CSSE 220 Day 21

Object-Oriented Design

No SVN checkout today

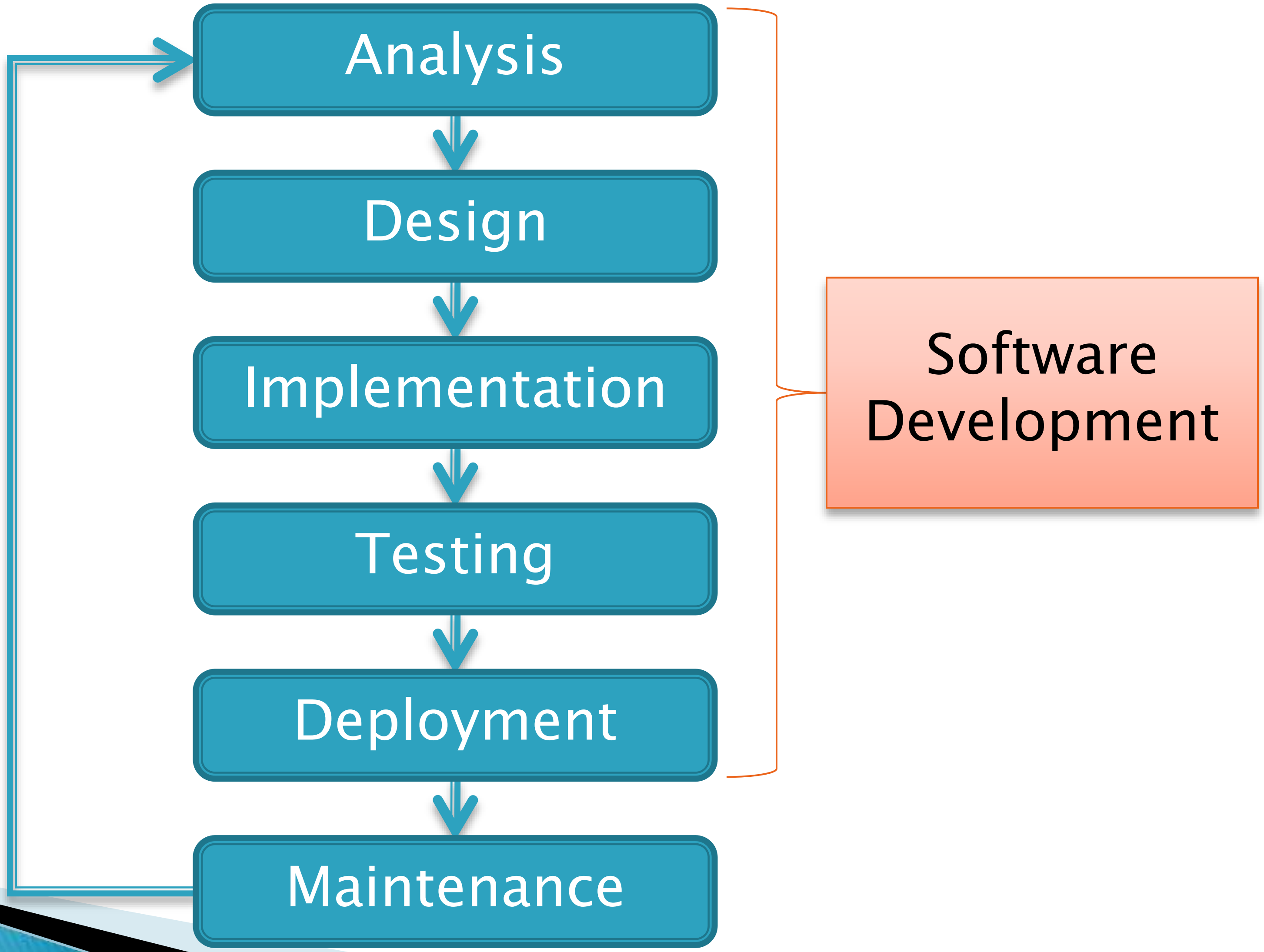
Questions?

