

# Final Review

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- Only info from last half of class
  - But this includes all of VM

# Memory management

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- Understand the alternatives for memory management
  - Tradeoffs, other issues
- Understand paging
  - Structure of page tables, VAs, etc.
  - Paging math
  - Other bookkeeping
- Understand the memory hierarchy

# Paging/VM

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- TLBs
  - Why they work
- Page eviction
  - Understand all the algorithms: FIFO, clock, LRU, LFU
  - Tradeoffs: when they work well, when they don't

# Disks

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- General layout of disks
  - Cylinders, tracks, heads, etc.
- Physical performance characteristics
  - Seek time, r/w bandwidth, etc.
  - Given disk chars., how long would a read take?
- Disk scheduling
  - Understand the tradeoffs

# File systems

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- Basic purpose of a file system
  - The file system hierarchy
  - Operations, file types, access types
- Directory structure
- Alternatives for data structures
  - Free space list
  - Indexed files, linked files, etc.

# Basic UNIX file format

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- inodes
- Direct blocks, indirect, doubly indirect
  - Understand the math
- Boot block, superblock, inode blocks, data blocks

# File protection

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- Principals, objects, actions
- Know the security matrix:
  - Principals on one side
  - Objects on the other
  - Actions are the entries
  - Minimizing a sparse table
    - Principal-based: capabilities
    - Object-based: ACLs

# Disk layout

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- How to structure file systems on disk
- FFS/LFS
  - Understand how they do the layout, understand why
  - What workloads do they work well on?
- RAID
  - Know your raid levels, and your raid math



# Distributed FS

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- Adds some wrinkles
  - Naming: how to keep unique
  - Performance: how to hid the network delay
    - Caching and cache coherency
  - Replication

# Distributed systems

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- What are they? Types?
- Basic networking
  - Ethernet/LL, IP, TCP
- RPC
  - Why?
  - How? (take all the regular function call steps, and decide how the network affects them)

# Basic problems

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- Terminology, structure-type problems
  - What are the advantages and disadvantages of a micro-kernel OS over the traditional monolithic system?
  - Sub-type: algorithm families
    - Scheduling of processes & disk, evictions
- Arithmetic problems
  - What's the average time to read a 1MB file on a disk with  $x$  cylinders,  $y$  rotation speed,  $z$  transfer BW?

# Basic problems (2)

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- Algorithm problems
  - Given a reference to VA  $x$ , sketch the data structures and procedures necessary to read the value addressed?
    - Page tables, secondary storage, TLB, etc.
- Programming questions