constructors.

?????

**Oops, you got that wrong. Want to try again?**

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The Object Class

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**Initialization**

This lesson discusses initialization of variables in Java.

**Question # 1**

***Can we change the contents of a final array as in the code snippet below?***

**final int[] array = new int[5];  
    array[0] = 1;**

**It may appear counterintuitive, but we can actually change the *contents* of the array even though it is marked as final.** The **array** variable points to a particular start location in the memory where the contents of the array are placed. The location or the memory address can't be changed. For instance, the following code will not compile:

**final int[] array = new int[5];  
    array = new int[10];**

However, the following code is perfectly legal and will work.

**public class FinalArrayExample {  
   
    final int[] array = new int[5];  
      
    // Allowed   
    void changeArrayContents(int  i, int val) {  
        array[i] = val;  
    }  
   
    // Not allowed and will not compile  
    /\*  
    void changeArray(){  
        array = new int[10];  
    }\*/  
}**

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class HelloWorld {

    static final int[] array = new int[5];

    public static void main( String args[] ) {

      changeArrayContents(0, 9);

    }

    // Allowed

    static void changeArrayContents(int  i, int val) {

        array[i] = val;

    }

    // Not allowed and will not compile

    /\*

    static void changeArray(){

        array = new int[10];

    }\*/

}





RUN

SAVERESET

**Question # 2**

***What are static initialization blocks?***

**A static initialization block is a normal block of code enclosed in braces, { }, and preceded by the static keyword. It can be used to initialize static fields of a class.** A class can have any number of static initialization blocks, and they can appear anywhere in the class body. The runtime system guarantees that static initialization blocks are called in the order that they appear in the source code.

**Static Initialization Block Example**

**public class EducativeCourse {  
   
    static String courseName;  
    static String version;  
   
    // We have two static initialization blocks  
    static {  
        version = "1.0";  
    }  
   
    static {  
        courseName = "Java Interview Bible";  
    }  
}**

The Java compiler copies initializer blocks into every constructor. Therefore, this approach can be used to share a block of code between multiple constructors.

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class Demonstration {

    public static void main( String args[] ) {

        EducativeCourse ec = new EducativeCourse();

        System.out.println( "name: " + ec.courseName );

    }

}

class EducativeCourse {

    static String courseName;

    static String version;

    // We have two static initialization blocks

    static {

        version = "1.0";

    }

    static {

        courseName = "Java Interview Bible";

    }

}





RUN

SAVERESET

**Question # 3**

***Can initialization block also be used to initialize instance fields?***

Yes,

* initialization blocks
* final methods

can be used to initialize instance fields. **Both of them are alternatives to using a constructor.**

**Initialization Using Final Method and Initialization Block**

**public class EducativeCourse {  
   
    String courseName = setCourseName();  
   
    String version;  
   
    // initialization block  
    {  
        version = "1.0";  
    }  
   
    // final method used for intialization  
    private String setCourseName() {  
        return "Java Interview Bible";  
    }  
}**

Note that we could have marked the **setCourseName** as non-final and not have a compile error. However, non-final methods used during initialization can cause problems as the object may not be fully constructed. Using a method for initialization may be useful if subclasses want to reuse the initialization method.

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class Demonstration {

    public static void main( String args[] ) {

        EducativeCourse ec = new EducativeCourse();

        System.out.println( "Course name: " + ec.courseName );

    }

}

class EducativeCourse {

    String courseName = setCourseName();

    String version;

    // initialization block

    {

        version = "1.0";

    }

    // final method used for intialization

    private String setCourseName() {

        return "Java Interview Bible";

    }

}



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# nitialization

This lesson discusses initialization of variables in Java.

#### Question # 1

***Can we change the contents of a final array as in the code snippet below?***

**final int[] array = new int[5];  
    array[0] = 1;**

**It may appear counterintuitive, but we can actually change the *contents* of the array even though it is marked as final.** The **array** variable points to a particular start location in the memory where the contents of the array are placed. The location or the memory address can't be changed. For instance, the following code will not compile:

**final int[] array = new int[5];  
    array = new int[10];**

However, the following code is perfectly legal and will work.

