CS 482/682 Machine Learning: Deep Learning  
Fall 2020 Syllabus (4 credits)

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Office hours: Mathias Unberath: TBD  
Suzanna Sia: TBD  
Hao Ding: TBD

Time: Asynchronous consumption of lecture recordings  
Synchronous Q/A and flipped classroom session (chose one session)  
   Session 1: Mondays 12.00pm to 1.15pm  
   Session 2: TBD based on time zone needs

Location: Asynchronous material is linked on Piazza  
Synchronous sessions on Zoom

Synopsis

Deep learning (DL) has emerged as a powerful tool for solving data-intensive learning problems such as supervised learning for classification or regression, dimensionality reduction, and control. As such, it has a broad range of applications including speech and text understanding, computer vision, medical imaging, and perception-based robotics. The goal of this course is to introduce the basic concepts of DL. The course will include a brief introduction to the basic theoretical and methodological underpinnings of machine learning, commonly used architectures for DL, current challenges, and specialized applications to computer vision, speech understanding, and medicine. Students will be expected to solve several DL problems on standardized data sets and will be given the opportunity to pursue team projects on topics of their own interest.

Prerequisites

(AS.110.201 or AS.110.212 or EN.553.291) and (EN.553.310 | EN.553.311 | EN.553.420 | EN.560.348) and (EN.601.475 or equivalent); Calc III and numerical optimization recommended. Recommended co-req: EN.601.382.
Communication Plan

In Fall 2020, this course will be held entirely remotely for the first time. It consists of both asynchronous and synchronous elements to enable remote learning in various time zones and schedules while preserving some of the valuable face to face and personalized interactions that distinguish this course from other online material. Because technology-mediated interactions are not quite comparable to in-person events just yet, we will use multiple channels to communicate as effectively as possible.

**How does this work?** You will find below a list of lectures and/or other material for you to consume during the specified week of the semester. Consuming this material is asynchronous and you can decide your schedule as long as you finish that week. Questions that arise during self-study or homework can be 1) posted on Piazza and/or 2) submitted anonymously via Google Forms as a request for recitation and clarification during our next synchronous session. During our synchronous sessions, we will then review the most important and most frequently requested topics, provide guidance for solving the homework assignments, or discuss flipped classroom tasks.

**Where do I find the material?** The course’s home is on Piazza and you should sign up as soon as possible using this link: [piazza.com/jhu/fall2020/cs482682](http://piazza.com/jhu/fall2020/cs482682). On Piazza you will find links to recorded lectures, slides, assignments, and other relevant course material and resources. You are encouraged to post any questions and discussions on Piazza and contribute to answering questions your peers have posted. Please note that, while you can remain anonymous to peers, posting anonymously to instructors is disabled.

Homework assignments will be submitted through [Gradescope](http://gradescope.com).

In addition, we will use [Google Forms](http://forms.google.com) for quizzes and anonymous recitation requests. Links to the recitation requests are provided together with the semester schedule below. Links to Quizzes will be shared during the synchronous Zoom sessions.

**Instructional Material**

A fairly exhaustive list of additional reading material (including textbooks, blog articles, tutorials, and scientific articles) will be made available in the “Resource” section of Piazza.

**Grading**

We will have short weekly quizzes to test your comprehension and recollection of the course material you prepared asynchronously. The link to participate in quizzes will be shared over the zoom link during the respective synchronous session. Further, the course has 7 assignments, 3 of which are written and the remaining 4 focusing on programming. The bulk of the homework assignment workload (1 to 6) is condensed into the first two-thirds in the first two thirds of the semester to free up time for the final project. Starting in Week 10, most time will be spent on the
final project that will be completed in groups of four. Individual grades will be computed as a weighted combination of these factors:

1) Quizzes: 10%
2) Homework Assignments: 50%
3) Final Project: 40%

There is opportunity for bonus points. Bonus points are earned by completing additional assignments that will be described in homework assignment 7.

