Exception

WHAT IS AN EXCEPTION

- An exception is an error condition that occurs during the execution of program
- Disrupts the normal flow of the program's instructions
- Halt’s the program execution, if not handled

- Examples
  - Running out of memory
  - Accessing an invalid array index
  - Trying to open a file that does not exist
  - Division by Zero

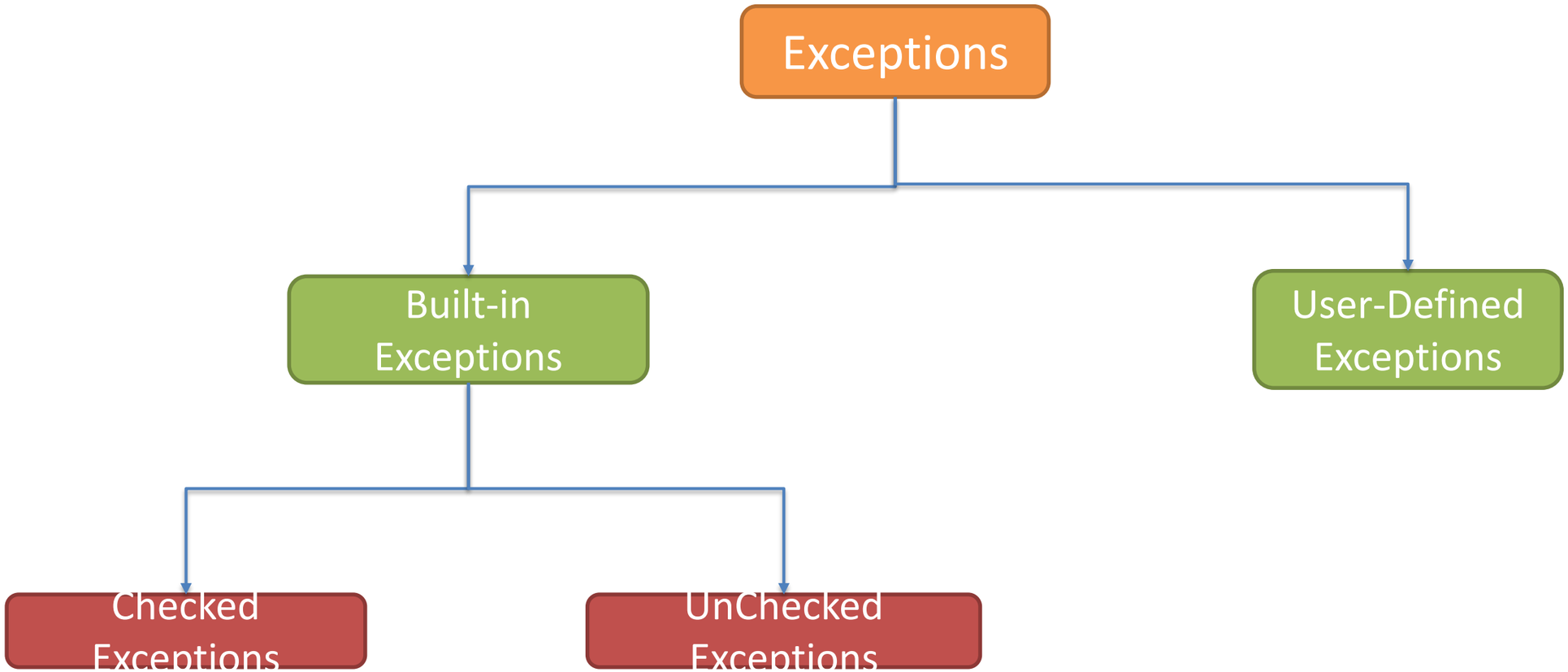
THROWING AN EXCEPTION

- When an exception occurs in a method
  - The method creates an exception object based on the type of error and hands it over to runtime system – known as *throwing an exception*

