Lecture 7

Review

Exceptions

IO

Review

Interfaces? Interfaces!

- It's a contract!
- If you must implement **ALL** the methods
- All fields are **`final`** (cannot be changed)

```
public interface ICar {
  boolean isCar = true;

  int getNumWheels();
}
```

BigRig

```
class BigRig implements ICar {
    int getNumWheels() {
          return 18;
    }
}
```

That Homework!

- Bouncer draws a Sprite that
  - Moves around
  - Bounces in a box
- A Sprite is an interface
  - You can draw anything
- Mover
  - Keeps updating the coordinates of a Sprite

An Oval Sprite

```
public class Oval implements Sprite {
    private int width, height;
    private Color color;

    public Oval(int width, int height, Color color) {
        // set the fields ...
    }

    public void draw(Graphics surface, int x, int y) {
        surface.setColor(color);
        surface.fillOval(x, y, width, height);
        surface.drawOval(x, y, width, height);
    }
   ...
}
```

A Mover that doesn’t bounce

```
public class StraightMover {
    private int x, y, xDirection, yDirection;
    private Sprite sprite;

    public StraightMover(int startX, int startY, Sprite sprite) {
        x = startX;
        y = startY;
        this.sprite = sprite;
    }
    public void setMovementVector(int xIncrement, int yIncrement) {
        xDirection = xIncrement;
        yDirection = yIncrement;
    }
    public void draw(Graphics graphics) {
        sprite.draw(graphics, x, y);
        x += xDirection;
        y += yDirection;
    }
}
```

Inheritance

Exceptions

I/O

Inheritance

Very *Very* Basic Inheritance

- Making a Game

```
public class Dude {
    public String name;
    public int hp = 100
    public int mp = 0;

    public void sayName() {
          System.out.println(name);
    }
    public void punchFace(Dude target) {
          target.hp -= 10;
    }
}
```

Inheritance..

- Now create a Wizard…

```
public class Wizard {
    // ugh, gotta copy and paste
    // Dude's stuff
}
```

Inheritance?

- Now create a Wizard…

But Wait!

A Wizard does and has everything a Dude does and has!

Inheritance?

- Now create a Wizard…

Don’t Act Now!

You don’t have to Copy & Paste!

Buy Inheritance!

- Wizard is a **subclass** of Dude

```
public class Wizard extends Dude {
}
```

Buy Inheritance!

- Wizard can use everything* the Dude has!

```
wizard1.hp += 1;
```

- Wizard can do everything* Dude can do!

```
wizard1.punchFace(dude1);
```

- You can use a Wizard like a Dude too!

```
dude1.punchface(wizard1);
```

*except for private fields and methods

Buy Inheritance!

- Now augment a Wizard

```
public class Wizard extends Dude {
    ArrayList<Spell> spells;
    public class cast(String spell) {
        // cool stuff here
        ...
        mp -= 10;
    }
}
```

Inheriting from inherited classes

- What about a Grand Wizard?

```
public class GrandWizard extends Wizard {
    public void sayName() {
      System.out.println("Grand wizard" + name)
    }
}

grandWizard1.name = "Flash"
grandWizard1.sayName();
((Dude)grandWizard1).sayName();
```

How does Java do that?

- What Java does when it sees

```
grandWizard1.punchFace(dude1)
```

1. Look for `punchFace()` in the GrandWizard class
2. It's not there! Does GrandWizard have a parent?
3. Look for `punchFace()` in Wizard class
4. It's not there! Does Wizard have a parent?
5. Look for `punchFace()` in Dude class
6. Found it! Call `punchFace()`
7. Deduct hp from dude1

