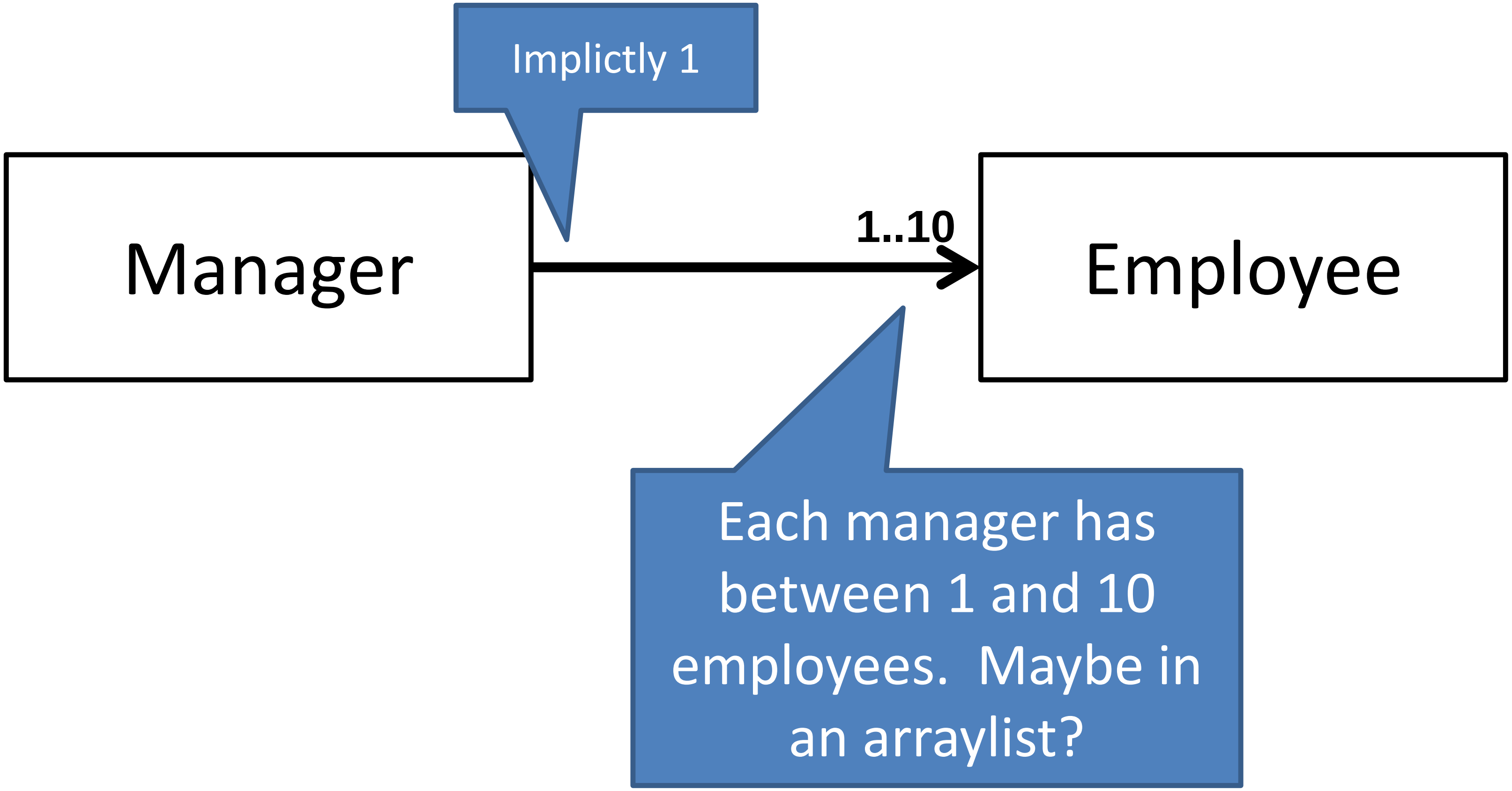
CSSE 220

Object-Oriented Design

Files & Exceptions

Check out *FilesAndExceptions* from SVN

New UML Notation: Cardinality



Implictly 1

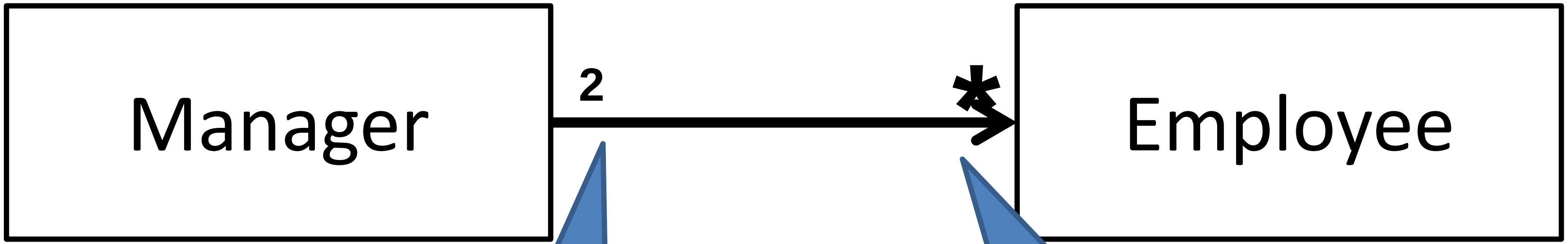
Manager

1..10

Employee

Each manager has between 1 and 10 employees. Maybe in an arraylist?

More Cardinality

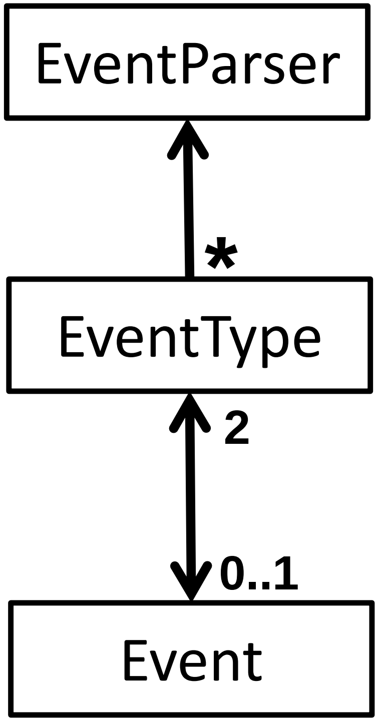


Every employee has exactly 2 managers. Note that this can be used even if there is no reference from Employee to Manager

