Exception handling in java with examples

Exception handling is one of the most important feature of java programming that allows us to handle the runtime errors caused by exceptions. In this guide, we will learn what is an exception, types of it, exception classes and how to handle exceptions in java with examples.

What is an exception?

An Exception is an unwanted event that interrupts the normal flow of the program. When an exception occurs program execution gets terminated. In such cases we get a system generated error message. The good thing about exceptions is that they can be handled in Java. By handling the exceptions we can provide a meaningful message to the user about the issue rather than a system generated message, which may not be understandable to a user.

Why an exception occurs?

There can be several reasons that can cause a program to throw exception. For example: Opening a non-existing file in your program, Network connection problem, bad input data provided by user etc.

Exception Handling

If an exception occurs, which has not been handled by programmer then program execution gets terminated and a system generated error message is shown to the user. For example look at the system generated exception below:

An exception generated by the system is given below

```
 Exception in thread "main" java.lang.ArithmeticException: / by zero at
ExceptionDemo.main(ExceptionDemo.java:5)
 ExceptionDemo : The class name
 main : The method name
 ExceptionDemo.java : The filename
 java:5 : Line number
```

This message is not user friendly so a user will not be able to understand what went wrong. In order to let them know the reason in simple language, we handle exceptions. We handle such conditions and then prints a user friendly warning message to user, which lets them correct the error as most of the time exception occurs due to bad data provided by user.

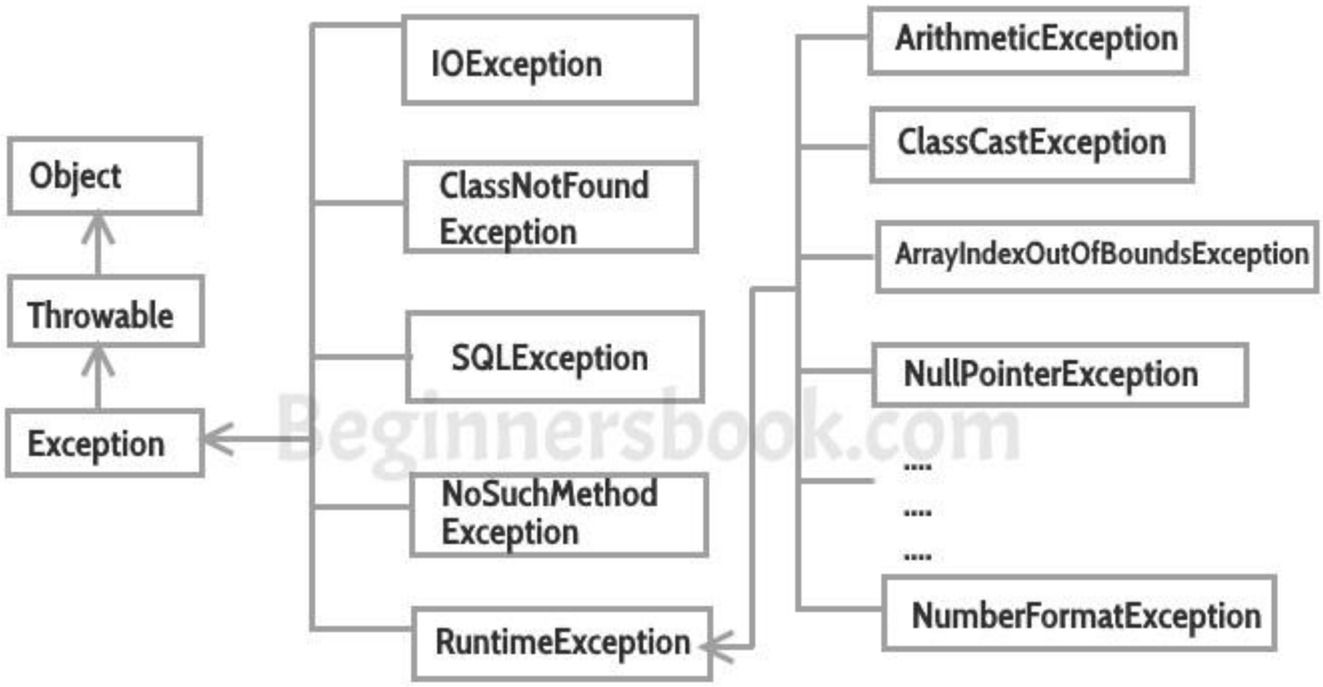
Advantage of exception handling

Exception handling ensures that the flow of the program doesn’t break when an exception occurs. For example, if a program has bunch of statements and an exception occurs mid way after executing certain statements then the statements after the exception will not execute and the program will terminate abruptly. By handling we make sure that all the statements execute and the flow of program doesn’t break.

