CENG 453/ELEC 553 – Introduction to Parallel and Cluster Computing

Term – Spring 2016 (201601)

Instructor
Dr. Nikitas Dimopoulos
Phone: (250) 721-8902
E-mail: nikitas@ece.uvic.ca

Office Hours
Days: MR
Time: 14:30-15:00
Location: EOW 437

I can be reached via email (please use “CENG453ELEC553 question” as your subject)
If you need to see me in person at a different time, please make an appointment (via email).
If you need to see me urgently, please try to see if I am in my office.

Course Objectives
The focus of the course is to explore the programming practices for clusters (and High Performance Computers).
This will be accomplished through the use of the two prevailing standard environments i.e. MPI (Message Passing Interface) and OpenMP. We will study fundamental algorithms and their parallel implementations. You will be gaining hands-on experience on a cluster environment (4-node/32-core Intel Xeon X5520 system)

Learning Outcomes
The student will be able to
- Describe the domain of High Performance Computers including shared memory, distributed memory, pipelining, clusters, many-core and non-homogeneous systems.
- Describe the use of HPC in solving problems that are societally relevant.
- Explain the interplay of communications and computation in an HPC environment.
- Evaluate the latency and throughput of a communications link.
- Describe collective communications.
- Analyze the performance of an application running on a parallel system and choose the appropriate scaling.
- Use collective communication primitives in a parallel algorithm.
- Design parallel algorithms using domain or functional decomposition.
- Use MPI or OpenMP to implement a parallel algorithm.
- Describe the architecture and use of GPUs.
- Describe the parallel implementation of a number of important algorithms including N-body problem, Matrix-Vector multiplication, Monte-Carlo methods etc.
- Evaluate the performance of the implemented algorithm through speedup and scaling studies

Syllabus
- Preliminaries. The space of high performance computers
- Clusters. Commodity nodes and interconnection network strategies. Why performance depends on interconnections
- Programming. MPI and OpenMP. Develop programming skills through a number of applications.
• Partition, data decomposition, communication, granularity.
• The Sieve of Eratosthenes (finding prime numbers)
• The shortest-path problem
• Linear algebra (matrix-vector, matrix-matrix multiplication, linear systems)
• Monte Carlo Methods
• Finite Difference Methods
• Fast Fourier Transform
• GPGPU computing (time permitting).

CENG 453 A-Section(s): A01, A02 / CRN 20366,20367
ELEC 553 A-Section(s): A01 / CRN 21190
Days: MR
Time: 13:00-14:20
Location: MAC D010

Required Text
Title: Parallel Programming in C and OpenMP
Author: M. J. Quinn
Publisher: McGraw Hill
Year: 2004

Optional Text
Title:
Author:
Publisher:
Year:

References: Class notes http://www.ece.uvic.ca/~ceng453

Assessment:

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<th>CENG 453</th>
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<tr>
<td>Assignments</td>
<td>10%</td>
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<td>Project</td>
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Date: Thursday, February 18, 2016

Note:
For ELEC 553, Failure to complete the project, will result in a grade of N being awarded for the course.
For both CENG 453 and ELEC 553, Failure to pass the final exam will result in a failing grade for the course.
Homework will be assigned and collected, but it will not be corrected.
Solutions will be posted after the due dates.

The final grade obtained from the above marking scheme for the purpose of GPA calculation will be based on the percentage-to-grade point conversion table as listed in the current Undergraduate Calendar.

Assignment of E grade and supplemental examination for this course will be at the discretion of the Course Instructor. The rules for supplemental examinations can be found in the current Undergraduate Calendar.

http://web.uvic.ca/calendar/FACS/UnIn/UARe/Grad.html

Note to Students:
Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Chair's Secretary to set up an appointment.
Accommodation of Religious Observance
http://web.uvic.ca/calendar/GI/GUPo.html

Policy on Inclusivity and Diversity
http://web.uvic.ca/calendar/GI/GUPo.html

Standards of Professional Behaviour
You are advised to read the Faculty of Engineering document Standards for Professional Behaviour, which contains important information regarding conduct in courses, labs, and in the general use of facilities.
https://www.uvic.ca/engineering/assets/docs/professional-behaviour.pdf

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the entry in the current Undergraduate Calendar for the UVic policy on academic integrity.
http://web.uvic.ca/calendar/FACS/UnIn/UARe/PoAcI.html

Course Lecture Notes
Unless otherwise noted, all course materials supplied to students in this course have been prepared by the instructor and are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.