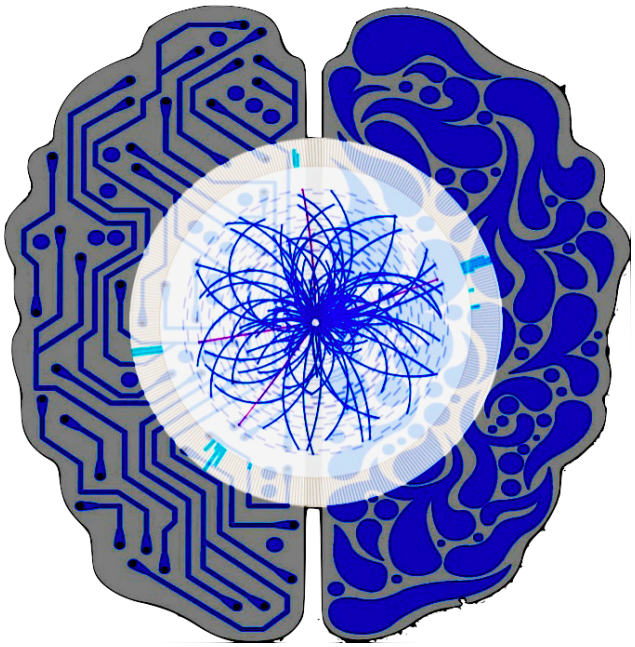
Phys 417 AA - Hsu

Jump to Today



Description

Welcome to PHYS 417 "Neural Network Methods for Signals in Engineering and Physical Sciences." The course materials were co-developed by Prof. Shih-Chieh Hsu (http://faculty.washington.edu/schsu) from Physics and Prof. Eli Shlizerman (https://faculty.washington.edu/shlizee/) from AMath/ECE.

We will provide a **practical introduction to Neural Networks, and their application** in the analysis of signal data common in engineering and physical sciences. We will build computational skills for training neural networks, understanding, and working with modern algorithms. The course will conclude with projects developing NN models to solve data provided by the NSF HDR Institutes A3D3 (https://a3d3.ai/) (https://a3d3.ai/) .

Learning Goal

The learning goal is to enable students to use industry-standard tools (git, Python, PyTorch) to build appropriate neural network models and solve data-driven analyses in engineering and physical sciences.

Requirements

Basic Computer Science and Python Programming Skills at an equivalent level as (ASTR300, AMATH 301, EE 241, CSE160, STAT180)

Classroom Format

The format of instruction will be divided between **lectures (theoretical concepts)** and **labs (practical aspects).** Students are required to study pre-lecture recording (https://canvas.uw.edu/courses/1720662/external_tools/21130) as well as lab videos (https://uw.hosted.panopto.com/Panopto/Pages/Sessions/List.aspx?embedded=0&isFromTeams=false#folderID=%22c4eca397-0372-4c91-b0b9-b13c01716b64%22) prior to the lecture time.

Logistics

Instructor: Shih-Chieh Hsu (http://faculty.washington.edu/schsu/) (schsu@uw.edu (mailto:schsu@uw.edu) office hours Monday 3:30pm - 4:30pm; PAB B213)

Teaching Assistant:
Daniela Koch (danikoch@uw.edu, office hours Wed 11:30am~12:30pm)
Jiayi Wang (jiayiw98@uw.edu, office hours TBA)
Murali Saravanan (msarav@uw.edu, office hours TBA)

Office hours survey: To optimize the Office Hours with instructors and TAs, please complete this survey by **Mar 29**. https://www.when2meet.com/?24276190-AgZFg (https://www.when2meet.com/?24276190-AgZFg)

Lecture (PAB A110): Mon 11:30pm~12:20pm
Lab Sessions (PAB B143):
Tue 1:30pm~4:20pm (A)
Wed 1:30pm~4:20pm (B)

Discord discussion: **https://discord.gg/Qy6zAqBB4F (https://discord.gg/Qy6zAqBB4F)**

- For the sake of communication and identification, please use your Full Name as the Display Name.