Difference between error and exception

Errors indicate that something severe enough has gone wrong, the application should crash rather than try to handle the error.

Exceptions are events that occurs in the code. A programmer can handle such conditions and take necessary corrective actions. Few examples:
NullPointerException – When you try to use a reference that points to null.
ArithmeticException – When bad data is provided by user, for example, when you try to divide a number by zero this exception occurs because dividing a number by zero is undefined.
ArrayIndexOutOfBoundsException – When you try to access the elements of an array out of its bounds, for example array size is 5 (which means it has five elements) and you are trying to access the 10th element.



Types of exceptions

There are two types of exceptions in Java:
1)Checked exceptions
2)Unchecked exceptions

Checked exceptions

All exceptions other than Runtime Exceptions are known as Checked exceptions as the compiler checks them during compilation to see whether the programmer has handled them or not. If these exceptions are not handled/declared in the program, you will get compilation error. For example, SQLException, IOException, ClassNotFoundException etc.

Unchecked Exceptions

Runtime Exceptions are also known as Unchecked Exceptions. These exceptions are not checked at compile-time so compiler does not check whether the programmer has handled them or not but it’s the responsibility of the programmer to handle these exceptions and provide a safe exit. For example, ArithmeticException, NullPointerException, ArrayIndexOutOfBoundsException etc.

Compiler will never force you to catch such exception or force you to declare it in the method using throws keyword.

Try Catch in Java – Exception handling

In the previous tutorial we discussed what is exception handling and why we do it. In this tutorial we will see try-catch block which is used for exception handling.

Try block

The try block contains set of statements where an exception can occur. A try block is always followed by a catch block, which handles the exception that occurs in associated try block. A try block must be followed by catch blocks or finally block or both.

Syntax of try block

```
try{
   //statements that may cause an exception
}
```

While writing a program, if you think that certain statements in a program can throw a exception, enclosed them in try block and handle that exception

Catch block

A catch block is where you handle the exceptions, this block must follow the try block. A single try block can have several catch blocks associated with it. You can catch different exceptions in different catch blocks. When an exception occurs in try block, the corresponding catch block that handles that particular exception executes. For example if an arithmetic exception occurs in try block then the statements enclosed in catch block for arithmetic exception executes.

Syntax of try catch in java

```
try
{
     //statements that may cause an exception
}
catch (exception(type) e(object))
{
     //error handling code
}
```

Example: try catch block

If an exception occurs in try block then the control of execution is passed to the corresponding catch block. A single try block can have multiple catch blocks associated with it, you should place the catch blocks in such a way that the generic exception handler catch block is at the last(see in the example below). The generic exception handler can handle all the exceptions but you should place is at the end, if you place it at the before all the catch blocks then it will display the generic message. You always want to give the user a meaningful message for each type of exception rather then a generic message.

```
class Example1 {
  public static void main(String args[]) {
    int num1, num2;
    try {
      /* We suspect that this block of statement can throw
       * exception so we handled it by placing these statements
       * inside try and handled the exception in catch block
       */
      num1 = 0;
      num2 = 62 / num1;
      System.out.println(num2);
      System.out.println("Hey I'm at the end of try block");
    }
    catch (ArithmeticException e) {
      /* This block will only execute if any Arithmetic exception
       * occurs in try block
       */
      System.out.println("You should not divide a number by zero");
    }
    catch (Exception e) {
      /* This is a generic Exception handler which means it can handle
       * all the exceptions. This will execute if the exception is not
       * handled by previous catch blocks.
       */
      System.out.println("Exception occurred");
    }
    System.out.println("I'm out of try-catch block in Java.");
  }
}
```

Output:

```
You should not divide a number by zero
I'm out of try-catch block in Java.
```

Multiple catch blocks in Java

The example we seen above is having multiple catch blocks, lets see few rules about multiple catch blocks with the help of examples. To read this in detail, see catching multiple exceptions in java.
1. As I mentioned above, a single try block can have any number of catch blocks.
2. A generic catch block can handle all the exceptions. Whether it is ArrayIndexOutOfBoundsException or ArithmeticException or NullPointerException or any other type of exception, this handles all of them. To see the examples of NullPointerException and ArrayIndexOutOfBoundsException,.

```
catch(Exception e){
  //This catch block catches all the exceptions
}
```