**public class FinalArrayExample {  
   
    final int[] array = new int[5];  
      
    // Allowed   
    void changeArrayContents(int  i, int val) {  
        array[i] = val;  
    }  
   
    // Not allowed and will not compile  
    /\*  
    void changeArray(){  
        array = new int[10];  
    }\*/  
}**

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class HelloWorld {

    static final int[] array = new int[5];

    public static void main( String args[] ) {

      changeArrayContents(0, 9);

    }

    // Allowed

    static void changeArrayContents(int  i, int val) {

        array[i] = val;

    }

    // Not allowed and will not compile

    /\*

    static void changeArray(){

        array = new int[10];

    }\*/

}





RUN

SAVERESET

#### Question # 2

***What are static initialization blocks?***

**A static initialization block is a normal block of code enclosed in braces, { }, and preceded by the static keyword. It can be used to initialize static fields of a class.** A class can have any number of static initialization blocks, and they can appear anywhere in the class body. The runtime system guarantees that static initialization blocks are called in the order that they appear in the source code.

##### Static Initialization Block Example

**public class EducativeCourse {  
   
    static String courseName;  
    static String version;  
   
    // We have two static initialization blocks  
    static {  
        version = "1.0";  
    }  
   
    static {  
        courseName = "Java Interview Bible";  
    }  
}**

The Java compiler copies initializer blocks into every constructor. Therefore, this approach can be used to share a block of code between multiple constructors.

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class Demonstration {

    public static void main( String args[] ) {

        EducativeCourse ec = new EducativeCourse();

        System.out.println( "name: " + ec.courseName );

    }

}

class EducativeCourse {

    static String courseName;

    static String version;

    // We have two static initialization blocks

    static {

        version = "1.0";

    }

    static {

        courseName = "Java Interview Bible";

    }

}





RUN

SAVERESET

#### Question # 3

***Can initialization block also be used to initialize instance fields?***

Yes,

* initialization blocks
* final methods

can be used to initialize instance fields. **Both of them are alternatives to using a constructor.**

##### Initialization Using Final Method and Initialization Block

**public class EducativeCourse {  
   
    String courseName = setCourseName();  
   
    String version;  
   
    // initialization block  
    {  
        version = "1.0";  
    }  
   
    // final method used for intialization  
    private String setCourseName() {  
        return "Java Interview Bible";  
    }  
}**

Note that we could have marked the **setCourseName** as non-final and not have a compile error. However, non-final methods used during initialization can cause problems as the object may not be fully constructed. Using a method for initialization may be useful if subclasses want to reuse the initialization method.

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class Demonstration {

    public static void main( String args[] ) {

        EducativeCourse ec = new EducativeCourse();

        System.out.println( "Course name: " + ec.courseName );

    }

}

class EducativeCourse {

    String courseName = setCourseName();

    String version;

    // initialization block

    {

        version = "1.0";

    }

    // final method used for intialization

    private String setCourseName() {

        return "Java Interview Bible";

    }

}





RUN

SAVERESET

**Mark as Completed**

[**←    Back**](https://www.educative.io/courses/java-interview-handbook/m2EN4qQpD90)

This lesson discusses the concept of classes in Java and related questions around them.

#### Question # 1

***Explain the concept of class in Java?***

A class in object orientated languages is the fundamental building block of any program. It can be thought of as a blueprint and its instance objects as manifestations of that blueprint. **A class, in the context of Java, are templates that are used to create objects, and to define object data types and methods. Except for primitive types (int, double, float, char etc), all objects (String, Lists, Runnable, etc) in Java are instances of a class.**

#### Question # 2

***What is the root class in Java?***

***or***

***What class is the superclass of all classes in Java?***

The **java.lang.Object** class is the super class of all classes in Java. All classes implicitly extend the object class. *All objects including arrays are instances of the Object class.*

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class Demonstration {

    public static void main( String args[] ) {

        Demonstration[] array = new Demonstration[1];

        array[0] = new Demonstration();

        if( array[0] instanceof Object) {

          System.out.println( "Demonstration is instance of Object");

        }

        if( array instanceof Object) {

          System.out.println( "Array is instance of Object");

        }

    }

}





RUN

SAVERESET

**Mark as Completed**

[**←    Back**](https://www.educative.io/courses/java-interview-handbook/mE702D6VAyG)

This lesson explains nested classes in Java.