Credit: 3 credits, graded

Activities

To support the learning goal above, the following activities are incorporated into the course. For a detailed schedule, please see the syllabus table below.

(i) Fundamental Concepts (Canvas quiz - Individual)

To ensure that students gain a strong theoretical foundation, there will be a weekly canvas quiz with ~5 questions related to fundamental concepts discussed in the **lectures (https://canvas.uw.edu/courses/1720662/external_tools/21130)** . You will first fill in **your initial answers before the lecture session (due 11:59pm Sunday),** and **your final answers after the lecture (due 11:59pm Monday)**. This is intended to be an individual activity.

(ii) Hands-on Practice with Neural Networks (Lab report - Individual)

To introduce deep learning tools and their applications, students will work on a weekly lab assignment in the form of a GitHub report (**due 11:59pm Thursday next week)**. For each assignment, students will solve a particular problem by building and training a neural net. You are highly encouraged to experiment with your neural net architecture, as long as you follow the problem constraints. **Discussions with other students and usage of on-line tools are encouraged, but the final lab report "MUST" be your own work.** After report submissions, each student will grade 2 other students' reports (**due 11:59pm Monday next week**). Peer reviews help you to spot gaps in the code training, and give you the opportunity to learn from your cohorts.

(iii) Project (Application to data of choice - Team)

As a culminating project, students will form teams of two and apply the techniques studied in class to one of several real-world scientific datasets. The datasets for the project will be provided later in the quarter. Project submission will include a presentation and a short report in Jupyter Notebook. The weekly activities are summarized below:

Week	Sun 11:59pm	lecture quiz Due
	Mon 11:30am	lecture begins
	Tue 11:59pm	lecture quiz modification Due
	Tue/Wed 1:30pm	lab begins
	Tue/Wed 4:20pm	lab sign-off Due
Week+1	Thu 11:59 pm	lab report Due
Week+2	Thu 11:59 pm	lab peer review Due

Grading

Grading is divided between the three activities of the course:

(i) Fundamental Concepts (Canvas quiz - Individual, weekly): 20%

Each quiz is worth 10 pts and will be graded in two phases: your initial answers before the lecture discussion **(5pts, graded for completion)** and your final answers after attending the lecture discussion **(5pts).** Your lowest quiz score will be dropped. This activity will start from week 2. Your lowest lecture quiz score will be dropped.

(ii) Hands-on Practice with Neural Networks (Lab report - Individual, weekly): 40%

Each lab report is worth 10 pts and is evaluated on 1) Lab attendance **(1pt)**, 2) Code completeness/meeting the assignment goal **(4pts)**, 3) Code organization **(2pts)**, 4) Code documentation **(2pts)** and 5) Peer review **(1pt)**. Your lowest lab report score will be dropped.

(iii) Project (Application to data of choice - Team): 40%

Evaluated based on project presentation and report. More information will follow during the quarter.

Course Policies

Missing a lecture session

You won't be penalized for missing a lecture, but you will lose an opportunity to discuss the lecture quiz answers and lab reviews with the instruction team.

Late quiz submission

Initial answers - Any quiz question that is left unanswered, makes no sense or doesn't answer the question being asked is considered incomplete and won't receive a completion score.

Final answers - Only your final answers before the due date will be considered for grading. Modification to your answers after the due date will not be accepted.

Lab report guidelines

For tips regarding forming your lab report, see the **lab report guideline (https://canvas.uw.edu/courses/1720662/files/118278762?wrap=1)** .

Missing a lab session

Missing a lab session without approval from the instruction team will result in a **deduction of lab participation scores**. This may be waived if a student has special circumstances (e.g. feeling sick, personal/family emergencies, etc). If you believe such circumstances apply to you, you **must contact the instruction team before the lab session.**

Late lab report submission

We will deduct -2pts from the lab report score for each day late.

