**1.Explain the evolution of JAVA. List out java buzzwords:**

Java is a class-based, object-oriented programming language that is designed to have as few implementation dependencies as possible. It is intended to let application developers write once, and run anywhere (WORA), meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java was first released in 1995 and is widely used for developing applications for desktop, web, and mobile devices. Java is known for its simplicity, robustness, and security features, making it a popular choice for enterprise-level applications.

**JAVA** was developed by James Gosling at **Sun Microsystems** Inc in the May **1995** and later acquired by Oracle Corporation. It is a simple programming language. Java makes writing, compiling, and debugging programming easy. It helps to create reusable code and modular programs. [Java](https://www.geeksforgeeks.org/java/) is a class-based, object-oriented programming language and is designed to have as few implementation dependencies as possible. A general-purpose programming language made for developers to write once run anywhere that is compiled Java code can run on all platforms that support Java. Java applications are compiled to byte code that can run on any Java Virtual Machine. The syntax of Java is similar to c/c++.

**History:**Java’s history is very interesting. It is a programming language created in 1991.James Gosling, Mike Sheridan, and Patrick Naughton, a team of Sun engineers known as the **Green team**initiated the Java language in 1991. **Sun Microsystems** released its first public implementation in 1996 as **Java 1.0**. It provides no-cost -run-times on popular platforms. Java1.0 compiler was re-written in Java by Arthur Van Hoff to strictly comply with its specifications. With the arrival of Java 2, new versions had multiple configurations built for different types of platforms.

In 1997, Sun Microsystems approached the ISO standards body and later formalized Java, but it soon withdrew from the process. At one time, Sun made most of its Java implementations available without charge, despite their proprietary software status. Sun generated revenue from Java through the selling of licenses for specialized products such as the Java Enterprise System.

On November 13, 2006, Sun released much of its Java virtual machine as free, open-source software. On May 8, 2007, Sun finished the process, making all of its JVM’s core code available under open-source distribution terms.

The principles for creating [java programming language](https://www.geeksforgeeks.org/courses/free-java-course-online) were simple, robust, secured, high-performance, portable, multi-threaded, interpreted, dynamic, etc. In 1995 Java was developed by **James Gosling**, who is known as the Father of Java. Currently, Java is used in mobile devices, internet programming, games, e-business, etc.

**Java programming language is named JAVA. Why?**

After the name OAK, the team decided to give it a new name to it and the suggested words were Silk, Jolt, revolutionary, DNA, dynamic, etc. These all names were easy to spell and fun to say, but they all wanted the name to reflect the essence of technology. In accordance with James Gosling, Java the among the top names along with Silk, and since java was a unique name so most of them preferred it.

Java is the name of an island in Indonesia where the first coffee (named java coffee) was produced. And this name was chosen by James Gosling while having coffee near his office. Note that Java is just a name, not an acronym.

**Java Terminology:**

1. **Java Virtual Machine (JVM):**

 This is generally referred to as [JVM](https://www.geeksforgeeks.org/jvm-works-jvm-architecture/#:~:text=JVM(Java%20Virtual%20Machine)%20acts,(Write%20Once%20Run%20Anywhere).). There are three execution phases of a program. They are written, compile and run the program.

* Writing a program is done by a java programmer like you and me.
* The compilation is done by the JAVAC compiler which is a primary Java compiler included in the Java development kit (JDK). It takes the Java program as input and generates bytecode as output.
* In the Running phase of a program, JVM executes the bytecode generated by the compiler.
* Now, we understood that the function of Java Virtual Machine is to execute the bytecode produced by the compiler. Every Operating System has a different JVM but the output they produce after the execution of bytecode is the same across all the operating systems. This is why Java is known as a platform-independent language.

1. **Bytecode in the Development Process:**  As discussed, the Javac compiler of JDK compiles the java source code into bytecode so that it can be executed by JVM. It is saved as .class file by the compiler. To view the bytecode, a disassembler like [javap](https://www.geeksforgeeks.org/javap-tool-in-java-with-examples/) can be used.
2. **Java Development Kit (JDK):** While we were using the term JDK when we learn about bytecode and JVM. So, as the name suggests, it is a complete Java development kit that includes everything including compiler, Java Runtime Environment (JRE), java debuggers, java docs, etc. For the program to execute in java, we need to install JDK on our computer in order to create, compile and run the java program.
3. **Java Runtime Environment (JRE):** JDK includes JRE. JRE installation on our computers allows the java program to run, however, we cannot compile it. JRE includes a browser, JVM, applet support, and plugins. For running the java program, a computer needs JRE.
4. **Garbage Collector:** In Java, programmers can’t delete the objects. To delete or recollect that memory JVM has a program called [Garbage Collector](https://www.geeksforgeeks.org/garbage-collection-java/). Garbage Collectors can recollect the objects that are not referenced. So Java makes the life of a programmer easy by handling memory management. However, programmers should be careful about their code whether they are using objects that have been used for a long time. Because Garbage cannot recover the memory of objects being referenced.
5. **ClassPath:** The [classpath](https://www.geeksforgeeks.org/classpath-in-java/) is the file path where the java runtime and Java compiler look for .class files to load. By default, JDK provides many libraries. If you want to include external libraries they should be added to the class path.

**Primary/Main Features of Java:**

1. **Platform Independent:**

Compiler converts source code to bytecode and then the JVM executes the bytecode generated by the compiler. This bytecode can run on any platform be it Windows, Linux, or macOS which means if we compile a program on Windows, then we can run it on Linux and vice versa. Each operating system has a different JVM, but the output produced by all the OS is the same after the execution of the bytecode. That is why we call java a platform-independent language.

