Exception Handling

Christian Rodríguez Bustos

Edited by Juan Mendivelso

Object Oriented Programming

Agenda

1. Exception Handling Basis
2. Exception Handling Flow
3. Exception Rules

```
CPUID:GenuineIntel 5.2.c irql:1f  SYSVER 0xf0000565

Dll Base DateStmp - Name                Dll Base DateStmp - Name
80100000 3202c07e - ntoskrnl.exe        80010000 31ee6c52 - hal.dll
80001000 31ed06b4 - atapi.sys           80006000 31ec6c74 - SCSIPORT.SYS
802c6000 31ed06bf - aic78xx.sys         802cd000 31ed237c - Disk.sys
802d1000 31ec6c7a - CLASS2.SYS          8037c000 31eed0a7 - Ntfs.sys
fc698000 31ec6c7d - Floppy.SYS          fc6a8000 31ec6ca1 - Cdrom.SYS
fc90a000 31ec6df7 - Fs_Rec.SYS          fc9c9000 31ec6c99 - Null.SYS
fc864000 31ed868b - KSecDD.SYS          fc9ca000 31ec6c78 - Beep.SYS
fc6d8000 31ec6c90 - i8042prt.sys        fc86c000 31ec6c97 - mouclass.sys
fc874000 31ec6c94 - kbdclass.sys        fc6f0000 31f50722 - VIDEOPORT.SYS
feffa000 31ec6c62 - mga_mil.sys         fc890000 31ec6c6d - vga.sys
fc708000 31ec6ccb - Msfs.SYS            fc4b0000 31ec6cc7 - Npfs.SYS
fefbc000 31eed262 - NDIS.SYS            a0000000 31f954f7 - win32k.sys
fefa4000 31f                                                 .SYS
feb8c000 31e
feacf000 31f                                                 ys
fc550000 316
fc718000 31e                                                 .sys
fc870000 31e                                                 SYS
fc5b0000 31e
fea3b000 31f

Address  dwo
fec32d84 801                                                 SecDD.SYS
801471c8 801                                                 toskrnl.exe
801471dc 801                                                 toskrnl.exe
80147304 803                                                 toskrnl.exe

Restart and set the recovery options in the system control panel
or the /CRASHDEBUG system start option.
```

Application Error

Bluescreen has performed an illegal operation. Bluescreen must be closed.

No matter how good developer you are, you can not control everything.

```
CPUID:GenuineIntel 5.2.c irql:1f  SYSVER 0xf0000565

Dll Base DateStmp - Name                 Dll Base DateStmp - Name
80100000 3202c07e - ntoskrnl.exe         80010000 31ee6c52 - hal.dll
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fc874000 31ec6c94 - kbdclass.sys         fc6f0000 31f50722 - VIDEOPORT.SYS
feffa000 31ec6c62 - mga_mil.sys          fc890000 31ec6c6d - vga.sys
fc708000 31ec6ccb - Msfs.SYS             fc4b0000 31ec6cc7 - Npfs.SYS
fefbc000 31eed262 - NDIS.SYS             a0000000 31f954f7 - win32k.sys
fefa4000 31f                                                     .SYS
feb8c000 31e
feacf000 31f                                                    ys
fc550000 316
fc718000 31e                                                     .sys
fc870000 31e                                                    SYS
fc5b0000 31e
fea3b000 31f

Address  dwo                                                    e
fec32d84 801                                                    SecDD.SYS
801471c8 801                                                    toskrnl.exe
801471dc 801                                                    toskrnl.exe
80147304 803                                                    toskrnl.exe

Restart and set the recovery options in the system control panel
or the /CRASHDEBUG system start option.
```

Application Error

Bluescreen has performed an illegal operation. Bluescreen must be closed.

Your code must be prepared to *handle exceptional situations*

1. Exception Handling Basis

1.1 Exceptions

1.2 Try and Catch

1.3 Finally

1.1 Exceptions

Exceptions are Java run-time errors

Run-time errors (**exceptions**) are common if we do not use **exception handling** to deal with them

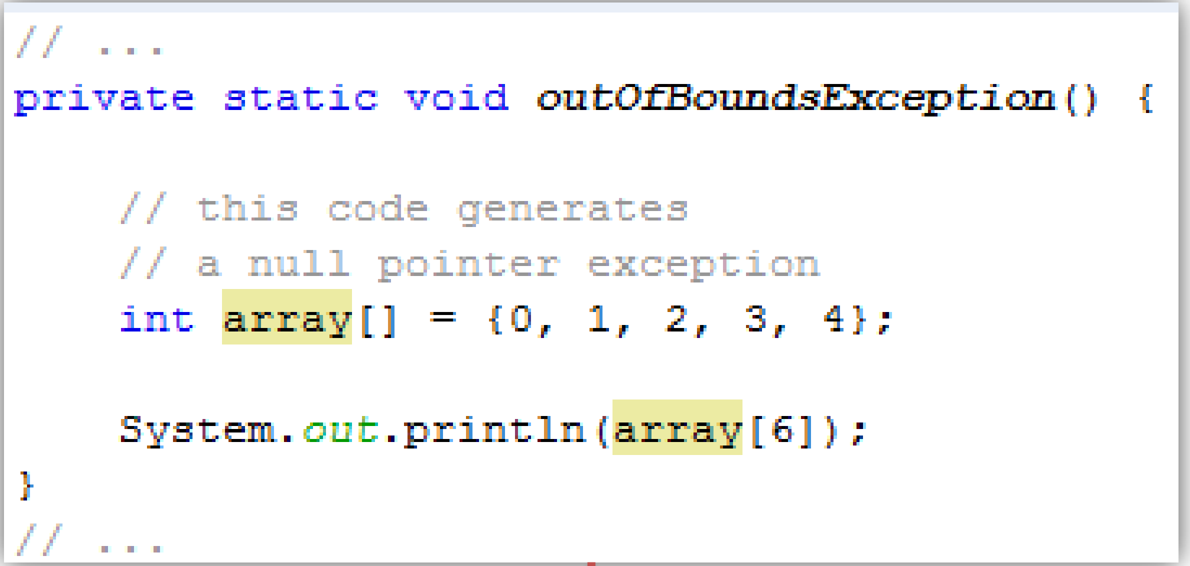
Out of bounds array access

Operate null objects

Division by zero

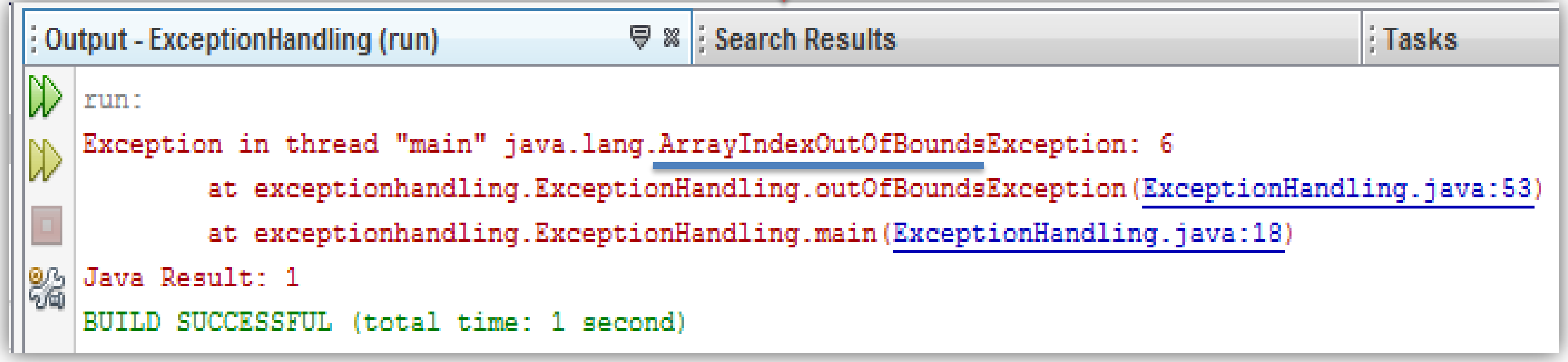
Invalid casting

Exceptions are Java run-time errors



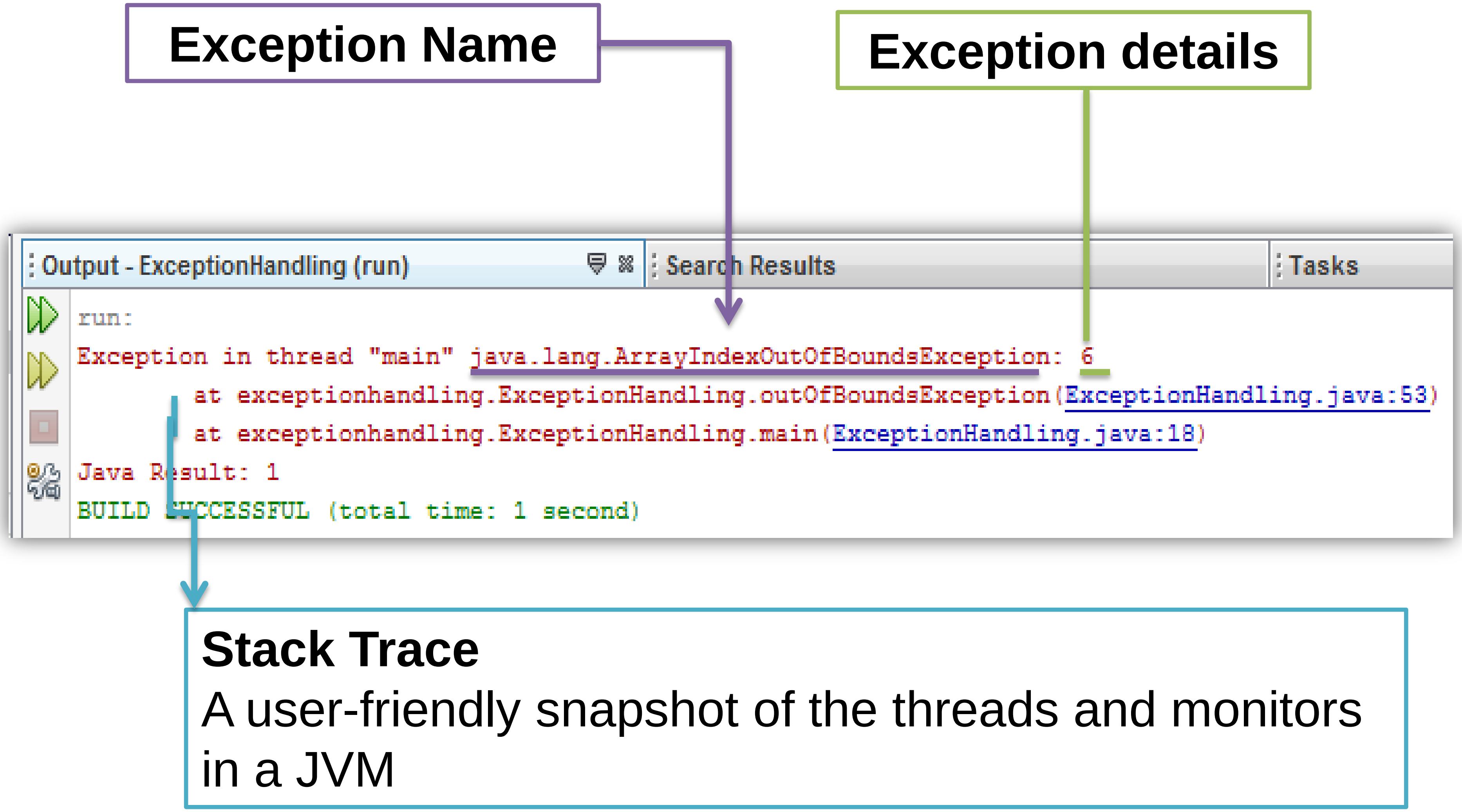
```
// ...
private static void outOfBoundsException() {

    // this code generates
    // a null pointer exception
    int array[] = {0, 1, 2, 3, 4};

    System.out.println(array[6]);
}
// ...
```

Out of bounds array access throws an Exception



```
run:
Exception in thread "main" java.lang.ArrayIndexOutOfBoundsException: 6
        at exceptionhandling.ExceptionHandling.outOfBoundsException(ExceptionHandling.java:53)
        at exceptionhandling.ExceptionHandling.main(ExceptionHandling.java:18)
Java Result: 1
BUILD SUCCESSFUL (total time: 1 second)
```

