CSCI 473/573-01 Introduction to Parallel Systems (@ CCU) Spring 2012
ECE 473/673-01 Introduction to Parallel Systems (@ CU)

Instructor

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Room	@ Coastal Carolina University	Coastal Science Center 318
	@ Clemson University	Riggs Hall 219

Prerequisites

@ Coastal Carolina University:	Grade of C or better in CSCI 220
@ Clemson University:	Grade of C or better in ECE 322 or ECE 329 or equivalent

Description

This course introduces parallel computer architectures and their programming. It includes an introduction to MPI and OpenMP and a number of engineering problems, including numerical simulations. It also provides an introduction to performance evaluation and modeling as well as scalability analysis. **(573 reflects the graduate-level course number at CCU while 673 refers to the graduate-level course CU)**

Course Objectives

a. Understand concepts of concurrent programming to write parallel programs to solve problems
b. Understand some typical high-performance computing architectures, sets of system software, programming paradigms,and tools used to address challenges faced by the high-performance computing community

Student Learning Outcomes

The student will be able to:

1. define and describe a variety of parallel computer architectures and discuss the performance tradeoffs among these (473/573CCU/673CU)
2. define, describe and discuss both numerical and non-numerical algorithms and to demonstrate an understanding of their parallel formulations (473/573CCU/673CU)
3. apply fundamental principles to synthesize parallel programs to solve problems using both explicit message-passing and shared-memory programming paradigms (473/573CCU/673CU)
4. define and describe challenges faced by the high-performance computing community and explain techniques and technologies appropriate to their solution (473/573CCU/673CU)
5. apply standard analysis techniques to predict the performance and scalability of a parallel program and/or a high-performance computing system (473/573CCU/673CU)
6. integrate concepts of explicit message-passing with the shared-memory programming paradigm to solve a problem through the design and implementation a hybrid solution involving both paradigms and to ultimately compare and contrast this solution to non-hybrid solutions with respect to overall performance (573 only at CCU and 673 only at CCU)

Texts

Parallel Programming in C with MPI and OpenMP (required)
By: Michael J. Quinn,
McGraw Hill ISBN: 0-07-282256-2

MPI 2.2 Specification Document (required)
(Online or Spiral bound at bookstore)

Grading Scale

90 - 100	A	70 - 76	C
87 - 89	B+	67 - 69	D+
80 - 86	B	60 - 66	D
77 - 79	C+	0 - 59	F

Grading
Grades will be assigned according to the standard 10-point grading scale with possible "+" letter grades.

There will be no curving of grades during the semester. I **MAY** decide after all grades are in at the end of the semester to curve, based on the cumulative difficulty of the material, averages, etc; however you should not assume that any curve will be given.
Grades will assignments, a mid-term exam, and a final exam. Your final grade will be calculated as follows:

Mid-Term Exam:	30%	(1 additional page for 573(673) students over 473 students)
Assignments and Projects:	40%	(2 additional projects for 573(673) students over 473 students)
Final Exam:	30%	(1 additional page for 573(673) students over 473 students)

As you can see, the assignments constitute a large fraction of the course grade. **(573 reflects the graduate-level course number at CCU while 673 refers to the graduate-level course CU)**

Course Policies

Attendance:

Attendance is expected, and you are expected to be on time for class. The CCU University Catalog states, with respect to attendance, that "An instructor is permitted to impose a penalty, including assigning the grade of F, for unexcused absences in excess of 25% of the regularly scheduled class meetings." Attendance will be taken, and absences in excess of 25% of our class meetings will result in a failing grade, no matter what your actual performance in the course happens to be. The Catalog also states that "Absences will be excused for documented cases of:

a) incapacitating illness,
b) official representation of the University (excuses for official representation of the University should be obtained from the official supervising the activity),
c) death of a close relative, and
d) religious holidays."

In short: **Attendance is required**
No late work accepted.
Make-up tests by prior appointment only.
Wait 15 minutes for late instructor.

Tests

Tests will be given during regularly scheduled class times. Make-ups for missed tests will not be allowed without prior approval from the instructor and only when the absence is excused (verification may be required).

E-mail Communication

I will normally respond to e-mails within one day. I do not normally read student e-mails on the weekends, so do not expect an immediate response if an e-mail is sent then; however in some cases I will be able to respond during the weekend. University policy dictates that all e-mail communication regarding class issues be conducted with students via their Coastal e-mail address. E-mail from other addresses will not be answered.

An e-mail must have the correct course number in the subject. If you send me email without a subject, it is very likely that I will throw it away as spam. If you send me email, use correct spelling, grammar and punctuation. Do not send email to me using instant messaging code. If you do, I will throw away your email.

