Course Description

Study of computer science techniques and tools that support computational sciences and engineering. Emphasis will be on visualization, performance evaluation, parallel computing, and distributed computing. Prerequisites: CS-115, CS/EE-380, and engineering standing. CS/MA/EGR 537 should be a prerequisite. All graduate students should take 537 before taking this course.

Requirements and Goals

Students need knowledge of programming in a modern object oriented language and a basic knowledge of machine organization and architecture. You need to know how to make presentations in either PowerPoint or Acrobat.

Students will learn about hardware and software support for high performance computing. They will learn to select algorithms and develop code for computing in a parallel (or distributed computing) environment. They will learn about benchmarking, optimization, and visualization. The course will include a hands on component utilizing a parallel computing environment.

Web Site, Textbook, and Course Outline

The course web site is http://www.mgnet.org/~douglas/Classes/cs521-s04 or you can get to the web site by clicking on Current Course from my home page of http://www.mgnet.org/~douglas.

The course will follow, where still appropriate, the lecture notes of the Computational Science Educational Project (CSEP). CSEP is somewhat dated, however. There are two recent books that I suggest you read:


The first book will teach you about basic numerical methods used in simulations. The second book will teach you how to solve many problems on parallel computers.
The lectures will cover some or all of the topics below. I may allow swapping of team members on a one for one basis as long as I approve it well in advance.

- An Overview of Computational Science
- Numerical Linear Algebra
- Computer Architecture and Networks
- DDDAS
- Cache Designs and Tricks
- Some High Performance Computing Issues in PDEs
- MPI and OpenMP
- Scientific Visualization in High Performance Computing
- Random Number Generators and Monte Carlo Methods

- Case Study: Ocean Modeling
- Case Study: Sports Lighting
- Case Study: Dust Particle Movement
- Case study: Flame Simulation
- Case Study: Semiconductor Modeling
- Case Study: Nanomaterials
- Case Study: Bioinformatics
- Case Study: Wildfires
- Case Study: Contaminant Tracking
- Case Study: Direct and Inverse Bioelectric Fields Problems

We will cover as many of these topics as time permits. Which case studies we consider will depend on the class' interests.

**Office Hours and Contact Information**

My office hours will be on Tuesday through Thursday.

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<thead>
<tr>
<th>Day</th>
<th>Time</th>
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<tbody>
<tr>
<td>Tuesday</td>
<td>2:30-3:30</td>
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<tr>
<td>Wednesday</td>
<td>10:00-11:00</td>
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<tr>
<td>Thursday</td>
<td>9:00-10:00</td>
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or by appointment.

My office is 321A McVey Hall. My office telephone number is 257-2326 and the FAX is 323-1029. Feel free to telephone my office as late as 11:00pm. In a pinch, I can be reached at home on weekends at 203-625-9449. Please do not call me at home before 8:30am or after 9:00pm. I respond to e-mail (douglas@ccs.uky.edu or douglas-craig@cs.yale.edu) fairly quickly (always include a phone number where I can call you back). If you are stuck on something, please do not hesitate to contact me.
**Warning:** The entrance to my office is inside another office (321 McVey). I really do not hear knocking on the outer office's door. Please just walk in and continue right into 321A and let me know that you are present. Do not assume that I will know that you are in the outer office. If I am not in my office, go straight to 325 McVey and ask where am I. I may well be in there and have to be extracted from another inner office. Please be utterly brazen.

**Grading**

Your grade will be based on the homework and class participation. Only letter grades will be given (no +/-'s). Homework assignments usually have a presentation associated with them. You will be expected to use overhead transparencies and/or a computer to make the presentation. Our lecture hall has both projection and computer equipment to do both styles of presentations including in parallel. I would prefer that you use PowerPoint for your presentations, however, I will allow Acrobat. I do not want weird Linux/Unix presentation tools (e.g., Star, K, or Open Office). I want to see your presentations one week in advance so that I can offer advice. I expect that your presentation will be grammatically correct without misspellings.

From a legal viewpoint, I am allowed to change the grading system anytime in the course as long as I give adequate notice to the class. The university ombud issues memorandums that cover this and many more topics. However, you should watch the class web page for any changes in the grading policy.

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It is very difficult to either cheat or plagiarize in this course. However, either can be done. I ask that you not copy, verbatim, presentations given in earlier years. Seeing them twice will put me to sleep and then you will not get a very good grade since I will not have noticed that you did the project. There are plenty of interesting things on the web on any of these topics that will be different from before and you will learn more by doing some research on the topics. *Getting caught cheating or plagiarizing will result in a grade of E and possibly much worse, including expulsion from the university and legal proceedings against you.*

The projects are done in small groups in which everyone gets the same mark. If one fails, the whole group fails on the assignment. A lot of the information is available through CSEP and other web resources. It is considered good academic form to cite others’ work that you use. A simple mechanism is to include a set of references at the end of a presentation with pointers to interesting places to visit to get more information.

**327 and 326 McVey**
The lecture hall is normally locked. The staff (Teresa Moody and Sandy Leachman) in 325 McVey have a key and can let you in. The system administrators for CCS also have keys and can answer technical questions about the computers, but are usually very busy. Room 327 is in use MWF 9-10, Tu 12-1, W 3-5. During working hours (M-F 8:30-4:30) you can usually get in by asking. You can prepare your lectures on the computers in the room using PowerPoint. Be sure to keep a copy somewhere else.