Today's Plan

- Software development methods
- Object-oriented design with CRC cards
- LayoutManagers for Java GUIs
- BallWorlds work time

Software Development Methods

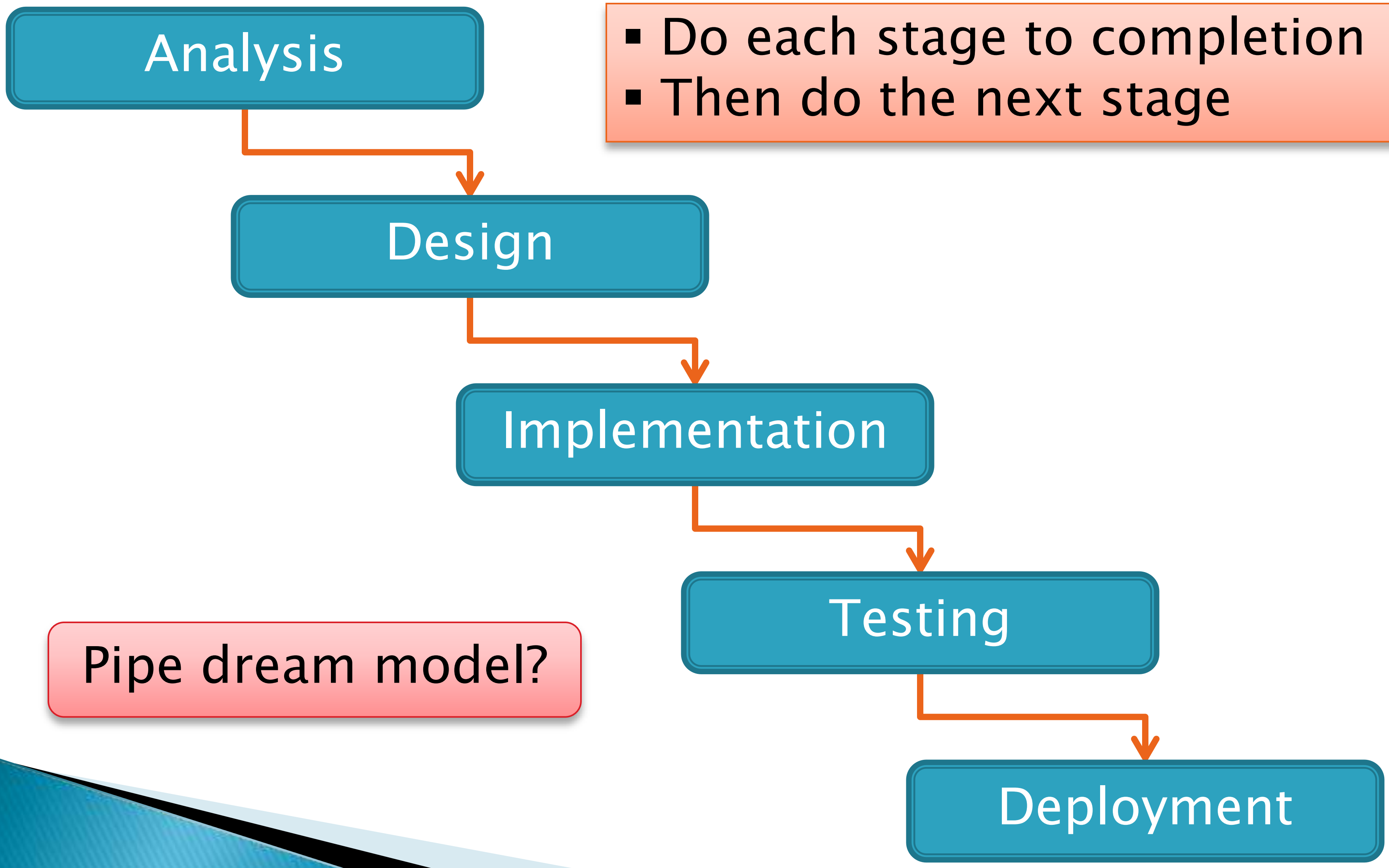
Software Life Cycle



Formal Development Processes

- Standardized approaches intended to:
  - Reduce costs
  - Increase predictability of results
- Examples:
  - Waterfall model
  - Spiral model
  - “Rational Unified Process”

