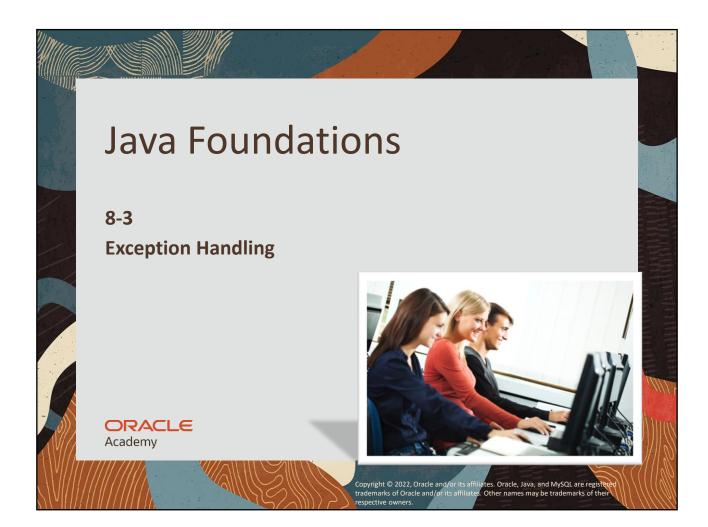
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Objectives

- This lesson covers the following objectives:
 - -Explain the purpose of exception handling
 - -Handle exceptions with a try/catch construct
 - -Describe common exceptions thrown in Java



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JFo 8-3 Exception Handling

What Is an Exception?

- To understand exception handling, you need to first understand what is an exception
- An exception is an error that occurs during the execution of a program(run-time) that disrupts the normal flow of the Java program
- However, you can handle such conditions within your program and take necessary corrective actions so that the program can continue with its execution(exception handling)



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Why Should You Handle Exceptions?

- If an exception occurs while your program is executing:
 - -Execution of the program is terminated
 - A stack trace, with the details of the exception, is printed in the console



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When You Don't Handle Exceptions: Example

 In Java, the following code throws an exception because you can't divide an integer by zero:

- A stack trace, with the details of the exception, is printed in the console
- Execution of the program is terminated at line 4, and so the statement at line 5 isn't executed



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In this example, the following stack trace is printed:

```
Exception in thread "main" java.lang.ArithmeticException: / by zero at com.example.ExceptionHandling.main(ExceptionHandling.java:4)
```

When You Don't Handle Exceptions

- When Java encounters an error or condition that prevents execution from proceeding normally, Java "throws" an exception
- If the exception isn't "caught" by the programmer, the program crashes
- The exception description and current stack trace are printed to the console



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Dealing with Exceptions

- One way to deal with exceptions is to simply avoid them in the first place
- For example, avoid an ArithmeticException by using conditional logic:
 - Test to see if the condition will arise before you attempt the potentially risky operation

```
int divisor = 0;

if(divisor == 0){
    System.out.println("Can't be zero!");
}
else {
    System.out.println(5 / divisor);
}//endif
```

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Exception Categories

- Java exceptions fall into two categories:
- Checked Exceptions:
 - -Compiler checks and deals with exceptions
 - If the exceptions aren't handled in the program, it gives a compilation error
 - -Examples:
 - FileNotFoundException, IOException
- Unchecked Exceptions:
 - -Compiler does not check and deal with exceptions
 - -Examples:
 - ArrayIndexOutOfBoundsException,
 NullPointerException, ArithmeticException

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Exercise 1

- Create a new project and add the ExceptionEx1.java file to the project
- Import and open the ExceptionsEx project
- Examine ExceptionEx1.java:
 - -Execute the program and observe the output:
 - -ArrayIndexOutOfBoundsException occurs
 - -Is it a good practice to handle the exception for this program?
 - -Modify the program to compute the sum of the array



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Handling Exceptions with the try/catch Block

- But not all exceptions can be prevented because you don't always know whether a given operation will fail before it's invoked
- Another strategy is to use the try/catch block for exception handling



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Understanding the try/catch Block

- For code that's likely to cause an exception, you can write the code inside a special "try" block
- You associate exception handlers with a try block by providing one or more catch blocks after the try block
- Each catch block handles the type of exception indicated by its argument
- The ExceptionType argument type declares the type of exception



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Flow Control in try/catch Blocks: Success

If the try block succeeds, no exception occurs

```
try {
                                                                           First the try
          // risky code that is likely to cause
                                                                           block runs,
          // an exception
                                                                           and then the
                                                                           code after the
     }
                                                                           catch block
     catch(ExceptionType ex) {
                                                                           runs
          // exception handling code
     }
    System.out.println("We made it");
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                                                                                                  13
                       Exception Handling
```

Flow control skips over the catch block. The execution continues with the rest of the code outside the catch block.

Flow Control in try/catch Blocks: Failure

• If the try block fails, an exception occurs

```
try {
                                                                        The try block runs, an
          //risky code that is likely to cause
                                                                        exception occurs,
                                                                        and the rest of the
          //an exception
                                                                        try block doesn't run
     }
     catch(ExceptionType ex) {
                                                                         The catch block
          //exception handling code
                                                                         runs, and then the
                                                                         rest of the code
     }
                                                                         runs
     System.out.println("We made it");
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                                                                                                 14
                       Exception Handling
```

Flow control immediately moves to the catch block. When the catch block is completed, execution of the rest of the code continues.

