Computer Science Syllabi

NJIT Syllabi

Summer 2023

DS 677: Deep Learning

Ioannis Koutis

Deep Learning - CS677 - Syllabus
Summer 2023

Course Modality:
This is an online course, which will be conducted fully online, asynchronously via Canvas. For more information on using Canvas and other supported learning tools, visit the IST Service Desk [Knowledge Base](#).

Instructor Information

Instructor	Email	Office Hours
Ioannis Koutis	ikoutis+677@njit.edu	reserve slot also by appointment

*I will respond to all emails/Inbox messages within 48 hours. Quizzes, homework, and discussions will be graded weekly.

Grader: TBA

General Information

Prerequisites/Co-requisites
CS675 or instructor permission.

Course Description
This course covers current topics in data science. The topics include but are not limited to parallel programming on GPU and CPU multi-cores, deep learning, representation learning, optimization algorithms, and algorithms for big datasets. Students will present recent papers in data science, work on programming assignments, and do a machine learning/deep learning/data science project.

Extended Course Description
Deep Learning (DL) is a subfield of Machine Learning that has delivered disruptive technologies, and created AI algorithms that outperform humans in various tasks. It paves the way for broader

advances in science. DL consists of a set of specialized techniques that exploit the abundant availability of data and computational power to build models that are composed of multiple processing layers and learn representations of data at multiple levels of abstraction. Only a few years back, the development of DL models required significant expertise, but the introduction of open-source DL libraries like TensorFlow and PyTorch has opened the area to scientists and professionals with more diverse backgrounds. The course opens with a review of Artificial Neural Networks that guides you through PyTorch and enables you to build novel ANN architectures. Then it presents the evolution of progressively deeper architectures for Convolutional Neural Networks, that addressed various training difficulties and led to very successful image classification models. The course then takes you to the emerging applications of Recurrent Neural Networks in temporal data, including Natural Language Processing. In this context, you will learn how Attention and Transformers have led to better language models. You will also learn about Graph Neural Networks and their applications in the analysis of real-world networks (e.g., social, or biological networks). The course may also touch upon selected topics like the ability of deep networks to generalize, techniques for 'pruning' deep networks to make them more computationally efficient, and successful applications of DL methods in the Sciences.

Course Learning Outcomes
By the end of the course, students will be able to:
1. Program in widely used parallel frameworks for Deep Learning (DL)
2. Recognize problems amenable to DL methods
3. Describe and explain a wide variety of DL methods for various data types
4. Adapt existing DL resources to novel data and applications
5. Evaluate new developments in the field of DL
6. Explain the broader impact of DL in the Sciences

Required Materials
Dive into Deep Learning
A. Zhang , Z. Lipton, M. Li, A. Smola
The textbook is open, free and available here.

Grading Policy
The grading policy is designed to reflect the NJIT Grading Legend

Final Grade Calculation
Final grades for all assignments will be based on the following percentages:

Short Quizzes	**10%**
Summary Quiz	**20%**
Discussion Forums and Participation	**15%**

Exercises/ Learning Activities	25%
Projects (Milestone-1= 8%, Milestone-2= 2% Milestone 3= 20%)	**30%**

Letter to Number Grade Conversions

Raw numerical scores will be converted to letter grades using the following bounds.

A	B+	B	C+	C	F
≥93	≥85	≥70	≥60	≥50	<50

In some cases a letter grade can be upgraded to the next letter to reflect natural clusters of performance.

Course Work

Assignment and Projects

Short Quizzes: (10% of grade) There will be weekly short multiple-choice quizzes, worth 10% of the total grade. These are meant to help you keep up with the most important theoretical concepts. These quizzes are not proctored and the two weakest scores will be dropped.

Summary Quiz: (20% of grade) There will be one 90-minutes summary quiz, worth 20%. This is required and proctored. It is meant to assess your overall understanding of the material.

Discussion Forums and Participation Activities: (15% of grade) When all students participate in a discussion, it creates an active learning environment that will help you better understand the materials and be more successful in the class. You are expected to participate in two types of forums: (i) Weekly discussion forums in Canvas, with Q&A about the week's material (10%). Your contributions are due by Sunday, 11:59 pm. (ii) A permanent discussion forum on successful applications of the material we cover, and a final-week forum for discussing course projects (5%).

