WICHITA STATE UNIVERSITY

ECE 694, High Performance Computer Systems, Spring, 2020

- Instructor: Abu Asaduzzaman
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- Preferred Method of Contact: In person during office hours or via e-mail
- Student/Office Hours: Tuesday and Thursday 3:15–3:45PM & 5:20–6:20PM
- Classroom, Day/Time: 261JB, Tuesday and Thursday 2:00–3:15 PM
- Prerequisites: ECE 394 or instructor's consent
- Teaching Assistant (TA): Vikas Thammanna Gowda
- TA Contact: E-mail – vxthammannagowda@shockers.wichita.edu

How to use this syllabus

This syllabus provides you with information specific to this course, and it also provides information about important university policies. This document should be viewed as a course overview; it is not a contract and is subject to change as the semester evolves. Any changes should be shared via lecture and/or Blackboard.

University Policies and Procedures

The Wichita State University Policies and Procedures Manual can be found at: https://www.wichita.edu/about/policy/.

Academic Integrity

Students at Wichita State University are expected to uphold high academic standards. WSU will not tolerate a lack of academic integrity. Students are responsible for knowing and following the Student Code of Conduct (see https://www.wichita.edu/about/policy/ch_08/ch8_05.php) and the Student Academic Honesty policy (see https://www.wichita.edu/about/policy/ch_02/ch2_17.php). When the faculty member determines sanctions are warranted for violations of academic integrity, regardless of severity, the faculty member must report the infraction to the Office of Student Conduct and Community Standards. If you need more information about the process or wish to appeal a decision, please visit

https://www.wichita.edu/about/student_conduct/AcademicDishonesty.php.

All homework (HW) assignments in this course are individual assignments (unless otherwise stated). Students can discuss with others, but they should not write the solution together; one's submission (wording/coding) should be substantially different from others' submissions. "Collaboration is good, cheating is not!" There will be severe consequences for academic dishonesty. Cheating (such as copying word-for-word from other sources) in any test will automatically result in an F grade for the course; this applies to all the parties involved (including the ones who help/show).

Course Description

Introduces modern high performance computer systems that are built using multicore central processing unit (CPU) and many-core graphics processing unit (GPU) architectures. Special attention is given to the cache-memory hierarchy of CPU/GPU and multithreading. Projects focus on contemporary scholarly activities and help students develop teamwork skills.

Definition of a Credit Hour

CS 697AM is a 3 credit-hour course. Success in this 3 credit-hour course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally 3 hours per unit per week with 1 of the hours used for lecture) for instruction and preparation/studying or course related activities for a total of 135 hours. [Here, one unit of credit means one credit-hour.]

For more information on courses and credit hour offerings, please go to: https://www.wichita.edu/academics/academic_affairs/DefinitionAndAssignmentOfCreditHours.php.

Measurable Student Learning Outcomes

Measurable Student Learning Outcomes: Undergraduate (UG) Level

After passing this course, undergraduate students will be able to:

- Understand the fundamental concepts, challenges, and opportunities of high performance computer systems.
- Apply knowledge effectively on studying simple to moderate high performance computer systems as appropriate.
- Understand the importance and benefits of high performance computer systems and engage in life-long learning of high performance computer systems for professional success.

Measurable Student Learning Outcomes: Graduate (GR) Level

After passing this course, graduate students will be able to:

- Design and develop high performance computer systems (such as multicore/many-core systems).
- Analyze and critically assess high performance computer systems, their applications, and related research articles.
- Understand the importance and benefits of high performance computer systems and engage in life-long learning of high performance computer systems for professional success.

Required Texts/Readings Textbook

Please talk to the instructor before buying books for this course.

Textbook: "COMPUTER ARCHITECTURE: A Quantitative Approach," John L. Hennessy and David A. Patterson, Morgan Kaufmann, 6th edition, 2017.

Reference Book: "Structured Computer Organization," Andrew S. Tanenbaum and Todd Austin, Pearson, sixth edition, 2016.

