

CS 615 Deep Learning

Winter 2022

Catalog description:

Introduces a machine learning technique called deep learning and its applications, as well as core machine learning concepts such as data set, evaluation, overfitting, regularization and more. Covers neural network building blocks: linear and logistic regression, followed by shallow artificial neural networks and a variety of deep networks algorithms and their derivations. Includes implementation of algorithms and usage of existing machine learning libraries. Explores the usage of deep learning on a variety of problems including image classification, speech recognition, and natural language processing. Concludes with student-chosen project demonstrations accompanied by a conference-style paper.

Course Objectives:

The course objectives are to:

- Understand limitations of shallow learning and the need (and uses) for deep learning
- Understand back propagation, its derivations, and its applications
- Review existing algorithms in deep learning, including deep artificial neural networks, convolutional neural networks, autoencoders, recurrent neural networks, and more
- Be able to train and test deep networks fairly and be able to analyze their results.

As learning outcomes, students completing this course should be able to:

- Implement back propagation
- Derive back propagation rules for various deep learning algorithms
- Implement a variety of deep learning algorithms from scratch
- Make use of existing deep learning libraries for training and testing
- Apply deep learning to a real-world problem and present associated research and results in the form of a presentation and conference-style paper.

Credit Hours

3 Credits

Instructor:

Matt Burlick: mjburlick@drexel.edu
3675 Market St., Room 1139
[Zoom](#)

Office Hours: [Tuesday 2-3pm \(Remote, CS 432 priority\)](#)
[Tuesday 3-4pm \(Remote, CS 435 priority\)](#)
[Tuesday 4-5pm \(Remote, CS 615 priority\)](#)
Thursdays 4-6pm (Face-to-Face)
And by appointment

Teaching Assistant(s):

Vivek Khimani vck29@drexel.edu
Thursdays 4-6pm

Meetings:

Lecture:

Section 001	Thursdays 06:30pm-09:20pm	3675 Market St., Room 1139
Section 900	Remote Asynchronous (videos posted on BBlearn)	

Prerequisite:

CS 520 (Computer Science Foundations) or CS 502
CS 570 (Programming Foundations) or CS 501
CS 571 (Advanced Programming Techniques) or CS 503
CS 504 (Introduction to Software Design)

Required Textbooks:

None

Suggested Textbooks

- Deep Learning, by Ian Goodfellow, et al, The MIT Press. ISBN: 978-0262035613
- Introduction to Deep Learning, by Eugene Charniak, ISBN: 978-0-262-03951-2
- Mathematics for Machine Learning, by M.P Deisenroth, et. al, ISBN: 978-1-108-47004-9

Software:

Programming Environment: Python 3.x with the following libraries:

- Python 3.x
- NumPy
- Matplotlib
- Pillow
- opencv-python
- Pandas

Typesetting Environment: Latex

- Online LaTeX: www.overleaf.com
- Local LaTeX
 - Download LaTeX: <https://latex-project.org/ftp.html>
 - Optionally use a LaTeX IDE:
 - <http://www.xm1math.net/texmaker/download.html#windows>
 - <https://github.com/TeXworks/teXworks/releases>

Lectures: In-Person/Zoom

- All lectures will be recorded on Zoom.

Discussion Forum: Discord

- For discussions and questions, we will be using Discord.
- Our course will be on the CCI Discord Server as **CS615-WI22**

Remote Office Hours: Zoom

- To facilitate larger discussions, Tuesday faculty office hours will be conducted over zoom.
- Additional face-to-face office hours with the instructor is available on Thursdays.

Course Assessment:

This course will have several graded components:

- Homework Assignments
- Exam
- Project Proposal/Presentation/Paper

Homework assignments will allow students to implement algorithms from scratch, perform training, testing, and analysis.

The project components will allow students to identify and digest existing research in problems of interest to them, obtain necessary data for training and testing, create relevant tests, and construct formal presentations and papers based on their findings.

