Exception Handling in Java

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.

What is Exception in Java?

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

What is Exception Handling?

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

Advantage of Exception Handling

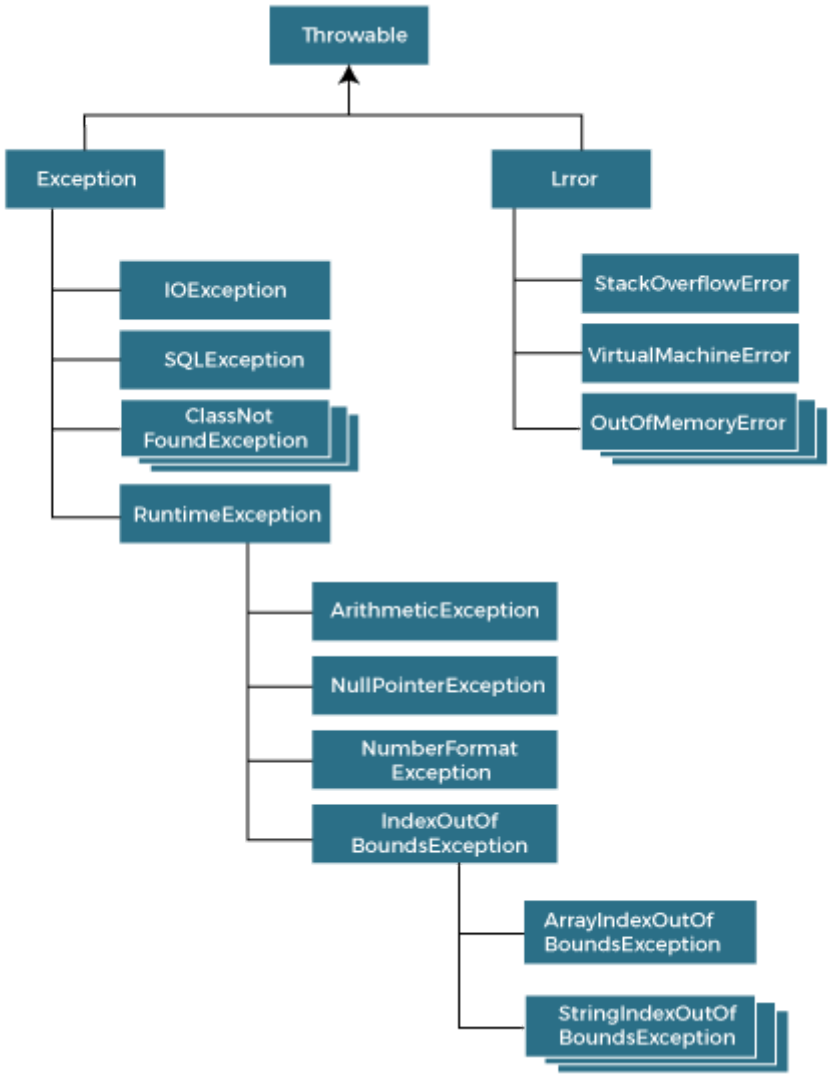
The core advantage of exception handling is **to maintain the normal flow of the application**. An exception normally disrupts the normal flow of the application; that is why we need to handle exceptions. Let's consider a scenario:

1. statement 1;
2. statement 2;
3. statement 3;
4. statement 4;
5. statement 5;//exception occurs
6. statement 6;
7. statement 7;
8. statement 8;
9. statement 9;
10. statement 10;

Suppose there are 10 statements in a Java program and an exception occurs at statement 5; the rest of the code will not be executed, i.e., statements 6 to 10 will not be executed. However, when we perform exception handling, the rest of the statements will be executed. That is why we use exception handling in Java.