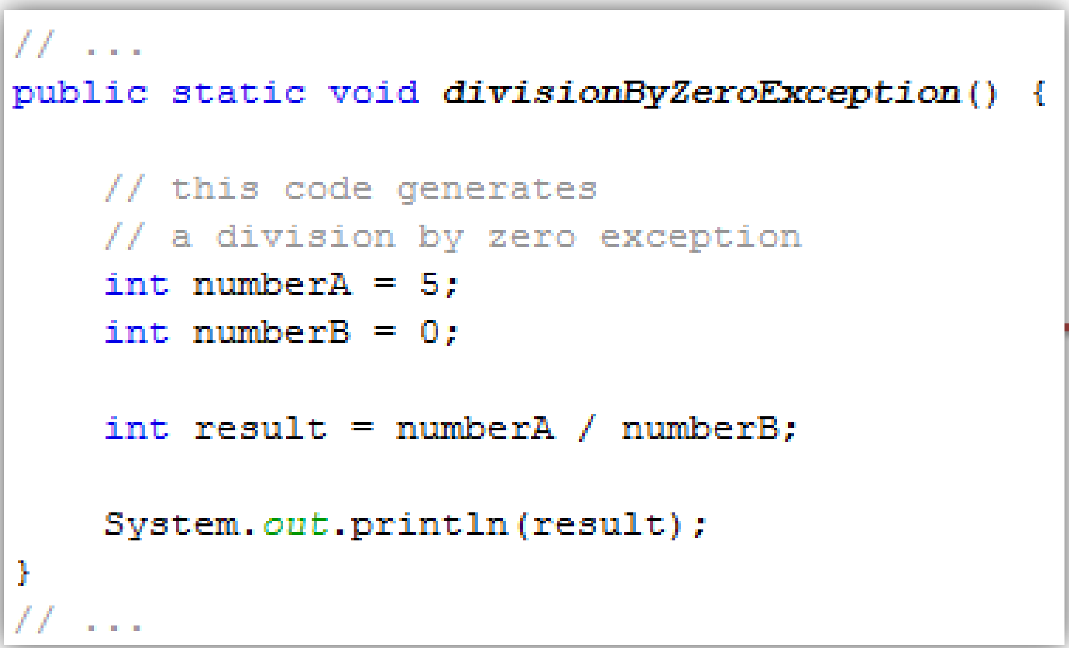
Exceptions are Java run-time errors



```
run:
Exception in thread "main" java.lang.ArrayIndexOutOfBoundsException: 6
        at exceptionhandling.ExceptionHandling.outOfBoundsException(ExceptionHandling.java:53)
        at exceptionhandling.ExceptionHandling.main(ExceptionHandling.java:18)
Java Result: 1
BUILD SUCCESSFUL (total time: 1 second)
```

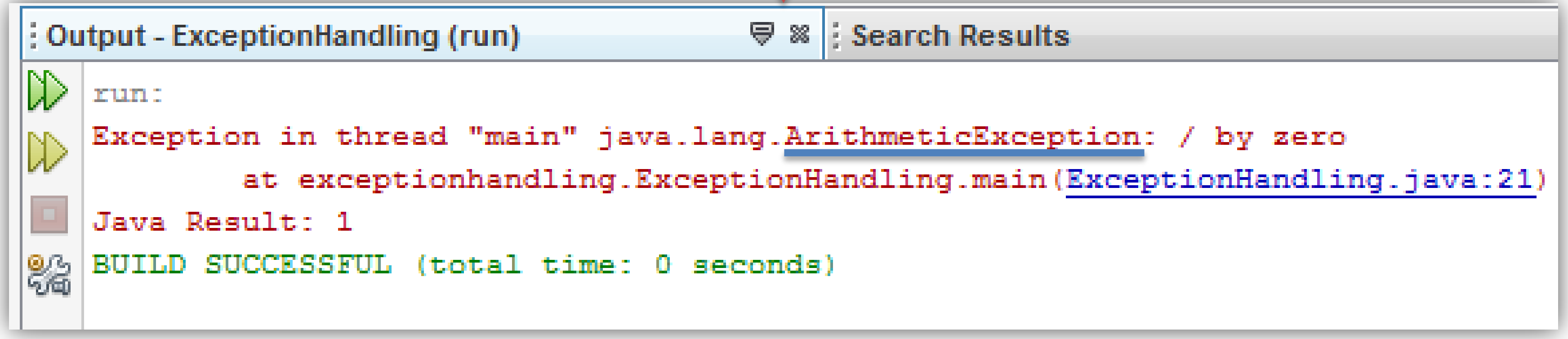
Stack Trace
A user-friendly snapshot of the threads and monitors in a JVM

Exceptions are Java run-time errors



```
// ...
public static void divisionByZeroException() {

    // this code generates
    // a division by zero exception
    int numberA = 5;
    int numberB = 0;

    int result = numberA / numberB;

    System.out.println(result);
}
// ...
```

Division by zero throws an Exception (run time error)

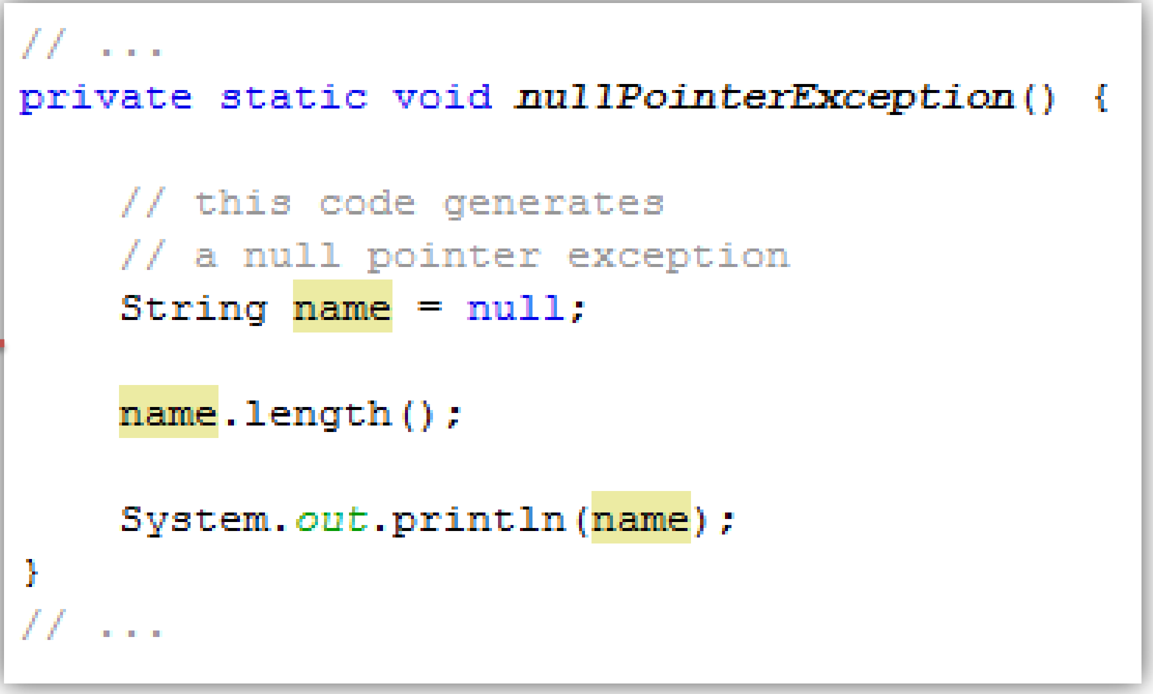


Output - ExceptionHandling (run) | Search Results

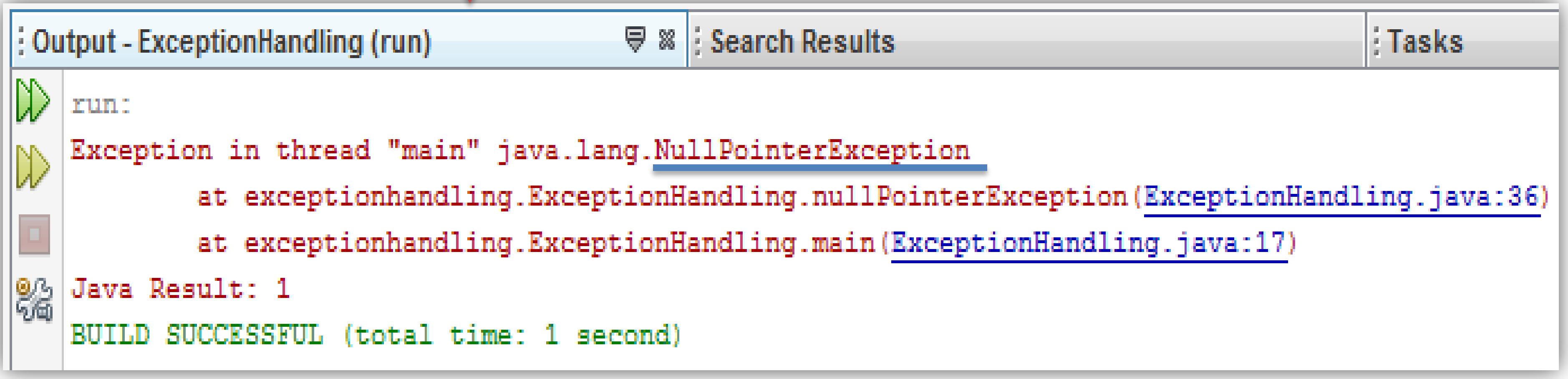
```
run:
Exception in thread "main" java.lang.ArithmeticException: / by zero
        at exceptionhandling.ExceptionHandling.main(ExceptionHandling.java:21)
Java Result: 1
BUILD SUCCESSFUL (total time: 0 seconds)
```

Exceptions are Java run-time errors

Operate null objects throws an Exception

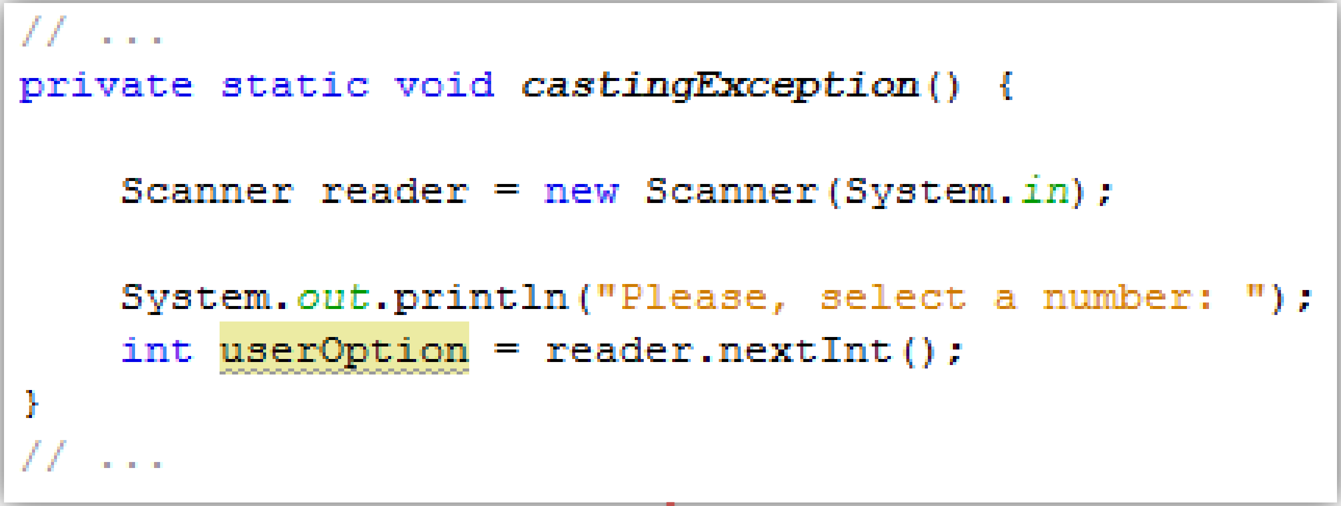


```
// ...
private static void nullPointerException() {

    // this code generates
    // a null pointer exception
    String name = null;

    name.length();

    System.out.println(name);
}
// ...
```



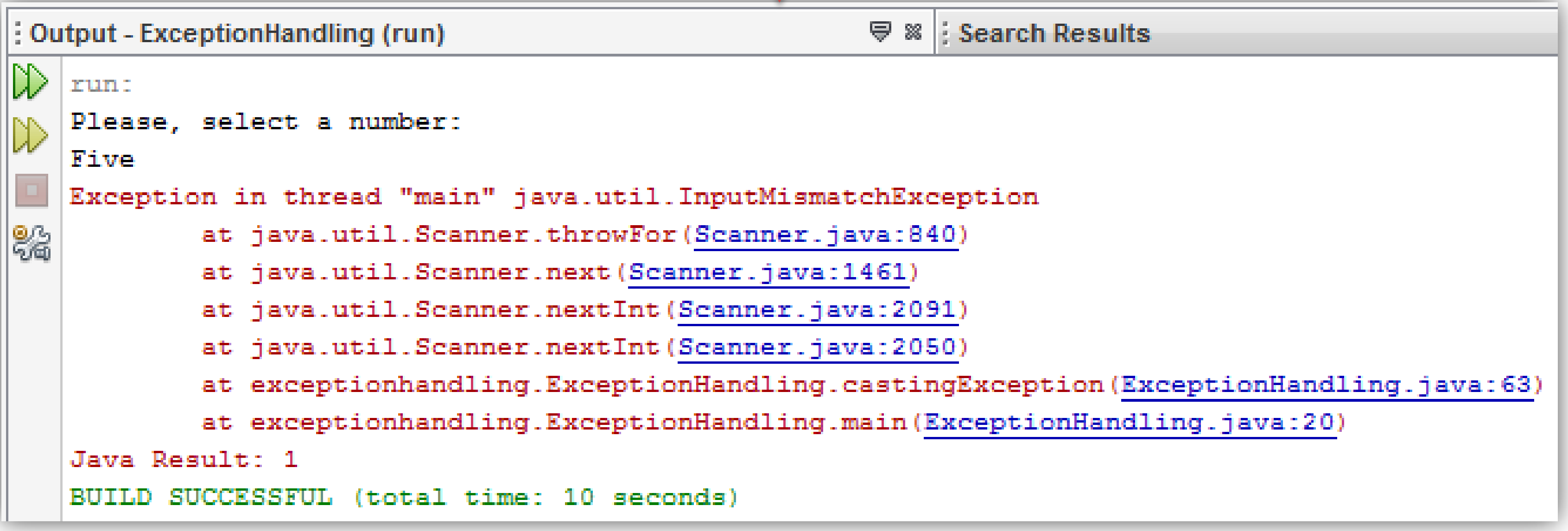
```
run:
Exception in thread "main" java.lang.NullPointerException
        at exceptionhandling.ExceptionHandling.nullPointerException(ExceptionHandling.java:36)
        at exceptionhandling.ExceptionHandling.main(ExceptionHandling.java:17)
Java Result: 1
BUILD SUCCESSFUL (total time: 1 second)
```

