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OBJECT ORIENTED PROGRAMMING WITH JAVA

Exception Handling in Java – I

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Concept of Errors in Java



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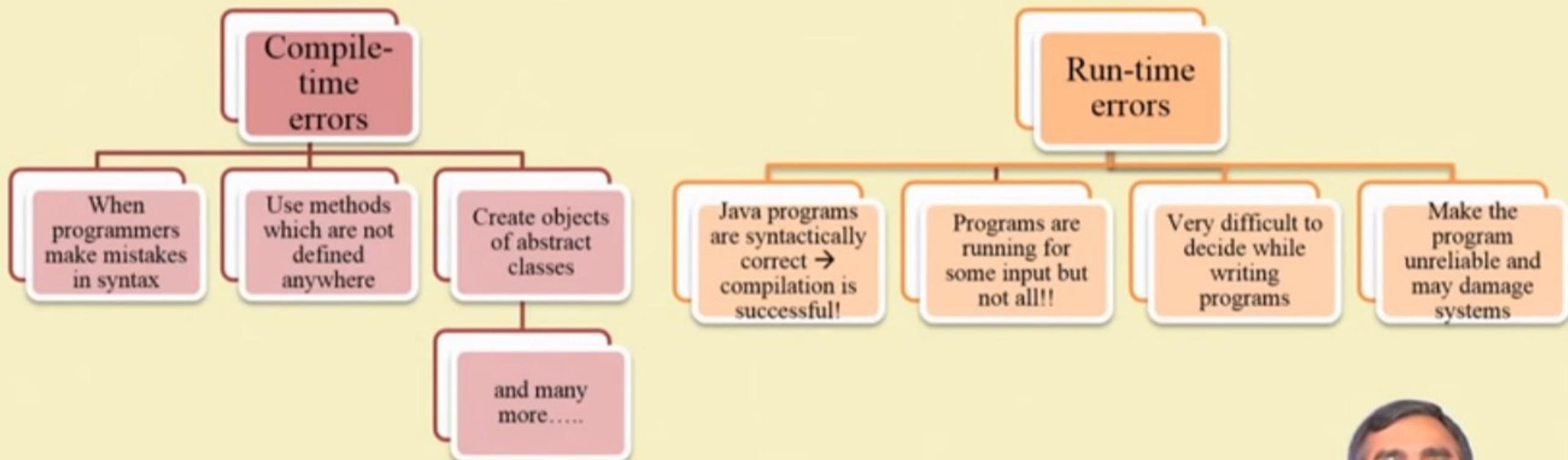


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Errors in Java programs



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Compile-time errors: Examples

```
Class Error {
    Public static void main (string args [ ]) {
        system.out.print("Can you find errors in me?")
    }
    class AnotherError {
        public void insert( ){
            System.out.print("To insert a text");
        }

        abstract void delete( ){
            System.out.print("To delete a text");
        }
    }
}
```



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Compile-time errors: Examples

```
Class Error {  
    Public static void main (string args [ ]) {  
        system.out.print("Can you find errors in me?")  
    }  
    class AnotherError {  
        public void insert( ){  
            System.out.print("To insert a text");  
        }  
        abstract void delete( );  
        System.out.print("To delete a text");  
    }  
}
```



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Some common compile-time errors

- Missing semicolons.
- Missing (or mismatch of brackets) in classes and methods.
- Misspelling of identifiers or keywords.
- Missing double quotes in strings.
- Use of undeclared variables.
- Incomplete types in assignment / initialization.
- Bad references to objects.

and many more



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Run-time errors: Examples

```
class Error {  
    public static void main (String args [ ]) {  
        int a = Integer.parseInt(args[0]);  
        int b = Integer.parseInt(args[1]);  
        int c = a/b;  
        System.out.println("Value of c =" + c);  
    }  
}
```

javac Error.java	→	Error.class
java Error 1 2	→	Value of c = 0
java Error -1 -2	→	Value of c = 0
java Error 0 1	→	Value of c = 0
java Error 1 0	→	?????



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Run-time errors: Examples

```
class Error {  
    public static void main (String args [ ]) {  
        int a = Integer.parseInt(args[0]);  
        int b = Integer.parseInt(args[1]);  
        int c = a/b;  
        System.out.println("Value of c =" + c);  
    }  
}
```

java Error 1.5 2.5 → ??????



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Some common run-time errors

- A user has entered invalid data.
- Dividing an integer by zero.
- Accessing an element that is out of the bounds of an array.
- Trying to store a value into an array of an incomplete class or type.
- Trying to cast an instance of a class to one of its subclasses.
- Trying to illegally change the state of a thread.
- Attempting use a negative size for an array.
- Null object reference.
- A file that needs to be opened cannot be found.
- A network connection has been lost in the middle of communications, or the JVM has run out of memory.

and many more



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Some common run-time errors

- A user has entered invalid data.
- Dividing an integer by zero.
- Accessing an element that is out of the bounds of an array.
- Trying to store a value into an array of an incomplete class or type.
- Trying to cast an instance of a class to one of its subclasses.
- Trying to illegally change the state of a thread.
- Attempting use a negative size for an array.
- Null object reference.
- A file that needs to be opened cannot be found.
- A network connection has been lost in the middle of communication memory.

So errors are due to users, programmers and physical resources which are very difficult to taken into consideration while writing the programs ...

and many more



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Errors and exceptions in Java

Whenever an Error or Exception occurs, Java Run-Time Environment throws an object corresponding to that.

Examples:

Java Run-Time Environment throws an object called `IllegalArgumentException`
when a method `m(int x, int y)` is called as `m(1.5, 4);`

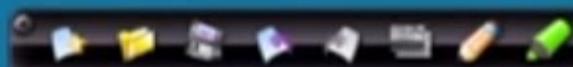
Java Run-Time Environment throws an object called `ArithmaticException`
when `a = x/(b - c);` and `b = c;`



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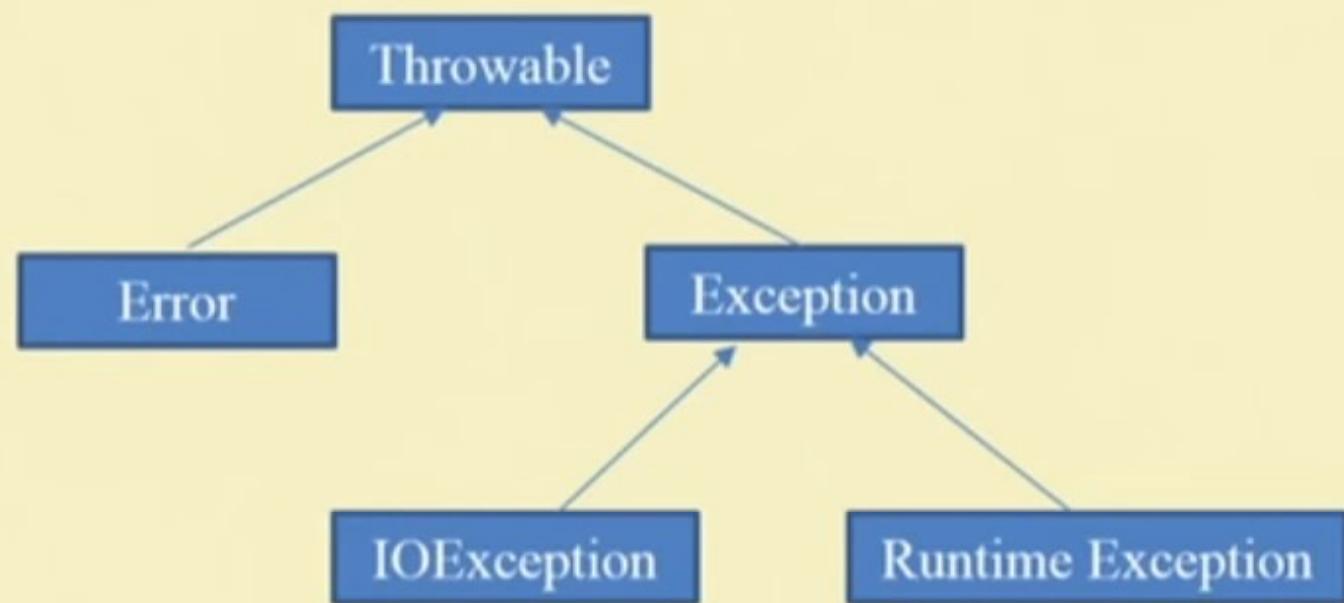
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Errors and exceptions in Java

To handle the common possible errors and exceptions, **Java** offers a class hierarchy



All these classes (and subclasses) are defined in **java.lang** package



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Exception Handling Mechanism

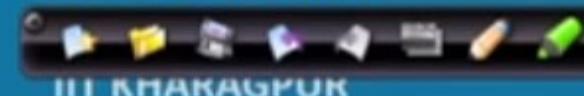


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Exception handling in Java

- Java provides Run Time Error Management to deal with errors and exceptions.
- During the execution of a program, when an exceptional condition arises, an object of the respective exception classes is created and thrown in with method which caused the exception.
- That method may choose to catch the exception and then can guard against premature exit or may have a block of code to execute.
- Java exception handling is managed via five keywords:





Exception handling in Java

- Java provides Run Time Error Management to deal with errors and exceptions.
- During the execution of a program, when an exceptional condition arises, an object of the respective exception classes is created and thrown in with method which caused the exception.
- That method may choose to catch the exception and then can guard against premature exit or may have a block of code to execute.
- Java exception handling is managed via five keywords:

```
try {      ...      }
catch {    ...    }
throw
throws
finally {   ...   }
```





Exception handling in Java

method
{

```
try{
    statement(s) that may cause
    exception(s)
    throw exception object
}
catch {
    statement(s) that handle the
    exception(s)
}
catch {
    statement(s) that handle the
    exception(s)
}
finally {
    statement(s) that execute on
    exit of the exception handling
}
```

Try block

Catch block 1

Catch block 2

Finally block



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Exception handling in Java

Simple try-catch

try with a single catch

try with multiple catch

try with multiple catch

Multiple exceptions

Multiple exception with one catch

Exception with exit code

try-catch with finally

Throwing own exception

Throws/throw in try-block

Nested try-catch block

try within another try



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Simple try-catch block



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Simple try-catch

```
method
{
    try{
        statement(s) that may cause
        exception(s)
    }
    catch {
        statement(s) that handle the
        exception(s)
    }
}
```

Try block

Catch block 1



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Simple try-catch: Example

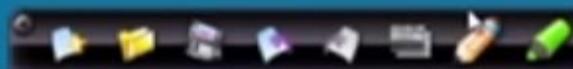
```
class DivideZero {  
    static int anyFunction ( int x, int y ) {  
        int a = x/y;  
        return (a);  
    }  
    public static void main (String args [ ] ) {  
        int result = anyFunction (25, 0) ;  
        // Exception occurs here as y = 0  
        System.out.println ( " Result : " + result );  
    }  
}
```



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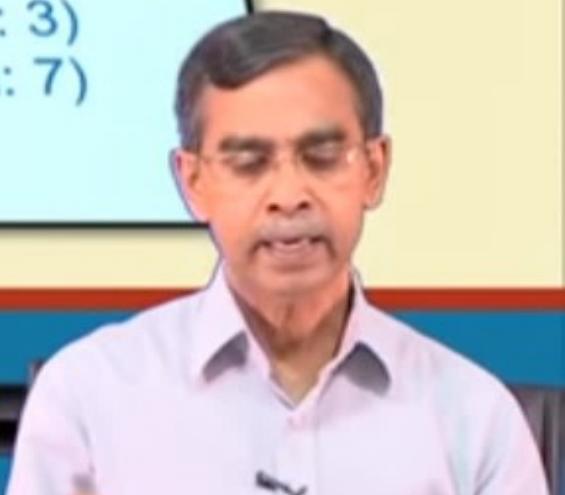
Simple try-catch: Example

Run time report while running the Application DivideZero

```
C:\> java DivideZero // To run the Application DivideZero
```

System produce the output as :

```
java.lang.ArithmetricException: / by zero
    at DivideZero.AnyFunction
    at DivideZero.main
(DivideZero.Java: 3)
(DivideZero.Java: 7)
```





Simple try-catch: Example

The Java program with try for any run-time error and catch it ...

```
class DivideZero {  
    static int anyFunction (int x, int y ){  
        try {  
            int a = x/y;  
            return(a);  
        }  
        catch (ArithmaticException e) {  
            System.out.println ("a = x/y is bypassed... Enter y as non-  
            zero" );  
        }  
    }  
..... main method in the next slide
```

Continued to the next

...



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Simple try-catch: Example

Continued from the previous slide...

```
public static void main (String args[ ] {  
    int a,b, result;  
    system.out.print("Enter any two integers : ");  
    a = System.in.read();  
    b = System.in.read();  
    result = any Function (a, b);  
    System.out.println ("Result : " + result);  
}  
}
```



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try-catch: Making program robust

```
Class TestException {  
    public static void main (String args[ ] {  
        int a, b, c;  
        int x, y;  
        try {  
            x = a / (b-c);  
        }  
        catch (ArithmetricException e) {  
            System.out.println(" b = c: Divide by zero error...!");  
        }  
        y = a / (b + c);  
        System.out.println ("y = " + y);  
    }  
}
```



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try-catch: Making program robust

```
class CommandLineInput {  
    public static void main (String args[ ]) {  
        int number, count;  
        for (int i = 0; i < args.length; i++) {  
            number = Integer.parseInt(args[i]);  
            System.out.println ("Number at " + i + args.[i]);  
        }  
    }  
}
```

What are the vulnerabilities in this program?



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try-catch: Making program robust

```
class CommandLineInput {  
    public static void main (String args[ ]) {  
        int number, count;  
        for (int i = 0; i < args.length; i++) {  
            number = Integer.parseInt(args[i]);  
            System.out.println ("Number at " + i + args[i]);  
        }  
    }  
}
```

Will the program work with the following test cases?

C:\> java CommandLineInput 1 2 3

C:\> java CommandLineInput 1 -2 3

C:\> java CommandLineInput 1.5 2 3.9

C:\> java CommandLineInput 1 Java -0.5



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try-catch: Making program robust

```
class CommandLineInput {  
    public static void main (String args[ ]) {  
        int number, count;  
        for (int i = 0; i < args.length; i++) {  
            number = Integer.parseInt(args[i]);  
            System.out.println ("Number at " + i + args[i]);  
        }  
    }  
}
```

Will the program work with the following test cases?

C:\> java CommandLineInput 1 2 3 ✓
C:\> java CommandLineInput 1 -2 3 ✓
C:\> java CommandLineInput 1.5 2 3.9 ✗
C:\> java CommandLineInput 1 Java -0.5 ✗



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try-catch: Making the program robust

```
class CommandLineInput {  
    public static void main (String args[ ]) {  
        int number, InvalidCount = 0; validCount = 0;  
        for (int i = 0; i < args.length; i++) {  
            try {  
                number = Integer.parseInt(args[i]);  
            } catch (NumberFormatException e) {  
                inavlidCount++;  
                System.out.println ("Invalid number at " + i + args.[i]);  
            }  
            validCount++;  
            System.out.println ("Valid number at " + i + args.[i]);  
        }  
        System.out.println ("Invalid entries: " + inValidCount);  
        System.out.println ("Valid entries: " + validCount);  
    }  
}
```



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try-catch: Making the program robust

```
class CommandLineInput {  
    public static void main (String args[ ]) {  
        int number, InvalidCount = 0; validCount = 0;  
        for (int i = 0; i < args.length; i++) {  
            try {  
                number = Integer.parseInt(args[i]);  
            } catch (NumberFormatException e) {  
                inavlidCount++;  
                System.out.println ("Invalid number at " + i + args.[i]);  
            }  
            validCount++;  
            System.out.println ("Valid number at " + i + args.[i]);  
        }  
        System.out.println ("Invalid entries: " + inValidCount);  
        System.out.println ("Valid entries: " + validCount);  
    }  
}
```

C:\> java CommandLineInput 10 22.34 55 Java K 69 2012



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Question to think...

- How to make more simple yet effective program against multiple errors?
- Is there any other feature(s) for exception handling?



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OBJECT ORIENTED PROGRAMMING WITH JAVA

Exception Handling in Java – II

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try- with Multiple catch



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try with Multiple catch

method

{

 try{

 statement(s) that may cause
 exception(s)

throw exception object

 }

catch {

 statement(s) that handle the
 exception(s)

 }

 :

 :

catch {

 statement(s) that handle the
 exception(s)

 }

 :

}

Try block

Catch block 1

Catch block n



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try with Multiple catch: Why?

```
class MultiCatch {  
    public static void main (String args[ ]) {  
        int i = args.length;  
        String myString = new String [i];  
        if(args[0].equals("Java"))  
            System.out.println("First word is Java !");  
        System.out.println( " Number of arguments = " + i );  
        int x = 18/ i;  
        int y[ ] = {555, 999};  
        y[i] = x;  
    }  
}
```

Identify the source of exceptions in the above program, if any.



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try with Multiple catch: Why?

```
class MultiCatch {  
    public static void main (String args[ ]) {  
        int i = args.length;  
        String myString = new String [i];  
        if(args[0].equals("Java"))  
            System.out.println("First word is Java !");  
        System.out.println( " Number of arguments = " + i );  
        int x = 18/ i;  
        int y[ ] = {555, 999};  
        y[i] = x;  
    }  
}
```

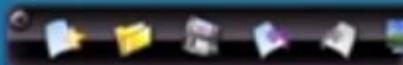
Identify the source of exceptions in the above program, if any.