The exam will act to verify that students understand the theoretical and mathematical fundamentals of deep learning.

Grading Matrix

Assignments: 40%
Exam: 30%
Project: 30%

The following scale will be used to convert points to letter grades:

<i>Points</i>	<i>Grade</i>	<i>Points</i>	<i>Grade</i>	<i>Points</i>	<i>Grade</i>
97-100	A+	82-86.99	B	70-71.99	C-
92-96.99	A	80-81.99	B-	67-69.99	D+
90-91.99	A-	77-79.99	C+	60-66.99	D
87-89.99	B+	72-76.99	C	0-59.99	F

CS615 Week by Week

This is a preliminary outline and will be revised and augmented during the term as needed

Week	Topic(s)	Assessment
Week 1:	Introduction Fundamentals of Machine Learning Building Blocks Forward Propagation	
Week 2:	Objectives and Gradients	HW1 Due: Forward Prop
Week 3:	Backpropagation and Basic Architectures	HW2 Due: Objectives and Gradients
Week 4:	Improving Learning	HW3 Due: Back Prop 1
Week 5:	Generative Networks	HW4 Due: Back Prop 2
Week 6:	Project Logistics Convolutional Neural Networks (CNNs)	HW5 Due: MLPs
Week 7:	Project Proposals	
Week 8:	Exam Logistics/Review	Exam
Week 9:	Recurrent Neural Networks (RNNs/LSTMs)	HW6 Due: GANs
Week 10:	DL APIs	
Finals Week:	Final Project Presentations Due	

Course Policies

- You, your instructor, and the TA (if applicable) are bound by the Academic Honesty policy. Students are responsible for reading and understanding the course policies in this syllabus and for announcements made in class and in the course email list. See the academic policy at the end of the syllabus.
- Since this course involves computer programming, while the majority of your work should be original, if at any point you use part of someone else's solution you **MUST** cite the source of the code. Copy from others (online or classmates) results in an automatic zero for the assignment and additional possible penalties (including course failure and/or escalation to the honor board).
- While you are encouraged to use a versioning system like github or bitbucket, please make your work for this course **private**. Making your code for this course publicly available to others would constitute an academic integrity violation.
- Assignments are due **Sunday at 11:59:00pm** unless otherwise stated.
- You will lose 1pt for every hour late (round up) on an assignment up to 48hrs (after which you will receive a zero).
- Any dispute about an assignment grade must be made and resolved within 5 days of receiving your grade. After this period your grade cannot be adjusted.
- Except when groups are explicitly allowed, work must be done individually. You are encouraged to discuss the problems with your classmates but you must not share details of the solutions. If you are unsure whether you have shared too much, discuss the situation with the TA or instructor; it is your obligation to avoid even the appearance of cheating.

University Policies

In addition to the course policies listed on this syllabus, course assignments or course website, the following University policies are in effect:

- Academic Honesty:
http://www.drexel.edu/provost/policies/academic_dishonesty.asp
- Judicial Affairs Academic Integrity:
http://drexel.edu/studentaffairs/community_standards/facultyStaff/integrity/
- Official Final Exam Schedule:
<http://www.drexel.edu/registrar/scheduling/exams/>
- Students with Disability Statement:
http://www.drexel.edu/ods/student_reg.html
- Course Drop Policy:
http://www.drexel.edu/provost/policies/course_drop.asp
- Drexel Student Learning Priorities:
<http://www.drexel.edu/provost/learningpriorities/>

Academic Integrity/Plagiarism Policy

As a reminder, below is the university's academic integrity/plagiarism policy:

"Drexel University Policy on Plagiarism:

Violations of the Academic Integrity Policy include, but are not limited to:

1. Plagiarism
2. Fabrication
3. Cheating
4. Academic Misconduct

1. Plagiarism— the inclusion of someone else's words, ideas, or data as one's own work. When a student submits work for credit that includes the words, ideas, or data of others, the source of that information must be acknowledged through complete, accurate, and specific references, and, if verbatim statements are included, through quotation marks as well. By placing his/her name on work submitted for credit, the student certifies the originality of all work not otherwise identified by appropriate acknowledgments.