If you are wondering why we need other catch handlers when we have a generic that can handle all. This is because in generic exception handler you can display a message but you are not sure for which type of exception it may trigger so it will display the same message for all the exceptions and user may not be able to understand which exception occurred. Thats the reason you should place is at the end of all the specific exception catch blocks

3. If no exception occurs in try block then the catch blocks are completely ignored.
4. Corresponding catch blocks execute for that specific type of exception:
catch(ArithmeticException e) is a catch block that can hanlde ArithmeticException
catch(NullPointerException e) is a catch block that can handle NullPointerException
5. You can also throw exception,

Example of Multiple catch blocks

```
class Example2{
  public static void main(String args[]){
    try{
        int a[]=new int[7];
        a[4]=30/0;
        System.out.println("First print statement in try block");
    }
    catch(ArithmeticException e){
      System.out.println("Warning: ArithmeticException");
    }
    catch(ArrayIndexOutOfBoundsException e){
      System.out.println("Warning: ArrayIndexOutOfBoundsException");
    }
    catch(Exception e){
      System.out.println("Warning: Some Other exception");
    }
  System.out.println("Out of try-catch block...");
 }
}
```

Output:

```
Warning: ArithmeticException
Out of try-catch block...
```

In the above example there are multiple catch blocks and these catch blocks executes sequentially when an exception occurs in try block. Which means if you put the last catch block (catch(Exception e)) at the first place, just after try block then in case of any exception this block will execute as it can handle all exceptions. This catch block should be placed at the last to avoid such situations.

Finally block

I have covered this in a separate tutorial here: java finally block. For now you just need to know that this block executes whether an exception occurs or not. You should place those statements in finally blocks, that must execute whether exception occurs or not.

How to Catch multiple exceptions

In the previous tutorial, I have covered how to handle exceptions using try-catch blocks. In this guide, we will see how to handle multiple exceptions and how to write them in a correct order so that user gets a meaningful message for each type of exception.

Catching multiple exceptions

Lets take an example to understand how to handle multiple exceptions.

```
class Example{
  public static void main(String args[]){
    try{
      int arr[]=new int[7];
      arr[4]=30/0;
      System.out.println("Last Statement of try block");
    }
    catch(ArithmeticException e){
      System.out.println("You should not divide a number by zero");
    }
    catch(ArrayIndexOutOfBoundsException e){
      System.out.println("Accessing array elements outside of the limit");
    }
    catch(Exception e){
      System.out.println("Some Other Exception");
    }
    System.out.println("Out of the try-catch block");
  }
}
```

Output:

```
You should not divide a number by zero
Out of the try-catch block
```

In the above example, the first catch block got executed because the code we have written in try block throws ArithmeticException (because we divided the number by zero).

Now lets change the code a little bit and see the change in output:

```
class Example{
  public static void main(String args[]){
    try{
      int arr[]=new int[7];
      arr[10]=10/5;
      System.out.println("Last Statement of try block");
    }
    catch(ArithmeticException e){
      System.out.println("You should not divide a number by zero");
    }
    catch(ArrayIndexOutOfBoundsException e){
      System.out.println("Accessing array elements outside of the limit");
    }
    catch(Exception e){
      System.out.println("Some Other Exception");
    }
    System.out.println("Out of the try-catch block");
  }
}
```

Output:

```
Accessing array elements outside of the limit
Out of the try-catch block
```

In this case, the second catch block got executed because the code throws ArrayIndexOutOfBoundsException. We are trying to access the 11th element of array in above program but the array size is only 7.

What did we observe from the above two examples?
1. It is clear that when an exception occurs, the specific catch block (that declares that exception) executes. This is why in first example first block executed and in second example second catch.
2. Although I have not shown you above, but if an exception occurs in above code which is not Arithmetic and ArrayIndexOutOfBounds then the last generic catch handler would execute.

Lets change the code again and see the output:

```
class Example{
  public static void main(String args[]){
    try{
      int arr[]=new int[7];
      arr[10]=10/5;
      System.out.println("Last Statement of try block");
    }
    catch(Exception e){
      System.out.println("Some Other Exception");
    }
    catch(ArithmeticException e){
      System.out.println("You should not divide a number by zero");
    }
    catch(ArrayIndexOutOfBoundsException e){
      System.out.println("Accessing array elements outside of the limit");
    }
    System.out.println("Out of the try-catch block");
  }
}
```
Output:

```
Compile time error: Exception in thread "main" java.lang.Error:
Unresolved compilation problems: Unreachable catch block for ArithmeticException.
It is already handled by the catch block for Exception Unreachable catch block
for ArrayIndexOutOfBoundsException. It is already handled by the catch block for
Exception at Example.main(Example1.java:11)
```

Why we got this error?
This is because we placed the generic exception catch block at the first place which means that none of the catch blocks placed after this block is reachable. You should always place this block at the end of all other specific exception catch blocks.

