Mentor Assessment #1

Mentor: Kyle Icban

Profession: Frontend Software Engineer

Date/Time: October 25th, 2024, 12:00 p.m. - 1:00 p.m.

Assessment:

My mentor, Mr. Icban, and I have spent the past few weeks exploring and discussing convolutional neural networks and how to use them in image detection for my Original Work. Prior to my last meeting, I researched the basics of how convolutional neural networks (CNNs) work to recognize patterns through different layers and make decisions based on a series of weights associated with the connections between different neurons, represented as nodes in a larger graphical data structure. I then spent the following week building a simple neural network classifying different hand-written numbers from the popular MNIST dataset, while annotating the syntax associated with the model's construction. In my meeting with Mr. Icban, we discussed interpreting the results of this neural network's predictions, the linear algebra associated with neural networks, and what next steps I should pursue in my endeavors to build a neural network detecting the similarity between two images for my Original Work.

While learning about neural networks in prior weeks, I was careful to place emphasis on thoroughly understanding the theory of how CNNs work. Unexpectedly, one of the biggest challenges with studying CNNs so far has been linking the theory I have learned back to the Python syntax used to build, train, and effectively use these models in the first place. So even though I'd built a neural network, the model's predictions weren't initially apparent. Mr. Icban and I spent the first part of our meeting discussing each piece of syntax in my project and its role in the model's overarching function. Through this, I gained a better understanding of how to use

Matplotlib, one of the libraries used in my project. I also used our conversation as an opportunity to verify my previous research on popular libraries in deep learning projects. For example, some libraries like Tensorflow aid in the construction of the model; however, these libraries lack visualization to verify that models are functioning properly. Therefore, libraries like Matplotlib and Seaborn are necessary to visualize the processing of data inputted into the neural network. In the context of my project, Matplotlib was recording and handling the data associated with the model's predictions. Mr. Icban and I discussed how, in order to determine the model's best prediction, we would have to find the highest output value in the list of predictions that the model made. And finally, to my satisfaction, we coded my model to output its results given a specific image.

Deep learning is interesting since its theory is incredibly intricate – from normalizing input data to applying activation functions, the construction and operation of a CNN involves numerous processes all heavily backed by linear algebra and statistics. So, after discussing the syntax behind my project, Mr. Icban and I then proceeded to have a lengthy conversation about the math behind CNNs. I initially brought up the relationships between scalars, vectors, matrices and tensors, which I found incredibly interesting as I previously had not seen the relationship between these four mathematical representations of the physical world. This led us to consider spending the rest of our conversation discussing the linear algebra behind CNNs, prompting us to consider another question: What was the importance of understanding the math behind CNNs? In the context of simply building a piece of software, the math may not be necessary; after all, the construction and usage of the model only requires a few lines of simple Python syntax. However, the theory is still essential for knowing how to design an efficient software system implementing a deep learning algorithm. This way, a developer can pick the most optimal solution for the use

case at hand. Mr. Icban then walked me through the basics of linear algebra — specifically, how to visualize and evaluate basic dot and cross products. However, as we ran out of time in our meeting, we decided to pick up on the topic in a later meeting, and Mr. Icban ultimately left me with an introductory guide on linear algebra and its applications to machine learning.

Before we concluded our meeting, Mr. Icban and I talked about what I should build next and explore in the following weeks to complete my Original Work. We decided that I am now going to build my first independent project, given what I've learned: a CNN that can differentiate between AI-generated images and human images. Equipped with a better understanding of the systems working behind image detection, I am excited to move forward with the next stage of building my Original Work.