Week 4 Reflections

Course	CS 598 - Deep Learning for Healthcare
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General Summary

After introducing us with the concepts of Machine learning last week, this week was focussed on introducing Deep Neural Networks. The lectures introduced us to various components of Deep Neural Networks before discussing about a few applications in health care.

Below are the topics with some high level details covered in this chapter -

- Basics on Single Neuron
  - A Neuron is a a computational unit that takes inputs and their associated weights along with a bias term and output value y to a linear combination followed by a non-linear activation function
  - To learn a model for a single neuron - we need to specify the activation function and learn the parameter weights and bias term from the data
  - Popular activation functions include
    - Tanh, Sigmoid, Rectified Linear Function (RELU)
- Training a Single Neuron
  - Gradient Descent Method: Is one of the basic Optimization methods that is widely used in Machine Learning Applications
  - Stochastic Gradient Descent: Is a variant of the Gradient Descent method which is typically applied for handling large datasets
    - The idea is to compute the likelihood function on a random subset of data points

> 💡 SGD for Neural Networks
> - Initialize each weight (wi) and bias (b) to a small random value until convergence
> - Pick training sample
> - Compute gradient
> - Update weight vector
> - Update bias

- Forward and Backward computation
  - In order to train a neuron based on training data we need to perform two passes over the network

- One forward pass to compute the ouput y
- One backward pass to compute the gradients for each parameter

> 💡 Understanding the concepts calculus (Derivatives and the chain rule) is key for grasping the concepts and formulae

- Multilayer neural Network
  - A neural network is constructed by connecting many neurons such that the ouput of one neuron becomes the input of another
  - There can be n number of hidden layers in a multilayer neural network
  - The general concepts are the same as a single neuron
  - Forward and backward propagation follow the same principles as discussed in the Single neuron

> 💡 Understanding vectors and matrices is essential for a better understanding of the application of the concepts.
> Modern libraries handle the calculations but for a better understanding of linear algebra is essential.

Questions

What are the main messages you learned from this chapter?

The 'General Summary' section above summarizes the primary messages and ideas that I learned from this chapter.

What are the typos?

I couldn't find any typos (honestly I wasn't looking to find typos, was more keen in understanding the concepts presented in the slides and the chapter).

Which part do you want to improve in this chapter?

I found the lecture very helpful and it helped me understand the concepts of Deep Neural Networks very nicely. I had also taken a course on Applied Machine Learning where we were introduced to Convolutional Neural Networks, but this set of lectures further solidified my understanding.

The professor explained difficult concepts in easy to understand manner which helped me in understanding.

If I had to suggest on how to improve this chapter I would only suggest sharing a practical example with code / libraries in Python when discussing the applications of Deep Neural Networks in Healtchare. Perhaps this is included in the part of the assignment?

Which types of health data do you think can be benefited most by DNN methods? Why?

Deep Learning as we found out in the series of lectures is computationally intensive, but in many cases performs better than other regression models. Deep Learning can enable researches to discover hidden opportunities in data.

I think (we were also introduced to a couple of these in lectures) DNN can be applied for following use cases -

- Biomedical data for drug discovery
- Medical Imaging data for analyzing diseases and providing clinical decision support
- Structured Health data for Readmission analysis (as presented in the lecture) or insurance fraud claims

I'm sure there are various other applications of DNN which I'm excited to learn in future lectures.

Which types of health data do you think can be benefited least by DNN methods? Why?

I think the following kinds of data have challenges

- Continuous signal data: The data volume are so high and being accurate is key so I'm not sure how DNN can help with this kind of data and what kind of analysis can it assist in.
- Unstructured clinical notes: The data by its nature is unstrctured and includes a lot of abbreviations and potential misspellings. I'm unable to think of how DNN can help with this kind of data.
- Medical publications and journals: There is a lot of learning in this kind of data, but again I'm unable to visualize how DNN can be applied to this data and what analysis can it assist in providing.