Nested try catch block in Java – Exception handling

When a try catch block is present in another try block then it is called the nested try catch block. Each time a try block does not have a catch handler for a particular exception, then the catch blocks of parent try block are inspected for that exception, if match is found that that catch block executes.

If neither catch block nor parent catch block handles exception then the system generated message would be shown for the exception, similar to what we see when we don’t handle exception.

Lets see the syntax first then we will discuss this with an example.

Syntax of Nested try Catch

```
....
//Main try block
try {
   statement 1;
   statement 2;
   //try-catch block inside another try block
   try {
      statement 3;
      statement 4;
      //try-catch block inside nested try block
      try {
         statement 5;
         statement 6;
      }
      catch(Exception e2) {
         //Exception Message
      }
   }
   catch(Exception e1) {
       //Exception Message
   }

}
//Catch of Main(parent) try block
catch(Exception e3) {
      //Exception Message
}
....
```

Nested Try Catch Example

Here we have deep (two level) nesting which means we have a try-catch block inside a nested try block. To make you understand better I have given the names to each try block in comments like try-block2, try-block3 etc.

This is how the structure is: try-block3 is inside try-block2 and try-block2 is inside main try-block, you can say that the main try-block is a grand parent of the try-block3. Refer the explanation which is given at the end of this code.

```
class NestingDemo{
   public static void main(String args[]){
      //main try-block
      try{
            //try-block2
        try{
          //try-block3
          try{
            int arr[]= {1,2,3,4};
            /* I'm trying to display the value of
             * an element which doesn't exist. The
             * code should throw an exception
             */
            System.out.println(arr[10]);
          }catch(ArithmeticException e){
            System.out.print("Arithmetic Exception");
            System.out.println(" handled in try-block3");
          }
        }
        catch(ArithmeticException e){
          System.out.print("Arithmetic Exception");
          System.out.println(" handled in try-block2");
        }
    }
    catch(ArithmeticException e3){
            System.out.print("Arithmetic Exception");
            System.out.println(" handled in main try-block");
    }
    catch(ArrayIndexOutOfBoundsException e4){
            System.out.print("ArrayIndexOutOfBoundsException");
            System.out.println(" handled in main try-block");
    }
    catch(Exception e5){
            System.out.print("Exception");
            System.out.println(" handled in main try-block");
     }
  }
}
```
Output:

```
ArrayIndexOutOfBoundsException handled in main try-block
```

As you can see that the ArrayIndexOutOfBoundsException occurred in the grand child try-block3. Since try-block3 is not handling this exception, the control then gets transferred to the parent try-block2 and looked for the catch handlers in try-block2. Since the try-block2 is also not handling that exception, the control gets transferred to the main (grand parent) try-block where it found the appropriate catch block for exception. This is how the the nesting structure works.

Example 2: Nested try block

```
class Nest{
  public static void main(String args[]){
            //Parent try block
    try{
            //Child try block1
        try{
          System.out.println("Inside block1");
          int b =45/0;
          System.out.println(b);
        }
        catch(ArithmeticException e1){
          System.out.println("Exception: e1");
        }
        //Child try block2
        try{
          System.out.println("Inside block2");
          int b =45/0;
          System.out.println(b);
        }
        catch(ArrayIndexOutOfBoundsException e2){
          System.out.println("Exception: e2");
        }
       System.out.println("Just other statement");
    }
    catch(ArithmeticException e3){
            System.out.println("Arithmetic Exception");
        System.out.println("Inside parent try catch block");
    }
    catch(ArrayIndexOutOfBoundsException e4){
            System.out.println("ArrayIndexOutOfBoundsException");
        System.out.println("Inside parent try catch block");
    }
    catch(Exception e5){
            System.out.println("Exception");
        System.out.println("Inside parent try catch block");
    }
    System.out.println("Next statement..");
  }
}
```

Output:

```
Inside block1
Exception: e1
Inside block2
Arithmetic Exception
Inside parent try catch block
Next statement..
```

This is another example that shows how the nested try block works. You can see that there are two try-catch block inside main try block's body. I've marked them as block 1 and block 2 in above example. **Block1:** I have divided an integer by zero and it caused an ArithmeticException, since the catch of block1 is handling ArithmeticException "Exception: e1" displayed.