Waterfall Model



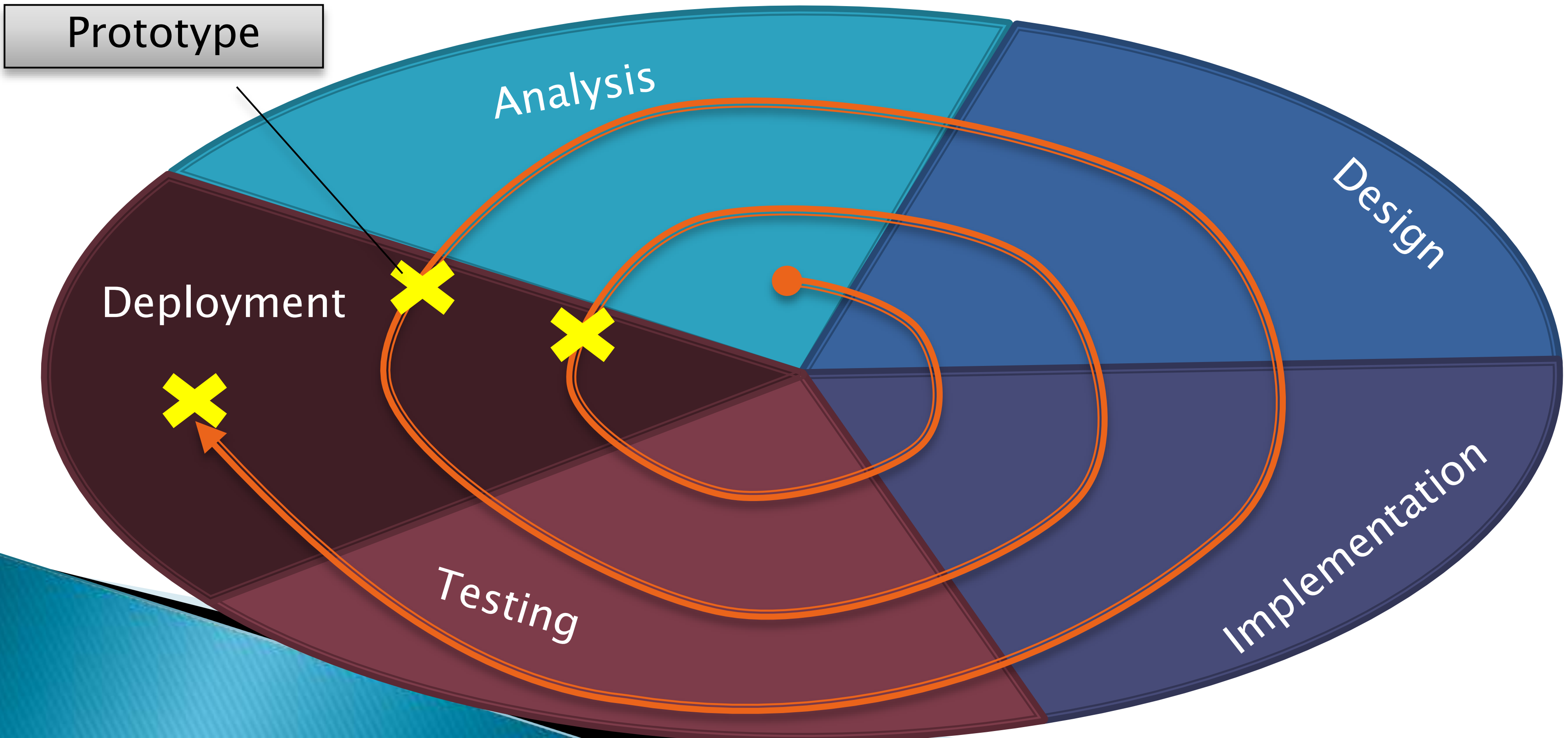
- Do each stage to completion
- Then do the next stage

Pipe dream model?

Spiral Model

- Schedule overruns
- Scope creep

- Repeat phases in a cycle
- Produce a prototype at end of each cycle
- Get early feedback, incorporate changes



Extreme Programming—XP

- Like the spiral model with **very** short cycles
- Pioneered by Kent Beck
- One of several "agile" methodologies, focused on building high quality software quickly
- Rather than focus on rigid process, XP espouses 12 key practices…

The XP Practices

- Realistic planning
- Small releases
- Shared metaphors
- Simplicity
- **Testing**
- **Refactoring**
- **Pair programming**
- Collective ownership
- Continuous integration
- 40-hour week
- On-site customer
- **Coding standards**

When you see opportunity to make code better, do it

Use descriptive names

Q1

Object-Oriented Design

- A practical technique

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

Q2

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?

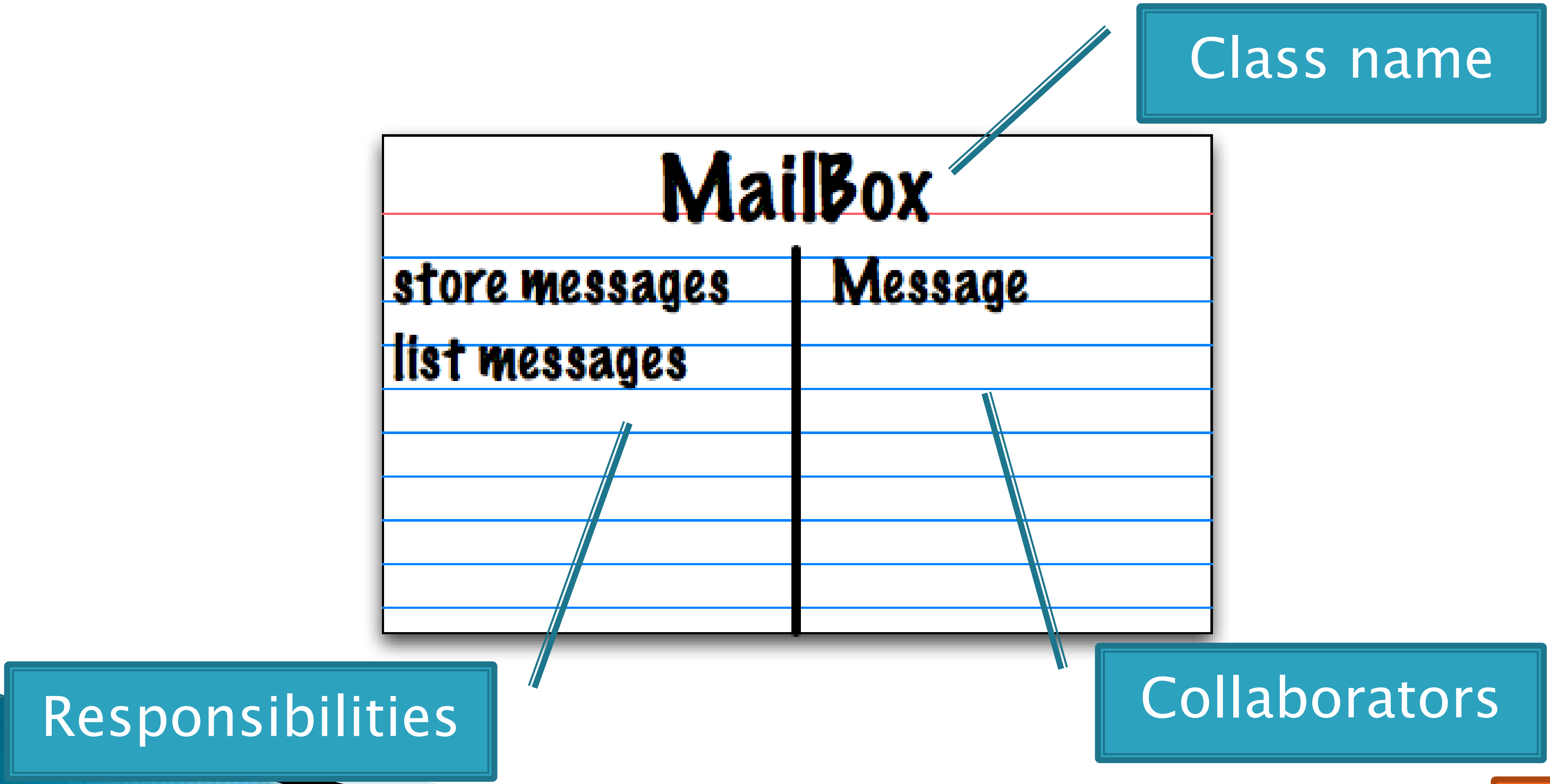
- Don't expect to find them all → add as needed