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try with Multiple catch: Why?

```
class MultiCatch {  
    public static void main (String args[ ]) {  
        int i = args.length;  
        String myString = new String [i];  
        → if(args[0].equals("Java"))  
            System.out.println("First word is Java !");  
        System.out.println( " Number of arguments = " + i );  
        int x = 18/ i;  
        int y[ ] = {555, 999};  
        y[i] = x;  
    }  
}
```

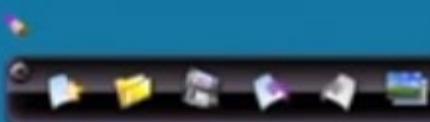
Identify the source of exceptions in the above program, if any.



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try with Multiple catch: Why?

```
class MultiCatch {  
    public static void main (String args[ ]) {  
        int i = args.length;  
        String myString = new String [i];  
        if(args[0].equals("Java"))  
            System.out.println("First word is Java !");  
        System.out.println( " Number of arguments = " + i );  
        int x = 18/ i;  
        int y[ ] = {555, 999};  
        y[i] = x;  
    }  
}
```

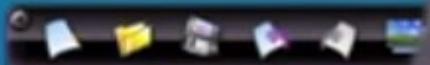
Identify the source of exceptions in the above program, if any.



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try with Multiple catch: Why?

```
class MultiCatch {  
    public static void main (String args[ ]) {  
        int i = args.length;  
        String myString = new String [i];  
        if(args[0].equals("Java"))  
            System.out.println("First word is Java !");  
        System.out.println( " Number of arguments = " + i );  
        int x = 18/ i;  
        int y[ ] = {555, 999};  
        y[i] = x;  
    }  
}
```

Identify the source of exceptions in the above program, if any.



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try with Multiple catch: Why?

```
class MultiCatch {  
    public static void main (String args[ ]) {  
        int i = args.length;  
        String myString = new String [i];  
        if(args[0].equals("Java")){  
            System.out.println("First word is Java !");  
            System.out.println( " Number of arguments = " + i );  
            int x = 18/ i;  
            int y[ ] = {555, 999};  
            y[ i ] = x;  
        }  
    }  
}
```

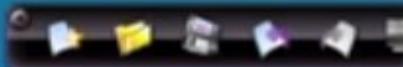
C:\> java MultiCatch Java Welcome
C:\> java MultiCatch Welcome to Java World !
C:\> java MultiCatch



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try with Multiple catch: Remedy

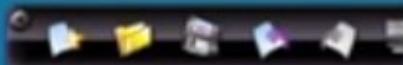
```
class MultiCatch {  
    public static void main (String args[ ]) {  
        int i = args.length;                      // No of arguments in the command line  
        String myString = new String [i];  
        // If i = 0 then myString null pointer error  
        // #1 // if(args[0].equals("Java"));  
        System.out.println("First word is Java !");  
        System.out.println( " Number of arguments = " + i );  
        // # 2 //          int x = 18/ i;  
        int y[ ] = {555, 999};                     // y is an array of size 2 and index are 0,1  
        // #3 //      y[ i ] = x;                  // Index is out-of-range may occur if i > 1  
    }  
}
```



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try with Multiple catch: Remedy

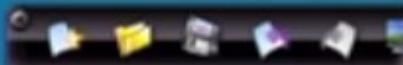
```
class MultiCatch {  
    public static void main (String args[ ]) {  
        int i = args.length; // No of arguments in the command line  
        String myString = new String [i];  
        // If i = 0 then myString null pointer error  
        // #1 / if(args[0].equals("Java"));  
        System.out.println("First word is Java !");  
        System.out.println( " Number of arguments = " + i );  
        // # 2 / int x = 18/ i;  
        int [ ] = {555, 999}; // y is an array of size 2 and index are 0,1  
        // #3 / y[ i ] = x; // Index is out-of-range may occur if i > 1  
    }  
}
```



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try with Multiple catch: Remedy

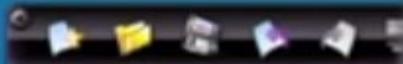
```
class MultiCatch {
    public static void main (String args[ ]) {
        int i = args.length;                      // Number of arguments in the command line
        try {
            String myString = new String [i];
            if(args[0].equals("Java"));           // #1 : If i = 0 then myString null pointer error
                System.out.println("First word is Java !");
            System.out.println( " Number of arguments = " + i )
            int x = 18/ i;                     // #2 : Divide by zero error//
            int y[ ] = {555, 999};             // y is an array of size 2 and index are 0,1
            y[ i ] = x;                      // #3 : Index is out-of-range may occur if i > 1
        }
        catch (NullPointerException e) {          // To catch the error at #1
            System.out.println ( " A null pointer exception : " + e );
        }
        catch (ArithmetricException e) {         // To catch the error at #2
            System.out.println ( " Divide by 0 : " + e );
        }
        catch (ArrayIndexOutOfBoundsException e) { // To catch the error at #3
            System.out.println ("Array Index OoB : " + e);
        }
    }
}
```



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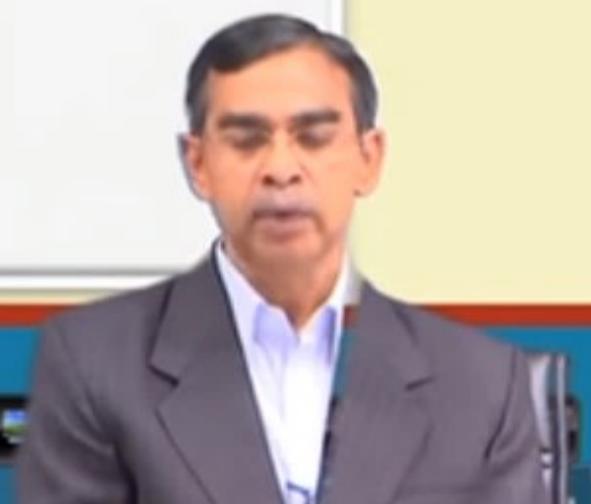
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try with Multiple catch: Remedy

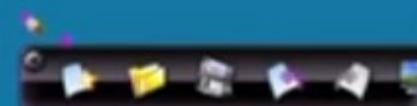
```
class MultiCatch {
    public static void main (String args[ ]) {
        int i = args.length; // Number of arguments in the command line
        try {
            String myString = new String [i];
            if(args[0].equals("Java")); // #1 : If i = 0 then myString null pointer error
                System.out.println("First word is Java !");
            System.out.println( " Number of arguments = " + i )
            int x = 18/ i; // #2 : Divide by zero error//
            int y[ ] = {555, 999}; // y is an array of size 2 and index are 0,1
            y[ i ] = x; // #3 : Index is out-of-range may occur if i > 1
        }
        catch (NullPointerException e) { // To catch the error at #1
            System.out.println ( " A null pointer exception : " + e );
        }
        catch (ArithmetricException e) { // To catch the error at #2
            System.out.println ( " Divide by 0 : " + e );
        }
        catch (ArrayIndexOutOfBoundsException e) { // To catch the error at #3
            System.out.println ("Array Index OoB : " + e);
        }
    }
}
```



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Multiple Errors with Single catch

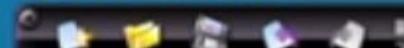


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Multiple errors with single catch

```
method
{
    try{
        statement(s) that may cause
        exception(s)
    }
    catch {
        statement(s) that handle the
        exception(s)
    }
}
```

try{

statement(s) that may cause
exception(s)

}

catch {

statement(s) that handle the
exception(s)

}

Try block

Catch block



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Multiple errors with single catch: An Example

```
class ExceptionTest {  
    public int j;  
    static void main (String args[ ] ) {  
        for (int i = 0; i < 4; i++ ) {  
            switch (i) {  
                case 0 :  
                    int zero = 0;  
                    j = 999/ zero;  
                    break;  
                case 1:  
                    int b[ ] = null;  
                    j = b[0] ;  
                    break;  
                case 2:  
                    int c[ ] = new int [2];  
                    j = c[10];  
                    break;  
                case 3:  
                    char ch = "Java".charAt(9);  
                    break;  
            }  
        }  
    }  
}
```



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Multiple errors with single catch: An Example

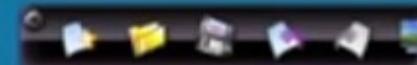
```
class ExceptionTest {  
    public int j;  
    static void main (String args[ ] ) {  
        for (int i = 0; i < 4; i++ ) {  
            switch (i) {  
                case 0 :  
                    int zero = 0;  
                    j = 999/ zero;  
                    break;  
                case 1:  
                    int b[ ] = null;  
                    j = b[0] ;  
                    break;  
                case 2:  
                    int c[ ] = new int [2];  
                    j = c[10];  
                    break;  
                case 3:  
                    char ch = "Java".charAt(9);  
                    break;  
            }  
        }  
    }  
}
```



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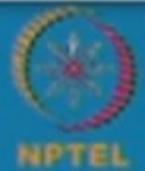


Multiple errors with single catch: An Example

```
class ExceptionTest {
    public int j;
    static void main (String args[ ] ) {
        for (int i = 0; i < 4; i++ ) {
            try {
                switch (i) {
                    case 0 :
                        int zero = 0;
                        j = 999/ zero; // Divide by zero
                        break;
                    case 1:
                        int b[ ] = null;
                        j = b[0]; // Null pointer error
                        break;
                    case 2:
                        int c = new int [2] ;
                        j = c[10]; // Array index is out-of-bound
                        break;
                    case 3:
                        char ch = "Java".charAt(9) ;// String index is out-of-bound
                        break;
                }
            } catch (Exception e) {
                System.out.println("In Test case"+i+ "\n");
                System.out.println (e.getMessage() );
            }
        }
    }
}
```



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finally in try-catch



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finally in try-catch

```
method
{
    try {
        statement(s) that may cause
        exception(s)
        throw exception object
    }
    catch {
        statement(s) that handle the
        exception(s)
    }
    finally {
        statement(s) that handle the
        exception(s)
    }
}
```

The code diagram illustrates the structure of a Java try-catch-finally block. It consists of three nested blocks: Try block, Catch block, and Finally block. The Try block contains statements that may cause exceptions and a throw statement. The Catch block handles the exceptions. The Finally block handles the exceptions regardless of whether they were caught or not. A pink vertical line highlights the try, catch, and finally keywords.

