



# Object Oriented Programming with Java 8

**Akshita Chanchlani**



# Agenda

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- Exception Handling



# Operating System Resources

- Following are the operating system resources that we can use it in the program:
  1. Memory (RAM)
  2. File
  3. Thread
  4. Socket
  5. Connection
  6. IO Devices etc.
- Since OS resources are limited, we should handle it carefully. In other words, we should avoid their leakage.



# Resource Type and resource in Java

- AutoCloseable is interface declared in java.lang package.
- Methods:
  1. void close() throws Exception
  2. This method is invoked automatically on objects managed by the try-with-resources statement.
- java.io.Closeable is sub interface of java.lang.AutoCloseable interface.
- Methods:
  1. void close() throws IOException
  2. This method is invoked automatically on objects managed by the try-with-resources statement.



# Resource Type and resource in Java

```
//Class Test => Resource Type
class Test implements AutoCloseable{
    private Scanner sc;
    public Test() {
        this.sc = new Scanner(System.in);
    }
    //TODO
    @Override
    public void close() throws Exception {
        this.sc.close();
    }
}

public class Program {
    public static void main(String[] args) {
        Test t = null;
        t = new Test( );    //Resource
    }
}
```



# Resource Type and resource in Java

- In the context of exception handling, any class which implements `java.lang.AutoCloseable` or its sub interface( e.g. `java.io.Closeable` ) is called resource type and its instance is called as resource.
- We can use instance of only resource type inside try-with-resource.
- `java.util.Scanner` class implements `java.io.Closeable` interface. Hence `Scanner` class is called as resource type.



# Exception Handling

- **Why we should handle exception**

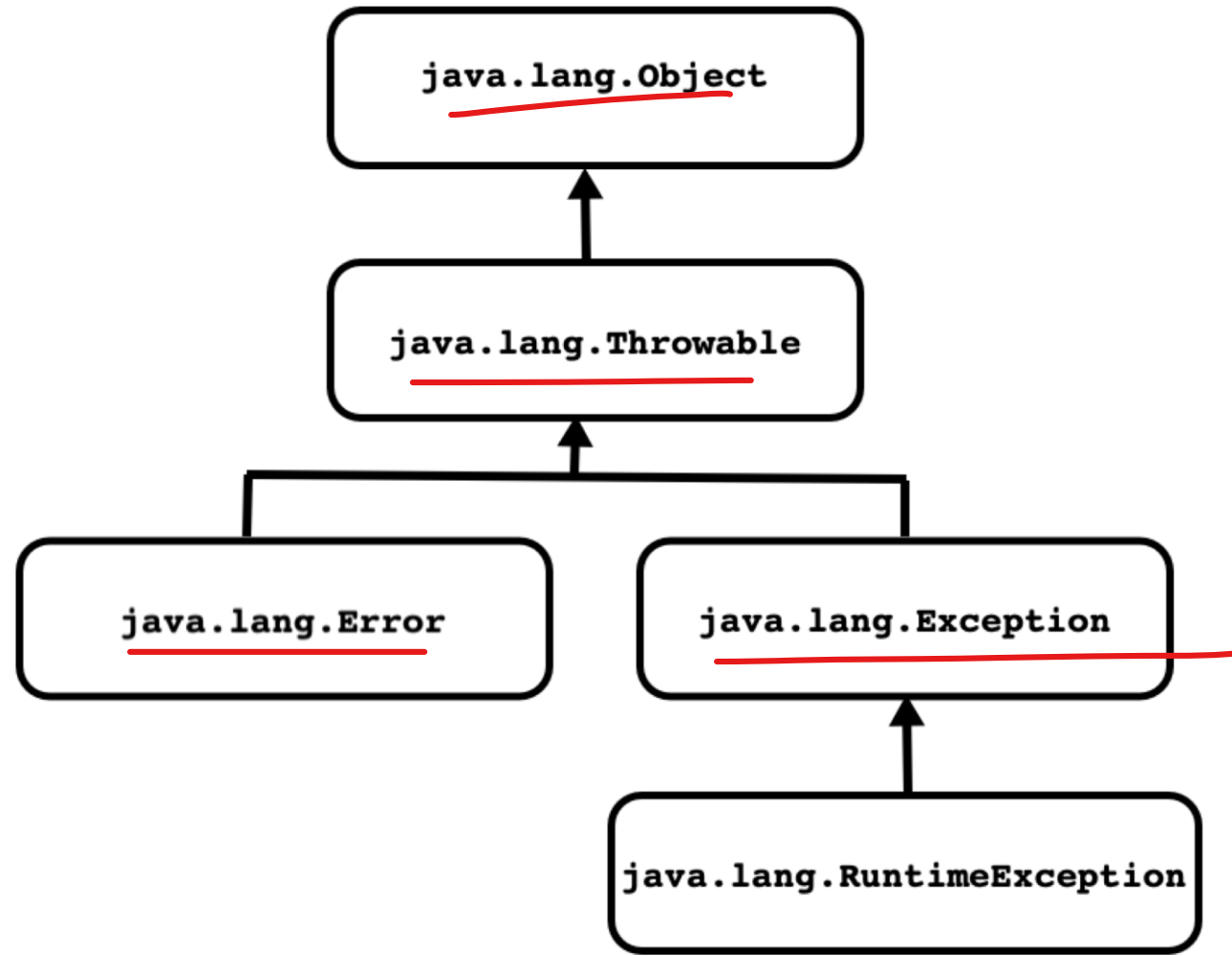
1. To handle all runtime errors at single place. It helps developer to reduce maintenance.
2. To avoid resource leakage/ to manage OS resources carefully.

