



Module 1 Day 16

Exceptions
File I/O: Processing File Input

Module 1 Day Unit 16

Can you ... ?

1. ... describe the concept of exception handling
2. ... implement a try/catch structure in a program
3. ... use and discuss the `java.io` library's `File` and `Directory` classes
4. ... explain what a character stream is
5. ... use a try-with-resources block
6. ... handle File I/O exceptions and write code to recover from them
7. ... talk about ways that File I/O might be used on the job

Exceptions

What are Exceptions?

Exceptions are events that alter the flow of the program away from the intended, ideal or “happy” path.

- *Sometimes it's the developer's fault:* i.e. accessing an array element greater than the actual number of elements present.
- *Other times it's not:* i.e. loss of internet connection, a data file that was supposed to be there has been removed by a systems admin.

Checked Exceptions

A **checked exception** is a type of exception that must be either **caught or declared in the method in which it is thrown**. For example, the `java.io.IOException` is a checked exception.

- **FileNotFoundException:** This is thrown programmatically, when the program tries to do something with a file that doesn't exist.
 - We just saw this!
- **IOException:** A more general exception related to problems reading or writing to a file.
 - Note that `FileNotFoundException` extends from `IOException`.

Bottom Line: They are not runtime exceptions, but they **must** be handled or declared as thrown.

Runtime (Un-Checked) Exceptions

Runtime exceptions are errors that occur during program execution in the JVM and are usually the result of unexpected input or object state. Here are three common examples:

- **NullPointerException**: you tried to call a method or access a data member for a null reference.
- **ArithmeticException**: you tried to divide by zero.
- **ArrayIndexOutOfBoundsException**: you tried to access an array element with an index that is out of bounds.

Custom Exceptions & Errors

- Custom exceptions are program specific errors that occur during execution. They often represent a data or program state that is contrary to the rules of the system. **Read more at:** [Why, When and How to Implement Custom Exceptions in Java; \(2017\), THORBEN, JANSSEN](#)
- Errors are events that are outside the control of the developer, user management, or even the JVM. They may represent O/S events or resource problems. Because they are system level errors, we should not try to catch them; instead relying on the built-in O/S functionality.

Exceptions “Throwing”

Throwing means immediately halting execution and issuing a warning to make everyone aware that some deviation from normal program flow has occurred.

- Throwing can be done behind the scenes by the JVM. As is the case for RunTime Exceptions and handled exceptions.
- It can also be triggered manually via code by using a *throw* statement. This allows us to use logical tests to create our own exceptions when necessary.

throw new Exception(“Something Unexpected Happened”);

Exceptions “Catching”

Exception handlers are blocks of code we define to take whatever actions are necessary, or desired, when an exception is encountered.



Exceptions Handling: Example

Code declared as throwing an exceptions must have that exception handled by the caller:

```
import java.io.FileNotFoundException;

public class SuspiciousClass {

    public void doSomething() throws FileNotFoundException {

        throw new FileNotFoundException();

    }

}
```

An exception is
programatically thrown.

```
public class MyMainClass {

    public static void main(String[] args) {
        SuspiciousClass test = new SuspiciousClass();
        test.doSomething();
    }

}
```

Java will complain as we try
to invoke doSomething() as it
expects us to handle or catch
the exception.

Exceptions Handling: Example

Our first choice is to just state that on the main method (from which we call doSomething) that there is a possibility an exception will be thrown. This pattern of “passing the buck” or “hot potato” is a bad practice and simply elevates the error further and further up in the application, potentially making it more difficult to address.


```
public static void main(String[] args) throws FileNotFoundException {  
    SuspiciousClass test = new SuspiciousClass();  
  
    test.doSomething();  
  
}
```

Exceptions Handling: Example

Instead, we should use a try / catch block to both catch the exception and specify a set of actions to execute when we run into the **caught** exception.

```
public static void main(String[] args) {  
  
    SuspiciousClass test = new SuspiciousClass();  
  
    try {  
        test.doSomething();  
    }  
    catch (FileNotFoundException e) {  
        System.out.println("ok... that's fine, moving on.");  
    }  
}
```

You must specify the name of the exception along with a placeholder variable.