Try block

Catch block

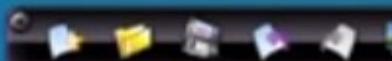
Finally block



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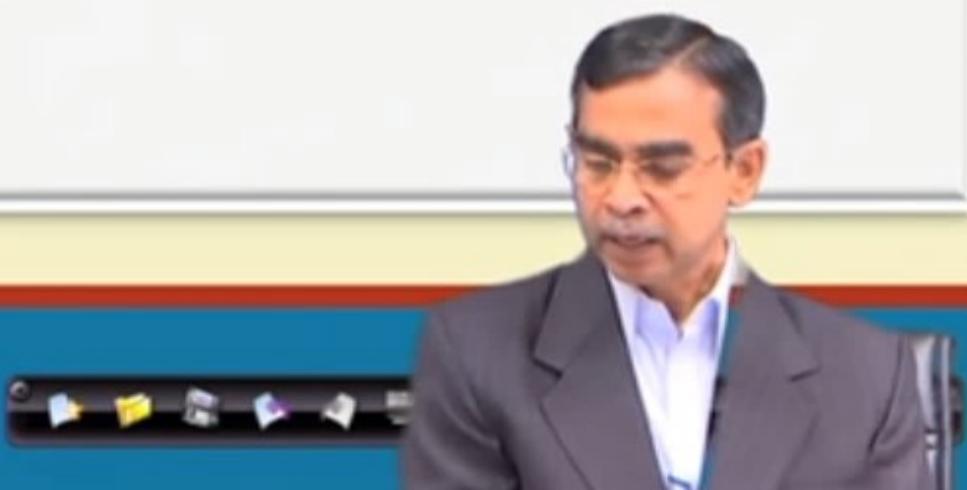
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finally in try-catch : An example

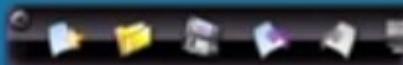
```
class FinallyDemo {  
    public static void main (String [ ] args ) {  
        int i = 0;  
        String greetings [ ] = { "Hello Twinkle !", "Hello Java !", "Hello World ! "};  
        while ( i < 4) {  
            try {  
                System.out.println (greetings [i++]);  
            }catch (Exception e ) {  
                System.out.println (e.toString());// Message of exception e in String format  
            }  
            finally {  
                System.out.println("You should quit and reset index value < 3 :");  
            }  
        } // while ()  
    } // main ()  
} // class
```



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throw in try-catch

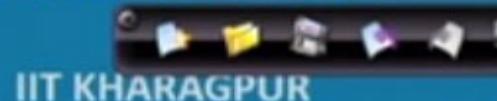


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throw in try-catch

```
method
{
    try{
        statement(s) that may cause
        exception(s)
        throw exception object
    }
    catch {
        statement(s) that handle the
        exception(s)
    }
    .
    .
    .
}
```

Try block

Catch block



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throw in try-catch

```
method
{
    try {
        statement(s) that may cause
        exception(s)
        throw exception object
    }
    catch {
        statement(s) that handle the
        exception(s)
    }
    .
    .
    .
}
```

Try block

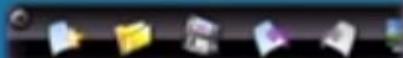
Catch block



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throw in try-catch : Mechanism

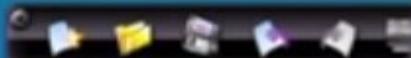
- If a method is capable of causing an exception that it does not handle, it must specify this behavior so that callers of the method can guard themselves against that exception.
- This is done by **throw** in the method declaration.
- A **throw** clause lists the types of exceptions that a method might throw.
- All other exceptions that a method can throw must be declared in the **throw** clause.
- If they are not, a compile-time error will result.



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throw in try-catch : An Example

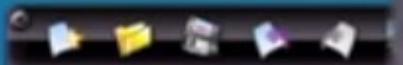
```
import java.lang.Exception;
class MyException extends Exception {
    MyException (String message) {
        super(message);
    }
}
class TestMyException {
    public static void main (String args[ ]) {
        int x = 5;  y = 1000;
        try {
            float z = (float) x / (float) y;
            if (z < 0.01) throw new MyException ("Given data are not proper");
        }
        catch (MyException e) {
            System.out.println(e.getMessage());
        }
        finally {
            System.out.println ("It prints always!");
        }
    }
}
```



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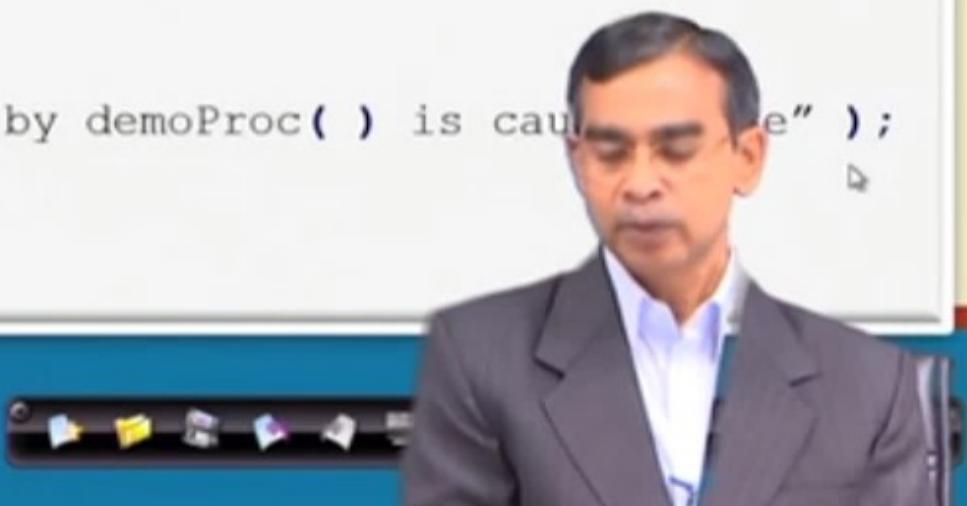
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throw in try-catch: An Example

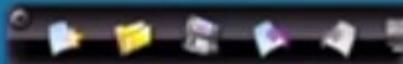
```
class ThrowDemo {  
    static void demoProc ( ) {  
        try {  
            throw new InterruptedException( "An Interrupt occurred" );  
                // An exception object is created  
.....   // Some code for demoProc( ) is here  
        } catch (InterruptedException e) {  
            System.out.println("Exception is caught in demoProc( )" );  
            throw e; // Exception will be thrown to the caller of demoProc( )  
        }  
    }  
    public static void main (Strings [ ] args ) {  
        try {  
            demoProc ( );  
        } catch (Exception e) {  
            System.out.println ( " Exception thrown by demoProc( ) is caught " + e );  
        }  
    }  
}
```



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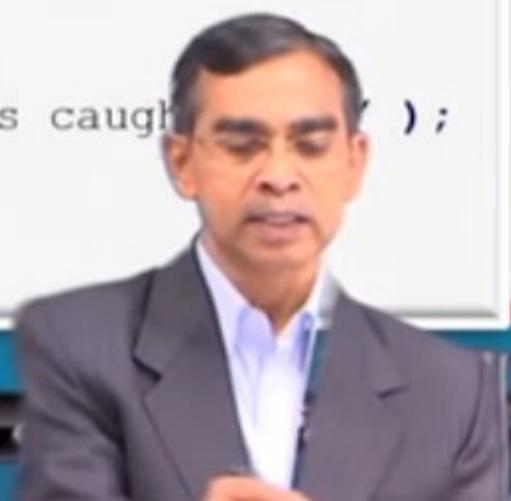


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throw in try-catch: An Example