1. **Object-Oriented Programming Language:**

 Organizing the program in the terms of a collection of objects is a way of object-oriented programming, each of which represents an instance of the class.

The four main concepts of Object-Oriented programming are:

* Abstraction
* Encapsulation
* Inheritance
* Polymorphism

1. **Simple:**

 Java is one of the simple languages as it does not have complex features like pointers, operator overloading, multiple inheritances, and Explicit memory allocation.

1. **Robust:**

Java language is robust which means reliable. It is developed in such a way that it puts a lot of effort into checking errors as early as possible, that is why the java compiler is able to detect even those errors that are not easy to detect by another programming language. The main features of java that make it robust are garbage collection, Exception Handling, and memory allocation.

1. **Secure:**

 In java, we don’t have pointers, so we cannot access out-of-bound arrays i.e it shows ArrayIndexOutOfBound Exception if we try to do so. That’s why several security flaws like stack corruption or buffer overflow are impossible to exploit in Java. Also, java programs run in an environment that is independent of the os(operating system) environment which makes java programs more secure.

1. **Distributed:**

 We can create distributed applications using the java programming language. Remote Method Invocation and Enterprise Java Beans are used for creating distributed applications in java. The java programs can be easily distributed on one or more systems that are connected to each other through an internet connection.

1. **Multithreading:**

 Java supports multithreading. It is a Java feature that allows concurrent execution of two or more parts of a program for maximum utilization of the CPU.

1. **Portable:**

 As we know, java code written on one machine can be run on another machine. The platform-independent feature of java in which its platform-independent bytecode can be taken to any platform for execution makes java portable.

1. **High Performance:**

 Java architecture is defined in such a way that it reduces overhead during the runtime and at sometimes java uses Just In Time (JIT) compiler where the compiler compiles code on-demand basics where it only compiles those methods that are called making applications to execute faster.

1. **Dynamic flexibility:**

 Java being completely object-oriented gives us the flexibility to add classes, new methods to existing classes, and even create new classes through sub-classes. Java even supports functions written in other languages such as C, C++ which are referred to as native methods.

1. **Sandbox Execution:**

Java programs run in a separate space that allows user to execute their applications without affecting the underlying system with help of a bytecode verifier. Bytecode verifier also provides additional security as its role is to check the code for any violation of access.

1. **Write Once Run Anywhere**:

 As discussed above java application generates a ‘.class’ file that corresponds to our applications(program) but contains code in binary format. It provides ease t architecture-neutral ease as bytecode is not dependent on any machine architecture. It is the primary reason java is used in the enterprising IT industry globally worldwide.

1. **Power of compilation and interpretation:**

 Most languages are designed with the purpose of either they are compiled language or they are interpreted language. But java integrates arising enormous power as Java compiler compiles the source code to bytecode and JVM executes this bytecode to machine OS-dependent executable code.

class : class keyword is used to declare classes in Java

public : It is an access specifier. Public means this function is visible to all.

static : static is again a keyword used to make a function static. To execute a static function you do not have to create an Object of the class. The main() method here is called by JVM, without creating any object for class.

void : It is the return type, meaning this function will not return anything.

main : main() method is the most important method in a Java program. This is the method which is executed, hence all the logic must be inside the main() method. If a java class is not having a main() method, it causes compilation error.

String[] args : This is used to signify that the user may opt to enter parameters to the Java Program at command line. We can use both String[] args or String args[]. Java compiler would accept both forms.  
System.out.println : This is used to print anything on the console like “printf” in C language.

**2.What is a Java Exception? List out the difference between checked and Unchecked exceptions with a program examples.**

The **Exception Handling in Java** is one of the powerful mechanisms to handle the runtime errors so that the normal flow of the application can be maintained.

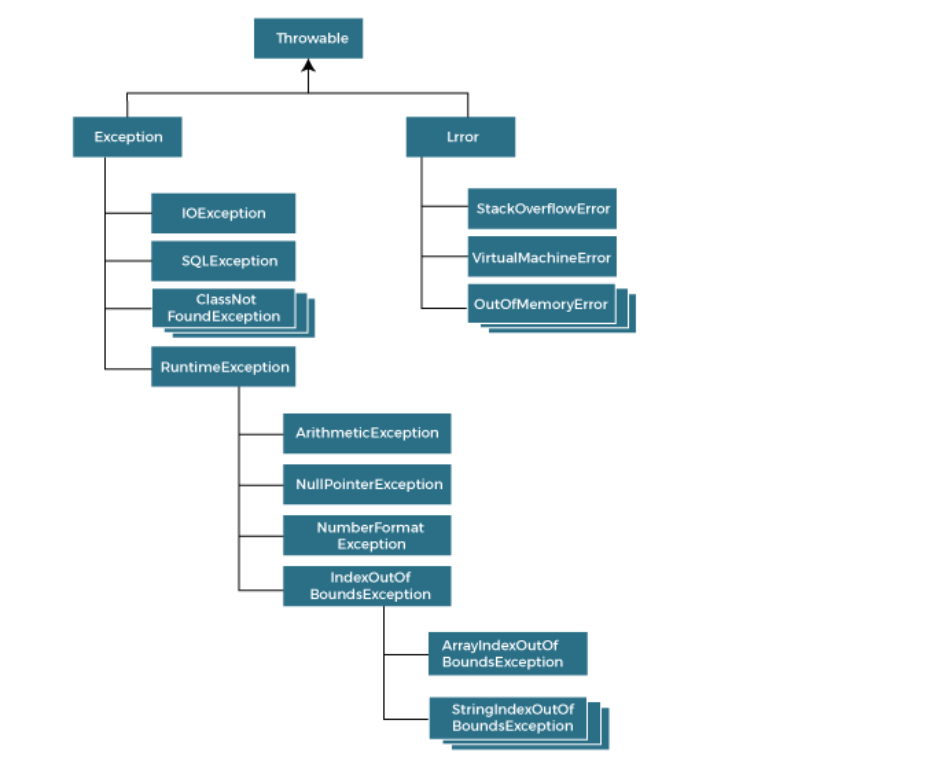
Exception is an abnormal condition. In Java, an exception is an event that disrupts the normal flow of the program. It is an object which is thrown at runtime.