Exceptions are Java run-time errors



```
// ...
private static void castingException() {

    Scanner reader = new Scanner(System.in);

    System.out.println("Please, select a number: ");
    int userOption = reader.nextInt();
}
// ...
```

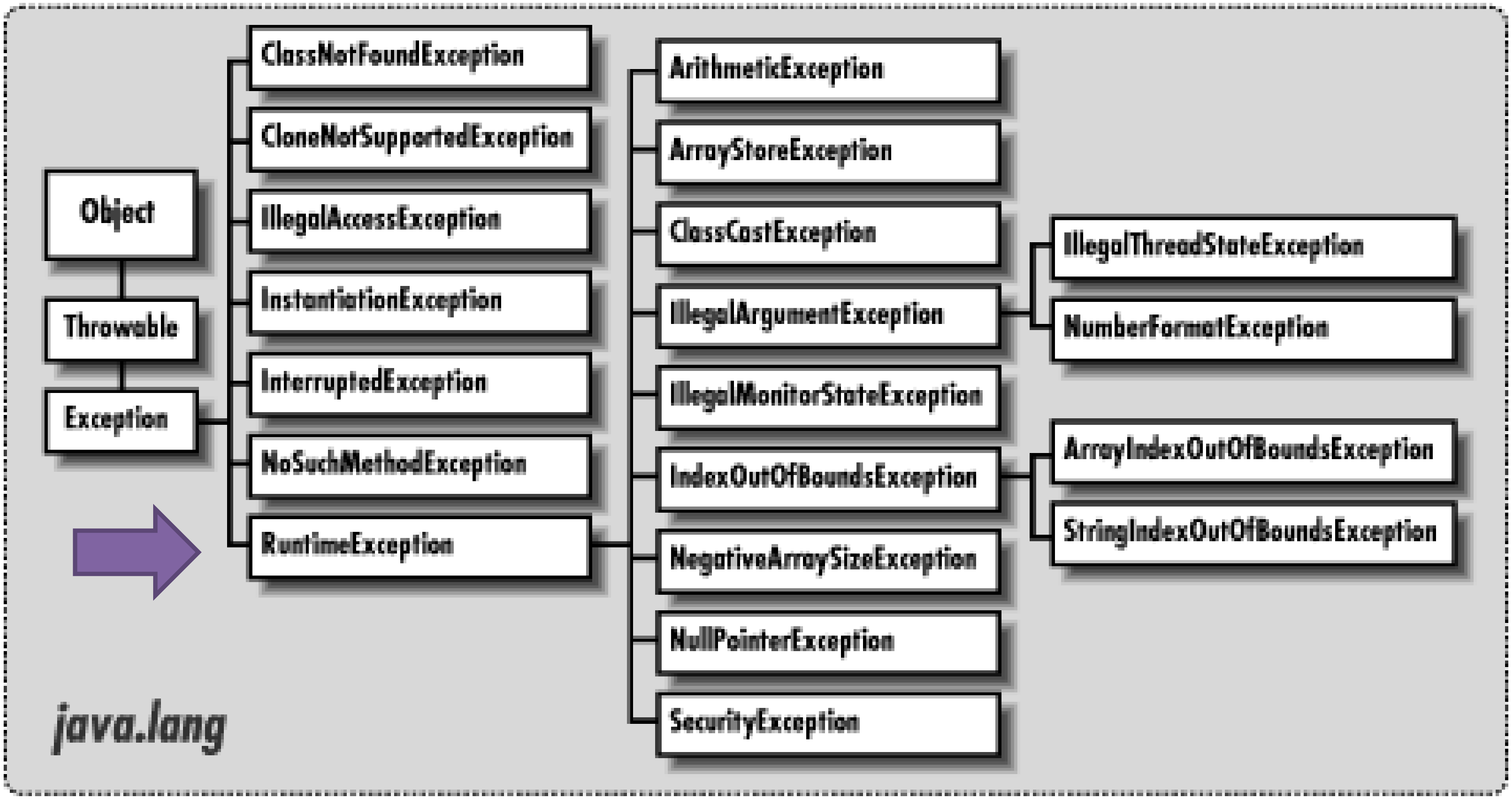
Invalid casting throws an Exception



Output - ExceptionHandling (run)   Search Results

```
run:
Please, select a number:
Five
Exception in thread "main" java.util.InputMismatchException
        at java.util.Scanner.throwFor(Scanner.java:840)
        at java.util.Scanner.next(Scanner.java:1461)
        at java.util.Scanner.nextInt(Scanner.java:2091)
        at java.util.Scanner.nextInt(Scanner.java:2050)
        at exceptionhandling.ExceptionHandling.castingException(ExceptionHandling.java:63)
        at exceptionhandling.ExceptionHandling.main(ExceptionHandling.java:20)
Java Result: 1
BUILD SUCCESSFUL (total time: 10 seconds)
```

The compiler checks for everything except RuntimeExceptions.



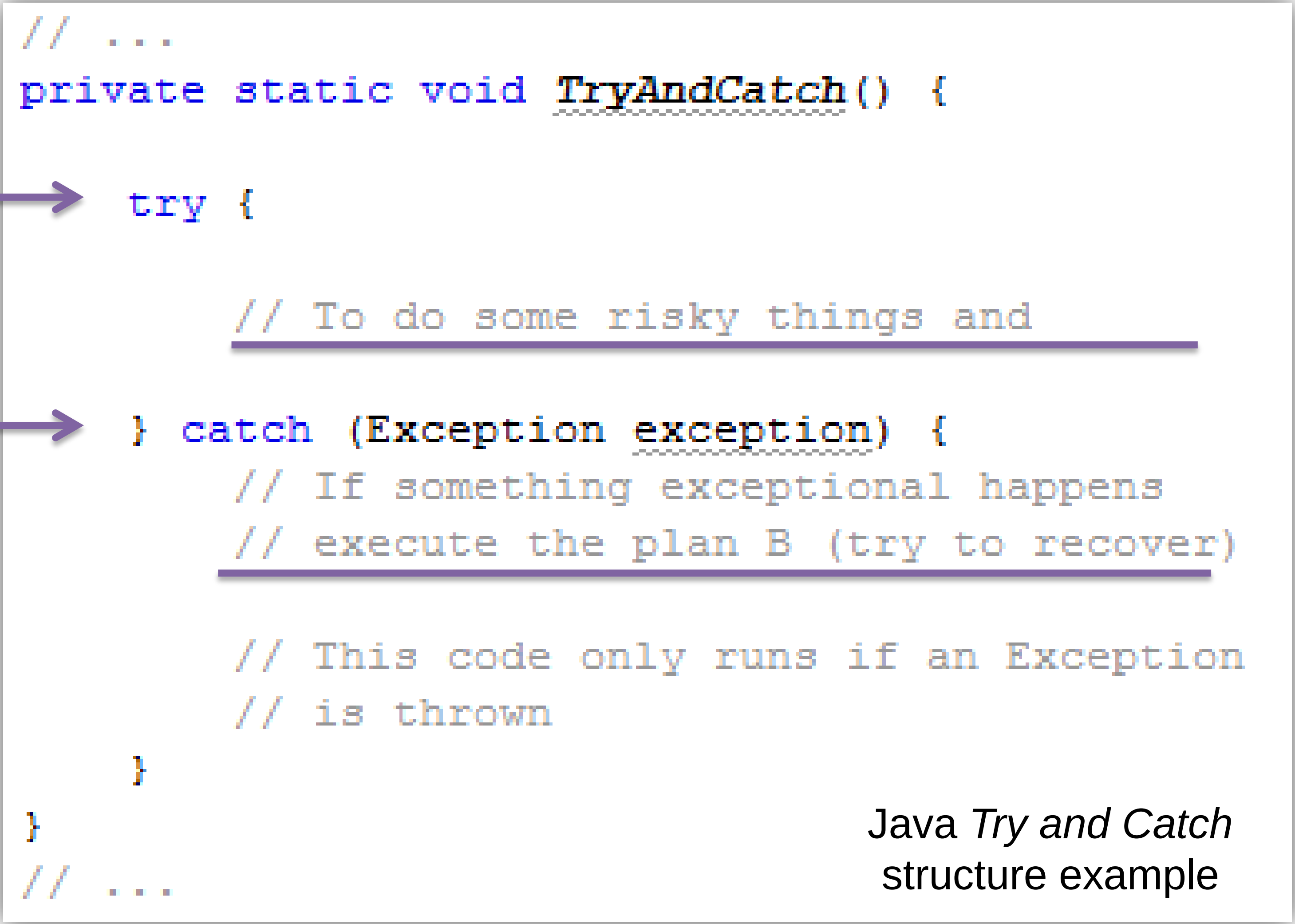
http://docstore.mik.ua/orelly/java/langref/ch09_04.htm

Exception Handling is “Plan B” to handle errors

Exception Handling allows us to be prepared for **unexpected run-time errors**

1.2 Try and Catch

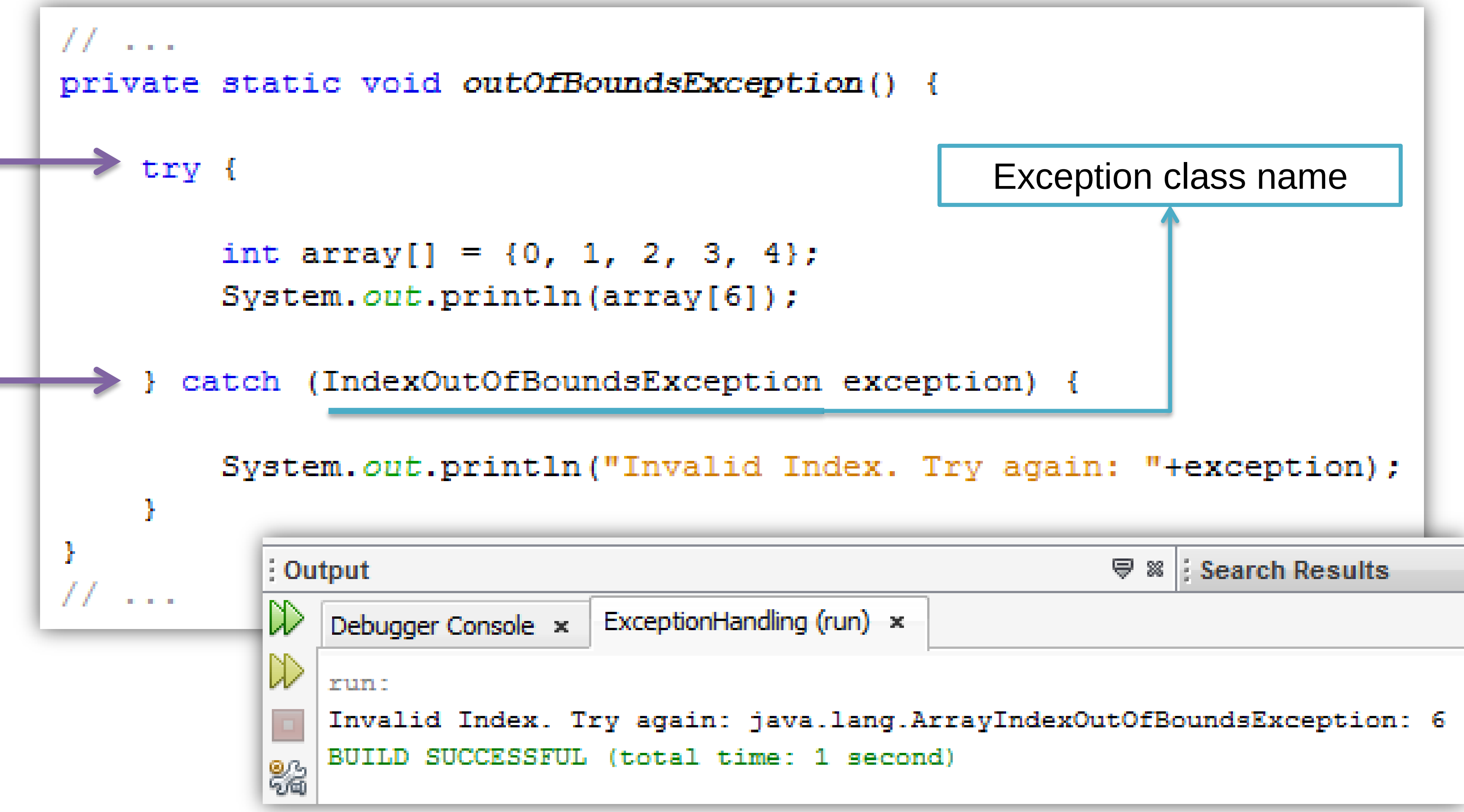
Try and catch are used to handle exceptions



```
// ...
private static void TryAndCatch() {

    try {

        // To do some risky things and

    } catch (Exception exception) {
        // If something exceptional happens
        // execute the plan B (try to recover)

        // This code only runs if an Exception
        // is thrown
    }
}
// ...
```