Grading Policies

The worst quiz score of every student will be automatically dropped from scoring.

For late assignment submissions, you have a total of 3 late days that you can use at your discretion. However, no smaller quantity than “day” can be used but you can use multiple days for the same homework. Late days must be requested ahead of submission deadline via private message to instructors on Piazza.

Topics and Schedule

Homework assignments are released / and are due Fridays (latest submission 11.59pm).

**Week 1 (Aug 31): Introduction and Basics**
**Synchronous:** Welcome and Course Logistics
**Asynchronous:** Submit questions here NO LINK PUBLIC VERSION
L-1) Overview
L-2) Basics Part I: Image Features, Regression, and Classification

**Friday, Sep 04:** Homework 1 released

**Week 2 (Sep 07): Basics**
**Synchronous:** Q/A Week 1 and intro to Python
**Asynchronous:** Submit questions here NO LINK PUBLIC VERSION
L-3) Basics Part II: Regularization and Optimization
L-4) Computational Graphs and Backpropagation Part I

**Friday, Sep 11:** Homework 1 due, Homework 2 released

**Week 3 (Sep 14): Convolutional Neural Networks**
**Synchronous:** Q/A Week 2
**Asynchronous:** Submit questions here NO LINK PUBLIC VERSION
L-5) History of and Introduction to Neural Networks
L-6) Convolutional Neural Networks
Friday, Sep 20: Homework 2 due, Homework 3 released

Week 4 (Sep 21): Training Neural Networks
Synchronous: Q/A Week 3
Asynchronous: Submit questions here NO LINK PUBLIC VERSION
L-7) Training Part I: Activation, Initialization, Preprocessing, Dropout, Batch norm
L-8) Training Part II: Update rules (Momentum), Augmentation, Transfer Learning

Friday, Sep 25: Homework 3 due, Homework 4 released

Week 5 (Sep 28): Architectures
Synchronous: Q/A Week 4
Asynchronous: Submit questions here NO LINK PUBLIC VERSION
L-9) Inverse Classroom: It’s not working! Help!
L-10) Network Architectures: AlexNet, VGG, ResNet, U-Net, ...

Week 6 (Oct 05): Architectures continued – Form project groups of 3
Synchronous: Q/A Week 5 and Inverse Classroom Discussion
Asynchronous: Submit questions here NO LINK PUBLIC VERSION
L-11) Inverse Classroom: What does this network do?

Friday, Oct 09: Homework 4 due, Homework 5 released

Week 7 (Oct 12): Sequence Modeling
Synchronous: Q/A Week 6 and Inverse Classroom Discussion
Asynchronous: Submit questions here NO LINK PUBLIC VERSION
L-12) RNNs and LSTM

Friday, Oct 17: Homework 5 due, Homework 6 released

Week 8 (Oct 19): Unsupervised Learning
Synchronous: Q/A Week 7
Asynchronous: Submit questions here NO LINK PUBLIC VERSION
L-13) Unsupervised and Self-supervised Learning
L-14) Autoencoders, Variational Autoencoders, and Disentanglement

Week 9 (Oct 26): Generative Models
Synchronous: Q/A Week 8
Asynchronous: Submit questions here NO LINK PUBLIC VERSION
L-15) Generative Adversarial Networks
L-16) Inverse Classroom: Labeling? Ain’t nobody got time for that.