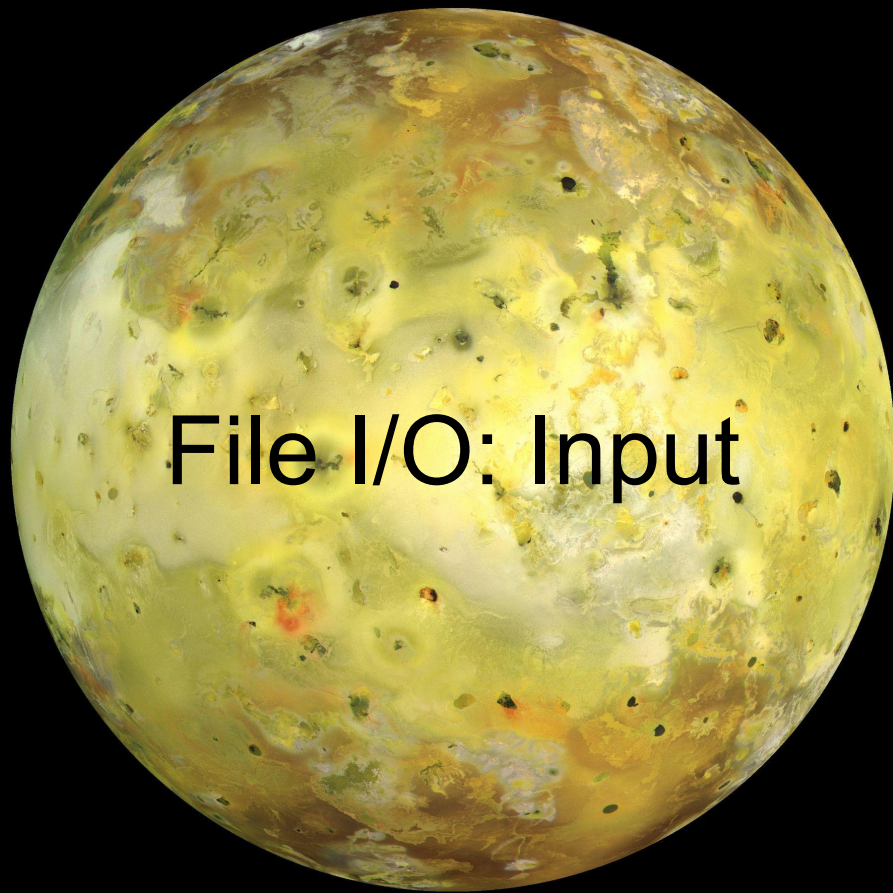


Try / Catch

The Try Catch block follows the following format:

```
try {  
    // Code where an exception might be triggered.  
}  
catch (FileNotFoundException e) {  
    // Catch and specify actions to take if an exception is encountered.  
}  
finally {  
    // Action to take regardless of whether an exception was encountered.  
}
```

Both the catch and finally blocks are optional.



File I/O: Input

File Input: The “I” in File I/O

Java has the ability to read data that is stored in a text file.

It is just one of many forms of inputs available in Java. Others include:

- Command Line user input (From Module 1 Week 2)
- Through a relational database (Coming Soon! In Module 2)
- Through a web interface using the Spring framework (Module 3)
- Through an external API (Module 3)

File Input : The File Class

The **File** class is the class that encapsulates what it means to be a file in the file system. File objects are instantiated as :

```
File <<variable name>> = new File(<<Location of the file>>);
```

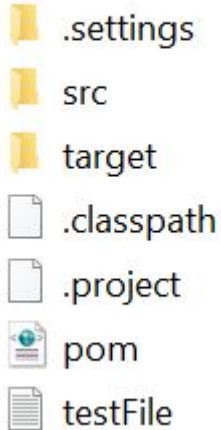
In its basic form, it has a constructor that takes in the location of the file (including the name and extension). As a concrete example:

```
File inputFile = new File("testFile.txt");
```


File Input : The File Class

The file location corresponds to the root of that particular Java project. Again, in this example our file is testFile.txt:

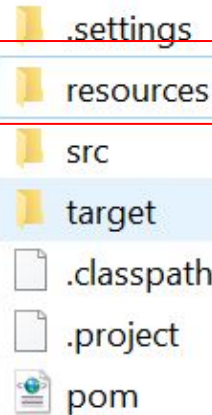
Name



In this example, testFile.txt is located in the project root, we can refer to it like so:

```
File inputFile = new File("testFile.txt");
```

Name



In this example, testFile.txt has been moved **inside a folder called resources**.

```
File inputFile = new  
File("resources/testFile.txt");
```

File Input : The File Class Methods

There are two methods of the file class that are essential for file input:

- **.exists()**: returns a boolean to check to see if a file exists. We would not want to proceed to parse a file if the file itself was missing!
- **.getAbsolutePath()**: returns the same File object you instantiated but with an absolute path. You can think of this as a getter. It returns a File object.

The .exists() method can be used to notify the user and prompt them to enter a valid file or ***throw an exception*** to a method that requests user input for re-entry.

File and Scanner

A File object and a Scanner object work in conjunction with one another to read file data.

Once a file object exists, we instantiate a Scanner object with the file as a constructor argument just as we used System.in as the constructor argument in prior weeks.

File and Scanner: Example

```
public static void main(String[] args) throws FileNotFoundException {  
  
    File inputFile = new File("resources/testFile.txt");  
  
    if (inputFile.exists()) {  
        System.out.println("found the file");  
    }  
  
    try (Scanner inputScanner = new  
Scanner(inputFile.getAbsolutePath())) {  
  
        while (inputScanner.hasNextLine()) {  
            String lineInput = inputScanner.nextLine();  
            String [] wordsOnLine = lineInput.split(" ");  
  
            for (String word : wordsOnLine) {  
                System.out.print(word + ">>>");  
            }  
        }  
    }  
}
```

We need to handle an exception, more on this later.

New file object being instantiated.

Instantiating a scanner but using an "absolute path" file.

The while loop will iterate until it has processed all lines.

File and Scanner: Example

Without all the markup and callouts ...

```
public static void main(String[] args) throws FileNotFoundException {  
  
    File inputFile = new File("resources/testFile.txt");  
  
    if (inputFile.exists()) {  
        System.out.println("found the file");  
    }  
  
    try (Scanner inputScanner = new Scanner(inputFile.getAbsolutePath())) {  
  
        while (inputScanner.hasNextLine()) {  
            String lineInput = inputScanner.nextLine();  
            String [] wordsOnLine = lineInput.split(" ");  
  
            for (String word : wordsOnLine) {  
                System.out.print(word + ">>>");  
            }  
        }  
    }  
}
```