

Java Exception Handling

Handling errors using Java's exception handling mechanism

James Tam

Approaches For Dealing With Error Conditions

- Use branches/decision making and return values
- Use Java's exception handling mechanism

James Tam

Class Inventory: An Earlier Example

```
public class Inventory
{
    public final int MIN = 0;
    public      final int MAX = 100;
    public final int CRITICAL = 10;
    public boolean add(int amount)
    {
        int temp;
        temp = stockLevel + amount;
        if (temp > MAX)
        {
            System.out.print("Adding " + amount + " item will
                cause stock ");
            System.out.println("to become greater than " + MAX +
                " units (overstock)");
            return(false);
        }
    }
}
```

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Class Inventory: An Earlier Example (2)

```
    else
    {
        stockLevel = stockLevel + amount;
        return(true);
    }
} // End of method add()
...
```

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Some Hypothetical Method Calls: Condition/Return

```
reference1.method1()  
    if (reference2.method2() == false)  
        return(false);
```

```
reference2.method2()  
    if (store.addToInventory(amt) == false)  
        return(false);
```

```
store.addToInventory(int amt)  
    if (temp > MAX)  
        return(false);
```

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Some Hypothetical Method Calls: Condition/Return

```
reference1.method1()  
    if (reference2.method2() == false)  
        return(false);
```

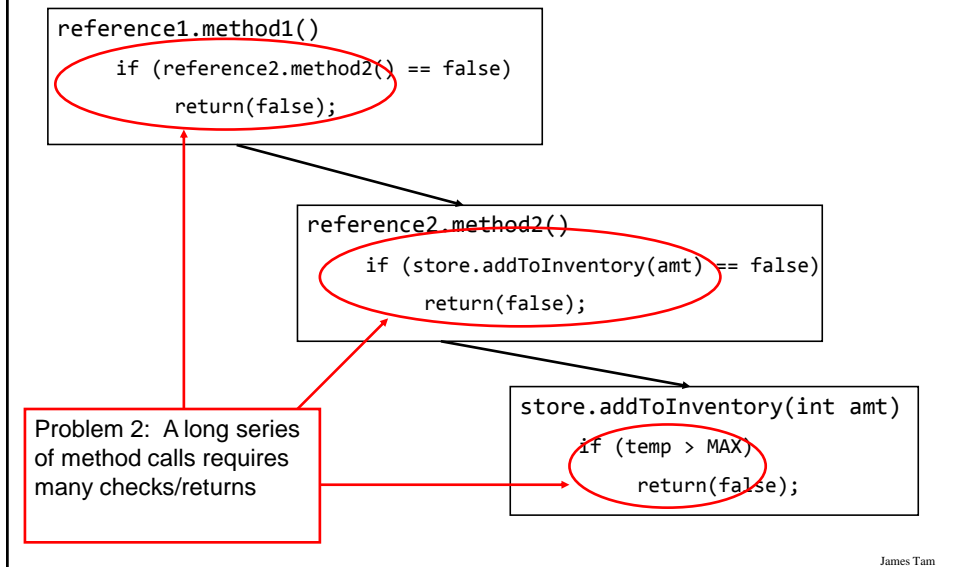
Problem 1: The calling method may forget to check the return value

```
reference2.method2()  
    if (store.addToInventory(amt) == false)  
        return(false);
```