Managers have any number of employees.

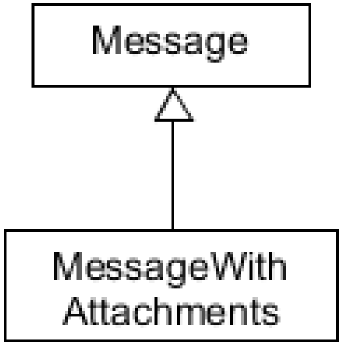
The * means “zero to infinity” – any arbitrary number. You can also occasionally see something like 4..* to mean 4 or more.

What does this diagram mean?

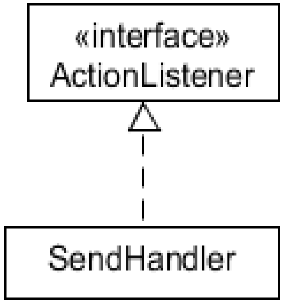


Summary of
UML Class Diagram Arrows

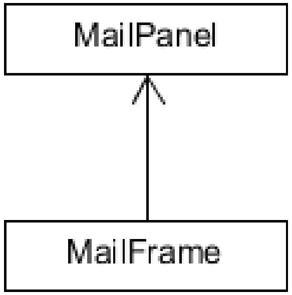
Inheritance
(is-a)



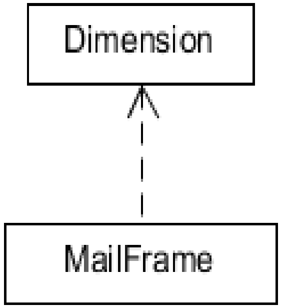
Interface
Implementation
(is-a)