Java *Try and Catch* structure example

Try and catch are used to handled exceptions

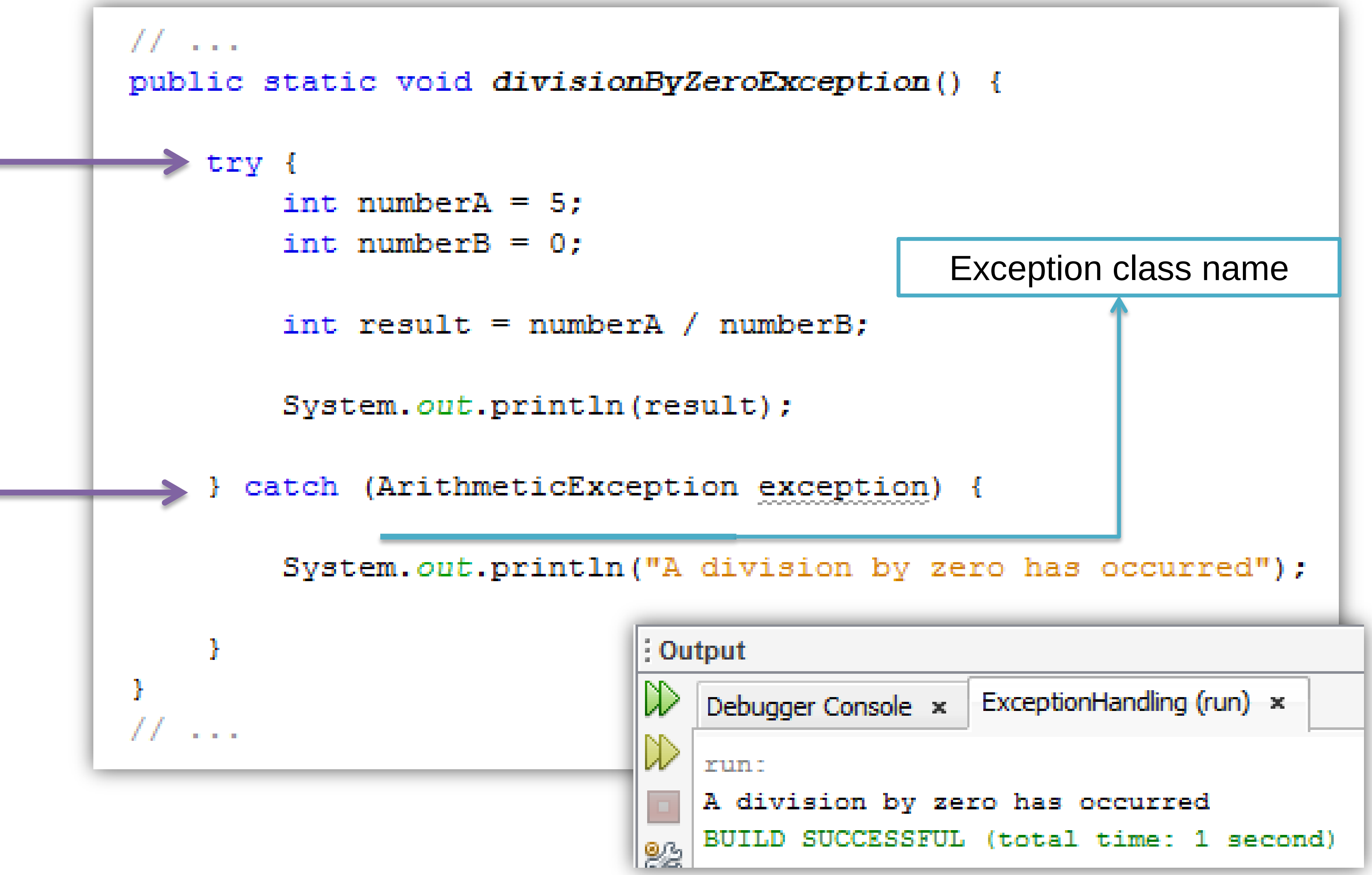


Exception class name

```
// ...
private static void outOfBoundsException() {

    try {

        int array[] = {0, 1, 2, 3, 4};
        System.out.println(array[6]);

    } catch (IndexOutOfBoundsException exception) {

        System.out.println("Invalid Index. Try again: "+exception);
    }
}
// ...
```

```
run:
Invalid Index. Try again: java.lang.ArrayIndexOutOfBoundsException: 6
BUILD SUCCESSFUL (total time: 1 second)
```

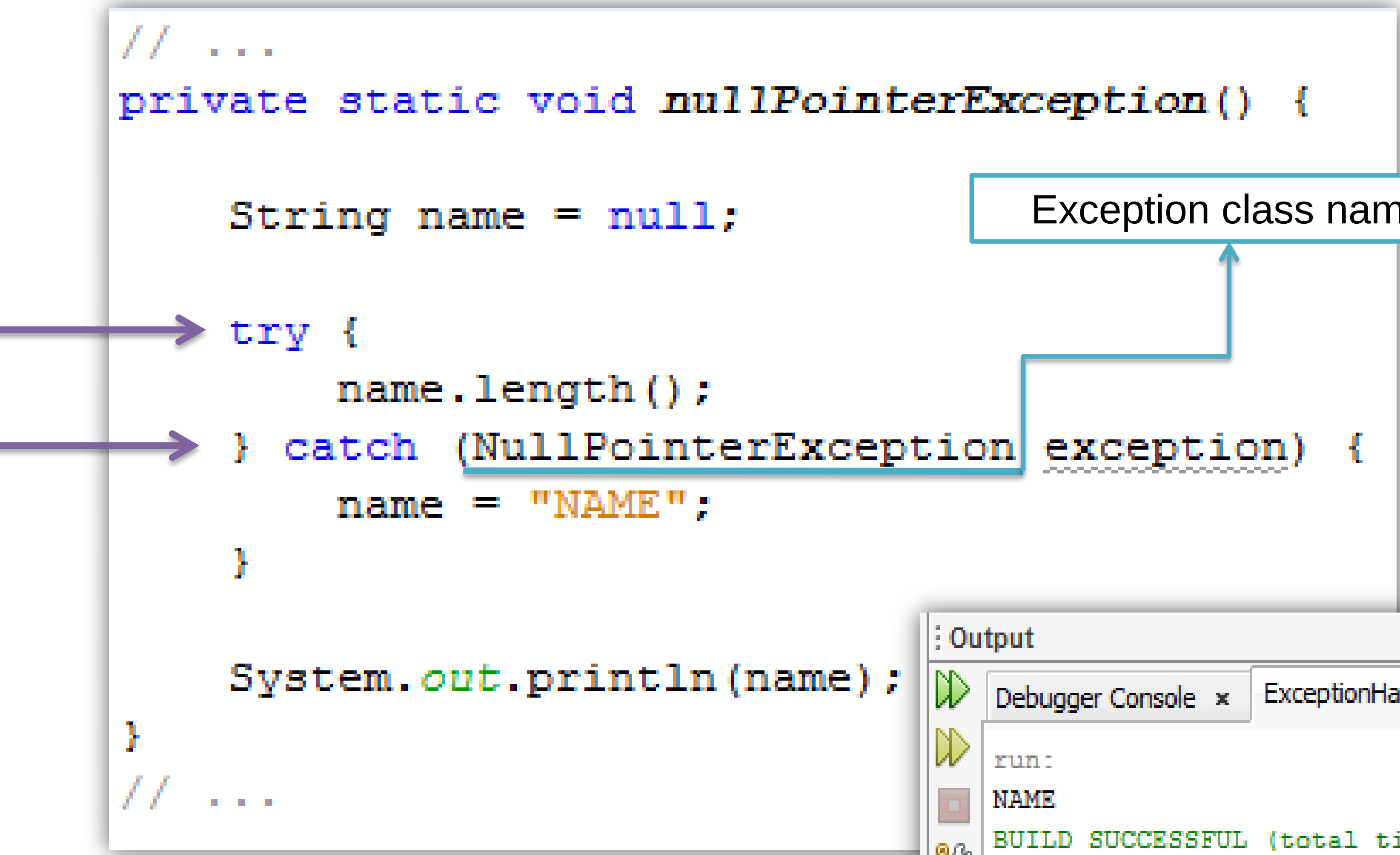
Try and catch are used to handled exceptions



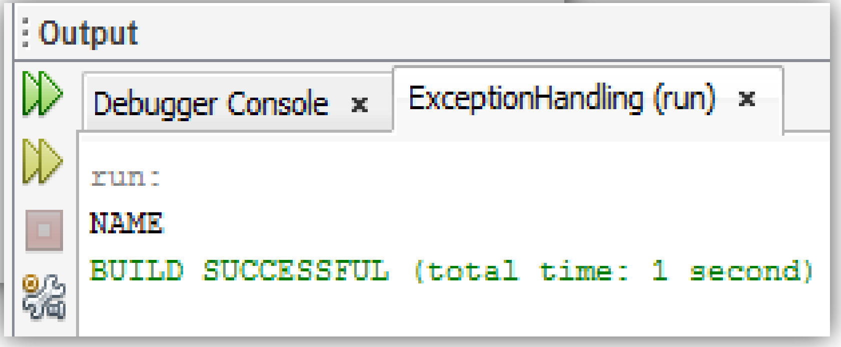
```
// ...
public static void divisionByZeroException() {

    try {
        int numberA = 5;
        int numberB = 0;

        int result = numberA / numberB;

        System.out.println(result);

    } catch (ArithmeticException exception) {

        System.out.println("A division by zero has occurred");

    }
}
// ...
```

```
run:
A division by zero has occurred
BUILD SUCCESSFUL (total time: 1 second)
```

Try and catch are used to handled exceptions

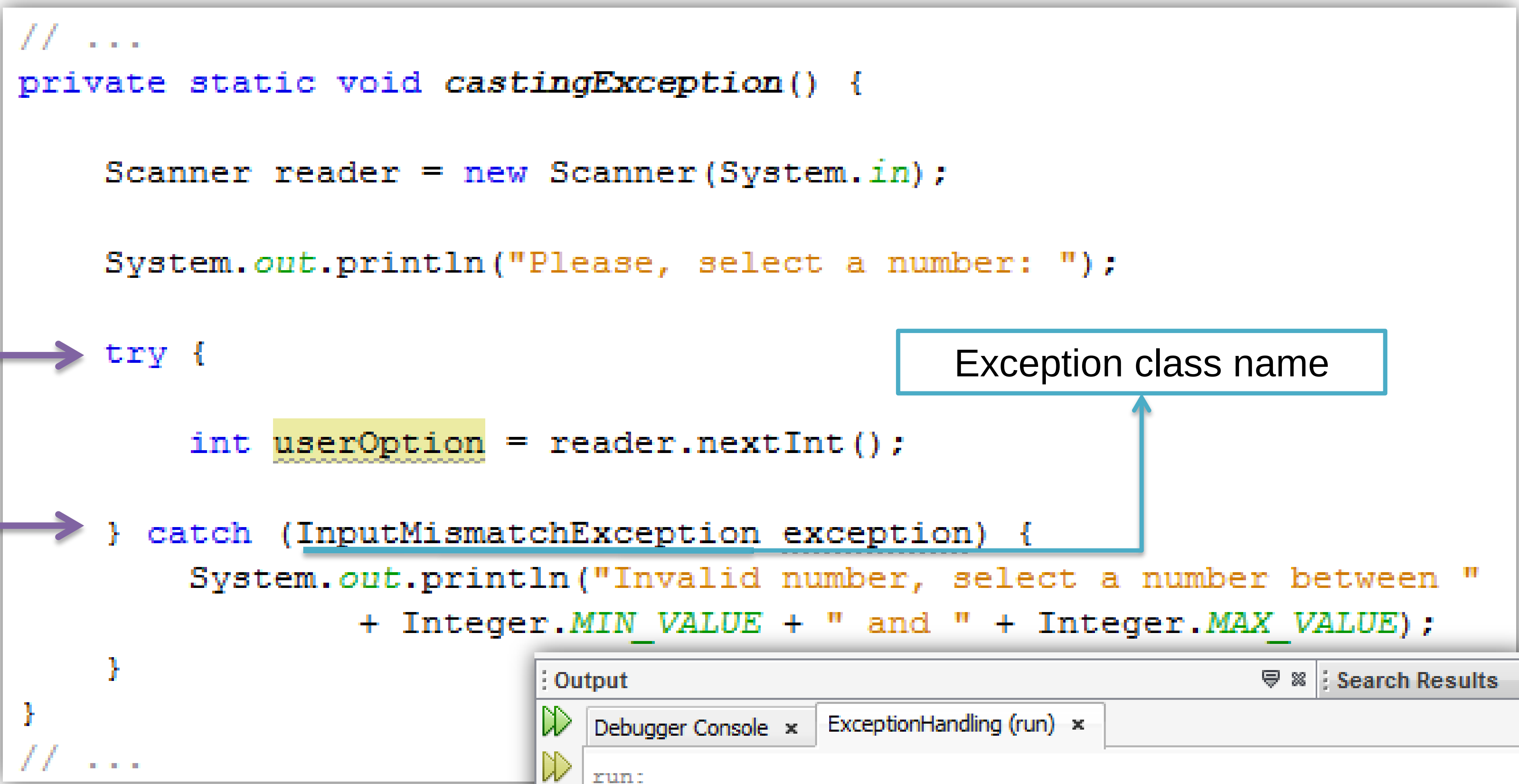


```
// ...
private static void nullPointerException() {

    String name = null;

    try {
        name.length();
    } catch (NullPointerException exception) {
        name = "NAME";
    }

    System.out.println(name);
}
// ...
```