How does Java do that? pt2

- What Java does when it sees

```
((Dude)grandWizard1).sayName()
```

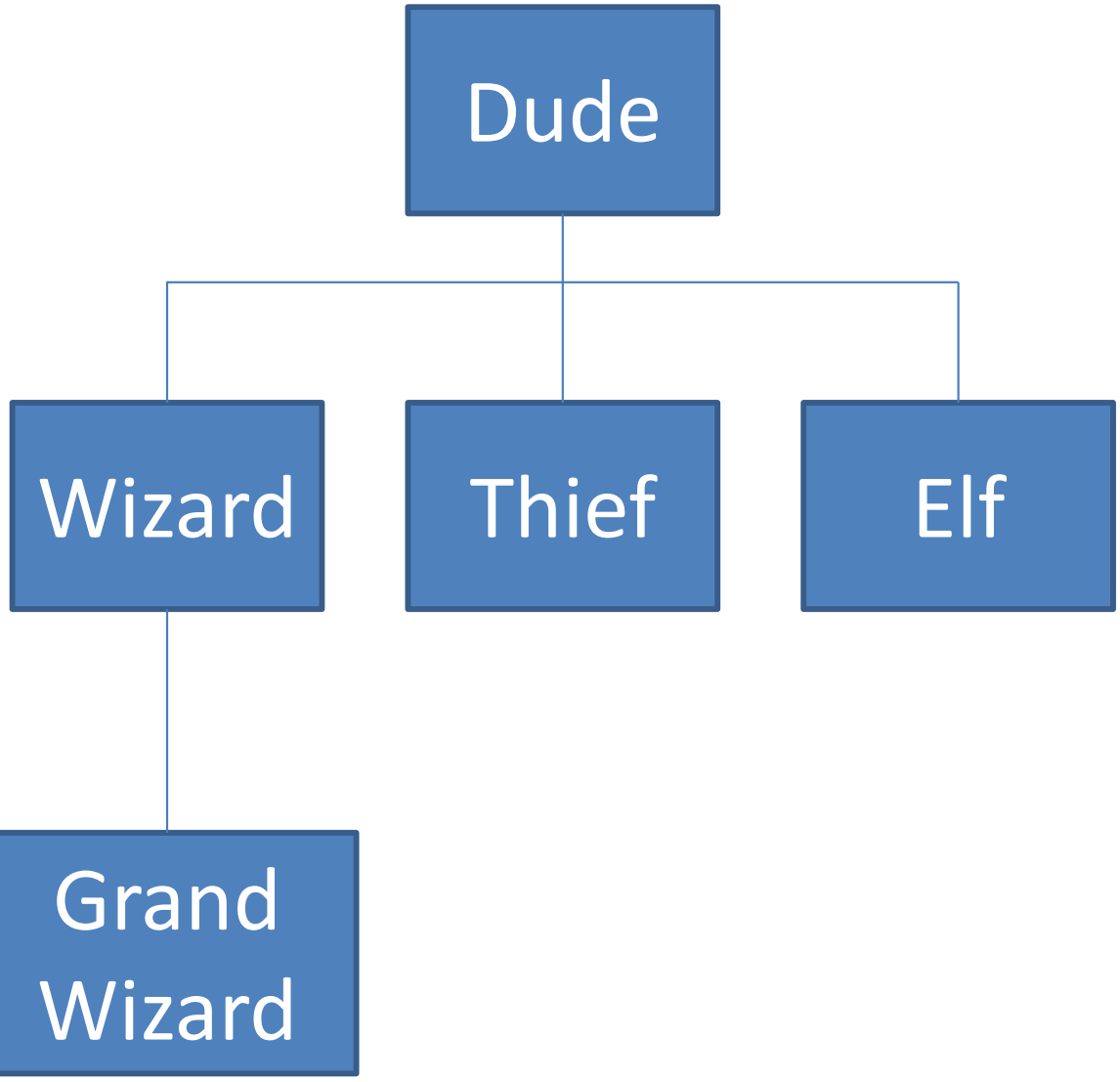
1. Cast to `Dude` tells Java to start looking in `Dude`
2. Look for `sayName()` in Dude class
3. Found it! Call `sayName()`

What's going on?

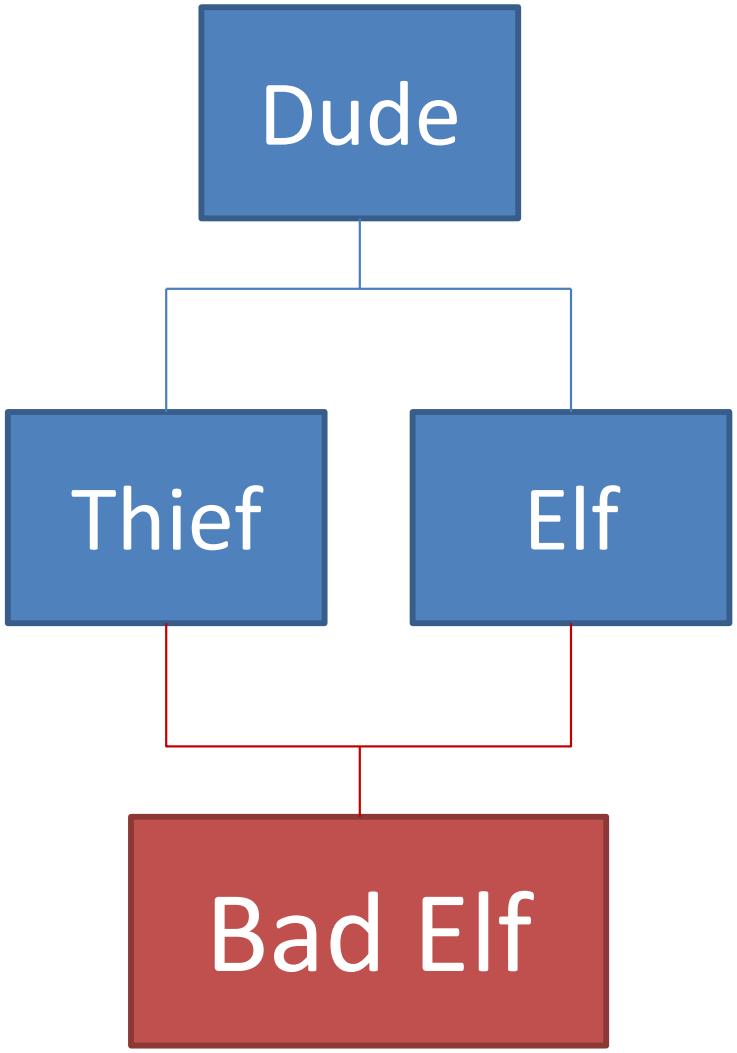
Parent of Wizard, Elf..