Exception Handling is a mechanism to handle runtime errors such as ClassNotFoundException, IOException, SQLException, RemoteException, etc.

### Advantage of Exception Handling:

### The core advantage of exception handling is **to maintain the normal flow of the application**. An exception normally disrupts the normal flow of the application; that is why we need to handle exceptions. Let's consider a scenario.

## **Hierarchy of Java Exception classes:**



## **Java Exception Handling Example:**

public class JavaExceptionExample{

  public static void main(String args[]){

   try{

      //code that may raise exception

      int data=100/0;

   }catch(ArithmeticException e){System.out.println(e);}

   //rest code of the program

   System.out.println("rest of the code...");

  }

}

## **Common Scenarios of Java Exceptions**

There are given some scenarios where unchecked exceptions may occur. They are as follows:

### 1) A scenario where ArithmeticException occurs

If we divide any number by zero, there occurs an ArithmeticException.

1. **int** a=50/0;//ArithmeticException

### 2) A scenario where NullPointerException occurs

If we have a null value in any [variable](https://www.javatpoint.com/java-variables), performing any operation on the variable throws a NullPointerException.

1. String s=**null**;
2. System.out.println(s.length());//NullPointerException

### 3) A scenario where NumberFormatException occurs

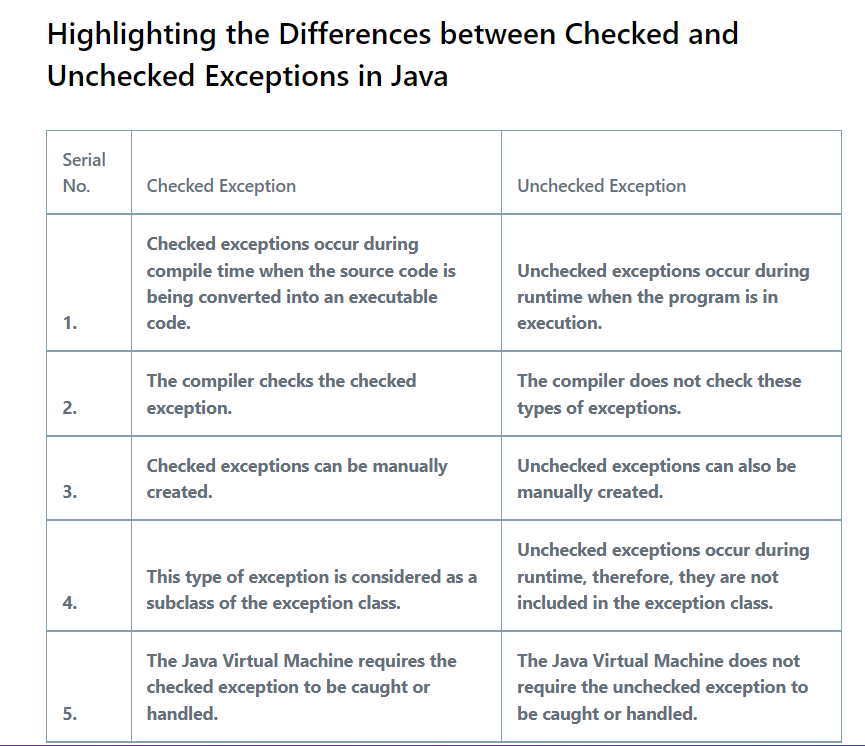
If the formatting of any variable or number is mismatched, it may result into NumberFormatException. Suppose we have a [string](https://www.javatpoint.com/java-string) variable that has characters; converting this variable into digit will cause NumberFormatException.

1. String s="abc";
2. **int** i=Integer.parseInt(s);//NumberFormatException

### 4) A scenario where ArrayIndexOutOfBoundsException occurs

When an array exceeds to it's size, the ArrayIndexOutOfBoundsException occurs. there may be other reasons to occur ArrayIndexOutOfBoundsException. Consider the following statements.

1. **int** a[]=**new** **int**[5];
2. a[10]=50; //ArrayIndexOutOfBoundsException



**3.Design and implement JAVA cod snippet to create five threads with different priorities. Send two threads of the highest priority to sleep state. Check the aliveness of the threads and mark which is long lasting.**

public class ThreadPriorityExample {

  public static void main(String[] args) {

      // Create five threads with different priorities

      Thread thread1 = new Thread(new Task(), "Thread-1");

      Thread thread2 = new Thread(new Task(), "Thread-2");

      Thread thread3 = new Thread(new Task(), "Thread-3");

      Thread thread4 = new Thread(new Task(), "Thread-4");

      Thread thread5 = new Thread(new Task(), "Thread-5");

      // Set different priorities

      thread1.setPriority(Thread.MIN\_PRIORITY); // 1

      thread2.setPriority(Thread.NORM\_PRIORITY); // 5

      thread3.setPriority(Thread.NORM\_PRIORITY); // 5

      thread4.setPriority(Thread.MAX\_PRIORITY); // 10

      thread5.setPriority(Thread.MAX\_PRIORITY); // 10

      // Start the threads

      thread1.start();

      thread2.start();

      thread3.start();

      thread4.start();

      thread5.start();

