

ASEN 6519/MSEN 6228 High Performance Computing Spring 2011

Lectures: Monday/Wednesday/Friday 2:00 – 2:50 ECCR 139

Purpose: The course will focus on the process of taking existing algorithms (e.g., discretization and equation solving) and making them perform well on high performance computers. Some aspects will relate to single core performance (e.g., cache performance) but much of the class will be devoted to massively parallel performance. I/O and data analysis will also be a major topic. Pre-requisites will be courses that have already introduced the algorithms (e.g., P.D.E. discretization courses, linear algebra courses) since those topics will not be the focus of this class but rather the foundation upon which we build.

Learning Goals/Major Topics

Fundamental kernels

- High performance computing hardware
 - Processors
 - Memory subsystem
 - Communication Fabric
- Single core performance
- Parallel paradigm
 - Work division
 - Communication paradigm
- Parallel performance analysis (e.g., weak scaling vs. strong scaling)

Application of kernels on indexed grids

- Domain decomposition
- Discretization
- Equation solution
 - Direct/banded solvers
 - Conjugate Gradient solver
- Particle tracking
- Fast Marching Methods (for level set)

Applications of kernels on unstructured grids

- Domain Decomposition
- Discretization
- Equation solution
- Adaptivity

Parallel I/O and Data Analytics

- File based
- In situ* data analysis

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Office hours: walk-in or by appointment	walk-in or by appointment

Grading

Grade Breakdown According to Assignments: Your final grade is determined according to the following percentage breakdown:

Homework	50
Project	50
	100%

1. Students with disabilities who qualify for academic accommodations must provide a letter from Disability Services (DS) and discuss specific needs with the professor, preferably during the first two weeks of class. DS determines accommodations based on documented disabilities (303)-492-8671, Willard 322, www.colorado.edu/sacs/disabilityservices)
2. Please read the University's policies on classroom behavior and associated procedures at <http://www.colorado.edu/policies/classbehavior.html>.

Special Campus Notes

1. The Provost's Disability Task Force recently reviewed disability issues on campus regarding reasonable academic accommodations and recommends that faculty include in their syllabi, the specific disability statement below that informs all parties of the proper process.
 - If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. (303-492-8671, Willard 322, <http://www.Colorado.EDU/disabilityservices>)
 - Disability Services' letters for students with disabilities indicate legally mandated reasonable accommodations. Other letters/requests you may receive from agencies such as the Wardenburg Student Health Center, or other health providers, such as physicians or counselors, are recommendations you may choose to follow to assist students but are not necessarily legal mandates. The syllabus statements and answers to Frequently Asked Questions can be found at <http://www.colorado.edu/disabilityservices>.
2. The Chancellor and the President have recently fielded several valid complaints from students and parents regarding the lack of adequate faculty accommodation for some students who have serious religious obligations which may conflict with academic requirements such as scheduled exams. Campus policy states that faculty must make reasonable accommodation for such religious observances and in so doing, be careful not to inhibit or penalize those students who are exercising their rights to religious observance. The policy states that 'every effort' shall be made to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. If a student and an instructor cannot come to a mutually satisfactory agreement for a particular situation, the student may appeal the matter to the department chair and then, if necessary, to the relevant Dean's office. It is the responsibility of every instructor to clearly explain his or her procedures in this regard in the course syllabus so that all students are fully informed, in writing, near the beginning of each semester's classes. Please explicitly encourage students to notify you of anticipated conflicts as early in the semester as possible so that there is adequate time to make necessary arrangements. Faculty should be aware that a given religious holiday may be observed with very different levels of attentiveness by different members of the same religious group and thus may require careful attention to the particulars of each individual case. The full text of the Boulder campus policy can be read on the web at http://www.colorado.edu/policies/fac_relig.html.
3. The University has recently adopted a student Honor Code. Individual faculty members are encouraged to familiarize themselves with its tenets and procedures. We also recommend that faculty incorporate specific language suggestions provided at <http://www.colorado.edu/academics/honorcode/Faculty.html>. Other information on the Honor Code can be found at <http://www.colorado.edu/policies/honor.html> and at <http://www.colorado.edu/academics/honorcode/>
4. Faculty and students should be aware of the campus "Classroom Behavior" policy at <http://www.colorado.edu/policies/classbehavior.html> as well as faculty rights and responsibilities listed at <http://www.colorado.edu/FacultyStaff/faculty-booklet.html>. These documents describe examples of unacceptable classroom behavior and provide information on how to handle such circumstances should they arise. Faculty are encouraged to address the issue of classroom behavior in the syllabus.

Recommended syllabus statement:

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me

of this preference early in the semester so that I may make appropriate changes to my records. See policies at <http://www.colorado.edu/policies/classbehavior.html> and at <http://www.colorado.edu/studentaffairs/judicialaffairs/code.html>

5. The Office of Discrimination and Harassment recommends the following syllabus statement:

The University of Colorado at Boulder policy on Discrimination and Harassment, the University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships apply to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of discrimination or harassment based upon race, color, national origin, sex, age, disability, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH, the above referenced policies and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at <http://www.colorado.edu/odh>