Subclass of Dude

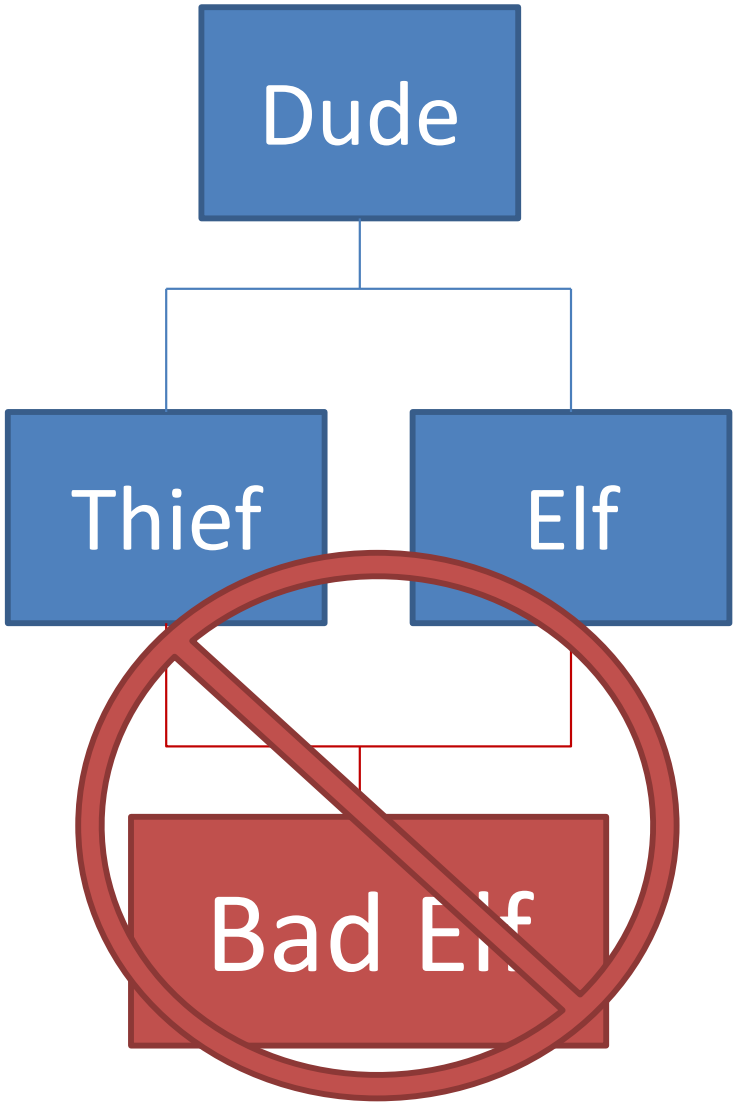
Subclass of Wizard



You can only inherit from one class



You can only inherit from one class



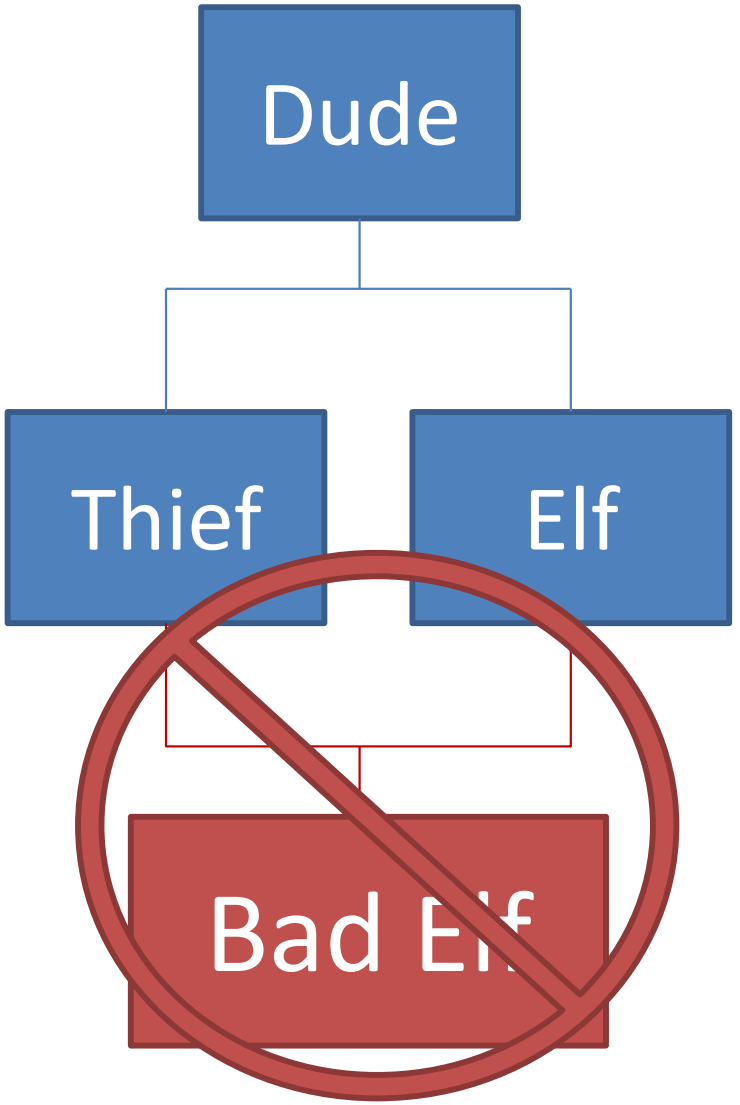
You can only inherit from one class

What if Thief and Elf both implement

```
public void sneakUp()
```

If they implemented differently, which `sneakUp()` does BadElf call?

