Final Project – Deep Neural Networks (CS525 191N, Whitehill, Spring 2017)

1 Introduction & Scope

For the remainder of the course, you will define and conduct a "miniature research project" consisting of some machine learning problem that you will tackle using neural networks as the computational framework. The topic is mostly up to you, but you will need to submit a brief proposal (see below) describing what it is you are trying to accomplish. In addition to defining the problem, implementing neural network(s) to try to solve it, and conducting computational experiments, you will also need to write a short (3-4 page) paper describing your work.

All of the following kinds of projects are acceptable:

- **New domain**: Tackling a novel (i.e., never before tried) machine learning problem using neural networks.
- **Old domain, new approach**: Devising a novel neural network architecture to try to outperform an existing baseline on a machine learning problem.
- **Fancy network implementation**: Implementing and training a non-trivial neural network architecture (e.g., ImageNet, Word2Vec, Inception, etc.) yourself from scratch (using any standard neural networks software package).

You may **not** do a project on handwritten digit recognition using the MNIST dataset – it's time for something new.

2 Proposal

By 11:59pm on Tuesday, 11 April 2017, please submit a concise and precise 1-paragraph description of the problem you want to tackle including: (1) Who are the members of the project team; (2) what you want to accomplish; (3) the data you have available for training; (4) and how you will measure performance. For (4) in particular, you should define a **reasonable baseline** that you are trying to beat. If the problem has never before been tackled and it's unclear whether a neural network could be useful at all, then the baseline might consist of just "guessing" the target labels (e.g., the mean value for regression, or a uniform distribution for classification). If there's already a lot of prior research, then outperforming some well-known machine learning approach (e.g., ImageNet) would be reasonable.

I will provide feedback on your project proposal. You **must** obtain approval from me before proceeding with the project (I will respond to everyone by Thurdsay, 13 April 2017 at 11:59pm).

3 Paper

As described in class, every team is required to produce a short (maximum 4 pages, not including references) project report. See `CS525FinalProject2017.zip` in the Files section of Canvas for more details. It is fine (and recommended) to use the LaTeX template; however, if you prefer another text-editing environment (e.g., Google Docs, Microsoft Word), that is fine too – **just make sure that your paper looks very similar (in formatting, not content) to the template I provided**.

4 Software

In contrast to the previous homework assignments, you are free to use whatever neural network library you wish, e.g., TensorFlow, Keras, Caffe, Torch, etc.

5 Deliverables

Your final project submission will consist of (1) all your code that you used to implement your project and conduct experiments; and (2) your 3-4 page final report.

6 Teams

It is **strongly preferred** that you complete the final project in teams of 2-3 people. However, teams of size 1 are allowed.

7 Grading

Projects will be graded primarly on the basis of the paper (not the code), but of course the results in the paper should be obtainable from your code.

The maximum score is 100 points, divided as follows:

- Methodology (**30 points**): What procedures did you use to design and optimize both the parameters and hyperparameters of your network?
- Performance (**20 points**): How much more accurate, relative to the difficulty of the problem you defined, did your network get?
- Thoroughness (**20 points**): Obtaining one research result often opens up many more questions. Does your project offer clear "lessons learned", or does it simply report a few numbers with little insight? Were there obvious research questions that could have easily been explored but weren't?
- Writing (**30 points**): Is the paper understandable? Are all important details clear? Is it well organized? Does the paper cite relevant prior research and explain the signficance of the results relative to the prior state-of-the-art? (Note: for "fancy network implementation" projects, make sure that you relate the network you are implementing to prior architectures and motivate why it is computationally interesting, effective, or promising.)

  To earn a good grade, please make sure that your paper clearly describes your methodology and empirical results (to evaluate performance), and highlights your thoroughness in examining your research problem. Note that, for a course-based project such as this one, **negative results are acceptable**. While desirable, it is **not** necessary to obtain excellent performance in order to earn a good grade. As long as your methodology is sound and you conducted a thorough (within the confines of a 3-week project) exploration of your target domain, you can still earn an A.