#### Question # 1

***What are nested classes?***

**Java allows defining a class within another class. A nested class is a member of its enclosing class. Nested classes can be either static or non-static.**

* Static Nested Class
* Non-Static Nested Class or Inner Class. The following classes are also considered inner classes.
  + Local Class
  + Anonymous Class

The below code snippet shows an outer class declaring a static and a non-static nested class.

##### Static and Non-static Nested Classes

**public class OuterClass {  
   
    String myName = "outerclass";  
    private static String staticName = "outerclass";  
   
    private class InnerClass {  
   
        String myName = "innerClass";  
   
        void printNames() {  
            System.out.println(  
                    "I can access both static & non-static members of my outer class : " + staticName + " " + myName);  
        }  
    }  
   
    void createInnerClassInstance() {  
        // Creating inner class instance  
        InnerClass ic = new InnerClass();  
        ic.printNames();  
    }  
   
    static class StaticInnerClass {  
   
        String myName = "staticInnerClass";  
   
        void printName() {  
            System.out.println("I can access static members of my outerclass but not non-static ones: " + staticName);  
        }  
    }  
}**

The above snippet can be executed in the code widget below.

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class Demonstration {

    public static void main( String args[] ) {

        // Declaring an instance of the outer class

        OuterClass oc = new OuterClass();

        System.out.println(oc.myName);

        oc.createInnerClassInstance();

        // Declaring instance of innerClass

        OuterClass.StaticInnerClass sic = new OuterClass.StaticInnerClass();

        sic.printName();

    }

}

class OuterClass {

    String myName = "outerclass";

    private static String staticName = "outerclass";

    private class InnerClass {

        String myName = "innerClass";

        void printNames() {

            System.out.println(

                    "I can access both static & non-static members of my outer class : " + staticName + " " + myName);

        }

    }

    void createInnerClassInstance() {

        // Creating inner class instance





RUN

SAVERESET

#### Question # 2

***What are non-static nested classes or inner classes?***

Non-static nested classes are called inner classes.

##### example

**public class OuterClass {  
   
    String myName = "outerclass";  
   
    private class innerClass {  
   
        String myName = "innerClass";  
   
        void printNames() {  
            System.out.println("I am the inner class");  
        }  
    }  
}**

The following two types of classes are also referred to as inner classes.

* Local Classes
* Anonymous Classes

**Note, that inner classes can access instance fields declared in the enclosing class. However, nested static classes can't access instance fields of the enclosing class.**

Serialization of inner classes including local and anonymous classes is discouraged for compatibility issues across different JRE implementations.

#### Question # 3

***What are static nested classes?***

A class defined within an outer class and marked static is called a static nested or static inner class. **A static nested class is behaviorally similar to a top-level class that has been nested in another top-level class for packaging convenience.**

#### Question # 4

***Can nested classes be declared private?***

Yes. **A top-level class can only be marked public or package private.** But a nested class can be declared private, public, protected, or package private.

#### Question # 5

***What are some of the use-cases of nested classes?***

The **primary purpose of nested classes is logically grouping related classes in one place and improving encapsulation.**

Say, you write a class to hold all the employees of a company. It may make sense to nest an employee iterator class as it iterates only on the objects of the employee class.

#### Question # 6

***What would be the output of the method sayName in the code below?***

**public class OuterClass {  
   
    String myName = "outerClass";  
   
    private class InnerClass {  
   
        String myName = "innerClass";  
   
        void printName() {  
            System.out.println("I am " + myName);  
        }  
    }  
   
    void sayName() {  
        InnerClass ic = new InnerClass();  
        ic.printName();  
        System.out.println("I am " + myName);  
    }  
}**

**Q**

**A)**

I am innerClass  
I am outerClass

**B)**

I am innerClass  
I am innerClass

**C)**

I am outerClass  
I am outerclass

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class Demonstration {

    public static void main( String args[] ) {

        OuterClass oc = new OuterClass();

        oc.sayName();

    }

}

class OuterClass {

    String myName = "outerClass";

    private class InnerClass {

        String myName = "innerClass";

        void printName() {

            System.out.println("I am " + myName);

        }

    }

    void sayName() {

        InnerClass ic = new InnerClass();

        ic.printName();

        System.out.println("I am " + myName);

    }

}





RUN

SAVERESET

#### Question # 7

***Can a top-level class in Java be declared static?***

**Q**

**A)**

Yes

**B)**

No

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#### 1 of 1

**Mark as Completed**

# Anonymous and Local Classes

This lesson discusses anonymous and local classes in Java.