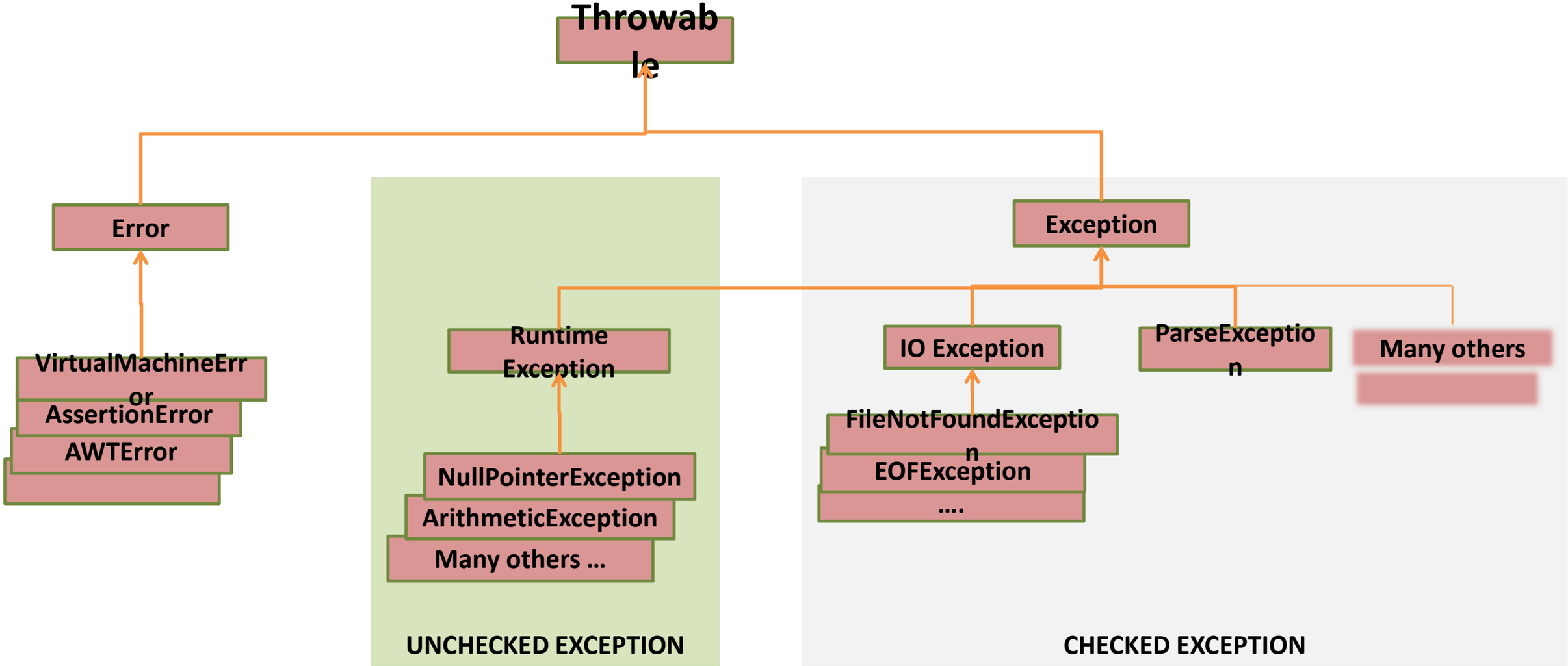
- The exception object created contains
  - information about the error and the type of error
  - where the error occurred

- The runtime system attempts to find a handler which can take appropriate action
- If no handler is found, the runtime system terminates the program

Categories of Exceptions



JAVA EXCEPTION HIERARCHY



UNCHECKED EXCEPTIONS

- Exceptions that are not checked during compile time
- Subclasses of RuntimeException and Error

- Examples
  - ArrayIndexOutOfBoundsException
  - NullPointerException
  - ClassCastException
  - ArithmeticException

- NumberFormatException
- IllegalArgumentException
- StackOverflowError

- Not supposed to be handled by programmer
- Code leading to unchecked exceptions needs to be debugged

RUNTIME EXCEPTIONS

- ArrayIndexOutOfBoundsException : An out-of-bounds array access

```
int[] array = new int[]{1,2,3,4};
System.out.print(array[4]);
```

- NumberFormatException

```
int i = Integer.parseInt("12.25")
```

- ArithmeticException : Divide by Zero

```
int a = 5; int b = 3; int c = 2;
int result = a / (a - (b +c)) ;
```

RUNTIME EXCEPTIONS

- ClassCastException : illegal Casting of Objects

```
Number num = new Integer(10);
Float f = (Float) num;
```

- NullPointerException : Null Pointer access

```
String str = null;
System.out.print(str.length());
```