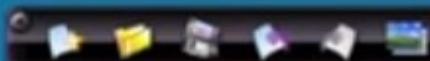
```
class ThrowDemo {  
    static void demoProc ( ) {  
        try {  
            throw new InterruptedException( "An Interrupt occurred" );  
            // An exception object is created  
            ..... // Some code for demoProc( ) is here  
        } catch (InterruptedException e) {  
            System.out.println("Exception is caught in demoProc( )" );  
            throw e; // Exception will be thrown to the caller of demoProc( )  
        }  
    }  
    public static void main (String s [ ] args ) {  
        try {  
            demoProc ( );  
        } catch (Exception e) {  
            System.out.println ( " Exception thrown by demoProc( ) is caught " );  
        }  
    }  
}
```



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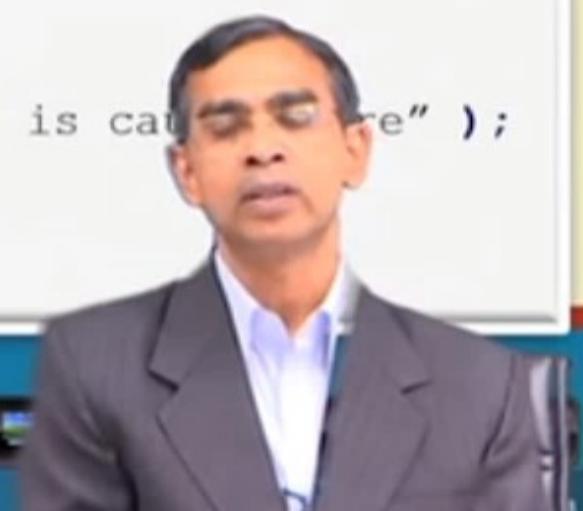
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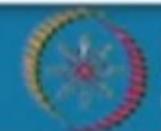


throw in try-catch: An Example

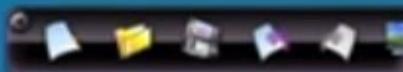
```
class ThrowDemo {  
    static void demoProc ( ) {  
        try {  
            throw new InterruptedException( "An Interrupt occurred" );  
                // An exception object is created  
.....   // Some code for demoProc( ) is here  
        } catch (InterruptedException e) {  
            System.out.println("Exception is caught in demoProc( )" );  
            throw e; // Exception will be thrown to the caller of demoProc( )  
        }  
    }  
    public static void main (Strings [ ] args ) {  
        try {  
            demoProc ( );  
        } catch (Exception e) {  
            System.out.println ( " Exception thrown by demoProc( ) is caught here" );  
        }  
    }  
}
```



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throw in try-catch: An Example

```
class ThrowDemo {  
    static void demoProc ( ) {  
        try {  
            throw new InterruptedException( "An Interrupt occurred" );  
                // An exception object is created  
.....   // Some code for demoProc( ) is here  
        } catch (InterruptedException e) {  
            System.out.println("Exception is caught in demoProc( )" );  
            throw e; // Exception will be thrown to the caller of demoProc( )  
        }  
    }  
    public static void main (Strings [ ] args ) {  
        try {  
            demoProc ( );  
        } catch (Exception e) {  
            System.out.println ( " Exception thrown by demoProc( ) is caught here" );  
        }  
    }  
}
```



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throws in try-catch : Mechanism

The general form of a method declaration that includes a `throws` clause:

```
type method-name(parameter-list) throws exception-list
{
    // body of method
}
```

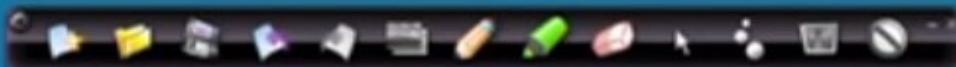
Here, `exception-list` is a comma-separated list of the exceptions that a method can throw.



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throws in try-catch : Mechanism

```
class InterestCalculator{
    public static void main(String args[ ] ) throws Exception {
        Float principalAmount = new Float(0);
        Float rateOfInterest = new Float(0);
        int numberOfYears = 0;
        try {
            DataInputStream in = new DataInputStream(System.in);
            String tempString;
            System.out.println("Enter Principal Amount: ");
            System.out.flush();
            tempString = in.readLine();
            principalAmount = Float.valueOf(tempString);
            System.out.println("Enter Rate of Interest: ");
            System.out.flush();
            tempString = in.readLine();
            rateOfInterest = Float.valueOf(tempString);
            System.out.println("Enter Number of Years: ");
            System.out.flush();
            tempString = in.readLine();
            numberOfYears = Integer.parseInt(tempString);
        }
        catch (Exception e) {}
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
}
```



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throws in try-catch : Mechanism

```
class InterestCalculator{
    public static void main(String args[ ] ) throws Exception {
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        Float rateOfInterest = new Float(0);
        int numberOfYears = 0;
        try {
            DataInputStream in = new DataInputStream(System.in);
            String tempString;
            System.out.println("Enter Principal Amount: ");
            System.out.flush();
            tempString = in.readLine();
            principalAmount = Float.valueOf(tempString);
            System.out.println("Enter Rate of Interest: ");
            System.out.flush();
            tempString = in.readLine();
            rateOfInterest = Float.valueOf(tempString);
            System.out.println("Enter Number of Years: ");
            System.out.flush();
            tempString = in.readLine();
            numberOfYears = Integer.parseInt(tempString);
        }
        catch (Exception e) {}
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
}
```



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throws in try-catch : Mechanism

```
class InterestCalculator{
    public static void main(String args[ ] ) throws Exception {
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        Float rateOfInterest = new Float(0);
        int numberOfYears = 0;
        try {
            DataInputStream in = new DataInputStream(System.in);
            String tempString;
            System.out.println("Enter Principal Amount: ");
            System.out.flush();
            tempString = in.readLine();
            principalAmount = Float.valueOf(tempString);
            System.out.println("Enter Rate of Interest: ");
            System.out.flush();
            tempString = in.readLine();
            rateOfInterest = Float.valueOf(tempString);
            System.out.println("Enter Number of Years: ");
            System.out.flush();
            tempString = in.readLine();
            numberOfYears = Integer.parseInt(tempString);
        }
        catch (Exception e) {}
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
}
```



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throws in try-catch : Mechanism

```
class InterestCalculator{
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        int numberOfYears = 0;
        try {
            DataInputStream in = new DataInputStream(System.in);
            String tempString;
            System.out.println("Enter Principal Amount: ");
            System.out.flush();
            tempString = in.readLine();
            principalAmount = Float.valueOf(tempString);
            System.out.println("Enter Rate of Interest: ");
            System.out.flush();
            tempString = in.readLine();
            rateOfInterest = Float.valueOf(tempString);
            System.out.println("Enter Number of Years: ");
            System.out.flush();
            tempString = in.readLine();
            numberOfYears = Integer.parseInt(tempString);
        }
        catch (Exception e) {}
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
}
```



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throws in try-catch : Mechanism

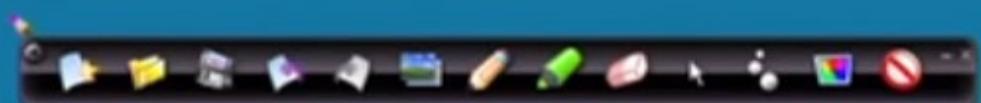
```
class InterestCalculator{
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        Float principalAmount = new Float(0);
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        int numberOfYears = 0;
        try {
            DataInputStream in = new DataInputStream(System.in);
            String tempString;
            System.out.println("Enter Principal Amount: ");
            System.out.flush();
            tempString = in.readLine();
            principalAmount = Float.valueOf(tempString);
            System.out.println("Enter Rate of Interest: ");
            System.out.flush();
            tempString = in.readLine();
            rateOfInterest = Float.valueOf(tempString);
            System.out.println("Enter Number of Years: ");
            System.out.flush();
            tempString = in.readLine();
            numberOfYears = Integer.parseInt(tempString);
        }
        catch (Exception e) {}
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
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```



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throws in try-catch : Mechanism

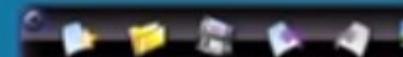
```
class InterestCalculator{
    public static void main(String args[ ] ) throws Exception {
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        int numberOfYears = 0;
        try {
            DataInputStream in = new DataInputStream(System.in);
            String tempString;
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            System.out.println("Enter Rate of Interest: ");
            System.out.flush();
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            rateOfInterest = Float.valueOf(tempString);
            System.out.println("Enter Number of Years: ");
            System.out.flush();
            tempString = in.readLine();
            numberOfYears = Integer.parseInt(tempString);
        }
        catch (Exception e) {}
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
}
```



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throws in try-catch : Mechanism

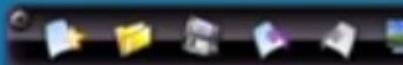
```
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        int numberOfYears = 0;
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            String tempString;
            System.out.println("Enter Principal Amount: ");
            System.out.flush();
            tempString = in.readLine();
            principalAmount = Float.valueOf(tempString);
            System.out.println("Enter Rate of Interest: ");
            System.out.flush();
            tempString = in.readLine();
            rateOfInterest = Float.valueOf(tempString);
            System.out.println("Enter Number of Years: ");
            System.out.flush();
            tempString = in.readLine();
            numberOfYears = Integer.parseInt(tempString);
        }
        catch (Exception e) {}
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
}
```



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throws in try-catch : Mechanism

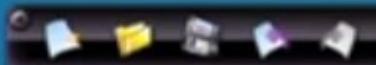
```
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        int numberOfYears = 0;
        try {
            DataInputStream in = new DataInputStream(System.in);
            String tempString;
            System.out.println("Enter Principal Amount: ");
            System.out.flush();
            tempString = in.readLine();
            principalAmount = float.valueOf(tempString);
            System.out.println("Enter Rate of Interest: ");
            System.out.flush();
            tempString = in.readLine();
            rateOfInterest = Float.valueOf(tempString);
            System.out.println("Enter Number of Years: ");
            System.out.flush();
            tempString = in.readLine();
            numberOfYears = Integer.parseInt(tempString);
        }
        catch (Exception e) {}
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
}
```



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throws in try-catch : Mechanism

