![Northeastern University College of Engineering]

Multidisciplinary Graduate Engineering
Course Syllabus

Course Information

Course Title: High-Performance Parallel Machine Learning & AI
Course Number: CSYE 7105
Term and Year: Spring 2022
Credit Hour: 4
Course Format: on campuse
Where: Boston Campus | Ryder Hall | Room 157
Days: Tuesday & Friday
Class Time: 09:50 AM – 11:30 AM
Office Hour: every Friday 1:30PM – 2:30PM
Course website: Canvas

Instructor Information

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

Course Prerequisites

Undergraduate level INFO 5100 Minimum Grade of B- or Graduate level INFO 5100 Minimum Grade of B- or Graduate level CSYE 6200 Minimum Grade of B-

Course 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 mainly composed of four parts:

- Shared-memory model, distributed-memory model, OpenMP, MPI and implementations.
- Parallel Machine Learning Implementation on multiple CPUs (Python ecosystem).
- GPU architecture and Mixed-Percision DL training for high performance (Nvidia DL Platforms).
- Data Parallelism and Model Parallelism for accelerating Deep-Learning training on multiple GPUs (PyTorch Enviroment).

In addition, every student in this course will get an account to access Northeastern high-performance computing supercomputer Disccovery and practice many hands-on labs on Discovery CPU and GPU nodes.

Standard Learning Outcomes

Learning outcomes common to all College of Engineering Graduate programs:
1. *An ability to identify, formulate, and solve complex engineering problems.*
2. *An ability to explain and apply engineering design principles, as appropriate to the program's educational objectives.*
3. *An ability to produce solutions that meet specified end-user needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.*

The Information Systems Program accepts students of different engineering backgrounds with minimum programming skills and produces first class Information Systems engineers that operate at the intersection of real-world complexity, software development, and IT management. Graduating students will be able to construct end-to-end advanced software applications that meet business needs.

Specific Learning Outcomes for the Information Systems program:
1. *Create a strong technical foundation through diverse, high-level courses*
2. *Built crucial interpersonal skills needed to succeed in any industry*
3. *Foster a deep level of applied learning through project based case studies*

Grading/Evaluation Standards

Grade Scale

95-100%	A	87-89.9%	B+	77-79.9%	C+	69.9% or below	F
		84-86.9%	B	74-76.9%	C		
90-94.9%	A-	80-83.9%	B-	70-73.9%	C-		

Grade Breakdown:

This course consists of 3 homework assignments, 2 class quizzes, and a research project.
- 3 homework assignments: 30%, 10% for each homework.
  Homework is finished in one week after assigned.
- 2 class quizes: 30%, 15% for each quiz.
  Each class quizz is conducted for 1 hour. The content is taken from the courseware to test basic knowledge.
- Research Project: 40%
  The details will be explained when students start projects.

Course Schedule

The course schedule will be given in detail in the first class.

Teaching Courseware

The teaching courseware is that the Professor teach in the class, includes the slides, code files and data sets if needs.

The courseware will be posted after the class mostly within the same day, no later than the next day. You can find the courseware information at Canvase => Modules.

End-of-Course Evaluation Surveys

Your feedback regarding your educational experience in this class is very 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 HuskyMail 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.

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 http://www.northeastern.edu/drc/getting-started-with-the-drc/.

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 http://subjectguides.lib.neu.edu/edresearch.

24/7 Blackboard Technical Help

For immediate technical support for Blackboard, call 617-373-4357 or emailhelp@northeastern.edu

Within Blackboard, open a support case via the red support button on the right side of the screen, click Create Case

myNortheastern, e-mail, and basic technical support
Visit the Information Technology Services (ITS) Support Portal
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, member 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 www.northeastern.edu/titleix for a complete list of reporting options and resources both on- and off-campus.