#### Question # 1

***What are local classes?***

**A class that is defined in a *block* is called a local class. A block is a group of zero or more statements between balanced braces.** Usually, local classes are defined inside a method, though they can also be defined inside a for loop or even an if statement. Local classes do have access to members of their enclosing class. They can also access local variables, but they need to be declared final.

**When local classes use variables in the scope of the outer class, they are said to have *captured* the variable.**

##### Example of local class

**class LocalClassExample {  
    public void someMethod() {  
   
        String name = "mainClass";  
   
        // Declare our local class  
        class LocalClass {  
            String myName = "superFineLocalClass";  
   
            public LocalClass(String name) {  
                this.myName = name;  
            }  
   
            public void print() {  
                System.out.println("My name is " + myName + " and I am enclosed by " + name);  
            }  
        }  
   
   
        LocalClass lc1 = new LocalClass("test");  
        LocalClass lc2 = new LocalClass("rest");  
   
        lc1.print();  
        lc2.print();        
   
      }  
}**

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class LocalClassExample {

    public static void main( String args[] ) {

        String name = "mainClass";

        // Declare our local class

        class LocalClass {

            String myName = "superFineLocalClass";

            public LocalClass(String name) {

                this.myName = name;

            }

            public void print() {

                System.out.println("My name is " + myName + " and I am enclosed by " + name);

            }

        }

        LocalClass lc1 = new LocalClass("test");

        LocalClass lc2 = new LocalClass("rest");

        lc1.print();

        lc2.print();

      }

}





RUN

SAVERESET

#### Question # 2

***What are anonymous classes?***

**An anonymous class is like a local class except they don't have a name and should be used in place of a local class when the intended use is only one time.**

##### Anonymous class implementing an interface

**// Anonymous class implementing the Comparator  
        // interface. The class is declared and instantiated  
        // at the same time.  
        Comparator myCustomComparator = new Comparator<Integer>() {  
   
            public int compare(Integer i1, Integer i2) {  
   
                return (int)Math.pow(-1, i1) \* (i1 - i2);  
            }  
        };  
   
        PriorityQueue<Integer> q = new PriorityQueue<Integer>(myCustomComparator);**

##### Anonymous class extending another class

**Thread t = new Thread() {  
   
            @Override  
            public void run() {  
                System.out.println("I just extended the thread class.");  
            }  
        };  
   
        t.start();**

**Mark as Completed**

***What is the super keyword?***

* If a method overrides one of its superclass's methods, the overridden can be invoked through the use of the keyword **super**.
* The **super** keyword can also be used to refer to a hidden field of the super type.
* Interface default methods can be invoked using the **super** keyword.
* Constructors for superclasses can be invoked using the **super** keyword.

Pay attention to the code below for an instance of each of the above scenarios.

**class ChildClass extends ParentClass implements AnInterface {  
   
    int counter = 0;  
   
    public ChildClass() {  
        // invoking parent class's constructor  
        // using the super keyword  
        super(9);  
    }  
   
    public void accessHiddenFields() {  
        // accessing parent class's counter field which gets  
        // hidden with the local counter field.  
        super.counter++;  
        counter++;  
        System.out.println("sublcass counter: " + counter + " parent class counter: " + super.counter);  
   
        // accessing the interface's default method which is hidden  
        AnInterface.super.accessHiddenFields();  
    }  
}  
   
   
   
interface AnInterface {  
   
    default void accessHiddenFields() {  
        System.out.println("Default method of AnInterface invoked.");  
    }  
}  
   
class ParentClass {  
   
    protected int counter;  
   
    public ParentClass(int val) {  
        this.counter = val;  
    }  
}**

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    public void accessHiddenFields() {

        // accessing parent class's counter field which gets

        // hidden with the local counter field.

        super.counter++;

        counter++;

        System.out.println("sublcass counter: " + counter + " parent class counter: " + super.counter);

        // accessing the interface's default method which is hidden

        AnInterface.super.accessHiddenFields();

    }

}

interface AnInterface {

        super(9);

    }

    public ChildClass() {

        // invoking parent class's constructor

        // using the super keyword

class ChildClass extends ParentClass implements AnInterface {

    int counter = 0;

        (new ChildClass()).accessHiddenFields();

    }

}

class Demonstration {

    public static void main( String args[] ) {