CS 1181
Week Three

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Review

- Well Developed Classes
  - Good Encapsulation
  - Common interfaces
  - Good use of Inheritance
- Exceptions

How are exceptions passed?

Call method

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```
main(){
    performAction()
}
```

```
performAction(){
    return divide(5, 0)
}
```

```
divideByTwo(int n, int d){
    if(d == 0){
        throw new ArithmeticException
    }

    return n / d
}
```

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```

Exception Thrown!

If caller doesn't handle it, alert it's caller

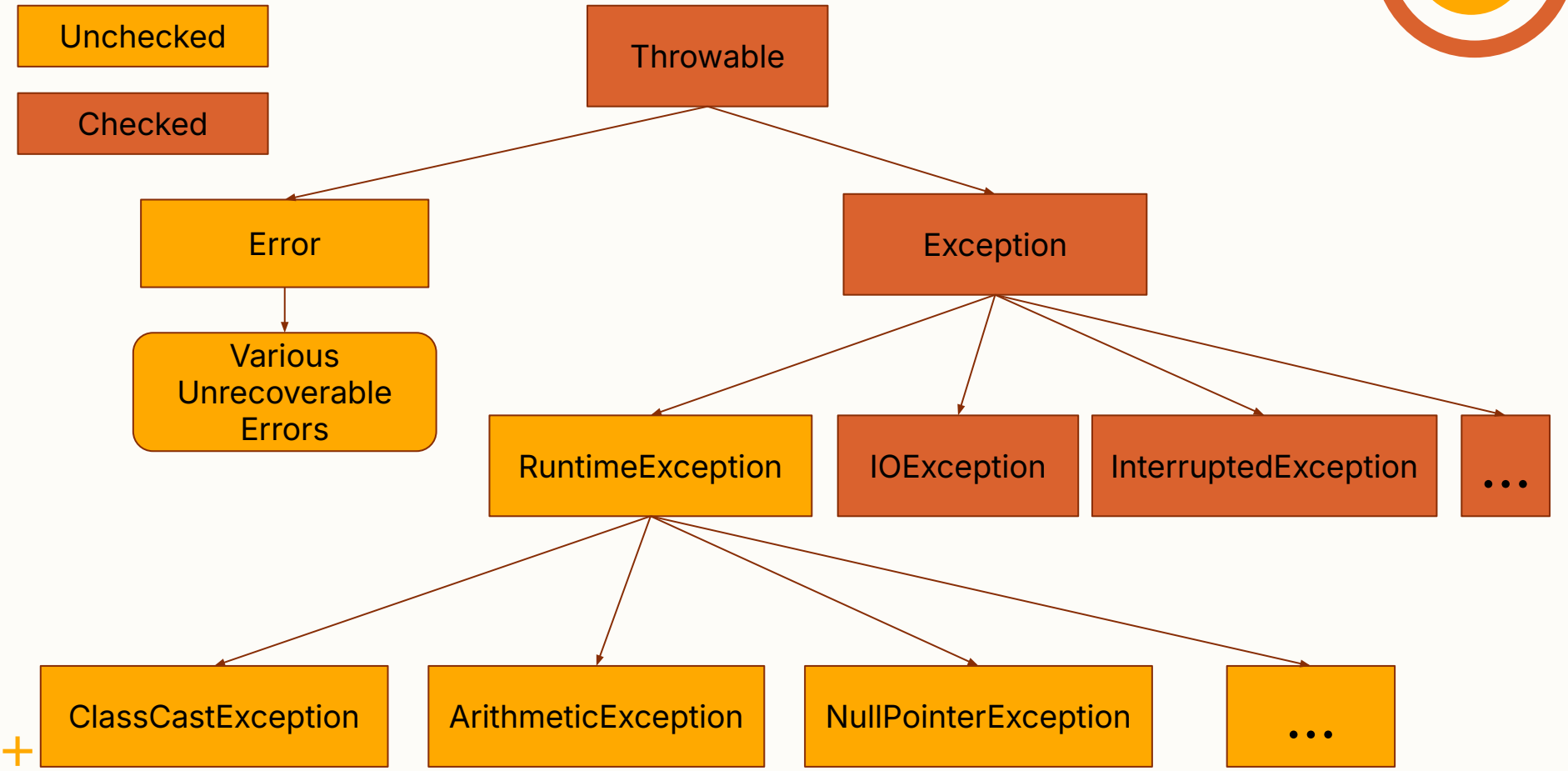
Alert whoever called divide method!

How are exceptions passed?

- Exceptions get pass up the chain of method callers until:
  - Someone handles the exception
    - try/catch
  - Main throws the exception
    - Program crashes

Review

- Two types of exceptions:
  - Checked (extends Exception)
  - Unchecked (extends RuntimeException)


Unchecked
Checked
Throwable
Error
Exception
Various Unrecoverable Errors
RuntimeException
IOException
InterruptedException
...
ClassCastException
ArithmeticException
NullPointerException
...

Checked Exceptions

- RuntimeExceptions do *not* force the caller to handle it

- What does it mean for an exception to be “checked”?

Checked Exceptions

- What does it mean for an exception to be “checked”?

- Must be handled
  - “throws” in declaration
  - try/catch block

Throws

- I don’t care if something goes wrong
- Let my caller deal with it

- Diversion of responsibility
- “throws” is considered “handling” an exception

try/catch

- Try
  - Attempt to run a block of code
  - That code *might* throw some exception
- Catch
  - What exception to catch
  - How to handle it

try/catch

- Let's use try/catch with some built in java classes

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Exception Thrown!

try/catch

- We get to decide “where” the exception gets caught at
- What if there was multiple exceptions that could be thrown?

try/catch

- Say divide could throw two exceptions
- ArithmeticException
- NumberTooBigException
    - Let’s make this
    - What should this extend?

try/catch

- We can have multiple catch blocks
- Catch blocks are lazily evaluated
- Top to bottom

- Most specific → most general

finally

- Finally blocks *always* run
  - Even if you return inside of a try/catch

- Primarily used to clean up resources
  - *Please* don't use this for anything else
- Lets see that!

Aside: try-with-resources

- Your editor might give you a 💡 when you write a try/catch

