Northeastern
College of Engineering

CSYE7105 High-Performance Parallel Machine Learning & AI

Course Information

Course Title: High-Performance Parallel Machine Learning & AI
Course Number: CSYE7105
Credit Hours: 4
Course Format: On-Ground
Course website: Canvas
Contact via ***Teams*** (Course Group)

Instructor Information

Full name: Handan Liu
Email Address: h.liu@northeastern.edu

Course Prerequisites

DAMG 6105 with a minimum grade of B or INFO 6105 with a minimum grade of B
https://catalog.northeastern.edu/graduate/engineering/multidisciplinary/#coursestext
Search CSYE 7105
The instructor's further advice is as follows:

(1) Understand machine learning and data processing (refer to INFO6105)
(2) Understand Python programming (refer to DAMG6105)
(3) It's even better if you understand simple C syntax, and simple Linux commands.

Course Objective and Description

The objective of this course is to understand the principles of high-performance computing and the practice of the emerging parallelism-based machine learning paradigm. We will learn high-performance parallel architectures and parallel programming models. And we will explore the parallelism of machine learning and deep learning to achieve high-speed and high-performance on heterogeneous cluster architectures, as well as the applications to a variety of domains, including image classification, speech recognition, and natural language processing, etc.

This course is composed of three main parts:

- High-performance parallel architectures and parallel programming models based on OpenMP and MPI standard libraries.
- Parallel machine learning and implementations on multiple CPUs.
- GPU accelerating architecture for high-performance parallel deep learning on multiple GPUs.

Every student in this course will get an account to access Northeastern supercomputing *Discovery* cluster and practice many hands-on labs on *Discovery* CPU and GPU nodes.

Grading

- 3 Homework assignments: 30%
- 2 Quizzes: 24%
- Attendance and Participation: 10%
- Final Research Project: 36%
  The final project will be completed by a team of 1 or 2 students. The final project provides students an opportunity to practice creativity in the application of knowledge gained in this course to real-world scenarios.

Course Schedule

6 Lectures: High-performance computing architectures and parallel programming models.
1 Lecture: Learn to use Northeastern Discovery Cluster
1 Lecture: Linux Essentials
1 Lecture: Introduction to supercomputing cluster job scheduling system SLURM
4 Lectures: Parallelism in Python
4 Lectures: Parallel Machine Learning
1 Lecture: Introduction to High Performance Deep Learning
1 Lecture: Introduction to GPU and CUDA
1 Lecture: Introduction to PyTorch
4 (or more) Lectures: Parallel Deep Learning in PyTorch
2 Lectures: HPC, machine learning, deep learning conference and discussion (this depends on if the conference is available)
4-6 lectures: Project Process

Note: This schedule is subject to change and will be adjusted as needed throughout the semester. The details are shown in the Syllabus on Canvas

Others

For all further information, see *Syllabus@Canvas* for details.

End-of-Course Evaluation Surveys

Your feedback regarding your educational experience in this class is particularly important to the College of Professional Studies. Your comments will make a difference in the future planning and presentation of our curriculum.

At the end of this course, please take the time to complete the evaluation survey at **https://neu.evaluationkit.com**. Your survey responses are **completely anonymous and confidential**. For courses 6 weeks in length or shorter, surveys will be open one week prior to the end of the courses; for courses greater than 6 weeks in length, surveys will be open for two weeks. An email will be sent to your Husky Mail account notifying you when surveys are available.

Academic Integrity

A commitment to the principles of academic integrity is essential to the mission of Northeastern University. The promotion of independent and original scholarship ensures that students derive the most from their educational experience and their pursuit of knowledge. Academic dishonesty violates the most fundamental values of an intellectual community and undermines the achievements of the entire University.

As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, examinations of whatever kind, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Students are responsible for learning the conventions of documentation and acknowledgment of sources in their fields. Northeastern University expects students to complete all examinations, tests, papers, creative projects, and assignments of any kind according to the highest ethical standards, as set forth either explicitly or implicitly in this Code or by the direction of instructors.

Go to http://www.northeastern.edu/osccr/academic-integrity-policy/ to access the full academic integrity policy.

University Health and Counseling Services

As a student enrolled in this course, you are fully responsible for assignments, work, and course materials as outlined in this syllabus and in the classroom. Over the course of the semester if you experience any health issues, please contact UHCS.

For more information, visit https://www.northeastern.edu/uhcs.

Student Accommodations

Northeastern University and the Disability Resource Center (DRC) are committed to providing disability services that enable students who qualify under Section 504 of the Rehabilitation Act and the Americans with Disabilities Act Amendments Act (ADAAA) to participate fully in the activities of the university. To receive accommodations through the DRC, students must provide appropriate documentation that demonstrates a current substantially limiting disability.

For more information, visit https://drc.sites.northeastern.edu.

Library Services

The Northeastern University Library is at the hub of campus intellectual life. Resources include over 900,000 print volumes, 206,500 e-books, and 70,225 electronic journals.

For more information and for education specific resources, visit https://library.northeastern.edu.

24/7 Canvas Technical Help

For immediate technical support for Canvas, call 617-373-4357 or email help@northeastern.edu
Canvas Faculty Resources: https://canvas.northeastern.edu/faculty-resources/
Canvas Student Resources: https://canvas.northeastern.edu/student-resources/
For assistance with my Northeastern e-mail, and basic technical support:
Visit ITS at https://its.northeastern.edu
Email: help@northeastern.edu
ITS Customer Service Desk: 617-373-4357

Diversity and Inclusion

Northeastern University is committed to equal opportunity, affirmative action, diversity, and social justice while building a climate of inclusion on and beyond campus. In the classroom, members of the University community work to cultivate an inclusive environment that denounces discrimination through innovation, collaboration, and an awareness of global perspectives on social justice.
Please visit http://www.northeastern.edu/oidi/ for complete information on Diversity and Inclusion

Title IX

Title IX of the Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender-identity, in educational programs and activities that receive federal financial assistance.

Northeastern's Title IX Policy prohibits Prohibited Offenses, which are defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. The Title IX Policy applies to the entire community, including male, female, transgender students, faculty, and staff.

In case of an emergency, please call 911.

*Please visit **https://www.northeastern.edu/ouec** for a complete list of reporting options and resources both on- and off-campus.*