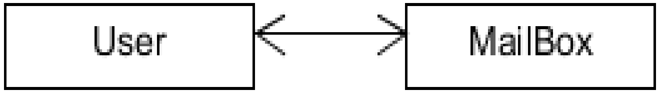


Association
(has-a-field)

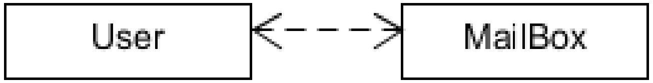


Dependency
(depends-on)

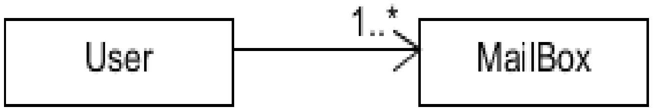




Two-way Association



Two-Way Dependency



Cardinality
(one-to-one, one-to-many)
One-to-many is shown on left

Q2

A practical technique

OBJECT-ORIENTED DESIGN

Object-Oriented Design

- We won’t use full-scale, formal methodologies
  - Those are in later SE courses

- We will practice a common object-oriented design technique using **CRC Cards**

- Like any design technique,
  the key to success is practice

Key Steps in Our Design Process

1. **Discover classes** based on requirements

2. **Determine responsibilities** of each class

3. **Describe relationships** between classes

Discover Classes Based on Requirements

- Brainstorm a list of possible classes
    - Anything that might work
    - No squashing

Discover Classes
Based on Requirements

- Prompts:
  - Look for **nouns**
  - Multiple objects are often created from each class
    - So look for **plural concepts**
  - Consider how much detail a concept requires:
    - A lot? Probably a class
    - Not much? Perhaps a primitive type

Tired of hearing this yet?

- Don’t expect to find them all → add as needed

Determine Responsibilities

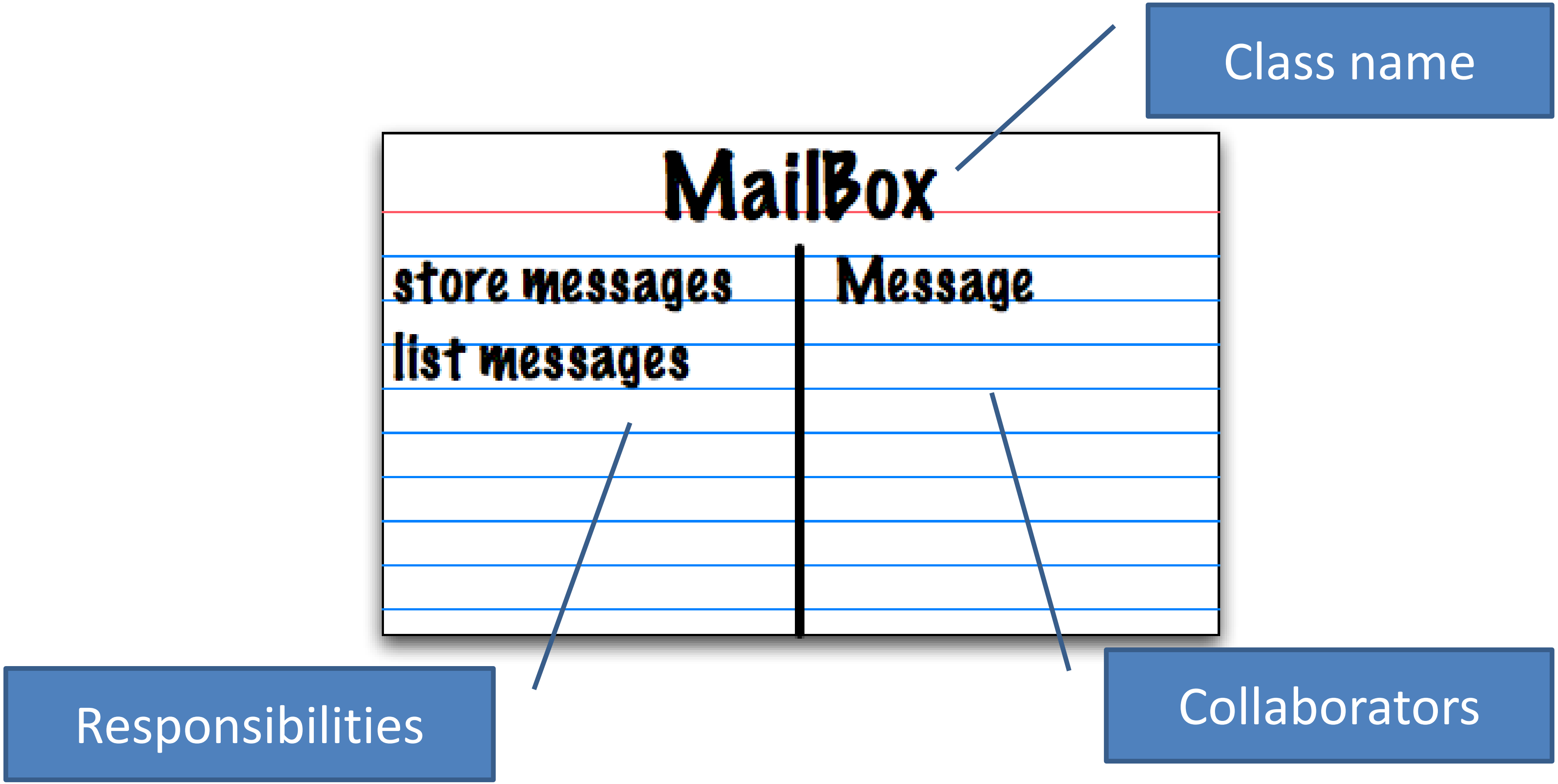
- Look for **verbs** in the requirements to identify **responsibilities** of your system

