SAINT LOUIS UNIVERSITY

CSCI 4850/5850 High Performance Computing

Instructor:
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Office Hours: Mon 11am – 12:30pm, Tue 10am – 11:30am, or by appointment

Class Meeting Time/Location/Credit:
> Time: Tue, Thu 12:45pm-2:00pm
> Location: 115 Ritter Hall
> Credit: 3 Credits

Pre-requisites:
- CSCI 2100 Data Structure
- CSCI 3100 Algorithms

(Exceptions if non-mathcs major students have strong programming skills and computer/numerical concepts) with enthusiasm for learning HPC.
Overall requirements: Students will be expected to have knowledge of algorithms and data structures, and linear algebra at an undergraduate level. Students are expected to be proficient in either C, C++, or FORTRAN, and to be familiar with the Unix environment.

Course Description:
> High-performance computing refers to a specialized use and parallel programming of supercomputers, computer clusters, and everything from software to hardware to speed up computations. This course introduces state-of-the-art technologies and programming skills for the HPC. Main topics include basic HPC hardware architectures, parallel programming languages, new trends of HPC, and more. The contents of the course provide a balance of theoretical and practical aspects in parallel computing. A student of this course is expected to develop the right skills to design parallel applications and to effectively use modern HPC platforms.

Topical Outline:
- Introduce High-Performance Computing (HPC)
- Profiling applications for run time and parallel speed-up
- Computer organization and HPC architecture
- Distributed-memory programming with MPI
- Shared-memory programming with OpenMP
- MATLAB Parallel Computing Toolbox
- GPU programming with CUDA and OpenACC
- Cloud Computing and Apache Spark

Learning Objectives: At the completion of this course, students will be able to:
- Know fundamental concepts and new trends of high-performance computing

- Optimize software to take advantage of processor feature
- Design, implement, and analyze distributed-memory programming with MPI
- Design, implement, and analyze shared-memory programming with OpenMP
- Parallelize an existing application using an appropriate parallel programming paradigm
- Utilize MATLAB parallel computing toolbox
- Understand the concept and implement simple GPU programs with CUDA and OpenACC
- Learn cutting-edge cloud computing techniques using Amazon AWS and Apache Spark

Course Textbook:

No textbook is required for this course. Assigned slides/materials will be posted on class website (blackboard). However, several reference books are recommended as below:

- An Introduction to Parallel Programming by Peter Pacheco (Morgan Kaufman, 2011, ISBN:978-0123742605).
- Introduction to High Performance Computing for Scientists and Engineers by Georg Hager and Gerhard Wellein, 1st Edition (Chapman & Hall/CRC Computational Science , ISBN-13: 978-1439811924)
- Introduction to Parallel Computing by Ananth Grama, George Karypis, Vipin Kumar, and Anshul Gupta (Addison-Wesley, 2nd edition, 2003, ISBN:978-0201648652).
- Principles of Parallel Programming by Calvin Lin, and Larry Snyder (Addison-Wesley, 2008, ISBN:978-0321487902).Bioinformatics and Functional Genomics 2nd or 3rd Edition by Jonathan Pevsner (Hoboken, N.J. : Wiley-Blackwell, c2009)

Grading:

Course Item Percent of Final Grade	Percent of Final Grade
Homework Assignments	60%
Take-home Midterm Exam	20%
Take-home Final Exam	20%
Miss class without in advance notice	-1%

Final grades for the course will be based on the following scale. The instructor reserve the right to make adjustments to grades based on overall performance in the course. There will be <u>no</u> opportunity for "extra credit" to improve grades that have already been earned. Bargaining for grades will not be tolerated.

Letter Grade	F	D	C-	C	C+	B-	B	B+	A-	A
%	<60	≥60 <70	≥70 <73	≥73 <77	≥77 <80	≥80- <83	≥83 <87	≥87 <90	≥90 <93	≥93

Attendance policy:

You are expected to attend every lecture and take notes. There is no makeup for exams unless you demonstrate in advance (and agreed by the instructor) that a significant life-event prevents you from attending class or if you have a documented emergency. If you schedule something else during a class when you take an exam, you will get a zero for that grade.

ACADEMIC INTEGRITY AND HONESTY

Students are expected to be honest in their academic work. The University reserves the right to penalize any student whose academic conduct at any time is, in its judgment, detrimental to the University. Such conduct shall include cases of plagiarism, collusion, cheating, giving or receiving or offering or soliciting information in examinations, or the use of previously prepared material in examinations or quizzes. Violations should be reported to your course instructor, who will investigate and adjudicate them according to the policy on academic honesty of the College of Arts and Sciences. If the charges are found to be true, the student may be liable for academic or disciplinary probation, suspension, or expulsion by the University. Students should review the College of Arts and Sciences policy on Academic Honesty (http://www.slu.edu/x16363.xml).

STUDENTS WITH SPECIAL NEEDS-DISABILITY SERVICES

In recognition that people learn in a variety of ways and that learning is influenced by multiple factors (e.g., prior experience, study skills, learning disability), resources to support student success are available on campus. Students who think they might benefit from these resources can find out more about:

- Course-level support (e.g., faculty member, departmental resources, etc.) by asking your course instructor.
- University-level support (e.g., tutoring/writing services, Disability Services) by visiting the Student Success Center (BSC 331) or by going to www.slu.edu/success.

Students who believe that, due to a disability, they could benefit from academic accommodations are encouraged to contact Disability Services at 314-977-8885 or visit the Student Success Center. Confidentiality will be observed in all inquiries.

Course instructors support student accommodation requests when an approved letter from Disability Services has been received and when students discuss these accommodations with the instructor after receipt of the approved letter.

COURSE CONTENT DISCLAIMER

In this course, students may be required to read text or view materials that they may consider offensive. The ideas expressed in any given text do not necessarily reflect the views of the instructor, the English Department, the Writing Program, or Saint Louis University. Course materials are selected for their historical and/or cultural relevance, or as an example of stylistic and/or rhetorical strategies and techniques. They are meant to be examined in the context of intellectual inquiry of the sort encountered at the university level.

WRITING CENTER

I encourage you to take advantage of the writing services in the Student Success Center; getting feedback benefits writers at all skill levels. Trained writing consultants can help with any writing, multimedia project, or oral presentation. During the one-on-one consultations, you can work on everything from brainstorming and developing ideas to crafting strong sentences and documenting sources. These services do fill up, so please make an appointment! For more information, or to make, change, or cancel an appointment, call 977-3484 or visit http://www.slu.edu/writingservices.xml.