```
class InterestCalculator{
    public static void main(String args[ ] ) throws Exception {
        Float principalAmount = new Float(0);
        Float rateOfInterest = new Float(0);
        int numberOfYears = 0;
        try {
            DataInputStream in = new DataInputStream(System.in);
            String tempString;
            System.out.println("Enter Principal Amount: ");
            System.out.flush();
            tempString = in.readLine();  
          ↗
            principalAmount = float.valueOf(tempString);
            System.out.println("Enter Rate of Interest: ");
            System.out.flush();
            tempString = in.readLine();  
          ↗
            rateOfInterest = Float.valueOf(tempString);
            System.out.println("Enter Number of Years: ");
            System.out.flush();
            tempString = in.readLine();  
          ↗
            numberOfYears = Integer.parseInt(tempString);
        }
        catch (Exception e) {}
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
}
```



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throws in try-catch : Mechanism

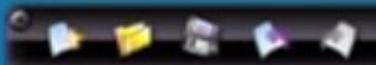
```
class InterestCalculator{
    public static void main(String args[ ] ) throws Exception {
        Float principalAmount = new Float(0);
        Float rateOfInterest = new Float(0);
        int numberOfYears = 0;
        try {
            DataInputStream in = new DataInputStream(System.in);
            String tempString;
            System.out.println("Enter Principal Amount: ");
            System.out.flush();
            tempString = in.readLine();
            principalAmount = Float.valueOf(tempString);
            System.out.println("Enter Rate of Interest: ");
            System.out.flush();
            tempString = in.readLine();
            rateOfInterest = Float.valueOf(tempString);
            System.out.println("Enter Number of Years: ");
            System.out.flush();
            tempString = in.readLine();
            numberOfYears = Integer.parseInt(tempString);
        }
        catch (Exception e) {}
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
}
```



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throws in try-catch : Mechanism

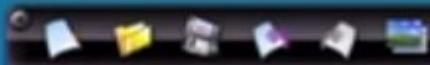
```
class InterestCalculator{
    public static void main(String args[ ] ) throws IOException {
        Float principalAmount = new Float(0);
        Float rateOfInterest = new Float(0);
        int numberOfYears = 0;
        try {
            DataInputStream in = new DataInputStream(System.in);
            String tempString;
            System.out.println("Enter Principal Amount: ");
            System.out.flush();
            tempString = in.readLine();
            principalAmount = Float.valueOf(tempString);
            System.out.println("Enter Rate of Interest: ");
            System.out.flush();
            tempString = in.readLine();
            rateOfInterest = Float.valueOf(tempString);
            System.out.println("Enter Number of Years: ");
            System.out.flush();
            tempString = in.readLine();
            numberOfYears = Integer.parseInt(tempString);
        }
        catch (Exception e) {}
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
}
```



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throws in try-catch : Mechanism

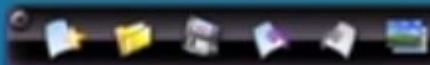
```
class InterestCalculator{
    public static void main(String args[ ] ) throws Exception {
        Float principalAmount = new Float(0);
        Float rateOfInterest = new Float(0);
        int numberOfYears = 0;
        try {
            DataInputStream in = new DataInputStream(System.in);
            String tempString;
            System.out.println("Enter Principal Amount: ");
            System.out.flush();
            tempString = in.readLine();
            principalAmount = Float.valueOf(tempString);
            System.out.println("Enter Rate of Interest: ");
            System.out.flush();
            tempString = in.readLine();
            rateOfInterest = Float.valueOf(tempString);
            System.out.println("Enter Number of Years: ");
            System.out.flush();
            tempString = in.readLine();
            numberOfYears = Integer.parseInt(tempString);
        }
        catch (Exception e) {}
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
}
```



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OBJECT ORIENTED PROGRAMMING WITH JAVA

Exception Handling in Java – III

Debasis Samanta

Department of Computer Science & Engineering
Indian Institute of Technology Kharagpur





Nested try-catch

method

```
{
```

```
try {
```

```
    Statement(s) that may cause exception(s)
```

```
.....
```

```
    try{  
        Statement(s) that cause another exception(s)  
    }  
    catch{  
        Statement(s) that handle the exception(s)  
    }
```

```
}
```

```
catch{
```

```
    Statement(s) that handle the exception(s)  
}
```

```
}
```

try block

Nested try block



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Nested try-catch

method

```
{  
:  
try {
```

Statement(s) that may cause exception(s)

.....

```
try{  
Statement(s) that cause another exception(s)  
}  
catch{  
:
```

Statement(s) that handle the exception(s)

```
}
```

```
catch{
```

Statement(s) that handle the exception(s)

```
}
```

```
}
```

try block

Nested try block



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Nested try-catch : An example

```
class NestedTry {  
    public static void main(String args[]) {  
        int a = args.length;  
        int b = 42 / a;  
        System.out.println("a = " + a);  
        if(a==1)  
            a = a/(a-a);  
        if(a==2) {  
            int c[] = { 1 };  
            c[2] = 99;  
        }  
    }  
}
```



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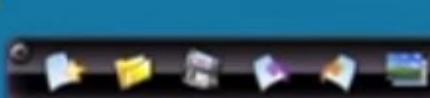


Next Page



Nested try-catch : An example

```
class NestedTry {  
    public static void main(String args[]) {  
        int a = args.length;  
        int b = 42 / a;  
        System.out.println("a = " + a);  
        if(a==1)  
            a = a/(a-a);  
        if(a==2) {  
            int c[] = { 1 };  
            c[2] = 99;  
        }  
    }  
}
```





Nested try-catch : An example

```
class NestedTry {  
    public static void main(String args[]) {  
        int a = args.length;  
        int b = 42 / a;  
        System.out.println("a = " + a);  
        if(a==1)  
            a = a/(a-a);  
        if(a==2) {  
            int c[] = { 1 };  
            c[2] = 99;  
        }  
    }  
}
```

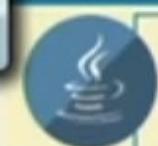


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Nested try-catch : An example

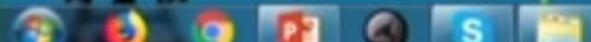
```
class NestedTry {  
    public static void main(String args[]) {  
        int a = args.length;  
        int b = 42 / a;  
        System.out.println("a = " + a);  
        if(a==1)  
            a = a/(a-a);  
        if(a==2) {  
            int c[] = { 1 };  
            c[2] = 99;  
        }  
    }  
}
```

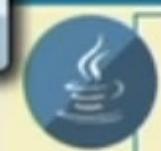


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Nested try-catch : An example

```
class NestedTry {  
    public static void main(String args[]) {  
        int a = args.length;  
        int b = 42 / a;  
        System.out.println("a = " + a);  
        if(a==1)  
            a = a/(a-a);  
        if(a==2) {  
            int c[1] = { 1 };  
            c[2] = 99;  
        }  
    }  
}
```



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Nested try-catch : An example

```
class NestedTry {  
    public static void main(String args[]) {  
        int a = args.length;  
        int b = 42 / a; // If no command-line args are present, then it generates a divide-by-zero exception  
        System.out.println("a = " + a);  
        if(a==1)  
            a = a/(a-1); // If one command-line arg is used, then a divide-by-zero exception  
        if(a==2) {  
            int c[] = { 1 };  
            c[a] = 99; // If two command-line args are used, then an out-of-bound exception  
        }  
    }  
}
```

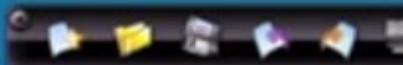
```
C:\> java NestedTry 1 2 3  
C:\> java NestedTry 1 2  
C:\> java NestedTry 1  
C:\> java NestedTry
```



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Nested try-catch : An example