      // Put the highest priority threads to sleep

      try {

          Thread.sleep(1000); // Ensure all threads have started

          System.out.println(thread4.getName() + " is going to sleep.");

          thread4.sleep(2000);

          System.out.println(thread5.getName() + " is going to sleep.");

          thread5.sleep(2000);

      } catch (InterruptedException e) {

          e.printStackTrace();

      }

      // Check the aliveness of the threads

      System.out.println(thread1.getName() + " is alive: " + thread1.isAlive());

      System.out.println(thread2.getName() + " is alive: " + thread2.isAlive());

      System.out.println(thread3.getName() + " is alive: " + thread3.isAlive());

      System.out.println(thread4.getName() + " is alive: " + thread4.isAlive());

      System.out.println(thread5.getName() + " is alive: " + thread5.isAlive());

      // Join the threads to ensure main thread waits for them to finish

      try {

          thread1.join();

          thread2.join();

          thread3.join();

          thread4.join();

          thread5.join();

      } catch (InterruptedException e) {

          e.printStackTrace();

      }

      // Determine which thread lasted the longest

      System.out.println("All threads have finished execution.");

  }

}

class Task implements Runnable {

  @Override

  public void run() {

      for (int i = 0; i < 5; i++) {

          System.out.println(Thread.currentThread().getName() + " - Priority: " + Thread.currentThread().getPriority() + " - Count: " + i);

          try {

              Thread.sleep(500); // Simulate work with sleep

          } catch (InterruptedException e) {

              e.printStackTrace();

          }

      }

  }

}

**Explanation:**

1. **Thread Creation and Priority Setting:**
   * Five threads are created, each running a Task which prints its name, priority, and a count.
   * Priorities are set using setPriority with Thread.MIN\_PRIORITY, Thread.NORM\_PRIORITY, and Thread.MAX\_PRIORITY.
2. **Starting Threads:**
   * Threads are started using the start method.
3. **Sleeping Threads:**
   * The main thread sleeps for a second to ensure all threads have started.
   * The two highest priority threads (thread4 and thread5) are then put to sleep for two seconds each.
4. **Checking Aliveness:**
   * The isAlive method is used to check if the threads are still running.
5. **Joining Threads:**
   * The join method is used to make sure the main thread waits for all threads to finish execution.
6. **Task Execution:**
   * The run method of the Task class simulates some work by printing a message and sleeping for 500 milliseconds in a loop.

4. Explain the following with program examples:

i)< = ii) > = iii) >> iv) << v ) >>>

public class OperatorExamples {

    public static void main(String[] args) {

        int a = 5;

        int b = 10;

        int num = 8;

        int negativeNum = -8;

        // Less than or equal to (<=)

        System.out.println("Example of <= operator:");

        if (a <= b) {

            System.out.println(a + " is less than or equal to " + b);

        } else {

            System.out.println(a + " is greater than " + b);

        }

        // Greater than or equal to (>=)

        System.out.println("\nExample of >= operator:");

        if (b >= a) {

            System.out.println(b + " is greater than or equal to " + a);

        } else {

            System.out.println(b + " is less than " + a);

        }

        // Right shift (>>)

        System.out.println("\nExample of >> operator:");

        int rightShiftResult = num >> 2; // binary: 1000 >> 2 = 0010

        System.out.println(num + " >> 2 = " + rightShiftResult);

        // Left shift (<<)

        System.out.println("\nExample of << operator:");

        int leftShiftResult = num << 2; // binary: 1000 << 2 = 100000

        System.out.println(num + " << 2 = " + leftShiftResult);

        // Unsigned right shift (>>>)

        System.out.println("\nExample of >>> operator:");

        int unsignedRightShiftResult = negativeNum >>> 2;

        System.out.println(negativeNum + " >>> 2 = " + unsignedRightShiftResult);

    }

}

**Explanation:**

1. **Less than or equal to (<=):**
   * Checks if a (5) is less than or equal to b (10).
   * Output: 5 is less than or equal to 10.
2. **Greater than or equal to (>=):**
   * Checks if b (10) is greater than or equal to a (5).
   * Output: 10 is greater than or equal to 5.
3. **Right shift (>>):**
   * Shifts the bits of num (8, binary 1000) to the right by 2 positions.
   * 8 >> 2 results in 2 (binary 0010).
   * Output: 8 >> 2 = 2.
4. **Left shift (<<):**
   * Shifts the bits of num (8, binary 1000) to the left by 2 positions.
   * 8 << 2 results in 32 (binary 100000).
   * Output: 8 << 2 = 32.
5. **Unsigned right shift (>>>):**
   * Shifts the bits of negativeNum (-8, binary 11111111111111111111111111111000) to the right by 2 positions, filling with 0s.
   * -8 >>> 2 results in 1073741822 (binary 00111111111111111111111111111110).
   * Output: -8 >>> 2 = 1073741822.

**5.List out the best practices for Java Collections Framework?**

**Choose the Right Collection Type:**

Use the most appropriate collection type for your needs (e.g., ArrayList for fast random access, LinkedList for frequent inserts/deletes, HashSet for unique elements).

**Prefer Interfaces Over Implementations:**

Declare variables and parameters using interfaces (e.g., List, Set, Map) rather than specific implementations (e.g., ArrayList, HashSet, HashMap).

List<String> list = new ArrayList<>();

Set<String> set = new HashSet<>();

Map<String, String> map = new HashMap<>();

**Initial Capacity:**

Set an initial capacity if you know the expected size of the collection to avoid unnecessary resizing.

ArrayList<String> list = new ArrayList<>(100);

HashMap<String, String> map = new HashMap<>(200);

**Use Generics:**

Always use generics to ensure type safety and avoid ClassCastException.