Reference Book: "CUDA by Example: An Introduction to General-Purpose GPU Programming," Jason Sanders and Edwards Kandrot, Addison-Wesley, first edition, 2010.

Other Readings

Class notes and handouts will be made available via WSU Blackboard.

Other Equipment/Materials

Students will be provided accounts to the EECS Computer Architecture and Parallel Programming Laboratory (CAPPLab) 'cudasrv' and service supports so that they can perform parallel programming for homework assignments and/or projects. More information will be made available in class as/if needed.

Class Protocol

There are points on class performance. It is expected that students arrive to the assigned room before class starts. Students are always encouraged to ask questions, especially if they find ambiguity in assignments and materials covered.

Grading Scale

WSU uses a +/- grading scale for final grades and to calculate grade point averages. In this class, usually grades are assigned according to the following chart. However, the grading scale may change as/if needed. (Other classes might assign grades differently: Be sure to understand the different grading scales in all of your classes.)

Points/Percentage	Letter Grade	Grade Points	Interpretation
93 and up	A	4.00	A range denotes excellent performance
90 – less than 93	A-	3.70	
87 – less than 90	B+	3.30	
83 – less than 87	B	3.00	B range denotes good performance
80 – less than 83	B-	2.70	
77 – less than 80	C+	2.30	
73 – less than 76	C	2.00	C range denotes satisfactory performance
70 – less than 73	C-	1.70	
67 – less than 70	D+	1.30	
63 – less than 67	D	1.00	D range denotes unsatisfactory performance
60 – less than 63	D-	0.70	
0 – less than 60	F	0.00	

Assignments

List of grading assignments/components and values toward final grades are shown below. For exams and project, different grading scales will be used for undergraduate and graduate students. Graduate students will have additional activities in the project assignments that have higher weightage. The same grading scale will be used for all students on class performance, homework, and quiz. Homework assignments and their due dates will be announced in class and/or made available via Blackboard. Similarly, the due dates for Quiz, Exam, and Project will be announced in class and/or made available via Blackboard.

Grading Assignments/Components	Undergraduate	Graduate
Class Performance (random check)	4%	4%
Homework (seven of eight, take home)	14%	14%
Quiz (two of three, 30-minute in classroom)	10%	10%
Exam-1 (~ Week 5, TBD, 60-minute in classroom)	15%	13%
Exam-2 (~ Week 10, TBD, 60-minute in classroom)	15%	13%
Exam-3 (cumulative, TBD, 70-minute in classroom)	22%	20%
Project (Proposal, Presentation, and Report)	20%	26%

Extra Credit

Extra credits are possible as/if needed. Depending on class performance around Week 10, if required, extra credit assignments and their due dates will be determined.

Late Assignments

For homework assignments, late submissions will not be accepted after five days from the original due date/time. It should be noted that up to 50% points may be subtracted for any late submission. Exceptions include documented emergency situations and prior consents.

There is no late submission for Project reports.

Missed Tests and Labs

Makeup for missed tests (Quiz and Exam) will be given only when there is a genuine reason, with clear proof. It is students' responsibility to provide the proof; if the reason for missing a test is illness, a doctor's note will be required. Students should contact the instructor before any makeup test.

Important Academic Dates

For spring 2020 semester, classes begin on January 21, and end on May 7. The last date to drop a class and receive a W (withdrawn) is April 3. There are no classes on March 23-29 (Spring Break). The final exam period is May 9–14, 2020.

Disabilities

If you have a physical, psychiatric/emotional, or learning disability that may impact on your ability to carry out assigned course work, I encourage you to contact the Office of Disability Services (DS).

The office is located in Grace Wilkie, room 203, (316) 978-3309 (voice/tty) (316-854-3032 videophone). DS will review your concerns and determine, with you, what academic accommodations are necessary and appropriate for you. All information and documentation of your disability is confidential and will not be released by DS without your written permission.

