Introduction

IN 5400/ IN 9400 — Machine 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 (from February)

Schedule

Lectures

- Tuesday 14.15-16.00, zoom (digital only) until including 15th of March at least. Reason: 97 students sign up, room allows for 41 at most.

Mandatory exercises

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

Groups

- Wednesdays 12.15-14.00 or Fridays 14.15-16.00
- Physically planned from 02 Feb - 15 persons max each time! – OJD, Datastue Fortress
- Group lecturers:
  Ghadi al Hajj – ghadia@ifi.uio.no
  James B. Claxton – jamesbc@ifi.uio.no
- zoom group session Fridays 16.30-18.00 (Alex) for all those who cannot join the physical ones

Schedule

Groups

- Physically planned from 02 Feb - 15 persons max each time! – OJD, Datastue Fortress
- How to sign up for the physical sessions? Announce intention every week in the mattermost channel "Signup for the physical group session of the week: Wednesday" and "Signup for the physical group session of the week: Friday" - with writing your first name and last name.
- signups are only valid for a week from Sunday 20:00 Oslo time (no grabbing of slots weeks ahead!). Cut-off date is the day before the group session 23:59 Oslo time

  First 15 students can come for each slot. The rest can join the zoom group session (see below). Retract your signing up if you changed your mind.
- if one of the physical sessions has by mattermost signups a count of ≤ 8 in one week, then we convert the first class, to which this applies, to a digital one – for this one week only
- if one of the physical sessions has over weeks ≤ 5 in practice (means the signups are not real), this will happen as well for one lecture but not both
- zoom group session Fridays 16.30-18.00 (Alex) for all those who cannot join

Exam

- Exam: focus on understanding the topics
- 4 hours duration written exam.
- end of may or beginning of June

Who is this course for?

- Core focus: Master and PhD students working on image analysis problems using deep learning
- You should feel comfortable to code in python. Not recommended if one has no knowledge of python and is not a quick self-learner for python.
- This is not an introductory course to ML
- Fundamental knowledge in machine learning assumed (what is the aim of ML, what is generalization, having seen machine learning models).
- 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
  - Derivation of loss functions
  - probability: expectations, conditional probabilities of n variables
  - Basic optimization (gradient descent)
- suggested to have a first understanding of machine learning (e.g. from a previous course)

Prelimary schedule

- 18.1 Introduction, Linear models
- 25.1 Softmax, Logistic regression, Cross-entropy loss, Densely connected neural nets
- 1.2 Convolutional nets (CNNs)
- 8.2 Recap on Gradient Based learning, Chain rule, Back propagation, initialization
- 15.2 CNN Architectures I, fine tuning
- 22.2 Data Augmentation, CNN Architectures II
- 1.3 Optimizers, tricks of the trade for training
- 8.3 Robustness, cohort overfitting
- 15.3 Adversarial Attacks on deep learning and Defenses
- 22.3 Recurrent nets (RNNs)
- 29.3 Segmentation
- 5.4 Object Detection
- 19.4 Explaining neural network decisions (gradient, guided backprop, LRP)
- 26.4 GANs I (classic GAN, Wasserstein GANs)
- 3.5 GANs II (Progressive Growing, Style GAN), attention models
- 10.5 Repetition / Bonus Topic
- End of May or early June: 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/IN5400/v22/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. Not 100% sure whether at home or in Silurveien.

Web page

- https://www.uio.no/studier/emner/matnat/ifi/IN5400/v22/index.html
- Lectures with links to lecture slides / pdf writeups, curriculum, weekly exercises, and mandatory exercises.
- Messages on the web page

Communication within IN5400

- course website (no zoom links here except the first – trolls)
- mattermost team for IN5400/IN9400: `https://mattermost.uio.no/ifi-in5400/`
- Urgent messages and zoom links emailed to studenter.in5400@ifi.uio.no and studenter.in9400@ifi.uio.no. Links to your official uio-email - read this!

Zoom rules

Questions:

- during lecture: Voice questions are not allowed – due to recording vs. data protection laws. Raise hand or write in chat.
- during unrecorded time in the break: voice questions are allowed

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 15th Feb, Deadline: 28th of February 2022 23:59 (two weekends in between).
- Exercise 2: (tentative topic, might change) Image captioning in PyTorch using a pretrained CNN and a Recurrent network, available around 29th March, Deadline: 18th of April 2022 23:59 (three weekends in between).
- PhD-students: Mandatory essay in addition to mandatory exercises
- Programming exercises are individual work, and the solution should be your own code.
- 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

Groups first week

- First group Wednesday 26.1 12.15-14.00 and Friday 28.1 14.15-16.00 (zoom only in this week)
- tutorial for pytorch + exercise to get familiar with pytorch (matrix multiplication)
- Download zip-file with exercises

Using python3 and pytorch

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

Questions?