CS 6253  Heterogeneous Computing

Fall 2019, Credit Hrs: 3

General Information

Instructor: Hai Jiang
Office: CSM, Room 127
Phone: 870-680-8164
Email: hjiang@astate.edu

Time: Mon Wed 4:00 p.m. - 5:15 p.m.

Location: CSM 212

Office Hours: Mon Wed 9:00 - 9:30 a.m. & 10:45 a.m. - 1:00 p.m. & 2:15 - 4:00 p.m.


Course Homepage: [http://myweb.astate.edu/hjiang/cs6253.html](http://myweb.astate.edu/hjiang/cs6253.html)
( Lecture notes, homework assignments, etc. )

Course Description

The study of the ecosystem of co-processing elements such as the Graphics Processing Unit or GPU in modern computing systems, covering hardware architecture, software design, the programming paradigm, and related libraries. Prerequisites, CS 3113 or “B” or better in CS 5032, and CS 3233.

Detailed Description

As multicore CPUs and many-core GPUs become popular, more parallel computing platforms are available. This course intends to cover the architectures of several newly appeared non-CPU based platforms and then provide students some opportunities to acquire hands-on programming experience on them. NVIDIA CUDA and OpenCL will be used to learn GPU programming on NVIDIA and ATI GPUs, respectively. OpenACC will be covered for the latest programming styles. Advanced topics will be covered as well. This course also includes some literature reviews and course projects. The outcomes of this course include enlarging students’ knowledge and improving their programming skills for future employment. They will be evaluated through exams, projects and presentations. Tentative topics will include:

- Introduction to parallel programming
- Reconfigurable computing
- GPU architecture
- CUDA programming
- CUDA code optimization
- OpenCL programming
• GPU clusters
• OpenACC programming
• Advanced topics

Student Learning Outcomes for This Course

• Utilize GPU computing terminology accurately
• Describe the structure of GPU structures in details
• Learn CUDA programming in details
• Optimize CUDA programs
• Learn OpenCL programming
• Grasp OpenACC programming concepts
• Accomplish term projects

M.S. Computer Science Student Learning Outcomes Supported by This Course

• M.S. Computer Science graduates should have a deeper understanding of the theory and application of algorithms, programming languages, and computer processes
• M.S. Computer Science graduate students should have the ability to apply advanced analysis techniques to problem identification and solution in computing applications
• M.S. Computer Science graduate students should have the ability to apply advanced implementation techniques to problem identification and solution in computing applications

Prerequisites

CS 3223 (Computer Organization) or consent of the instructor

Textbook

• There is no textbook for this course. Latest programming guides, white papers and publications will be provided in class.

References

• More course materials will be available on course homepage. Please visit it often for changes and announcements.

**Resources**

• CUDA Course Map: [http://www.nvidia.com/object/cuda_courses_and_map.html](http://www.nvidia.com/object/cuda_courses_and_map.html)
• Khronos OpenCL Homepage
• OpenACC Home
• Intel Xeon Phi coprocessor
• More links will be posted on course homepage

**Grading**

Final grades will be calculated based on the following weights:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>10%</td>
</tr>
<tr>
<td>Homework Assignments</td>
<td>15%</td>
</tr>
<tr>
<td>Course Project</td>
<td>20%</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>25%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>30%</td>
</tr>
</tbody>
</table>

The final grade will be distributed as:

- A [85-100]
- B [75-85]
- C [60-75]
- D [50-60]
- F [0-50]

**Computer Science Classwork and Assessment Delivery Environment**

CSCADE system ([http://cscade.cs.astate.edu/](http://cscade.cs.astate.edu/)) will be used for homework submission and grading.

**Policies**

**Food and Drinks**

Department policy restricts bringing either food or drinks into the classroom.
**Electronic Devices**

Cell phones are restricted during class. Cell phones must be turned off during the lecture. If your cell phone rings during class, you may be asked to leave. Other devices (computers, recorders, etc.) may be allowed, but you must ask the instructor before you use them during class.

**Special Facilities**

Students who require academic adjustments in the classroom due to a disability must first register with ASU Disability Services. Following registration and within the first two weeks of class, please contact the instructor to discuss the appropriate academic accommodations to ensure equal access to this course.

**Rescheduling Tests**

Tests cannot be rescheduled due to testing in other classes. If a test is missed due to extenuating circumstances then you must notify me as soon as possible. The circumstances must be documented by you and must be excusable in order to reschedule a test.

**Late Assignments**

For most homework assignments, the class will receive a working solution within four days after the due date. **NO** assignments will be accepted that are more than four days late. Assignments that are less than a week late, will be accepted with certain penalty (25% per day).

**Cheating**

You are encouraged to discuss problems and programming assignments with each other. Helping others learn is often the most powerful way of mastering material yourself. However, taking somebody else's solution without their knowledge or consent is cheating and will be punished. Do not leave copies of the programming assignments in the trash can in a public place -- throw them away at home or some other private place. Also do not leave your directories unprotected. There are harsh penalties for those found cheating.

**Attendance**

Attendance is required. If you miss a class, you are responsible for material covered during the class you missed, this includes any assignments made. Note that I do not provide one-on-one instruction for missed classes.