Java Doesn't Know!!



Inheritance Summary

- class A extends B {} == A is a subclass of B
- A has all the fields and methods that B has
- A can add it's own fields and methods
- A can only have 1 parent
- A can replace a parent's method by re-implementing it
- If A doesn't implement something Java searches ancestors

So much more to learn!

- http://java.sun.com/docs/books/tutorial/java/IandI/subclasses.html
- http://home.cogeco.ca/~ve3ll/jatutor5.htm
- http://en.wikipedia.org/wiki/Inheritance_(computer_science)
- http://www.google.com

Exceptions

Exceptions

- NullPointerException
- ArrayIndexOutOfBoundsException
- ClassCastException
- RuntimeException

What is an “Exception”?

- Event that occurs when something “unexpected” happens
  - null.someMethod();
  - (new int[1])[1] = 0;
  - int i = “string”;

Why use an Exception?

- To tell the code using your method that something went wrong

```
Exception in thread "main"
  java.lang.ArrayIndexOutOfBoundsException: 5
  at RuntimeException.main(RuntimeException.java:8)
```

Accessed index 5, which isn't in the array

The method that called it was main

- Debugging and understanding control flow

How do exceptions “happen”?

- Java doesn’t know what to do, so it
  - Creates an Exception object
  - Includes some useful information
  - “throws” the Exception

- You can create and throw Exceptions too!

public class Exception

- Exception is a class
- Just inherit from it!

```
public class MyException extends Exception
{
}
```

- Or use existing ones
  - http://rymden.nu/exceptions.html

Warn Java about the Exception

```
public Object get(int index) throws
  ArrayOutOfBoundsException {
   If (index < 0 || index >= size())
      throw new
        ArrayOutOfBoundsException(“”+index);
}
```

- **`throws`** tells Java that `get` may throw the ArrayOutOfBoundsException
- **`throw`** actually throws the Exception (sorry)

Catching an Exception

- Java now expects code that calls `get` to deal with the exception by
  - Catching it
  - Rethrowing it

Catching it

- What it does
  - `try` to run some code that may throw an exception
  - Tell Java what to do if it sees the exception (`catch`)

```
try {
  get(-1);
} catch (ArrayOutOfBoundsException err) {
  System.out.println("oh dear!");
}
```

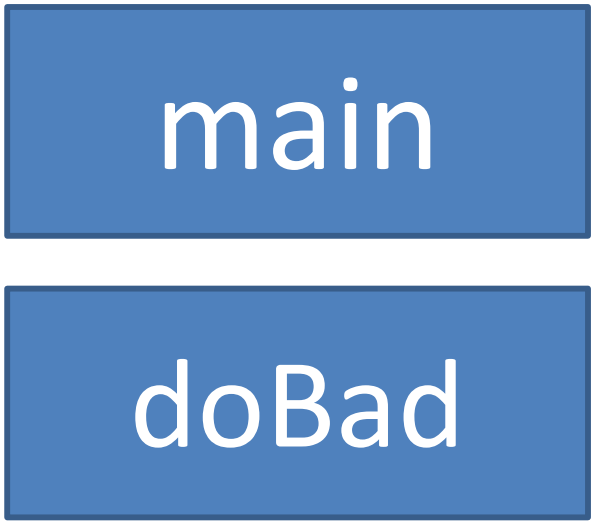
Rethrowing it

- Maybe you don’t want to deal with the Exception
- Tell Java that your method throws it too

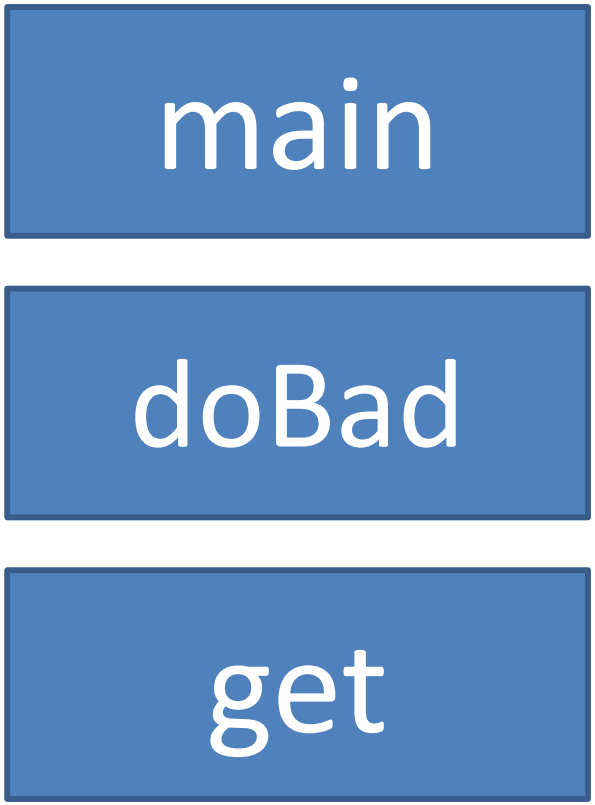
```
void doBad() throws ArrayOutOfBoundsException {
    get(-1);
}
```