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



Q3

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
        - Add additional responsibilities to the collaborators' cards

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

- These go to 11

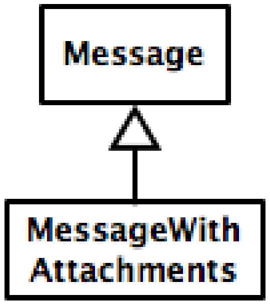
Describe the Relationships

- 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**

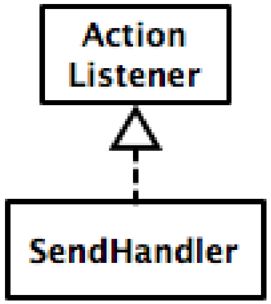
NEW!

Summary of UML Class Diagram Arrows

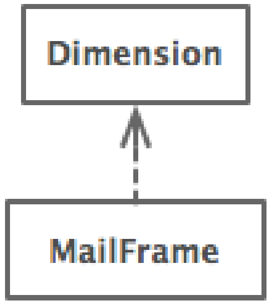
Inheritance (is a)



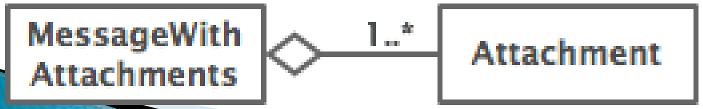
Interface Implementation (is a)



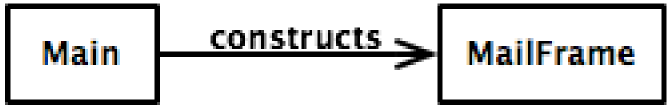
Dependency (depends on)



Aggregation (has a)



Association



Q4

Object-Oriented Design

- Draw UML class diagrams based on your CRC cards
- Initially just show classes (not insides of each)
- Add insides for two classes