- Which class handles the responsibility?

- Can use **CRC Cards** to discover this:
  - **Classes**
  - **Responsibilities**
  - **Collaborators**

CRC Cards

- Use one index card per class



Class name

Responsibilities

Collaborators

Q1

CRC Card Tips

- **Spread the cards out** on a table
  - Or sticky notes on a whiteboard instead of cards
- **Use a “token”** to keep your place
  - A quarter or a magnet
- **Focus on high-level responsibilities**
  - Some say < 3 per card
- **Keep it informal**
  - Rewrite cards if they get too sloppy
  - Tear up mistakes
  - Shuffle cards around to keep “friends” together

CRC Card Technique

1. Pick a **responsibility** of the program
2. Pick a **class** to carry out that responsibility
   - Add that responsibility to the class's card
3. Can that class carry out the responsibility by itself?
   - Yes → Return to step 1
   - No →
     - Decide which classes should help
     - List them as **collaborators** on the first card

Use the email messaging system description given on today's handout to create CRC cards.

Describe the Relationships

- Classes usually are related to their collaborators

- Draw a UML class diagram showing how

- Common relationships:
  - **Inheritance**: only when subclass **is a** special case
  - **Dependency**: transient use of a type, usually for method parameters, **“has a” temporarily**
  - **Association**: **“has-a” field** of the specified type

When JFrame’s and JPanel’s defaults just don’t cut it.

