COSC 462

Midterm Review

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Parallel Computing and Performance Models

- Speedup: Amdahl's and Gustafson's Laws
  - Be familiar with formulas
  - Look at questions on Piazza
- What's the difference?
  - Parallel vs. concurrent
- Dependencies vs. hazards
- Flynn taxonomy
- PRAM, BSP

Threads

- Thread vs process
  - What is shared what is separate for each?
- Mutex
  - Mutex types
  - Mutex policies
  - How is their performance affected
    - Contested vs. uncontested mutex
- Conditional Variables
- Semaphores
- Atomic instructions

MPI

- Starting and stopping
- Sending and receiving
  - Blocking, non-blocking
  - Standard, Buffered, Synchronous
  - Completion testing and waiting
- Data types
  - Standard-defined
  - User-defined
  - Portable vs. non-portable
- Communicators and Groups
  - Intra vs. Inter
- Collectives
  - Classes

Parallel Algorithm Design

- 4 major phases
  - What are they for?
  - How do they differ?
- Analysis
  - Computation-communication ratio
  - Amount of data coming in/out of a process
  - Total number local process steps
- Know how to apply each phase to basic algorithms from lectures and the textbook
- Consider dimensions in data and process arrangement
  - Apply 1D partitioning to 3D problem
- Consider techniques for dealing with non-divisible dimensions, prime numbers, etc.
  - You are unlikely to resolve all the implementation details on the exam

Problems from Homeworks

- Similar problems may occur on the exam
  - They will be simplified, or
  - The answers will be allowed to be simplified
  - A correct solution may be a combination of faulty code and the discussion of all the problems it has, such as:
    - Scalability problems
    - Lack of parallelism
    - Too much communication
    - Problems with special problem sizes and process counts
- Please provide comments for your code!
  - The code is either correct or has a bug
    - More bug possibilities in parallel
  - Comments communicate to me your intention
    - Almost everybody has good intentions

Textbook Content

- Chapters covered in the exam
  - Chapter 3 Parallel algorithm design
  - Chapter 4 Message passing
  - Chapter 7 Performance analysis
  - Chapter 8 Matrix-vector multiplication
  - Chapter 11 Matrix multiplication
  - Chapter 12 Solving linear systems
  - Chapter 13 Finite difference methods
  - Chapter 14 Sorting
  - Chapter 15 Fast Fourier Transform
- The book covers more than the lectures
  - Stick to topics covered in lectures
  - Use the textbook for additional explanation of lecture topics

General Guidelines

- Show your work
- No calculators
  - Leave large/hard numbers plugged in
    - Estimate the answer if you needed for something else
      - Tell me you used an estimate (but be reasonable!)
      - You can answer based on how you estimated the answer
        - For example when comparing speedup1 with speedup2, you may use the wrong value for speedup1 or speedup2 but the comparison might be valid