Course: DD2424 - Information about the project and some project ideas

Teachers and TAs of DD2424 2020

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Due to the current virus situation, a few of you might find it especially hard to work in groups. However, we really do not have the man-power to examine many one person projects. So we have put on some restrictions to those who go for this option. We feel that the team nature of the project is an important part of the learning experience as 1) it helps you get better at collaboration, 2) lets you learn from your peers, 3) helps you pass on your skills to your group and 4) you can just get more done when you are several people working together. And thus the group project option is the one we want students to take if at all possible. In the following we will describe the restrictions imposed on the one person projects Vs the multi-person groups.

1 Special Project Area: COVID-19 Detection/Recognition

Work on detecting and/or recognising COVID-19 using x-ray images. Researchers are currently gathering x-ray images from COVID-19 patients and making them publicly available COVID-19 image data collection and some initial results have already been reported about using deep learning methods to perform recognition and predictions:

- Rapid AI Development Cycle for the Coronavirus (COVID-19) Pandemic: Initial Results for Automated Detection & Patient Monitoring using Deep Learning CT Image Analysis by Ophir Gozes et al
- Deep Learning System to Screen Coronavirus Disease 2019 Pneumonia by Xiaowei Xu et. al

It would be fun and potentially useful if we could get several groups working on this problem and thus potentially make significant progress especially if there is some form of high-level coordination between groups facilitated by the TAs. The latter could allow for the sharing of code for generic tasks such as dataloaders etc. and ensuring the groups working in the area are not all running exactly the same experiments. If a sufficient number of students/groups are interested in working on this problem then we could help coordinate the effort and perhaps help assign sensible projects.

Groups working on this project would have to produce all the same material as other groups, the only difference is that there would be some coordination between groups when deciding what experiments to run, networks to train etc.

2 One-person project

This option is really only meant for people who for very valid reasons[1], such as underlying health conditions, think it will be too difficult and stressful to collaborate remotely with other students. As we are not going to get you to ask our permission to complete a one-person project, we have attached a cost to choosing this option to help dissuade most of you from choosing if it is merely inconvenient for you to work in groups. The restriction is that you can only choose from a couple of project proposals. The project proposals are:

- Join the COVID-19 detection/project umbrella group. Note this could be potentially be quite challenging especially if you do not have much deep learning experience and/or not experienced with software development. So please be realistic in your assessment of your strengths and deciding if this
- **Paper**: Unsupervised Representation Learning by Predicting Image Rotations by Spyros Gidaris, Praveer Singh, and Nikos Komodakis, ICLR 2018.
  - **Main high-level idea**: You want to train a classification ConvNet using unlabelled images. You can, however, automatically generate a labelled dataset from the unlabelled one for some auxiliary task. In this paper the auxiliary task is to predict the rotation applied to an image. So during the *unsupervised training* phase an image is rotated by a known amount and then a ConvNet is trained (from a random initialization) to predict the rotation applied to the image. After training a ConvNet in this fashion, a small subset of training images labelled with the labels for the task you actually want to predict is used to upgrade and fine-tune your trained ConvNet to solve the prediction task of interest (image classification). The paper shows this simple unsupervised training approach can be quite effective.
  - **Basic project**: A re-implementation from scratch with a standard modern ConvNet such as a variation of a VGG, ResNet and then trained on `CiFAR-10`, `CiFAR-100` and/or `tiny_imagenet.zip`.
- **Paper**: Distilling the Knowledge in a Neural Network by Geoffrey Hinton, Oriol Vinyals, and Jeffrey Dean, NIPS Deep Learning and Representation Learning Workshop (2015)
  - **Main high-level idea**: Have a high-capacity well-trained network. Train a simpler network (from a random initialization) to match the probabilities output by the high-performing network for each training image as opposed to its one-hot encoding. Paper shows this approach allows the simple network to reach a better accuracy than a network trained on the images with one-hot encoding labels.
  - **Basic project**: Download a high-performing ConvNet and then use knowledge distillation to train from scratch a simpler and shallower network. Compare the knowledge distillation trained network to the same network trained conventionally. Apply idea to any image classification dataset.

[1]The reason "*I work better individually than in groups*" in our eyes is not a compelling one and selfish in the current circumstances. Before choosing the option please think of the extra cost you are putting on us. I have been very generous is allowing almost all students who wanted to take the course join the course. But I have finite resources and the COVID-19 situation has made working conditions much more challenging and time inefficient.

Please note also it will be a big effort for one person to complete and produce all the material required for a project. So choosing this option is not an easy one.

3 Group project