- **How can we handle exception in Java?**

1. try
2. catch
3. throw
4. throws
5. finally



# Exception Handling





# Throwable Class

- It is a class declared in java.lang package.
- The Throwable class is the super class of all errors and exceptions in the Java language.
- Only instances that are instances of Throwable class (or one of its subclasses) are thrown by the Java Virtual Machine or can be thrown by the Java throw statement.

```
throw 0;    //Not OK ✗  
  
int x = 0;  
throw x;    //Not OK ✗  
  
class Test{  
}  
throw new Test( ); //Not OK ✗  
  
class MyExcetion extends Throwable{  
}  
throw new MyException(); //OK ✓
```



# Throwable Class

- Constructors of Throwable class:

1. public Throwable()

```
Throwable t1 = new Throwable( );
```

2. public Throwable(String message)

```
Throwable t1 = new Throwable( "exception message" );
```

3. public Throwable(Throwable cause)

```
Throwable cause = new Throwable( );
```

```
Throwable t1 = new Throwable( cause );
```

4. public Throwable(String message, Throwable cause)

```
Throwable cause = new Throwable( );
```

```
Throwable t1 = new Throwable( "exception message", cause );
```



# Throwable Class

- **Methods of Throwable class:**

1. public Throwable initCause(Throwable cause) ✓
2. public Throwable getCause() ✓
3. public String getMessage() ✓
4. public void printStackTrace() ✓
5. public void printStackTrace(PrintStream s) ✓
6. public void printStackTrace(PrintWriter s) ✓



# Error

- java.lang.Error is a sub class of Throwable class.
- It gets generated due to environmental condition/Runtime environment ( For Example, problem in RAM/JVM, Crashing HDD etc. ).
- We can not recover from error hence we should not try to catch error. But can write try-catch block to handle error.
- Example:
  - ✓ 1. VirtualMachineError
  - ✓ 2. OutOfMemoryError
  - ✓ 3. InternalError
  - ✓ 4. StackOverflowError



# Exception

- java.lang.Exception is a sub class of Throwable class.
- It gets generated due to application.
- We can recover from exception hence it is recommended to write try-catch block to handle exception in Java.
- Example:
  1. NumberFormatException ✓
  2. NullPointerException ✓
  3. NegativeArraySizeException ✓
  4. ArrayIndexOutOfBoundsException ✓
  5. ArrayStoreException ✓
  6. IllegalArgumentException ✓
  7. ClassCastException ✓



# Types Of Exception

- Unchecked Exception

- java.lang.RuntimeException and all its sub classes are considered as unchecked exception.
- It is not mandatory to handle unchecked exception.
- Example:
  1. NullPointerException
  2. ClassCastException
  3. ArrayIndexOutOfBoundsException
- During the execution of arithmetic operation, if any exceptional situation occurs then JVM throws ArithmeticException.