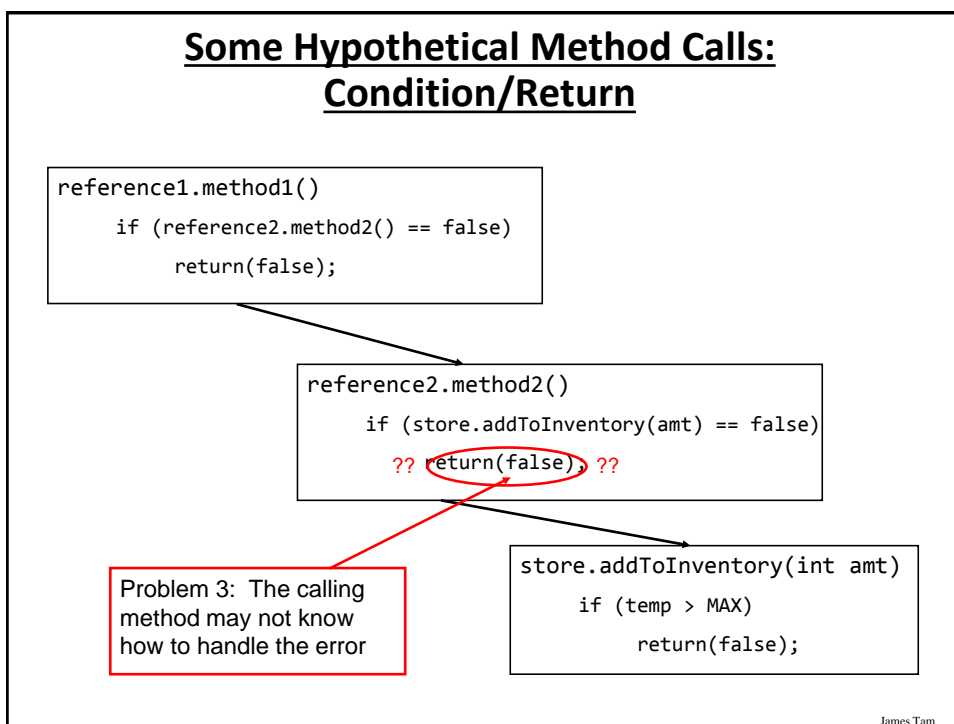
```
store.addToInventory(int amt)  
    if (temp > MAX)  
        return(false);
```

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Some Hypothetical Method Calls: Condition/Return



Some Hypothetical Method Calls: Condition/Return



Approaches For Dealing With Error Conditions

- Use branches/decision making constructs and return values
- Use Java's exception handling mechanism

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Handling Exceptions

Format:

```
try
{
    // Code that may cause an error/exception to occur
}
catch (ExceptionType identifier)
{
    // Code to handle the exception
}
```

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Handling Exceptions: Reading Input

Location of the online example:

/home/233/examples/exceptions/handlingExceptions/inputExample

```
public class Driver {
    public static void main (String [] args)
    {
        BufferedReader stringInput;
        InputStreamReader characterInput;
        String s;
        int num;
        characterInput = new InputStreamReader(System.in);
        stringInput = new BufferedReader(characterInput);
```

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Handling Exceptions: Reading Input (2)

```
try
{
    System.out.print("Type an integer: ");
    s = stringInput.readLine();
    System.out.println("You typed in..." + s);
    num = Integer.parseInt (s);
    System.out.println("Converted to an integer..."
        + num);
}
catch (IOException e)
{
    System.out.println(e);
}
catch (NumberFormatException e)
{
    ...
}
}
```

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Handling Exceptions: Where The Exceptions Occur

```
try
{
    System.out.print("Type an integer: ");
    s = stringInput.readLine();
    System.out.println("You typed in..." + s);
    num = Integer.parseInt (s);
    System.out.println("Converted to an integer..."
        +num);
}
```

The first exception can occur here

James Tam

Handling Exceptions: Result Of Calling BufferedReader.ReadLine()

```
try
{
    System.out.print("Type an integer: ");
    s = stringInput.readLine();
    System.out.println("You typed in..." + s);
    num = Integer.parseInt (s);
    System.out.println("Converted to an integer..."
        +num);
}
```

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Where The Exceptions Occur In Class BufferedReader

- For online documentation for this class go to:

- <http://docs.oracle.com/javase/7/docs/api/java/io/BufferedReader.html>

```
public class BufferedReader
{
    public BufferedReader(Reader in);
    public BufferedReader(Reader in, int sz);
    public String readLine() throws IOException;
    ...
}
```

James Tam

Handling Exceptions: Result Of Calling Integer.parseInt ()

```
try
{
    System.out.print("Type an integer: ");
    s = stringInput.readLine();
    System.out.println("You typed in..." + s);
    num = Integer.parseInt (s);
    System.out.println("Converted to an integer..."
        +num);
}
```

The second exception
can occur here

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Where The Exceptions Occur In Class Integer

- For online documentation for this class go to:

- <http://docs.oracle.com/javase/7/docs/api/java/lang/Integer.html>

```
public class Integer
{
    public Integer(int value);
    public Integer(String s) throws NumberFormatException;
    ...
    public static int parseInt(String s) throws
        NumberFormatException;
    ...
}
```

