Introduction

IN 3310/ IN 4310 — Deep Learning for Image Analysis

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University of Oslo

Plan for today

- Information about the course
- Information about exercises, exams and Python/PyTorch
- Lecture on linear regression, generalization, linear model geometry

Introduction to the course

Lecturers

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Overview

Lectures

- Machine learning
- Deep learning and image analysis
- Getting deep learning to work in practice
- Applications

Groups

- Pytorch Exercises and Theory exercises
- Exercises on image classification, image captioning, image segmentation
- Students get time-limited access to GPU-servers at USIT for the two mandatory exercises (around 23.2-17.3 and 7.4-28.4)

Schedule

Lectures

- Thursday 14.15-16.00, zoom until including 16th of March**. From 23rd of March physically in the Seminarrom Caml. Reason: Alex is adjunct, lives quite far outside of Europe.

Mandatory exercises

- 2 Mandatory exercises, in PyTorch, UiO will provide cluster machines with shared GPUs for those for some time.

Groups

- Mondays 14.15-16.00
- Physically in OJD, Datastue Assembler
- Group lecturers:
  mostly James B. Claxton – jamesbc@ifi.uio.no, sometimes Ghadi al Hajj – ghadia@ifi.uio.no

Exam

- Exam: focus on understanding the topics
- 4 hours duration written exam.
- 15th June 2023, 9 AM , Silurveien 2 Sal 4D

Who is this course for?

- Core focus: Bachelor and Master students working on image analysis problems using deep learning
- You should feel comfortable to code in python. Not recommended if one has very little knowledge of python and is not a quick self-learner for python.
- This is not an introductory course to ML, neither to python
- Fundamental knowledge in machine learning assumed (what is the aim of ML, what is generalization, having seen machine learning models, how to use data) even though it is briefly repeated.
- Will be useful for others with a good background in Python and linear algebra wanting to learn deep learning
- Demanding programming exercises: highly suggested to do all of them!
- Learning is about loss functions and derivations - you are expected to do calculations
- Expertize wanted for many companies - good job prospects, but getting good results is tough – your motivation must be high!

Required background

- Good knowledge in Python programming
- Good knowledge in mathematics (as a tool)
  - Linear algebra: vectors, matrix operations, dot products
  - Derivatives of loss and other functions
  - probability: expectations, conditional probabilities of n variables
  - Basic optimization (gradient descent)
- suggested to have an understanding of machine learning (e.g. from a previous course)

Prelimary schedule

- 26.1 Introduction, Linear models
- 2.2 Softmax, Logistic regression, Cross-entropy loss, Densely connected neural nets
- 9.2 Convolutional nets (CNNs)
- 16.2 Recap on Gradient Based learning, Chain rule, Back propagation, initialization
- 23.2 CNN Architectures I, fine tuning - planned mandatory 1 release
- 2.3 Performance estimation and robustness
- 9.3 Optimizers, tricks of the trade for training
- 16.3 Data Augmentation, CNN Architectures II - mandatory 1 submission
- 23.3 tba slot
- 30.3 Recurrent nets (RNNs)
- 7.4 – planned mandatory 2 release
- 13.4 Adversarial Attacks on deep learning and Defenses
- 20.4 Segmentation
- 27.4 Object Detection – mandatory 2 submission
- 4.5 Explaining neural network decisions (gradient, guided backprop, LRP)
- 11.5 Attention, Transformers
- 25.5 Repetition / Bonus Topic
- 15.6 Exam

Curriculum

- Lecture notes, weekly exercises, and mandatory exercises define the curriculum
- The field is rapidly changing so that we wont stick to a book
- Links to useful notes and online lectures will be given.

Course resources

- Course web page:
  `https://www.uio.no/studier/emner/matnat/ifi/IN3310/v23/index.html`
- No book closely followed, but links to relevant literature/notes given, see:
  - `http://d2l.ai` for a free online book
  - `http://neuralnetworksanddeeplearning.com/` for the first 3 lectures as soft intro into the basic topics
- Links to relevant online lectures given for each week
- Devilry for submitting mandatory exercises
- Exam: focus on understanding the topics. 4 hours duration written exam.

Web page

- `https://www.uio.no/studier/emner/matnat/ifi/IN3310/v23/index.html`
- Lectures with links to lecture slides / pdf writeups, curriculum, weekly exercises, and mandatory exercises.
- Messages on the web page

Communication within IN3310/4310

- course website
- mattermost team for IN3310/IN4310
- Urgent messages and zoom links emailed to studenter.in3310@ifi.uio.no and studenter.in4310@ifi.uio.no. Links to your official uio-email - read this email regularly!

Zoom rules

This applies to the zoom lectures only:

- Be mindful that it is a recorded lecture. If you feel not comfortable to raise voice questions due to the recording, please write in the zoom chat (which will not be recorded, optimal place for curses). The recording will be paused during the 10-15 mins break after 45 mins.

Mandatory exercises

- Required: use Python and PyTorch
- Exercise 1: implement training with finetuning for a medium size prediction problem (a few thousand images, not millions), available around 23th Feb, Deadline: 17th of March 2023 23:59.
- Exercise 2: (tentative topic, might change) Image captioning in PyTorch using a pretrained CNN and a Recurrent network, available around 6th April, Deadline: 28th of April 2023 23:59.
- Mandatory exercises are individual work, and the solution should be your own code. In order to not preempt an expected coming university policy, using chatGPT and the like is not allowed for the mandatory exercises.
- Plagiarism on mandatory exercises can be sometimes an issue at IFI, and the consequenses are severe.
- You are required to read the regulations at https://www.uio.no/english/studies/examinations/compulsory-activities/mn-ifi-mandatory.html
- Master-students: one extra task in the mandatory exercises

Groups first week

- First group Monday 30.1 14.15-16.00
- tutorial for pytorch + exercise to get familiar with pytorch (matrix multiplication)
- Download zip-file with exercises

Using python3 and pytorch

- Install python3, pytorch, matplotlib, numpy on your own computer (Windows: anaconda, Unixes: many options)
- Later in the course: access GPUs on servers

Questions?