List<String> list = new ArrayList<>();

**Avoid Raw Types:**

Avoid using raw types as they lead to unsafe operations and warnings.

Bad

List list = new ArrayList();

Good

List<String> list = new ArrayList<>();

**Use Collections Utility Class:**

Utilize methods from the Collections utility class for common operations like sorting, searching, and reversing.

Collections.sort(list);

Collections.reverse(list);

**Immutability:**

Use immutable collections where possible to ensure thread safety and to avoid accidental modification.

List<String> immutableList = Collections.unmodifiableList(list);

**Fail-Fast Iterators:**

Be aware that most collections provide fail-fast iterators which throw ConcurrentModificationException if the collection is modified while iterating.

List<String> list = new ArrayList<>();

Iterator<String> iterator = list.iterator();

while (iterator.hasNext()) {

        // Do not modify the list here

        String item = iterator.next();

    }

**Avoid Unnecessary Synchronization:**

Prefer using concurrent collections from java.util.concurrent over manually synchronizing collections.

ConcurrentHashMap<String, String> map = new ConcurrentHashMap<>();

**Use forEach and Streams:**

Leverage the enhanced for loop, forEach method, and Stream API for cleaner and more readable code.

list.forEach(System.out::println);

list.stream().filter(s -> s.startsWith("A")).forEach(System.out::println);

**Specific Collection Types Best Practices**

1. **Lists:**
   * Prefer ArrayList for most cases unless you need constant time for inserts and removes, in which case use LinkedList.
   * Use subList method for partitioning lists but be cautious as changes to sublist reflect in the original list.
2. **Sets:**
   * Use HashSet for most cases due to its performance. Use TreeSet when you need sorted sets or LinkedHashSet when you need a predictable iteration order.
   * Avoid using mutable objects as elements in sets.
3. **Maps:**
   * Prefer HashMap for most cases due to its performance. Use TreeMap for sorted maps or LinkedHashMap for predictable iteration order.
   * Use getOrDefault to handle default values easily.

map.getOrDefault(key, defaultValue);

1. **Queues:**
   * Use PriorityQueue for priority-based ordering. Use ArrayDeque as a general-purpose queue/deque implementation.
   * Avoid LinkedList for queue operations due to potential performance issues and use ArrayDeque instead.

**What is String Parsing in Java? Explain parsing of Integers to String with a program example.**

String parsing in Java refers to the process of converting a String into another data type, such as an integer, double, boolean, etc. This is often necessary when dealing with data input from users, files, or other external sources that are initially read as strings but need to be converted to another type for further processing.

**Parsing Integers from Strings**

Parsing an integer from a string in Java can be done using the Integer.parseInt() method or the Integer.valueOf() method. Both methods take a String as an argument and convert it into an int.

* Integer.parseInt(String s): Converts the string s into a primitive int.
* Integer.valueOf(String s): Converts the string s into an Integer object.

public class StringParsingExample {

    public static void main(String[] args) {

        // Parsing String to int using parseInt

        String numberStr1 = "123";

        int number1 = Integer.parseInt(numberStr1);

        System.out.println("Parsed int using parseInt: " + number1);

        // Parsing String to Integer using valueOf

        String numberStr2 = "456";

        Integer number2 = Integer.valueOf(numberStr2);

        System.out.println("Parsed Integer using valueOf: " + number2);

        // Converting int to String using toString

        int number3 = 789;

        String numberStr3 = Integer.toString(number3);

        System.out.println("Converted int to String using toString: " + numberStr3);

        // Converting Integer to String using toString

        Integer number4 = 101112;

        String numberStr4 = number4.toString();

        System.out.println("Converted Integer to String using toString: " + numberStr4);

        // Another way to convert int to String using String.valueOf

        String numberStr5 = String.valueOf(number3);

        System.out.println("Converted int to String using String.valueOf: " + numberStr5);

    }

}

**Explanation:**

1. **Parsing String to int using parseInt:**
   * Integer.parseInt(numberStr1): Converts the string "123" to the primitive integer 123.
2. **Parsing String to Integer using valueOf:**
   * Integer.valueOf(numberStr2): Converts the string "456" to the Integer object 456.
3. **Converting int to String using toString:**
   * Integer.toString(number3): Converts the primitive integer 789 to the string "789".
4. **Converting Integer to String using toString:**
   * number4.toString(): Converts the Integer object 101112 to the string "101112".
5. **Another way to convert int to String using String.valueOf:**
   * String.valueOf(number3): Converts the primitive integer 789 to the string "789".

**Design JAVA code snippet to demonstrate the creation of Threads in two different ways.**

**Method 1: Extending the Thread Class**

// Thread1 class extends the Thread class

class Thread1 extends Thread {

    public void run() {

        for (int i = 0; i < 5; i++) {

            System.out.println("Thread1: " + i);

            try {

                Thread.sleep(1000); // pause for 1 second

            } catch (InterruptedException e) {

                e.printStackTrace();

            }

        }

    }

}

public class ExampleThread1 {

    public static void main(String[] args) {

        Thread1 thread1 = new Thread1();

        thread1.start(); // start the thread

    }

}

**Method 2: Implementing the Runnable Interface:**

// MyRunnable class implements the Runnable interface

class MyRunnable implements Runnable {

    public void run() {

        for (int i = 0; i < 5; i++) {

            System.out.println("Thread2: " + i);

            try {

                Thread.sleep(1000); // pause for 1 second

            } catch (InterruptedException e) {

                e.printStackTrace();

            }

        }

    }

}

public class ExamThread {

    public static void main(String[] args) {

        Thread thread2 = new Thread(new MyRunnable()); // create a thread with the runnable

        thread2.start(); // start the thread

    }

}

**Explain how type safety can be achieved in Collections with an example.**

Type safety in collections can be achieved through the use of generics in Java. Generics allow you to specify the type of elements that a collection can hold, which helps catch type-related errors at compile-time rather than at runtime. This ensures that only objects of the specified type can be added to the collection, preventing ClassCastException and improving code readability and maintainability.

