Applied High-Performance GPU Computing
Autumn 2018

Time: Thursdays from 6:00-9:50 PM in EEB 361

Instructor: Dr. Colin Reinhardt (colinrei@uw.edu)

Office Hours: TBD (will take poll of class preferences)

TA: TBD

Office Hours: Tuesday 7:00-8:30pm; Sunday 3:00-4:00pm (may be varied week to week pending travel)

Any additional hours can be setup via email if these do not work for you.

Course Overview:

There will be 10 lectures given in the EEB 361 computer lab. Hand-on programming exercises will be part of the weekly lecture. Also there will be 5 homework assignments which will consist of (a) readings, (b) coding. The remainder of the quarter will be focused on a final project which will be comprised of a fairly significant GPU code design and implementation on a topic approved by the course instructor, utilizing and applying techniques learned in the class.

Grading:

- Homeworks (5) 50%
- Final Project 50%

Course Materials:

There is no required textbook for this course.

Reading materials for the course as well as a list of supplementary reading materials will be posted on the course website. Nearly all materials will be available in online electronic formats, either freely available public literature or through UW Library (www.lib.washington.edu)

Prerequisites

- proficiency programming with C and/or C++ programming and integrated software development environments (Visual Studio, Eclipse)
    - The standard template library (STL) will be used.
- familiarity with vector calculus and partial differential equations (PDEs); physical foundations and formulation of PDEs, particularly the Maxwell's Eqns, the wave equation, and the dispersion equation.
- comfort with applied matrix analysis and linear algebra and numerical analysis, eigensystems, eigenvalue problems and solutions

Course Policies

You may collaborate and discuss homework assignments and project design and implementation with your fellow classmates, professor, TA and others. However, the work you submit must be your own, and you must write your own code(s). Copying code and plagiarizing is not allowed.

Course Schedule: Lecture Topics & Assignments

Week 1 : Introduction, evolution, and overview of parallel computing. Introduction and overview to OpenCL.

Week 2 : Introduction to OpenCL host and kernel design and programming. Basic kernel analysis techniques.

- Homework-1 DUE : 12 JAN, 6 PM

Week 3 : OpenCL host and kernel programming details. Kernel analysis, profiling, debugging.

- Homework-2 DUE : 19 JAN, 6 PM

Week 4 : Parallel software and performance theory. Parallel patterns & algorithms, part 1.

- Homework-3 DUE : 26 JAN, 6 PM

Week 5 : Parallel patterns & algorithms, part 2.

- Homework-4 DUE : 2 FEB, 6 PM

Week 6 : Parallel FFT and convolution on GPU and applications in image processing

- Homework-5 DUE : 9 FEB, 6 PM

Week 7 : Extended case study on parallelizing machine learning with GPUs and OpenCL: deep convolutional neural networks (CNNs) and GPU-parallelized training algorithms

- Final Project : Proposals DUE : 15 FEB, 6 PM

Week 8 : Extended case study on parallelizing machine learning with GPUs and OpenCL: deep convolutional neural networks (CNNs) and GPU-parallelized training algorithms.

- Final Project : Design DUE : 22 FEB, 6 PM

Week 9 : Extended Case study in physics simulation with parallelized PDEs and efficient interactive 3D scientific visualization with GPUs, OpenCL, and OpenGL.

Week 10 : Extended Case study in physics simulation with parallelized PDEs and efficient interactive 3D scientific visualization with GPUs, OpenCL, and OpenGL.

- Final Project : DUE : 16 MAR, 11 PM