Engineering Machine Learning Systems (3 credits)

Instructor

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Course Description

Engineering Machine Learning Systems are applied in an array of real-world applications. This course focuses on their conceptualization, estimation, computational implementation, and optimization. Topics supervised and unsupervised learning, linear and logistic regression, dimensionality reduction, regularization, neural networks, convolution neural networks, decision trees, and select additional deep learning topics.

Course Prerequisites

Basic probability theory, discrete math, simple calculus, linear algebra (preferred), and programming experience, particularly in Python, or equivalents.

Course Objectives

Upon completion of this course, students will be able to:
- Cast relevant real-world problems into engineering machine learning formulations
- Design and implement effective strategies for engineering, data science, and real-world problems
- Explain how machine learning concepts can be used to address engineering, data science and real-world problems
- Choose and optimize appropriate settings for machine learning algorithms
- Identify meaningful evaluation metrics to gauge expected performance
- Understand the ethical implications and mitigate human-based liabilities of engineering machine learning algorithms
- Understand connections between different fields and applications of engineering machine learning

This course will equip students with an engineering machine learning mindset that includes the underlying theories, principles, successful practice, analysis, and practical limitations.

Grading Policy

Grading Weighting

Assignments (written & computer)	35%
Three tests	35%
Participation	5%
Quizzes	5%
Project	20%

Assignment Instructions

You will post your completed assignments in your personal mailbox in Canvas. I will review and assess your work, enter feedback and a grade directly in the document you have submitted, and then post the updated document in your private mailbox.

Policy on Late Submissions

The regular assignment drop box closes on the submission date of an assignment. You will be able to submit your assignment to a late submission drop box. However, the late submission will result in a 50% penalty. Assignments that are more than one week late will not be graded. Exceptions may be made for valid excuses such as illness or a work crisis. The exceptions are on a case-by-case basis.

Resources

- See [CANVAS@UD](#) for comprehensive list of resources: lecture materials, resources (primary and secondary textbooks), computing resources, syllabus, assignments, etc.

Computing Resources

1. [Welcome To Colaboratory - Colaboratory](#)
2. [Project Jupyter | Home](#)
3. [GitHub: Where the world builds software · GitHub](#)

Require Textbooks

1. Pattern Recognition and Machine Learning (**ML**)

a. Christopher Bishop
   b. Springer, 2006
   c. ISBN: 978-0-38731-073-2
   d. Online freely available: [Christopher Bishop at Microsoft Research](#)
2. Book 0: Machine Learning: A Probabilistic Perspective (**B0**)
   a. Kevin Patrick Murphy
   b. MIT Press, 2012
   c. ISBN: 978-0-262-01802-9
   d. Online freely available: [Machine Learning: a Probabilistic Perspective](#)
3. Book 1: Probabilistic Machine Learning: An Introduction (**B1**)
   a. Kevin Patrick Murphy
   b. MIT Press, 2022
   c. ISBN: 978-0-26204-682-4
   d. Online freely available: [Probabilistic Machine Learning: An Introduction](#)
4. The Elements of Statistical Learning: Data Mining, Inference, and Prediction (**SL**)
   a. Trevor Hastie, Robert Tibshirani, Jerome Friedman
   b. Second Edition
   c. Springer Series in Statistics, 2009
   d. ISBN: 978-0-38784-857-0
   e. Online freely available: [Elements of Statistical Learning: data mining, inference, and prediction. 2nd Edition.](#)

Secondary Textbook Resources

1. Book 2: Probabilistic Machine Learning: Advanced Topics (**B2**)
   a. Kevin Patrick Murphy
   b. MIT Press, 2022
   c. Online freely available: [Probabilistic Machine Learning: Advanced Topics](#)
2. Introduction to Machine Learning (**IML**)
   a. Ethem Alpaydin
   b. 4th edition
   c. The MIT Press, 2020
   d. ISBN: 978-0262-04379-3
3. Deep Learning (**DL**)
   a. Ian GoodFellow, Yoshua Bengio and Aaron Courville
   b. MIT Press, 2016
   c. ISBN: 978-0-262-03561-3
   d. Online freely available: [Deep Learning Book](#)
4. Python Data Science Handbook – Essential Tools for Working with Data (**PDS**)
   a. Jake VanderPlas
   b. O'Reilly Media, 2016
   c. ISBN: 978-1-491-91205-8
   d. [Python Data Science Handbook | Python Data Science Handbook](#)