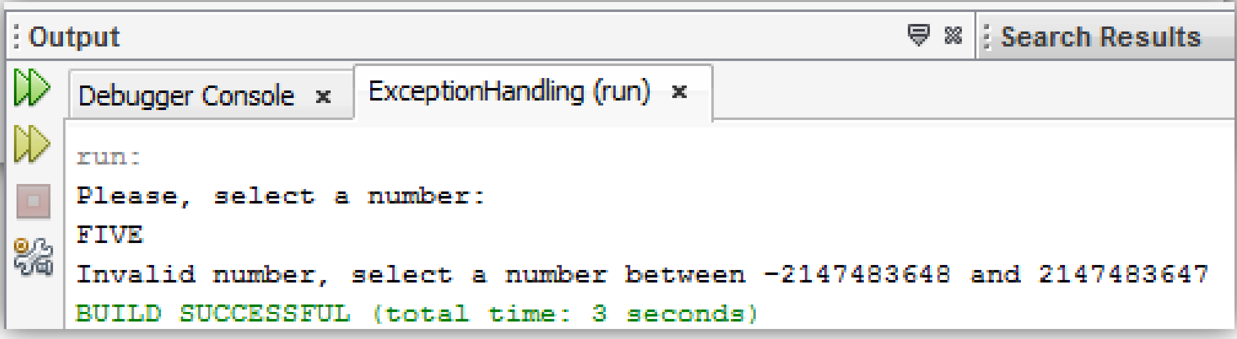


```
run:
NAME
BUILD SUCCESSFUL (total time: 1 second)
```

Try and catch are used to handled exceptions

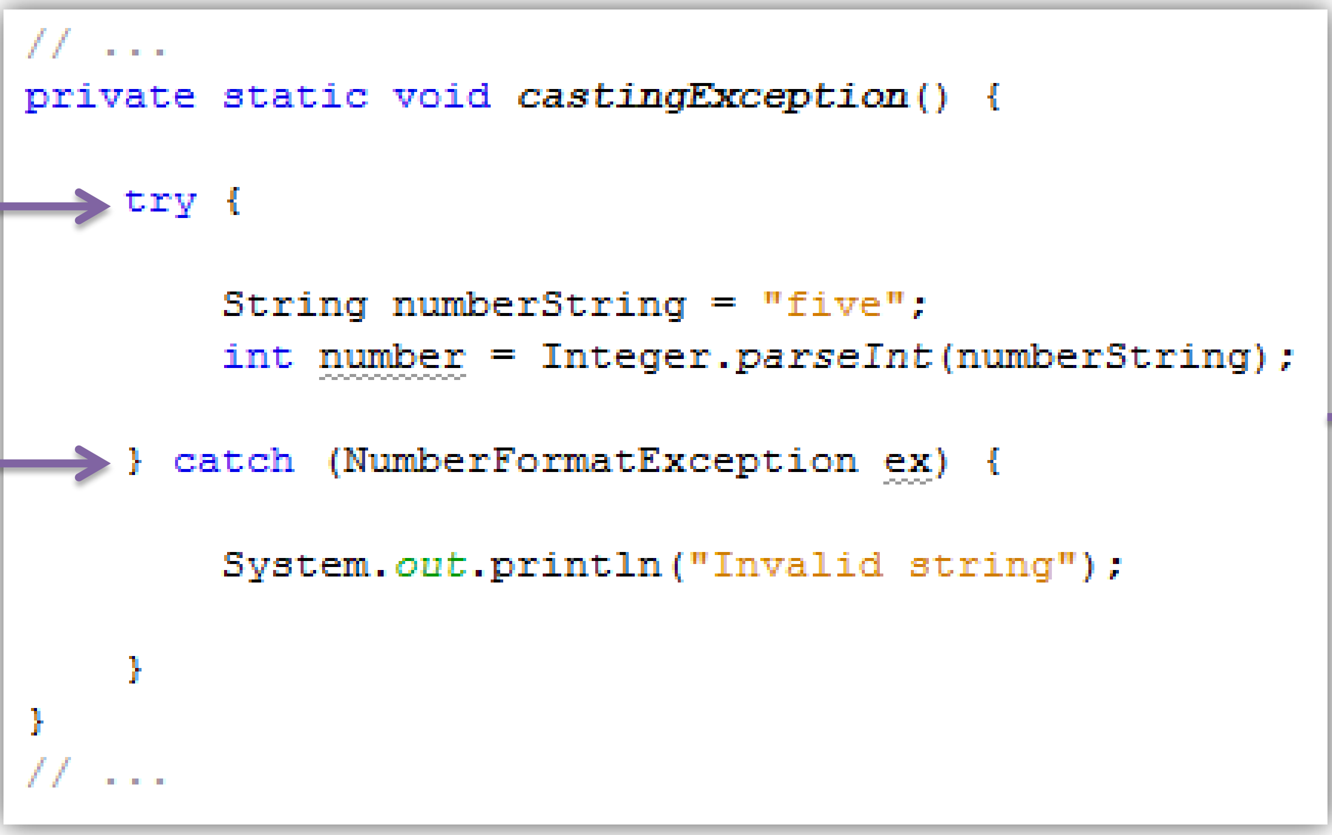


```
// ...
private static void castingException() {

    Scanner reader = new Scanner(System.in);

    System.out.println("Please, select a number: ");

    try {

        int userOption = reader.nextInt();

    } catch (InputMismatchException exception) {
        System.out.println("Invalid number, select a number between "
                + Integer.MIN_VALUE + " and " + Integer.MAX_VALUE);
    }
}
// ...
```



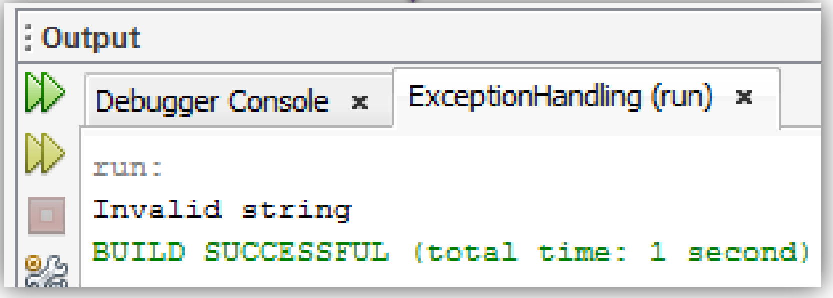
```
run:
Please, select a number:
FIVE
Invalid number, select a number between -2147483648 and 2147483647
BUILD SUCCESSFUL (total time: 3 seconds)
```

Try and catch are used to handled exceptions



```
// ...
private static void castingException() {

    try {

        String numberString = "five";
        int number = Integer.parseInt(numberString);

    } catch (NumberFormatException ex) {

        System.out.println("Invalid string");

    }
}
// ...
```

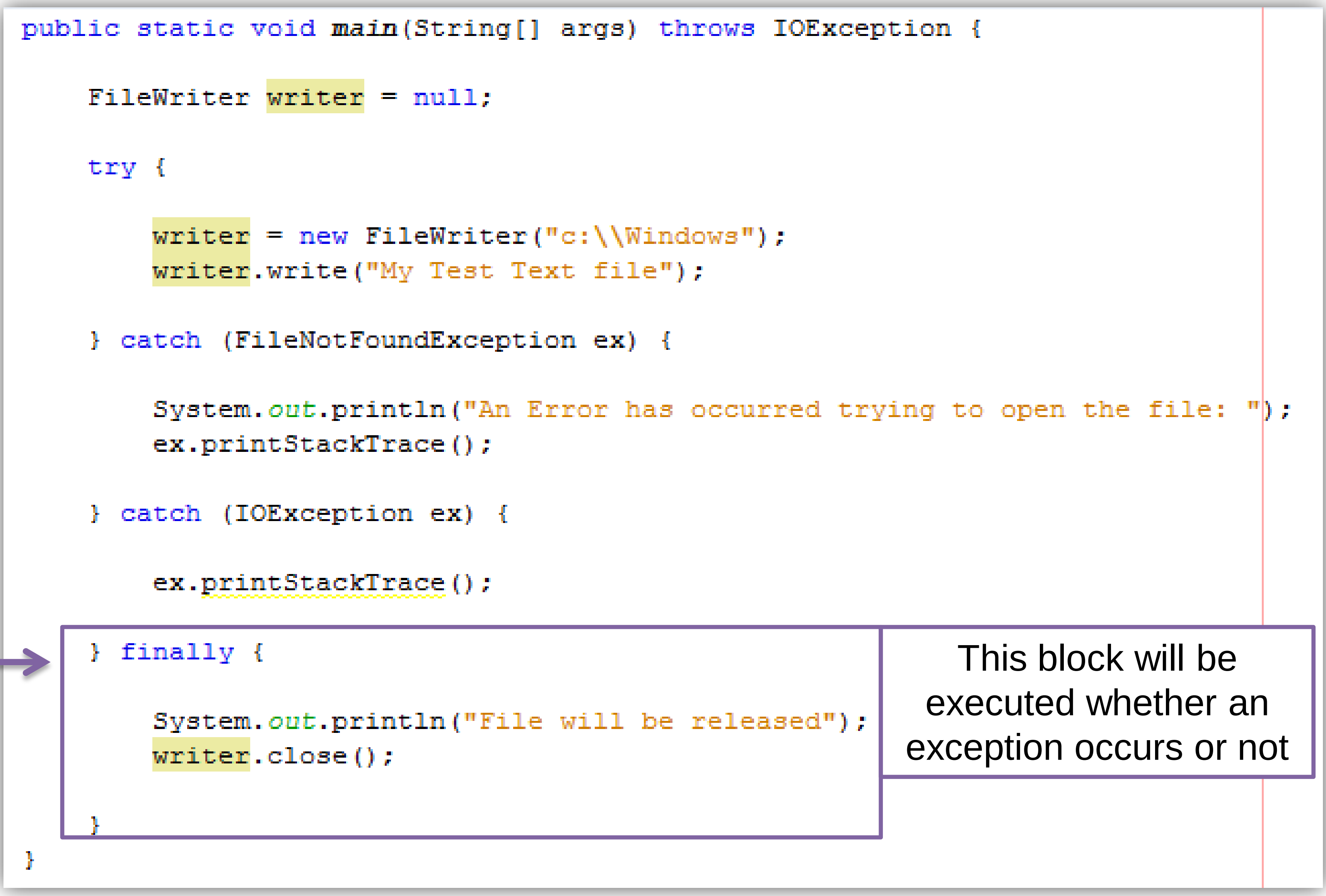
Invalid casting throws an Exception



```
run:
Invalid string
BUILD SUCCESSFUL (total time: 1 second)
```

1.3 Finally

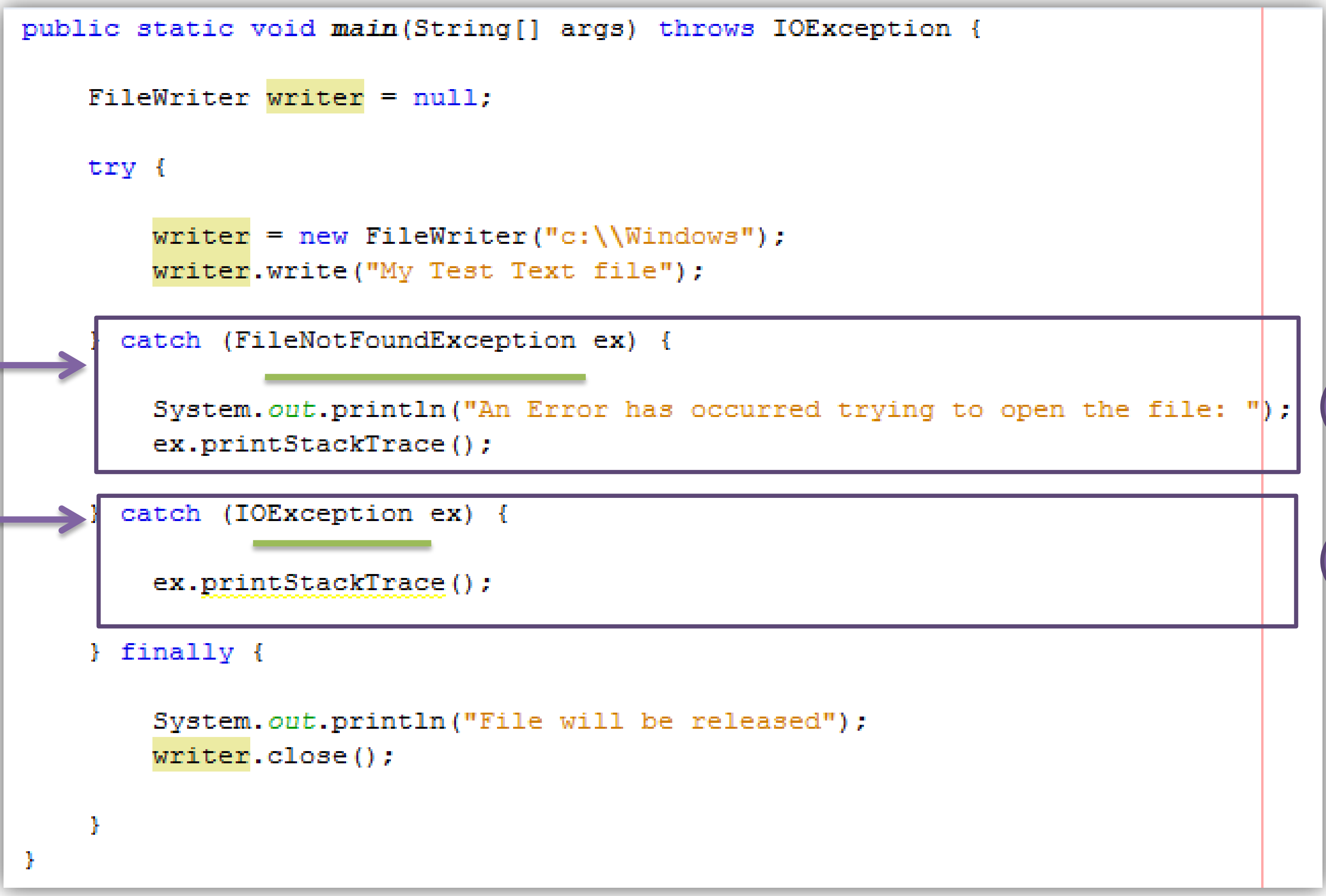
Finally block is used to do things no matter what happen



```
public static void main(String[] args) throws IOException {

    FileWriter writer = null;

    try {

        writer = new FileWriter("c:\\Windows");
        writer.write("My Test Text file");

    } catch (FileNotFoundException ex) {

        System.out.println("An Error has occurred trying to open the file: ");
        ex.printStackTrace();

    } catch (IOException ex) {

        ex.printStackTrace();

    } finally {

        System.out.println("File will be released");
        writer.close();

    }
}
```

