Midwestern State University
Department of Computer Science
Fall 2020

Course Information
Course syllabus: Topics in High Performance Computing – GPU Programming
Course number: CMPS 4563
Session number: 101.
Class hours: 12:00 pm to 12:50 pm, Monday, Wednesday and Fridays.
Class room: Bolin 213.

Instructor Information
Instructor's Name: Doctor Eduardo Colmenares.
Instructor's office: Bolin Hall, office 126C.
Instructor's email: eduardo.colmenares@msutexas.edu

Office Hours
All office hours will be virtual via zoom.
Monday and Wednesday: 1 pm to 2 pm.
Tuesday and Thursday: 3:30 pm to 4:30 pm.
Friday: 9 am to 10 am.

ZOOM information
Zoom Link

Course Description
A practical introduction to the principles of parallel computing, parallel algorithm development and analysis, as well as, design, implementation, and evaluation of parallel programs by using and targeting and adequate balance between multicore CPU's and many-core Graphics Processing Units (GPU's).

Course Prerequisites
Minimum grade of C in Data Structures and Computer Architecture.

Textbook
Is the textbook required? The answer is yes.
Textbook name: Programming Massively Parallel Processors. A hands-on Approach
Textbook edition: Third edition.
Textbook Author: Kirk and Hwu.

Required Software
Winscp
Putty

Student Resources:
- CS-HPC Turing Cluster.
- Maverick, at Texas Advanced Computer Center (TACC)
    - Per Node:

- Two 10-core Intel Xeon E5-2680 v2 "Ivy Bridge" CPUs (twenty total cores at 2.8GHz)
- 256 GB RAM
- NVIDIA Tesla K40 "Atlas" GPU with 12 GB G-RAM
- Machine:
- 132 nodes, 2560 total cores, 33.8 TB total RAM
- Mellanox FDR InfiniBand interconnect

Required Hardware

- Regular traditional PC/Mac. Chromebooks are NOT allowed since they do not work really well with D2L.
- Printer and Paper

Scanning Capabilities

Students are required to have scanning capabilities from day one until the end of the semester. The scanning of documents will play a critical part in our tests, final exam, homeworks and quizzes. If you have a smartphone you can take advantage of free scanner apps. Please download the one of your choice and familiarize with it ahead of time.

Evaluation Process

The final grade for this course will be based on participation, projects and exams. A description is provided below:

- You will have one tests (T1) and one final exam (FE). T1 is worth 25 percent. Your final exam is also worth 25 percent.
- You will have several programming assignments. All your programming assignments will count for 25 percent of final your grade.
- The next category is participation, this will count for ten percent of your final grade. Please be aware that this category includes in class activities and quizzes. Below you will find additional information about this category.
    - Assignments given in class, also known as in class activities will be unannounced in nature.
    - Quizzes will be non-pop-up quizzes. There are three potential formats for our Quizzes, the instructor decides which format to use and when.
        - Format 1 (online quizzes): if this option is used then you are required to use D2L to take the quiz, you cannot use a Chromebook for this purpose, and you should have
        - Format 2 (online but by hand): You will be required to print the document and scan it.
        - Format 3: Traditional in class hard copy.
    - No makeup participation assignments are given.
    - Arriving late, leaving early to class voids the right to take a quiz or in class activity if it already started or it is about to start.
- The last category is your GPU Project. This category is worth 15 percent of your grade. More information will be given during the semester.

Evaluation Process Summary Table

Category	Percentage
Midterm	25
Final Exam	25
Homework (THH and ICH)	25
Participation (Quizzes and In Class Activities (ICAs)	10
Project	15

Grading Policy

89 to 100 points is an A.
79 to 88.99 points is a B.
69 to 78.99 points is a C.
59 to 68.99 points is a D.
0 to 58.99 points is an F.

Attendance

Attendance is NOT a component of the course grade; however, the student will be subject to any attendance associated requirement as specified/required/stipulated by the University. The student is responsible for covering any missed lecture unless proper medical documentation is presented to the instructor on time.

Tests

Tests are comprehensive in nature. No make-up exams will be given, except for the following cases:

1. Surgery, Medical Emergency, Death in the family, Presentation at a Conference, some others as determined by the instructor.
    a. If you miss an exam, you will receive a permanent zero unless you notify the instructor and demonstrate with the proper official documentation that an emergency that you could not circumvent existed. This documentation must be presented not later than 24 hours after the test.
    b. Students who miss an exam due to University business should notify the instructor in advance, and present the sponsoring university member's written justification.

