

**Kutztown University
Kutztown, Pennsylvania**

**Computer Science Department
College of Liberal Arts and Sciences**

I. Course Description: CSC 552: Advanced UNIX Programming

This course studies the concepts dealing with UNIX system programming. A lot of emphasis will be placed on working with processes and interprocess communication (IPC). Details of various aspects of IPC will be explored and implemented, including pipes, semaphores, sockets, message queues and shared memory.

Prerequisites: Unconditional acceptance to the graduate program or permission of the instructor.

II. Rationale

UNIX is a popular Operating System for servers used in networks. It is necessary for graduate students to have a strong foundation in systems programming on UNIX systems. Applications using these concepts will be implemented. This course will provide the student with a strong systems programming background.

III. Course Objectives

Upon satisfactory completion of this course the student will be able to:

- A. Define basic terminology used in UNIX Interprocess Communication (IPC).
- B. Write programs using UNIX sockets.
- C. Write programs utilizing various IPC techniques, such as message passing, semaphores, and shared memory.
- D. Demonstrate synchronization in UNIX programming.
- E. Write programs using multiple processes and IPC facilities, such as pipes.

IV. Course Assessment

The course assessment will be a subset of tests, projects, papers, presentations, quizzes, homework, team assignments and final exam.

IV. Course Outline

A. Programming with Processes

1. The fork, wait and exec system calls
2. Signals and killing a process

B. Introduction to InterProcess Communication

3. Terminology
4. Concepts

C. Sockets

1. Internet communication
2. Internet addressing and ports
3. The connection-oriented model
4. The connectionless model

D. Message Passing

1. Pipes
2. FIFOs
3. Message queues

E. Synchronization

1. Locks and Record Locking
2. Semaphores

F. Shared Memory

G. Threads

1. Concepts
2. Concurrency
3. Designing programs utilizing threads
4. POSIX threads

H. Classical IPC Problems

1. Producer and Consumer
2. Dining Philosophers
3. Sleeping Barber

V. Instructional Resources

Chan, Terrence, *UNIX System Programming Using C++*. Upper Saddle River, NJ., Prentice-Hall, Inc., 1997.

Comer, Douglas E., *Internetworking with TCP/IP*. Fourth Edition. Prentice Hall, Upper Saddle River, NJ, 2000. (TK5105.585 .C66 2000)

Deitel, Harvey M., Deitel, Paul J., and Choffnes, David R. *Operating Systems*. Pearson/Prentice Hall, Upper Saddle River, NJ, 2004. (QA76.76.O63 D46 2004)

Gay, Warren W. *Advanced UNIX Programming*. Sams Publishing, Indianapolis, IN, 2000.

Glass, Graham and Ables, King. *UNIX for programmers and users*. Third edition. Pearson Education, Upper Saddle River, NJ, 2003. (Library ordered 9/7/2007)

Gray, John Shapley. *Interprocess Communications in UNIX: The Nooks and Crannies*. (Second edition). Prentice Hall PTR, 1998.

Haviland, Keith, Dina Gray, and Ben Salama, *UNIX: System Programming*, Second Edition, Reading, MA, Addison-Wesley, 1999.

Robbins, Arnold. *UNIX in a Nutshell*. O'Reilly, Cambridge, MA, 2006. (QA76.76.O63 R566 2006)

Robbins, Kay A, and Robbins, Steven. *Practical UNIX Programming: A Guide to Concurrency, Communication, and Multithreading*. Upper Saddle River, NJ, Prentice Hall PTR, 1996. (QA76.76.O63 R615 1996)

Robbins, Kay and Robbins, Steven, *Unix Systems Programming: Communication, Concurrency, and Threads*. Second edition. Prentice Hall, 2003.

Rochkind, Marc, J. *Advanced UNIX Programming*. Second edition. Addison-Wesley Professional, 2004.

Schneider, Fred B. *On Concurrent Programming*. Springer, New York, 1997. (QA76.642 .S36 1997)

Stallings, William. *Operating systems: internals and design principles*. Fifth edition. Prentice Hall, Upper Saddle River, NJ, 2005. (QA76.76.O63 S733 2005)

Stevens, W. Richard. *UNIX Network Programming, Vol 2: Interprocess Communications*. Second Edition, Upper Saddle River, NJ, Prentice-Hall PTR, 1999.

Stevens, W. Richard, Fenner, Bill, and Rudoff, Andrew M. *UNIX Network Programming, Vol 1: The Sockets Networking API*. Third edition. Addison-Wesley, Boston, MA, 2004. (Library ordered 9/7/2007)

Stevens W. Richard and Rago, Stephen A. *Advanced Programming in the UNIX Environment*. Second edition. Addison-Wesley Professional, 2005.

Tanenbaum, Andrew S. *Modern Operating Systems*. Second edition. Prentice Hall, Upper Saddle River, NJ, 2001. (QA76.76.O63 T359 2001)

Teer, Rich. *Solaris systems programming*. Addison-Wesley, Boston, 2005. (QA76.76.O63 T44 2005)