```
class NestedTry {  
    public static void main(String args[]) {  
        int a = args.length;  
        int b = 42 / a; // If no command-line args are present, then it generates a divide-by-zero exception  
        System.out.println("a = " + a);  
        if(a==1)  
            a = a/(a-1); // If one command-line arg is used, then a divide-by-zero exception  
        if(a==2) {  
            int c[] = { 1 };  
            c[a] = 99; // If two command-line args are used, then an out-of-bound exception  
        }  
    }  
}
```

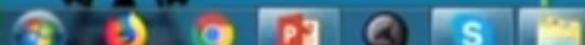
```
C:\> java NestedTry 1 2 3  
C:\> java NestedTry 1 2  
C:\> java NestedTry 1  
C:\> java NestedTry
```



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Nested try-catch : An example

```
class NestedTry {  
    public static void main(String args[]) {  
        int a = args.length;  
        int b = 42 / a; // If no command-line args are present, then it generates a divide-by-zero exception  
        System.out.println("a = " + a);  
        if(a==1)  
            a = a/(a-1); // If one command-line arg is used, then a divide-by-zero exception  
        if(a==2) {  
            int c[] = { 1 };  
            c[a] = 99; // If two command-line args are used, then an out-of-bound exception  
        }  
    }  
}
```

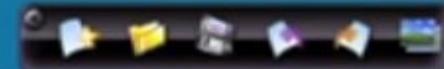
C:\> java NestedTry 1 2 3 ✓
C:\> java NestedTry 1 2
C:\> java NestedTry 1
C:\> java NestedTry



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Nested try-catch : An example

```
class NestedTry {  
    public static void main(String args[]) {  
        try {  
            // To catch divide-by-zero  
            int a = args.length;  
            int b = 42 / a;  
            // divide-by-zero exception  
            System.out.println("a = " + a);  
            if(a==1)  
                a = a/(a-a);  
            // another divide-by-zero exception  
            try {  
                // nested try block  
                if(a==2) { // If two command-  
                    line args are used, then an  
                    out-of-bounds exception  
                    int c[ ] = { 1 };  
                    c[a] = 99;  
            }  
        }  
    }  
}
```

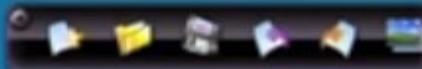
```
        } catch(ArrayIndexOutOfBoundsException e) {  
            System.out.println("Array  
            index out-of-bounds: " + e);  
        } } catch(ArithmetricException e) {  
            System.out.println("Divide by 0:" + e);  
        } }  
    }  
}
```



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Nested try-catch : An example

```
class NestedTry {  
    public static void main(String args[]) {  
        try {  
            // To catch divide-by-zero  
            int a = args.length;  
            int b = 42 / a;  
            // divide-by-zero exception  
            System.out.println("a = " + a);  
            if(a==1)  
                a = a/(a-a);  
            // another divide-by-zero exception  
            try {  
                // nested try block  
                if(a==2) { // If two command-  
                    line args are used, then an  
                    out-of-bounds exception  
                    int c[ ] = { 1 };  
                    c[a] = 99;  
            }  
        }  
    }  
}
```

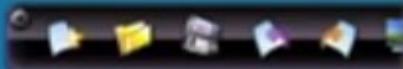
```
        } catch(ArrayIndexOutOfBoundsException e) {  
            System.out.println("Array  
            index out-of-bounds: " + e);  
        } } catch(ArithmetricException e) {  
            System.out.println("Divide by 0:" + e);  
        } }  
    }  
}
```



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Built-in Exception Handling in Java

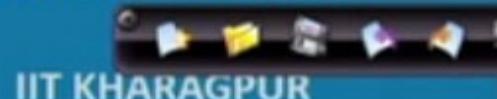


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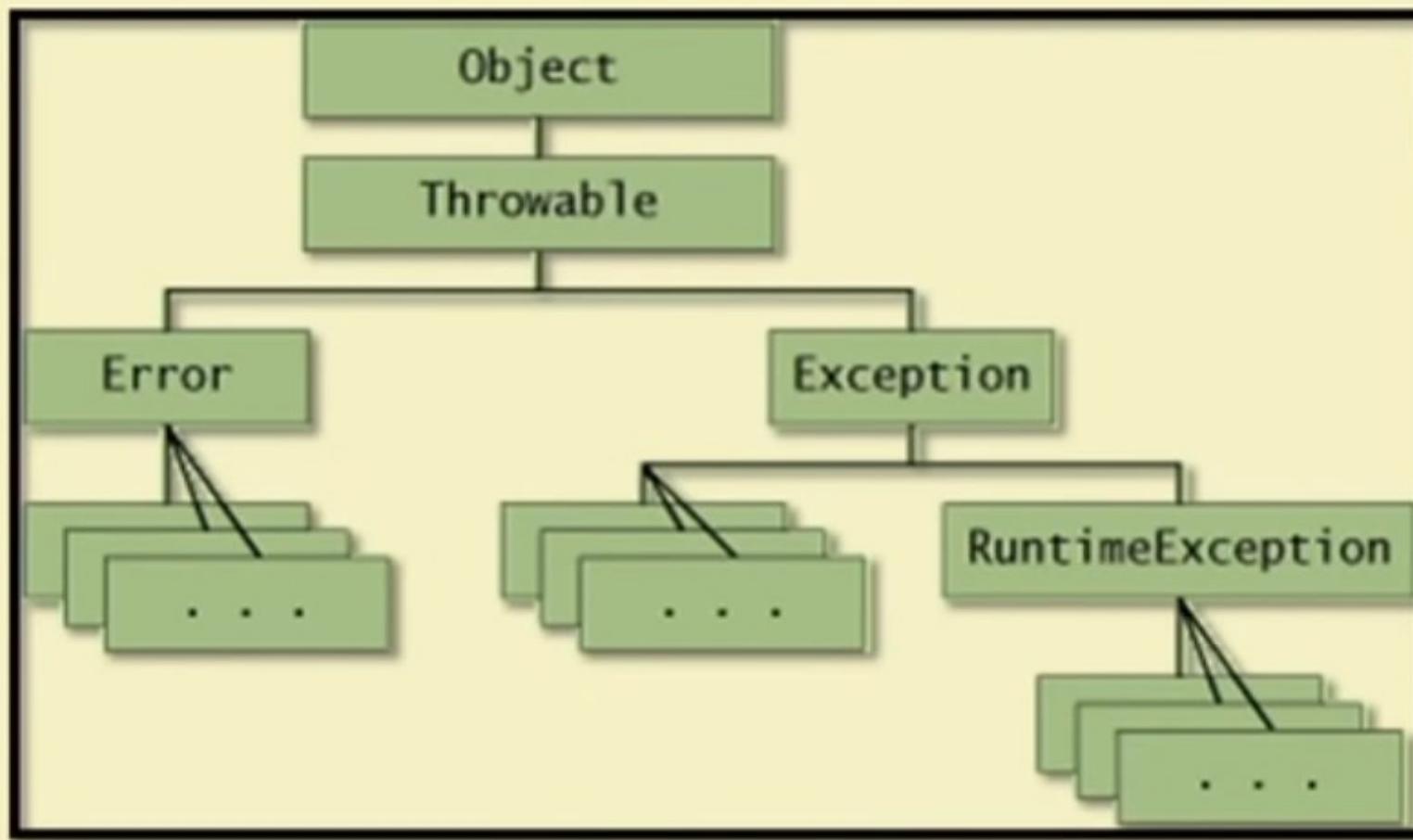
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Exception classes in `Java.lang.Throwable`



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Exception classes in Java.lang.Throwable

RuntimeException sub classes:

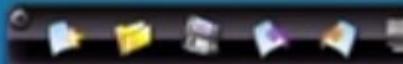
- ArithmeticException
- ArrayIndexOutOfBoundsException
- ArrayStoreException
- ClassCastException
- IllegalArgumentException
- SecurityException
- IncompatibleClassChangeError
- IndexOutOfBoundsException
- NegativeArraySizeException
- NullPointerException
- NumberFormatException
- StringIndexOutOfBoundsException



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Exception classes in Java.lang.Throwable

Exception sub classes:

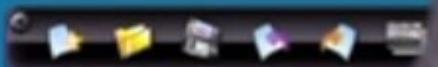
- ClassNotFoundException
- DataFormatException
- IllegalAccessException
- InstantiationException
- InterruptedException
- NoSuchMethodException
- RuntimeException



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Exception classes in Java.lang.Throwable

Error Classes:

- ClassNotFoundException
- DataFormatException
- IllegalAccessException
- InstantiationException
- InterruptedException
- NoSuchMethodException
- RuntimeException



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Exception classes in Java.lang.Throwable

- ClassCircularError
- ClassFormatError
- Error
- IllegalAccessError
- IncompatibleClassChangeError
- InstantiationException
- LinkageError
- NoClassDefFoundError
- NoSuchMethodError
- NoSuchFieldError
- OutOfMemoryError
- StackOverflowError
- Throwable
- UnknownError
- UnsatisfiedLinkError
- VerifyError
- VirtualMachineError





Exception classes in Java.lang.Throwable

- ClassCircularError
- ClassFormatError
- Error
- IllegalAccessError
- IncompatibleClassChangeError
- InstantiationException
- LinkageError
- NoClassDefFoundError
- NoSuchMethodError
- NoSuchFieldError
- OutOfMemoryError
- StackOverflowError
- Throwable
- UnknownError
- UnsatisfiedLinkError
- VerifyError
- VirtualMachineError



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Exception methods

SN	Methods with Description
1	public String getMessage(): Returns a detailed message about the exception that has occurred. This message is initialized in the Throwable constructor.
2	public Throwable getCause(): Returns the cause of the exception as represented by a Throwable object.
3	public String toString(): Returns the name of the class concatenated with the result of getMessage()
4	public void printStackTrace(): Prints the result of toString() along with the stack trace to System.err, the error output stream.
5	public StackTraceElement [] getStackTrace(): Returns an array containing each element on the stack trace. The element at index 0 represents the top of the call stack, and the last element in the array represents the method at the bottom of the call stack.
6	public Throwable fillInStackTrace(): Fills the stack trace of this Throwable object with the current stack trace, adding to any previous information in the stack trace.



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User Defined Exceptions

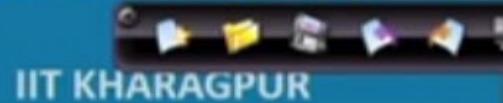


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Declaring your own exception

- All exceptions must be a child of `Throwable`.
- If you want to write a checked exception that is automatically enforced by the Handle or Declare Rule, you need to extend the `Exception` class.
- If you want to write a runtime exception, you need to extend the `RuntimeException` class
- Syntax

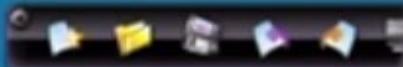
```
class MyException extends Exception {  
    . . .  
}
```



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Own exception: Example

