Midterm 1 Overview

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Overview of Topics

1. Software development & software life cycle
2. Object-oriented design
3. Unified Modeling Language (UML)
4. Networking
5. Algorithmic complexity
Software Life Cycle

- Phases of cycle
  - Specification ⇒ ... ⇒ maintenance
  - Waterfall model

- Program design methods
  - Top down
  - Object oriented

- Testing
  - Verification
  - Empirical
    - Unit, integration, acceptance tests
    - Code coverage

Object-Oriented Design

- Objects & classes
  - Motivation
  - State, behavior, identity
  - Inheritance

- Finding classes
  - Nouns in problem specification

- Finding methods
  - Verbs in problem specification
Unified Modeling Language (UML)

- UML Views
  - Logical, use-case

- Class diagrams
  - Association (has a ...)
  - Dependency (uses a ...)
  - Generalization (is a ...)
  - Implementation
  - Multiplicity

- Sequence diagrams

Networking

- Network model
  - Physical layer ⇒ ... ⇒ application layer

- Network concepts
  - IP address, sockets, ports, URLs
  - Reliability
  - Connections vs. packets
  - TCP vs. UDP
  - Client / server

- Java network support
  - Socket, ServerSocket, DatagramSocket, URL
  - Applets, Java sandbox
Algorithmic Complexity

- Benchmarking vs. analysis
- Asymptotic analysis
  - Big-O notation
  - Average & worst case
  - Comparing complexity
- Finding critical sections
  - Finding code
  - Evaluating complexity
- Recursive algorithms

Midterm Question Formats

- Multiple choice questions
- Short 1-sentence answers
- Design classes (from specification)
- Analyze UML class diagrams
- Draw UML class diagrams (from code)
- Analyze complexity of code fragments
Multiple Choice Question Example

Using Object-Oriented design, we view a problem as a collection of
- Objects
- Functions
- None of the above

We find objects in the problem specification by looking for
- Nouns
- Verbs
- All of the above

Short 1-Sentence Answer Example

What is an IP address?
- A unique 64-bit number for each computer connected to the internet using the Internet Protocol (IP)

How do you get an IP address for your computer?
- Your IP address is assigned by a server at your service provider when you connect to the internet
Class Design Example

- Given the following problem specification
  - Design a heating simulation where each room has a thermostat that controls a heater. The thermostat turns on the heater if the current temperature in the room is lower than the thermostat setting.

- Design the classes for solving the problem
  - Data for each class
  - Methods for each class

Analyze UML Example

- Given the following UML class diagram
  - Which classes contain class W?
  - Which classes use class Z?
  - Which classes may change if class Z changes?
  - How many instances of class W does class Y have?
  - Can class X be used wherever class Y is used?
Draw UML Example

Draw UML class diagram for following code

```java
class foo {
    go() {
        class bar b;
    }
}

class bar {
    class foo f;
}

class test extends foo {
}
```

Analyze Complexity Example

What is the complexity of the following codes?

```java
for (i = 1; i < n; i++) {
    for (j = 1; j < 2*n; j++)
        ...
}

for (i = 1; i < n; i=i*4) {
    for (j = 1; j < 100; j++)
        ...
}
```