

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
- Room
 - Class in model
- Temperature
 - State in class (Room)

Thermostat

Dial Setting

Heater

Room

Temp

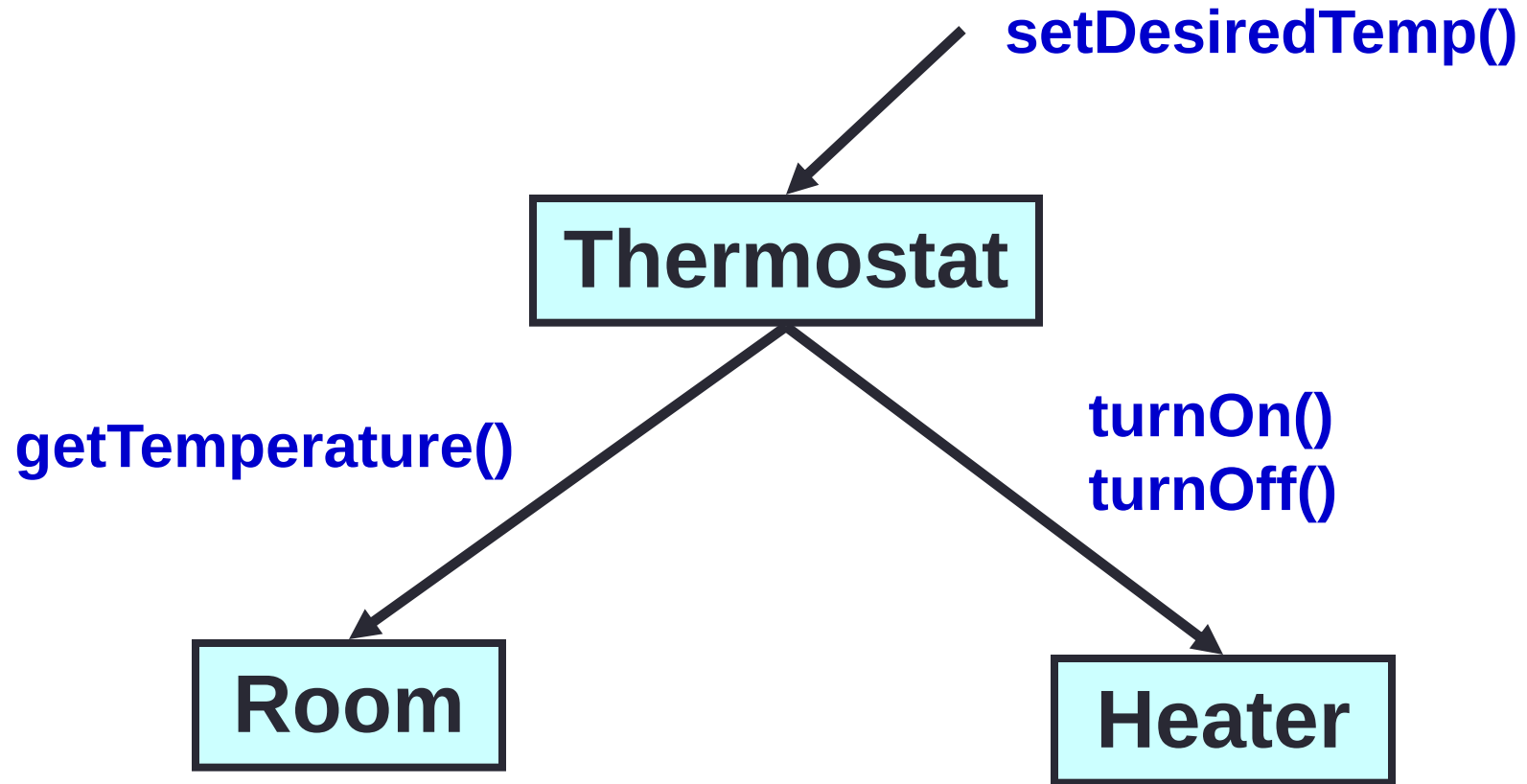
2) Finding Messages

- 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...”
 - $\Rightarrow$ Thermostat.setDesiredTemp(int degrees)
- Control
 - “To **control** a heater...”
 - $\Rightarrow$ Heater.turnOn()
 - $\Rightarrow$ Heater.turnOff()
- Maintain
 - “To **maintain** constant temperature in room”
 - $\Rightarrow$ 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

