EECS 739: Parallel Scientific Computing
Spring 2017

Course Description
This course is concerned with the application of parallel processing to real-world problems in engineering and the sciences. State-of-the-art serial and parallel numerical computing algorithms are studied along with contemporary applications. The course takes an algorithmic design, analysis, and implementation approach and covers an introduction to scientific and parallel computing, parallel computing platforms, design principles of parallel algorithms, analytical modeling of parallel algorithms, MPI programming, direct and iterative linear solvers, numerical PDEs and meshes, numerical optimization, GPU computing, and applications of parallel scientific computing.

Course Meetings
TR, 11am-12:15pm, 3150 Learned Hall

Instructor
Dr. Suzanne Shontz
3016 Eaton Hall
Dept. of Electrical Engineering and Computer Science
Office Phone: (785) 864-8816
E-mail: shontz@ku.edu

Office Hours: Tuesdays from 1-2pm and Thursdays from 2-3pm or send e-mail to schedule an appointment in advance. (Note that I have a second office which is 238 Nichols Hall. You may be asked to come to Nichols Hall to meet with me if you request a meeting with me outside of office hours on certain days of the week.)

Teaching Assistant
None

Texts
Introduction to Parallel Computing, Second Edition, by Ananth Grama, George Karypis, Vipin Kumar, and Anshul Gupta, Pearson-Education, 2003. Required.

Parallel Scientific Computing in C++ and MPI: A Seamless Approach to Parallel Algorithms and Their Implementation, by George Karniadakis and Robert M. Kirby, II, Cambridge University Press, 2003. Required. (On reserve at Spahr Library.)

References
The following books have also been placed on reserve at Spahr Library.

Parallel Programming with MPI, by Peter S. Pacheco, Morgan Kaufmann Publishers, 1997.

Parallel Programming in C with MPI and OpenMP, by Michael J. Quinn, McGraw-Hill Publishers, 2004.

Multicore and GPU Programming: An Integrated Approach by Gerassimos Barlas, Morgan Kauffman Publishers, 2015.

Prerequisites
Math 122 or Math 126; Math 290; experience programming in C, C++, or Fortran; EECS 639 (or equivalent). Highly recommended: Math 127 or Math 223.

Course Requirements
Lecture attendance is required, although attendance will not be recorded. The course requirements for EECS 739 include class participation, four homework assignments, one midterm exam, and a final exam. The homework assignments will require a combination of algorithmic design, problem solving, mathematical analysis, and computer programming (using C/C++, MPI, and CUDA) (not all on every assignment). *Prior knowledge of C/C++, MPI, and CUDA programming is not a prerequisite for the course.*

Homework assignments will be due approximately 14 days after they are assigned. Due dates for homework assignments will be announced in class. (The dates listed on the course calendar are simply a guide for me.) **There will be a late penalty of 20% per day for homework handed in up to 48 hours late. No homework assignments will be accepted which are either (i) more than 48 hours late or (ii) is not submitted by 11:59pm the day before Stop Day.**

There will be one midterm exam scheduled for Thursday, March 9 and one final exam scheduled for Monday, May 8. Please reserve these dates on your calendar. The midterm and final exam will be closed-book. The final exam will not be comprehensive. A make-up midterm or final exam will be given to any student who is absent from an exam for a compelling reason and gets permission from the instructor.

If you have a mandated religious observance with conflicts with the midterm examination, please contact me privately at the beginning of the semester so that a make-up examination can be scheduled at a mutually acceptable time. (The university policy which applies to religious observances in conflict with examinations does not apply to the final examination since instructors do not schedule final exams.)

The exams will cover topics drawn from the lectures and homework, and from the underlying algorithms and mathematics.

Grading
Class participation will count for 5% of the final grade. The homework assignments will count for 20% of the final grade. The midterm exam will each count for 35% of the final grade, and the final exam will count for 40%.

Your final grade in the class will then be computed by using the weighted average given above and the following scale:

Grade	Percentage
A	[88%-100%]
B	[78%-88%)

Class Schedule
The course calendar shows a week-by-week syllabus. The dates and order of topics are subject to change by the instructor. Any significant changes will be announced in class.