- Checked Exception

- java.lang.Exception and all its sub classes except java.lang.RuntimeException are considered as checked exception.
- It is mandatory to handle checked exception.
- Example:
  1. java.lang.CloneNotSupportedException
  2. java.lang.InterruptedException



# Exception Handling

- **try**
  - It is a keyword in Java.
  - If we want to keep watch on statements for the exception then we should put all such statements inside try block/handler.
  - try block must have at least one:
    1. catch block or ✓
    2. finally block or ✓
    3. Resource ✓
  - We can not define try block after catch or finally block.



# Exception Handling

- **Catch**

- It is a keyword in Java.
- If we want to handle exception then we should use catch block/handler
- Only Throwable class or one of its subclasses can be the argument type in a catch clause.
- Catch block can handle exception thrown from try block only.
- For single try block we can define multiple catch block.
- Multi-catch block allows us to handle multiple specific exception inside single catch block.

```
try {  
    //TODO  
} catch (ArithmeticException | InputMismatchException e) {  
    e.printStackTrace( );  
}
```





# Exception Handling

Let us consider hierarchy of ArithmeticException class:

- java.lang.Exception
  - java.lang.RuntimeException
    - java.lang.ArithmeticException

```
ArithmeticException e1 = new ArithmeticException( );    //OK
RuntimeException e2 = new ArithmeticException( );    //OK : Upcasting ✓
Exception e3 = new ArithmeticException( );    //OK : Upcasting ✓
```

Let us consider hierarchy of InterruptedException class:

- java.lang.Exception
  - java.lang.InterruptedIOException

```
InterruptedException e1 = new InterruptedException( ); -
Exception e2 = new InterruptedException( ); //OK : Upcasting ✓
```



# Exception Handling

- A catch block, which can handle all type of exception is called generic catch block.
- Exception class reference variable can contain reference of instance of any checked as well as unchecked exception. Hence to write generic catch block, we should use java.lang.Exception class.

```
try{  
  
}catch( Exception ex ){ //Generic catch block  
    ex.printStackTrace( );  
}
```



# Exception Handling

- In case of hierarchy, It is necessary to handle all sub type of exception first.

```
try {  
    //TODO  
} catch (ArithmeticException e) { ✓  
    e.printStackTrace();  
} catch (RuntimeException e) { ✓  
    e.printStackTrace();  
} catch (Exception e) { ✓ * last  
    e.printStackTrace();  
}
```



# Exception Handling

- **throw**

Custom Ex

- It is a keyword in Java.
- If we want to generate new exception then we should use throw keyword.
- Only objects that are instances of Throwable class (or one of its subclasses) are thrown by the Java Virtual Machine or can be thrown by the Java throw statement.
- throw statement is a jump statement.



# Exception Handling

- **finally**

- It is a keyword in Java.
- If we want to release local resources then we should use finally block.
- We can not define finally block before try and catch block.
- Try block may have only one finally block.
- JVM always execute finally block.
- ✱ ◦ If we call System.exit(0) inside try block and catch block then JVM do not execute finally block.



# Exception Handling

- **throws**

- It is a keyword in Java.
- If we want to redirect/delegate exception from one method to another then we should use throws clause.
- Consider declaration of following methods:
  1. `public static int parseInt(String s) throws NumberFormatException`
  2. `public static void sleep(long millis) throws InterruptedException`



# Exception Handling

- try-with-resources

- The try-with-resources statement is a try statement that declares one or more resources.
- A `Resource` is an object that must be closed after the program is finished with it.
- The try-with-resources statement ensures that each resource is closed at the end of the statement.
- Any object that implements `java.lang.AutoCloseable`, which includes all objects which implement `java.io.Closeable`, can be used as a resource.

```
public static String readFirstLineFromFile(String path) throws IOException {  
    try (BufferedReader br = new BufferedReader(new FileReader(path))) {  
        return br.readLine();  
    }  
}
```



# Custom Exception

- JVM can not understand, exceptional situations/conditions of business logic. If we want to handle such exceptional conditions then we should use custom exceptions.

## Custom unchecked exception

```
class StackOverflowException extends RuntimeException{  
    //TODO  
}
```

## Custom checked exception

```
class StackOverflowException extends Exception{  
    //TODO  
}
```







**Thank you.**

**akshita.Chanchlani@sunbeaminfo.com**