This block will be executed whether an exception occurs or not

It is possible to handle to different Exceptions



```
public static void main(String[] args) throws IOException {

    FileWriter writer = null;

    try {

        writer = new FileWriter("c:\\Windows");
        writer.write("My Test Text file");

    } catch (FileNotFoundException ex) {

        System.out.println("An Error has occurred trying to open the file: ");
        ex.printStackTrace();

    } catch (IOException ex) {

        ex.printStackTrace();

    } finally {

        System.out.println("File will be released");
        writer.close();

    }
}
```

1

2

2. Exception Handling Flow

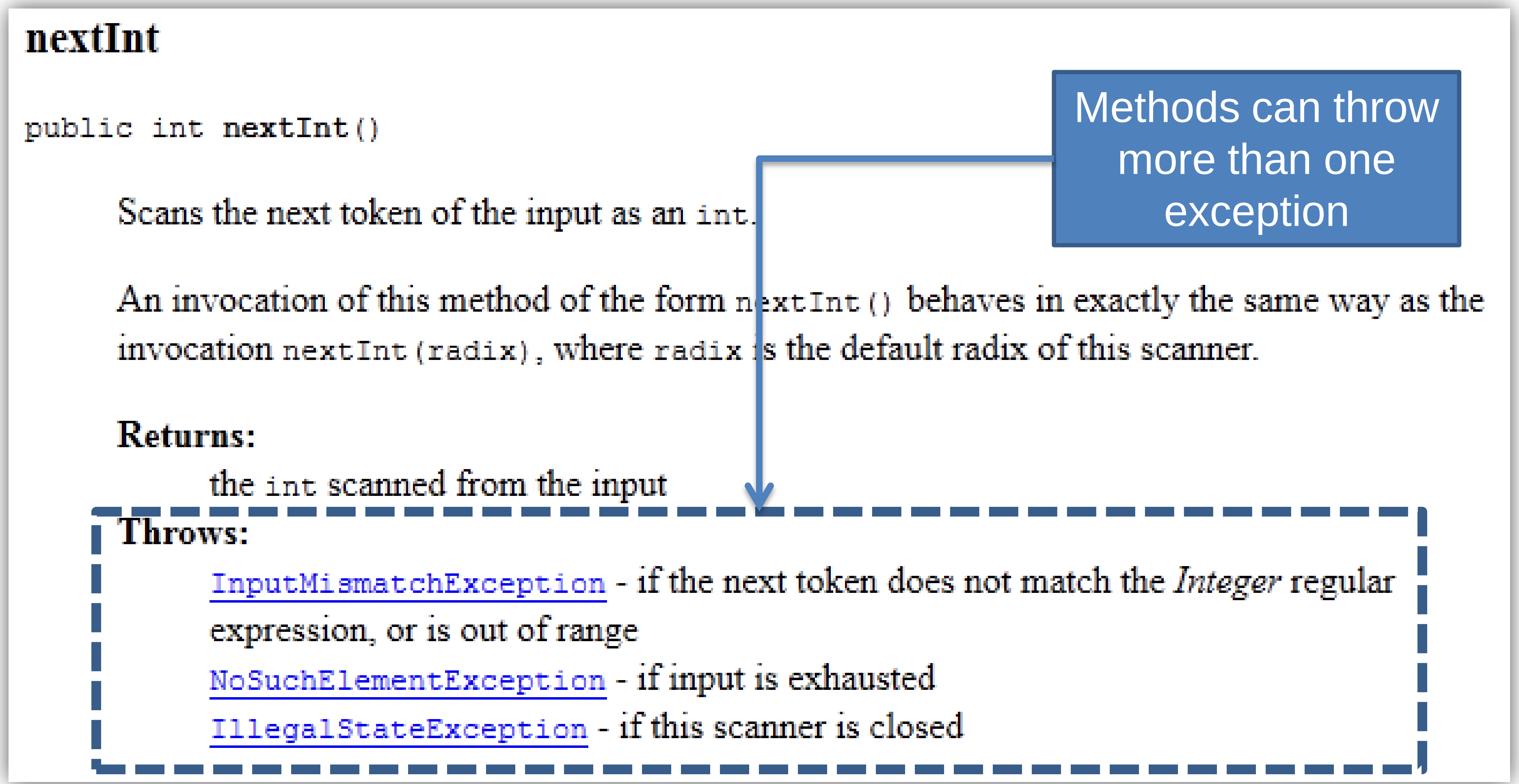
2.1 Who throws exceptions?

2.2 Exception handling flow

2.1 Who throws exceptions?

2.2 Exception handling flow

One method will catch what another method throws



nextInt

```
public int nextInt()
```

Scans the next token of the input as an `int`.

An invocation of this method of the form `nextInt()` behaves in exactly the same way as the invocation `nextInt(radix)`, where `radix` is the default radix of this scanner.

Returns:

the `int` scanned from the input

Throws:

`InputMismatchException` - if the next token does not match the *Integer* regular expression, or is out of range

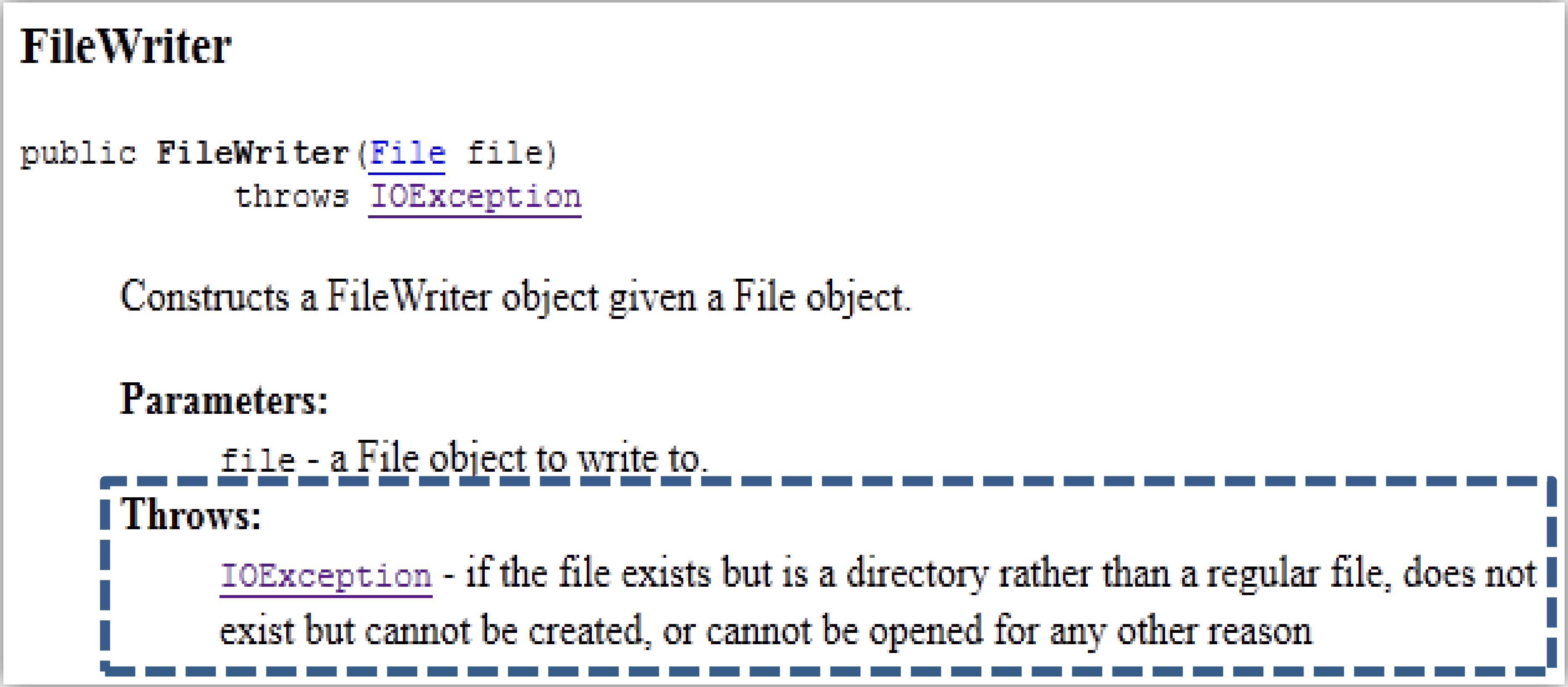
`NoSuchElementException` - if input is exhausted

`IllegalStateException` - if this scanner is closed

Methods can throw more than one exception

Class Scanner – Method nexInt

One method will catch what another method throws



FileWriter

```
public FileWriter(File file)
           throws IOException
```

Constructs a FileWriter object given a File object.

Parameters:

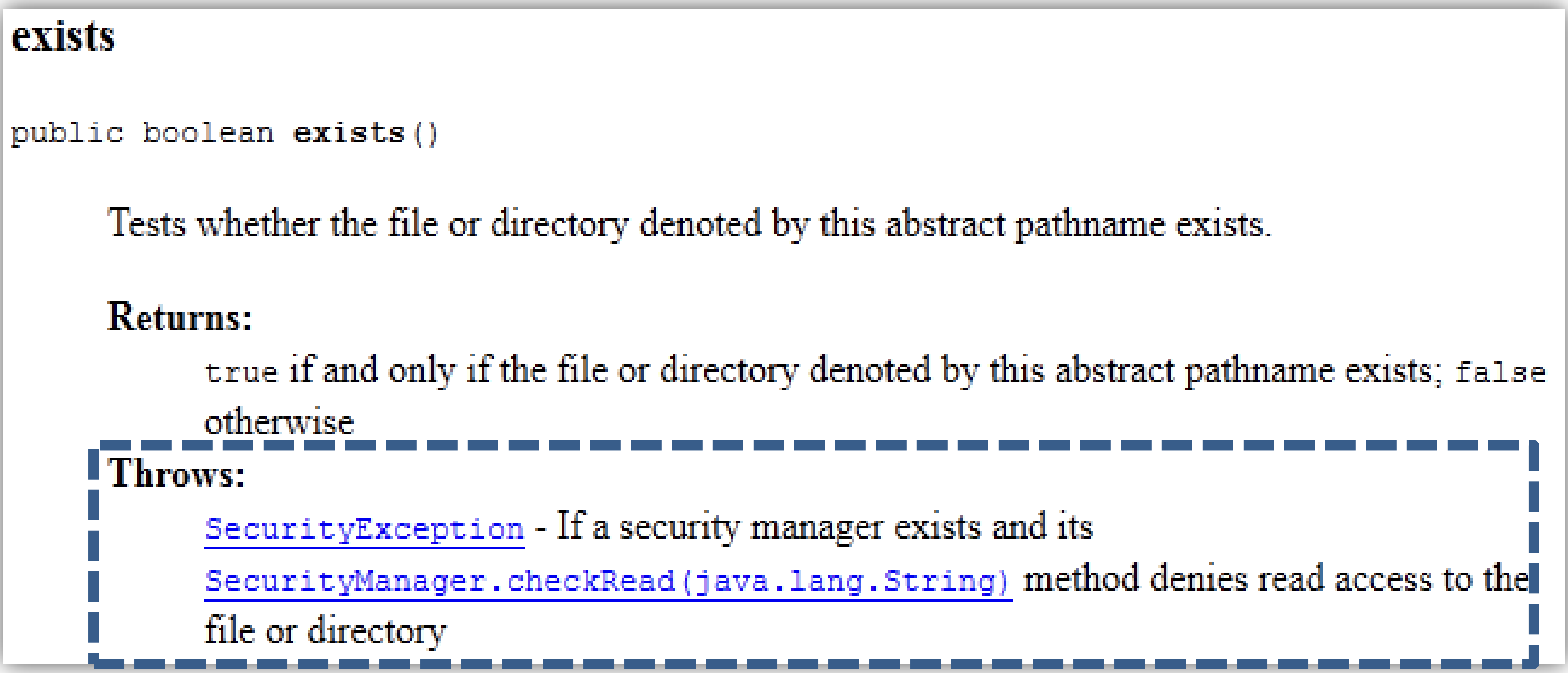
`file` - a File object to write to.

Throws:

`IOException` - if the file exists but is a directory rather than a regular file, does not exist but cannot be created, or cannot be opened for any other reason

Class FileWritter – Constructor FileWriter(File)

One method will catch what another method throws


exists

```
public boolean exists()
```

Tests whether the file or directory denoted by this abstract pathname exists.

