

CSE 120

Principles of Operating Systems

Fall 2001

Final Review
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Course Plugs

- If you like CSE 120 topics, you might find some other courses interesting
- CSE 121: OS Arch and Implementation (Sp) (Yee)
 - OS Implementation using BSD 4.4 as a case study
 - Projects modify BSD 4.4 kernel
- CSE 123A/B: Computer Networking (Sp/Sp)
 - 123A (Varghese) – link layer up to internetworking (IP)
 - 123B (Savage) – internetworking up to session/application
- CSE 128: Concurrency (Sp) (Marzullo)
 - Whole quarter of concurrency!
 - Much more in-depth treatment, extends to distributed domain

Course Plugs (2)

- CSE 190: Software System Design and Implementation (Voelker)
 - ♦ One project the entire quarter
 - » Distributed, real-time, multiplayer 3D game
 - » It might not seem like it, but it is not really a games course
 - ♦ Groups of six
 - ♦ Three lectures, then weekly group meetings
 - ♦ Basically, you do all the work
 - ♦ No homeworks, exams
 - ♦ Oriented towards graduating seniors
 - ♦ By instructor permission only

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Overview

- Final mechanics
- Memory management
- Paging
- Page replacement
- Disk I/O
- File systems
- Advanced topics

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Final Mechanics

- Bulk of the final covers material after midterm
 - Memory management, file systems, advanced topics
- Some material on concurrency, synchronization
 - Synch primitives, synch problems
- Based upon lecture material, homeworks, and project
 - I will use at least one question from this review on the exam
- Closed book, one 8.5"x11" sheet of notes
 - Just one
 - Sample final on class web site
- Again, please, do not cheat
 - Cheating has been a minimum, would like to keep it that way

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Memory Management

- Why is memory management useful?
 - Why do we have virtual memory if it is so complex?
- What are the mechanisms for implementing MM?
 - Physical and virtual addressing
 - Partitioning, paging, and segmentation
 - Page tables, TLB
- What are the policies related to MM?
 - Page replacement
- What are the overheads related to providing memory management?

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Virtualizing Memory

- What is the difference between a physical and virtual address?
- What is the difference between fixed and variable partitioning?
 - ♦ How do base and limit registers work?
- What is internal fragmentation?
- What is external fragmentation?
- What is a protection fault?

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Paging

- How is paging different from partitioning?
- What are the advantages/disadvantages of paging?
- What are page tables?
- What are page table entries (PTE)?
- Know these terms
 - ♦ Virtual page number (VPN), page frame number (PFN), offset
- Know how to break down virtual addresses into page numbers, offset
- How have you implemented paging in Nachos?

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Page Table Entries

- What is a page table entry? In Nachos?
- What are all of the PTE bits used for?
 - Modify
 - Reference
 - Valid
 - Protection

Segmentation

- What is segmentation?
- How does it compare/contrast with paging?
- What are its advantages/disadvantages with respect to partitioning, paging?
- What is a segment table?
- How can paging and segmentation be combined?

Page Tables

- Page tables introduce overhead
 - Space for storing them
 - Time to use them for translation
- What techniques can be used to reduce their overhead?
- How do two-level (multi-level) page tables work?

TLBs

- What problem does the TLB solve?
- How do TLBs work?
- Why are TLBs effective?
- How are TLBs managed?
 - What happens on a TLB miss fault?
- What is the difference between a hardware and software managed TLB?

Page Faults

- What is a page fault?
- How is it used to implement demand paged virtual memory?
- What is the complete sequence of steps, from a TLB miss to paging in from disk, for translating a virtual address to a physical address?
 - What is done in hardware, what is done in software?

Advanced Mem Management

- What is shared memory?
- What is copy on write?
- What are memory mapped files?

Page Replacement

- What is the purpose of the page replacement algorithm?
- What application behavior does page replacement try to exploit?
- When is the page replacement algorithm used?
- Understand
 - Belady's (optimal), FIFO, LRU, Approximate LRU, LRU Clock, Working Set, Page Fault Frequency
- What is thrashing?

Disk

- Understand the memory hierarchy concept, locality
- Physical disk structure
 - Platters, surfaces, tracks, sectors, cylinders, arms, heads
- Disk interface
 - How does the OS make requests to the disk?
- Disk performance
 - What steps determine disk request performance?
 - What are seek, rotation, transfer?

Disk Scheduling

- How can disk scheduling improve performance?
- What are the issues in disk scheduling?
 - ♦ Response time, throughput, fairness
- Understand
 - ♦ FCFS, SSTF, SCAN, C-SCAN

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File Systems

- Topics
 - ♦ Files
 - ♦ Directories
 - ♦ Sharing
 - ♦ Protection
 - ♦ Layouts
 - ♦ Buffer Cache
- What is a file system?
- Why are file systems useful (why do we have them)?

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Files and Directories

- What is a file?
 - What operations are supported?
 - What characteristics do they have?
 - What are file access methods?
- What is a directory?
 - What are they used for?
 - How are they implemented?
 - What is a directory entry?
- How are directories used to do path name translation?

Protection

- What is file protection used for?
- How is it implemented?
- What are access control lists (ACLs)?
- What are capabilities?
- What are the advantages/disadvantages of each?

File System Layouts

- What are file system layouts used for?
- What are the general strategies?
 - Contiguous, linked, indexed?
- What are the tradeoffs for those strategies?
- How do those strategies reflect file access methods?
- What is an inode?
 - How are inodes different from directories?
 - How are inodes and directories used to do path resolution, find files?

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File Buffer Cache

- What is the file buffer cache, and why do operating systems use one?
- What is the difference between caching reads and caching writes?
- What are the tradeoffs of using memory for a file buffer cache vs. VM?

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Advanced Topics

- What is FFS, and how is it an improvement over the original Unix file system?
- What is LFS, and how is it an improvement over FFS?
- What is RAID, and how does it help file system performance and reliability?
- What is RPC, and how is it implemented?

Conclusion

- Congratulations on surviving CSE 120
 - ♦ It's a tough course, but I hope you found it worthwhile
- See you Friday morning, 12/7, bright and early
 - ♦ CSB 001 @ 8am
- Good luck, and thanks for a great class!