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INSTITUTE OF COMPUTER SCIENCE

CMSC 180 Course Guide

Second Semester 2023-2024

I. Course Description

Course Number	**CMSC 180**
Section	**T**
Course Title	**Introduction to Parallel Computing**

II. Course Introduction

Welcome to CMSC 180! In this course, we will be learning how to design correct parallel algorithms and then write, compile, run and debug parallel programs. What do we mean when we say correct parallel algorithms? Well, we will talk about that later on. What we would like to put in the back of our minds is that, the end product of this course is a student who is able to design, write, implement, run and debug programs that possess the attributes of correct parallel algorithms. In this course, we will start with a discussion on a real-world example as an argument for parallelization. We will enhance the solutions in the real-world example using parallelization techniques, including the parallel machines that will be used to run the techniques. Towards the second half of the semester, we will learn to implement these techniques using a very popular parallel programming paradigm called message-passing interface (MPI). MPI's power relies on socket programs.

Parallel programming is not difficult to learn, but our old way of thinking in series will be challenged and we will learn a new paradigm of solving things: Parallel processes. A beginner like us can benefit from its beauties after the first few topics of the course. The laboratory research activities will give us some programming experience that we can use as patterns to solve some more advanced problems in the future whose solutions cannot be found directly from the lecture. They are research activities because you get to discover the ideas yourself through experimentation and be able to communicate your discoveries in a technical manner. If we see ourselves as future programmers, software engineers, system administrators, and even tech company owners, then we should be knowledgeable on how to design industry-sized parallel systems.

We will be guided, step by step, through the various important areas of Parallel Computing and be shown the links that exist between them. The algorithmic components of parallel programs, what computational technologies and innovations are available, and several hands-on programming examples are all dealt with in great detail in the lecture. Upon finishing this course, we will be compiling a sufficient library of algorithms and programming tools as well as be adept in the current software and hardware technologies.

III. Course Objectives

At the end of the course, we, the students should be able to:

1. Explain the limitations of serial computers;
2. Classify parallel computers;
3. Measure parallel performance; and
4. Implement simple parallel programs.

IV. Course Materials and Schedule

We, the students, will receive the course materials in the lecture component of the course through a hybrid face-to-face meetings in Eliezer A. Albacea Hall (formerly ICS Mega Lecture Hall) and asynchronous online meetings via the course's Google Classroom site. We will meet in a face-to-face manner in the laboratory component of the course during the scheduled laboratory meetings. Table 1 lists the lecture topics with the corresponding tentative schedule while Table 2 lists the schedule of the laboratory research activities.

Table 1. CMSC 180 lecture topics and schedule.

Week	Topic	Approximate Schedule*
1	Introduction to Parallel Computing	06, 08 February
2	Parallel Programming Platforms	13, 15 February
3		20, 22 February
4		27, 29 February
5	Principles of Parallel Algorithm Design	05, 07 March
6		12, 14 March
7		19, 21 March
8	Exam 1	26 March
9	Reading and Wellness Break	02, 04 April
10	*Buong Linggo ng Kagitingan*	8-12 April
11	Basic Communication Operations	16, 18 April
12	Analytical Modeling of Parallel Programs	23, 25 April
13		30 April, 02 May
14	Parallel Algorithms	07, 09 May
15		14, 16 May
16	Exam 2	21 May
17	*Freedom or Slavery*	28, 30 May
*Schedule is tentative so that we can be adaptive to the changing times.		

Table 2. CMSC 180 laboratory research activities and section-specific schedules.

Week	Topic	Section-specific Schedule*
1	Laboratory Research Problem 1	
2	Laboratory Research Problem 2	
3		
4		
5	Laboratory Research Problem 3	
6		
7		
8	Laboratory Research Problem 4	
9		
10		
11	Laboratory Research Problem 5	
12		
13		

V. Assessment

Our respective grades for the course will be computed using the following percentages:

Lecture		**40%**
Examinations	30%	
Quizzes	10%	
Laboratory		**60%**
Laboratory Research Problem 1	5%	
Laboratory Research Problem 2	10%	
Laboratory Research Problem 3	10%	
Laboratory Research Problem 4	20%	
Laboratory Research Problem 5	15%	
TOTAL		**100%**

VI. Grading Scheme

Our performance in the assessment above will have a final percentage ranging from 0% to 100%, inclusive. The following is the scheme that will be used for converting that final percentage into a numerical grade:

Percentage range	Grade	Percentage Range	Grade
< 65	5.00	81 – 84	2.00
65 – 68	3.00	85 – 88	1.75
69 – 72	2.75	89 – 92	1.50
73 – 76	2.50	93 – 96	1.25
77 – 80	2.25	> 96	1.00

Note here that we will use the ceiling of the percentage to avoid the fuzziness brought about by decimal boundaries. What do we mean by this? Well, ceiling means computing the next higher integer (why are we explaining this to us beats us?). This means that if our final percentile is 64.000001 (or however far is the decimal place as long as it is greater than 64), then its ceiling is 65 which will have a corresponding numerical grade of 3.00. However, if our final percentile is 64.000000 (and however far the decimal place, we still get zero), then its corresponding numerical grade is 5.00. Late submission of the requirements will only be given a maximum grade of 70% of the grade had the requirement been submitted on time. Being punctual is one of the core values that we must train ourselves towards being a professional. This means that even if our technical writing was flawless and we deserved a percentage of 100%, which is equivalent to a grade of 1.00, our requirement's score in percentage will be at most 70%, which is equivalent to a grade of 2.75. That big of a difference in grade is what punctuality affords us.

VII. Course Resources

I.T. Foster. 1995. **Designing and Building Parallel Programs**. Addison-Wesley (Available online www.mcs.anl.gov/~itf/dbpp)

A. Grama, A. Gupta, G. Karypis and V. Kumar. 2003. **Introduction to Parallel Computing**. Pearson Education Ltd.: England. pp. 636 (ISBN: 0-201-64865-2)

Additional resources will be given during asynchronous online and laboratory meetings