Object Oriented Programming with Java 8
PG-DAC

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Agenda

- 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

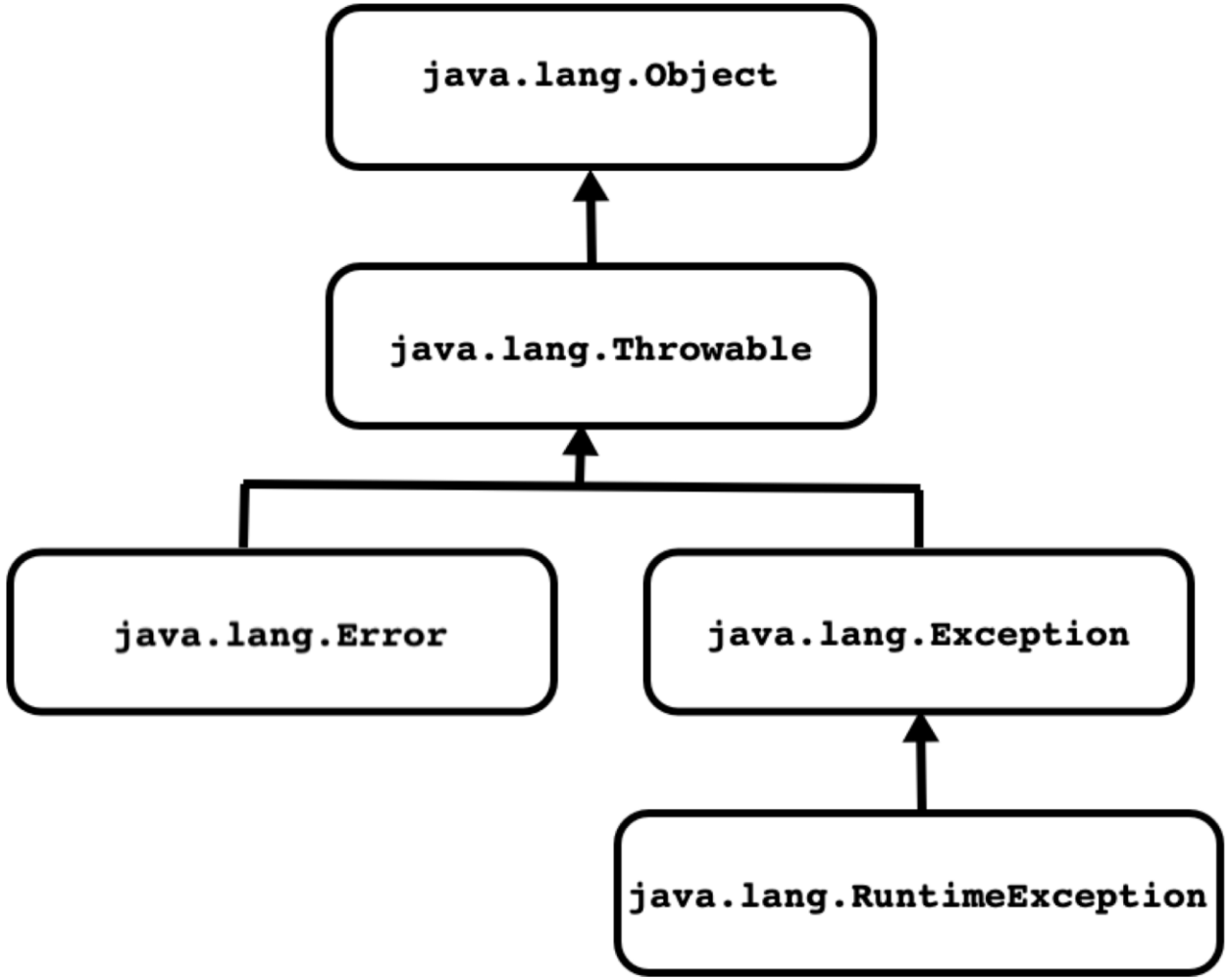
- In the context of exception handling, any class which implements java.lang.AutoCloseable or its sub interface(e.g. java.io.Closeable) is called resource type and its instance is called as resource.
- We can use instance of only resource type inside try-with-resource.
- java.util.Scanner class implements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

```
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) {
    e.printStackTrace();
}
```

