Exception Handling

"Understanding, Using, and Handling runtime errors "

Advanced in Programming

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Agenda

1. Understanding Exception
2. Exceptions in Java
   - Introduction
   - Different Scenarios
   - Catching Exceptions; Syntax, and Example
3. Exceptions in PHP
4. Exceptions in Python
5. Questions and Discussion

What are exceptions?

- **Exception**: errors that rise during programs execution, indication of problem that occurs during a program's execution, or an event that disrupts the normal flow of the program (e.g. divide by zero)
- **Exception Handling**: mechanism to handle such problems and errors e.g IndexOutOfBound, IO, SQL, Remote etc.
- Core advantage is to *maintain the normal flow of the application*
- There are mainly two types of exceptions:
    - Checked exceptions: exceptions that occurs at compile time, can not be ignored (e.g. IOException, SQLException etc.)
    - Unchecked exceptions: occurs at program execution time also called runtime exceptions, and are ignored at compile time. These include programming bugs, such as logic errors or improper use of an API (e.g. ArithmeticExceptions, NullPointerException etc.)
    - Errors: These are not exceptions at all, but problems that arise beyond the control of the user or the programmer
      (e.g. OutOfMemoryError, VirtualMachineError etc.)

Exception Handling Terminology

- Common terms used by most of the programming languages in exception handling *throw, rise, try, except, catch, finally*
  - throw; used to trigger an exception, must have at least one catch
  - rise; same as throw statement
  - try; a block where an exception may occur and for which a particular exception will be activated
  - catch; specify the type of exception to be handled
  - except; same as catch statement
  - finally; block that run in either condition, whether an exception occur or not

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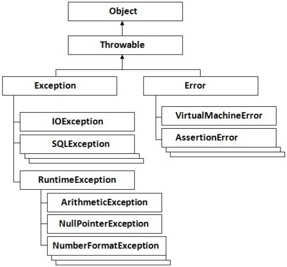
Java and Exception handling

- Java Exception Handling Keywords: *try, catch, finally, throw, and throws*
- All exception classes are subtypes of java.lang.Exception class
- Exception class is a subclass of the Throwable class
- There is another subclass called Error which is derived from the Throwable class



[1]

Figure: Hierarchy of Java Exception classes

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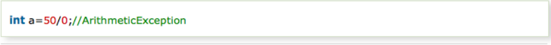
Common Java exceptions scenario

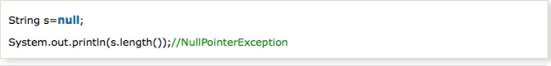
- Common scenario in which exceptions may occur:
  1. ArithmeticException



```
int a=50/0;//ArithmeticException
```

[1]

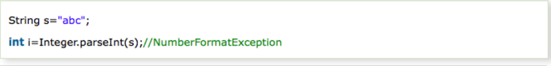
  2. NullPointerException



```
String s=null;
System.out.println(s.length());//NullPointerException
```

[1]

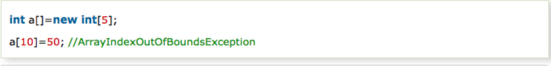
  3. NumberFormatException



```
String s="abc";
int i=Integer.parseInt(s);//NumberFormatException
```

[1]

  4. ArrayIndexOutOfBoundsException



```
int a[]=new int[5];
a[10]=50; //ArrayIndexOutOfBoundsException
```

[1]

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Catching Exception

- A method catches exception using a combination of *try* and *catch* blocks.
- *try/catch* block is placed around the code which might rise an exception
- Code within *try/catch* block is referred to as protected code

Syntax [2]

```
try{
    // protected code
  } catch (ExceptionName excep){
        // code that execute in case an exception occur
       }
```

Catching Exception Example

Handling IndexOutOfBoundsException Example [2]

```
// File Name : ExcepTest.java
import java.io.*;
public class ExcepTest {
    public static void main(String args[]) {
        try {
            int var[] = new int[2];
            System.out.println(”Access element three :” + var[3]);
        }catch(ArrayIndexOutOfBoundsException e) {
            System.out.println(”Exception thrown :” + e);
            }
        System.out.println(”Out of the block”);
    }
}
```

throw and throws keywords

- *throws*: used to postpone the handling of a checked exception
- *throw*: used to invoke and exception explicitly