Counseling & Prevention Services

WSU Counseling & Prevention Services (CAPS) provides quality mental health services to enrolled students by licensed providers and presents programs and trainings on topics promoting personal growth and optimal wellbeing. Services are by appointment, low cost and confidential. They are located in room 320 of Grace Wilkie Hall and will move to the new YMCA/Student Wellness Center in January. Their phone number is (316) 978-3440. CAPS is open during regular University business hours. If you have a mental health emergency while Counseling & Prevention Service is not open, please call 911 or COMCARE Crisis Services at (316) 660-7500 for 24-hour assistance.

Diversity and Inclusion

Wichita State University is committed to being an inclusive campus that reflects the evolving diversity of society. To further that goal, Wichita State University does not discriminate in its employment practices, educational programs or activities on the basis of age (40 years or older), ancestry, color, disability, gender, gender expression, gender identity, genetic information, marital status, national origin, political affiliation, pregnancy, race, religion, sex, sexual orientation, or status as a veteran. Retaliation against an individual filing or cooperating in a complaint process is also prohibited. Complaints or concerns related to alleged discrimination may be directed to the Office of Institutional Equity and Compliance, Wichita State University, 1845 Fairmount, Wichita, KS 67260, telephone 316-978-3187.

Intellectual Property

Wichita State University students are subject to Board of Regents and University policies (see http://webs.wichita.edu/inaudit/ch9_10.htm) regarding intellectual property rights. Any questions regarding these rights and any disputes that arise under these policies will be resolved by the President of the University, or the President's designee, and such decision will constitute the final decision.

Shocker Alert System

Get the emergency information you need instantly and effortlessly! With the Shocker Alert System, we will contact you by email the moment there is an emergency or weather alert that affects the campus. Sign up at www.wichita.edu/alert.

Student Health Services

WSU's Student Health Services (SHS) provides professional medical care and health education to enrolled students by licensed health care providers. General health care services are available ranging from routine and preventive care to managing acute illnesses and minor injuries. SHS offers convenient onsite laboratory and medication services including vaccinations. Staff are available to provide health education on a variety of topics, both in and out of the classroom setting. SHS is located in 209 Ahlberg Hall and will move to the new YMCA/Student Wellness Center in January 2020. Hours are 8:00 a.m. to 5:00 p.m., Monday through Friday, and the phone number is (316) 978-3620. Check out www.wichita.edu/shs for health information and access to myShockerHealth, the online patient portal where students can schedule appointments, send a secured message to a healthcare provider, check immunizations and more. All services are confidential.

Title IX

Wichita State University is committed to the elimination of sexual misconduct, relationship violence, and stalking within the University community. These incidents may interfere with or limit an individual's ability to benefit from or fully participate in the University's educational programs. Students are asked to immediately report incidents to the University Police Department, (316) 978-3450 or students may contact Sara Zafar, J.D., Title IX Coordinator at (316) 978-5177 or Sara.zafar@wichita.edu.

Students may also report incidents to an instructor, faculty or staff member, who are required by law to notify the Title IX Coordinator. If a student wishes to keep the information confidential, the student may speak with staff members of the Counseling and Prevention Services (316) 978-3440 or Student Health Services (316) 978-3620. For more information please refer to the Title IX Policy at https://www.wichita.edu/about/policy/ch_08/ch8_16.php.

The Heskett Center and Campus Recreation

Whether you are wanting to be active on campus, relieve the stress from classes or take care of your body, Wichita State Campus Recreation is the place for you. Campus Recreation, located inside the Heskett Center, contributes to the health, education, and development of Wichita State University students, faculty, staff, alumni, and community members by offering quality programs and services. With many programs and facilities which are free to all students and members, Campus Recreation offers its members limitless opportunities. For more information about our services see www.wichita.edu/heskett.

Video and Audio Recording

Video and audio recording of lectures and review sessions without the consent of the instructor is prohibited. Unless explicit permission is obtained from the instructor, recordings of lectures may not be modified and must not be transferred or transmitted to any other person, whether or not that individual is enrolled in the course.