Exception Handling

- **throw**
  - 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 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

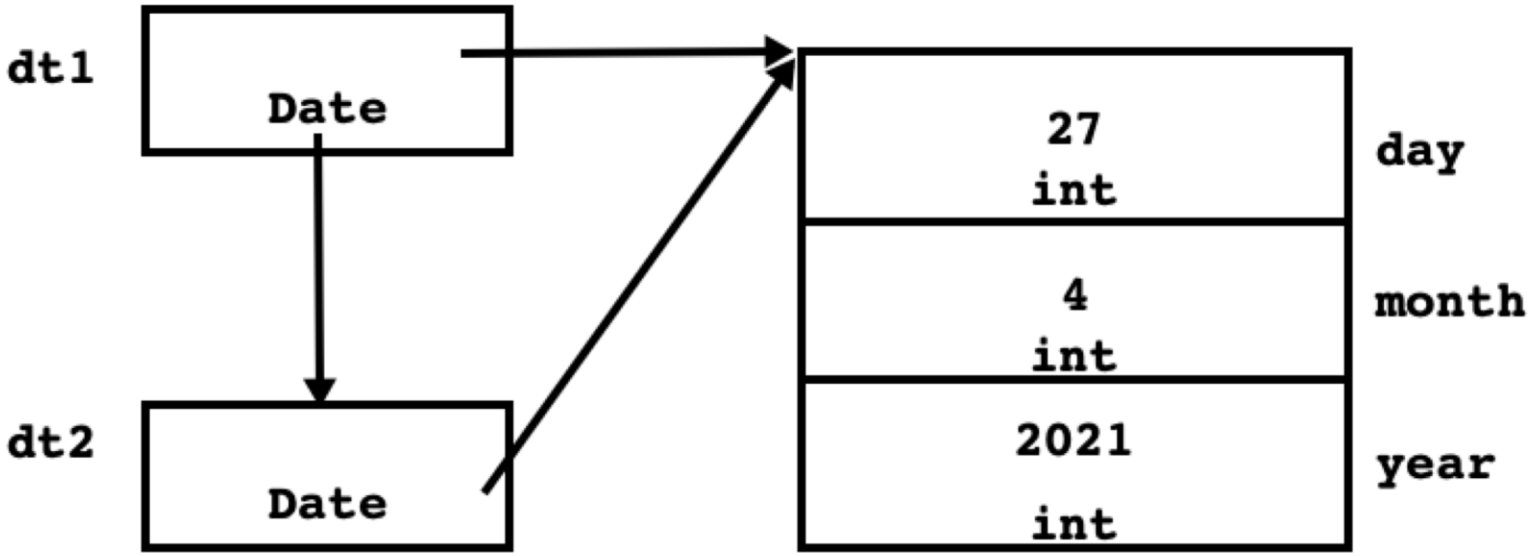
```
class StackOverflowException extends RuntimeException{
    //TODO
}
```

Custom checked exception

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

Cloneable Interface Implementation

- `Date dt1 = new Date( 27, 4, 2021 );`
- `Date dt2 = dt1;  //Shallow Copy Of References`

