MLP Group Project Guide 2019/2020

1. Preface

This document contains guidelines and ideas for designing a semester 2 project for the MLP course. The listed ideas are non-exhaustive, and in no way do they represent the space of possible projects. They are merely a tool provided to you, so you can create your own project, by simply combining the provided tips and ideas. You can see this project as an opportunity to apply what you learned in the class to a problem of your interest.

2. Choosing your group

Semester two will be based on group projects.

- Each group should consist 2-3 students. Note that it is not allowed to have more than 3 people and not recommended to do the project alone. We are expecting projects to have the amount of work from a 2-3 person group while marking. Also interacting with your team is an important experience.

- You can discuss any aspects of the assignment with your group and divide up the tasks any way you like. Note that best projects happens when the team collaborates on each part.

- You can use Piazza "Search for Teammates" to help form a group – but make sure you use the MLP Piazza for Semester 2 (`www.piazza.com/ed.ac.uk/spring2020/infr11132`).

3. Choosing your project

Your first task is to pick a project topic. If you don't have an interesting project idea yet where you can apply deep learning techniques, you might want to have a look at the publications from previous years and example projects from other courses. Here are some examples:

- Machine learning conferences: ICLR, NIPS, ICML.

- Computer vision conferences: CVPR, ICCV.

- NLP conferences: ACL, EMNLP

- Speech conferences: ICASSP, Interspeech,

- Challenges: Kaggle,

- Projects from other courses: Stanford CS229, CS231.

To get a better feeling for what we expect from MLP group projects, we encourage to take a look at the example project reports from previous year:

- G008 - Audio Super-Resolution with Generative Adversarial Networks

- G045 - Image deconvolution with deep image prior

- G056 - Does adversarial training generalize across adversaries?

- G060 - Generative Audio Inpainting in the Frequency Domain

- G065 - Forging the Perfect Recognition

- G085 - 3D Shape Reconstruction from Two View Images

- G109 - Reinforcement Learning with Neuroevolution

Most students do one of three kinds of project.

3.1. Application project.

This is by far the most common type. It involves applying an existing method to an interesting application.

1. Choose a dataset with an interesting task in mind (e.g. image/video/document classification, image/audio generation (GANs), translation,

2. Identify a state-of-the-art method for your task (see the conference links above) and apply it to the dataset, evaluate its performance,

3. This method is now your baseline. Investigate its architecture/setup and aim to improve its performance in terms of an appropriate metric (e.g. classification accuracy, BLEU score, convergence speed, memory consumption). This can be done via exploration of architectures, data augmentation strategies, loss functions, optimization techniques and/or regularization methods.

Here are some example abstracts from the previous year's project reports that fall into this group:

- Speech/audio project example: Audio super-resolution with Generative Adversarial Networks.

- Computer vision project example: 3D Shape Reconstruction from Two View Images.

- NLP project example: Forging the Perfect Recognition.

3.2. Analysis project.

It involves analysing certain aspects of a family of methods which has not been explored before. This requires critical understanding of existing methods and usually a rigorous experimentation to analyse the influence of several factors in terms of performance.

1. Choose an interesting method/learning paradigm,

2. Read related papers from recent conferences (tip: once a paper is picked, use google scholar to find related papers; other recommended alternatives are Semantic Scholar, and Papers with Code),

3. Identify the strengths/weaknesses of the existing methods,

4. See whether the existing methods have been compared to each other on a fair basis (using similar experimental procedure, similar network architecture, hyperparameters are well-tuned for all the methods), whether the comparison still holds when applied to different datasets (indoor/outdoor images, English/French documents) or when the data is varied (e.g. low/high resolution images) or when a more meaningful evaluation metric is chosen (BLEU/CIDEr).

5. Choose the appropriate research question,

6. Compare the methods in a rigorous experimental setting and analyze them.

Analysis project example: Does adversarial training generalize across adversaries?

3.3. Algorithm project.

It involves developing a new learning method or a novel extension to an existing method and experimentally demonstrating that the proposed method is superior to the existing method. This is typically *significantly harder* than the other project types and requires good knowledge of the field and critical understanding of existing methods.