Hierarchy of Java Exception classes

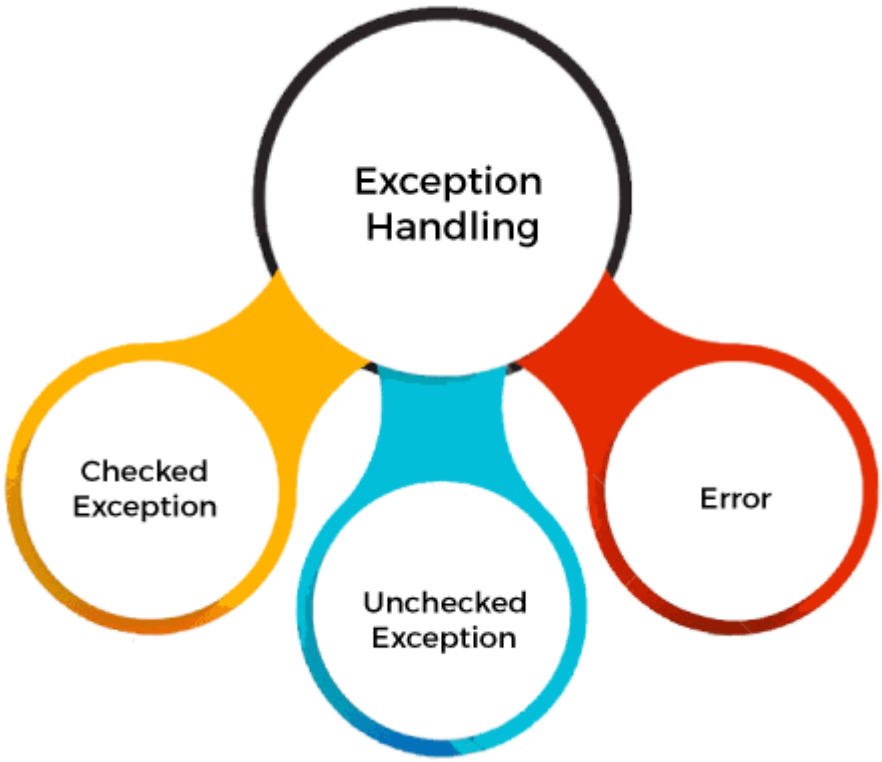
The java.lang.Throwable class is the root class of Java Exception hierarchy inherited by two subclasses: Exception and Error. The hierarchy of Java Exception classes is given below:



Types of Java Exceptions

There are mainly two types of exceptions: checked and unchecked. An error is considered as the unchecked exception. However, according to Oracle, there are three types of exceptions namely:

1. Checked Exception
2. Unchecked Exception
3. Error



Difference between Checked and Unchecked Exceptions

1) Checked Exception

The classes that directly inherit the Throwable class except RuntimeException and Error are known as checked exceptions. For example, IOException, SQLException, etc. Checked exceptions are checked at compile-time.

2) Unchecked Exception

The classes that inherit the RuntimeException are known as unchecked exceptions. For example, ArithmeticException, NullPointerException, ArrayIndexOutOfBoundsException, etc. Unchecked exceptions are not checked at compile-time, but they are checked at runtime.

3) Error

Error is irrecoverable. Some example of errors are OutOfMemoryError, VirtualMachineError, AssertionError etc.

Java Exception Keywords

Java provides five keywords that are used to handle the exception. The following table describes each.

Keyword	Description
try	The "try" keyword is used to specify a block where we should place an exception code. It means we can't use try block alone. The try block must be followed by either catch or finally.
catch	The "catch" block is used to handle the exception. It must be preceded by try block which means we can't use catch block alone. It can be followed by finally block later.
finally	The "finally" block is used to execute the necessary code of the program. It is executed whether an exception is handled or not.
throw	The "throw" keyword is used to throw an exception.
throws	The "throws" keyword is used to declare exceptions. It specifies that there may occur an exception in the method. It doesn't throw an exception. It is always used with method signature.

Java Exception Handling Example

Let's see an example of Java Exception Handling in which we are using a try-catch statement to handle the exception.

JavaExceptionExample.java

```
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...");
 }
}
```

Output:

```
Exception in thread main java.lang.ArithmeticException:/ by zero
rest of the code...
```

In the above example, 100/0 raises an ArithmeticException which is handled by a try-catch block.