### Example without Generics (Not Type-Safe)

Without generics, collections are not type-safe, meaning they can hold any type of objects. This can lead to runtime errors when retrieving and casting elements.

import java.util.\*;

public class NonGenericExample {

    public static void main(String[] args) {

        List list = new ArrayList(); // Raw type, not type-safe

        list.add("Hello");

        list.add(123); // No compile-time error, but not safe

        for (Object obj : list) {

            String str = (String) obj; // Causes ClassCastException at runtime

            System.out.println(str);

        }

    }

}

### Example with Generics (Type-Safe)

With generics, you can specify the type of elements that a collection can hold, making the code type-safe and preventing runtime errors.

import java.util.ArrayList;

import java.util.List;

public class GenericExample {

    public static void main(String[] args) {

        List<String> list = new ArrayList<>(); // Type-safe, holds only Strings

        list.add("Hello");

        // list.add(123); // Compile-time error, prevents adding non-String

        for (String str : list) {

            System.out.println(str); // No need for casting, safe

        }

    }

}

**Explanation:**

1. **Without Generics (Not Type-Safe):**
   * The list is declared without a type, so it can hold any type of objects.
   * Adding different types of objects (String and Integer) is allowed.
   * When retrieving elements, a ClassCastException can occur if the types do not match.
2. **With Generics (Type-Safe):**
   * The list is declared with a type parameter <String>, making it type-safe.
   * Only String objects can be added to the list.
   * Attempting to add an Integer to the list will result in a compile-time error, preventing runtime issues.
   * No casting is needed when retrieving elements, reducing the risk of ClassCastException.

**Benefits of Using Generics:**

* **Compile-Time Type Checking:** Errors are caught during compilation rather than at runtime, making the code more robust.
* **Elimination of Casting:** No need to cast elements when retrieving them from the collection, improving code readability and safety.
* **Code Reusability:** Generic methods and classes can be written to work with any object type, making the code more reusable and flexible.

**Design Java code snippet to demonstrate the following**

**i.foreach loop ii.Switch iii.dowhile**

### i. foreach Loop

The foreach loop is used to iterate over elements in a collection or array.

import java.util.ArrayList;

import java.util.List;

public class ForeachLoopExample {

    public static void main(String[] args) {

        List<String> fruits = new ArrayList<>();

        fruits.add("Apple");

        fruits.add("Banana");

        fruits.add("Cherry");

        // foreach loop

        for (String fruit : fruits) {

            System.out.println(fruit);

        }

    }

}

### ii. switch Statement

The switch statement allows you to execute different parts of code based on the value of an expression.

public class SwitchExample {

    public static void main(String[] args) {

        int dayOfWeek = 3; // Let's say 1=Monday, 2=Tuesday, ..., 7=Sunday

        // switch statement

        switch (dayOfWeek) {

            case 1:

                System.out.println("Monday");

                break;

            case 2:

                System.out.println("Tuesday");

                break;

            case 3:

                System.out.println("Wednesday");

                break;

            case 4:

                System.out.println("Thursday");

                break;

            case 5:

                System.out.println("Friday");

                break;

            case 6:

                System.out.println("Saturday");

                break;

            case 7:

                System.out.println("Sunday");

                break;

            default:

                System.out.println("Invalid day of the week");

                break;

        }

    }

}

### iii. do-while Loop

The do-while loop executes a block of code at least once and then repeatedly executes the block as long as a condition is true.

public class DoWhileExample {

    public static void main(String[] args) {

        int number = 1;

        // do-while loop

        do {

            System.out.println("Number: " + number);

            number++;

        } while (number <= 5);

    }

}

**Explanation:**

1. **foreach Loop:**
   * Iterates over each element in a collection (List in this case) and prints each fruit.
2. **switch Statement:**
   * Evaluates the value of dayOfWeek and executes the corresponding case block. If no matching case is found, the default block is executed.
3. **do-while Loop:**
   * Executes the code inside the do block at least once and continues to execute it as long as the condition (number <= 5) is true. It prints the numbers from 1 to 5.

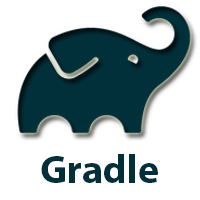
**Write about**

**i)Gradle Fundamentals ii) TDD with Junit 5.**

**i)Gradle Fundamentals:**

**Gradle** is an open-source build automation tool that is designed to be flexible enough to build almost any type of software. It is widely used in Java projects but is also suitable for building projects in other languages. Gradle combines the best features of Ant and Maven and introduces a Groovy-based DSL (Domain-Specific Language) for writing build scripts.

# **Gradle Tutorial**



**Gradle tutorial** provides basic and advanced concepts of the Gradle tool. Our Gradle tutorial is developed for beginners and professionals.

Our Gradle tutorial includes **project task**, **installation and configuration**, **Gradle build**, **Gradle Build Scans**, **Gradle dependencies**, **Gradle Projects**, **Gradle eclipse plug-in**, **Gradle with Java**, **Gradle with spring**, **Gradle with Android** and more concepts related to Gradle.

