

CIS 372 - Fall 2007
University of Delaware

Group Mini-Research Project

Due Dates:

Deliverable 1: start of class, Friday, November 2, 2007

Deliverable 2: dated 8 am, Wednesday, November 21, 2007

Deliverable 3: presentation day, either November 26, 28, or 30, 2007

Deliverable 4: start of class, Wednesday, December 5, 2007

1 Overview of Project and Goals

The overall goal of this project is for students to creatively and cooperatively formulate, investigate, and present their investigation and results for an experimental research question involving parallel computing.

2 The Project Process

1. Create a group of 2-4 people in the class to work together on this project.
2. **Deliverable 1: Research Question and Plan.** Develop a research question to be experimentally investigated. The question should involve parallel programming in MPI, and empirical investigation into some question involving a concept in parallel programming. The deliverable is a (less than 1-page) report that includes clear statements of:
 - (a) The Research Question - a question that your group will investigate experimentally. Phrase it like a question such as "Which sorting algorithm works best in practice for large data sets on few processors?"
 - (b) Hypothesis - your group's hypothesis regarding the research question. For example: We believe that algorithm X will achieve better performance on large data sets with few processors because...
 - (c) Experimental Design - your group's experimental design - the steps you will take to investigate the research question, including what will be implemented, what will be measured, and how the measurements will be used to answer the research question. Be as clear and detailed as possible here so I can help you with refining the design if needed.
 - (d) Work Plan - the list of names of the group members and their email addresses and what parts of the work you plan to have each member charged with doing
 - (e) Preferred Presentation Day - see online course schedule
3. **Deliverable 2: Program Implementation.** Any programs that need to be developed to answer your research question should be working correctly by this deliverable date. The programs should be made available to the TA through emailing a tarfile of the program code including a README on how to compile and run the codes, and any data sets you can provide for testing.
4. **Deliverable 3: Oral Presentation.** Your group will develop and conduct a Powerpoint presentation of about 20 minutes to the class, covering the same material as your written report. This provides you with more oral communications skills building and allows everyone to hear about the other projects and their results. Each person in the group should have a speaking part. Load balance during the presentation is a good idea. Your presentation should contain: Research question, hypothesis, experimental methodology, some overview of what you implemented, the data you collected (preferably in graph form), conclusions you made from the data, any issues that you ran into throughout your experiments, and any future directions you would suggest to further investigate the question based on what you learned.

5. **Deliverable 4: Written Experimental Report.** A written report that includes the following sections:

- (a) Research Question - a clear statement of the research question investigated
- (b) Hypothesis - a clear statement of the group's hypothesis regarding the research question
- (c) Experimental Design - a clear description of the experimental design as it was actually done, including steps you took to investigate the research questions, what you implemented, what measurements you took, and how measurements were used to answer the question. Be sure to talk about how you tried to limit threats to the validity of your experiments (ie., bias,...).
- (d) Collected Data and Analysis - tables or graphs of data collected during the experimental study and your analysis of the data with regard to the research question
- (e) Conclusions - a single paragraph summarizing your observations and conclusions that you drew with regard to your research question, based on your experimental design and data collection. Be sure to mention any threats to the validity of your conclusions. That is, what limitations does your study have in making general conclusions? Where might the results not be an accurate reflection of the same research question in other situations?

3 Some Example Kinds of Experimental Research Studies

- Choose a computation and compare the impacts of a few different domain decompositions for that computation
- Choose a problem and compare different parallel algorithms for that problem
- Choose a problem and domain decomposition and compare different approaches to input/output of data to/from workers
- Choose a problem and compare different load balancing schemes for that problem
- Choose a problem and compare a data parallel versus task parallel approach to the problem
- Compare using collective communication versus send-receive for different size data communication
- Compare using derived data types versus normal data types in communication for different sizes/shapes of data to be sent
- Compare overlapping communication with computation with isend and irectv versus normal send and receive communications with different kinds of computation that allow for such overlap

Hint: It is easy to split up the work between the group members, by having each write one of the programs or decompositions or versions to be compared.

4 Evaluation and Grading

Your project will be evaluated according to the following criteria:

- 1. (10 pts) Deliverable 1.
 - (3) Interesting, Concise research question
 - (2) Clear Hypothesis with some justification
 - (3) (Proposed) Detailed and Technically Sound Experimental Design
 - (2) Reasonable Work Plan

- 2. (30 pts) Deliverable 2.
 - (25) correctness of program code
 - (2) internal documentation
 - (3) external documentation

3. (30 pts) Deliverable 3.
 - (5) Speaker's understanding of the topic
 - (5) Organization of the presentation
 - (5) Content
 - (5) Presentation of the material
 - (5) Quality of visual aids
 - (5) Treatment of questions

4. (30 pts) Deliverable 4.
 - (3) Research question
 - (2) Hypothesis
 - (10) Detailed Final Experimental Design
 - (10) Collected Data and Analysis
 - (5) Conclusions

NOTE: Individual grades will be assigned as a percentage of the grade of the group project, based on feedback on how well the group worked together and fairly divided the work on the project. Each student will complete a peer review that has the goal of determining how well the group worked together, and how the workload was handled. (see course web site for review form example)

Each student in the class will fill out an evaluation form for each presentation. These evaluations will be anonymous, and given to the students as feedback at the final exam. The instructor will independently grade each oral presentation. Both the student evaluation and the grade will be based on: the speaker's perceived understanding of the topic, organization of the material, presentation of the material, quality of visual aids, treatment of questions, enjoyment level of talk, and overall effectiveness of the presentation. The set of students in charge of a given topic will receive the same grade for the presentation.

5 Using Others' Work

You should be writing your own programs (this is part of the learning experience!), not using existing programs found anywhere. You may use a sequential code version to get you started from another source as long as you reference that source in your code documentation as well as your report. You should not be taking credit for anyone else's work.

You are free to cut and paste pictures and graphs from other sources to place in your presentation as long as you cite your sources on the last page of the presentation. You should not be using actual text slides from online talks that you might find.