CS4234 PARALLEL COMPUTATION

MWF 8:00–8:50 McBryde 216

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Office Hours: 9:00–11:00 MWF and by appointment.

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Prerequisite: CS3204 with a C or better.
Web page: http://courses.cs.vt.edu/~cs4234/S03/


Learning objectives: Parallel computation is becoming pervasive in all levels of computing—from massively parallel supercomputers used in large scale computational science, to multiprocessor servers supporting transaction processing and the World Wide Web. The major issues raised in each of the core areas of computer science (e.g., algorithms, systems, languages, architecture, etc.) become even more challenging when considered in the context of parallel computing. Hence, this course challenges students to apply in a new context the concepts and tools they have studied in earlier computer science courses. This course will also introduce students to a topic of fundamental importance to a wide variety of application areas. Having successfully completed this course, the student will be able to

• explain the basic concepts of parallel computation,
• compare alternative approaches to designing and implementing parallel algorithms and architectures,
• solve large scale problems on at least one parallel computing platform,
• measure and evaluate the performance of parallel applications.

Grading: the final grade will be based on homework (50%), a midterm (25%), and the final exam (25%). There will be approximately 10 homework assignments, of which at most 3 will be MPI programming assignments on department and university parallel computing facilities. Homework may be submitted at any time, and can be submitted for grading multiple times until it is correctly completed, subject to the following constraints. Homework submitted after April 18, 2003 will be graded only once, with no partial credit. No homework will be accepted after April 25, 2003.

Honor Code: the Honor Code applies to all graded work for this course. Any work submitted for grading must be your own work; collaboration on homework or exams is not permissible.
Parallel Computation Topics Covered:

Survey of parallel and vector computers.

Central questions: processing elements, memory, I/O, communication, synchronization, granularity, degree, level, paradigms, algorithms, programming.

DAG model, complexity measures, speedup, efficiency, Amdahl’s law.

Computational models, classification, problem complexity, examples.

Interconnection topologies — mesh, ring, star, tree, hypercube, CCC, crossbars, busses, multistage switches, fault tolerance.

Communication links, data link control, routing, broadcast, scatter, gather, exchange.

Hypercube particulars — Gray codes, communications, normal algorithms, examples.

Concurrency/communication tradeoffs.

Parallel algorithms: linear equations, optimization, network flows, two-point boundary value problems, Markov chains, genetic algorithms, cellular automata, simulating annealing.

Architecture: SIMD, MIMD, hybrid.

Parallel software: languages (MPI, OpenMP, Fortran 95), compilers, operating systems.

References:


