CSE 142

Objects, Values and Types

Outline

- Role-Playing Demonstration
- Discussion of Demonstration

- Major concepts
  - More about objects (properties and responsibilities)
  - Types
  - Values
  - State
  - Queries and commands (messages)

Acrobats Role-Playing

- We have objects that are basically responsible for knowing how to:
  - Clap
  - Twirl
  - TellCount
- We have different types of such objects, with slightly different responsibilities:
  - Acrobat
  - Choreographer
  - AcrobatWithBuddy
  - Actor
  - Curmudgeon

What did we see? (1)

- Acrobats as objects
  - What are their properties?
  - What are their responsibilities?
- Values: pieces of information manipulated by a program
  - Examples: numbers, characters, point on a plane
  - What values did we see?
- State
  - The collection of property values in an object is called its *state*
  - Values (state) of objects can change over time
  - How did values change?

What did we see? (2)

- Commands and Queries
  - Examples from demonstration?
  - *Commands* can change the state of an object
  - *Queries* determine values associated with an object
- Commands and queries are *messages*
  - May include *Parameters* to pass information
  - May include *Return values*
    - Queries always return a value
  - Chained messages
- Errors
  - Did we see any errors?

Values

- Information manipulated by a program
- May describe a property of an object
- Examples: numbers, characters, point on a plane
- Simple vs. Composite values
  - *Atomic* (or *simple* or *elementary*) values: cannot be broken down
  - *Composite* values: composed of multiple simple values

  Are the following values atomic or composite?
  a. 3
  b. "welcome"
  c. The point (3,5) on the Cartesian plane
  d. M
  e. 2.9783

State

- At any given time, a particular object can be described by the *values* of its properties.
- The set of all an object's values is called its *state*
- The state of an object changes over time

Types

- Type: Set of possible *values* and associated *operations*
- Example: integers with +, -, /, *
  - The *values* are the numbers 0, 1, -1, 2, -2, etc.
  - The *operations* are addition, subtraction, division, and multiplication
- The operations have to be defined somehow
  - For addition, it may be obvious
  - For division... not necessarily obvious. What is 4/3?
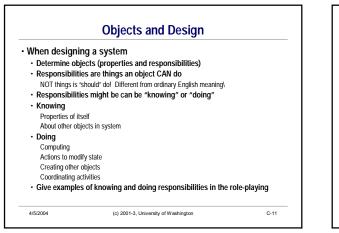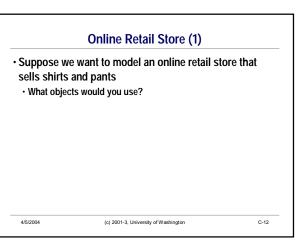
Some Types

Primitive types (Yes, this is real Java!)

```
type name      sample values        operations
  int
  double
  char
  boolean
  etc.
```

Object types (composites)

```
type name      sample values        operations
  2D Points
  Strings
  Acrobats
  etc.
```

Technical Terminology

- *type, value, object, state, message, command, query, parameter, return value...*
- These are not just random English words
- They are widely used in programming, with specific technical meanings
- Unfortunately, giving precise technical definitions for some of them is difficult
  - especially at this stage of the course
- Nevertheless, try to use the terms, and use them appropriately!
- {Are those previous two statements contradictory??}

Objects and Design

- When designing a system
  - Determine objects (properties and responsibilities)
  - Responsibilities are things an object CAN do
    NOT things is "should" do! Different from ordinary English meaning\
  - Responsibilities might be can be "knowing" or "doing"
  - Knowing
    Properties of itself
    About other objects in system
  - Doing
    Computing
    Actions to modify state
    Creating other objects
    Coordinating activities
  - Give examples of knowing and doing responsibilities in the role-playing

Online Retail Store (1)

- Suppose we want to model an online retail store that sells shirts and pants
  - What objects would you use?

Online Retail Store (2)

- Let's model a shirt:
  - <u>Property</u>   <u>Type</u>   <u>Value</u>

Online Retail Store (3)

- Shirt
  - <u>Responsibility</u>   <u>Command or Query</u>   <u>Changes state?</u>

Online Retail Store (4)

- Let's model an online shopping cart
  - <u>Property</u>   <u>Type</u>   <u>Value</u>

Online Retail Store (5)

- Online shopping cart
  - <u>Responsibility</u>   <u>Command or Query</u>   <u>Changes state?</u>

Summary

- Values are pieces of information manipulated by a program
- A type consists of a set of values and operations on those values
- Objects have properties with associated values
- The set of property values is the state of the object
- Objects have responsibilities that consist of queries and commands (messages that are passed to the object)