# Final Exam Study Guide

CS 4632: Modeling and Simulation

## Contents

# 1 Object-Oriented Design and Architecture

1. Define the main activities involved in an object-oriented design process. Why are each of these steps essential?

2. Describe the role of **"object interfaces"** in object-oriented design. How do they contribute to modularity?

3. Explain the difference between **inheritance and composition** in object-oriented design. Give examples of when each should be used.

4. **True/False**: In object-oriented architecture, classes must always inherit from a single base class.

5. **Multiple Choice**: Which of the following is NOT a key activity in the object-oriented design process?

   (a) Defining object interfaces

   (b) Establishing system constraints

   (c) Designing user interfaces

   (d) Modeling data relationships

# 2 System Context and Interaction Models

1. Describe the purpose of a system context model. How does it help in understanding system interactions?

2. What is the difference between a static and a dynamic system context model? Provide examples of each.

3. True/False: The system context model only includes internal system components.

4. Multiple Choice: Which element is typically NOT included in a system context model?

   (a) External entities

   (b) Data flow diagrams

   (c) Interaction constraints

   (d) Object hierarchy

5. Define **"interaction model"** and explain its significance in modeling and simulation.

# 3 Quality and Evaluation in Software Architecture

1. What are quantitative methods used for assessing software quality? **Provide two examples.**
2. Explain the concept of "software verifiability" and its role in quality assessment.
3. **True/False:** Completeness checks are unnecessary in a high-quality architectural design.
4. Discuss the importance of consistency checks in software architecture.
5. Multiple Choice: Which of the following criteria is NOT used in software quality evaluation?
   (a) Usability
   (b) Accessibility
   (c) Complexity
   (d) Affordability

# 4 Software Design Methods and Patterns

1. Define a **"design pattern"** in software engineering. How do design patterns promote reuse?
2. Explain the Singleton pattern and describe a situation in which it might be useful.
3. **True/False**: All design patterns focus on reducing memory usage in a system.
4. Multiple Choice: Which of these patterns is primarily concerned with object creation?
   (a) Factory
   (b) Observer
   (c) Composite
   (d) Decorator
5. Describe the difference between structural and behavioral design patterns.

# 5 Component and Infrastructure in Software Architecture

1. What is an **infrastructure component** in software design? List two examples.
2. Describe the role of database components within a software architecture.
3. **True/False**: Interface components handle data storage in a system.
4. **Multiple Choice**: Which of the following is NOT considered an infrastructure component?
   (a) Network configurations
   (b) Memory management
   (c) Authentication modules
   (d) Business logic classes
5. Explain why integration of infrastructure components is essential in large-scale software systems.

# 6 Software Testing and Quality Assurance

1. What is unit testing in the context of object-oriented software?
2. Describe the purpose of regression testing. When should it be performed?
3. **True/False**: Statistical quality assurance only involves automated tools.
4. **Multiple Choice**: Which technique is NOT used in quality assurance?
   (a) Code review
   (b) Black-box testing
   (c) Code generation
   (d) Regression testing
5. Explain the importance of coverage metrics in quality assurance.

# 7 Software Engineering Process and Management

1. Define **"software engineering process"** Why is it crucial for complex projects?
2. Discuss the importance of stakeholder communication in the software engineering process.
3. **True/False**: Agile methods eliminate the need for any form of documentation.
4. Multiple Choice: Which of the following is NOT a part of the software engineering life-cycle?
   (a) Planning
   (b) Development
   (c) Marketing
   (d) Maintenance
5. Describe the role of a **project manager** in software development.

# 8 Product and Quality Management in Software Engineering

1. What are the key stages in the product measurement process?
2. Explain "quality management" in software. How is it implemented?
3. True/False: Quality management focuses solely on defect detection.
4. Multiple Choice: Which is NOT a software quality attribute?
   (a) Maintainability
   (b) Interoperability
   (c) Profitability
   (d) Usability
5. Describe how product metrics help in quality assurance.

# 9 Safety and Security in System Development

1. Define **"safety case"** in the context of software engineering.
2. List three types of evidence commonly included in a safety case.
3. **True/False**: Security checking in software development involves only static testing.
4. **Multiple Choice**: Which approach is NOT typically part of a security assessment?
   (a) Penetration testing
   (b) Code obfuscation
   (c) Compliance check
   (d) Load balancing
5. Explain the difference between security testing and safety testing.

### Concept Summary

A quick recap of core concepts in this section:

- **Object-Oriented Design**: Focuses on creating a structured approach by defining objects, interfaces, and inheritance.
- **Design Patterns**: Provide reusable solutions to common design problems, promoting modularity and flexibility.
- **Quality Assurance**: Ensures that software meets requirements and is free from critical defects before release.

## Glossary

**Modularity** A design technique that breaks down a system into smaller parts, or modules, that can be independently created and maintained.

**Static Model** A model that represents a system at a single point in time, often depicting relationships without changes over time.

**Verification** The process of ensuring that software correctly implements a specific function.

## Practice Problem

**Question:** Describe how you would use a system context model to understand a software system's interaction with its environment.
**Solution:** First, identify all external entities that interact with the system, such as users, external databases, and third-party services...

## Additional Resources

- **Textbook**: "Software Modeling and Design" by Hassan Gomaa - **Online Lecture**: [Introduction to System Modeling](http://example.com) - **Video Tutorial**: "Understanding Design Patterns" on YouTube

## Key Formulas

$$\text{Reliability} = \frac{\text{Number of Successful Operations}}{\text{Total Operations}}$$

$$\text{Response Time} = \text{End Time} - \text{Start Time}$$

# Sample Exam Questions

**1. True/False**: In modeling, a dynamic model represents a system's behavior over time.
**2. Multiple-Choice**: Which of the following best describes encapsulation in object-oriented design?

- A) Hiding data implementation
- B) Enforcing data access rules
- C) Inheritance across classes
- D) All of the above

# Exam Preparation Checklist

- Understand the concept and applications of object-oriented design.
- Review system context and interaction models.
- Practice quantitative methods for software quality evaluation.
- Familiarize with common software design patterns and their use cases.
- Ensure understanding of software testing methodologies.

# Tips for Online Exam Success

- Read each question carefully, especially in multi-select questions, to avoid missing any correct options.
- Manage your time: Allocate roughly equal time per question, and flag any difficult questions to revisit.
- Use written notes effectively by organizing them based on key topics for quick reference.