Schedule

Wk	Subject	Lecture discussions	Lab sessions	Report
1	Introduction to Neural Networks Methods, Feed Forward Networks	Intro to Neural Networks	Python review, Numpy, Matplotlib [video (https://uw.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=97db0c37-486a-4add-bd6b-b13e0131133b)]	Lab1 (ht
2		Machine Learning Practices and Problems	Introduction to PyTorch, Regression (https://canvas.uw.edu/courses/1720662/assignments/9221744)	Lab2 (ht
3		Deep Learning Practices	Training Fully Connected Neural Networks (FCN) for MNIST classification	Lab3 (ht
4		Convolutional Neural Networks	Training CNN for Fashion MNIST	Lab4 (ht
5	Sequence Models	Recurrent Neural Networks	Vanilla RNN, Natural Language Processing example (CharRNN)	Lab5 (ht
6		Data Analysis and Modeling of Sequences	Encoder/Decoder on temporal data	Lab6 ($CANVA
7		Data Analysis and Modeling of Sequences with Neural Networks	Transformer on Natural Language Processing	Lab7 (ht
8	Applications to Signals Data	• Particle Physics Data • Gravitational Wave Data • Lightening talk G01-G07 (https://docs.google.com/presentation/d/17icZasIcsMyYJ7-Tg_DJ0W3d8Eh6i0QN8Unwl0lVqp0/edit#slide=id.g222e13ff129_0_0)	Selecting and understanding the dataset for the project (Analysis, visualization, physical meanings, etc)	Lab8 (ht
9		• Analysis of Neural Recordings • Lightening talk G08-G14 (https://docs.google.com/presentation/d/1SA_gbqhTL2uW4-mwQsTQBPjJaEn9vdJ-p_YsLnqTZy0/edit?usp=sharing)	Selected project	Lab9 (ht

10	Student Poster	Memorial day (5/27) May 29 (Wed) 1pm~3pm	WRF Data Science Studio, 6th floor PAT	Poster (

Textbooks and Lecture Notes

There is no required textbook for this course. We will make lecture notes, slides, and examples used in class available. Additional references are listed below.

Python Programming

1. **Python Programming and Numerical Methods: A Guide for Engineers and Scientists** (https://pythonnumericalmethods.berkeley.edu/notebooks/Index.html) by Berkeley.

Deep Learning

1. ***Deep learning*** (https://www.deeplearningbook.org/) by Ian Goodfellow, Yoshua Bengio, and Aaron Courville (theory and concepts; available online)
2. ***Neural Networks and Deep Learning*** (http://neuralnetworksanddeeplearning.com/) by Michael Nielsen (concepts and examples; online book)
3. *Deep Learning with Python* by Francois Chollet (learning through examples; Keras)

Practical Deep Learning

1. **Machine Learning Yearning** (https://www.mlyearning.org/) by Andrew Ng (practical concepts; available online)
2. *Hands-On Machine Learning with Scikit-Learn and TensorFlow* by Aurélien Géron *(ML and Tensorflow)*
3. *TensorFlow Deep Learning Cookbook* by Antonio Gulli and Amita Kapoor *(cookbook examples)*

Machine Learning

1. ***A Course in Machine Learning*** *(http://ciml.info/)* by Hal Daume III (Introduction; available online)
2. *Machine Learning: A Probabilistic Perspective* by Kevin Murphy (Extensive text)

Accessibility

We endeavor to make the course welcoming and accessible to all students. Standard accessibility requests will be handled through DRS.

Accommodations for students with disabilities: In compliance with the University of Washington policy and equal access laws, the course Instructor is available to discuss appropriate academic accommodations that may be required for students with disabilities. Requests for academic accommodations are to be made during the first three weeks of the quarter, except for unusual circumstances, so arrangements can be made. Students are encouraged to register with Student Disability Services to verify their eligibility for appropriate accommodations.

