GMU Spring 2018
CS 531 - Fundamentals of Systems Programming
Instructor: Hal Greenwald (hgreenwa@gmu.edu)

This course is a hands-on in-depth introduction to the structure of the Unix operating system with emphasis on the system libraries using ANSI C. It is appropriate for students who want to learn the principles of how to design and implement system applications. The course begins with an accelerated introduction to the C programming language and continues with the basic Unix Operating System data structures and Application Programming Interface (API). Unix Signals, Process/thread management, and interprocess communication (IPC) are covered in some depth.

Goals

- Demystify systems programming
- Focus on principles, methods, and tools
- Sound application design principles
- Efficient and secure implementation strategies
- Concepts and mechanics of secure programming.
- UNIX operating system programming environment.
- Develop applications using popular tools and systems including C, UNIX, Signaling, IPC, and threading.

Textbooks

Required:

- *The C Programming Language, Second Edition* by **Kernighan and Ritchie**. (ISBN 0-13-110362-8) [**Prentice Hall**] [**Amazon**]
- *Advanced Programming in the UNIX Environment, 3rd Edition* by W. Richard Stevens (Author), Stephen A. Rago (ISBN-13 978-0321637734)

Supplemental Texts: (not required, but helpful C references)

- *UNIX Systems Programming: Communication, Concurrency and Threads, 2 Ed.* by Kay Robbins and Steve Robbins. San Antonio, Texas, Prentice Hall ISBN-10:0130424110, ISBN-13: 978013042411
- *Practical C Programming, Third Edition* by Steve Oualline. (ISBN 1-56592-306-5) [**Amazon**][**OReilly**]
- *Mastering Algorithms with C* by Kyle Loudon. (ISBN 1-56592-453-3). [**Amazon**][**OReilly**]
- *C How To Program, Fourth Edition* by Harvey and Paul Deitel. (ISBN 0-13-142644-3). [**Prentice Hall**][**Amazon**]

Grading:

- Homework 1: *10 points*
- Homework 2: *20 points*
- Exam 1: *20 points*
- Exam 2: *20 points*
- Final Exam: *30 points*

Course Schedule

(Subject to adjustment)

	Topic	**Assigned Reading** In addition to posted lecture notes	**Assignment**
Lecture 1	Greetings, Course overview, C Programming Language overview: Variables, Expressions, Operators, Control Flow	Read: TCPL Chapters 1, 2, 3	
Lecture 2	Header files, Functions, Pointers, Arrays & Strings, Typedef, Unions, Structures, C standard library	Read: TCPL Chapters 4, 5, 6	Homework 1 assigned
Lecture 3	Pointers *cont*, Memory Management, Standard I/O Library, Buffering, Strings, Math, Utilities	Read: TCPL Chapters 7, 8 APUE Chapter 5	
Lecture 4	Bitwise Operators, Modularity, Files & Directories, Process Environment	Read: APUE Chapters 3, 4, 7, 9	
Lecture 5	**Exam 1** Introduction to Virtual Memory		Homework 1 Due
Lecture 6	Virtual Memory, Shared Dynamic Libraries Into to Byte Ordering (Big/Little) Endian	APUE Chapter 7	Homework 2 assigned
Lecture 7	Process Control, Daemon Processes, Signals	APUE Chapter 8,10,13	

Lecture 8	System Data Files Introduction to Concurrency	APUE Chapter 6, 15, 16	
Lecture 9	POSIX Threads	APUE Chapter 11,12	
Lecture 10	Review **Exam 2**		
Lecture 11	POSIX Threads, Conditional Variables, Intro to IPC	APUE Chapter 11,12,15	
Lecture 12	IPC continued, Advanced IPC	APUE Chapter 15,16,17	
Lecture 13	Advanced IPC	APUE Chapter 15,16,17	Homework 2 Due
Lecture 14	Socket Programming Review for Final Exam	APUE Chapter 16,17	
May 15	**Final Exam**		

Spring Break: March 12

Grading:

- A+ at least 97.5 points
- A: at least 90 points
- B+: at least 87.5 points
- B: at least 80 points
- C: at least 70 points
- D: at least 60 points