CSSE 220 Day 19

Object-Oriented Design

Files & Exceptions

Check out *FilesAndExceptions* from SVN

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

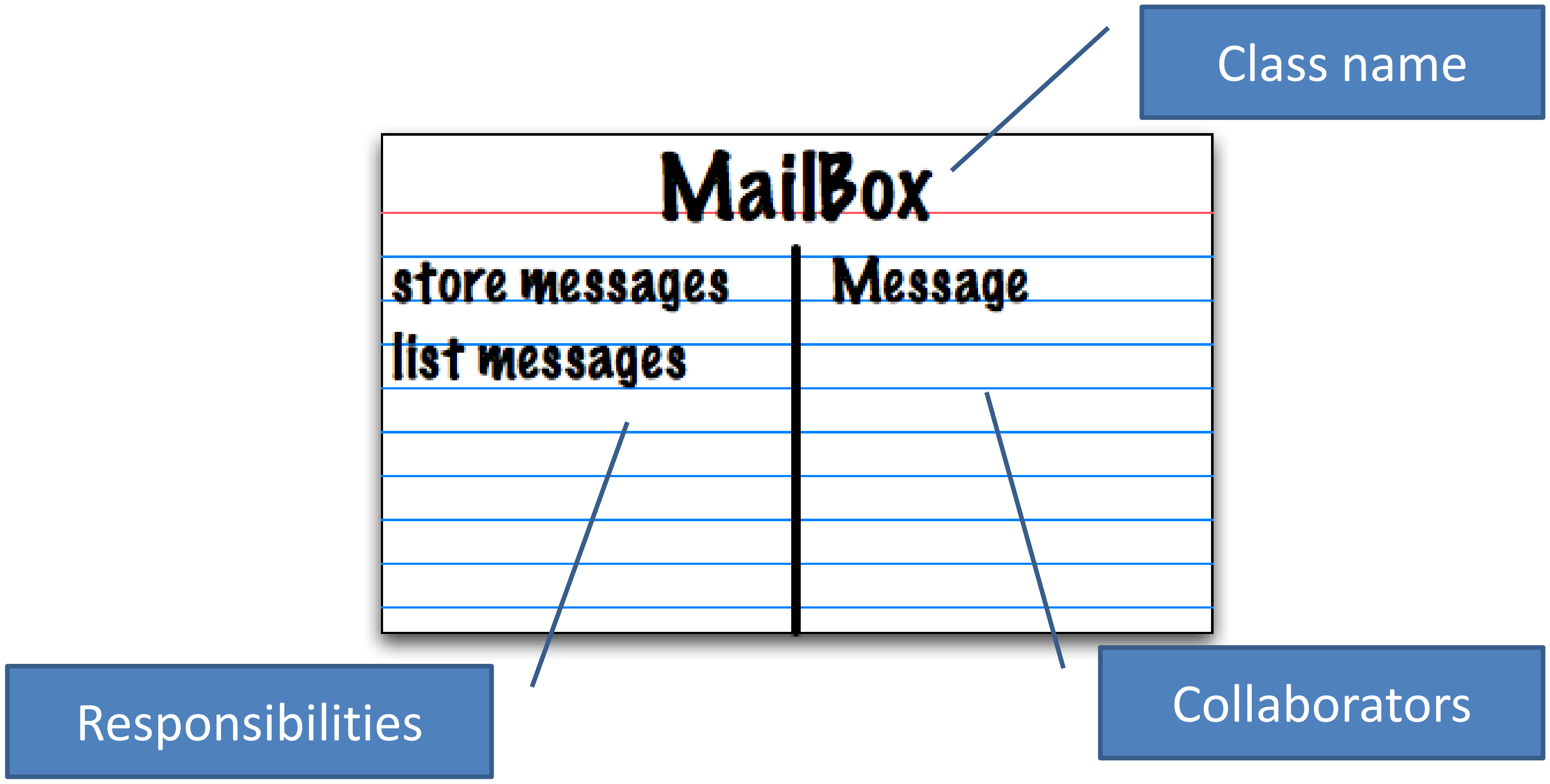
- Look for **verbs** in the requirements to identify **responsibilities** of your system

- Which class handles the responsibility?

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

CRC Cards

- Use one index card per class



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
     - `

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

BREAK

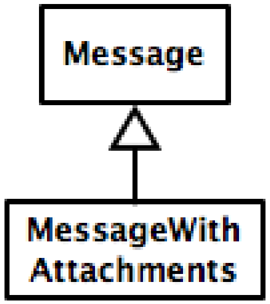
Describe the Relationships

- Classes usually are related to their collaborators
- Draw a UML class diagram showing how
- Common relationships:
  - **Inheritance**: only when subclass **is a** special case
  - **Aggregation**: when one class **has a** **field** that references another class
  - **Dependency**: like aggregation but transient, usually for method parameters, **"has a" temporarily**
  - **Association**: any other relationship, can label the arrow, e.g., **constructs**

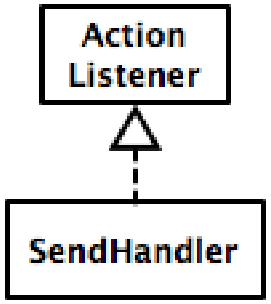
NEW!

