Princeton University
COS 217: Introduction to Programming Systems
Spring 2003 Final Exam Preparation

You are responsible for all material covered in lectures, precepts, assignments, and assigned readings.

The exam will be cumulative, but will emphasize the recent material heavily.

The exam will be closed book, but you may use a self-generated one-page summary sheet.

Topics

New topics are in **boldface**.

Programming style
- Modularity, interfaces, implementations
- Abstract data types
- Abstract objects
- Testing strategies
- Profiling and instrumentation
- Robust programming, error handling strategies

Advanced C programming
- Memory layout
- Dynamic memory management
- Void pointers
- Function pointers
- Variable declarations and definitions
- Variable scope, linkage, and duration
- Const variable declarations and definitions
- Function declarations and definitions
- Opaque pointers
- Macros and their dangers
- The assert macro
- Unions, enumerations, tagged unions
- **Bitwise operators** (~ & | ^ << >>)
- **Structure bit-fields**

The UNIX/GNU programming environment
- Emacs, gcc, gdb, make, gprof, **bash, gdb for SPARC assembly language**
Digital Circuits

Combinational Circuits
   Building blocks: NOT, AND, and OR gates
   Common combinational circuits: decoder, multiplexer, demultiplexer, adder, ALU

Designing combinational circuits using NOT, AND, and OR gates
   Truth tables
   Boolean expressions in sum of products form

Sequential Circuits
   Building blocks: RS flip flops, clocked RS flip flops, clocked D flip flops, Clocked master slave D flip flops
   Common sequential circuits: register, register bank, memory

Designing sequential circuits using clocked master slave D flip flops
   State machines
   Truth tables
   Boolean expressions in sum of products form

SPARC Architecture and Assembly Language

Registers vs. cache vs. memory vs. disk

Register windows

Instruction pipelining and delay slots

Assembly language
   Directives
   Mnemonics
   Using the stack
   Subroutines and leaf subroutines
   Optimization: minimize memory access; postpone use of loaded data; fill delay slots with useful instructions; the annul bit

Machine language
   The binary, octal, and hexadecimal number systems
   Representation of signed numbers
      Signed magnitude
      One’s complement
      Two’s complement
   Representation of floating point numbers
   Mnemonic formats

Assemblers
   Pass1: Create symbol table
   Pass2: Create data section, text section, relocation records

Linkers
   Symbol resolution
   Symbol relocation
Operating Systems

Operating system history
UNIX shells
UNIX shell built-in commands vs. executable binary commands

Processes
Scheduling, context switching
UNIX system calls: getpid, execvp (and other exec functions), fork, wait, kill, chdir, setenv, unsetenv
Standard C functions: exit, getenv

I/O
UNIX file descriptors
UNIX file redirection
UNIX system calls: creat, open, close, dup, dup2, read, write
Standard C functions: fopen, fclose, fflush, perror, fgetc, fputc, fgets, fputs, fscanf, fprintf, scanf, printf, getc, putc, putchar, getchar, gets, puts, etc.

Inter-Process Communication
Network communication: the Socket API
UNIX pipelines
UNIX system call: pipe

Signals
UNIX kill command
Standard C function: signal

Virtual memory
Segmentation, paging

Applications
String manipulation
Hash tables, symbol tables
Digital circuit simulation
Assemblers
UNIX Shells
Readings

New readings are in boldface.

Extracted from the course web pages:

Loukides: 2, 3, 4, 6, 7, 9  
King: 10, 15, 16.4-5, 17, 18, 19, 20  
Paul: 2, 3, 4, 5, 7, 8, 9  
Kernighan (UNIX Programming Environment): 7

Exams from Previous Semesters

Questions on new material are in boldface.

These old exam questions are particularly pertinent:

Fall 2002 Exam 1: 3, 4, 5  
Spring 2002 Exam 1: 1, 2, 3, 4, 5, 6, 8, 9 (generally, although the Set ADT is not pertinent)  
Fall 2001 Exam 1: 3, 4, 5, 6, 10  
Fall 2002 Exam 2: 1, 2, 3, 4a, 5, 6  
Spring 2002 Exam 2: 1, 2, 3, 4, 5, 6, 7, 8, 9  
Fall 2001 Exam 2: 1, 2, 3, 4, 5, 6, 7, 8

Copyright © 2003 by Robert M. Dondero, Jr.