Friday, Oct 31: Homework 6 due, Homework 7 released
Week 10 (Nov 02): Current Topics – Start project work
Synchronous: Q/A Week 9 and Inverse Classroom Discussion
Asynchronous: Submit questions here NO LINK PUBLIC VERSION
L-17) Generalization, domain gaps, and explainable AI
L-18) Domain gaps and black boxes

Friday, Nov 07: Project proposals due

Week 11 (Nov 09): Current Topics
Synchronous: Q/A Week 10
Asynchronous: Submit questions here NO LINK PUBLIC VERSION
L-19) DL4Health
L-20) Natural Language Processing and Transformers

Week 12 (Nov 16): Current Topics
Synchronous: Q/A Week 11
Asynchronous: Submit questions here NO LINK PUBLIC VERSION
L-21) Character and word embedding
L-22) Deep Reinforcement Learning

Week 13 (Nov 23): Thanksgiving Vacation

Week 14 (Nov 30): Wrap up
Synchronous: Q/A Week 12
Asynchronous: Submit questions on Piazza for asynchronous clarifications, this is the last week!
L-23) Human-centered AI, ethics, etc.
L-24) Wrap Up

Friday, Dec 04: Homework 7 due

Final Exam Date minus few days: Final project reports due

Final Exam Date, 3h slot (we will address time zone concerns): Synchronous project pitch and breakout rooms

Ethics

The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Report any suspected violations to the instructor. You can find more information about university misconduct policies on the web at these sites:
• Undergraduates: [http://e-catalog.jhu.edu/undergrad-students/student-life-policies/](http://e-catalog.jhu.edu/undergrad-students/student-life-policies/)
• Graduate students: [http://e-catalog.jhu.edu/grad-students/graduate-specific-policies/](http://e-catalog.jhu.edu/grad-students/graduate-specific-policies/)

**Personal Wellbeing**

- If you are sick, in particular with an illness that may be contagious, notify us by email but do not come to class. Also discuss with us opportunities for accommodation regarding homework.
  
  Visit the Health and Wellness Center: 1 East 31 Street, (410) 516-8270.
  
  Also refer to: [http://studentaffairs.jhu.edu/student-life/support-and-assistance/absences-from-class/illness-note-policy/](http://studentaffairs.jhu.edu/student-life/support-and-assistance/absences-from-class/illness-note-policy/)

- All students with disabilities who require accommodations for this course should contact me at their earliest convenience to discuss their specific needs.
  
  If you have a documented disability, you must be registered with the JHU Office for Student Disability Services (385 Garland Hall; (410) 516-4720; [http://web.jhu.edu/disabilities/](http://web.jhu.edu/disabilities/)) to receive accommodations.

- If you are struggling with anxiety, stress, depression or other mental health related concerns, please consider visiting the JHU Counseling Center. If you are concerned about a friend, please encourage that person to seek out these services. The Counseling Center is located at 3003 North Charles Street S-200 and can be reached at (410) 516-8278 and online at [http://studentaffairs.jhu.edu/counselingcenter/](http://studentaffairs.jhu.edu/counselingcenter/).

**Classroom Climate**

We are committed to creating a classroom environment that values the diversity of experiences and perspectives that all students bring. Everyone here has the right to be treated with dignity and respect. I believe fostering an inclusive climate is important because research and my experience show that students who interact with peers who are different from themselves learn new things and experience tangible educational outcomes. Please join me in creating a welcoming and vibrant classroom climate. Note that you should expect to be challenged intellectually by me, the TAs and CAs, and your peers, and at times this may feel uncomfortable. Indeed, it can be helpful to be pushed sometimes in order to learn and grow. But at no time in this learning process should someone be singled out or treated unequally based on any seen or unseen part of their identity.

If you ever have concerns in this course about harassment, discrimination, or any unequal treatment, or if you seek accommodations or resources, I invite you to share directly with me or the TAs. I promise that we will take your communication seriously and to seek mutually acceptable resolutions and accommodations. Reporting will never impact your course grade. You may also share concerns with the department chair (Randal Burns, chairadm@cs.jhu.edu), the Director of Undergraduate Studies (Joanne Selinski, joanne@cs.jhu.edu), the Assistant Dean for Diversity and Inclusion (Darlene Saporu, dsaporu@jhu.edu), or the Office of Institutional Equity.
(oic@jhu.edu). In handling reports, people will protect your privacy as much as possible, but faculty and staff are required to officially report information for some cases (e.g. sexual harassment).