In this lab we explored the applications and importance of convolutional neural networks and how it relates to image classification. CNNs are essentially the cornerstone of image classification; as they perform feature extraction techniques by applying filters to images to learn patterns such as edges, textures, sharpness, clarity, colors, and other complex features. They also participate in hiearchacial learning where the early layers learn basic patterns wheras the deeper layers focus on the more complex features. CNNs also use pooling layers like (MaxPooling) to reduce spacial dimensions. This makes computations more efficient and helps the model focus on the most important features.

In this lab we used CNNs instead of traditional neural networks to train the model to differentiate between the muffins and the chihuahuas. CNNs are much better at automatically extracting features by using the convolutional layers. They were also better at capturing local patterns by using the filters to slide over the input data. I was also able to play around with the parameters to see if the model would still be able to comprehend the inputs. There are actually several ways to increase the model’s performance such as increasing the size of the dataset and collecting more images. Another way to improve the model would be to use pre-trained models that are more equipped to handle smaller datasets such as (ResNet). The learning rates, batch sizes and optimizers can all be tuned down by using the hyper-peramaters. Stopping the machine while it is training can also significantly prevent the model from overfitting and not performing at its peak ("Key Differences Between Convolutional Neural Networks (CNNs) and Traditional Neural Networks (NNs)”).

As far as real world applications, the model might struggle to recognize unseen environments or not understand image variations. If the model is biased, it may generate biased result. Training these models also require also of computational power which can exceed the computer’s capabilities. Data augmentation such as random flips, rotations, scaling, and cropping help to improve the model’s understanding my simulating real world variations in the data. Rotations help the model recognize objects at different angles. Scaling and cropping ensure the model understand features regardless of the size of the object. All of these reduce the chances of overfitting ("Roles and Challenges of Convolutional Neural Networks in Image Classification.").

In regards to ethical considerations, the images being used to train the model should respect user privacy and also adhere to regulations. Training the model with biased data could generate negative views of alienation towards a certain group; therefore, the dataset must be diverse. These models can also be used to take advantage of others by being used for video survellience and profiling. This is why developers are strongly encouraged to provide clear documentation about system limitations, potential biases, and decision-making processes ("Roles and Challenges of Convolutional Neural Networks in Image Classification.").

In conclusion for this lab, I was able to learn how CNNs worked in comparison to a traditional NN and how effective they can be. In our lab, the model was able to generate the images of both the chihuahua and muffin and make the right prediction on which was which. The model was able to learn from being trained from the dataset, which was more intricate than I initially anticipated. The challenging part for me was understanding how the learning rates and hyper-perameters impacted the model’s performance.

Works Cited

"Key Differences Between Convolutional Neural Networks (CNNs) and Traditional Neural Networks (NNs)." OpenAI, 6 Nov. 2024, chat.openai.com.

"Roles and Challenges of Convolutional Neural Networks in Image Classification." Your Source Name Here. Accessed 6 Nov. 2024.