CSE 4351/5351 SYLLABUS: PARALLEL PROCESSING

(Fall 2001: TTh 3:30-4:50, Nedderman 112)

Instructor: Bob Weems, Associate Professor
Office: 344 Nedderman, 817/272-2337, weems@uta.edu
Hours: TTh 1:00-3:00

GTA: Geoff Dale
Hours: TBA

Prerequisite: Operating Systems (CSE 3320)

Objective: Introduction to the variety of topics necessary for developing parallel software.

Goals: 1. Ability to implement small applications on shared-memory multiprocessor (Linux SMP) using pthreads.
2. Ability to implement small applications in message-passing paradigm using MPI.
3. Understanding of concepts of parallel algorithms
4. Understanding of elementary topologies and communication techniques
5. Understanding of compiler concurrentization concepts


Course notes - available in PDF form from http://reptar.uta.edu/NOTES4351/cse4351.html.

The first two sets of notes are available.


Exams: Three exams (see calendar for topic coverage)

Test 3 will be on Thursday, December 13, 2:00-4:30

Homeworks: Homework problems are integrated with the notes. Solutions are included with the notes.
Programs: Six assignments to reinforce the algorithm ideas and to provide exposure to practical issues. Alternate project(s) may be proposed based on your interests/research.

Grade: Based on the following weights:

- Exams: 60% (divided evenly among the three exams)
- Programs: 40% (divided evenly among the six assignments)

Policies:

1. Faithful attendance is expected. Consult me in advance if you must miss class.

2. If you need a handout, check with me during office hours.

3. CHEATING - YOU ARE EXPECTED TO KNOW UNIVERSITY POLICIES. If you are suspected of cheating, the matter must go through university channels outside of the CSE Department.

4. Any request for special consideration must be appropriately documented in advance. (Special consideration does not include giving a higher grade than has been earned.)

5. Late programs are penalized according to the following schedule. LABS ARE DUE AT 3:30 PM, NOT MIDNIGHT. After the due date I will not provide assistance (nor will the grader).

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<thead>
<tr>
<th>Degree of lateness</th>
<th>Penalty</th>
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<tr>
<td>Up to 3:30 next day</td>
<td>10 pts</td>
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<tr>
<td>Up to 3:30 two days</td>
<td>30 pts</td>
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<tr>
<td>Up to 3:30 three days</td>
<td>60 pts</td>
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Late labs submitted on non-class days should be submitted to the CSE Dept. receptionist, who will timestamp the submission.

6. Each student will have available one two-day no-penalty extension that may be applied to one of the lab assignments. To use your extension you must send an email to the grader before the due time.

7. Each lab is graded as follows:

- Correctness 30%
- Efficiency 30%
- Coding Style 15%
- Analysis 25%

If your program is not working correctly, you should show what portions of your program do work. *No credit will be given for analysis of incorrect programs.*

8. Electronic mail. I try to check my mail at least twice a day, less frequently on weekends. Please include your name in the message.

9. Before logging off the systems, check for orphan processes by using ps -g. Use kill -9 <processid> to remove them. Leaving active processes (or “core” files) will lead to suspension of account privileges.

YOU MUST BE LOGGED IN WHEN RUNNING ANY PROCESSES!!!
10. GTA duties:
   a. Provide first-level of assistance for homeworks and labs.
   b. Grade programs.
   c. Proctor examinations

11. Instructor duties:
   a. Lecture.
   b. Guidance
   c. Tests - preparation and grading.
   d. Special consideration.
   e. Design homework and programming assignments.

Course Contents and Readings - number to left is lecture note #, section numbers in parentheses refer to MPI book or Andrews book

1. Motivation/Introduction (MPI: 1.1-1.6, 11.1-11.9, 12.1-12.8, Andrews Chapter 1)
   History of high performance computing - government, academe, and industry
   Challenge problems
   Classic metrics
2. Data parallel programming techniques using pthreads (Andrews 4.6, 5.5, 12.1.1)
   Process management
   Shared memory
   Synchronization
   Problem decomposition- static (interleaved, contiguous) and dynamic approaches
   Examples
   Enumeration of combinatorial objects - another example of contiguous decomposition
   Multiple processor ‘‘binary’’ search/finding roots
   Multiple processor merging of ordered tables
3. Elementary message-based programming using MPI (MPI: 3.1-3.6, 4.1-4.5, 5.1-5.10, 9.1-9.7, 10.1-10.7)
   Process management
   Messages
   Examples
   MPI collective operations
4. Synchronization: shared memory and message passing (Andrews Chapters 2-6)
   Barriers
   Highly-concurrent queue
   Concurrent AVL trees
   Four forms of message passing: procedure call, process creation, asynchronous message, rendezvous
   Termination detection: Mattern’s credit-recovery technique and Dijkstra-Scholten Tree Technique
5. Interconnections (MPI: 2.1-2.4)
   Linear Array/Mesh/Toruses
   Butterfly/Fat tree
   Benes/Hypercube Routing via perfect matching
   Mesh routing - static and dynamic
   Overview of other communication problems
   Broadcasting
   Sorting (MPI: 14.3-14.4)
6. Numerical problems - Systems of linear equations
Gaussian
LU
Householder
Iterative/Sparse
7. Task graph scheduling (function parallelism) & load balancing
TEST 2
8. DOACROSS style parallelism
9. PRAM and other theoretical models of parallel computing (Andrews 3.5)
  Isoefficiency
  Prefix sums
  Matrix multiplication
  Elementary list ranking
  Euler tours and tree traversals
  P-Completeness and its meaning to the parallel computing practitioner
10. Other problems that are difficult to parallelize
  Discrete event simulation
  Heuristic search
  Two-person games
TEST 3

Calendar/Topics

Calendar - with course content numbers

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CSE 4351 / 5351 Survey

(Please submit by the end of the third meeting)

Name:

Email:

Which Section: 4351  5351

In-Class   Distance

Other Courses this Semester:

Special Circumstances Affecting your Performance:

CS Related Experience/Interests:

Might you be interested in substituting other work in place of some of the lab assignments?

(Optional) What do you hope to gain from this course?