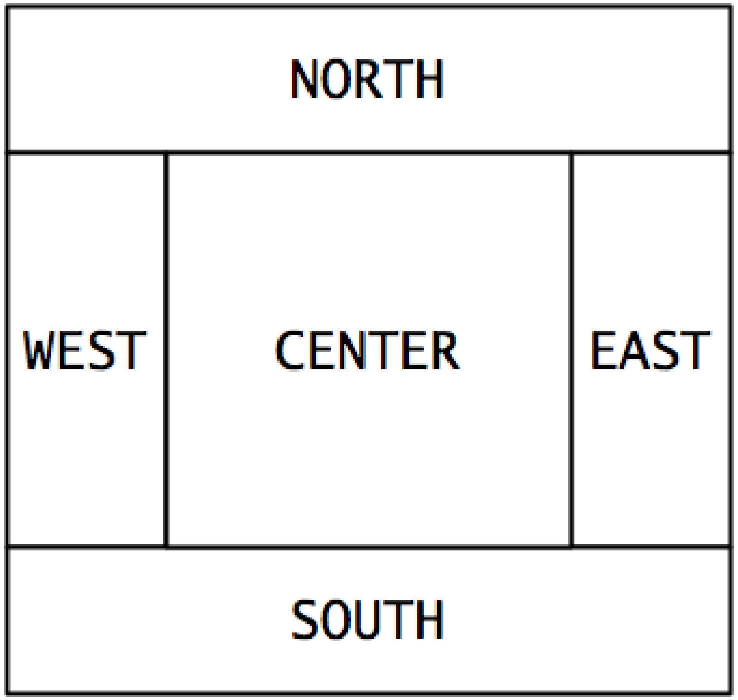
SOME NOTES ON LAYOUT MANAGERS

Recall: How many components can a JFrame show by default?

- Answer: 5
- We use the two-argument version of **add**:

-
  ```
  JPanel p = new JPanel();
  frame.add(p, BorderLayout.SOUTH);
  ```

- **`JFrame`**'s default **`LayoutManager`** is a **`BorderLayout`**
- **`LayoutManager`** instances tell the Java library how to arrange components
- **`BorderLayout`** uses up to five components



NORTH

WEST

CENTER

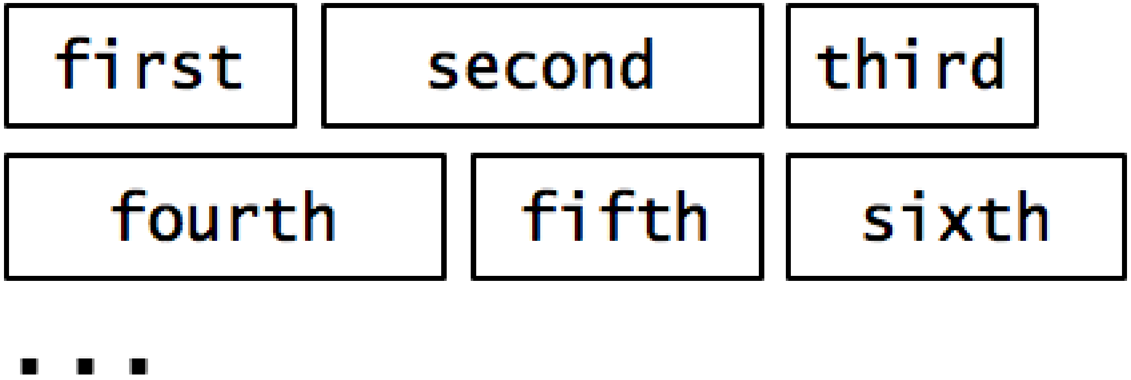
EAST

SOUTH

Recall: How many components can a JPanel show by default?

- Answer: arbitrarily many
- Additional components are added in a line

- **`JPanel`**'s default **`LayoutManager`** is a **`FlowLayout`**



first second third

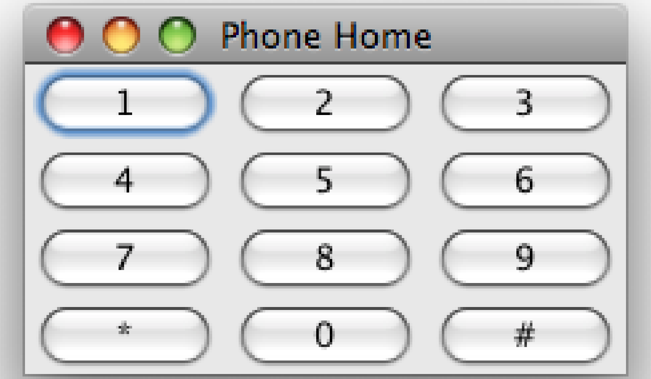
fourth fifth sixth

...

