EECE 7398: Advances in Deep Learning

SYLLABUS FALL-2021

**Instructor**

Professor Yanzhi Wang, Department of Electrical and Computer Engineering, Room Dana 329,

Tel: (617)373-8805, email: [yanzhiwang@northeastern.edu](mailto:yanzhiwang@northeastern.edu)

Office Hours: Tuesday 2:00pm – 4:00pm

Also available through Zoom connection at the same time.

Website: <https://web.northeastern.edu/yanzhiwang/>

Demonstration channels: <https://www.youtube.com/channel/UCCKVDtg2eheRTEuqIJ5cD8A>, <https://space.bilibili.com/573588276?from=search&seid=11881710196887435131>

**Class Location and Times**

Day: Tuesday & Friday

Time: 09:50 AM ~ 11:30 AM

Location: East Village 102

**Teaching Assistant**

Yanyu Li

Email: [li.yanyu@husky.neu.edu](mailto:li.yanyu@husky.neu.edu)

Office Hours: TBD

**Recording of Classes:**

*This course, or parts of this course, may be recorded for educational purposes. These recordings will be made available only to students enrolled in the course, instructor of record, and any teaching assistants assigned to the course. Classes will be recorded to enable all students to review material covered in synchronous classes. Please contact me if you have any concerns.*

**Classroom Technician (CT):** Dhankuwar Sisodiya;

Email: [sisodiya.d@northeastern.edu](mailto:sisodiya.d@northeastern.edu); Cell phone: 857-452-3635;

The college is assigning a Classroom Technician (CT) for every section of every COE course. The CT will automatically be present throughout every scheduled meeting of the course. During class, the CT will assist with the class and can monitor student questions. The CT can also help students with technology questions.

**Additional Support:** If there are technology questions that the CT is not able to resolve, an email can be sent to the NU IAs (Instructional Assistants) [classroomITsupport@northeastern.edu](mailto:classroomITsupport@northeastern.edu?subject=14510) with the course CRN 14510 in the subject. No message text is required. IAs will immediately come to the classroom.

**Description**

This class is a graduate-level and research-oriented class.

It will focus on the recent advances in the deep learning applications and research fields. The objective is to make students competitive in the growing job markets and research activities of artificial intelligence and big data areas. There are four major components in this course. The first is basic deep learning models, including feedforward neural networks, deep convolutional neural networks, recurrent neural networks (LSTM, GRU, etc.), transformer-based neural networks (e.g., BERT, ViT), autoencoder and representation, transfer learning, deep reinforcement learning (e.g., AlphaGo), generative adversarial networks (GANs), and their inference and training algorithms. The second part is different application fields of deep learning, including image classification, object detection, speech recognition, robotics, autodriving, automated control, medical systems, etc. The third part is effective accelerations and implementations of deep learning systems including GPU-based implementations, FPGA implementations, dedicated hardware such as Google TPU or IBM TrueNorth, deep learning model quantization, model compression, and FFT-based computations. The last part is the security aspects of deep learning, i.e., how deep learning can enhance the security levels of cyber-physical systems and how to enhance the security level of deep learning systems themselves.

This class requires programming in C++ and Python, and students will learn effective deep learning tools such as TensorFlow and PyTorch.

**Topics covered**

1. Introductions

2. Classification problem, basic machine learning models

3. Neural networks, deep convolutional neural networks (DCNN)

4. Training and inference techniques

5. Python, PyTorch, and TensorFlow

6. Using GPU to accelerate learning and inference

7. Recurrent neural networks (RNN)

8. Transformer-based neural networks

9. Autoencoder, representation and transfer learning

10. Neural networks for computer vision and autodriving

11. Deep reinforcement learning

12. Generative adversarial networks (GAN)

13. Hardware acceleration of deep learning systems

14. Security in deep learning systems

**Grading policy**

Final Project: 45%

Homework and Projects: 45%

Quizzes: 10%

Extra Points: up to 3%

**Grading Scale:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| A | : | 100~93 | C | : | 76.65~73.33 |
| A- | : | 92.99~90 | C- | : | 73.32~70 |
| B+ | : | 89.99~86.66 | D+ | : | 69.99~66.66 |
| B | : | 86.65~83.33 | D | : | 66.65~63.33 |
| B- | : | 83.32~80 | D- | : | 63.32~60 |
| C+ | : | 79.99~76.66 | F | : | 59.99~0 |

# Homework Policy

Homework assignments are to be submitted through Blackboard website or hand to the instructor on the assignment due date. Assignments submitted after the due date will be deducted 10 points for each day late.