```
try (FileInputStream in = new FileInputStream("input.txt")) {
        int data = in.read();
        System.out.println(data);
} catch (IOException e) {
        e.printStackTrace();
}
```

Stack Trace

- Common Exception methods
  - e.getMessage()
  - e.printStackTrace()
    - This is the console dump you have seen
  - Chain of methods = Call Stack

How to decide

- How should you pick a checked vs unchecked exception?

- Well one is annoying to deal with
- But is that good enough?

How to decide

- Cry in the dojo, fight in the battlefield
- Runtime Exceptions
    - You are not accepting that something could go wrong
  - Exception
    - Someone should deal with this problem

Review by Choice

Topics

- We have covered *a lot* already
  - Inheritance
  - Abstract Classes
  - Interfaces
  - Dynamic Dispatch
  - Implementation Separation
  - Data Modeling
  - Type Composition
  - Casting
  - Comparable/ator sorting
  - Copy Constructors
  - Checked/Unchecked Exceptions
  - try/catch/finally

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Software Testing and Debugging

Testing

- As you program more, your functions will get more complicated
- How can we ensure they work?

Testing

- Run your code a bunch
  - Is this enough?

- Would like a more rigorous system

Testing

- Want something that:
  - Will tell us when our code breaks
  - Tells us early if something goes wrong
  - Should test our code at an *atomic* level
- How would we accomplish this with our current tools?

Testing

- Two Programs?

- One to run all our of tests
  - Print the output if something isn't right
- One to actually run our program
  - Shouldn't interact with our test code

Testing

- This would get tedious very quickly
  - Does not scale as your team grows

- We should bring in a more rigorous system to solve this problem at scale

Aside: External Libraries

- Compile to a ".jar" file
- Let someone else use your code
- Your code provides a set of public:
  - Interfaces
  - Classes
  - Functions
  - Annotations*

Aside: External Libraries

- Compile with added jar files