Gradle is an advanced general-purpose build management tool that is based on **Groovy and Kotlin**. It is a **build automation** tool that is an open-source and based on the concepts of [Apache Maven](https://www.javatpoint.com/maven-tutorial) and [Apache Ant](https://www.javatpoint.com/apache-ant-tutorial). It is developed for the multi-projects, which can be quite large. It has been developed for building automation on many languages and platforms, including **Java**, **Scala**, **Android**, **C / C ++**, and **Groovy.**

## **What is Gradle?**

**Gradle** is an open source **build automation** tool that is based on the concept of **Apache Maven** and **Apache Ant**. It is capable of building almost any type of software. It is designed for the multi-project build, which can be quite large. It introduces a **Java and Groovy-based DSL(Domain Specific Language)** instead of XML (Extensible Markup Language) for declaring the project configuration. It uses a DAG (Directed Acyclic Graph) to define the order of executing the task.

Gradle offers an elastic model that can help the development lifecycle from compiling and packaging code for web and mobile applications. It provides support for the **building**, **testing**, and **deploying software** on different platforms. It has been developed for building automation on many languages and platforms, including Java, Scala, Android, C / C ++, and Groovy. Gradle provides integration with several development tools and servers, including Eclipse, IntelliJ, Jenkins, and Android Studio.

Gradle is used by large projects such as **Spring Projects**, **Hibernate Projects**, and **Grails Projects**. Some Leading Enterprise companies like **LinkedIn** and **Netflix** use Gradle.

Gradle was initially released in 2007, and it is stably released on November 18, 2019 (latest version 6.0.1). Gradle has taken the advantages of both Ant and Maven and remove the drawbacks of both.

## **What is a Build Tool?**

Build tools are **programs that are used to automate the creation of executable** applications from source code. The building process involves compiling, linking, and **packaging the code into a useful or executable form**. Developers often implement the build process manually for small projects. But this cannot be done for large projects where it is complicated to keep track of what is needed for construction, in what order, and what dependencies are in the building process. Using the automation tools makes the build process more consistent.

## **Projects and Tasks in Gradle**

Gradle describes everything on the basis of **projects** and **tasks**. Every **Gradle build** contains one or more projects, and these projects contain some tasks.

**Gradle Projects**

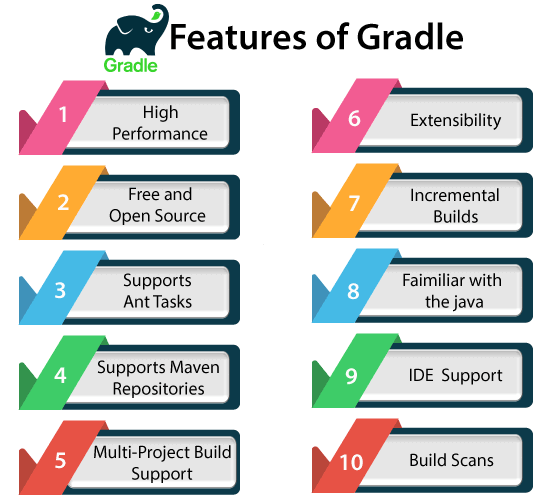
In Gradle, A project represents a library JAR or a web application. It may also represent a distribution ZIP, which is assembled from the JARs produced by other projects. A project could be deploying your application to staging or production environments. Each project in Gradle is made up of one or more tasks.

**Gradle Tasks**

In Gradle, Task is a single piece of work that a build performs. For example, it could **compile classes**, **create a JAR**, **Generate Javadoc**, and **publish some archives** to a repository and more.

## **Features of Gradle**

Some remarkable features of Gradle are as follows:



### High Performance

Gradle quickly completes the task by reusing the output from the previous execution. It processes tasks whose only input is changed and executes the task in parallel. Thus it avoids unnecessary tasks and provides faster performance.

### Free and open-source

Gradle is an **open-source** tool and is licensed under the **Apache License (ASL)**.

### Provide support for Ant Tasks and Maven repositories

Gradle provides support for the Ant build projects; we can import an Ant build project and reuse all of its tasks. However, we can also make Ant-based Gradle tasks. The integration includes the properties, paths, and more.

Gradle supports the Maven repository. Maven Repositories are designed to publish and fetch dependencies of the project. Therefore we can continue to use any available repository infrastructure.

### Multi-project build support

Gradle provides **powerful support for the multi-project builds**. A multi-project build may contain a root project and one or more subprojects that may also have subprojects. We can flexibly define our layout with the Gradle.

A project can simply be dependent on other projects or dependencies. We can describe a graph of dependencies among projects. Gradle also supports partial builds. It means that Gradle will find out whether a project, upon which our project depends, needs to be rebuilt. If the project needs to be rebuilt, Gradle will do so before building our own project.

### Extensibility

Extensibility is one of the decent features of Gradle. We can easily extend the Gradle to provide our task types or build models. For an example of this, see Android Build Support: It adds several new build concepts such as flavor and builds types.

### Incremental Builds

Gradle facilitates us with an incremental build, which means it **executes only the necessary tasks**. If we compile source code, it will check if the sources have changed since the previous execution. If the code is changed, then it will be executed; but, if the code is not changed, then it will skip the execution, and the task is marked as updated. There are many algorithms in Gradle to do so.

### Familiar with the Java

We need a JVM to run the Gradle, so our machine should have a Java Development Kit (JDK). Gradle is familiar with most of the Java features. It is a bonus for the java users as we can use the standard Java APIs in our build logic, such as **plug-ins** and **custom tasks**. Therefore it makes it easy to run Gradle on different platforms.