Academic Honesty

Coastal's policy on academic integrity as stated in the Student Code of Conduct:

> *Coastal Carolina University is an academic community that expects the highest standards of honesty, integrity and personal responsibility. Members of this community are accountable for their actions and reporting the inappropriate action of others and are committed to creating an atmosphere of mutual respect and trust.*

Clemson's policy on academic integrity is state in the Undergraduate Academic Integrity Policy:

> *As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a "high seminary of learning." Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.*

Furthermore, Clemson's Engineering Honor Code states:

> *As members of the College of Engineering and Science, we recognize that lasting excellence is achieved only through honor, demanding standards for personal integrity that reflect the standards of conduct expected of all engineers. All undergraduate and graduate engineering students, faculty members, and administrators in the College of Engineering and Science are expected to abide by the ethical standards defined herein. These standards are based on the following principles:*
>
> *Engineers, both students and professionals, must be of honorable and trustworthy character. It is dishonest to claim credit for work, which is not the result of one's own efforts.*
>
> *Students, faculty members, and administrators are bound by a mutual trust to uphold the principles and enforce the policies of the Honor Code. This makes it the duty and responsibility of all members of the College of Engineering and Science to report promptly any suspected violations of the Code.*

Cheating and plagiarism will not be tolerated. Students are required to turn in their own work, unless otherwise specifically allowed by the instructor. Submitting a copy of another student's work or allowing your work to be copied by another student is a violation of academic integrity. Falsification of program output is also a violation of academic integrity. Penalties for violations of academic integrity may include a grade of F for the course and notification of the Provost of the University. Please refer to the Student Handbook from the Office of Student Affairs for more information regarding Coastal Carolina University's Student Code of Conduct and Academic Responsibility. Similar measures apply at Clemson University.

Linux:

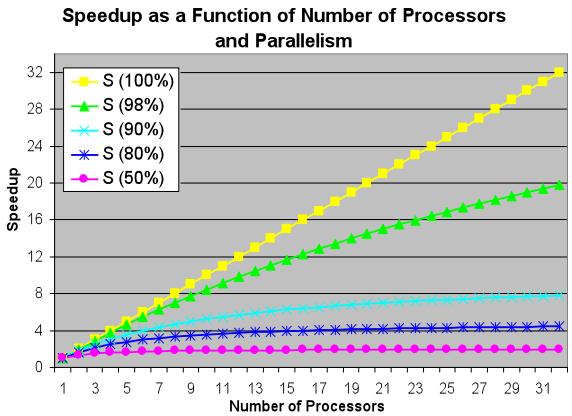
We will be using SSH to remotely connect to the Clemson Palmetto cluster computer. You will be expected to understand how to navigate the commandline in Linux, programming and compiling such programs, and you will have to learn to use the PBS queueing system there. You are also expected to have a distribution of Linux or linux-like environment on your local machine for use in class and on assignments. This can be accomplished a number of ways including but not limited to a native Linux install on the metal, a dual-boot with Windows, Wubi Ubuntu, or if you have Mac OSX, you may choose to have Xcode and then mpich2 installed.

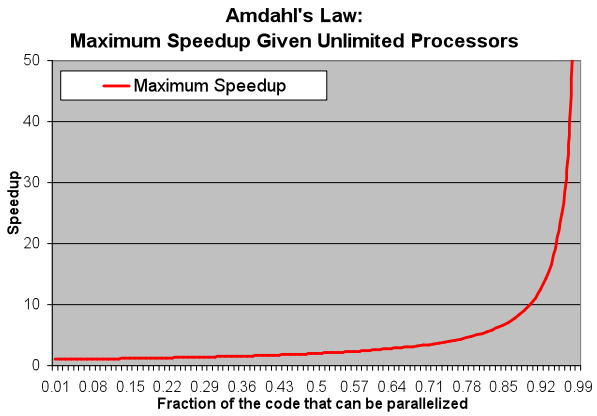
C Programming:

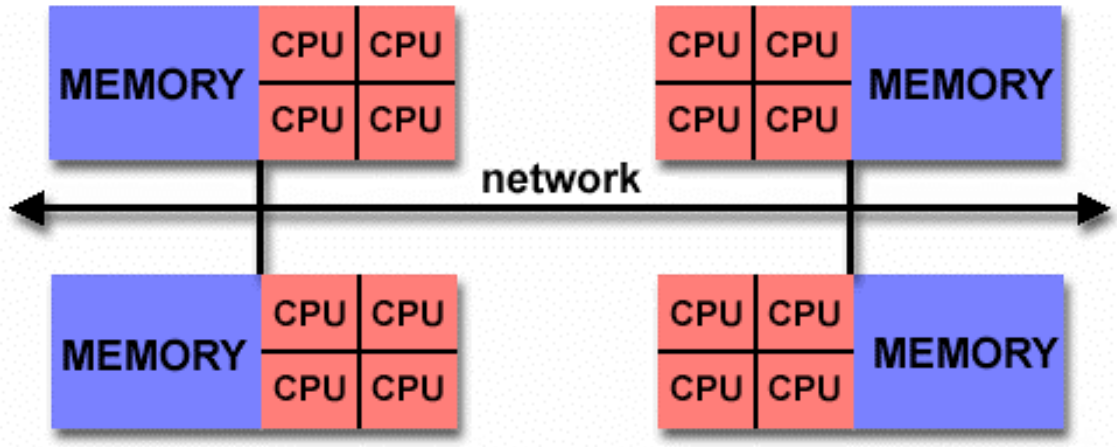
This course assumes you know how to program in C. If you are not strong in this area, you will likely need to spend considerable time outside of class getting up to speed on this. It might be a good idea to get a good reference / textbook on C programming to help you through this phase as would researching and using tutorials online. Please let me know how I can help.