- Must match directory structure

- VSCode → lib folder
- IntelliJ → File > Project Structure > Modules > [Your Module] > Dependencies

JUnit Library

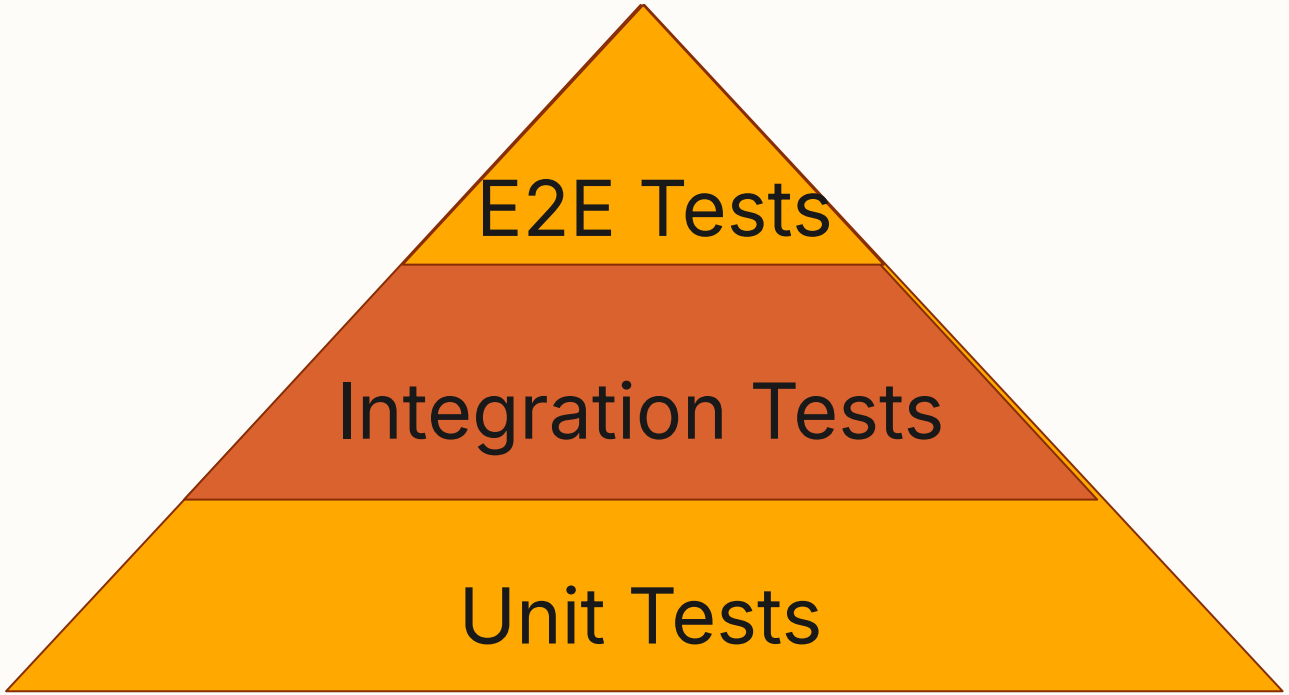
- JUnit is the de facto standard for testing
- File Conventions
  - Dog.java
  - DogTest.java

What does it mean to “test” a function

- Atomic level testing
- Smallest “unit” of code

- “Unit Testing” is the SE buzzword
- There are other types of testing

Aside: Types of Tests



How does JUnit work?

- Provides an @Test annotation
- Your editor will let you run just the test portion of the code

- Can run:
  - Individual Test
  - All tests in the class
  - All tests in the project

Actually writing test

- @Test
- public void [description]() { ... }

- Overly descriptive name
- Separate file just for test

Actually writing test

- Let’s write some test for some basic code
- Calculator.java

- We should put out code into CalculatorTests.java
- Can test for Exceptions too!

Test Driven Development

- Why am I doing this?
- How do problems look when they are given?

Test Driven Development

- Why am I doing this?
- How do problems look when they are given?

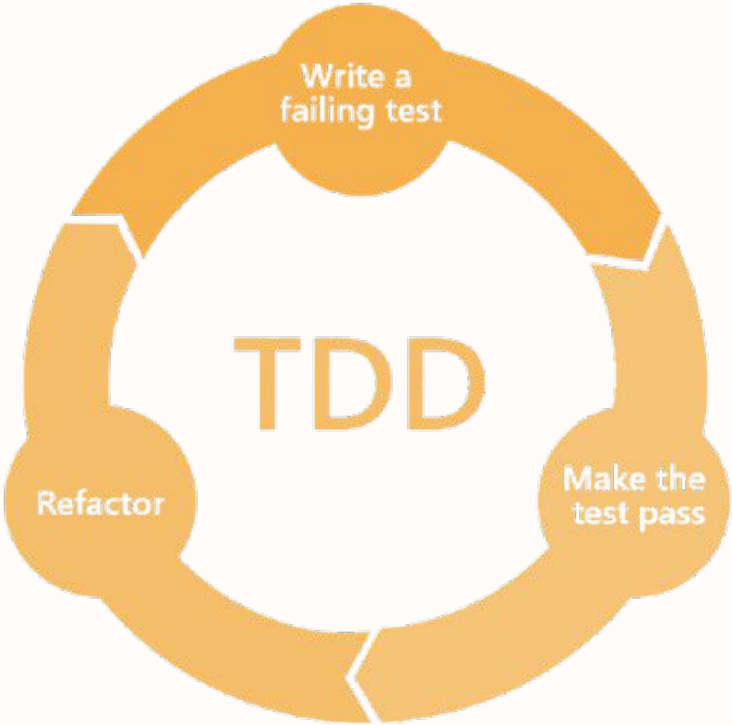
Test Driven Development

- This looks a lot like how tests work
- Why did we do that order of things?

Test Driven Development

- Code → Test?
- Test → Code?

- Iterate on this idea continuously



Test Driven Development

- Commonly seen in new projects
- Your boss will love this
- Not always the answer

Using TDD

- We have a function that does *a lot* of stuff
- processString() should:
  - Convert to lowercase
  - Remove all letter “z”s

Using TDD

- We know how processString() should work
- Write the tests first
- Then code it after
- Let’s do it

Using TDD

- New requirement just dropped
- Must pad string with “_ _ … _ _”
  - Fix code?
  - Fix tests?

Aside: Stateless tests

- Notice we only tested static methods
- How would we test non-static methods?
- We would need instances of everything our code relies on
- “Mocking” is how this is done IRL