

EEL-4736/5737
**Principles of Computer System
Design**

Midterm review slides

Midterm information

- Sep 30th in class
- Closed book, closed notes
- Focus on material discussed in class – lab assignments will not be in the midterm
- Example possible kinds of questions:
 - Describe how a design principle may apply to solve a problem
 - Work-out question based on a setup that uses a design principle or system discussed in class
 - E.g. interpreter loop, page table, file system
 - Multiple-choice conceptual questions

Major topics

- General principles to cope with complexity
 - Modularity
 - Abstraction
 - Layering
 - Hierarchy

Major topics

- Fundamental abstractions
 - Memory
 - READ/WRITE interface
 - Naming
 - Interpreter
 - Main interpreter loop
 - Its many instances
 - Communication links
 - SEND/RECEIVE
 - Contrast with the memory abstraction

Major topics

- Naming
 - Need for modularity
 - Name spaces
 - Name-mapping algorithms; resolver
 - Context and references
 - Recursive resolution
 - Naming networks
 - Multiple lookup

Major topics

- Names and layers
 - O/S layers, and their roles
 - System calls
 - Hardware layer – bus
 - Software layer – files

Major topics

- Case study – UNIX file system
 - Hierarchical organization
 - Objects
 - Naming layers: block, file, i-node, ...
 - Core API
 - Resolving names
 - Links
 - Implied contexts
 - Search paths

Major topics

- Enforcing modularity with client/service
 - Procedures, stack convention
 - Soft vs. enforced modularity
 - Client/service organization
 - Trusted intermediaries
 - Marshalling
 - RPC
 - Differences w.r.t. procedures
 - Timeouts and semantics

Major topics

- Case study: NFS
 - Client/server organization
 - Relationship to system calls
 - Virtual node layer
 - File handles and object lookup

Major topics

- Virtualization abstractions
 - Role in enforcing modularity
 - Multiplexing, emulation, aggregation
 - Threads
 - Virtual memory
 - SEND/RECEIVE with bounded buffers

Major topics

- Virtual links
 - SEND/RECEIVE primitives
 - Shared buffer and sequence coordination
 - Challenges: multiple writers, multiple-step operations, coherence, ordering
 - Race conditions
 - Locking
 - Read-set-memory and lock implementation; architecture implications

Major topics

- Memory modularity and virtual memory
 - Domains and role of domain register and memory manager
 - Progressively tackling shortcomings
 - Multiple domains
 - Memory sharing
 - Permissions
 - Kernel/user modes and gates
 - Bootstrapping
 - Virtual addresses
 - Page maps, page tables
 - Supporting thread virtual address spaces
 - Translation lookaside buffer