CHECKED EXCEPTIONS

- Exception that are checked during compile time
- If some code within a method might throws a checked exception, then the method
  - Must handle the exception
  - Or declare the exception

Java enforces handling of checked exceptions

- Classes other than RuntimeException and Error

CHECKED EXCEPTIONS Examples

- ParseException
  - Parsing a String containing invalid Date
- SQLException
  - Opening a connection to database with invalid IP address
- ClassNotFoundException
  - Trying to load a class which is not present in the class path
- IOException
  - Signal an exception during I/O operation
  - FileNotFoundException
    - Sub class of IOException
    - Trying to open a file that does not exist

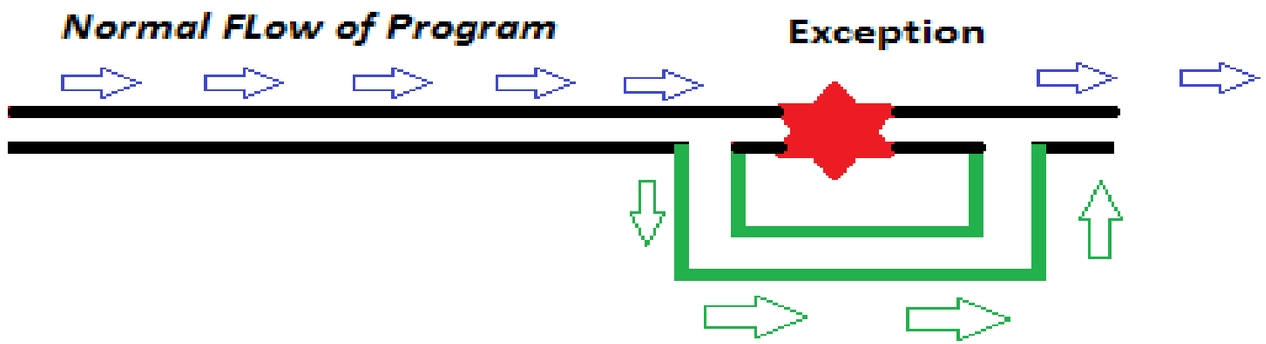
Commonly used methods of Throwable

- Following are some methods of Throwable class to retrieve information about exception

  - getMessage()
    - returns the detail message string

  - printStackTrace()
    - prints the most recently entered method first and continues down the call stack

WHY HANDLE EXCEPTIONS



EXCEPTION HANDLING

HANDLING EXCEPTION

- Exceptions can be handled using a try-catch block

```
try
 {
    // Code that might throw some exception
 }
 catch(Exception e1)
 {
    // Code to handle the exception of type e1
 }
```

- try block should contain the code which might throw an exception
- catch block contains the code for handling and exception, if exception occurs in try block

HANDLING EXCEPTION

```
try
 {
    statement1;
    statement2;
 }
 catch(Exception e1)
 {
    statement3;
 }
```

- If statement1 in try block throws an exception
  - Execution of statement2 is skipped
  - Control is transferred to catch block
- If try block executes successfully without any exception
  - catch clause is skipped

if exception thrown in try block does not match with the exception in the catch block, then runtime system halts the program execution

USING FINALLY BLOCK

- finally block is used to execute code that must run regardless of an exception occurence
  - Always executes when the try or catch block completes execution
  - Used as the clean up block to free up resources used in try block, like closing connections
  - A try block should have either a catch block or a finally block or can have both

```
try {
// Code that must be executed
 }
 catch(Exception e1) {
// code that handles exception e1
 }
finally {
// code to release any resource
allocated in the try clause.
 }
```

```
try {
// Code that must be executed
 }
finally {
// code to release any resource
allocated in the try clause.
 }
```

CATCHING MULTIPLE EXCEPTIONS

- A try block can be followed by multiple catch blocks

```
try {
        // Code that might throw an
exception
}
catch(NullPointerException e) {
          // Handle the
NullPointerException
}
catch(ParseException e) {
         // Handle the ParseException
}
```

CATCHING MULTIPLE EXCEPTIONS - Rules

- More than one type of Exception can be handled in a single catch block, if super class exception is caught.
- Catch block for IOException will catch IOException and all of its subclasses like FileNotFoundException,EOFException

```
 try {
          // Code that might throw an exception
  }
  catch(IOException e) {
        // Handle the IOException
  }
}
```