Rethrowing it

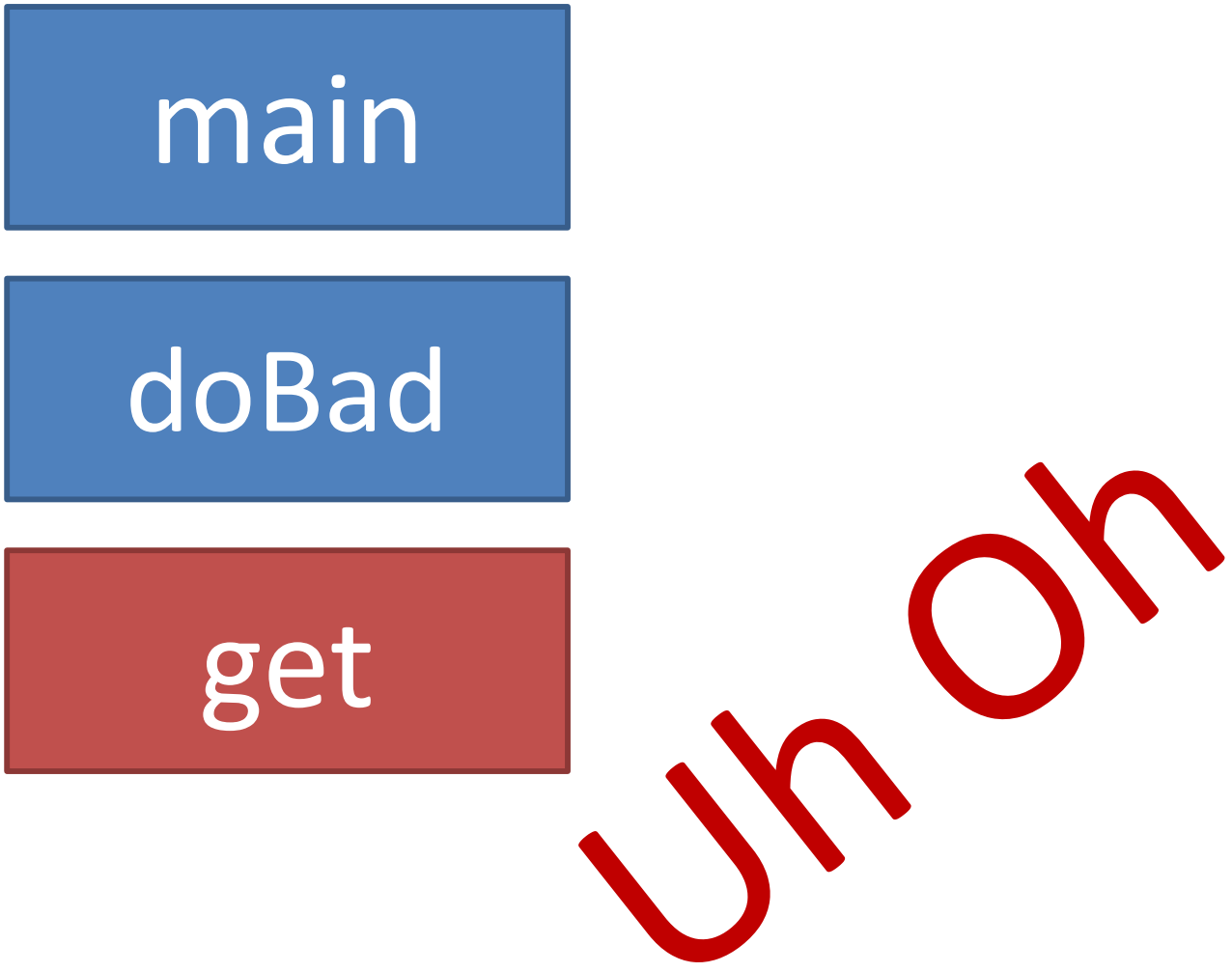
Rethrowing it



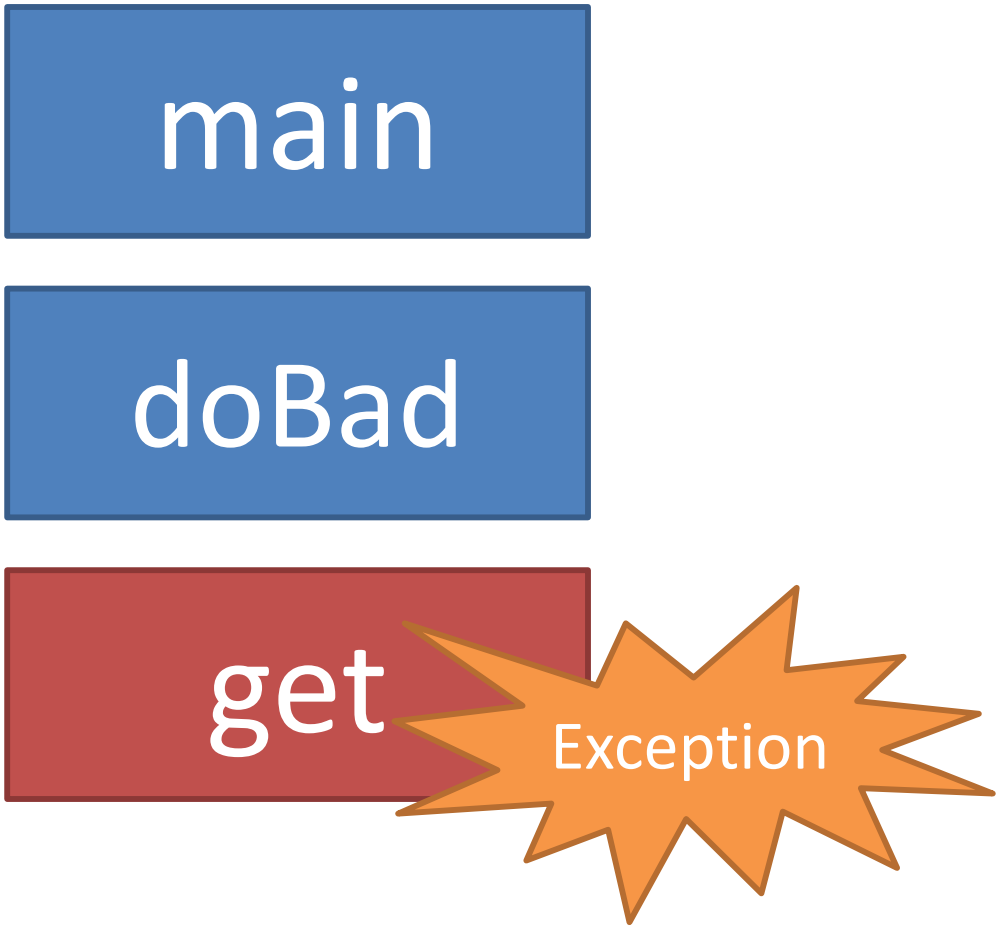
Rethrowing it



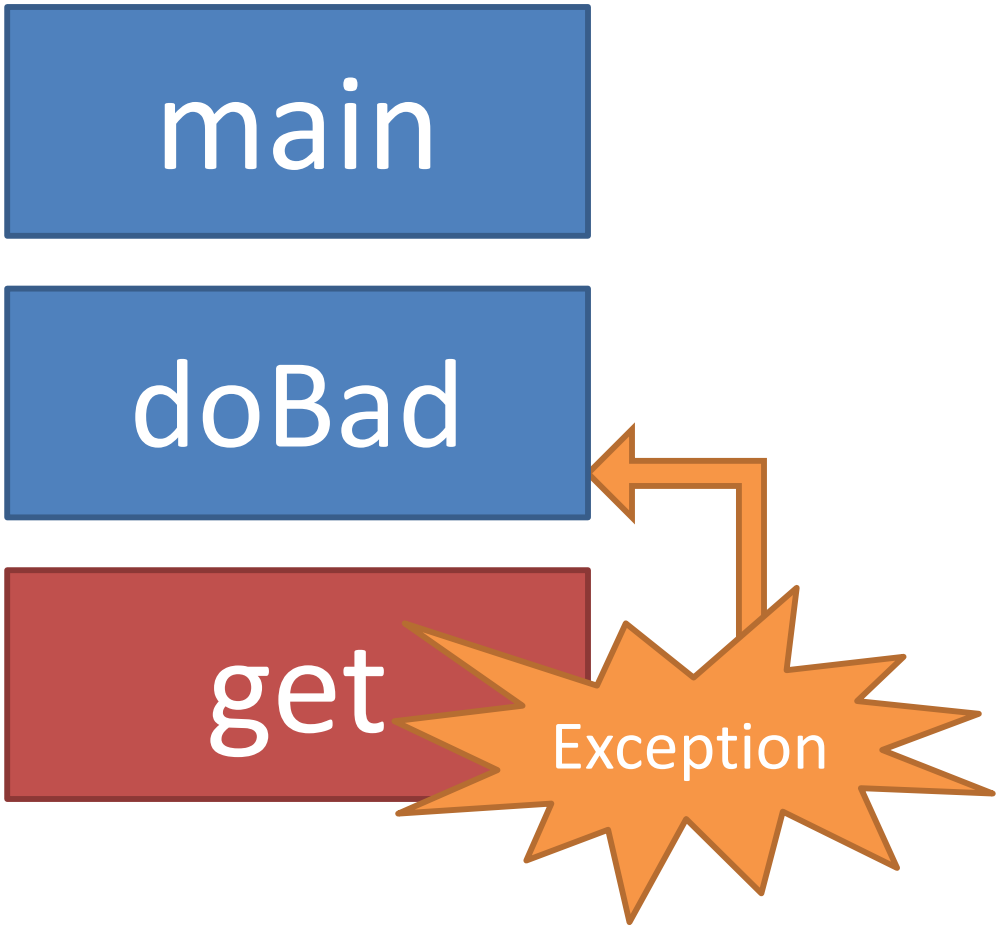
Rethrowing it



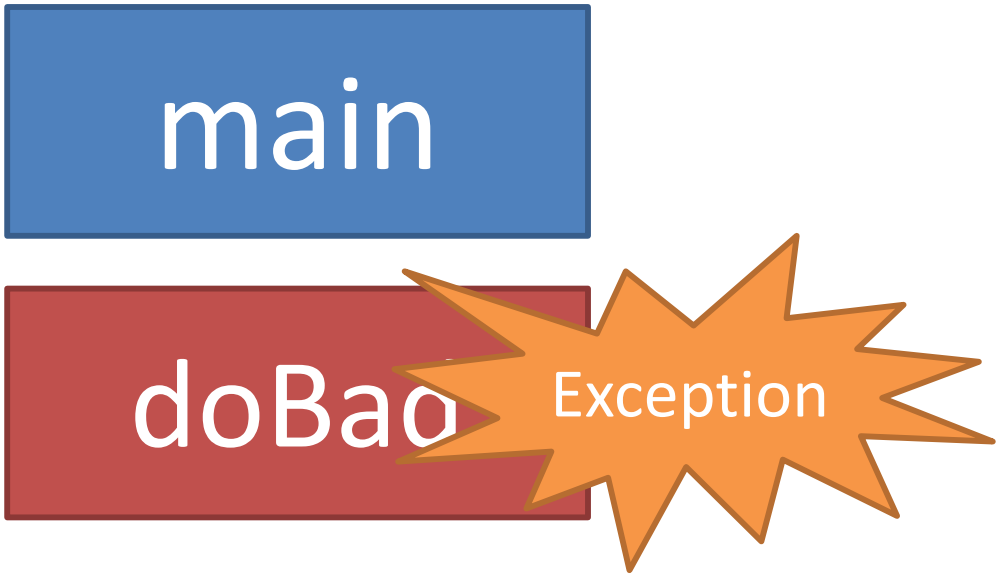
Rethrowing it



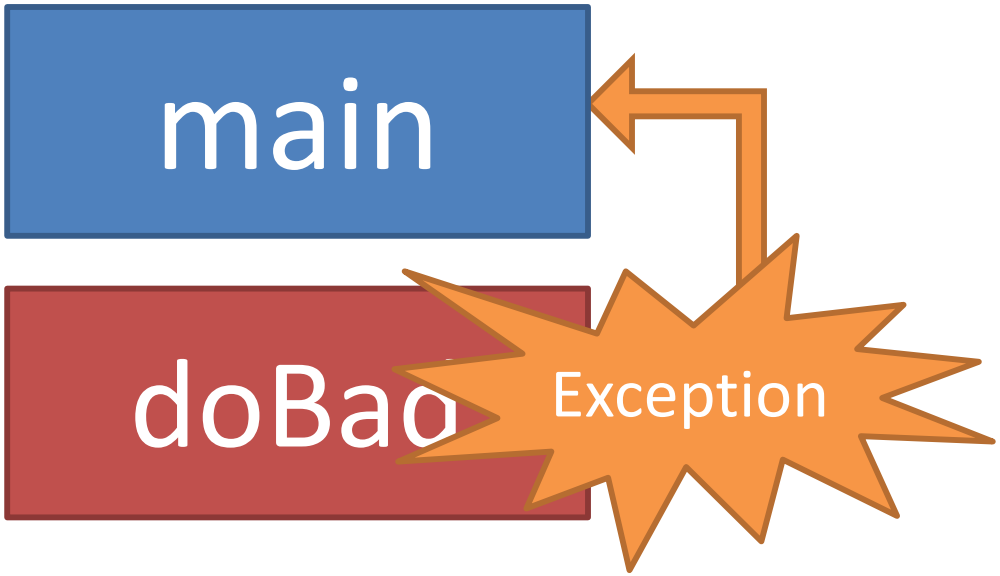
Rethrowing it



Rethrowing it

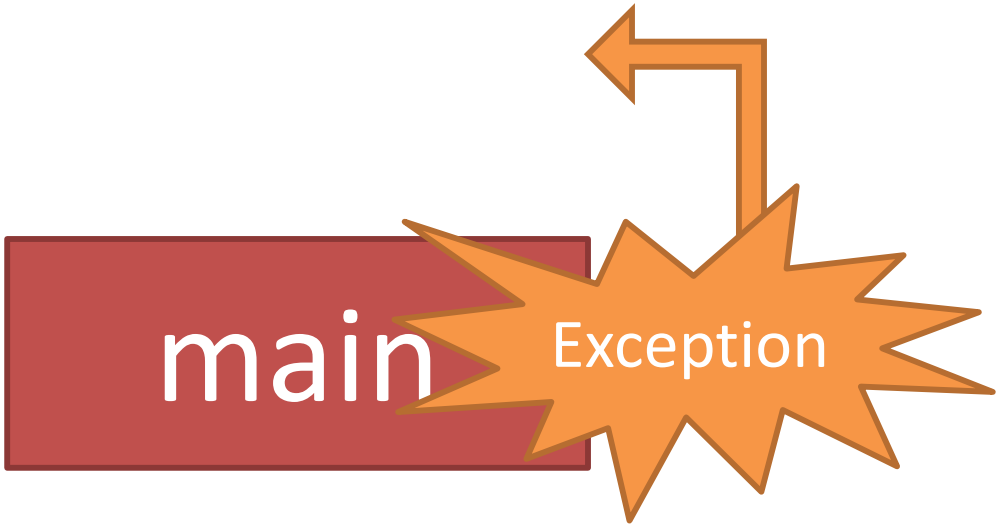


Rethrowing it



Rethrowing it

Rethrowing it



What it no one catches it?

- If you ran

```
public static void main(String[] args) throws Exception {
  doBad();
}
```

- Java will print that error message you see

```
Exception in thread "main"
java.lang.ArrayIndexOutOfBoundsException: -1
    at YourClass.get(YourClass.java:50)
    at YourClass.doBad(YourClass.java:11)
    at YourClass.main(YourClass.java:10)
```