Block2: In block2, ArithmeticException occurred but block 2 catch is only handling ArrayIndexOutOfBoundsException so in this case control jump to the Main try-catch(parent) body and checks for the ArithmeticException catch handler in parent catch blocks. Since catch of parent try block is handling this exception using generic Exception handler that handles all exceptions, the message "Inside parent try catch block" displayed as output.

Parent try Catch block: No exception occurred here so the “Next statement..” displayed.

The important point to note here is that whenever the child catch blocks are not handling any exception, the jumps to the parent catch blocks, if the exception is not handled there as well then the program will terminate abruptly showing system generated message.

Java Finally block – Exception handling

In the previous tutorials I have covered try-catch block and nested try block. In this guide, we will see finally block which is used along with try-catch.
A **finally block** contains all the crucial statements that must be executed whether exception occurs or not. The statements present in this block will always execute regardless of whether exception occurs in try block or not such as closing a connection, stream etc.

Syntax of Finally block

```
try {
    //Statements that may cause an exception
}
catch {
   //Handling exception
}
finally {
   //Statements to be executed
}
```

A Simple Example of finally block

Here you can see that the exception occurred in try block which has been handled in catch block, after that finally block got executed.

```
class Example
{
   public static void main(String args[]) {
      try{
           int num=121/0;
           System.out.println(num);
      }
      catch(ArithmeticException e){
         System.out.println("Number should not be divided by zero");
      }
      /* Finally block will always execute
       * even if there is no exception in try block
       */
      finally{
           System.out.println("This is finally block");
      }
      System.out.println("Out of try-catch-finally");
   }
}
```

Output:

```
Number should not be divided by zero
This is finally block
Out of try-catch-finally
```

Few Important points regarding finally block

1. A finally block must be associated with a try block, you cannot use finally without a try block. You should place those statements in this block that must be executed always.

2. Finally block is optional, as we have seen in previous tutorials that a try-catch block is sufficient for exception handling, however if you place a finally block then it will always run after the execution of try block.

3. In normal case when there is no exception in try block then the finally block is executed after try block. However if an exception occurs then the catch block is executed before finally block.

4. An exception in the finally block, behaves exactly like any other exception.

5. The statements present in the **finally block** execute even if the try block contains control transfer statements like return, break or continue.
Lets see an example to see how finally works when return statement is present in try block:

Another example of finally block and return statement

You can see that even though we have return statement in the method, the finally block still runs.

```
class JavaFinally
{
   public static void main(String args[])
   {
      System.out.println(JavaFinally.myMethod());
   }
   public static int myMethod()
   {
      try {
        return 112;
      }
      finally {
        System.out.println("This is Finally block");
        System.out.println("Finally block ran even after return statement");
      }
   }
}
```

Output of above program:

```
This is Finally block
Finally block ran even after return statement
112
```

To see more examples of finally and return refer: Java finally block and return statement
.

Cases when the finally block doesn't execute

The circumstances that prevent execution of the code in a finally block are:
– The death of a Thread

– Using of the System. exit() method.
– Due to an exception arising in the finally block.

Finally and Close()

close() statement is used to close all the open streams in a program. Its a good practice to use close() inside finally block. Since finally block executes even if exception occurs so you can be sure that all input and output streams are closed properly regardless of whether the exception occurs or not.

For example:

```
....
try{
    OutputStream osf = new FileOutputStream( "filename" );
    OutputStream osb = new BufferedOutputStream(opf);
    ObjectOutput op = new ObjectOutputStream(osb);
    try{
       output.writeObject(writableObject);
    }
    finally{
       op.close();
    }
}
catch(IOException e1){
     System.out.println(e1);
}
...
```

Finally block without catch

A try-finally block is possible without catch block. Which means a try block can be used with finally without having a catch block.

```
...
InputStream input = null;
try {
    input = new FileInputStream("inputfile.txt");
}
finally {
    if (input != null) {
       try {
         in.close();
       }catch (IOException exp) {
           System.out.println(exp);
        }
    }
}
...
```

Finally block and System.exit()

System.exit() statement behaves differently than **return statement**. Unlike return statement whenever System.exit() gets called in try block then **Finally block** doesn't execute. Here is a code snippet that demonstrate the same:

```
....
```

```
try {
  //try block
  System.out.println("Inside try block");
  System.exit(0)
}
catch (Exception exp) {
  System.out.println(exp);
}
finally {
  System.out.println("Java finally block");
}
....
```

In the above example if the **System.exit(0)** gets called without any exception then finally won’t execute. However if any exception occurs while calling **System.exit(0)** then finally block will be executed.

try-catch-finally block

- Either a try statement should be associated with a catch block or with finally.
- Since catch performs exception handling and finally performs the cleanup, the best approach is to use both of them.

