

CS 511 Concurrent Programming Syllabus

The syllabus below describes a recent offering of the course, but it may not be completely up to date. For current details about this course, please contact the course coordinator. Course coordinators are listed on the course listing for undergraduate courses and graduate courses.

Text Books

Required

, , Instructor's notes drawn from several sources cited below.

Recommended

B. Nichols, D. Butler, and J.P. Farrell, *Pthreads Programming*, 1996

A. Williams, *C++ Concurrency in Action*, 2012

C. Horstmann, *Core Java, Volume 1*, 9th ed., 2012

P. Butcher, *Seven Concurrency Models in Seven Weeks*, 2014

F. Hebert, *Learn You Some Erlang for Great Good*, 2013

M. Ben-Ari, *Principles of the Spin Model Checker*, 2008

Week-by-Week Schedule

Week	Topics Covered	Reading	Assignments
1	How concurrency arises on a single computer; Processes and threads on UNIX; Mechanisms and needs for communication and co-ordination across concurrent processes.	Notes	
2	Synchronous and Asynchronous events; Signals on UNIX; Uncontrolled concurrency: Race conditions. Safety properties and Reentrancy.	Notes	Assignment 1: multi-process program using fork, exec, pipes.
3	Mutual exclusion and preemptive scheduling. Desired properties of mutual exclusion. Mechanisms to achieve mutual exclusion. Algorithms for mutual exclusion: strict alternation, Peterson's algorithm, Dekker's algorithm.	Notes	
4	Pthreads. Reader/writer and hierarchical locks. Deadlock avoidance, detection, and prevention.	Notes	Assignment 2: Pthreads producer/consumer.
5	Pthreads. Scheduling algorithms and issues. Thread models: workers, pipeline, on-demand and thread pool. Dining philosophers, producer consumers.	Notes	
6	Semaphore and Monitor concepts.	Notes	Assignment 3: control warehouse cart system.
7	Semaphore and Monitor concepts.	Notes	
8	Java threads.	Notes	
9	Java threads.	Notes	Assignment 4: comparison of several threading approaches for same problem (using Java facilities).
10	Actors model.	Notes	
11	Erlang.	Notes	Assignment 5: Erlang concurrency

Week	Topics Covered	Reading	Assignments
12	Formal reasoning about concurrency: state models, partial correctness, liveness. Defining safety properties. Program correctness: interleavings, model checking.	Notes	
13	SPIN model checker.	Notes	Assignment 6: model checking
14	Flex time.	Notes	