# Attendance

You are expected to attend each class punctually and remain for the entire class period. You need to inform the instructor in advance if you expect to miss a class or leave the course before the end of the semester. If you miss class your absence will be excused by the instructor only if a doctor’s certificate or other evidence is submitted. You remain to be responsible for the work associated with the class you missed, even if your absence has a valid reason. There will be a number of unannounced popup quizzes during the semester.

**About Canvas and the Course:**

We will use Canvas as the main platform, where we communicate on announcements, course materials, homework, exams, etc. and access to the Zoom sessions for synchronous classes.  
You are encouraged to participate in the synchronous classes. And I understand that there may be remote students in different time zones, in that case the remote students can watch lecture videos to study the topics, request additional office hours, and arrange exam time with flexibility.  
Please post course-related questions at “Discussions” on Canvas. If you send the instructor an email with questions that may benefit others in the class, the instructor will ask you to post your questions on Canvas. For questions pertaining your personal situation, send an email to the instructor instead.

**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/*](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/*](http://www.northeastern.edu/drc/getting-started-with-the-drc/)*.*

**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. It is my intention that students from all backgrounds and perspectives will be well served by this course, and that the diversity that students bring to this class will be viewed as an asset. I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, socioeconomic background, family education level, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. Your suggestions are encouraged and appreciated.* *Please visit* [*http://www.northeastern.edu/oidi/*](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*](http://www.northeastern.edu/titleix) *for a complete list of reporting options and resources both on- and off-campus.*

**Expectations to Students:**

*The university has put into place a robust plan to make the campus healthy and safe for all - -- but you must do your part. On August 22, all students received an email from Senior Vice Chancellor for Student Affairs Madeleine Estabrook on the expectations for behavior both on campus and off campus.* ***Please read it carefully today****.   
To Summarize:*

1. *Gatherings on or off campus must conform to healthy practices as outlined by university and* [*Massachusetts state guidance*](https://www.mass.gov/doc/revised-gatherings-order-august-7-2020)*. If you host or attend an inappropriate party or gathering, you run the very real risk of immediate removal from the community.*
2. *Wear a mask indoors and outdoors as you maintain a 6-foot distance from everyone.*
3. *Get tested every three days using the COVID-19 Test Scheduler (*[*Covid19-testing.northeastern.edu*](http://covid19-testing.northeastern.edu/)*.) We may require more frequent testing as the semester progresses. It’s quick, easy and will help us to quickly identify and care for anyone who tests positive. I will not be told the identity of anyone who tests positive, and you do not need to share that information with me or anyone else unless you want to. If you receive a positive test result, you will be contacted by a member of the university’s telehealth team who will provide you with next steps.*
4. *Do a Daily Wellness Check (*[*wellness-check.northeastern.edu*](http://wellness-check.northeastern.edu/)*), wash your hands well and regularly, and disinfect high-touch surfaces and spaces.*
5. *I will be wearing a* [*face covering*](https://news.northeastern.edu/coronavirus/reopening/policies-and-protocols/#face-covering-protocol) *or mask as I teach and expect that you will do the same in class. If you come to class without a mask, I’ll ask you to go and* [*get one on campus*](https://news.northeastern.edu/coronavirus/reopening/frequently-asked-questions/#reopening)*. You can get a mask at the Visitor Center or at the Curry Student Center Help Desk. If you refuse to wear a mask in class, I won’t be able to continue the class. If you are not sitting six feet apart from your classmate, I’ll ask you to do so. We won’t be able to eat or drink in class (except water). If you test positive, you will need to enter isolation as directed by the university’s telehealth team. I expect that you will not come in-person to class and that you will follow the guidance from the university telehealth team to isolate and get appropriate healthcare if needed.*
6. *Staying safe is a responsibility that we all must take seriously. Keep in mind the “Protect the Pack” theme. Remember that our individual actions will help everyone stay safe this fall.*