Plagiarism covers unpublished as well as published sources. Examples of plagiarism include, but are not limited to:

- Quoting another person's actual words, complete sentences or paragraphs, or an entire piece of written work without acknowledgment of the source.
- Using another person's ideas, opinions, or theory, even if it is completely paraphrased in one's own words without acknowledgment of the source.
- Borrowing facts, statistics, or other illustrative materials that are not clearly common knowledge without acknowledgment of the source.
- Copying, or allowing another student to copy, a computer file that contains another student's assignment, and submitting it, in part or in its entirety, as one's own.
- Working together on an assignment, sharing the computer files and programs involved, and then submitting individual copies of the assignment as one's own individual work.

Students are urged to consult with individual faculty members, academic departments, or recognized handbooks in their field if in doubt regarding issues of plagiarism.

2. Fabrication - Fabrication is the use of invented information or the falsification of research or other findings. Examples include, but are not limited to:

- Citation of information not taken from the source indicated. This may include the incorrect documentation of secondary source materials.
- Listing sources in a bibliography not used in the academic exercise.
- Submission in a paper, thesis, lab report, or other academic exercise of falsified, invented, or fictitious data or information, or deliberate and knowing concealment or distortion of the true nature, origin, or function of such data or information.
- Submitting as your own written work, printing, sculpture, etc. prepared totally or in part by another."

3. Cheating - Cheating is an act or an attempted act of deception by which a student seeks to misrepresent that he or she has mastered information on an academic exercise that he/she has not mastered. Examples include, but are not limited to:

- Copying from another student's test, exam, quiz, and/or paper.
- Allowing another student to copy from a test, exam, quiz, and/or paper.
- Unauthorized use of course textbook or other materials, such as a notebook to complete a test or other assignment.
- Collaborating on a test/exam/quiz or other project with another person(s) without authorization.
- Using or processing specifically prepared materials during a test such as notes, formula lists, notes written on the students clothing, etc. that are not authorized.
- Taking a test for someone else or permitting someone else to take a test for you."

4. Academic Misconduct - Academic misconduct includes other dishonest acts such as tampering with grades or taking part in obtaining or distributing any part of an administered or unadministered test/assignment. Examples include, but are not limited to:

- Stealing, buying, or otherwise obtaining all or part of an administered or unadministered test.
- Selling or giving away all or part of an administered or unadministered test including questions and/or answers.
- Bribing any other person to obtain an administered or unadministered test or any information about the test.
- Any unauthorized action taken for the purpose of changing a grade in a grade book, on a test, or on other works for which a grade is given.
- Changing, altering, or being an accessory to the changing and/or altering of a grade in a grade book, on a test, a "change of grade" form, or other official academic records of the University that relate to grades.
- Continuing to work on an examination or project after the specified allotted time has elapsed.
- Any buying or otherwise acquiring any theme, report, term paper, essay, computer software, other written work, painting, drawing, sculpture, or other scholastic art work, and handing it in as your own to fulfill academic requirements.
- Any selling, giving, or otherwise supplying to another student for use in fulfilling academic requirements, any theme, report, term paper, essay, computer software, other written work, painting, drawing, sculpture, or other scholastic art work.
- Scientific Misconduct—See http://www.drexel.edu/provost/policies/conduct_of_research/"

A step-by-step guide for reporting a case of academic dishonesty can be found on the Student Life Website: http://drexel.edu/studentlife/community_standards/facultyStaff/integrity/. Should you have any questions or need further assistance regarding academic dishonesty, please call 215-895-6074 and ask for Stephen Rupprecht or email sccs@drexel.edu.