```
// 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;
    }
}
```



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Own exception: Example

```
// File Name CheckingAccount.java
import java.io.*;
public class CheckingAccount
{
    private double balance;
    private int number;
    public CheckingAccount(int number) {
        this.number = number;
    }
    public void deposit(double amount) {
        balance += amount;
    }
    public void withdraw(double amount) throws
InsufficientFundsException {
        if(amount <= balance){
            balance -= amount;
        }
    }
}
```



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Own exception: Example

```
// File Name CheckingAccount.java
import java.io.*;
public class CheckingAccount
{
    private double balance;
    private int number;
    public CheckingAccount(int number) {
        this.number = number;
    }
    public void deposit(double amount) {
        balance += amount;
    }
    public void withdraw(double amount) throws
InsufficientFundsException {
        if(amount <= balance){
            balance -= amount;
        }
    }
}
```

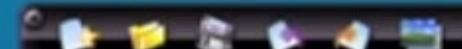
```
    else {
        double needs = amount - balance;
        throw new InsufficientFundsException(needs);
    }
}
public double getBalance() {
    return balance;
}
public int getNumber(){
    return number;
}
}
```



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Own exception: Example

```
// File Name BankDemo.java
public class BankDemo
{
    public static void main(String [] args)
    {
        CheckingAccount c = new CheckingAccount(101);
        System.out.println("Depositing $500...");
        c.deposit(500.00);
        try {
            System.out.println("\n Withdrawing $100...");
            c.withdraw(100.00);
            System.out.println("\n Withdrawing $600...");
            c.withdraw(600.00);
        } catch(InsufficientFundsException e){
            System.out.println("Sorry, but you are short $" + e.getAmount());
            e.printStackTrace();
        }
    }
}
```



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Own exception: Example

```
// File Name BankDemo.java
public class BankDemo
{
    public static void main(String [] args)
    {
        CheckingAccount c = new CheckingAccount(101);
        System.out.println("Depositing $500...");
        c.deposit(500.00);
        try {
            System.out.println("\n Withdrawing $100...");
            c.withdraw(100.00);
            System.out.println("\n Withdrawing $600...");
            c.withdraw(600.00);
        } catch(InsufficientFundsException e){
            System.out.println("Sorry, but you are short $" + e.amount);
            e.printStackTrace();
        }
    }
}
```

Depositing \$500...
Withdrawning \$100...
Withdrawning \$600...
Sorry, but you are short \$200.
InsufficientFundsException
at
CheckingAccount.withdraw(CheckingAccount.java:25)
at BankDemo.main(BankDemo.java:13)





Own exception: Example

```
// File Name BankDemo.java
public class BankDemo
{
    public static void main(String [] args)
    {
        CheckingAccount c = new CheckingAccount(101);
        System.out.println("Depositing $500...");
        c.deposit(500.00);
        try {
            System.out.println("\n Withdrawing $100...");
            c.withdraw(100.00);
            System.out.println("\n Withdrawing $600...");
            c.withdraw(600.00);
        } catch(InsufficientFundsException e){
            System.out.println("Sorry, but you are short $" + e.getMessage());
            e.printStackTrace();
        }
    }
}
```

Depositing \$500...
Withdrawning \$100...
Withdrawning \$600...
Sorry, but you are short \$200.0
InsufficientFundsException
at
CheckingAccount.withdraw(CheckingAccount.java:25)
at BankDemo.main(BankDemo.java:13)



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Final Round of Wrapping



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Example program for Scanner : Maximum

```
import java.util.Scanner;

public class MaximumCalculator {
    public static void main(String args[]) {
        Scanner scnr = new Scanner(System.in);
        // Calculating the maximum two numbers in Java
        System.out.println("Please enter two numbers to find maximum of two");
        int a = scnr.nextInt();
        int b = scnr.nextInt();
        if (a > b) {
            System.out.printf("Between %d and %d, maximum is %d \n", a, b, a);
        }
        else {
            System.out.printf("Between %d and %d, maximum number is %d \n", a, b, b);
        }
    }
}
```

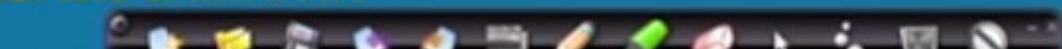


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Example program for Scanner : Maximum

```
import java.util.Scanner;

public class MaximumCalculator {
    public static void main(String args[]) {
        Scanner scnr = new Scanner(System.in);
        // Calculating the maximum two numbers in Java
        System.out.println("Please enter two numbers to find maximum of two");
        int a = scnr.nextInt();
        int b = scnr.nextInt();
        if (a > b) {
            System.out.printf("Between %d and %d, maximum is %d \n", a, b, a);
        }
        else {
            System.out.printf("Between %d and %d, maximum number is %d \n", a, b, b);
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```



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```



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Example program with Scanner and array

```
import java.util.*;
class SimpleArrayList{
public static void main(String args[]){
    int sum = 0;
    float avg = 0;
    ArrayList <Integer> l = new ArrayList<Integer>();
    System.out.println("Enter the input ");
    Scanner input = new Scanner(System.in);
    while (input.hasNextInt()) {
        l.add(input.nextInt());
    }
    for (int i = 0; i < l.size(); i++) {
        sum = sum+l.get(i);
    }
    avg = sum/(l.size());
    System.out.println("Average : " + avg);
}
}
```



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17:34

24-11-2018



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17:35

24-11-2018



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        sum = sum+l.get(i);
    }
    avg = sum/(l.size());
    System.out.println("Average : " + avg);
}
}
```

```
C:\Users\Desktop\Java\SimpleArrayList>Ent
er the input
5
6
4^Z
Average : 5.0
```

Note:

Press Ctrl+Z to stop scanning.

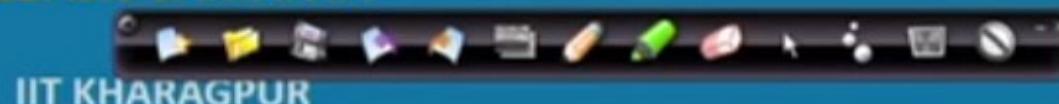


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Input with DataInputStream : Calculator Program

```
import java.io.*;

class InterestCalculator{
    public static void main(String args[ ] ) {
        Float principalAmount = new Float(0);
        Float rateOfInterest = new Float(0);
        int numberOfYears = 0;
        DataInputStream in = new DataInputStream(System.in);
        String tempString;
        System.out.println("Enter Principal Amount: ");
        System.out.flush();
        tempString = in.readLine();
        principalAmount = Float.valueOf(tempString);
        System.out.println("Enter Rate of Interest: ");
        System.out.flush();
        tempString = in.readLine();
        rateOfInterest = Float.valueOf(tempString);
        System.out.println("Enter Number of Years: ");
        System.out.flush();
        tempString = in.readLine();
        numberOfYears = Integer.parseInt(tempString);
        // Input is over: calculate the interest
        float interestTotal = principalAmount*rateOfInterest*numberOfYears;
        System.out.println("Total Interest = " + interestTotal);
    }
}
```



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}
```

throws IOException



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    }
}
```

C:\Users\Desktop\Java\InterestCalculator>
Enter Principal Amount:
100.0
Enter Rate of Interest:
12.5
Enter Number of Years:
2
Total Interest = 25.0

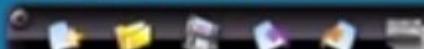


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Question to think...

- Java is well known for the distributed programming. How?
- How Java programming is to develop many sophisticated Internet programs?



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