Syntax:

```
try {
    //statements that may cause an exception
}
catch (…) {
    //error handling code
}
finally {
   //statements to be executed
}
```

Examples of Try catch finally blocks

Example 1: The following example demonstrate the working of finally block when no exception occurs in try block

```
class Example1{
  public static void main(String args[]){
    try{
       System.out.println("First statement of try block");
       int num=45/3;
       System.out.println(num);
    }
    catch(ArrayIndexOutOfBoundsException e){
       System.out.println("ArrayIndexOutOfBoundsException");
    }
    finally{
       System.out.println("finally block");
    }
    System.out.println("Out of try-catch-finally block");
  }
}
```

Output:

```
First statement of try block
15
finally block
Out of try-catch-finally block
```

Example 2: This example shows the working of finally block when an exception occurs in try block but is not handled in the catch block:

```
class Example2{
   public static void main(String args[]){
     try{
        System.out.println("First statement of try block");
        int num=45/0;
        System.out.println(num);
     }
     catch(ArrayIndexOutOfBoundsException e){
        System.out.println("ArrayIndexOutOfBoundsException");
     }
     finally{
        System.out.println("finally block");
     }
     System.out.println("Out of try-catch-finally block");
   }
}
```

Output:

```
First statement of try block
finally block
Exception in thread "main" java.lang.ArithmeticException: / by zero
at beginnersbook.com.Example2.main(Details.java:6)
```

As you can see that the system generated exception message is shown but before that the finally block successfully executed.

Example 3: When exception occurs in try block and handled properly in catch block

```
class Example3{
   public static void main(String args[]){
      try{
         System.out.println("First statement of try block");
         int num=45/0;
         System.out.println(num);
      }
      catch(ArithmeticException e){
         System.out.println("ArithmeticException");
      }
      finally{
         System.out.println("finally block");
      }
      System.out.println("Out of try-catch-finally block");
   }
}
```

Output:

```
First statement of try block
ArithmeticException
```

```
finally block
Out of try-catch-finally block
```

How to throw exception in java with example

In Java we have already defined exception classes such as ArithmeticException, NullPointerException, ArrayIndexOutOfBounds exception etc. These exceptions are set to trigger on different-2 conditions. For example when we divide a number by zero, this triggers ArithmeticException, when we try to access the array element out of its bounds then we get ArrayIndexOutOfBoundsException.

We can define our own set of conditions or rules and throw an exception explicitly using throw keyword. For example, we can throw ArithmeticException when we divide number by 5, or any other numbers, what we need to do is just set the condition and throw any exception using throw keyword. Throw keyword can also be used for throwing custom exceptions, I have covered that in a separate tutorial, see Custom Exceptions in Java.

Syntax of throw keyword:

```
throw new exception_class("error message");
```

For example:

```
throw new ArithmeticException("dividing a number by 5 is not allowed in this program");
```

Example of throw keyword

Lets say we have a requirement where we we need to only register the students when their age is less than 12 and weight is less than 40, if any of the condition is not met then the user should get an ArithmeticException with the warning message “Student is not eligible for registration”. We have implemented the logic by placing the code in the method that checks student eligibility if the entered student age and weight doesn’t met the criteria then we throw the exception using throw keyword.

```
/* In this program we are checking the Student age
 * if the student age<12 and weight <40 then our program
 * should return that the student is not eligible for registration.
 */
public class ThrowExample {
   static void checkEligibilty(int stuage, int stuweight){
      if(stuage<12 && stuweight<40) {
         throw new ArithmeticException("Student is not eligible for registration");
      }
      else {
         System.out.println("Student Entry is Valid!!");
      }
   }

   public static void main(String args[]){
     System.out.println("Welcome to the Registration process!!");
     checkEligibilty(10, 39);
     System.out.println("Have a nice day..");
 }
}
```

Output:

```
Welcome to the Registration process!!Exception in thread "main"
java.lang.ArithmeticException: Student is not eligible for registration
at beginnersbook.com.ThrowExample.checkEligibilty(ThrowExample.java:9)
at beginnersbook.com.ThrowExample.main(ThrowExample.java:18)
```

In the above example we have throw an unchecked exception, same way we can throw unchecked and user-defined exception as well.