Setting the Layout Manager

- We can set the layout manager of a JPanel manually if we don’t like the default:

```
JPanel panel = new JPanel();
panel.setLayout(new GridLayout(4,3));
panel.add(new JButton("1"));
panel.add(new JButton("2"));
panel.add(new JButton("3"));
panel.add(new JButton("4"));
// ...
panel.add(new JButton("0"));
panel.add(new JButton("#"));
frame.add(panel);
```



Lots of Layout Managers

- A **LayoutManager** determines how components are laid out within a container
  - **BorderLayout**. When adding a component, you specify center, north, south, east, or west for its location. (Default for a JFrame.)
  - **FlowLayout**: Components are placed left to right. When a row is filled, start a new one. (Default for a JPanel.)
  - **GridLayout**. All components same size, placed into a 2D grid.
  - Many others are available, including **BoxLayout**, **CardLayout**, **GridBagLayout**, **GroupLayout**
  - If you use **null** for the **LayoutManager**, then you must specify every location using coordinates
    - More control, but it doesn't resize automatically

Q3-4

Reading & writing files

When the unexpected happens

FILES AND EXCEPTIONS

Review of Anonymous Classes

- Look at GameOfLifeWithIO
  - GameOfLife constructor has 2 listeners, two *local anonymous* class
  - ButtonPanel constructor has 3 listeners which are *local anonymous* classes
- Feel free to use as examples for your project

File I/O: Key Pieces

- Input: `File` and `Scanner`
- Output: `PrintWriter` and `println`
- ☺ Be kind to your OS: `close()` all files
- Letting users choose: `JFileChooser` and `File`
- Expect the unexpected: `Exception` handling
- Refer to examples when you need to…

Exception – What, When, Why, How?

- What:
  - Used to signal that something in the code has gone wrong
- When:
  - An error has occurred that cannot be handled in the current code
- Why:
  - Breaks the execution flow and passes exception up the stack

Exception – How?

- Throwing an exception:

```
throw new EOFException("Missing column");
```

- Handling (catching) an exception:

```
try {
    //code that could throw an exception
}
catch (ExceptionType ex) {
    //code to handle exception
}
```

- When caught you can:
  - Recover from the error OR exit gracefully

Q5

What happens when no exception is thrown?

```
Scanner inScanner;
try {
        inScanner =
                new Scanner(new File(“test.txt”);
        //code for reading lines
} catch (IOException ex) {
        JOptionPane.
                showMessageDialog("File not found.");
} finally {
        inScanner.close();
}
```

If this line is successful

Code continues on

The catch never executes

This runs after code in try completes

What happens when exception is thrown?

```
Scanner inScanner;
try {
        inScanner =
                new Scanner(new File(“test.txt”);
        //code for reading lines
} catch (IOException ex) {
        JOptionPane.
                showMessageDialog("File not found.");
} finally {
        inScanner.close();
}
```

If this line throws exception

Code after exception never executes

This is the next line executed

After catch is executed, this runs

When exception is not handled?

```
public String readData(String filename)
                    throws IOException {
     Scanner inScanner =
          new Scanner(new File(filename));
     //code for reading lines
     inScanner.close();
}
```

If this line throws exception

Code does not execute,
Method breaks immediately

If unhandled, exception bounces to method that called it, then up the chain.

main -> readAllFiles -> readData

A Checkered Past

- Java has two sorts of exceptions

1. **Checked exceptions**: compiler checks that calling code isn’t ignoring the problem
   - Used for **expected** problems

1. **Unchecked exceptions**: compiler lets us ignore these if we want
   - Used for fatal or avoidable problems
   - Are subclasses of RunTimeException or Error

A Tale of Two Choices

Dealing with checked exceptions

1. Can **propagate** the exception
   - Just declare that our method will pass any exceptions along…

```
public void loadGameState() throws IOException
```

   - Used when our code isn’t able to rectify the problem

1. Can handle the exception
   - Used when our code can rectify the problem

Q6

Handling Exceptions

- Use try-catch statement:

```
try {
    // potentially “exceptional” code
} catch (ExceptionType var) {
    // handle exception
}
```

Can repeat this part for as many different exception types as you need.

- Related, try-finally for clean up:

```
try {
    // code that requires “clean up”
} finally {
    // runs even if exception occurred
}
```

Q7