Religious Accommodations: Washington state law requires that UW develop a policy for the accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (**https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/** (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/)). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (**https://registrar.washington.edu/students/religious-accommodations-request/** (https://registrar.washington.edu/students/religious-accommodations-request/)).

Other Policies:

COVID-19 Health and Safety:

EH&S has made a number of changes to the COVID guidelines to bring it up to date with the CDC recommendations. If you have any questions, please take some time to review the information found in the following links.

- COVID-19 Prevention and Response: **https://ehs.washington.edu/covid-19-prevention-and-response/covid-19-health-and-safety** (https://ehs.washington.edu/covid-19-prevention-and-response/covid-19-health-and-safety)
- Updated Flowchart: **https://ehs.washington.edu/resource/covid-19-public-health-flowchart-updated-21423-1175** (https://ehs.washington.edu/resource/covid-19-public-health-flowchart-updated-21423-1175)

Inclusivity Statement: We understand that our members represent a rich variety of backgrounds and perspectives. The University of Washington is committed to providing an atmosphere for learning that respects diversity. While working together to build this community we ask all members to:

- share their unique experiences, values, and beliefs
- be open to the views of others
- honor the uniqueness of their colleagues
- appreciate the opportunity that we have to learn from each other in this community
- value each other's opinions and communicate in a respectful manner
- keep confidential discussions that the community has of a personal (or professional) nature
- use this opportunity together to discuss ways in which we can create an inclusive environment in this course and across the UW community

Academic Misconduct:
It is essential that students in fulfillment of their academic requirements and in preparation to enter their profession shall adhere to the University of Washington's **Student Code of Conduct** (https://www.washington.edu/cssc/for-students/student-code-of-conduct/) . Any student in this course suspected of academic misconduct (e.g., cheating, plagiarism, or falsification) will be reported to the University's Office of Community Standards and Student conduct.

Student code of conduct applies to all mediums in which course activities are held (virtual lectures, discussion meetings, QA sessions, office hours, virtual discussions). In particular, the virtual discussion board is intended for questions and discussions exclusively related to course material. Anonymous posting is not supported and any offensive language toward students or course staff violates the student code of conduct and is to be reported to the Student Code of Conduct council. Communication is for constructive discussion of material and is not a replacement for QA sessions, lectures, and office hours. In particular, the discussion board is NOT intended for asking about problems in your code, Scheduling appointments, Sharing suggestions and impressions of course proceedings. For sharing feedback, we set up an anonymous feedback box and will appreciate any constructive feedback.

Course Summary:

Date	Details	Due
Sun Mar 31, 2024	Lecture Quiz 1 (https://canvas.uw.edu/courses/1720662/assignments/9221738)	due by 11:59pm
Thu Apr 4, 2024	Lab 1 Report (https://canvas.uw.edu/courses/1720662/assignments/9221743)	due by 11:59pm
Sun Apr 7, 2024	Lecture Quiz 2 (https://canvas.uw.edu/courses/1720662/assignments/9221739)	due by 11:59pm
Thu Apr 11, 2024	Lab 2 Report (https://canvas.uw.edu/courses/1720662/assignments/9221744)	due by 11:59pm
Sun Apr 14, 2024	Lecture Quiz 3 (https://canvas.uw.edu/courses/1720662/assignments/9221735)	due by 11:59pm
Thu Apr 18, 2024	Lab 3 Report (https://canvas.uw.edu/courses/1720662/assignments/9221745)	due by 11:59pm
Sun Apr 21, 2024	Lecture Quiz 4 (https://canvas.uw.edu/courses/1720662/assignments/9221740)	due by 11:59pm
Thu Apr 25, 2024	Lab 4 Report (https://canvas.uw.edu/courses/1720662/assignments/9221746)	due by 11:59pm
Thu May 2, 2024	Lab 5 Report (https://canvas.uw.edu/courses/1720662/assignments/9221747)	due by 11:59pm
Wed May 29, 2024	Poster presentation (https://canvas.uw.edu/courses/1720662/assignments/9221752)	due by 11:59pm