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, 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 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
```

Java finally block

Java finally block is a block used to execute important code such as closing the connection, etc.

Java finally block is always executed whether an exception is handled or not. Therefore, it contains all the necessary statements that need to be printed regardless of the exception occurs or not.

The finally block follows the try-catch block.

When an exception does not occur

Let's see the below example where the Java program does not throw any exception, and the finally block is executed after the try block.

TestFinallyBlock.java

```
class TestFinallyBlock {
  public static void main(String args[]){
  try{
//below code do not throw any exception
   int data=25/5;
   System.out.println(data);
  }
//catch won't be executed
  catch(NullPointerException e){
System.out.println(e);
}
//executed regardless of exception occurred or not
 finally {
System.out.println("finally block is always executed");
}

System.out.println("rest of phe code...");
  }
}
```

Output:

```
C:\Users\Anurati\Desktop\abcDemo>javac TestFinallyBlock.java

C:\Users\Anurati\Desktop\abcDemo>java TestFinallyBlock
5
finally block is always executed
rest of the code...
```

Difference between throw and throws in Java

The throw and throws is the concept of exception handling where the throw keyword throw the exception explicitly from a method or a block of code whereas the throws keyword is used in signature of the method.

There are many differences between throw and throws keywords. A list of differences between throw and throws are given below:

Sr. no.	Basis of Differences	throw	throws
1.	Definition	Java throw keyword is used throw an exception explicitly in the code, inside the function or the block of code.	Java throws keyword is used in the method signature to declare an exception which might be thrown by the function while the execution of the code.
2.	Type of exception Using throw keyword, we can only propagate unchecked exception i.e., the checked exception cannot be propagated using throw only.	Using throws keyword, we can declare both checked and unchecked exceptions. However, the throws keyword can be used to propagate checked exceptions only.	
3.	Syntax	The throw keyword is followed by an instance of Exception to be thrown.	The throws keyword is followed by class names of Exceptions to be thrown.
4.	Declaration	throw is used within the method.	throws is used with the method signature.
5.	Internal implementation	We are allowed to throw only one exception at a time i.e. we cannot throw multiple exceptions.	We can declare multiple exceptions using throws keyword that can be thrown by the method. For example, main() throws IOException, SQLException.

Java throw Example

TestThrow.java

```
public class TestThrow {
   //defining a method
    public static void checkNum(int num) {
       if (num < 1) {
            throw new ArithmeticException("\nNumber is negative, cannot calculate squ
are");
       }
        else {
          System.out.println("Square of " + num + " is " + (num*num));
       }
    }
    //main method
    public static void main(String[] args) {
           TestThrow obj = new TestThrow();
          obj.checkNum(-3);
     System.out.println("Rest of the code..");
    }
}
```

Output:

```
C:\Users\Anurati\Desktop\abcDemo>javac TestThrow.java

C:\Users\Anurati\Desktop\abcDemo>java TestThrow
Exception in thread "main" java.lang.ArithmeticException:
Number is negative, cannot calculate square
        at TestThrow.checkNum(TestThrow.java:6)
        at TestThrow.main(TestThrow.java:16)
```

Java throws Example

TestThrows.java

```
public class TestThrows {
   //defining a method
    public static int divideNum(int m, int n) throws ArithmeticException {
       int div = m / n;
```

```
        return div;
    }
    //main method
    public static void main(String[] args) {
        TestThrows obj = new TestThrows();
        try {
            System.out.println(obj.divideNum(45, 0));
        }
        catch (ArithmeticException e){
            System.out.println("\nNumber cannot be divided by 0");
        }

        System.out.println("Rest of the code..");
    }
}
```

Output:

```
C:\Users\Anurati\Desktop\abcDemo>javac TestThrows.java

C:\Users\Anurati\Desktop\abcDemo>java TestThrows

Number cannot be divided by 0
Rest of the code..
```

Java throw and throws Example

TestThrowAndThrows.java

```
public class TestThrowAndThrows
{
    // defining a user-defined method
    // which throws ArithmeticException
    static void method() throws ArithmeticException
    {
        System.out.println("Inside the method()");
        throw new ArithmeticException("throwing ArithmeticException");
    }
    //main method
    public static void main(String args[])
```

```
    {
        try
        {
            method();
        }
        catch(ArithmeticException e)
        {
            System.out.println("caught in main() method");
        }
    }
}
```

Output:

```
C:\Users\Anurati\Desktop\abcDemo>javac TestThrowAndThrows.java

C:\Users\Anurati\Desktop\abcDemo>java TestThrowAndThrows
Inside the method()
caught in main() method
```