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Handling Exceptions: The Details

```
try
{
    System.out.print("Type an integer: ");
    s = stringInput.readLine();
    System.out.println("You typed in..." + s);
    num = Integer.parseInt (s);
    System.out.println("Converted to an integer..."
        +num);
}
catch (IOException e)
{
    System.out.println(e);
}
catch (NumberFormatException e)
{
    ...
}
}
```

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Handling Exceptions: Tracing The Example

```
Driver.main ()
try
{
    num = Integer.parseInt(s);
}
:
catch (NumberFormatException e)
{
    :
}
```

```
Integer.parseInt(String s)
{
}
}
```

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Handling Exceptions: Tracing The Example

```
Driver.main ()
try
{
    num = Integer.parseInt(s);
}
:
catch (NumberFormatException e)
{
    :
}
```

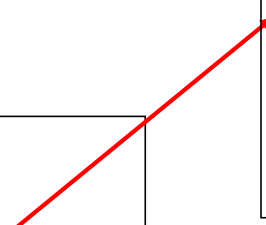
```
Integer.parseInt(String s)
{
    Oops!
    The user didn't enter an integer
}
}
```

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Handling Exceptions: Tracing The Example

```
Driver.main ()
try
{
    num = Integer.parseInt(s);
}
:
catch (NumberFormatException e)
{
    :
}
```

```
Integer.parseInt(String s)
{
    NumberFormatException e =
        new NumberFormatException ();
}
```

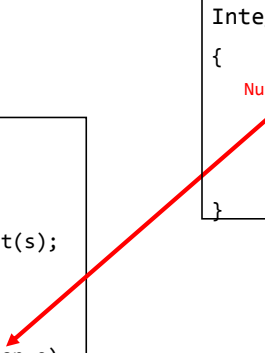


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Handling Exceptions: Tracing The Example

```
Driver.main ()
try
{
    num = Integer.parseInt(s);
}
:
catch (NumberFormatException e)
{
    :
}
```

```
Integer.parseInt(String s)
{
    NumberFormatException e =
        new NumberFormatException ();
}
```



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Handling Exceptions: Tracing The Example

```
Driver.main ()
try
{
    num = Integer.parseInt(s);
}
:
catch (NumberFormatException e)
{
    Exception must be dealt
    with here
}
```

```
Integer.parseInt(String s)
{
    NumberFormatException e =
    new NumberFormatException ();
}
```

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Handling Exceptions: Catching The Exception

```
catch (NumberFormatException e)
{
    ...
}
}
```

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Catching The Exception: Error Messages

```
catch (NumberFormatException e)
{
    System.out.println("You entered a non-integer
                        value.");
    System.out.println(e.getMessage());
    System.out.println(e);
    e.printStackTrace();
}
}
```

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Catching The Exception: Error Messages

```
catch (NumberFormatException e)
{
    System.out.println("You entered a non-integer
                        value.");
    System.out.println(e.getMessage());
    System.out.println(e);
    e.printStackTrace();
}
}
```

For input string: "james tam"

java.lang.NumberFormatException:
For input string: "james tam"

java.lang.NumberFormatException: For input string: "james tam"
at java.lang.NumberFormatException.forInputString(NumberFormatException.java:48)
at java.lang.Integer.parseInt(Integer.java:426)
at java.lang.Integer.parseInt(Integer.java:476)
at Driver.main(Driver.java:39)

James Tam

Avoid Squelching Your Exceptions

```
try
{
    s = stringInput.readLine();
    num = Integer.parseInt (s);
}
catch (IOException e)
{
    System.out.println(e);
}
catch (NumberFormatException e)
{
    // Do nothing here but set up the try-catch block to
    // bypass the "annoying" compiler error
}
```

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Avoid Squelching Your Exceptions

```
try
{
    s = stringInput.readLine();
    num = Integer.parseInt (s);
}
catch (IOException e)
{
    System.out.println(e);
}
catch (NumberFormatException e)
{
    // Do nothing here but set up the try-catch block to
    // bypass the "annoying" compiler error
}
```

NO!

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The Finally Clause

- An additional part of Java's exception handling model (try-catch-*finally*).
- Used to enclose statements that must always be executed whether or not an exception occurs.