**Gradle isn't limited to building just JVM projects; it also provides support for building native projects.**

### IDE Support

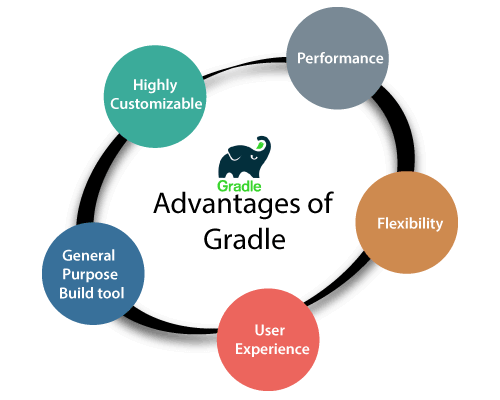
Gradle has **support for several IDE's**. They are allowed to import the Gradle builds and interact with them. Gradle also generates the required solution files to load a project into Visual Studio.

### Build Scans

The **Build Scans** provides comprehensive information about build run that can be used to identify build issues. They also help us to diagnose the problems with a build's performance. The build scans can be shared with others; this can be useful if we need the advice to fix an issue with the build.

## **Advantages of Gradle**

Some significant benefits of Gradle are as following:



### Highly Customizable

Gradle is highly customizable and extensible. It can be customized to different projects under different technologies. It can be customized in many ways like it can be used in Java projects, Android projects, Groovy projects, and more.

### Performance

Gradle is very fast in performance. It is about two times faster than Maven in all scenarios and a hundred times faster in large builds using build-cache.

### Flexibility

Gradle is a flexible tool. Gradle is a plug-in based build tool. We can create our plug-in in different programming language like Java, Groovy, Kotlin, Scala, and more. If we want to add any functionality after deployment to the project, to do this, we can create a plug-in and give control to the codebase.

### User Experience

Gradle supports a wide range of IDE's to provide an improved user experience. Most people prefer to work on the IDE, but many users prefer to work on the terminal, Gradle provides a command-line interface for them. Gradle command-line interface offers many powerful features like Gradle Tasks, Command line completion, and more.

It also provides interactive web-based UI for debugging and optimizing builds.

### Gradle is a general-purpose build tool

Gradle is a general-purpose build tool; it allows us to build any type of software.

### TDD with JUnit 5

**Test-Driven Development (TDD)** is a software development process that relies on the repetition of a very short development cycle: first, the developer writes a failing automated test case that defines a desired improvement or new function, then produces the minimum amount of code to pass that test, and finally refactors the new code to acceptable standards.

**JUnit 5** is the latest version of JUnit, which is a popular testing framework for Java. It introduces several new features and improvements over its predecessors, making it more flexible and extensible.

### TDD Cycle with JUnit 5

The TDD cycle consists of three main steps:

1. **Write a Failing Test**:
   * Start by writing a test for a new feature or a bug fix that you want to implement. This test should initially fail since the feature is not yet implemented.
2. **Write the Minimum Code to Pass the Test**:
   * Implement the simplest possible code that will make the test pass. The focus here is on getting the test to pass, not on writing perfect code.
3. **Refactor the Code**:
   * Clean up the code, ensuring it is well-structured and adheres to coding standards. Run the tests again to ensure that they still pass after refactoring.

### Setting Up JUnit 5 with Gradle

To get started with JUnit 5, you need to include the necessary dependencies in your build.gradle file:

groovy

Copy code

plugins {

id 'java'

}

repositories {

mavenCentral()

}

dependencies {

testImplementation 'org.junit.jupiter:junit-jupiter:5.7.0'

}

test {

useJUnitPlatform()

}

### Example of TDD with JUnit 5

Let's walk through an example of using TDD to implement a simple calculator class with an add method.

#### Step 1: Write a Failing Test

Create a test class and write a test for the add method that does not yet exist.

import org.junit.jupiter.api.Test;

import static org.junit.jupiter.api.Assertions.\*;

public class CalculatorTest {

@Test

public void testAddition() {

Calculator calculator = new Calculator();

assertEquals(5, calculator.add(2, 3), "2 + 3 should equal 5");

}

}

#### Step 2: Write the Minimum Code to Pass the Test

Create the Calculator class and implement the add method.

public class Calculator {

public int add(int a, int b) {

return a + b;

}

}

Run the test using ./gradlew test. The test should pass now.

#### Step 3: Refactor the Code

Since the implementation is straightforward, there might not be much to refactor. However, as you add more features, refactoring will become more important to maintain clean and manageable code.

### Additional Features with TDD

Let's add a new feature to our calculator: a subtract method.

#### Step 1: Write a Failing Test

Add a new test case for the subtract method.

public class CalculatorTest {

// Existing test

@Test

public void testAddition() {

Calculator calculator = new Calculator();

assertEquals(5, calculator.add(2, 3), "2 + 3 should equal 5");

}

// New test

@Test

public void testSubtraction() {

Calculator calculator = new Calculator();

assertEquals(1, calculator.subtract(3, 2), "3 - 2 should equal 1");

}

}

#### Step 2: Write the Minimum Code to Pass the Test

Implement the subtract method in the Calculator class.

java

Copy code

public class Calculator {

public int add(int a, int b) {

return a + b;

}

public int subtract(int a, int b) {

return a - b;

}

}

Run the tests again using ./gradlew test. Both tests should pass now.

#### Step 3: Refactor the Code

Ensure that the code is clean and adheres to best practices. In this simple example, the code is already straightforward, but as more features are added, refactoring will be necessary.

### Advantages of TDD

1. **Better Code Quality**:
   * TDD encourages developers to write only the necessary code to pass tests, which often results in simpler and cleaner code.
2. **Reduced Bugs**:
   * Since tests are written before the code, many bugs are caught early in the development process.
3. **Documentation**:
   * Tests serve as a form of documentation, explaining what the code is supposed to do.
4. **Refactoring Confidence**:
   * With a comprehensive suite of tests, developers can refactor code with confidence, knowing that any breaking changes will be caught by the tests.