If you do miss an exam and you fall in one of the categories above, this means that you have a properly documented case. Your instructor will proceed to assign a temporary grade of zero which will be substituted for your excused test grade (Final Exam). However, this substitution can only be performed once during the semester. Exams are uniquely composed for each term.

Final Exam

- There is no make-up final exam. The final exam will take place in our regular classroom. It is the student's responsibility to keep track of the designated date, time. A complete list of all MSU exams (by time) can be found at Final Exam Schedule.
- The date of our final exam is Wednesday December the 9th, from 3:30 pm to 5:30 pm.

- For the final exam students are required have scanner like capabilities. Please prepare well ahead of time, setup your system and have it ready to be used.
- If you have a smartphone you can take advantage of free scanner apps. Please download the one of your choice and familiarize with it ahead of time.

Policy on Testing Process

The Department of Computer Science has adopted the following policy related to testing.

a) All bags, purses, electronics (turned off), books, etc. will be placed in the front of the room during exams, or in an area designated by the instructor.
b) Unless otherwise announced by the instructor, nothing is allowed on the desk but pen/pencil/eraser and test papers.
c) You are not allowed to leave the classroom. Please take this seriously and into consideration before any test and the final. Prepare yourself to be in the classroom during the entire exam.
d) If you decide to leave the classroom during a test and/or the final exam, your exam will be collected, and you will not be allowed to continue.

Homework

- THH: Take Home Homeworks (Regular Homeworks)
- ICH: In Class Homeworks (These will be announced with plenty of time, so that the student can prepare for them. The instructor will announce what material can be used during the homework)
- Some assignments may be individual and some team assignments. It is OK (and encouraged) for you to work with each other ONLY to verbally discuss concepts associated with your assignments, such discussion must be at a very high level (superficial). However, any write up that you turn in, including any code, must be your own original production.
- Sharing partial or full code, working in pairs or groups, copying code from the web will be considering plagiarism and will lead a to a grade of zero. For more information see (Ethical Conduct – Page 3).
- Submitted work is due when specified, as specified (format) by the instructor. It is in the student's best interest to keep track of all deadlines.
- The instructor is not required to remind students of ANY date and/or deadline associated with tests, homework, reports, project assignment, etc.
- Assignments submitted to the instructor's email will be considered invalid and deleted. Even if submitted before the deadline.
- Students must be prepared to talk/explain/defend their homework during class time

Late Policy & Deadlines

- Submitted work is due when specified, as specified (format) by the instructor. It is in the student's best interest to keep track of all deadlines.
- The instructor is not required to remind students of ANY date and/or deadline associated with tests, homework, reports, project assignment, etc.
- Assignments submitted to the instructor's email will be considered invalid, even if submitted before the deadline. Assignments MUST be submitted to the corresponding dropbox via D2L
- Late assignments will NOT be accepted.
- Very Important: Before you submit any file, take your time and double OR triple check that
    a. You are uploading the correct and ALL necessary files
    b. Your work is correct at the best of your abilities

c. Failure to fulfill (a) and (b) ON TIME, WILL NOT excuse you from a bad grade.

What does it mean to be late?
Imagine that your assignment is due today at 8:00 am. If you deliver your assignment by 8:00:01 am (1 sec late) then it will be marked as "late submission".

VERY – VERY IMPORTANT
Before you submit any file, take your time and double OR triple check the following:

a) You are uploading the correct AND all files
b) Your work is correct at the best of your abilities
c) Failure to fulfill (1) and (2) ON TIME, DOES NOT excuse you from a bad grade.

The previous rule will be strongly enforced.

If you know you will be absent ahead of time, let the instructor know, and turn your assignment in early if possible. It is the student's responsibility to keep track of the designated date, time.

Additional Grade Policy
Once the grades, have been either returned to the students, or published via D2L, the student will have one week to examine them and check for inconsistencies, errors, etc. After the one week window of opportunity all grades will become PERMANENT and WILL NOT change. It is not only the student's responsibility to check the accuracy of his/her grades, but also in his/her best interest to do it. This rule DOES NOT apply to the final exam because the final is exam triple checked by the instructor before publishing the grade.