Example: throws RemoteException, InsufficientFundsException [2]

```
import java.io.*;
public class Account {
    public void deposit(double amount) throws RemoteException {
         // Method implementation
         throw new RemoteException();
     }
    public void withdraw(double amount) throws RemoteException, InsufficientFundsException {
         // Method implementation
         throw new RemoteException();
         if (this. amount < amount){
             throw new InsufficientFundsException();
         }
     }
    // Remainder of class definition
}
```

User defined exception

User defined InsufficientFundsException Example [2]

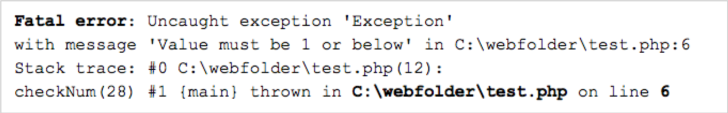
```
// File Name InsufficientFundsException.java
import java.io.*;
public class InsufficientFundsException extends Exception {
    private double amount;
    public InsufficientFundsException(double amount) {
        this.amount = amount;
    }
    public double getAmount() {
        return amount;
    }
}
```

Exception without catch

User defined InsufficientFundsException Example [3]

```
<?php
    //create function with an exception
    function checkNum($number) {
        if($number > 1) {
            throw new Exception("Value must be 1 or below");
        }
        return true;
    }
    //trigger exception
    checkNum(2);
?>
```

Output:



```
Fatal error: Uncaught exception 'Exception'
with message 'Value must be 1 or below' in C:\webfolder\test.php:6
Stack trace: #0 C:\webfolder\test.php(12):
checkNum(28) #1 {main} thrown in C:\webfolder\test.php on line 6
```

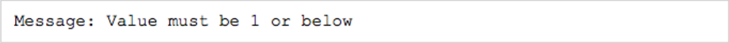
[3]

Exception with try and catch

User defined InsufficientFundsException Example [3]

```
<?php
    //create function with an exception
    function checkNum($number) {
        if($number > 1) {
            throw new Exception(”Value must be 1 or below”);
        }
        return true;
    }
    //trigger exception in a ”try” block
    try {
        checkNum(2);
        //If the exception is thrown, this text will not be shown
        echo 'If you see this, the number is 1 or below';
    }
            //catch exception
    catch(Exception $e) {
        echo 'Message: ' .$e->getMessage();
    }
?>
```

Output:



```
Message: Value must be 1 or below
```

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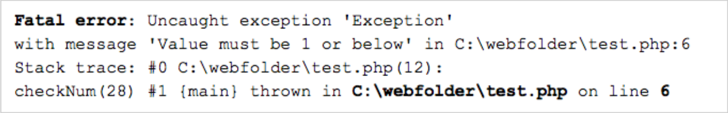
Exception without catch

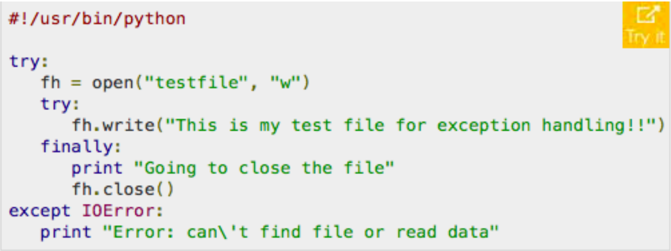
Python uses: *try, except, and finally for exception handling*



```
Fatal error: Uncaught exception 'Exception'
with message 'Value must be 1 or below' in C:\webfolder\test.php:6
Stack trace: #0 C:\webfolder\test.php(12):
checkNum(28) #1 {main} thrown in C:\webfolder\test.php on line 6
```

[3]

Your Turn: Time to hear from you!



```
#!/usr/bin/python

try:
   fh = open("testfile", "w")
   try:
      fh.write("This is my test file for exception handling!!")
   finally:
      print "Going to close the file"
      fh.close()
except IOError:
   print "Error: can\'t find file or read data"
```

[1]

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