

# CMP\_SC 8770 and ECE 8990: Neural Networks

## Project 2: Report due May 9<sup>th</sup>, 2019

In project 2, you are to identify an independent research topic on neural nets. You can pick a topic from class (something we have taught you) or you can pick a topic outside of what was covered (e.g., capsule nets, GANs, LSTM, differential equations NNs, neural nets and reinforcement learning, fusion in NNs, etc.). We do not want a formal proposal, but make sure you run your idea past us (catch Dr. j or d).

If you do not code it up yourself, e.g., you use some existing TensorFlow, PyTorch, etc., codes, that is fine, **BUT**, you must demonstrate in your report that you know it all from the ground up!

THE FOCUS OF THIS PROJECT IS NEURAL NETWORKS, NOT AN APPLICATION. For example, we will not allow you to spend 80% of your time doing your graduate research and say, hey it's a neural net homework!... Your goal is to focus on neural nets and if you pick a topic that is aligned with your research great, but we want to hear primarily about the neural nets. This is your chance to learn about some neural net topic in depth, apply it, and learn about theory and what happens when the wheels hit the road.

What are some examples?

- **Academic curiosity**; You can pick a topic, study the mathematics, implement it, and explore it by a series of controlled synthetic experiments (you pick patterns, control the noise, etc.) to better understand when it will break and/or when it will likely work well! For example, you could choose to look at something like capsule nets or segmentation/localization-based neural networks.
- **Implement a few different related methods and compare and contrast**; You should compare and contrast the algorithms, their implementation details, and performances. For example, if there are related methods out there, here is your chance to study them and see which is really best ;-)
- **Explainable AI**; You could pick a research paper and implement a way to open the hood and see inside these black boxes. Of course, we expect you to describe the procedure and to apply it to some data to see what we learn...
- **Novel application**; E.g., apply a neural net in a **novel** way. For example, maybe look at doing data fusion with a GAN. Remember, we do not care about the problem that you are trying to solve. We care about the neural networks in the class. We want to know just what is new and creative and we want to see that you have thoroughly investigated the neural net in the context of your work (how to use it, parameters, optimization, etc.).

What do you turn in? Same format as before.

(1) Title Page: 1 page: class, project, date, name.

(2) Technical Description: 5 pages: prove to us that you know this (description, math, pictures, etc.)

(3) Code Description: 2 pages: how to run your code and give a picture that connects all the code parts

(4) Experiments and Results: 10 to 20 pages: documentation, tables, plots, discussion.

(5) Lessons Learned: 2 pages: discuss unexpected things, summarize major findings, etc.