CARE Team

Wichita State University is committed to the safety and success of and cares about all members of the University community. If you or someone you know needs support, is distressed, or exhibits concerning behavior that is interfering with their own or others' academic or personal success or the safety of members of our community, resources and assistance are available. As your Faculty, I may seek support for you. If you or another member of our campus community is in need of help, please submit a concern at www.wichita.edu/ubit or call any CARE team member listed on that webpage. In case of emergency, please call the Wichita State University Police Department at (316) 978-3450 or 911.

Concealed Carry Policy

The Kansas Legislature has legalized concealed carry on public university campuses. Guns must be out of view, concealed either on the body of the carrier, or backpack, purse or bag that remains under the immediate control of the carrier. Gun owners must familiarize themselves with WSU's Concealed Carry Policy at http://webs.wichita.edu/?u=wsunews&p=/weapons_policy_documents and the Kansas Board of Regent's policy at http://www.kansasregents.org/about/policies-by-laws-missions/board_policy_manual_2/chapter_ii_governance_state_universities_2/chapter_ii_full_text#weapons. If you believe that there has been a violation of this policy, please contact the University Police Department at 316 978-3450

Additional Concealed Carry Language for lab courses or other courses where student belongings are unattended and out of immediate control

Under the Concealed Carry Policy, a backpack or other bag used to carry a handgun must be within the immediate control of the individual. This course requires students to leave belongings such as backpacks or other bags out of reach and unattended for the duration of class time. Students who choose to carry a concealed handgun in a backpack or other bag must plan each day accordingly and are responsible for making alternate arrangements as necessary. Wichita State does not provide publicly available secure storage for concealed handguns. If you believe that there has been a violation of this policy, please contact the WSU Police Department at 316 978-3450.

Names and Pronouns

Everyone has the right to be addressed as and referred to by the name and pronouns (including non-binary pronouns) that they choose and that correspond to their gender identity. Class rosters have a student's legal name and do not include pronouns, therefore, all students will be asked in class to indicate the names and pronouns they use for themselves. A student's chosen name and pronouns are to be respected at all times in the classroom.

First Generation Students

A first-generation (FGEN) college student is a student whose parents did not complete a four-year college degree. WSU strongly supports First Generation students and offers the following resources https://www.wichita.edu/student_life/firstgen/index.php.

Other: Important Notes

- Homework Submission: No submission via e-mail. (Repeat) No submission via e-mail. Everyone must turn in his/her own assignment in classroom, unless special permission is given.
- Project Report: One printed report should be submitted by each group. (In addition, the instructor may ask for an editable softcopy of the report.) NO late submission for project report.
- Communication via E-mail: You must use your WSU e-mail account for e-mail communication. (Repeat, no homework submission via e-mail.)
- Professionalism (e.g., proper manners) is highly expected.
- All academic dishonesty cases will be handled following the University Code of Academic Conduct. Please check the University Catalog for more information.

Other: Teaching Assistant (TA)

Grading TA:

Vikas Thammanna Gowda <vxthammannagowda@shockers.wichita.edu>

Office Hours/Room: Thu 8:00-9:00 AM and Fri 8:30-9:30 AM, 205JB

The Grading TA (if any) should grade test papers (homework, quiz, etc.). However, the TA is not allowed to solve problems (any problem) for students. If students have any questions regarding test questions and/or course materials, they should immediately contact the course instructor.

Other: Laboratory Information

Some assignments may require parallel programming resources/facilities available in the CAPPLab. In order to access 'cudasrv' (a CUDA server), students should have their Laptop/PC loaded with Secure Shell (SSH) and Telnet client software such as PuTTY. Username/password to access the CUDA servers (in the CAPPLab) should be provided, if/as needed.