Flow Control in try/catch Blocks: Example

```
1 public static void main(String args[]) {
 2
       int a = 100, res;
 3
       try{
           System.out.println("Enter the value for b");
 4
 5
           Scanner console = new Scanner(System.in);
           int b = console.nextInt();
 6
           System.out.println("Enter the value for c");
 7
           int c = console.nextInt();
 8
           res = 10 / (b - c);
 9
           System.out.println("The result is " + res);
 10
 11
       }
 12
       catch(Exception e){
 13
           String errMsg = e.getMessage();
 14
           System.out.println(errMsg);
 15
       }//end try catch
 16
       System.out.println("After catch block");
 17 }//end method main
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                         Exception Handling
                                                                                                           15
```

In this example, a try/catch block was added to catch ArithmeticException. The example illustrates the program flow when the exception is handled with try/catch. ArithmeticException occurs at line 9.

The control immediately passes to the catch block.

Statement #10 in the try block isn't executed.

Statements in the catch block are executed instead.

The execution program continues with the statement outside the catch block, and "After catch block" is displayed in the console.

Examples of Exceptions

- java.lang.ArrayIndexOutOfBoundsException
 - -Attempt to access a nonexistent array index
- java.lang.NullPointerException
 - -Attempt to use an object reference that wasn't instantiated
- java.io.IOException
 - -Failed or interrupted I/O operations



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Here are just a few of the exceptions that Java can throw. You've probably seen one or more of these exceptions when you worked on the practices or exercises in this class.

Understanding Common Exceptions

- Unchecked Exceptions due to programming mistake :
 - -Example:
 - -ArrayIndexOutOfBoundsException exception

```
01 int[] intArray = new int[5];
02 intArray[5] = 27;
```

-Stack trace:

```
Exception in thread "main"
    java.lang.ArrayIndexOutOfBoundsException: 5
    at TestErrors.main(TestErrors.java:17)
)
```



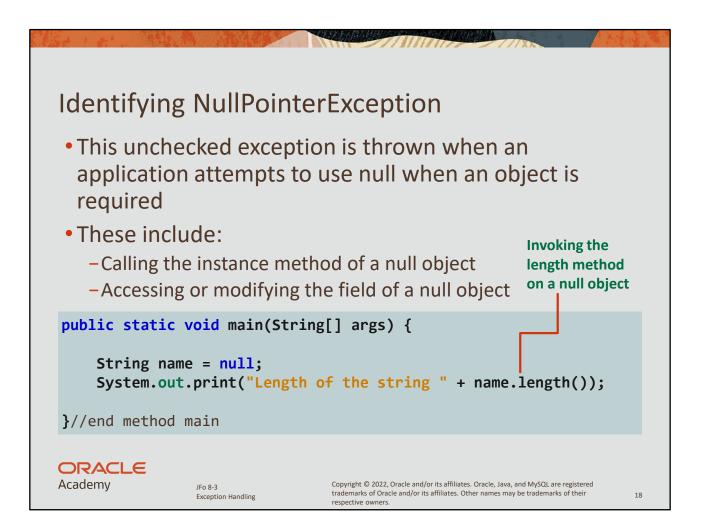
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This code shows a common mistake made when accessing an array. Remember that arrays are zero based (the first element is accessed by a zero index). Therefore, in an array with five elements, the last element is actually intArray[4].

intArray[5] tries to access an element that doesn't exist, Java responds to this programming
mistake by throwing an ArrayIndexOutOfBoundsException and the stack trace is printed to
the console.

Because accessing an invalid index in the array is an unchecked exception, you don't have to handle the exception with the try/catch block.



A NullPointerException is thrown because a method is being invoked on a null value.

Identifying IOException

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The slide example is handling the possible raised exception by:

Throwing the exception from the ${\tt testCheckedException} \ \ {\tt method}$

Catching the exception in the caller method

In this example, the catch block catches the exception because the path to the text file isn't correctly formatted. System.out.println(e) calls the toString method of the exception, and the result is java.io.IOException. That is, the file name, directory name, or volume label syntax is incorrect.

Best Practices for Exception Handling

- Try to be as specific as possible with the type of error you're trying to catch
- This allows the program to provide you with specific feedback on what went wrong
- Catch a generic exception is often too imprecise to be useful, but can be done as a last resort

```
catch (Exception e) {
    System.out.println(e);
}
```



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Example of Bad Practice

```
public static void main(String[] args) {
    try {
        File testFile = new File("//testFile.txt");
        testFile.createNewFile();
        System.out.println("testFile exists:"
                                + testFile.exists());
      }

    Catching any exception

      catch (Exception e) {
        System.out.println("Error Creating File");-
      }//end try catch
}//end method main
                                                   No processing of
                                                   exception class?
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```

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The code in the slide illustrates two poor exception-handling practices.

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Exception Handling

- 1. The catch clause catches an Exception type rather than an IOException type.
- 2. The catch clause doesn't analyze the Exception object. Instead, it simply assumes that the expected exception was thrown from the File object.

As a result of this careless programming style, the code prints the following message to the console: There is a problem creating the file!

The message suggests that the file wasn't created, and indeed any further code in the catch block will run. But what's actually happening in the code?

Somewhat Better Practice

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The code illustrates two good exception-handling practices:

- 1. The catch clause catches an IOException type.
- 2. The catch clause prints the exception details to the console.

Exercise 2

- Add the files Calculator.java and ShoppingCart.java to the project you created for exercise 1
- Examine Calculator.java and ShoppingCart.java
- Modify the programs to implement exception handling:
 - -Calculator.java:
 - · Identify the exception that might occur
 - Change the divide method signature to indicate that it throws an exception
 - -ShoppingCart.java:
 - · Catch the exception in the class that calls the divide method

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Summary

- In this lesson, you should have learned how to:
 - -Explain the purpose of exception handling
 - -Handle exceptions with a try/catch construct
 - -Describe common exceptions thrown in Java





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