Returns:

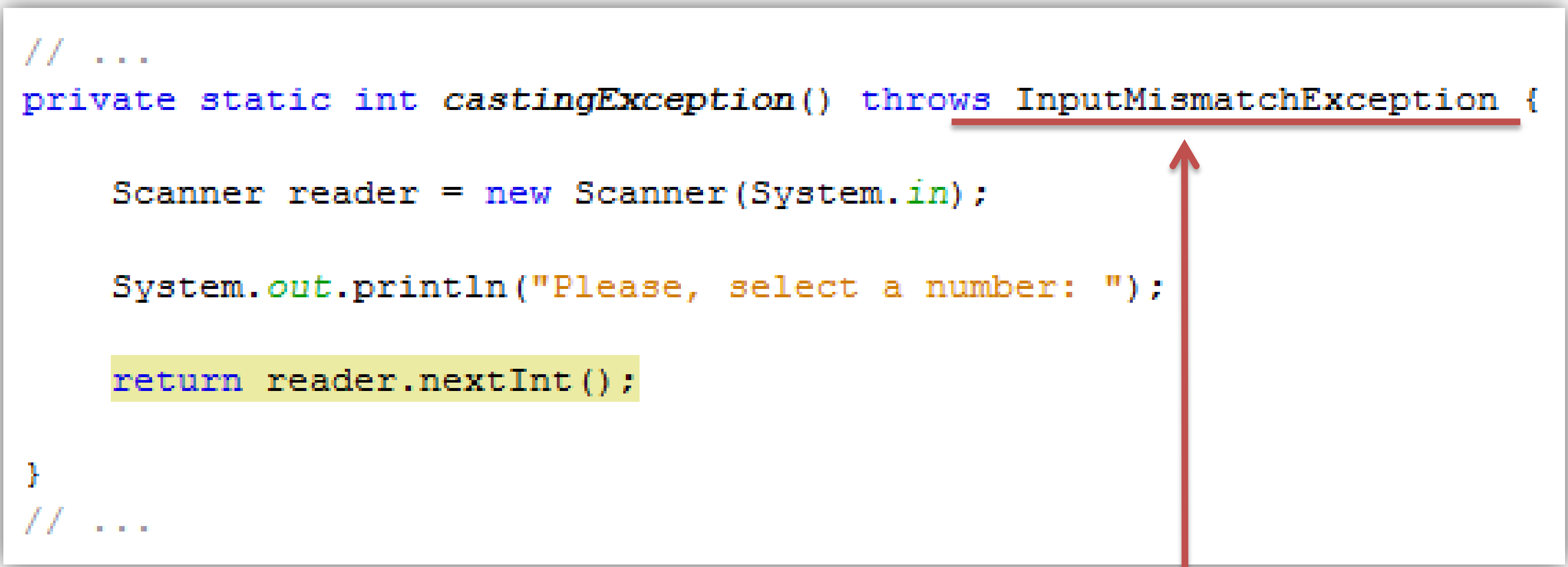
`true` if and only if the file or directory denoted by this abstract pathname exists; `false` otherwise

Throws:

`SecurityException` - If a security manager exists and its `SecurityManager.checkRead(java.lang.String)` method denies read access to the file or directory

Class File – method exists

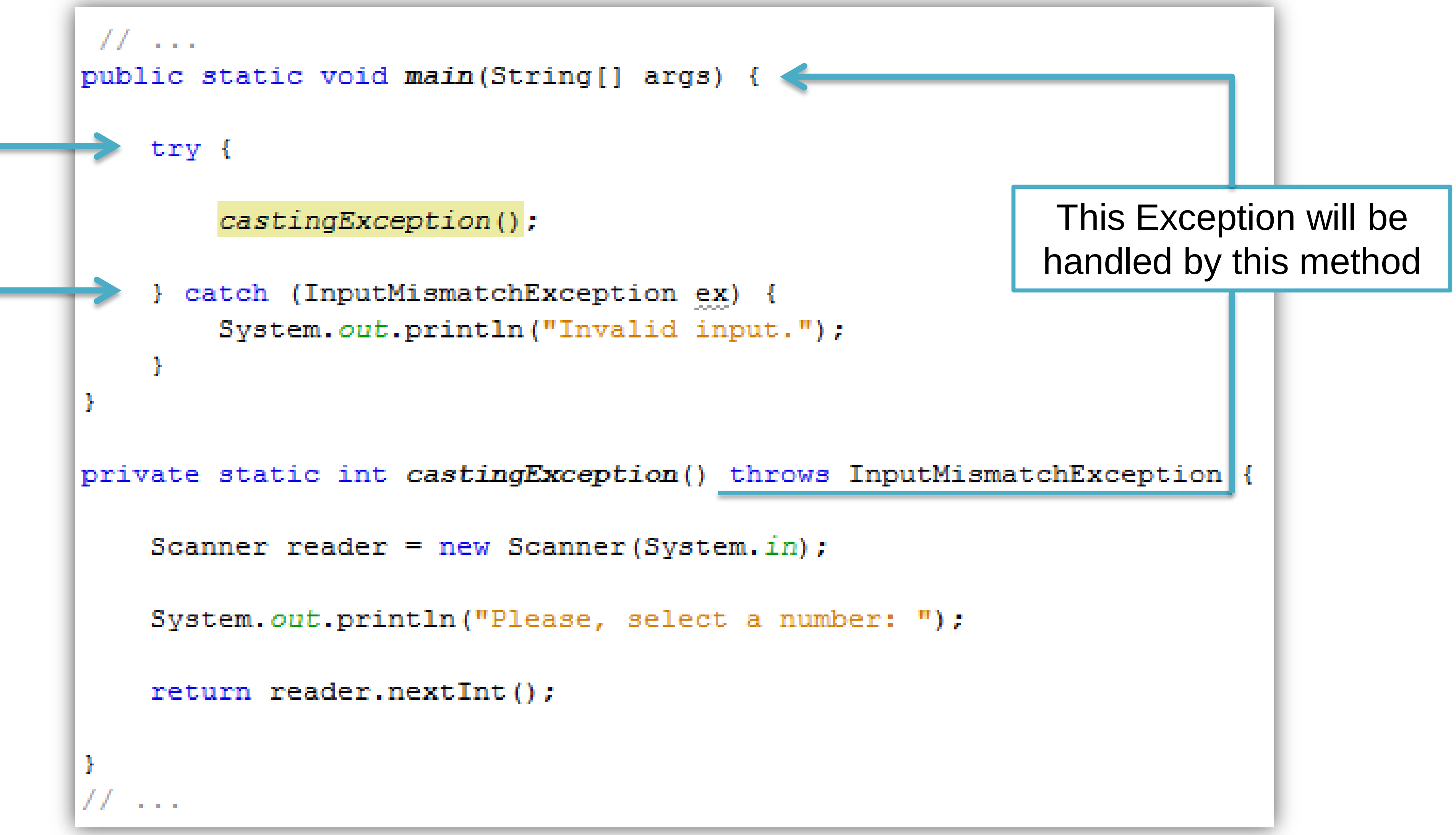
Exceptions can be thrown by user defined methods



```
// ...
private static int castingException() throws InputMismatchException {

    Scanner reader = new Scanner(System.in);

    System.out.println("Please, select a number: ");

    return reader.nextInt();

}
// ...
```

This Exception will not be handled by this method

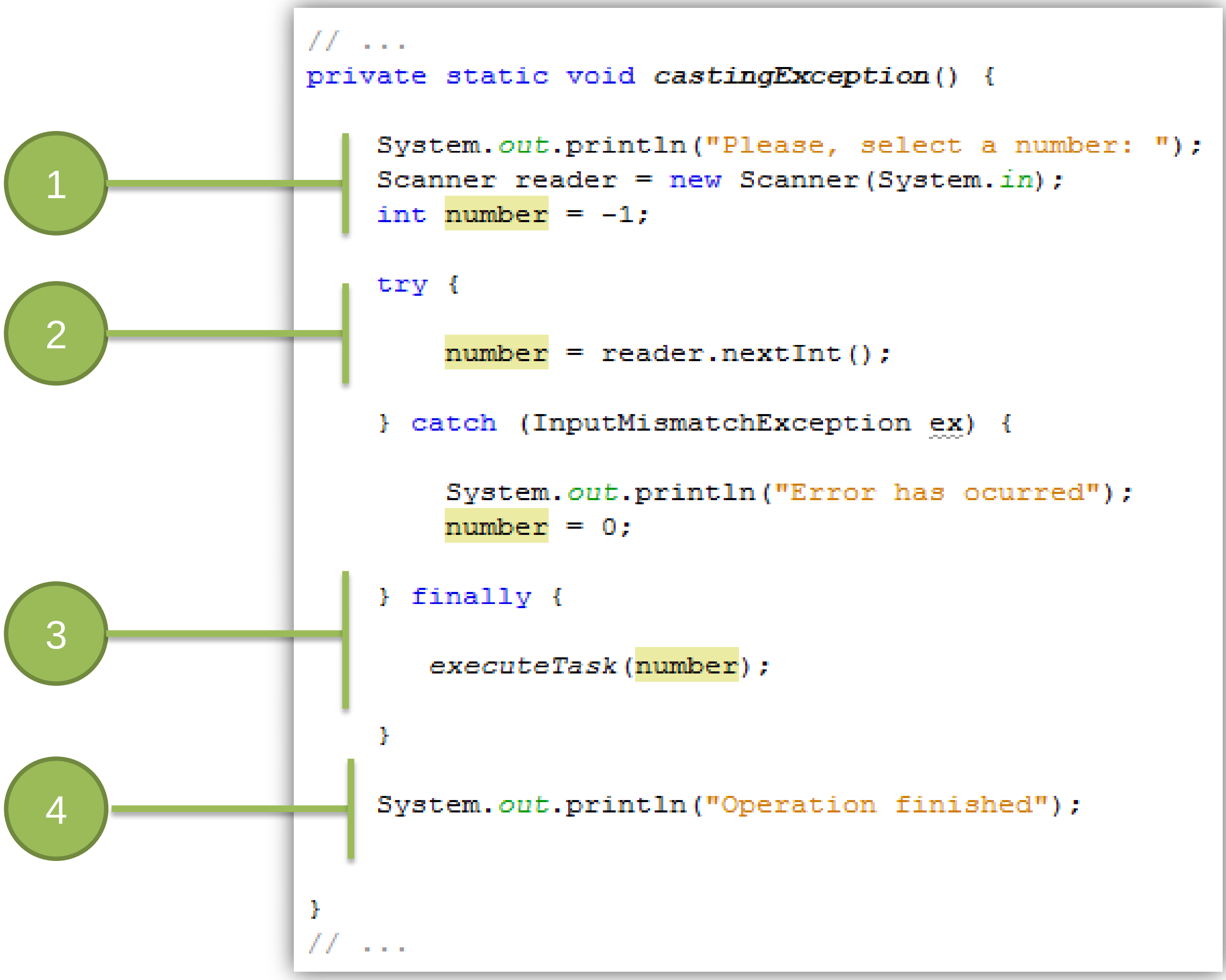
Exceptions can be thrown by user defined methods



```
 // ...
public static void main(String[] args) {

    try {

        castingException();

    } catch (InputMismatchException ex) {
        System.out.println("Invalid input.");
    }
}

private static int castingException() throws InputMismatchException {

    Scanner reader = new Scanner(System.in);

    System.out.println("Please, select a number: ");

    return reader.nextInt();

}
// ...
```

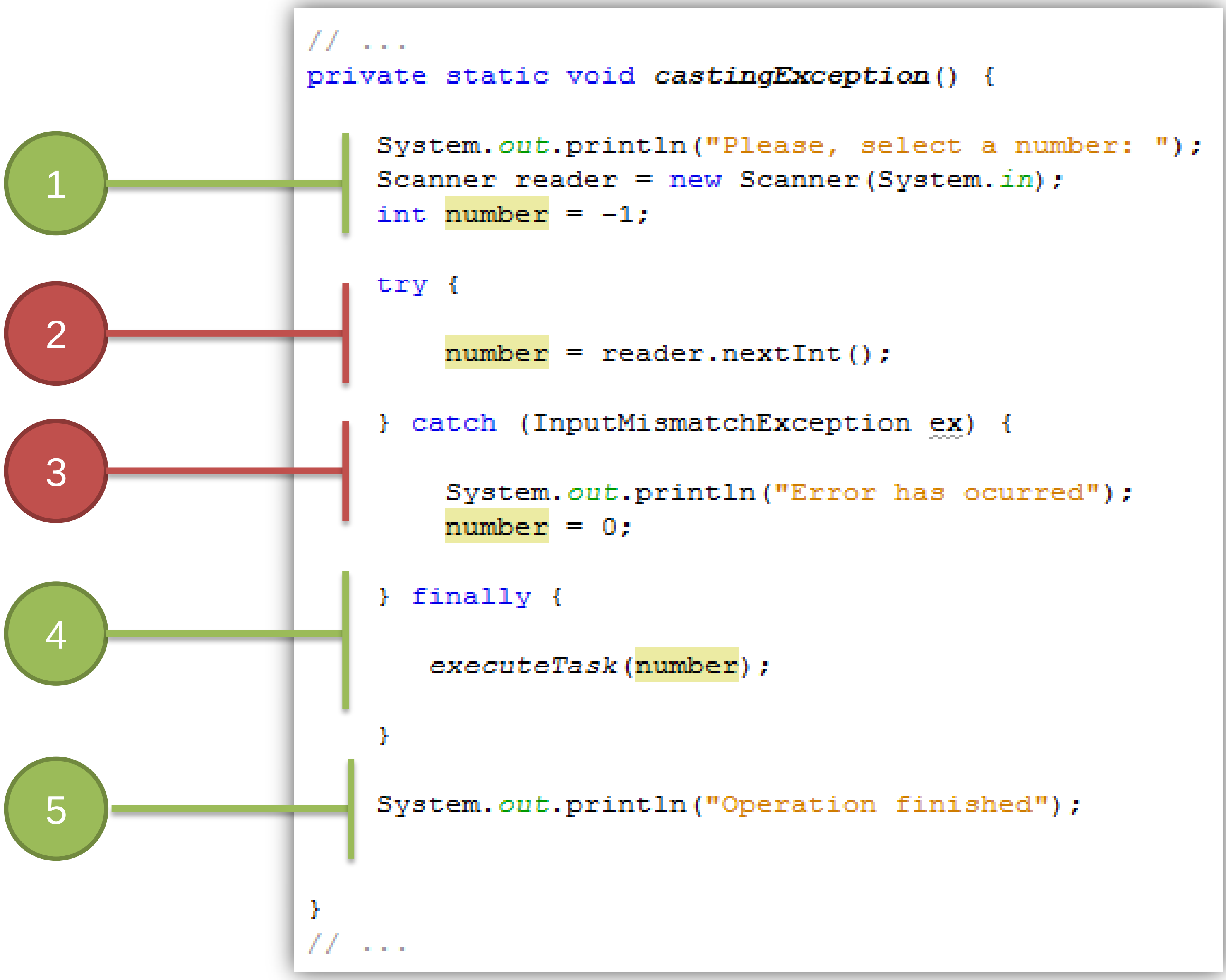
2.2 Exception handling flow

Normal Execution flow



```
// ...
private static void castingException() {

    System.out.println("Please, select a number: ");
    Scanner reader = new Scanner(System.in);
    int number = -1;

    try {

        number = reader.nextInt();

    } catch (InputMismatchException ex) {

        System.out.println("Error has ocurred");
        number = 0;

    } finally {

       executeTask(number);

    }

    System.out.println("Operation finished");


}
// ...
```

