

Midterm Study Guide for Operating Systems (ECSE 427 / COMP 310, Fall 2015)

The PDF version of the notes might have some extra slides that are not present in the version with the narration. You could easily skip those extra slides for the exams unless that material interests you.

How to prepare for the midterm?

1. First you need to listen to the lectures unless you have regularly attended the in class discussions and taken notes of what we discussed there.
2. Read the relevant sections of the book (see the course outline for relevant sections).
3. Look at the problems from the book and/or sample midterm questions.
4. Ask questions if you are not sure of some portions of the material.

Introduction to Operating Systems (Lectures 1 & 2)

- Definition of an Operating System
- The idea of processes; process versus program
- Concurrency versus parallelism – the basic idea
- Interrupt processing in computing systems
- Dual mode computer operation
- System call processing
- System call processing versus interrupt processing
- Types of system calls
- Major operating system services
- Operating systems structure: UNIX, layered, micro-kernel, modular approach

Problems from the book: 1.12, 1.19, 1.21, 1.27, 2.12, 2.17, 2.19, 2.21,

Simple Operating Systems (Lecture 3)

- “Real mode” in a simple computer: what happens when we don’t have address virtualization (or logical addresses)
- What happens when we have logical addresses?
- Address spaces
- User versus kernel level address spaces
- Process life cycle management; fork() system call
- Process state diagram; explanation of the different states in the diagram
- Process dispatcher; context switch; what needs to happen in a context switch
- File descriptor tables; The pipes example discussed in the class and how it related to the process creation

Problems from the book: 3.2, 3.3, 3.5, 3.9, 3.12,

Inter-Process Communications (Lecture 3.1)

- Shared memory versus message passing; what are the benefits of shared memory approach to IPC?
- Direct communication versus indirect communication; mailboxes
- UNIX signals (not how they are implemented); how to use them; what they do, etc

Problems from the book: 3.15, 3.18

Multi-Threading (Lecture 4)

- Process versus threads
- Multi-core programming
- Concurrency versus parallelism (revisited)
- Amdahl's Law (statement in words); application of the law to problems
- Multi-threading models; trade-offs

Problems from the book: 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 4.10, 4.11

Virtual Machines (Lecture 4.2)

- General idea of virtual machines (relation to processes and threads)
- Historical perspective of VMs
- Virtual machine monitors; various types; etc
- Sensitive instructions
- Privileged instructions
- IBM 360 versus Intel x86 for virtualization
- Binary translation approach
- Para virtualization

Problems from the book: 16.4, 16.5

Synchronization (Lecture 5)

- Concurrency: cooperation versus competition
- Race conditions; definition; examples
- Critical section as a solution for race conditions
- Requirements for critical section implementations
- Road to solutions for implementing critical sections
- Dekker's algorithm; Peterson's algorithm
- Hardware primitives
- Busy waiting; when we could use; why? Why we should not use it, etc

- Semaphores
- Monitors
- Classical problems: readers-writers, dining philosophers, producer-consumer, etc
- Equivalence of monitors and semaphores in terms of expressiveness; emulating one using the other

Problems from the book: 5.3, 5.4, 5.5, 5.7

Deadlock (Lecture 6)

- Deadlock; what is it?
- Classification of resources
- Conditions for deadlocks
- Solving deadlocks; approaches
- Resource allocation graphs
- Deadlock prevention; avoidance, and detection/recovery
- Safe state versus unsafe states
- Banker's algorithm
- Resource allocation graph approach to deadlock avoidance
- Summary of different strategies

Problems from the book: 7.2, 7.3, 7.10

Other study material:

- The little book of Semaphores (a free book on Semaphore – an excellent source of information).
- www.os-book.com - you can find answers to some of the questions in the textbook.