Throws clause in java – Exception handling

As we know that there are two types of exception checked and unchecked. Checked exception (compile time) force you to handle them, if you don't handle them then the program will not compile. On the other hand unchecked exception (Runtime) doesn't get checked during compilation. **Throws keyword** is used for handling checked exceptions . By using throws we can declare multiple exceptions in one go.

What is the need of having throws keyword when you can handle exception using try-catch?

Well, thats a valid question. We already know we can handle exceptions using try-catch block. The throws does the same thing that try-catch does but there are some cases where you would prefer throws over try-catch. For example:

Lets say we have a method myMethod() that has statements that can throw either ArithmeticException or NullPointerException, in this case you can use try-catch as shown below:

```
public void myMethod()
{
  try {
    // Statements that might throw an exception
  }
  catch (ArithmeticException e) {
    // Exception handling statements
  }
  catch (NullPointerException e) {
    // Exception handling statements
  }
}
```

But suppose you have several such methods that can cause exceptions, in that case it would be tedious to write these try-catch for each method. The code will become unnecessary long and will be less-readable.

One way to overcome this problem is by using throws like this: declare the exceptions in the method signature using throws and handle the exceptions where you are calling this method by using try-catch. Another advantage of using this approach is that you will be forced to handle the exception when you call this method, all the exceptions that are declared using throws, must be handled where you are calling this method else you will get compilation error.

```
public void myMethod() throws ArithmeticException, NullPointerException
{
  // Statements that might throw an exception
}

public static void main(String args[]) {
  try {
    myMethod();
  }
  catch (ArithmeticException e) {
    // Exception handling statements
  }
  catch (NullPointerException e) {
    // Exception handling statements
  }
}
```

Example of throws Keyword

In this example the method myMethod() is throwing two **checked exceptions** so we have declared these exceptions in the method signature using **throws** Keyword. If we do not declare these exceptions then the program will throw a compilation error.

```
import java.io.*;
class ThrowExample {
  void myMethod(int num)throws IOException, ClassNotFoundException{
     if(num==1)
        throw new IOException("IOException Occurred");
     else
        throw new ClassNotFoundException("ClassNotFoundException");
  }
}

public class Example1{
  public static void main(String args[]){
   try{
     ThrowExample obj=new ThrowExample();
     obj.myMethod(1);
   }catch(Exception ex){
     System.out.println(ex);
    }
  }
}
```

Output:

```
java.io.IOException: IOException Occurred
```

User defined exception in java

In java we have already defined, exception classes such as ArithmeticException, NullPointerException etc. These exceptions are already set to trigger on pre-defined conditions such as when you divide a number by zero it triggers ArithmeticException, In the last tutorial we learnt how to throw these exceptions explicitly based on your conditions using throw keyword.

In java we can create our own exception class and throw that exception using throw keyword. These exceptions are known as **user-defined** or **custom** exceptions. In this tutorial we will see how to create your own custom exception and throw it on a particular condition.

To understand this tutorial you should have the basic knowledge of try-catch block and throw in java.

Example of User defined exception in Java

```
/* This is my Exception class, I have named it MyException
 * you can give any name, just remember that it should
 * extend Exception class
 */
class MyException extends Exception{
   String str1;
   /* Constructor of custom exception class
    * here I am copying the message that we are passing while
    * throwing the exception to a string and then displaying
    * that string along with the message.
    */
   MyException(String str2) {
	str1=str2;
   }
   public String toString(){
	return ("MyException Occurred: "+str1) ;
   }
}

class Example1{
   public static void main(String args[]){
	try{
		System.out.println("Starting of try block");
		// I'm throwing the custom exception using throw
		throw new MyException("This is My error Message");
	}
	catch(MyException exp){
		System.out.println("Catch Block") ;
		System.out.println(exp) ;
	}
   }
}
```

Output:

```
Starting of try block
Catch Block
MyException Occurred: This is My error Message
```

Explanation:
You can see that while throwing custom exception I gave a string in parenthesis (`throw new MyException("This is My error Message");`). That's why we have a parameterized constructor (with a String parameter) in my custom exception class.

