AI Training Program

Syllabus - Fall 2025

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Meetings

Lectures	Saturdays 2:00pm - 3:00pm	Social Sciences 139
Office Hours	Saturdays 3:00pm - 4:00pm	Social Sciences 139
Project Showcase	Saturday, Oct 25, 2pm - 3pm	Wilkinson 139

DAML AI Training Program Fall 2025 Overview

Overview:

Duke Applied ML's AITP (Artificial Intelligence Training Program) aims to equip undergraduate students interested in data science and machine learning with the necessary theoretical understanding and technical skills to deliver end-to-end projects.

The program will be **quarterly-long** and serve as an introductory overview of core AI concepts —- from data science, machine learning, NLP, computer vision, and LLMs.

The training program also involves a **final project**, referencing the content that you cover through the workshops.

Successful completion of both the workshops and the final project will give Junior Engineers a AITP certification that allows them to work on more advanced projects in DAML as a Senior Engineer.

Project:

A final project (that Junior Engineers propose). For each project, Junior Engineers will work together in groups of 3-4. Each group has 3 milestones to meet for their project before presentations.

There will be in-person work sessions with the team following project assignment (Saturdays 3-4pm, SocSci 139)

Syllabus

The first four weeks cover foundational machine learning & statistical learning concepts, while the latter half dives into core deep learning architectures & frameworks.

SYLLABUS NOT CURRENTLY UPDATE FOR THIS SEMESTER - WILL BE CHANGED SOON.

Schedule

Week

Date

Topic

Description

Location

1

Sat Aug 30

How Machines Learn

Gradient Descent & Loss functions Bias–variance tradeoff and structural risk minimization Hyperparameter tuning and CV Train–Test Splits Model evaluation Examples: Linear & Logistic Regression, K-Nearest Neighbors, SVM and Kernels

2

Sat Sep 06

Data Science Pipeline

Cleaning (esp. missing data) Encodings and Curse of Dimensionality Text processing Image processing EDA methods ROC analysis Pearson After Week 2 – Choose Your Final Project Track & Team Assignment

3

Sat Sep 13

Dimension Reduction and Clustering

Linear dimension reduction – PCA Manifold learning, MDS, Isomap Spectral clustering, t-SNE Clustering – k-means & EM

4

Sat Sep 20

Ensemble Methods and Boosting

Decision trees & information theory Random Forest, AdaBoost, XGBoost, GAMs

5

Sat Sep 27

Introduction to Deep Learning

Neural network architectures – feed-forward, fully connected etc. Nonlinearity – Activation functions & bias Universal Approximation Theorem Back-Propagation

6

Sat Oct 04

Convolutional Neural Networks

Convolutional Layers & Kernels Max Pooling Designing CNN architectures Applications in Computer Vision

7

Sat Oct 11

Recurrent Neural Networks & LSTMs

Motivating the RNN architecture Vanishing Gradient Problem LSTMs – Input, Forget, and Output gates Applications in NLP

8

Sat Oct 18

Transformers & LLMs

Motivating the Transformers architecture Semi-Supervised Learning & Fine-Tuning BERT & Applications of LLMs Logistics

Suggested Pre-Requisites:

We recommend prospective Junior Engineers to have the following programming experiences:

- CS101 or CS201 concurrently, or taken CS courses in high school (AP or not)
- Familiarity to code with Python
- Basic Understanding of Linear Algebra or Multivariable Calculus

Attendance:

Synchronously attend the workshop each week (in-person preferred, Zoom if they cannot attend the workshop in-person). If Junior Engineers miss a workshop more than 2 times without advance notice or reasonable cause, they'll be unable to receive full points for completing the program. Reasonable causes for not attending workshops are either a) an immovable conflict during the time of the workshop or b) sickness/serious personal matters.

Those who have permanent scheduling conflicts during the time of the workshop must notify the division leads when the training program starts, and can attend workshops asynchronously via recordings.

During any missed workshop, the Junior Engineer must read the slides for that week and fill out the AITP Makeup Form on the technical content which will be a Google Form posted on Slack.

Notice on Project Contribution:

Contribute meaningfully to their final project Project Managers will check in with their teams every week to monitor progress, talk about blockers, and check in regarding individual performance and participation. If a Junior Engineer is inactive for a sufficient period of time, they will be removed from their project team and AITP for that semester. At the end of the project there will be a peer evaluation of group contribution. Those who do not demonstrate meaningful contribution to the project group will not be able to receive the AITP certification.

Successfully complete final deliverables Final presentation Attend final poster presentation Junior Engineers will present their work to the rest of DAML, faculty members & (potentially) recruiters at a end-of-semester project showcase Attendance is mandatory (unless there's an immovable conflict) in order to receive credit for the project Pass a final exam Junior Engineers will complete a short final exam on AITP material A weighted score on both the exam and presentation will be calculated to determine placements into DAML Senior Engineer positions. In general, Junior Engineers who consistently attend AITP workshops every week and work 1-2 hours on their team project tend to become Senior Engineers.