



## **CPE 412/512 2017 Exam 1 Review Guide**

**Exam Date: 10/19/2017**

### **Chapters 1-2**

- Performance metrics, Speedup Factor, Efficiency, Cost, computation/communication ratio. Difference between relative and absolute versions of these metrics.
- Amdahl's law.
- Flynn's Classification of computer systems (SISD, SIMD, MIMD)
- Amdahl's law
- Parallel Programming paradigms (SPMD, MPMD)
- Message Passing
  - message startup latency, bandwidth (linear model with  $T_{startup}$  and  $T_{data}$ )
- Shared Memory versus Distributed Local Memory Configurations.
- Task Parallelism and Data Parallelism
- Sources of overhead in parallel systems including communication, load balancing, idle time and synchronization.

### **Chapter 3 Message Passing with MPI**

- Process Creation (static/dynamic) in general and in MPI
- Message Passing (Blocking, Locally Blocking, Nonblocking, Buffered, Synchronous modes)
- Point to point message passing routines
- Deadlock definition and possible causes in a message passing environment
- Collective Communication Routines (Broadcast, Scatter, Gather, etc.)
- Understanding of the SPMD Computational Model
- Characteristics of deterministic versus nondeterministic applications. Page 137 of text.
- Performance and Time Complexity
  - Big O notation
  - Fixed workload, fixed time computation models
  - Estimating Performance
  - How to empirically measure the time of computation and communication routines
- Be able to analyze and create small MPI programs in pseudocode given the basic API information.

## **Chapter 4**

- Shared memory multiprocessors
- Concurrent Processes
- Heavyweight Processes versus light-weight Threads
- Fork/Join Model
- Shared data access and mutual exclusion
  - Locks, spin locks, busy waiting,
  - critical sections (what are they how can they be protected)
  - spin locks, busy waiting
  - Semaphores -- How semaphores differ from spin locks
  - Conditions variables
- What is deadlock. How can it occur in a shared memory multi-threaded environment.
- What are race conditions? How can they be avoided?
- pthreads -- What is a joined thread?
- Dependency Analysis -- Bernstein's Conditions for parallelism, loop-carried dependencies.

## **Other Useful Sources of Information**

- Class notes
- Old Exams
- Homework Solutions