Santa Clara University
School of Engineering

COEN 145/319-Programming Massively Parallel Processors

Fall Quarter 2013

Instructor:

Maria Pantoja **Office:** Bannan Labs 413C **email:** mpantoja@scu.edu

Phone: 554-2730 **Fax:** 554-5474

Office Hours:

Mon and Wed ? and by appointment

Catalog Description:

Right now all computers, including desktops, laptops, mobile devices and supercomputers are using multi/many cores processors. The aim of this course is to provide students with knowledge and hands-on experience in developing applications software for processors with massively parallel computing resources. We will be using NVIDIA processors and the CUDA™ programming tools in the lab section of the course. This is a course in programming massively parallel processors for general computation. The course will continue with a closer view of the internal organization of graphics processors and how it impacts performance. (4 units)

Prerequisites:

Knowledge of C programming (Coen10/11 or equivalent)

Recommended Computer Architecture Coen122/210 or equivalent

Beautiful if you have taken any Computer Graphics class

Course Objectives:

To understand parallel architectures.

Gain exposure to the diverse Parallel Programing Languages

To understand the architecture of graphics processor units (GPUs) and their differences from conventional processors.

To understand how the GPU's internal organization impacts performance

Ability to develop software that will run on parallel processors.

Optimize existing algorithms for execution on a GPU

Gain exposure to the Open Computing Language Framework (OpenCL)

Expected Learning Outcomes:

Understand GPU architectures

Understand and learn to develop software that runs on a GPU

Ability to solve a given problem using parallel computing on a GPU by utilizing CUDA

Basic understanding and ability to solve a given problem using parallel computing on a GPU using OpenCL

To develop an computationally intensive application from the ground up

Present a paper to summarize the previous project

Important dates:

Midterm

Final:

Last day of classes:

Required Book:
An Introduction to Parallel Programming ,Peter Pacheco, 2011

For Cuda:
Cuda C Programming Guide. (latest version, available free)
Cuda C Best Practices
http://developer.nvidia.com/nvidia-gpu-computing-documentation

OpenCL:
Khronos OpenCL Specification (latest version OpenCL 1.2 latest version, available free)
http://developer.nvidia.com/opencl
http://www.khronos.org/registry/cl/specs/opencl-1.2.pdf

Recommended books:
Programming Massively Parallel Processors by David B.Kirk and Wen-mei and W. Hwu. Publisher: Morgan Kaufmann ISBN: 978-0-12-381472-2

Cuda by example: An introduction to general purpose GPU Programming by Jason Sanders and Edward Kandrot. Publisher: Morgan Kauffman

Supplemental materials:

Lecture Slides, class notes, assignments and announcements will be posted on Angel. All students registered for the class have automatic access to Angel (no need for extra password)

Grade Calculation:

Midtem (40%)
Final(40%)
Homeworks (20%)

Homeworks:

Homework will be assigned every week, we will discuss it on the first half hour of the following class

Project:

To develop an application of your choice using CUDA/OpemCL. The project topics will be discussed and approved during the first week of classes. Project will be due on the last day of classes (DEC 5 23:59). The project must involve a demanding application such as mathematics- or physics-intensive simulation or other data-intensive computation, followed by some form of visualization and display of results. Deliverables: document 4 pages maximum that describes the project and electronic copies of the source code and the executable.

Week, Reading, Topics:

Week 1	Pthreads	
Week 2	OpenMP	
Week 3	**Introduction to Massive Pararallel Architectures** **Introduction to CUDA** Tools (SDK, debugging, profiler) First CUDA Program	
Week 4	**CUDA Memories:** **Shared** **Constant** **Texture**	
Weel 5	**CUDA Atomics** **Parallel Patterns I Reduction**	
Week 6	**Parallel Patterns II Scan** **Thrust**	**Midterm**
Week 7	**Streams** **Performance Considerations**	
Week 8	**Cuda on Multiple GPUs**	
Week 9	**OpenCL**	
Week 10	**MPI**	

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The University is committed to academic excellence and integrity. Students are expected to do their own work and to cite any sources they use. A student who is guilty of a dishonest act in an examination, paper, or other work required for a course, or who assists others in such an act, will receive a grade of "F" for the course. In addition, a student found guilty of a dishonest act may be subject to sanctions, up to and including dismissal from the University. A student who violates copyright laws, including those covering the copying of software programs, or who knowingly alters official academic records from this or any other institution is subject to similar disciplinary action.

ACADEMIC ACCOMMODATIONS FOR DISABILITIES

To request academic accommodations for a disability, students must contact Disabilities Resources in Benson Center, (408) 554-5111 or TTY (408) 554-5445. Students must register with Disabilities Resources and provide appropriate documentation to that office prior to receiving accommodations.