CATCHING MULTIPLE EXCEPTIONS - Rules

- If catch block for subclass exceptions are included , they should be coded before the catch block for super class exception

```
try {
          // Code that might throw an exception
    }
    catch(FileNotFoundException e) {
          // Handle the FileNotFound Exception
    }
     catch(EOFException e) {
          // Handle the EOF Exception
    }
    catch(IOException e) {
        // Handle the IOException
   }
```

- FileNotFoundException and EOFException are subclasses of IOException

CATCHING MULTIPLE EXCEPTIONS – Java 7

- In Java SE 7 and later, a single catch block can handle more than one type of exception separated with a vertical bar (|).

```
try {
      // Code that might throw an exception
}
catch (IOException | ArithmeticException ex) {
      // Handle IOException or ArithmeticException
}
```

NESTED TRY CATCH BLOCK

- Java allows nesting of try and catch blocks
- If an inner try statement does not have a matching catch statement then
  - ’s catch
- If
  - the Java

ru

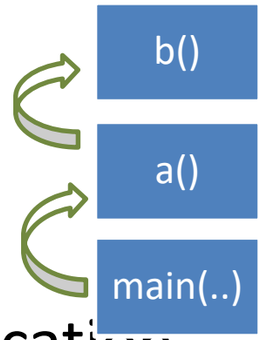
```
try {
        try {
             //code to be executed within the try block
           }
           catch (Exception1 e1)
           {   s1 //statementto handle the exception }
}
catch (Exception2 e2){
        s2 //statements to handle the exception
}
```

  - If exception e1 is thrown in inner try, inner catch handles the exception

Declaring Exceptions

PROPAGATING EXCEPTIONS

- A method can throw an exception back to its calling method

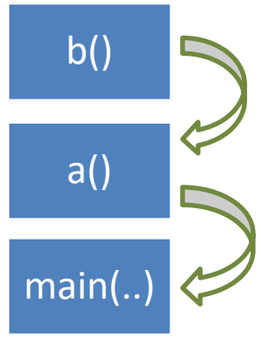


- Consider the call stack of a program to understand the method invocation

CALL STACK: Method Invocation

- In case a exception occurs and it not handled, the method throws the exception to its calling method

- Exception occurring in method b() is thrown to a(), and a() to main



CALL STACK: Exception propagation

DECLARING EXCEPTIONS

- A method can declare that it can propagate an exception to its calling method
- If a method doesn't handle a checked exception, it must declare it using **"throws"** clause

```
public String formatDate(String dateString) throws
ParseException{
      //code that can throw a ParseException
}
```

- Exception propagated must be handled by the calling method using try-catch

OR

declared using throws clause

- Finally the exception will have to be handled by the main() method else JVM will halt the program

OVERRIDING RULES

```
class Super{
      public void method1() throws IOException{
            //code that can throw a IOException
      }
}

class Sub extends Super{
      public void method1() throws _________________{
            //some code
      }
}
```

- When a sub class overrides a method that declares an exception, the sub class method can
  - Throw the same exception as superclass method throws
  - Throw a sub class of the exception that superclass method throws

USING THE THROW STATEMENT

- throw keyword is used to explicitly throw an exception
- Typically useful for throwing user defined exceptions

```
public double divide(int dividend, int divisor)throws
ArithmeticException {
   if(divisor == 0) {
      throw new ArithmeticException("Divide by 0 error");
   }
   return dividend / divisor;
}
```

- throw can also be used to throw any predefined exceptions in java

RE THROWING EXCEPTIONS

- Exception caught in catch clause can be thrown again using throw keyword.
- Re-thrown exception must be handled in the program, otherwise program will terminate abruptly.

```
class InvalidDataException extends Exception{}
class IllegalDataException extends Exception{}

public void validate(String test) throws Exception{
    try{
        //some code ...
        if(condition1) throw new InvalidDataException();

        if(condition2) throw new IllegalDataException();
        //some code ...

}catch(Exception e){
        throw e;
    }
}
```

Custom exceptions

CUSTOM EXCEPTIONS

- Program can run into a problem that is not adequately described by any of the java exception classes like any business validations
- A Custom Exception class can be created by extending any of the standard exception cla

```
class InvalidDataException extends IOException{
    public InvalidDataException() {
    super();
    }
    public InvalidDataException(String info){
    super(info);
    }
}
```

- This custom exception can be thrown and caught like any other exception