  e. Online freely available, including GitHub and colab
5. Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2 (**PML**)
  a. Sebastian Raschka and Vahid Mirjalili
  b. 3rd Edition
  c. Packt Publishing, 2019
  d. ISBN: 978-1-789-95575-0
6. Python Machine Learning By Example: Build intelligent systems using Python, TensorFlow 2, PyTorch, and scikit-learn (**PME**)
  a. Yuxi (Hayden) Liu
  b. 3rd Edition
  c. Packt Publishing, 2020
  d. ISBN: 978-1-800-2097-1
7. A Whirlwind Tour of Python (**WP**)
  a. Jake VanderPlas
  b. O'Reilly Media, 2016
  c. ISBN: 978-1-491-96465-1
  d. [A Whirlwind Tour of Python | A Whirlwind Tour of Python](#)
  e. Online freely available, including GitHub

Advanced Automated Tools in Coursework and Assignments

Advanced automated tools – artificial intelligence or machine learning tools such as [ChatGPT](#) or [Dall-E 2](#) that are sometimes described as "generative" or "autogenerative" tools – use sophisticated technology and very large data sets to create realistic writing, images, or other artifacts in response to natural language queries and prompts. They are very easy to use and some of their output is very difficult to distinguish from human-generated material.

Use only with acknowledgement

Students are allowed to use advanced automated tools (artificial intelligence or machine learning tools such as ChatGPT or Dall-E 2) on assignments in this course if that use is properly documented and credited. For example, text generated using ChatGPT-3 should include a citation such as: "Chat-GPT-3. (YYYY, Month DD of query). "Text of your query." Generated using OpenAI. https://chat.openai.com/" Material generated using other tools should follow a similar citation convention.

Academic Honesty and Plagiarism

Students at the University of Delaware are expected to be honest and forthright in their academic endeavors. It is the official policy of the University of Delaware that all acts or attempted acts of alleged academic dishonesty be reported to the Office of Student Conduct for disposition within the University Undergraduate Student Conduct System. To understand the forms of academic

dishonesty and how to proactively practice academic integrity, visit the following link from the Office of Student Conduct: [Welcome! | Office of Student Conduct](#).

Netiquette

Online communication can pose challenges in being understood properly. Without facial expressions, intonation, and body language, messages can be misconstrued. Netiquette refers to appropriate online discourse. Academic debate and differences are embraced in higher education and in this course. You can learn more about netiquette in the video linked [here.](#)

University Disability Accommodations

To request an accommodation for a disability, contact the Office of Disability Support Services (ODSS) office as soon as possible.

Phone: 302-831-4643
Email: dssoffice@udel.edu
Website: www.udel.edu/DSS
Fax: 302-831-3261
Source: http://www.udel.edu/DSS/resources_helping.html

Tech Support

Canvas Technical Support and Computer Technical Requirements

For all your courses in your program, you will use a Learning Management System called Canvas. Canvas runs on Windows, Mac, Linux, iOS, & Android or any other device with a modern web browser. For more detailed information, visit the [Computer Specifications](#) page.

Technical assistance related to the Canvas learning management system is available:

askIT@udel.edu
(302) 831-6000
 www.it.udel.edu/

Supported Browsers

Canvas ™ supports the two latest versions of the following browsers:
- [Mozilla Firefox](#)
- [Chrome](#)
- [Edge](#)
- [Safari](#)

Other Browser Requirements

- Javascript Enabled
- For more information, visit [Which browsers does Canvas support?](#)

Mobile Canvas™ Application

There is also an app form of Canvas™ for iOS and Android platforms, which facilitates mobile access to most, but not all, course components. If you would like to use the app to supplement computer access, be aware of some of its limitations (e.g. unable to submit some work).