

Course Review

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Major class topics

- Concurrency management
- Memory management
- Storage management

Concurrency management

- Processes and threads
 - Creating, dispatching
- Synchronization
 - Races conditions and inconsistency
 - Locks, condition variables, monitors
 - Lock implementation
- CPU Scheduling
 - Time slices; Round Robin; Priorities
- Deadlock
 - Conditions: limited access; no preemption; multiple independent requests; circular wait
 - Detection and Prevention

Memory management

- Linking (static and dynamic)
- Dynamic memory allocation
 - Stack and heap
 - Dangling pointers and memory leaks
- Static relocation and dynamic relocation
 - Base and bound, segmentation, paging

--- Midterm Exam Cutoff

Memory management

- x86-64 page tables
- Translation Lookaside Buffers (TLBs)
- Operating System and address spaces
- Fragmentation
- Demand paging
 - Demand fetching
 - Prefetching
 - Replacement policy: Random, FIFO, MIN, LRU, Clock, Global vs local
- Thrashing

Storage management

- Disks
 - Mechanism, operations, interrupts, programmed I/O, DMA
- Files
 - Access: sequential, random, keyed
 - Inodes
 - Block layout: contiguous, linked, multi-level indexes, FAT, Unix
 - Block size tradeoffs
- Free space management
 - Linked list
 - Bitmaps

Storage management

- Buffer cache
 - Delayed writes
- Disk scheduling
 - FIFO, Shortest positioning time first, CSCAN
- Directories - Naming
 - Hard links; Symbolic Links
- Crash recovery
 - fsck
 - Ordered writes
 - Write-ahead logging
- Flash memory
 - FTL

Major ideas to take away

- **Virtualization:** make one thing look like something else, or many of them
 - CPU: Threads
 - Storage: Files
 - Main memory: Address spaces
- **Managing concurrency** - synchronization is hard!
- **Atomic operations:** a collection of operations appear as a single indivisible op
 - Synchronization, file system consistency
- **Locality:** the past often predicts the future
 - Scheduling, TLBs, paging, file caches, etc.
- **Layering:** build higher-level abstractions to hide messy details
 - Solving hard problems so other people have a better world in which to work

What to try next?

If you enjoyed this, try:

- CS 112: Operating systems kernel implementation project
- CS 140E: Operating systems design and implementation
- CS 240: Advanced Topics in Operating Systems
- CS 143: Compilers
- CS 145: Databases - Intro to Big Data Systems
- CS 144: Introduction to Computer Networking
- CS 244C: Advanced Networking and Distributed Systems

Thanks