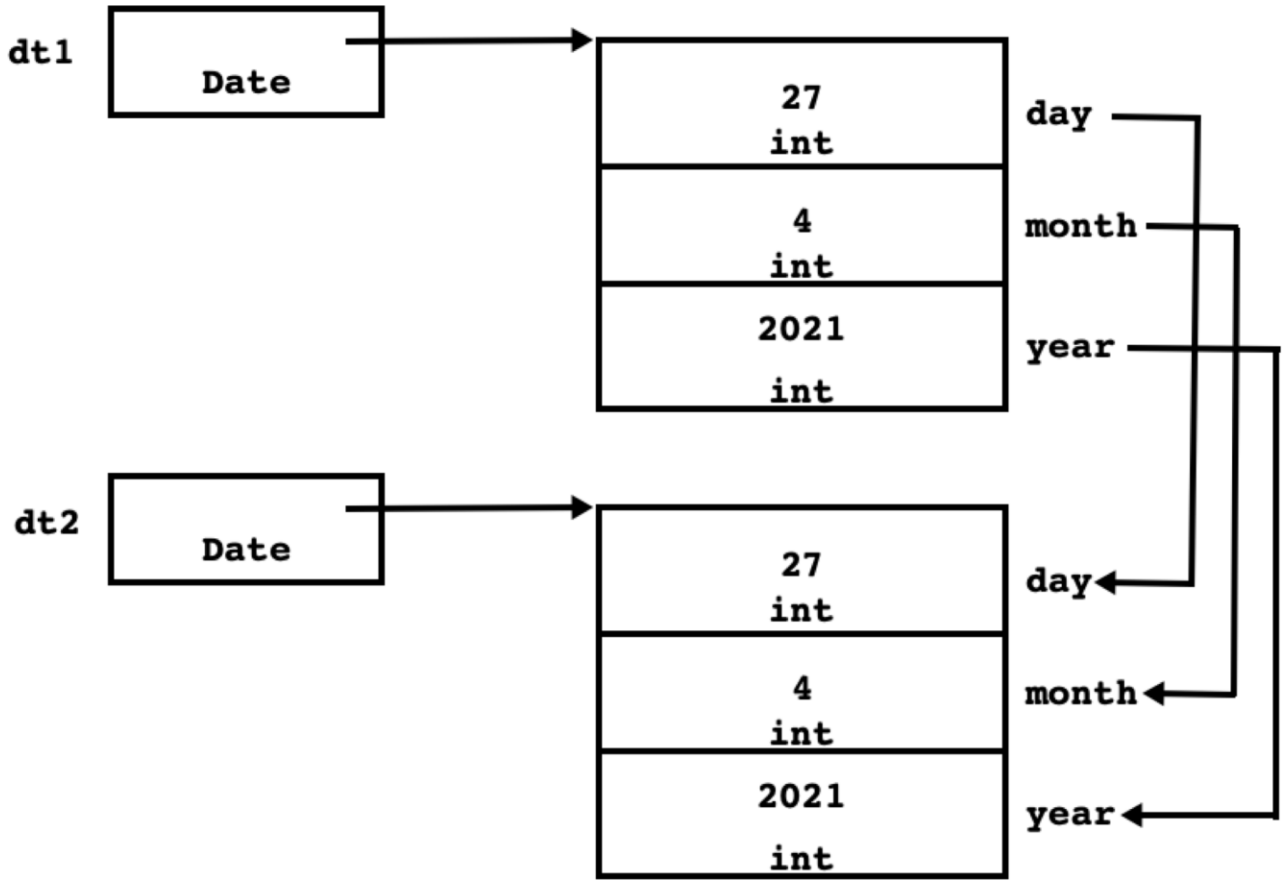


Cloneable Interface Implementation

- If we want to create new instance from existing instance then we should use clone method.
- clone( ) is non final native method of java.lang.Object class.
- Syntax:
  - **protected native Object clone( ) throws CloneNotSupportedException**
- Inside clone() method, if we want to create shallow copy instance then we should use super.clone( ) method.
- Cloneable is interface declared in java.lang package.
- Without implementing Cloneable interface, if we try to create clone of the instance then clone() method throws CloneNotSupportedException.

Cloneable Interface Implementation

- `Date dt1 = new Date( 27, 4, 2021 );`
- `Date dt2 = dt1.clone( ); //Shallow Copy Of Instance`



Marker Interface

- An interface which do not contain any member is called marker interface. In other words, empty interface is called as marker interface.
- Marker interface is also called as tagging interface.
- If we implement marker interface then Java compiler generates metadata for the JVM, which help JVM to clone/serialize or marshal state of object.
- Example:
    1. java.lang.Cloneable
    2. java.util.EventListener
    3. java.util.RandomAccess
    4. java.io.Serializable
    5. java.rmi.Remote

Thank you.

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