CMSC 132: OBJECT-ORIENTED PROGRAMMING II

Design

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Few Things About Projects

- Remember that we take academic integrity very seriously. We have software tools that allow us to:
  - Compare all students projects (even across sections)
  - Changing variable names, and spacing is something our tools recognize
- You should try to submit your project often
  - Even though through CVS you can get previous project versions, using the submit server is easier

About JUnit Tests

- Remember: you need to bring StudentTest to office hours
- Study public tests so you understand what they are testing
- Expected results are in the actual tests or in text files that are part of your project
- You can add output statements so you can see the your program results

```
public void testSumBasic() {
    /* test code goes here */
    output += result[result.length-1];

    /* We don't need to print the result */
        /* Just to show we can see results from our code */
    System.out.println(output);

    assertEquals("1,3,6,10,15,21", output);
}
```

- Be careful and don’t modify public test (copy test to StudentTest file)
- You can step through tests using the debugger

Applying Object-Oriented Design

- Look at objects participating in system
  - Find nouns in problem statement (requirements & specifications)
  - Noun may represent class/variables needed in design
  - Relationships (e.g., “has” or “belongs to”) may represent fields
- Look at interactions between objects
  - Find verbs in problem statement
  - Verb may represent message between objects
- Design classes accordingly
  - Determine relationship between classes
  - Find state & methods needed for each class

Classes

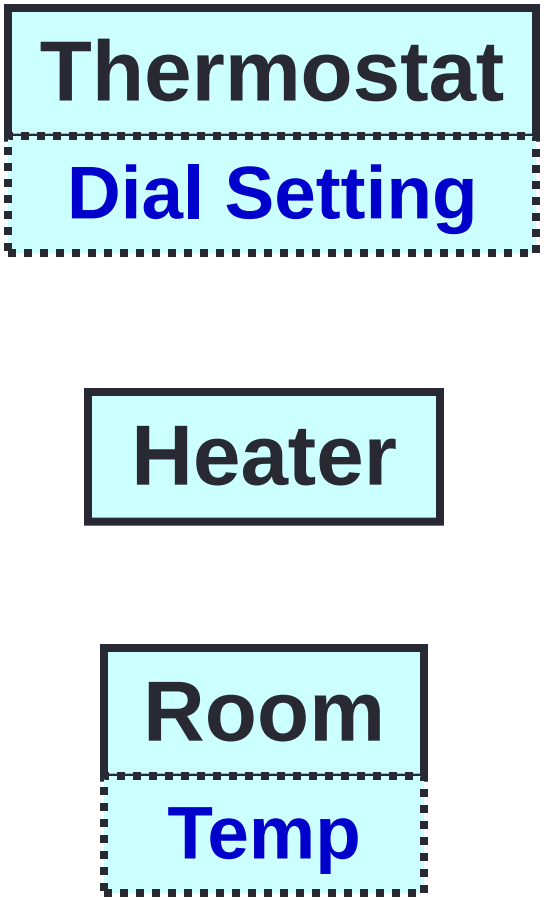
- A class or interface defines and describes a set of objects
- It describes a set of methods or messages that the object responds to
  - Not only the name and signature of the method, but the contract the method respects
- Classes also provide/describe fields and method implementations

1) Finding Classes

- Thermostat uses dial setting to control a heater to maintain constant temperature in room
- Nouns
  - Thermostat
  - Dial setting
  - Heater
  - Temperature
  - Room
- Analyze each noun
  - Does noun represent class needed in design?
  - Noun may be outside system
  - Noun may describe state in class

Analyzing Nouns

- Thermostat
  - Central class in model
- Dial setting
  - State in class (Thermostat)
- Heater
  - Class in model
- Room
  - Class in model
- Temperature
  - State in class (Room)