Summary of UML Class Diagram Arrows

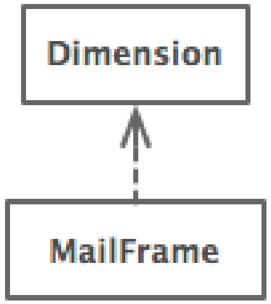
Inheritance (is a)



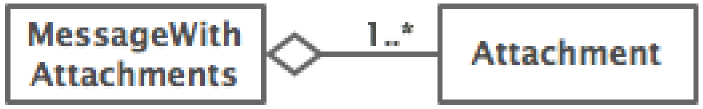
Interface Implementation (is a)



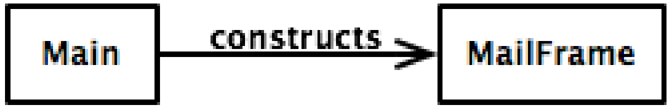
Dependency (depends on)



Aggregation (has a)



Association



Q4

Draw UML class diagrams based on your CRC cards

Initially just show classes
(not insides of each)

Add insides for two classes

OBJECT-ORIENTED DESIGN

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

SOME NOTES ON LAYOUT MANAGERS

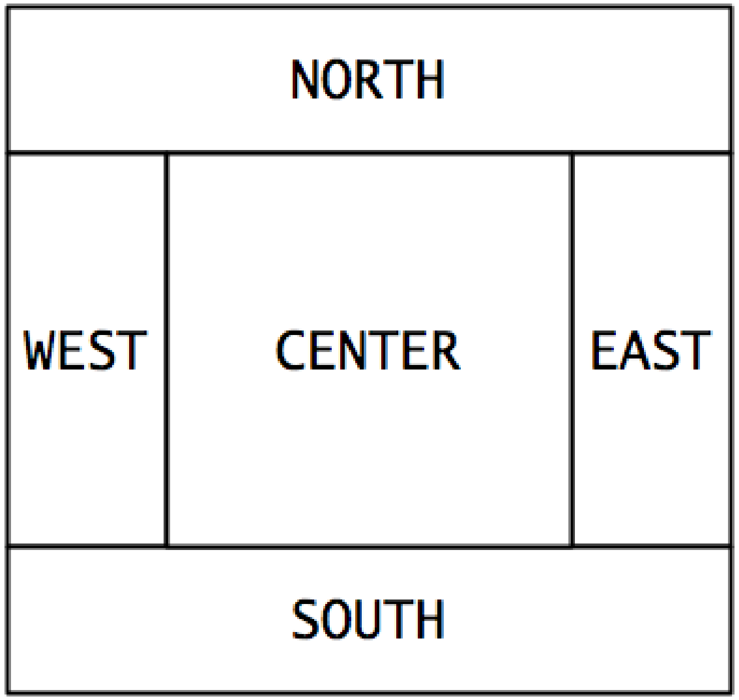
Recall: How many components can a JFrame show by default?

- 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

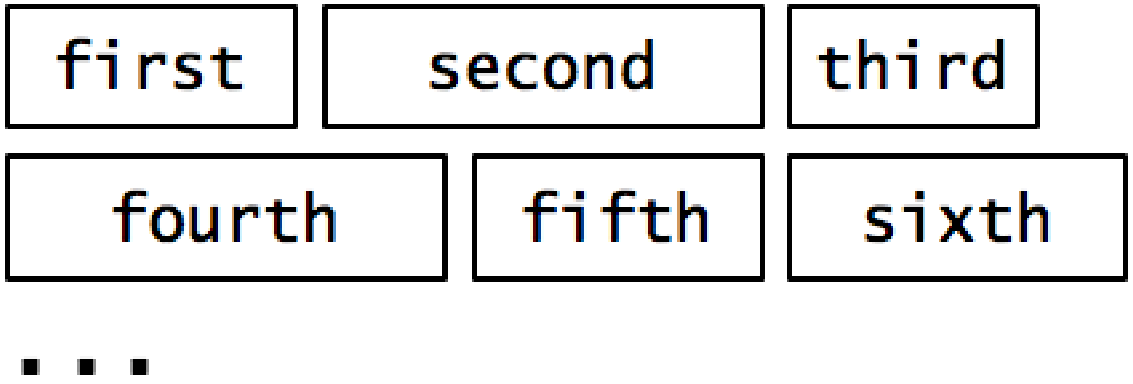
- **BorderLayout** uses up to five components



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

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

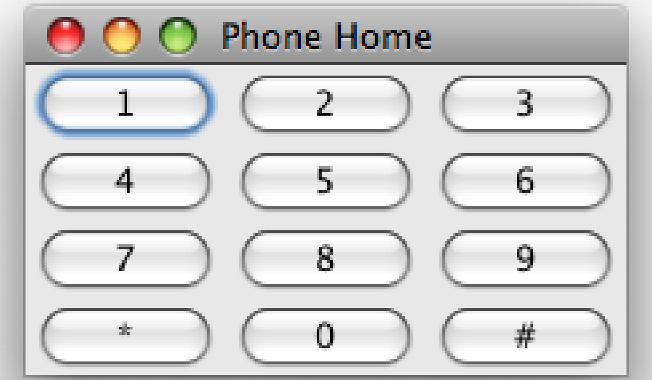
- **`JPanel`**'s default **`LayoutManager`** is a **`FlowLayout`**



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

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…

Q1-Q3

Exceptions

- Used to signal that something went wrong:

```
throw new EOFException(“Missing column”);
```

- Can be **caught** by **exception handler**
  - Recovers from error
  - Or exits gracefully

Q4

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

Q5-Q6

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

Q7

Handling Exceptions

- Use try-catch statement:

```
try {
    // potentially "exceptional
} 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
}
```

Q8-Q9