Students are welcome to visit the CAPPLab in room 256 Jabara Hall and/or online at https://www.wichita.edu/academics/engineering/eecs/faculty/Abu/CAPPLab.php. CAPPLab is an NVIDIA GPU Research Center (2015-2017). CAPPLab is used for research in advanced computer architecture, high performance computing systems,

and related fields. It is also used for teaching GPU-assisted parallel programming and microprocessor-based system design.

Other: Brief List of Topics to Cover

Introduction and Motivation

- Computer Systems: Past, Present, and Future

High Performance Computer Systems

- Parallelism (hardware/software): ILP, TLP, SMP, PLP
- Parallel Architectures: Multicore, SMT Capable Multicore with GPU
- Cache Memory Subsystems (dynamic behavior and power-hungry)

Parallel Computing

- Parallel Programming: OpenMP, Open MPI, GPU/CUDA
- Introduction to OpenMP C/C++ Programming
- Introduction to CUDA C/C++ Programming

Selected Research/Project Articles

- (UG) Understanding and applying HPC systems
- (GR) Design, develop, and/or analyze HPC systems
- (Special) Berkeley Lab / DOE Open2C [1] and OpenSoC Fabric [2] to develop HPC architectures

[1] https://crd.lbl.gov/departments/computer-science/cag/research/open2c/
[2] http://www.opensocfabric.org/home.php

Tentative Schedule for 16-week class

Week	Date	Note	**Important topics/readings, assignments, due dates, and reminders are listed here so that you can organize your time and academic work.**
1	01/21, 01/23		CS 697AM: Course syllabus; Course Project; K-probe; Computer Systems; HW-1 (due next week);

Week	Date	Note	Important topics/readings, assignments, due dates, and reminders are listed here so that you can organize your time and academic work.
2	01/28, 01/30	HW-1	Multilevel Computer Concept; Parallelism: ILP; HW-1 (due); Course Project: Groups;
3	02/04, 02/06	HW-2	Team-Project: Topics, Grading; Proposal due on Week 6; HW-2 (due); Parallelism: PLP, SMP; Quiz-1 next week;
4	02/11, 02/13	HW-3, Quiz-1	Parallelism: SMP, TLP; Cache Memory Subsystems; HW-3 (due) & Quiz-1 (30 minutes); Exam-1 next week;
5	02/18, 02/20	Exam-1	Cache Memory Subsystems; Exam-1 (60 minutes, Closed book)
6	02/25, 02/27	Exam-1 Update Project	Parallel Programming: OpenMP; Team-Project: Proposal (due);
7	03/03, 03/05	HW-4	Parallel Programming: OpenMP; HW-4 (due); Team-Project: Proposal (feedback);
8	03/10, 03/12	Mid-Pt HW-5	Parallel Programming: Open MPI; HW-5 (due); Quiz-2 next week;
9	03/17, 03/19	HW-6 Quiz-2	Parallel Programming: GPU/CUDA; HW-6 (due) & Quiz-2 (30 minutes); Exam-2 next week;
10	03/24, 03/26	Spr Brk	No Class!
11	03/31, 04/02	Exam-2	Parallel Programming: GPU/CUDA; Exam-2 (60 minutes, Closed book)

Week	Date	Note	Important topics/readings, assignments, due dates, and reminders are listed here so that you can organize your time and academic work.
12	04/07, 04/09	Exam-2 Update	Parallel Programming: GPU/CUDA; Team-Project: Presentation, Report;
13	04/14, 04/16	HW-7 SPTE	Selected Topics: HPC related published articles; HW-7 (due); Quiz-3 next week;
14	04/21, 04/23	HW-8 Quiz-3	Team-Project: Presentation, Report; Selected Topics; HW-8 (due) & Quiz-3 (30 minutes); Exam-3 next week;
15	04/28, 04/30	Exam-3	Selected Topics: HPC related published articles; Exam-3 (70 minutes, Closed book)
16	05/05, 05/07	Project	One demo/oral presentation per group, PPT slides; Final Report: One per group, printed copy on Study day;
Finals		N/A	None

[_v0) Updated on Feb. 20, 2021; from spring 2020; DRZ]