Some Notes on Layout Managers

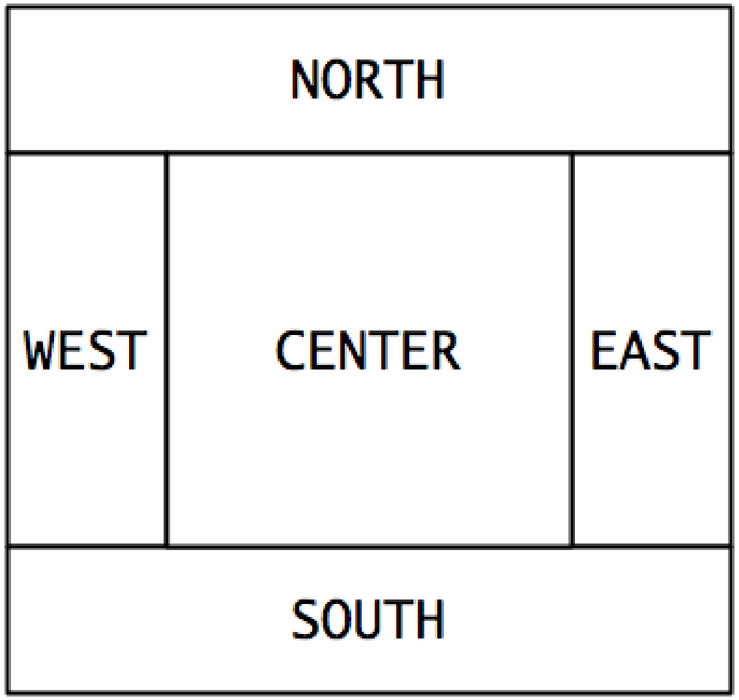
- When JFrame’s and JPanel’s defaults just don’t cut it.

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

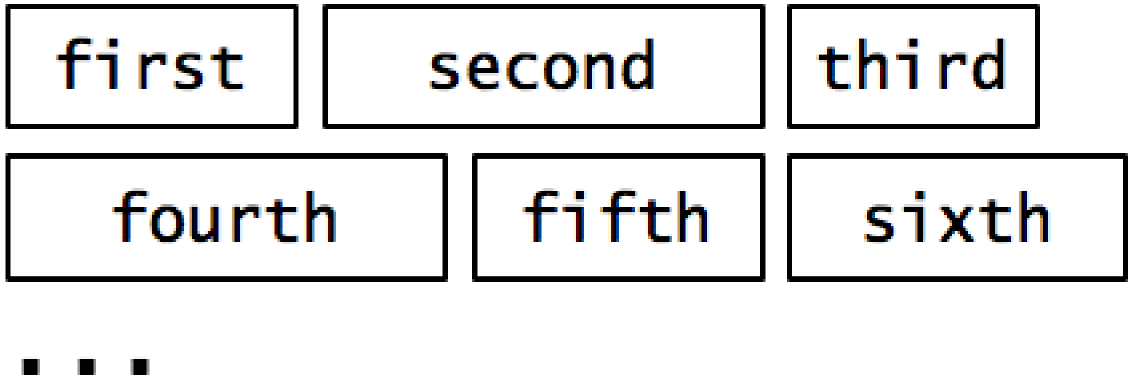


Q5

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

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

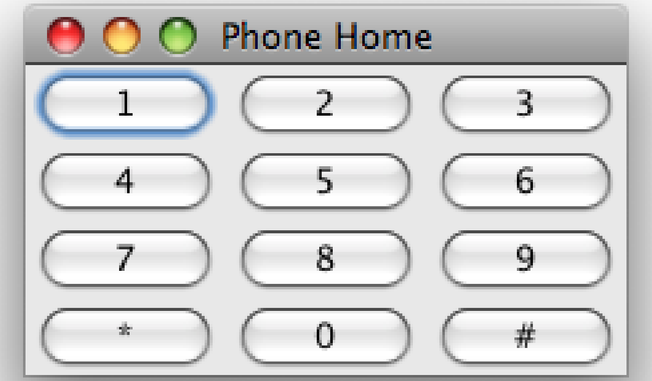
- **JPanel**'s default **LayoutManager** is a **FlowLayout**



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 the **null** for the **LayoutManager**, then you must specify every location using coordinates
    - More control, but it doesn't resize automatically

Q6

Additional Resources on Layout Managers

- Chapter 18 of Big Java

- Swing Tutorial
  - http://java.sun.com/docs/books/tutorial/ui/index.html
  - Also linked from schedule

Work Time

- BallWorlds

Q7–Q8