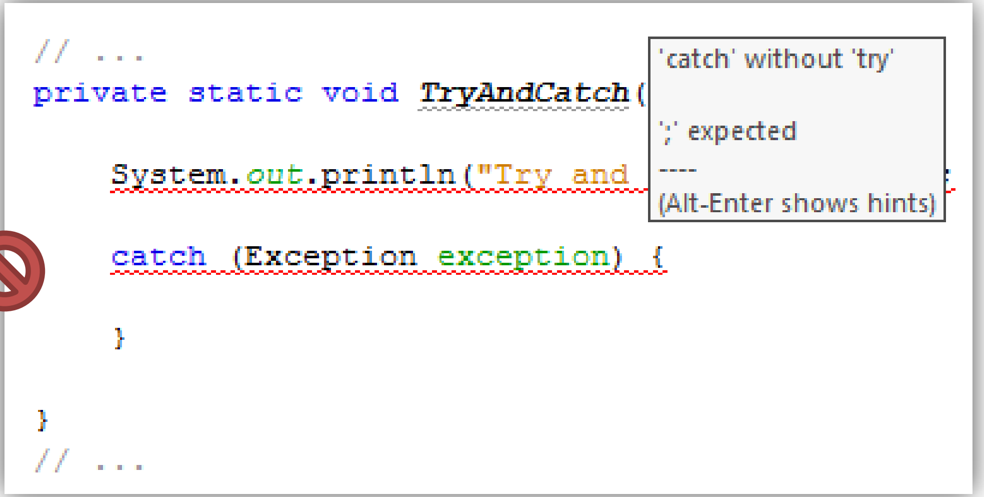
Error Execution flow



```java
// ...
private static void castingException() {

    System.out.println("Please, select a number: ");
    Scanner reader = new Scanner(System.in);
    int number = -1;

    try {

        number = reader.nextInt();

    } catch (InputMismatchException ex) {

        System.out.println("Error has ocurred");
        number = 0;

    } finally {

       executeTask(number);

    }

    System.out.println("Operation finished");


}
// ...
```

3. Exception Rules

You cannot have a catch or finally without a try

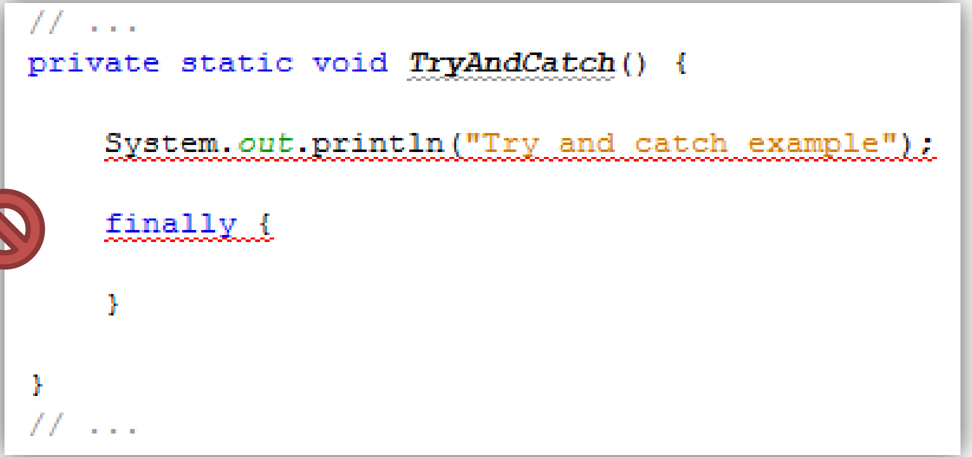


```
// ...
private static void TryAndCatch(

    System.out.println("Try and

    catch (Exception exception) {

    }

}
// ...
```

'catch' without 'try'

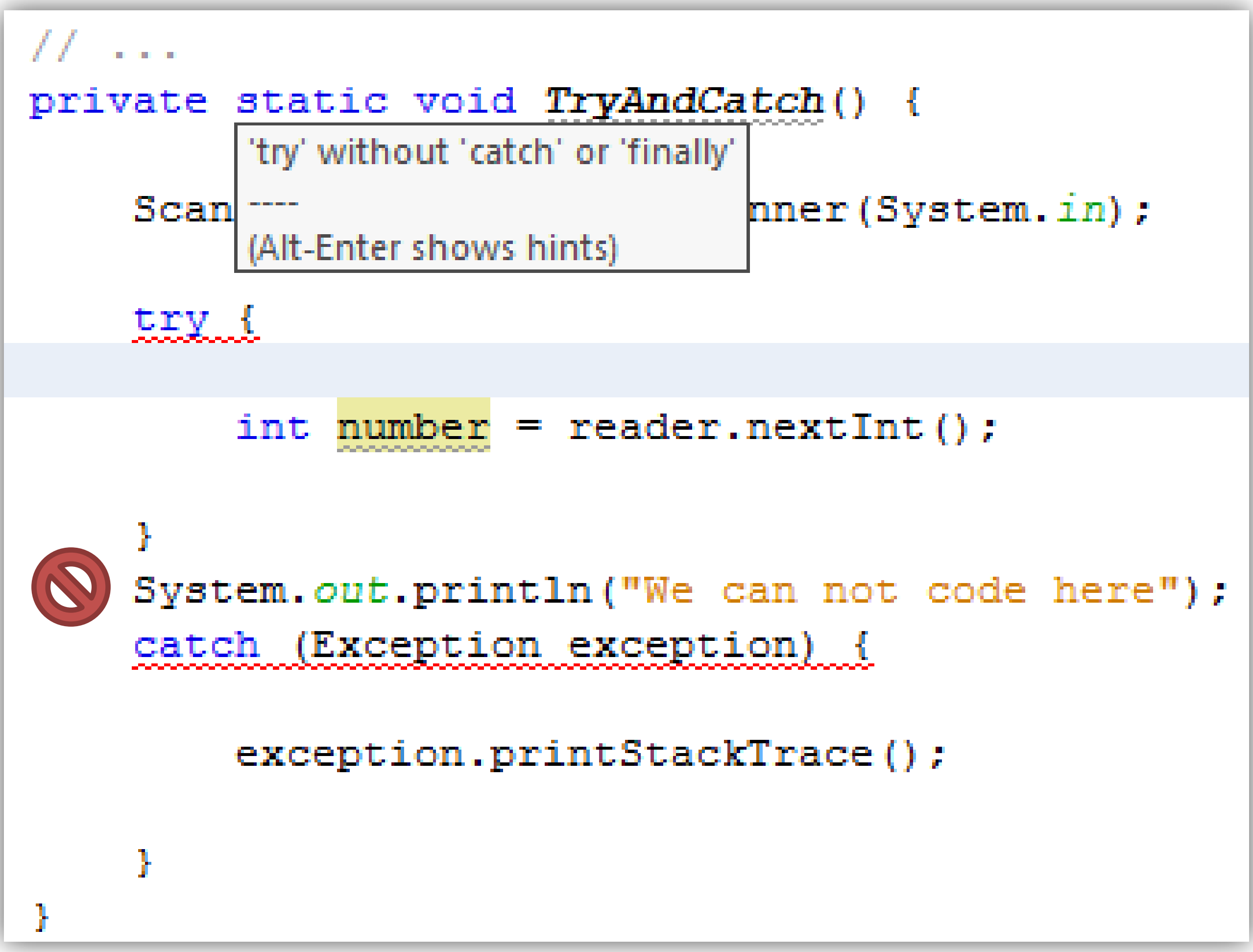
';' expected

(Alt-Enter shows hints)



```
// ...
private static void TryAndCatch() {

    System.out.println("Try and catch example");

    finally {

    }

}
// ...
```

You cannot put code between the try and the catch

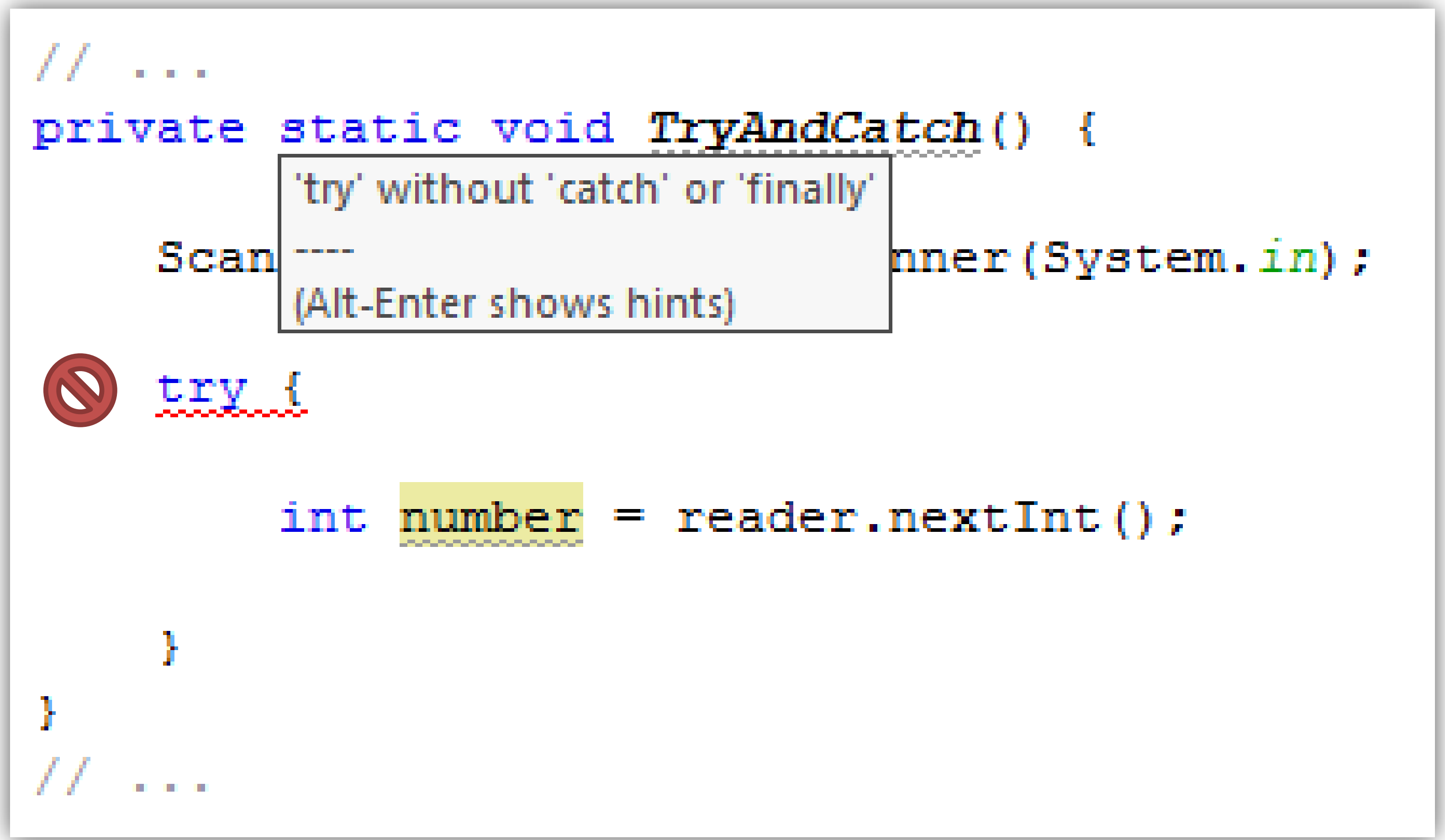


```
// ...
private static void TryAndCatch() {

    Scan                              nner(System.in);

    try {

        int number = reader.nextInt();

    }
    System.out.println("We can not code here");
    catch (Exception exception) {

        exception.printStackTrace();

    }
}
```

'try' without 'catch' or 'finally'

(Alt-Enter shows hints)

A try must be followed by either a catch or a finally



```
// ...
private static void TryAndCatch() {
    Scan                          nner(System.in);
    try {
        int number = reader.nextInt();
    }
}
// ...
```

'try' without 'catch' or 'finally'

(Alt-Enter shows hints)

References

[Deitel] H.M. Deitel and P.J. Deitel, *Java How to Program: Early Objects Version*, Prentice Hall, 2009.

[Sierra] K. Sierra and B. Bates, *Head First Java*, 2nd Edition, O'Reilly Media, 2005.