COVID-19 and Wichita State University

Wichita State will follow federal, state, and county public health recommendations and mandates related to university operations. The COVID-19 pandemic is a complex, challenging, and fluid situation, which continues to evolve rapidly. Students consistently should review https://www.wichita.edu/about/COVID-19/index.php for the Wichita State COVID-19 Response for information throughout the semester.

CS 794, Multicore Architectures and Programming, Fall, 2020

- Instructor: Abu Asaduzzaman
- Department: Electrical Engineering and Computer Science (EECS)
- Office Location: 253 Jabara Hall (JB) building
- Telephone: +1-316-978-5261
- Email: Abu.Asaduzzaman@wichita.edu
- Preferred Method of Contact: Via email or zoom/phone during office hours
- Student/Office Hours: Zoom/phone, Monday 3:30-4:30 PM and
  Zoom/phone, Wednesday 2:00-3:00 PM
- Classroom, Day/Time: Zoom/226JB, Monday and Wednesday 11:00-12:15 PM
- Prerequisites: CS 394
- Teaching Assistant (TA): TBD
- TA Contact: Email – <tbd@shockers.wichita.edu>

COVID-19 and Fall 2020 CS 794 Course

CS 794: Multicore Architectures and Programming

Planned Course Design: Fully remote, synchronous delivery (HYB) - not a true hybrid course

Testing Type: Required online testing

Suggested technology recommendations or other information: Students will need: good Internet connection; computer/laptop with zoom/audio/video; Students will have to: write/debug/run C/C++ code in Linux operating systems.

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 http://webs.wichita.edu/inaudit/ch8_05.htm and the Student Academic Honesty policy http://webs.wichita.edu/inaudit/ch2_17.htm. 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/ai.php

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 reasonably different from other 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 a Fail grade in this course; this grading policy applies to all parties involved (including the ones who help/show).

Course Description

Introduces architectures of modern multicore/many-core systems and techniques to program those systems. Particular attention is given to the following areas: high performance computer systems, multithreaded parallel programming using OpenMP/ CUDA (compute unified device architecture), and related advanced research. Programming assignments and projects give hands-on experience.

Measurable Student Learning Outcomes

After passing this course, students will be able to:

- Understand the concepts of contemporary multicore/many-core systems and parallel programming.
- Design, develop, and analyze parallel programs/codes for high performance computer systems using CUDA and OpenMP.
- Engage in life-long learning of high performance computing for professional success.

Required Texts/Readings Textbook

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

Textbook: Programming Massively Parallel Processors: A Hands-on Approach, David B. Kirk and Wen-mei W. Hwu, Morgan Kaufmann, 3rd Edition, 2016.

Reference Book: CUDA by Example: An Introduction to General-Purpose GPU Programming, Sanders and Kandrot, Addison-Wesley Professional, 1st edition, 2010.

Other Readings

Class notes and other reading materials (such as OpenMP, Open MPI, etc.) will be made available via WSU Blackboard.

Other Equipment/Materials

Students will be provided information about CUDA server and service supports so that they can complete programming assignments and projects. More information will be provided during class lectures as/if needed.

Class Protocol

Due to COVID-19, fall 2020 CS 794 is a remote/online course; however, class participation is still crucial. ”Participation” involves reading the assignments thoroughly, reading handouts provided by the instructor/TA, watching all videos uploaded on Blackboard, contributing to class discussions, and completing tests as assigned. To be successful in this class, you should be checking your student email regularly and logging in to this course at many times as require every week.

There are points on class performance. It is expected that students join the instructor and/or TA before classes start. Students are always encouraged to ask questions, especially if they find ambiguity in assignments and materials covered.

Contact Policy

Due to COVID-19, email communication is preferred. Feel free to email me any questions or concerns following these guidelines:

- **Always** email me from your WSU email address. Email sent from personal email servers like Gmail, Yahoo, etc., have a tendency to end up in my spam folder, and I never see them. You may also email me through Blackboard via the Email My Instructor tab. I also offer a Discussion Forum on Blackboard which allows common questions to be seen and responded to publicly.
- Always use the course name in the subject line of the email.
- Remember to sign your name.
- If you have a problem with accessing or uploading assignments, you should let me know as soon as possible before the assignment is due. You will also have to accompany this notification with the file in question, so I can verify that it is completed by the due date/time.
- You **should NOT** contact me for tech support.

- Any technical problems involving your computer, or issues regarding file uploading or sharing, should go through the OneStop. You can contact them at 316-978-3909. You can also fill out a request for help form at their website: https://wichita.edusupportcenter.com/sims/helpcenter/common/layout/SelfHelpHome.seam?inst_name=wichita

Response Time

To Email and Discussion Forum Questions:

As soon as possible within 24 hours. If you do not receive reply to your email within 24 hours, please re-send me the email, probably the email did not arrive to my Inbox.

Feedback on Assignments:

As soon as possible after the due date including the late submission date/time. Answer key will be discussed in lecture sessions and/or shared via Blackboard.

Grading Scale

WSU uses a +/- grading scale for final grades and to calculate grade point averages. In this class, grades are assigned according to the following chart. (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

Points/Percentage	Letter Grade	Grade Points	Interpretation
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

While determining letter grades, the same grading scale will be used for undergraduate and graduate students. List of grading assignments/components and values toward the final letter grades are shown below. Homework assignments and their due dates will be announced in class and/or made available via Blackboard. Similarly, the dates for Quiz, Exam, and Project will be announced in class and/or made available via Blackboard. Due to COVID-19, assignments and values may be changed!