MPI Programming:

This course will teach you how to use the MPI programming library to implement parallel programs. Our textbook has a good coverage of this, and there are numerous examples online as well. As such, you MUST have a copy of the textbook.







Changes

The instructor reserve the right to make changes in this syllabus at any time.

Student Learning Outcomes

The student will be able to:

1. define and describe a variety of parallel computer architectures and discuss the performance tradeoffs among these (473/573)
2. define, describe and discuss both numerical and non-numerical algorithms and to demonstrate an understanding of their parallel formulations (473/573)
3. apply fundamental principles to synthesize parallel programs to solve problems using both explicit message-passing and shared-memory programming paradigms (473/573)
4. define and describe challenges faced by the high-performance computing community and explain techniques and technologies appropriate to their solution (473/573)
5. apply standard analysis techniques to predict the performance and scalability of a parallel program and/or a high-performance computing system (473/573)
6. integrate concepts of explicit message-passing with the shared-memory programming paradigm to solve a problem through the design and implementation a hybrid solution involving both paradigms and to ultimately compare and contrast this solution to non-hybrid solutions with respect to overall performance (573 only)

Student Learning Outcomes mapped to ABET Program Curricular Outcomes

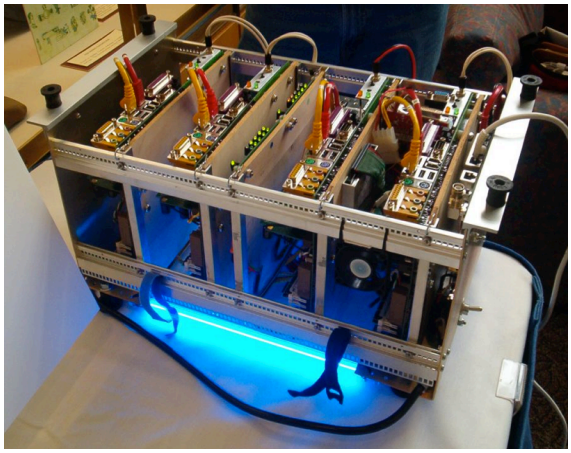
ABET PCO													
		a	b	c	d	e	f	g	h	i	j	k	l (j)
SLO	1	X					X		X				
	2	X	X										
	3	X	X	X							X		
	4	X	X										
	5	X	X								X		
	6	X	X	X							X		

ABET Program Curricular Outcomes

a) An ability to apply fundamental principles of computing and mathematics
b) An ability to analyze a problem, and identify and define the requirements appropriate to its solution
c) An ability to design, implement, and evaluate a solution to meet specific requirements subject to a set of constraints
d) An ability to function effectively on multi-disciplinary teams to accomplish a common goal
e) An understanding of professional and ethical responsibilities
f) An ability to communicate effectively, both verbally and in writing
g) An ability to analyze the local and global impact of computing on individuals, organizations, and society
h) Recognition of the need for and an ability to engage in life-long learning
i) An ability to use current techniques, skills, and tools necessary for computing practice Computer Science
j) [CS ONLY] An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems through the critical analysis of the tradeoffs involved in design choices
k) [CS ONLY] An ability to apply design and development principles in the construction of complex software systems
l) [IS ONLY] An understanding of processes that support the development, deployment, and management of information systems within a business-centric application environment

<Class Flyer>
CSCI 473 / 573
Introduction to Parallel Systems
Spring Semester, 2012

CU's Palmetto Supercomputer



CCU's LittleFE Mini-Cluster

CSCI 473, an introduction to parallel systems and programming, will be offered for the third time during the Spring 2012 semester. It is a three credit-hour course, and will count as an upper-level elective. In particular, **CSCI 473 will count for EITHER a "Computational" or "Application" elective (see the typical footnotes on your advisement sheets).** Additionally, it can count as your generic "300-level or above" elective. (Note, although it can count in any of these three categories, *it can only count once*)

We will be making use of Clemson University's supercomputing resources. The Palmetto cluster is the 96th fastest supercomputer in the world as of June 2011. Additionally, we will be making use of a local cluster called LittleFE.

We are also offering for the first time, CSCI 573, a graduate-level version of this same course. If you are interested in receiving graduate-level credit for this, please talk with Dr. Stamey and/or Dr. Jones.

Prerequisites: C or better in CSCI 220

If you have any questions or concerns, please do not hesitate to contact me.

Dr. William M. Jones: http://cs.coastal.edu