



## **CS 50011: Introduction to Systems II**

### **Review**

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# Final Exam

- ~75 questions
- Mix of multiple choice, true/false, and short answer
- Closed notes, closed books, no calculators
- Wednesday, 8/2 1pm-3pm LWSN B134



# Exam topics

- Storage
  - Types
  - Relative speed
    - Storage hierarchy
  - Basic characteristics
  - Interaction with host
    - Block abstraction
    - SANs
    - Network attached storage

- Data layout
  - Partitioning
  - Volume managers
  - File systems
  - RAID
  - LUKS
- File systems
  - Basic layout
  - inodes
    - Fields
    - Data block referencing



- Basic utilities
- File types
- Permissions
- Extended attributes
- DAC/MAC
- SELinux
- Additional \*NIX Utilities
  - I/O Redirection
  - tee
  - grep



- Simple regular expressions
- head, tail, cut, paste, wc, sort
- Architecture
  - Moore's law
  - Transistors, gates
  - Combinational vs. sequential circuits
  - Harvard vs. Von Neumann
  - Processor types
  - Storing programs



- Instruction sets
  - Opcodes, operands, results
  - Instruction format
  - CISC/RISC
  - Endianness
  - Simple ISA design
- DMA and MMU
- Execution modes or rings
- Trusting trust paper



- Software hierarchy
- Assembly
  - What is it
  - How do we get it
  - If-then-else and subroutine calls





- Intel x86 basics
  - Recognize common instructions
  - Interpret simple programs
  - Intel vs AT&T syntax
  - Registers
  - Flags
  - Addressing modes
- Programs vs. Processes



- Typical memory layout
- Stack
  - What is it?
  - How is it manipulated
  - Stack frame
  - Base pointer/stack pointer
  - Typical layout for x86
- Calling conventions
  - Register preservation
  - System calls



## ■ Security

- Virtualization overview
- VirtualBox example
- VT-x, AMD-V
  - Why? How?
- Instruction set support
- Microcode updates
- NX bit
- Exec shield
- Stack canaries
- ASLR



- Memory management
  - Virtual memory
    - Why? How?
  - Working set
  - Copy-on-write
  - Segmentation
  - Demand-based paging
    - Resident set
    - Page tables
      - Multi-level
    - Translation



- MMU
- TLB
- Virtually addressed caches
  - Aliasing
- Basic page fault handling
- mmap()
- Compilers
  - Executable file formats
  - ELF format
  - Utilities and output



- Building a program, steps
- Preprocessor
- Compiler steps
- Libraries
- Lazy binding
- Simple Makefile



- Networking
  - Basic architecture
  - Addressing
  - Routing
  - ARP
  - DNS
  - DHCP
  - UDP/TCP
  - NAT



- Sockets
  - Ports
  - Basic API
  - Usage
  - HTTP server
- Databases
  - SQL
  - Schema
  - Primary, foreign keys
  - JOINS





- Web applications
  - Client/server model
  - CGI
  - 3-tier model
  - Model/view/controller
  - AJAX
  - JSON
  - Sessions
  - Cookies
  - Cloud computing



# Questions?