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The Finally Clause: **Exception Thrown**

```
try
{
    f.method();
}
```

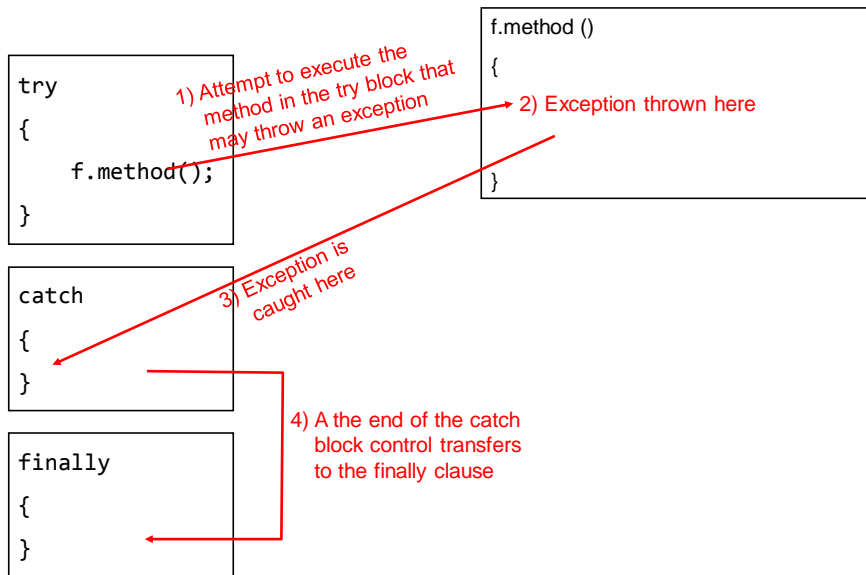
```
catch
{
}
```

```
finally
{
}
```

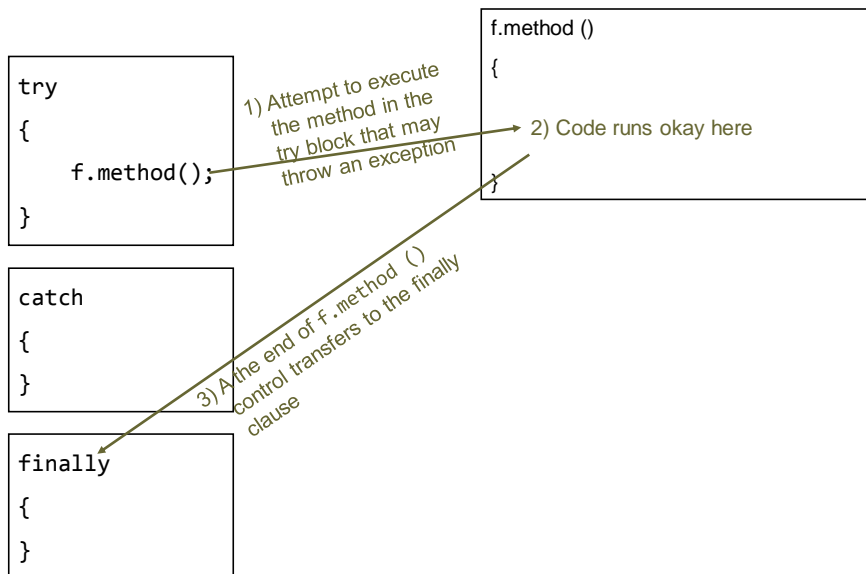
```
f.method ()
{
}
}
```

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The Finally Clause: Exception Thrown



The Finally Clause: No Exception Thrown



Try-Catch-Finally: An Example

Location of the online example:

`/home/233/examples/exceptions/handlingExceptions/tryCatchFinallyExample`

```
public class Driver
{
    public static void main (String [] args)
    {
        TCFExample eg = new TCFExample ();
        eg.method();
    }
}
```

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Try-Catch-Finally: An Example (2)

```
public class TCFExample
{
    public void method ()
    {
        BufferedReader br;
        String s;
        int num;
        try
        {
            System.out.print("Type in an integer: ");
            br = new BufferedReader(new
                InputStreamReader(System.in));
            s = br.readLine();
            num = Integer.parseInt(s);
            return;
        }
    }
}
```