Important Information about our grading policy
The instructor reserves the right to adjust the grade distributions for the whole class. What does it mean? It means that grade distributions will not be adjusted on an individual basis.

Departmental Cheating Policy and Ethical Conduct
Policy on Academic Honesty
The Department of Computer Science had adopted the following policy related to cheating (academic misconduct). The policy will be applied to all instances of cheating on assignments and exams as determined by the instructor of the course.

- 1st instance of cheating in a course: The student will be assigned a non-replaceable grade of zero for the assignment, project or exam. In addition, the student will receive a one letter grade reduction in course.
- 2nd instance of cheating in a course: The student will receive a grade of F in course & immediately be removed from course.
- All instances of cheating will be reported to the Department Chair and, in the case of graduate students, to the Department Graduate Coordinator.

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d) If you decide to leave the classroom during a test and/or the final exam, your exam will be collected, and you will not be allowed to continue.

Laptop Policy

For this class, you are not required to buy a laptop. However, if the instructor announces an ICH (In Class Homework) or ICA (In Class Activity), you are responsible for:

a. Bringing a laptop with all necessary programs properly installed, configured a tested.
b. Bringing the laptop's charger: If you do not bring your charger and cannot complete the assignment(s) because your battery died, then your grade will not be a good one.
c. Make sure that you have a fully working and in-classroom tested Wi-Fi capabilities. If you cannot submit your homework because your Wi-Fi does not work, then your grade will not be a good one.

Excusing Late Work

Any document used to excuse the late delivery of an assignment MUST be presented no longer than one week from the corresponding missed deadline. Valid excuses (Surgery, Medical Emergency, Death in the family, and Presentation at a Conference). Failure to fulfill this requirement will make null the excuse, leading to a permanent grade of zero in the corresponding assignment.

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RECORDING OF CLASS LECTURES

Permission must be requested in writing & obtained from the instructor before recording of class lectures. If permission is granted, the recording may only be used by the student making the recording. Recordings may NOT be posted on any internet source without written permission of the instructor. Failure to adhere to the policy may result in removal from the course with a grade of F or other appropriate punishment.

Classroom Civility

All violations of classroom civility will be reported to the Dean of Students.

Students are expected to assist in maintaining a classroom environment that is conducive to learning. In order to ensure that all students gain from time spent in class, students are prohibited from engaging in any form of distraction, e.g. leaving the room for extended periods of time, reading newspapers (or other articles), working on other courses, and using cell-phones or laptops for calls or messages. If you indulge in any such inappropriate behavior

(without explicit consent of the instructor), you will (at the very least) be asked to leave the classroom. MSU Dean of Students Website.

Student with Disabilities
Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from disability support office during the instructor's office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Disability Support Office has been provided. For additional information you may contact the Disability Support Office in Clark Student Center 168 - Phone: (940) 397-4140.
Disability Support Services.

Dean of Students
The Dean of Students can assist in notifying the campus community of student illnesses, immediate family deaths and/or student death. Generally, in cases of student illness or immediate family deaths, the notification to the appropriate campus community members occur when a student is absent from class for four consecutive days with appropriate verification. It is the student's responsibility for missed class assignments and/or course work during their absence. MSU Dean of Students Website.

University's Campus Carry
Senate Bill 11 passed by the 84th Texas Legislature allows licensed handgun holders to carry concealed handguns on campus, effective August 1, 2016. Areas excluded from concealed carry are appropriately marked, in accordance with state law. For more information regarding campus carry, please refer to the University's webpage at Campus Carry.

University COVID-19 Policy
All members of the MSU Texas Community (students, faculty, staff, visitors, vendors and contractors) are required to wear protective face coverings on campus or in University facilities as provided below:

I. Requirements
   a. In common areas on campus including, but not limited to, classrooms and other spaces used for teaching, research, and creative activity, student center, library, hallways, elevators, stairwells, restrooms, break rooms, foyers, event rooms and lobbies;
   b. Other areas where physical distancing of at least 6 feet is not maintained. Even when physical distancing of at least 6 feet can be maintained, face coverings are strongly recommended.