Notes:
1. User-defined exception must extend Exception class.
2. The exception is thrown using throw keyword.

Another Example of Custom Exception

In this example we are throwing an exception from a method. In this case we should use throws clause in the method signature otherwise you will get compilation error saying that “unhandled exception in method”. To understand how throws clause works, refer this guide: throws keyword in java.

```
class InvalidProductException extends Exception
{
    public InvalidProductException(String s)
    {
        // Call constructor of parent Exception
        super(s);
    }
}

public class Example1
{
   void productCheck(int weight) throws InvalidProductException{
            if(weight<100){
                        throw new InvalidProductException("Product Invalid");
            }
   }

    public static void main(String args[])
    {
            Example1 obj = new Example1();
        try
        {
            obj.productCheck(60);
        }
        catch (InvalidProductException ex)
        {
            System.out.println("Caught the exception");
            System.out.println(ex.getMessage());
        }
    }
}
```

Output:

```
Caught the exception
Product Invalid
```

Java Exception Handling examples

In this tutorial, we will see examples of few frequently used exceptions. If you looking for exception handling tutorial refer this complete guide: Exception handling in Java.

Example 1: Arithmetic exception

Class: Java.lang.ArithmeticException
This is a built-in-class present in java.lang package. This exception occurs when an integer is divided by zero.

```
class Example1
{
   public static void main(String args[])
   {
      try{
         int num1=30, num2=0;
         int output=num1/num2;
         System.out.println ("Result: "+output);
      }
      catch(ArithmeticException e){
         System.out.println ("You Shouldn't divide a number by zero");
      }
   }
}
```

Output of above program:

```
You Shouldn't divide a number by zero
```

Explanation: In the above example I've divided an integer by a zero and because of this ArithmeticException is thrown.

Example 2: ArrayIndexOutOfBounds Exception

Class: Java.lang.ArrayIndexOutOfBoundsException
This exception occurs when you try to access the array index which does not exist. For example, If array is having only 5 elements and we are trying to display 7th element then it would throw this exception.

```
class ExceptionDemo2
{
   public static void main(String args[])
   {
      try{
        int a[]=new int[10];
        //Array has only 10 elements
        a[11] = 9;
      }
      catch(ArrayIndexOutOfBoundsException e){
         System.out.println ("ArrayIndexOutOfBounds");
      }
   }
}
```

Output:

```
ArrayIndexOutOfBounds
```

In the above example the array is initialized to store only 10 elements indexes 0 to 9. Since we are try to access element of index 11, the program is throwing this exception.

Example 3: NumberFormat Exception

Class: Java.lang.NumberFormatException

This exception occurs when a string is parsed to any numeric variable.

For example, the statement int num=Integer.parseInt ("XYZ"); would throw NumberFormatException because String "XYZ" cannot be parsed to int.

```
class ExceptionDemo3
{
  public static void main(String args[])
  {
    try{
           int num=Integer.parseInt ("XYZ") ;
           System.out.println(num);
    }catch(NumberFormatException e){
            System.out.println("Number format exception occurred");
     }
  }
}
```

Output:

```
Number format exception occurred
```

Example 4: StringIndexOutOfBound Exception

Class: Java.lang.StringIndexOutOfBoundsException

- An object of this class gets created whenever an index is invoked of a string, which is not in the range.
- Each character of a string object is stored in a particular index starting from 0.
- To get a character present in a particular index of a string we can use a method charAt(int) of java.lang.String where int argument is the index.

E.g.

```
class ExceptionDemo4
{
  public static void main(String args[])
  {
    try{
           String str="beginnersbook";
           System.out.println(str.length());;
           char c = str.charAt(0);
           c = str.charAt(40);
           System.out.println(c);
    }catch(StringIndexOutOfBoundsException e){
            System.out.println("StringIndexOutOfBoundsException!!");
     }
  }
}
```
Output:

```
13
StringIndexOutOfBoundsException!!
```
Exception occurred because the referenced index was not present in the String.

Example 5: NullPointer Exception

Class: Java.lang.NullPointer Exception
An object of this class gets created whenever a member is invoked with a “null” object.

```
class Exception2
{
  public static void main(String args[])
  {
          try{
                    String str=null;
                    System.out.println (str.length());
          }
     catch(NullPointerException e){
                    System.out.println("NullPointerException..");
          }
  }
}
```
Output:

```
NullPointerException..
```
Here, length() is the function, which should be used on an object. However in the above example String object str is null so it is not an object due to which NullPointerException occurred.