More Info?

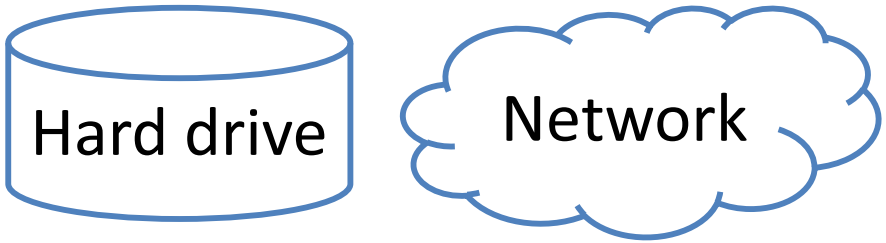
- http://java.sun.com/docs/books/tutorial/essential/exceptions
- http://en.wikipedia.org/wiki/Exceptions

I/O

We've seen Output

```
System.out.println("some string");
```

The Full Picture



1001010101010001010 …

InputStream

`System.in`

‘O’ ‘k’ ‘a’ ‘y’ ‘ ‘ ‘a’ ‘w’ ‘e’ …

InputStreamReader

“Okay awesome, cool\n” …

BufferedReader

InputStream

- InputStream is a stream of bytes
  - Read one byte after another using `read()`
- A byte is just a number
  - Data on your hard drive is stored in bytes
  - Bytes can be interpreted as characters, numbers..

```
InputStream stream = System.in;
```

InputStreamReader

- Reader is a class for character streams
  - Read one character after another using `read()`