Grading Assignments/Components	Value
Class Performance	4%
Homework/Programming (five of six, take home)	10%
Quiz (two of three, 30-minute, class-time)	12%
Exam-1 (~ Week 5, 65-minute, class-time)	18%
Exam-2 (~ Week 10, 65-minute, class-time)	18%
Exam-3 (before semester ends, 65-minute, class-time)	18%
Project (Proposal, Presentation, and Report)	20%

Extra Credit

Extra credits are possible as/if needed. Depending on class performance after 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. Up to 50% points may be subtracted for any late submission. Exceptions include documented emergency situations and prior consents.

Missed Tests and Labs

Makeup for missed tests (Quiz, Exam, and Project) 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.

Teaching Assistants

Grading TA:

TBD <tbd@shockers.wichita.edu>

Office Hours/Room: TBD

The Grading TA (if any) is not allowed to solve student problems (any problem). The TA should grade test papers and provide feedback to students for any missing points. If students have any questions regarding the course materials or assignments, they should immediately contact the course instructor.

Syllabus Policies and Student Resources available at www.wichita.edu/syllabuspolicies

Information on:

- Important Academic Dates
- Academic Integrity
- Definition of a credit hour
- Video and Audio recording
- Shocker Alert System
- Intellectual Property
- CARE Team
- Counseling and Prevention Services
- Student Health Services
- Heskett Center and Campus Recreation
- Inclusive Excellence
- First Generation Students
- Names and Pronouns
- Disability Services
- Title IX
- Concealed Carry Policy

Laboratory Information

Students in this course will need to access Beoshock, the High-Performance Computing (HPC) cluster at WSU, for their programming needs. Due to COVID-19, fall 2020 CS 794 is a remote/online course and there is no teaching/research lab associated to this course; however, we will provide full support so that you can perform the programming assignments. Information about Beoshock (such as how to log in and how to run CUDA programs) will be provided via lectures as needed. The main purpose of Beoshock is to provide students a HPC platform so that they can write/debug/run parallel programs for assignments and projects. If required and possible, you can meet me in the Computer Architecture and Parallel Programming Laboratory (CAPPLab) in 256 Jabara Hall.

Brief List of Topics to Cover

Introduction and Motivation

- Single-Core to Multicore Architecture
- Sequential to Parallel Programming

Modern Computer Architecture

- Parallelism: ILP, TLP, SMT
- Concurrency: PLP/DLP, multicore CPU, many-core GPU
- SMT-enabled GPU systems

Programming Multicore/Many-Core Systems

- Parallel Programming: OpenMP, Open MPI, and CUDA (in C/C++)
- OpenMP and CUDA/GPGPU Technology
- CUDA/GPU programming model

Selected Topics

- Parallel/Multithreaded Computing/Programming
- Performance and Power Evaluation (for Big Data)

Tentative Schedule for 16-week fall classes

Week	Dates	Note	Important topics/readings, assignments, due dates, and reminders are listed here so that you can organize your time and academic work.
1	8/17 8/19		CS 794: Multicore Architectures and Programming; Syllabus; K-probe; Project: Components, Grading; HW-1 Assign;

Week	Dates	Note	Important topics/readings, assignments, due dates, and reminders are listed here so that you can organize your time and academic work.
2	8/24 8/26	HW	Single-core to multicore arch; Project: Groups, Topics; HW-1 (Wed); Cache-memory hierarchy;
3	8/31 9/2	HW	Sequential to parallel programming; Parallelism: ILP … SMT HW-2 (Wed); Proposal due on Week 6; Quiz-1 discussion;
4	~~9/7~~ 9/9	Quiz	9/7 (Labor Day) No Class; Quiz-1 (Wed, 30/30); Project: Proposal with literature review;
5	9/14 9/16	Exam	Parallelism: ILP, PLP, TLP, SMP, SMT; Exam-1 discussion; EXAM-1 (Wed, 65 minutes, 65 points, Closed book);
6	9/21 9/23	Update	Project: Technical reading, writing, and presentation; Project: Proposal due (on Wed); GPU systems;
7	9/28 9/30	HW	GPU computing; Memory hierarchy in a CPU-GPU system; HW-3 (Wed); Concurrency: SMT-enabled GPU systems;
8	10/5 10/7	HW	Parallel Programming: OpenMP, Open MPI, CUDA/GPU; HW-4 (Wed); OpenMP programming; Quiz-2 discussion;
9	10/12 10/14	Quiz	CUDA/GPU programming; Applications, examples; Quiz-2 (Wed, 30 pts, 30-min); Exam-2 discussion;
10	10/19 10/21	Exam	CUDA/GPU programming; Threads/Blocks, examples; EXAM-2 (Wed, 65 minutes, 65 points, Closed book);
11	10/26 10/28	Update	CUDA/GPU programming; Threads/Blocks, examples; Project: Report, Presentation;

Week	Dates	Note	Important topics/readings, assignments, due dates, and reminders are listed here so that you can organize your time and academic work.
12	11/2 11/4	HW	CUDA/GPU programming; Threads/Blocks, examples; HW-5 (Wed); GPU computing; Report: Format, etc.;
13	11/9 11/11	HW	Performance and Power Evaluation (for big data); HW-6 (Wed); Project: Report; Quiz-3 discussion;
14	11/16 11/18	Quiz	Quiz-3 (Wed, 30 points, 30 minutes); Exam-3 discussion; Project: Presentation, Report – due dates;
15	~~11/23~~ ~~11/25~~		11/23-11/29 (Thanksgiving) No Classes;
16	11/30 12/2	Project Exam	Project Presentation: Team-work, via Zoom, PPT slides; Final Report: Team-work, via Blackboard on Study day; EXAM-3 (Wed, 65 minutes, 65 points, Closed book);
~~Finals~~		~~N/A~~	~~None~~

[Updated for COVID-19 on June 1, 2020 from contents that were updated on August 15th, 2018. DRZ]

[Updated on August 7, 2020; Tentative Schedule, etc. DRZ]