1. Choose an interesting method/learning paradigm,

2. Read related papers from recent conferences (tip: once a paper is picked, use google scholar to find related papers),

3. Identify the strengths/weaknesses of the existing methods and try to propose a new idea that can address the weakness of a method while maintaining its strengths.

4. Evaluate its performance and compare to the existing methods.

Algorithm project example: Image deconvolution with deep image prior

Note that some projects can also combine elements of different types.

4. Tutorials

Next semester we will have weekly lectures on advanced topics in deep learning by the course instructors and also by the industry people. Differently from the first semester, we will run weekly tutorials where you can discuss the progress of your project with a tutor. Each project group will be assigned to a tutor, who will discuss and review progress. We strongly encourage each project group to set up an Office 365 Doc for the group (shared with the tutors and instructors). This will be used as a communication channel between your group and tutor to report progress and experimental results, give plans, raise questions.

We understand that you might find it hard to choose a project and overwhelmed by the possibility of too many interesting topics or deciding whether the topic is good enough or too ambitious for the MLP project. We strongly encourage you to discuss about designing or evaluating the difficulty/feasibility of a project with your appointed tutor.

In addition, we will also use a new Piazza for next term (`www.piazza.com/ed.ac.uk/spring2020/infr11132`). Please keep using Piazza to ask and answer questions, search for teammates, etc. Note that there will be no scheduled labs in next semester.

5. IBM prizes

IBM UK kindly sponsor a prize for the best project in MLP. Once the final reports are marked, a committee including the instructors, TAs, 2 external academics from Informatics will shortlist the best 6-7 projects and select a winner. We'll announce the short list of projects for the IBM MLP Prize and have a prize giving event in late April. At the event each of the short-listed groups will be invited to give a short talk about their work and IBM UK will present the award (and also tell us why IBM are interested in this).

6. Frequently asked questions

- **When should I start working on the project?** You are not expected to start work on your project until the second semester but it is a good idea to think of what project topic you would like to work on and to find group members.

- **Is it ok to have my group project in the same topic with my dissertation project?** The group project needs to be different such that there is no issue of work done in the MLP project appearing as a contribution in your dissertation and you must also cite the group project report (maybe add your project report to the appendix of your dissertation).

- **What are the deadlines for the coursework in next semester?** The deadlines for cw3 and cw4 are at 16:00 on Thursday 13 February 2020 and Friday 20 March 2020 respectively:

  - Cw3 (Interim report) will not be marked and be only for feedback purpose. A good interim report should include motivation and introduction to the project, research goals, details of dataset and task, first phase of experiments, any interim conclusions, pan for the remainder of the project, including discussion of risks, backup plans.
  - Cw4 (Final report) will be marked and worth 50% of your total mark. A good report should include a brief introduction, including a reprise of the aims and objectives, details of the data and the task, experiments, methodology, results, discussion and interpretation, conclusions with respect to aims and objectives, research questions.

- **What are the computational resources that I can use?** We will use the MLP server in next semester that hosts several Nvidia GTX1060's which has 6GB memory. While these GPUs are suitable for many deep learning projects, many state-of-the-art deep methods use very deep and wide neural networks (e.g. ResNet101) and are trained on big datasets (e.g. ImageNet). We will have a lecture and provide a detailed guide about it early next semester.

- **Do we have to use PyTorch or TensorFlow?** No, you can use your favorite deep learning library such as Keras, MXNet, OpenAI Gym, etc.

- **Can this be part of my dissertation project?** No, it should be completely separate.

- **Are there any good resources to learn how to write good papers?** Yes, see the links below:

  - https://old.reddit.com/r/MachineLearning/comments/85cwiu/d_wellwritten_paper_examples/
  - https://cs.stanford.edu/people/widom/paper-writing.html
  - http://karpathy.github.io/2016/09/07/phd/

- **Can I use a company dataset which is not publicly available?** Depends. There should be no problem with using company data as long as (1) the company is happy for them to use the data, and to write about it in their report; (2) the data is available (make sure that you can get access to the data timely, experience tells me that the estimated duration between a company promising data and actually providing the data can be unbounded); and (3) you need to consider ethical issues if the data contains any personal information. For (3) you have to go through the ethics procedure if either the data contains any sort of personal information or if the date involves employing people in any stage of the process (e.g. subjective evaluation).