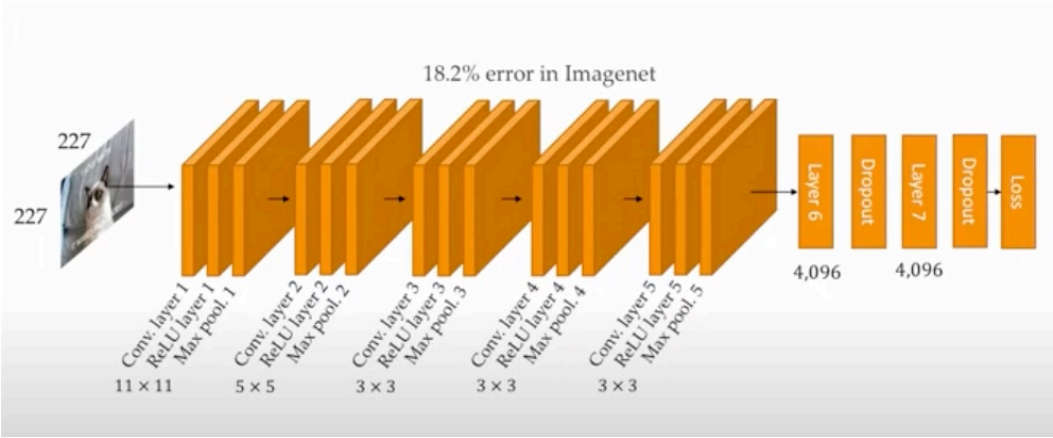
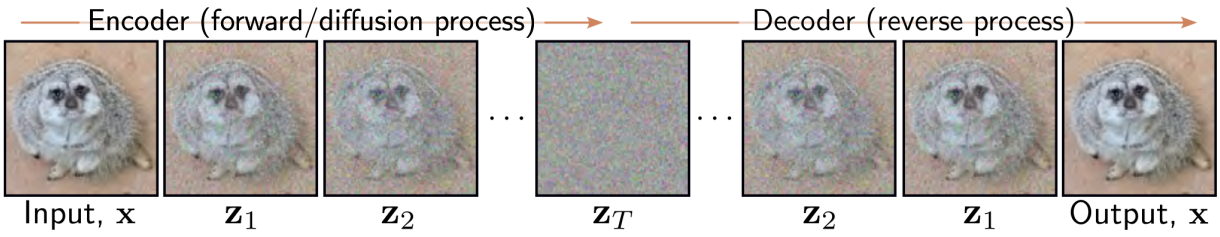
MATH 462, Fall 2023

Honours Mathematics for Machine Learning,





Class information

Professor: Adam Oberman

Class: Tuesday and Thursday, 11:35 am-12:55 am

Office Hours (Fall 2023): Tuesday and Thursday after class, 1:05 pm-2:00 pm BURN 1106, and by appointment.

- Course material: https://adam-oberman.github.io/
- Assignment submission: https://mycourses2.mcgill.ca/

Audience:

Math and Stats Majors or Honours students, Computer Science students. The course material will be more accessible to majors than in previous years.

Prerequisites

- Prerequisites: MATH 236, MATH 247, MATH 251, or equivalent. MATH248, MATH 314, or MATH 358.
- *Note:* Math 324/Math 357 (Statistics) is not needed for this course.

Course Webpages

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Grading

- 5/6 HW assignments (theory and code): 25%
- Project: 20%
- Participation (project presentation/feeback on projects): 5%.
    - Attendance: 5%
- Final exam: 45%

Course Description:

A mathematically motivated introduction to machine learning.

This introductory course will begin with putting AI and Machine Learning in context. We will cover basic models (decision trees, Bayes) with concrete examples to build intuition. Then we will go into linear classification and losses used in deep learning. We will provide an elementary introduction to generalization theory (overfitting). We will also go into unsupervised learning.

The goal of the course is to provide an understanding of those aspects of machine learning which are important for current AI models. The math and coding levels will be as simple as possible while still keeping the main ideas.

Course Topics

- Introduction to machine learning and AI
- Introduction to supervised learning: decision trees, nearest neighbors, linear models, neural networks
- Probabilistic Learning: logistic regression, bayesian methods (e.g. naive bayes for text classification)
- Convex losses, Linear Models
- Deep Neural Networks
- Unsupervised Learning: PCA, k-means, Encoders and decoders
- Learning theory: PAC learning and VC dimension
- Advanced Topics (chosen from): generative models, representation learning, features, computer vision, reinforcement learning.

Key Dates

https://www.mcgill.ca/importantdates/key-dates#Fall_2023

- Classes begin: Thursday August 31st
- Fall Reading Break: Friday, October 6 to Wednesday, October 11 inclusive
- Classes end: Tuesday, December 5
- Makeup Days: Thursday, November 30 (no class: monday schedule)

Related Courses

- COMP 451 Fundamentals of Machine Learning (offered fall 2023 by Prof Siamak Ravanbakhsh). Mutually exclusive.
- Math 308 Fundamentals of Statistical Learning (offered Winter 2024 by Prof Yi Yang)
- COMP 551 Applied Machine Learning
    - A complementary course, focused on implementation.

Code

- Coding will be in Python/Numpy using Collab or notebooks
- We will provide code to work with for assignments

Textbooks

Instructor notes based on textbook sections, e.g.:

- Introduction to Machine Learning by Ethem Alpaydin [EA]
- A Course in Machine Learning by Hal Daumé III http://ciml.info/
- https://mml-book.github.io/