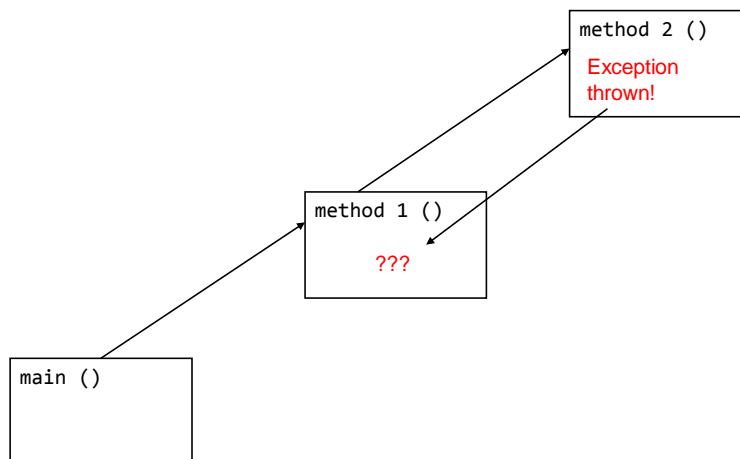
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Try-Catch-Finally: An Example (3)

```
    catch (IOException e)
    {
        e.printStackTrace();
        return();
    }
    catch (NumberFormatException e)
    {
        e.printStackTrace ();
        return();
    }
    finally
    {
        System.out.println("<<<This code will always
                            execute>>>");
        return;
    }
}
```

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When The Caller Can't Handle The Exceptions



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When The Caller Can't Handle The Exceptions: An Example

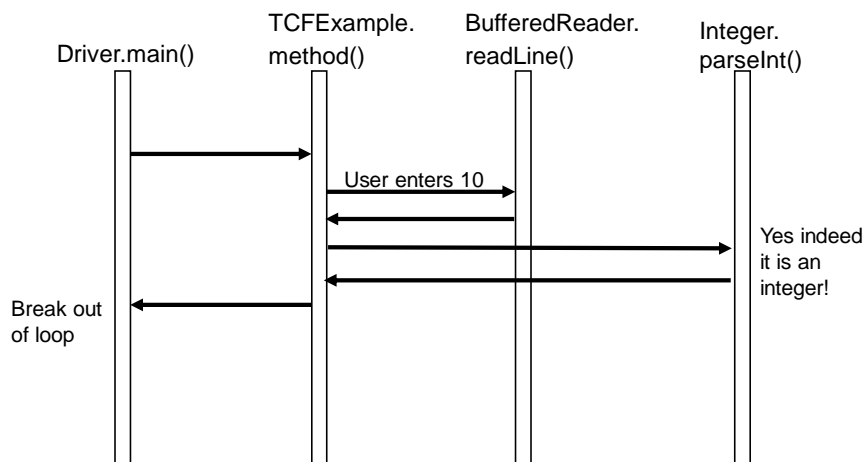
Location of the online example:

</home/233/examples/exceptions/handlingExceptions/delegatingExceptions>

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When The Caller Can't Handle The Exceptions: An Example (2)

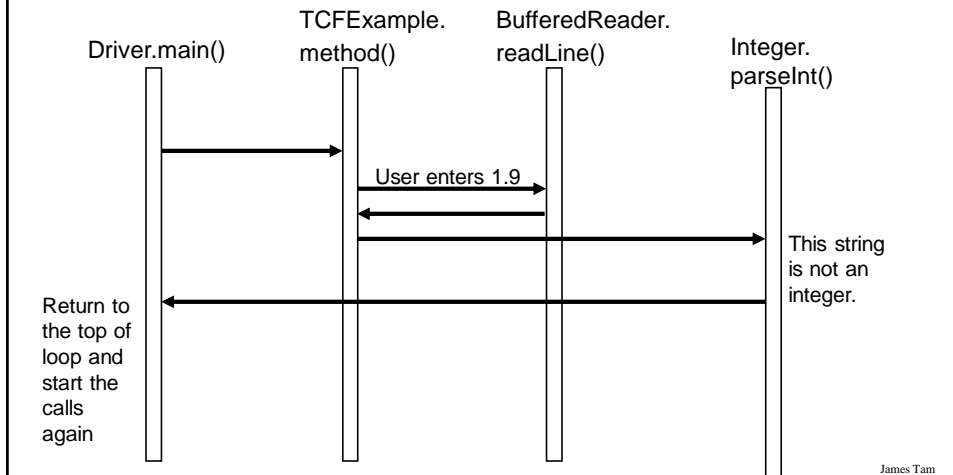
- Tracing the method calls when *no exception occurs*:



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When The Caller Can't Handle The Exceptions: An Example (3)

- Tracing the method calls when an *exception does occur*:



When The Caller Can't Handle The Exceptions: An Example (4)

```
public class Driver
{
    public static void main (String [] args)
    {
        TCFExample eg = new TCFExample ();
        boolean inputOkay = true;
```

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When The Caller Can't Handle The Exceptions: An Example (5)

```
do {
    try {
        eg.method();
        inputOkay = true;
    }
    catch (IOException e) {
        e.printStackTrace();
    }
    catch (NumberFormatException e) {
        inputOkay = false;
        System.out.println("Please enter a whole
            number.");
    }
} while(inputOkay == false);
} // End of main
} // End of Driver class
```

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When The Caller Can't Handle The Exceptions: An Example (6)

```
public class TCExample
{
    public void method () throws IOException,
                                NumberFormatException
    {
        BufferedReader br;
        String s;
        int num;

        System.out.print("Type in an integer: ");
        br = new BufferedReader(new
            InputStreamReader(System.in));
        s = br.readLine();
        num = Integer.parseInt(s);
    }
}
```

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When The Driver.Main () Method Can't Handle The Exception

```
public class Driver
{
    public static void main (String [] args) throws
        IOException, NumberFormatException
    {
        TCExample eg = new TCExample ();
        eg.method();
    }
}
```

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After This Section You Should Now Know

- The benefits of handling errors with an exception handler rather than employing a series of return values and conditional statements/branches.
- How to handle exceptions
 - Being able to call a method that may throw an exception by using a try-catch block
 - What to do if the caller cannot properly handle the exception
 - What is the finally clause, how does it work and when should it be used
- The effect of the inheritance hierarchy when catching exceptions

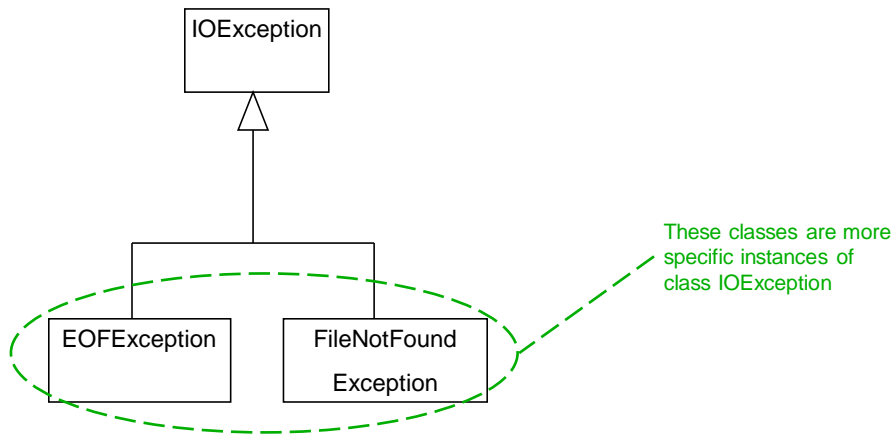
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Simple File Input And Output

You will learn how to write to and read from text files in Java.

James Tam

Inheritance Hierarchy For IOExceptions



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Inheritance And Catching Exceptions

- If you are catching a sequence of exceptions then make sure that you catch the exceptions for the child classes before you catch the exceptions for the parent classes
- Deal with the more specific case before handling the more general case

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Branches: Specific Before General

•Correct

```
If (x > 100)
    body;
else if (x > 10)
    body;
else if (x > 0)
    body;
```

•Incorrect

```
If (x > 0)
    body;
else if (x > 10)
    body;
else if (x > 100)
    body;
```

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Inheritance And Catching Exceptions (2)

