

CSC726 **Fall 2013**
Parallel Algorithms

Professor: Torgersen

Office Phone: 758-5536

Office Hours: Monday, Wednesday, Friday 2:00 to 4:00. Also by appointment.

Text: Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, Introduction to Parallel Computing.

Facilities: Dell PowerEdge C6146 (bally), Sun 5120 (genesis), WFU Linux Cluster (deac), LittleFE, possibly SGI Origin 2000 (kokua)

Goals:

1. Overview of Parallel Computing Paradigms
 - (a) Speedup, Amdahl's Law and Gustafson's Law
 - (b) Fine grain vs coarse grain parallelism
 - (c) Data parallelism vs functional parallelism
 - (d) Light weight threads
 - (e) Shared memory parallel programming directives (e.g., OpenMP)
 - (f) Message passing (MPI)
2. Overview of Parallel Architecture Designs
 - (a) Pipelining and super-scalar instructions
 - (b) Shared memory and memory issues, (e.g., contention, cache coherence)
 - (c) Memory Coherency models
 - (d) Message passing and communication issues
 - (e) Traditional interconnect topologies
 - (f) Multi-core processors (e.g., SPARC T2, AMD Bulldozer)
 - (g) Vector processors (e.g., IBM G5/Altivec)
3. Theory: Parallel time complexity
 - (a) Speedup
 - (b) Scalability: Asymptotic relation between problem size and number of processors.
 - (c) Parallel time
 - (d) Efficiency: Ratio of Speedup to number of processors
4. Hands-on
 - (a) Parallel programming projects.
 - (b) Include problems from a variety of disciplines, e.g., image processing, problems from your thesis research.
 - (c) Develop skill in programming with concurrent threads.
 - (d) Program correctness: you can't verify a parallel program by testing!!
5. Some widely-studied parallel problems,
 - (a) Parallel prefix
 - (b) Matrix algorithms, e.g., QR factorization
 - (c) Sorting (e.g., bitonic sort) and Searching
 - (d) Graph algorithms
 - (e) Parallel FFT (if time allows)

6. Data dependency analysis
7. Automatic detection of parallelism (as time allows)

Expectations:

1. Class participation.
2. Communicate if things get complicated.
3. Your best effort.

Grading:

Two exams (60%), a few take home problem sets (10%), as many programming projects as we can produce (30%).

Disability Notice:

If you have a disability that may require an accommodation for taking this course, then please contact the Learning Assistance Center (758-5929) within the first two weeks of the semester.

Pandemic Planning Notice:

The University has requested that faculty collect personal contact information as part of emergency planning and preparation. The information you provide is strictly confidential.