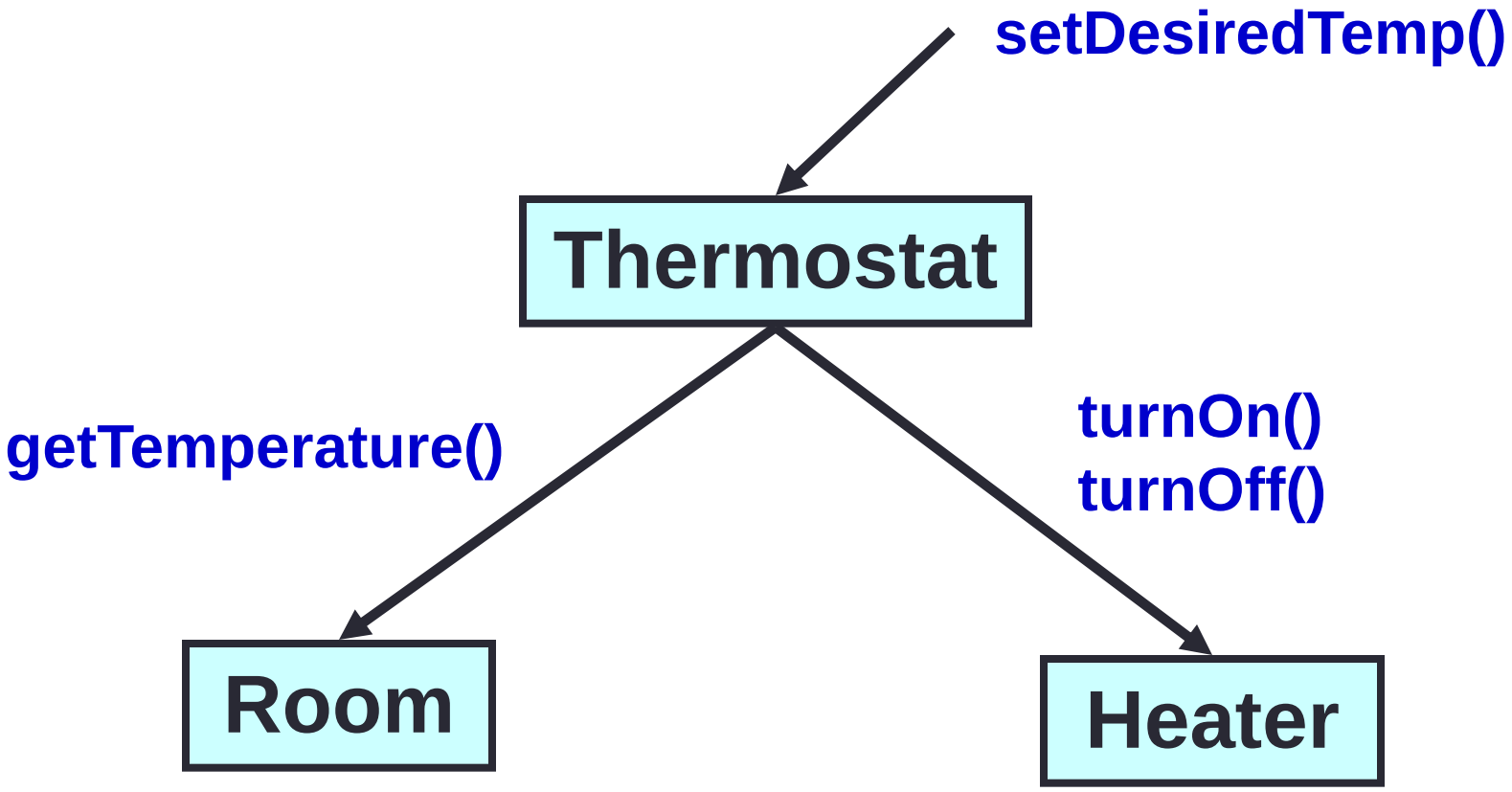
2) Finding Messages

- Thermostat uses dial setting to control a heater to maintain constant temperature in room
- Verbs
  - Uses
  - Control
  - Maintain
- Analyze each verb
  - Does verb represent interaction between objects?
- For each interaction
  - Assign methods to classes to perform interaction

Analyzing Verbs

- Uses
  - “Thermostat uses dial setting…”
  - ⇒ Thermostat.setDesiredTemp(int degrees)
- Control
  - “To control a heater…”
  - ⇒ Heater.turnOn()
  - ⇒ Heater.turnOff()
- Maintain
  - “To maintain constant temperature in room”
  - ⇒ Room.getTemperature()

Example Messages



Resulting Classes

- Thermostat
  - State – dialSetting
  - Methods – setDesiredTemp()
- Heater
  - State – heaterOn
  - Methods – turnOn(), turnOff()
- Room
  - State – temp
  - Methods – getTemperature()

is-a vs. has-a

- Say we have two classes: Engine and Car
- Two possible designs
  - A Car object has a reference to an Engine object
    - has-a
  - The Car class is a subtype of Engine
    - is-a

Prefer Composition over Inheritance

- Generally, prefer composition/delegation (has-a) to subtyping (is-a)
  - Subtyping is very powerful, but easy to overuse and can create confusion and lead to mistakes
- Using is-a restricts you from having a car with more than one engine, or with no engine
- Tempting to use subtyping in places where it doesn't really make conceptual sense to avoid having to delegate methods
  - Don't

Forms of Inheritance

- Extension
  - Adds new functionality to subclass
    - In Java → new method
- Limitation
  - Restricts behavior of subclass
    - In Java → override method, throw exception
- Combination
  - Inherits features from multiple superclasses
  - Also called multiple inheritance
  - Not possible in Java
    - In Java → implement interface instead

Multiple Inheritance Example

- Combination
  - AlarmClockRadio has two parent classes
  - State & behavior from both Radio & AlarmClock