EECS 566, Spring 2000

Parallel Processing: Algorithms and Architectures

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Prerequisites: EECS 460 (this is an instructor-recommended prereq), EECS 466 or equiv. or permission of instructor.

Summary: Parallel processing has found wide-spread use in many diverse applications ranging from robotics to weather forecasting to complex simulations to VLSI CAD. The latest trend in the VLSI CAD industry, for eaxmple, has been to develop parallel algorithms of some of the most complex CAD software (e.g., place and route) that run on multiple workstations. This course will teach the important concepts and techniques in parallel computing, introduce some popular multicomputer architectures and various tradeoffs in their design, and introduce PVM (Parallel Virtual Machines) as a parallel computing environment and programming language that can be used to run parallel program on multiprocessors like UIC's Convex Exemplar or HP 9000/800. The students will use PVM to design and run some simple parallel programs on the Convex Exemplar and/or HP 9000/800. The intended audience for this course is both CE and CS students.

Topics:

1. Introduction to concurrency and measures of performance (speedup, efficiency, isoefficiency, etc.)
2. Basic parallel algorithms (prefix computation, divide and conquer, matrix multiplication, sorting).
3. Interconnection topologies and their relation to the structure of some basic parallel computations.
4. Introduction to the parallel message-passing programming language PVM and its use on UIC's 16-processor Convex Exemplar/ HP 9000/800
5. Routing algorithms and flow control mechanisms for multicomputer communication
6. Architecture of routing switches (communication controllers)
7. Latency and throughput analysis of various multicomputer architectures

Text: Vipin Kumar, et al., Introduction to Parallel Computing—Design and Analysis of Algorithms, Benjamin/Cummings, 1994.

Reference Texts: (1) Robert Suaya and Graham Birtwistle, Ed., VLSI and Parallel Computation, Morgan Kaufmann, 1990.
(2) D. Culler, J.P. Singh and A. Gupta, Parallel Computer Architecture, Morgan Kaufmann, 1999.
(3) F. Thomson Leighton, Introduction to Parallel Algorithms and Architectures: Arrays-Trees-Hypercubes, Morgan Kaufmann, 1992.
(4) Selim G. Akl, The Design and Analysis of Parallel Algorithms, Prentice Hall, 1989.

Grading: Based on 4-5 homework sets and a project chosen by the student (in consultation with the instructor) that can involve parallel algorithm development and programming or parallel architecture component design at the block-diagram or HDL (hardware description language) level.