Ingredients for a successful mini-project report

THEORIES OF DEEP LEARNING: C6.5,
LECTURE / VIDEO 16
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Select one of the following general areas and write a report on a specific subtopic within one of the areas:

1. List to be released later in the term, tentatively Friday Week 7, due Thursday of Week 10.

Your report must include a discussion of some theoretical portion of deep learning along with numerical simulations selected to highlight the issue being investigated and a discussion of how the numerical simulations reflect on the issue. Your numerical simulations should be novel in some regard; e.g. data set, architecture parameter choices, training algorithm, etc... Ensure that your report has as its focus a theoretical issue rather than an application of deep learning.

Deep learning is a rich topic under intense investigation. Two of
the main venues for original research in this topic are the Neural
Information Processing Systems (NeurIPS) conference and the
International Conference on Machine Learning (ICML).
Proceedings for these conferences are available at
`https://papers.nips.cc` for NeurIPS and
`http://proceedings.mlr.press` for ICML (Volume 97 for ICML
2019) as well as other conferences on machine learning. You are
encouraged to select a topic and starting point for your report by
perusing these proceedings papers and selecting an article to your
liking.

Your report should be in the format and style of a NeurIPS Proceedings, abridged to not exceed 5 pages of text and graphics and 1 page of references (for a total length of not more than 6 pages). LaTeX style files and an example template are provided on the course page. Clearly indicate any ideas in your report which are your own and give appropriate attributions for all references (including research articles, software, data sets, etc....). Your report need not contain original research results, though you must use some original research articles as references (not just review articles or books). You should include a high level description of the code used to generate your numerical simulations, but should <u>not</u> submit the entire code; description of the code should not exceed one page of the report.

- ▶ Your topic must focus on a theoretical aspect of deep learning, by this we mean not focusing on an application/dataset.

- ▶ Most topics benefit from code to explore the issue being discussed. It is <u>much</u> easier to adapt others code than to write you own. It is very beneficial to build your report on papers that have code available online, `https://paperswithcode.com`.

- ▶ Focusing to narrowly on one paper makes it hard to avoid restating their work. Contrasting two more more papers on the same topic gives is far better: it gives new information, your views and understanding, rather than restating others results.

- ▶ Papers that came out on the same topic at the same time often haven't been directly compared and are especially good candidates for developing a mini-project around.

- You have now read a number of well written conference proceedings and journal articles in machine learning.

- Articles and proceedings that were recommended for reading are good examples of academic tone.

- Don't be overly informal, avoid words such as: "hope", "like to", "try to". These are fine in conversation, but not used in academic writing.

- Clearly state what you have done in the report; "In this paper we introduce...", "We gathered evidence that...", "Experiments in Figure 1 are novel (to the best of our knowledge)..." Don't leave the marker to have to guess what you did and what was done in the references.

Showing you have put a lot into the report
Novel experiments, well selected bibliography, not to close to lectures.

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- These mini-project reports are not intended to be original results that can be published, but are intended to be novel in that they tell <u>your views and understanding</u> rather than strictly summarising a paper. Focus on contrasting and explaining.

- Contrasting or experiments might benefit from being conducted on datasets not already used in the original reports; this adds something <u>your own</u> to the report.

- Reports should not focus on papers covered in lecture; that isn't as novel as selecting your own papers to build from.

- The bibliography should be a useful set of references for the reader, and show give context to the topic.

Three mini-projects from 2021 are available on the course page:

- Robustness and Accuracy: Are we trying to have our cake and eat it too?

- On manifold mixup for deep learning

- Backpropagation and predictive coding: an experimental comparison

Robustness and Accuracy: Are we trying to have our cake and e   too?

Contrasting, mathematical tone, and novel experiments.

- ▶ References [21] and [23] are contrasted; "The authors of [21], take a different viewpoint."

- ▶ A nice mathematical tone is set by stating and discussing theorems.

- ▶ A novel experiment is conducted "Taking the framework provided by [21], we consider another model adjustment – batch normalisation (BN) ([9])."

- ▶ You aren't expected to have a complete answer to the question being discussed. The results can be inconclusive: "Unfortunately, the question we asked ourselves in the introduction remains an open one."

▶ An exceptional quick review of the topic and bibliography: see the first paragraph of the introduction, and related work section "The advent of Mixup has sparked a wave of related data augmentation techniques for images names Puzzle Mix [5], CutMix [12], and AugMix [3].

▶ Originality: "In this section we seek to explore two phenomena: 1. in light of Theorem 1, ... 2. Can we understand ..."

▶ Originality beyond what is expected: "In all existing Mixup methods... We propose a novel Mixup algorithm..." This is great, but isn't necessary.

- ▶ Contrasting: "Throughout this work, I will try to explore the similarities and differences that arise…"

- ▶ Experiments conducted focus on connections to theory stated about the methods: "Predictive coding with condition 3 relaxed is the most similar to backpropagation."

- ▶ Techniques from lecture are used to explore phenomenon discussed: "Loss landscape of different models… This can explain the training instability experienced."

- ▶ Originality: "In this work I have shown how… Furthermore, adding a mild weight decay allows for…

- ▶ Note, this report is over the stated page limit; Figures 6 and 7 were not considered for the mark given. Don't go over the page limit….

- Start with an outline, fill things in, go over the page length, and then condense by selecting the most essential parts of the discussion. (Ensure your final report is within the page limit.)

- Take time to read and improve your report. Ask yourself if you are making good use of space (does this need to be here? such as restating a proof).

- Having a mini-project that can be selected from a wide range of topics is an opportunity for you to investigate something you find interesting, pick something you enjoy and have fun.

- Ask questions and be inquisitive. Select experiments to explore the question you are posing. Convey your interest in understanding the topic. Let your interest in the topic come through in your writing.