II. Exceptions
   a. When eating or drinking, which should still be conducted maintaining physical distance;
   b. In accordance with applicable law (e.g., an accommodation, including for medical reasons, under the Americans with Disabilities Act (ADA), or pursuant to a bona fide religious belief)
   c. For children under the age of 2 years old; or
   d. By an instructor/presenter in a classroom or event room when a physical distance of at least 10 feet can be maintained from the class members/audience

Additional COVID 19-Policy
In order to protect your wellbeing and the one of those that you care about, the following preventive measurements will take place:

a) Office hours will be virtual via ZOOM. Check your syllabus for detailed office hours.
b) Your Instructor will not touch any computer or USB Drive. NO Exemptions.
c) If at some point you need/want me to look at your programming assignment or class project, you can do it by sharing your desk via ZOOM (Virtually) during office hours.
d) Questions associated with ADVISING, degree plans, etc., will be addressed (Virtually-ZOOM) during office hours.

Research and Creative Activity Opportunities at MSU
Enhancing Undergraduate Research Endeavors and Creative Activities (EURECA) is a program that provides opportunities for undergraduates to engage in high-quality research and creative activities with faculty. EURECA provides incentives and funding through a system that supports faculty and students engaged in collaborative research and creative works. For more information contact the Office of Undergraduate Research at (940) 397-6274 or by email at eureca@mwsu.edu or better yet, stop by the UGR office located in the atrium of the Clark Student Center, room 161. Information and resources are also available at Eureca's website

Undergraduate Research Opportunities and Summer Workshop (UGROW)
Like EURECA, UGROW provides opportunities for students to conduct research with faculty. However, the research occurs in the summer. For five weeks UGROW students experience the authenticity of scientific research as well as research and creative activities in art, music, theater education, business, health and social sciences, English, history, etc. in a highly interdisciplinary environment. Students work on projects of their choice and present their findings at the end of program and the MSU Undergraduate Research and Creative Activity Forum. Faculty members will introduce their research ideas February 13th, 2019, at 5:00 p.m., Comanche Suites, Clark Student Center. A break-out session with individual faculty members will follow. If you have any questions, contact the Office of Undergraduate Research at (940) 397-6274 or by email at eureca@mwsu.edu. More information and resources are available at ugrow's website

Council on Undergraduate Research
To support undergraduate research and creative activities, Midwestern State University holds an enhanced institutional membership with the Council on Undergraduate Research (CUR). This institutional membership includes unlimited memberships for any interested faculty, staff, and students. Students find information on benefits and resources at the council for undergraduate research website and sign up at no cost at this website.
I would like to personally invite you to become a member of CUR so that you benefit from all the opportunities CUR offers to you.
CUR Undergraduate Resources Webpage contains:

- Research Opportunities;
- Presentation Opportunities;
- Undergraduate Research Journals;
- CUR-Sponsored Student Events;
- The Registry of Undergraduate Researchers;

- And more!

ScholarBridge

Midwestern State University is excited to announce a new resource designed to address a commonly expressed student need—the creation of a centralized searchable database of faculty research interests and opportunities. We have entered into a partnership with ScholarBridge, is a website designed to help students participate in undergraduate research and creative activities. I strongly encourage you to join ScholarBridge at your earliest convenience.

Tentative Agenda

We will try to respect this agenda as much as possible, however it is possible that some topics will require more, or less time to cover them, which may lead to changes. Students will be informed about those changes in class. The instructor reserves the right to modify, add, remove, and update the proposed agenda.

a) Syllabus, TACC, Turing, accounts, Why Parallel Computing is important, Virtual Machine, General Ideas
b) Chapter 1-2: - Introduction, GPU History
c) C Reinforcement: - Basic C, Functions in C, Arrays, Pointers, Bitwise operations (in C)
d) Data structures, Dynamic memory allocation, Linked Lists
e) Project Documentation: Doxygen
f) Project Management: Make files
g) Parallel Concepts: Speedup, Efficiency, etc, + Performance Analysis. Fast Fourier Transform (FFT)
h) Chapter 3: - Introduction To Data Parallelism and CUDA C
i) Chapter 4: - Data Parallel Execution Model
j) Chapter 5: - CUDA Memories
k) Chapter 5: - CUDA Memories
l) Chapter 6: - Performance Considerations
m) Chapter 7: Floating Point Format
n) Chapter 13: - Parallel Programming and Computational Thinking
o) Chapter 8: - Parallel Patterns, Convolution
p) Introduction to Distributed Memory Programming with MPI - Point to Point Comm. (Blocking and Non-Blocking)
q) In Class Project Presentation (3 groups – 20 min each group)
r) In Class Project Presentation (3 groups – 20 min each group)