Course Website and E-mail
By the end of the week, there will be a course website available at the following URL:
http://people.eecs.ku.edu/~shontz/eecs_739_spring_2017.html .
E-mail will be used for announcements not given in class.

Computing Facilities
Students will have access to a cluster in the Advanced Computing Facility at Nichols Hall in order to run your C/C++ and MPI codes. Students will have access to the cycle servers in Eaton Hall in order to run your CUDA codes on GPUs.

Academic Integrity Policy
Cheating in the course will not be tolerated. Students are allowed to collaborate on the homework assignments with at most one other student of the class. The collaboration should involve no more than the formulation of ideas as a pair. Each student is expected to write up the homework assignment by himself or herself. Students must not hand in homework that represents somebody else's ideas entirely. Students should do the C/C++ and MPI coding and the CUDA coding on assignments by themselves--no program code should be shared. No collaboration of any kind is allowed on the midterm or final exams.

Students are permitted to consult outside published material for the homework, although the homework will be fully based on lecture notes, course handouts, and the textbooks. If a student consults a source other than the lecture notes and textbooks, he or she must cite the source--failure to cite the source will be considered cheating.

If you are uncertain as to whether or not a particular behavior is considered cheating, you are highly encouraged to discuss it with the instructor before engaging in such behavior.

Anyone found cheating will receive a 0 on that work (homework assignment) or an F in the class (midterm exam or final exam). A second incident will result in an F grade for the course. These penalties will be received by all parties involved, following a hearing with the instructor. In all cases, reports of academic misconduct will also be made to the dean's office where further disciplinary action may be taken in accordance with School of Engineering and University of Kansas guidelines. This may result in much more serious sanctions.

Academic Achievement and Access
Any student in this course who has a disability that may prevent him/her from fully demonstrating his/her abilities should contact me personally as soon as possible so we can

discuss accommodations necessary to ensure full participation and facilitate the educational opportunity.

The Academic Achievement & Access Center (AAAC) coordinates accommodations and services for all KU students who are eligible. If you have a disability for which you wish to request accommodations and have not contacted the AAAC, please do so as soon as possible. Their office is located in 22 Strong Hall; their phone number is (785) 864-4064 (V/TTY). Information about their services can be found at http://www.achievement.ku.edu/ . Please contact me privately in regard to your needs in this course.

Suzanne M. Shontz, Associate Professor, Department of Electrical Engineering and Computer Science, University of Kansas, shontz@ku.edu

EECS 739: Scientific Parallel Computing
Week-by-Week Syllabus

Week	Lecture Topics	Notes
1	**Jan. 17 and 19:** Introduction to Scientific Parallel Computing and Its Applications	
2	**Jan. 24 and 26:** Design Principles of Parallel Algorithms	Homework #1 handed out Jan. 26
3	**Jan. 31 and Feb. 2:** Direct Linear Solvers	
4	**Feb. 7 and 9:** Direct Linear Solvers/MPI Programming	Homework #1 due Feb. 9
5	**Feb. 14 and 16:** MPI Programming	Homework #2 handed out Feb. 16
6	**Feb. 21 and 23:** Analytical Modeling of Parallel Algorithms	
7	**Feb. 28 and Mar. 2:** Iterative Linear Solvers	Homework #2 due Mar. 2
8	**Mar. 7 and 9:** Iterative Linear Solvers/**Midterm Exam**	**Midterm Exam on March 9.**
9	**Mar. 14 and 16:** Numerical PDEs and Meshes	
BREAK	**Mar. 21 and 23: Spring Break**	**No class this week.**
10	**Mar. 28 and 30:** Numerical PDEs and Meshes	Homework #3 handed out Mar. 30
11	**Apr. 4 and 6:** Numerical Optimization	
12	**Apr. 11 and 13:** Numerical Optimization	Homework #3 due Apr. 13
13	**Apr. 18 and 20:** Parallel Computing Architectures/GPUs	Homework #4 handed out Apr. 20
14	**Apr. 25 and 27:** GPUs	
15	**May 2 and 4:** GPUs	Homework #4 due May 4
FINAL	**May 8: Final Exam**	**Final exam on May 8 from 10:30am-1pm.**