Correct

```
try
{

}
catch (EOFException e)
{

}
catch (IOException e)
{

}
```

Incorrect

```
try
{

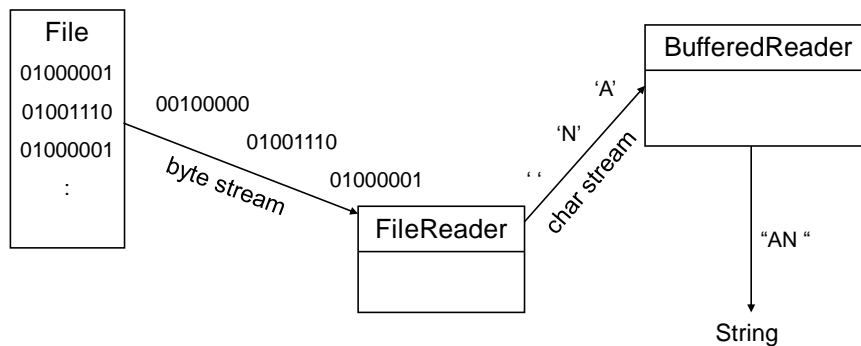
}
catch (IOException e)
{

}
catch (EOFException e)
{

}
```

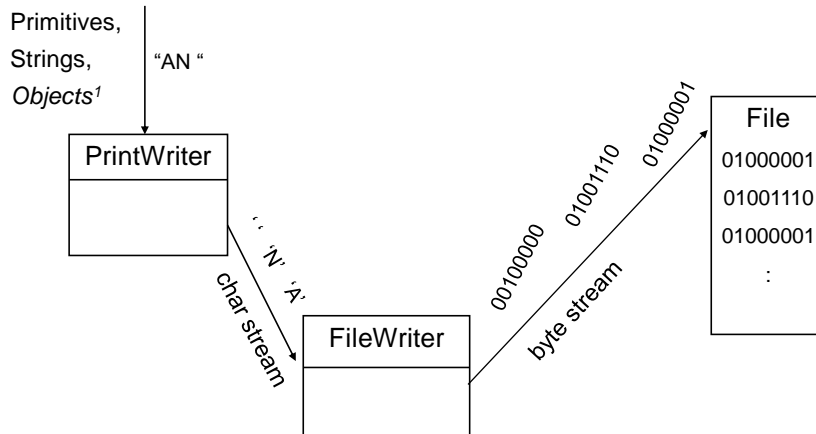
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Reading Text Input From A File



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Writing Text Output To A File



¹ By objects we of course mean references to objects

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File Input And Output: One Complete Example

Location of the online example:

/home/233/examples/fileIO/Driver.java

```
public class Driver
{
    final static int MAX = 4;
    public static void main(String [] args)
    {
        String line = null;
        String [] paragraph = null;
        int i;
        Scanner in;

        // File IO
        PrintWriter pw = null;
        FileWriter fw = null;
        BufferedReader br = null;
        FileReader fr = null;

        in = new Scanner(System.in);
        paragraph = new String[MAX];
```

James Tam

File IO: Get Data And Write To File

```
// Get paragraph information from the user.
for (i = 0; i < MAX; i++)
{
    System.out.print("Enter line of text: ");
    line = in.nextLine();
    paragraph[i] = line; //Add line as array element
}

// Write paragraph to file
try
{
    fw = new FileWriter("data.txt"); // Open
    pw = new PrintWriter(fw);
    for (i = 0; i < MAX; i++)
        pw.println(paragraph[i]);
    fw.close(); // Close
}
catch (IOException e)
{
    System.out.println("Error writing to file");
}
}
```

James Tam

File IO: Read Data From File

```
try {
    fr = new FileReader("data.txt"); // Open
    br = new BufferedReader(fr);
    line = br.readLine();

    if (line == null)
        System.out.println("Empty file, nothing to read");

    while (line != null) {
        System.out.println(line);
        line = br.readLine();
    }
    fr.close(); // Close
}
catch (FileNotFoundException e) {
    System.out.println("Could not open data.txt");
}
catch (IOException e) {
    System.out.println("Trouble reading from data.txt");
}
}
```

James Tam

You Should Now Know

- How to write to files with Java classes
 - `FileWriter`
 - `PrintWriter`
- How to reading text information from files with Java classes
 - `FileReader`
 - `BufferedReader`

James Tam