Exercises/Learning Activities: (25% of grade) Assignments will be given bi-weekly (up to week #12) to give you an opportunity to apply course concepts for that week. These activities are designed to help you practice and prepare for the project. The weakest grade will be dropped automatically.

Projects: 30% of grade The project will consist of three milestones, with weights [2%, 8%, 20%]. You will have opportunities to iterate and revise your work based on peer and instructor feedback.

Feedback

Assignment solutions will be distributed for each assignment, along with general class-level feedback from the grader. Occasionally, and when needed, you will also receive individualized comments directly on your assignment notebook. You can also always directly inquire about a specific grade item. In that case please email both the instructor and the grader.

Exam Information and Policies

This course has two proctored quizzes. These will take place in the classroom, and presence is required. The quizzes will be on the LockDown browser, so please make sure you bring your computers charged. The majority of your grade is based on authentic assessment, meaning that you will be assessed and graded on your ability to deliver real-world outputs as well as your participation and feedback to other students.

Policy for Late Work

2% will be subtracted from the delayed assignment grade for each hour of delay.

Collaboration and External Resources for Assignments

Some homework problems will be challenging. You are advised to first try and solve all the problems on your own. For problems that persist you are welcome to talk to the course assistant or the instructor. You are also allowed to collaborate with your classmates and search for solutions online. But you should use such solutions only if you understand them completely (admitting that you don't understand something is way better than copying things you don't understand). Also, make sure to give the appropriate credit and citation.

Academic Integrity

"Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the [NJIT academic code of integrity policy](#)*. Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at* dos@njit.edu*"*

Weekly Expectations

The course is organized into modules. Each week consists of 1 or 2 modules. The students are advised to watch the posted videos. The students are also expected to read the corresponding sections of the textbook, and participate in a class discussion forum as prompted by the instructor. The students must also be aware of any assignments due at the end of each week.

Course Schedule

Week	Topic	Textbook Reading	Due Work
1	● Introduction to CS677 ● Review: Optimization and PyTorch	● Chapter 1 ● Chapter 3	
2	● Softmax Regression ● Regularization, Dropouts, Initialization	● Chapters 4.1- 4.5 ● Chapters 3.7, 5.4 & 5.6	Assignment-1
3	● Introduction to CNNs	● Chapter 7	
4	● Modern CNNs	● Chapter 8	Assignment-2
5	● Introduction to RNNs and Language Modeling ● Modern RNNs and Language Translation	● Chapter 9 ● Chapter 10	Assignment-3
6	● Attention - Transformers	● Chapter 11	Project Milestone-1
7	● Graph Neural Networks	● Gentle Introduction to Graph Neural Networks	Project Milestone-2 Assignment-4
8	● Applications in Vision	● Chapter 14	
9	● Word Embeddings ● NLP applications	● Chapter 15 ● Chapter 16	Assignment-5
10	● Various Topics	● Chapter 20	Project Milestone-3
11	● Recommender Systems	● Chapter 21	Assignment-6 Project Reports/Videos & Feedback
12	● Final Week (2 days)		Summary Quiz

- Homeworks become available two weeks before their due date
- Homeworks and milestones are due on Sunday, at 23:55 pm
- There are also multiple attempts weekly quizzes due on Sunday at 23:55 pm

Additional Information and Resources

Netiquette

Throughout this course, you are expected to be courteous and respectful to classmates by being polite, active participants. You should respond to discussion forum assignments in a timely manner so that your classmates have adequate time to respond to your posts. Please respect opinions, even those that differ from your own, and avoid using profanity or offensive language.

Accessibility

This course is offered through an accessible learning management system. For more information, please refer to Canvas's Accessibility Statement.

Requesting Accommodations

The Office of Accessibility Resources and Services works in partnership with administrators, faculty, and staff to provide reasonable accommodations and support services for students with disabilities who have provided their office with medical documentation to receive services.
If you are in need of accommodations due to a disability, please contact the Office of Accessibility Resources and Services to discuss your specific needs.

Resources for NJIT Online Students

NJIT is committed to student excellence. To ensure your success in this course and your program, the university offers a range of academic support centers and services. To learn more, please review these Resources for NJIT Online Students, which include information related to technical support.