- InputStreamReader takes an InputStream and converts bytes to characters
- Still inconvenient
  - Can only read a character at a time

```
new InputStreamReader(stream)
```

BufferedReader

- BufferedReader buffers a character stream so you can read line by line
  - `String readLine()`

```
new BufferedReader(
    new InputStreamReader(System.in));
```

User Input

```
InputStreamReader ir = new
    InputStreamReader(System.in);
BufferedReader br = new BufferedReader(ir);

br.readLine();
```

FileReader

- FileReader takes a text file
  - converts it into a character stream
  - FileReader(“PATH TO FILE”);

- Use this + BufferedReader to read files!

```
FileReader fr = new FileReader(“readme.txt”);
BufferedReader br = new BufferedReader(fr);
```

FileReader Code

```
import java.io.BufferedReader;
import java.io.FileReader;
import java.io.IOException;

public class ReadFile {

  public static void main(String[] args)  throws IOException{
    // Path names are relative to project directory (Eclipse Quirk )
    FileReader fr = new FileReader("./src/readme");
    BufferedReader br = new BufferedReader(fr);
    String line = null;
    while ((line = br.readLine()) != null) {
      System.out.println(line);
    }
    br.close();

  }
}
```

More about I/O

- http://java.sun.com/docs/books/tutorial/essential/io/

Assignment

- Magic Squares
- Read two files
- Check that all rows and columns sum to 15

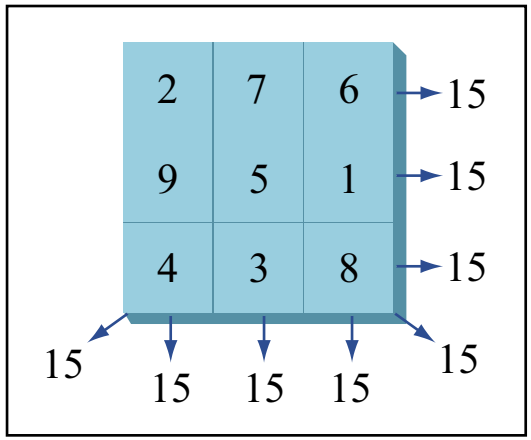


Figure by MIT OpenCourseWare.

6.092 Introduction to Programming in Java

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