University of Maine — ECE574: Cluster Computing
Spring 2021

Instructor:

Vincent Weaver
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Office: Barrows 203
Office Hours: e-mail to arrange an appointment

Course Website:
`http://web.eece.maine.edu/~vweaver/classes/ece574_2021s/`

Lectures: Tuesday/Thursday 11:00am-12:15pm, Barrows 125
Note: Lectures will be in person, but will also be streamed/recorded via Zoom.

Course Listing:

Advances in high-end computational technology continue to bring the digital revolution into academic, industrial and commercial areas. A popular approach for achieving high performance for these application domains is to use parallel computers. Introduces the primary parallel computer architectures, as well as the programming techniques applicable to concurrent, parallel and distributed computations. Students will gain experience in developing parallel computing solutions for challenging problems. Lec 3.

Pre-requisites:

C- or better in ECE177 or permission
This course involves extensive C coding.

Textbook:

None

Computer Accounts:

You will be assigned accounts on various Linux servers in order to do homework and project assignments. It is expected that you will use these accounts in a responsible way.

By the end of the course you will:

- Learn the definition of "High Performance Computing (HPC)"
- Be able to setup and conduct performance analysis using Linux perf and PAPI tools
- Be familiar with the concept of hardware performance counters
- Understand the challenges of multi-threaded programming, including race-conditions and locking
- Be able to write multi-threaded programs using pthreads
- Be able to write shared-memory multi-threaded programs using OpenMP
- Be able to write message-passing multi-threaded programs using MPI
- Be able to write GPGPU multi-threaded programs using CUDA
- Be aware of how network topology affects performance in large clusters
- Be aware of job scheduling issues in large clusters, including load balancing, fault tolerance, and power concerns
- Be aware of cluster filesystems and why they are useful and necessary
- Be aware of "Big Data" and how it applies to cluster computing

Assignments:
Assignments will be announced in class and posted to the website. Homework submissions will be done via e-mail.

Grading:

Class Participation (5%)
11 homework assignments (lowest one dropped) (50% total)
1 project (20%)
2 midterm exams (25%)

Late Work: Late work is penalized at 20% a day and in general cannot be accepted once solutions have been discussed in class.

University of Maine required Statements

Academic Honesty Statement

Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University. Please see the University of Maine System's Academic Integrity Policy listed in the Board Policy Manual as Policy 314 (Date Issued: September 1, 2020): `https://www.maine.edu/board-of-trustees/policy-manual/section-314/`

Students Accessibility Services Statement

If you have a disability for which you may be requesting an accommodation, please contact Student Accessibility Services, 121 East Annex, 581.2319, as early as possible in the term. Students who have already been approved for accommodations by SAS and have a current accommodation letter should meet with Professor Weaver privately as soon as possible.

Course Schedule Disclaimer (Disruption Clause)

In the event of an extended disruption of normal classroom activities (due to COVID-19 or other long-term disruptions), the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.

Observance of Religious Holidays/Events

The University of Maine recognizes that when students are observing significant religious holidays, some may be unable to attend classes or labs, study, take tests, or work on other assignments. If they provide adequate notice (at least one week and longer if at all possible), these students are allowed to make up course requirements as long as this effort does not create an unreasonable burden upon the instructor, department or University. At the discretion of the instructor, such coursework could be due before or after the examination or assignment. No adverse or prejudicial effects shall result to a student's grade for the examination, study, or course requirement on the day of religious observance. The student shall not be marked absent from the class due to observing a significant religious holiday. In the case of an internship or clinical, students should refer to the applicable policy in place by the employer or site.

Sexual Discrimination Reporting
The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell a teacher about an experience of **sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct or any form of gender discrimination** involving members of the campus, **your teacher is required to report** this information to Title IX Student Services or the Office of Equal Opportunity.

If you want to talk in confidence to someone about an experience of sexual discrimination, please contact these resources:

For *confidential resources on campus*: **Counseling Center: 207-581-1392** or **Cutler Health Center: at 207-581-4000**.

For *confidential resources off campus*: **Rape Response Services**: 1-800-871-7741 or **Partners for Peace**: 1-800-863-9909.

Other resources: The resources listed below can offer support but may have to report the incident to others who can help:

For *support services on campus*: **Title IX Student Services: 207-581-1406, Office of Community Standards: 207-581-1409, University of Maine Police: 207-581-4040 or 911**. Or see the OSAVP website for a complete list of services. `https://umaine.edu/titleix/`