Sha'Rise Griggs

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Department of Science, Technology, Engineering & Math

Patricia Mcmanus

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In this lab, I worked with a Convolutional Neural Network for image classification, specifically for the task of distinguishing between images of Chihuahuas and muffins. The CNN architecture I used is designed specifically to process images by capturing spatial hierarchies through convolutional layers. It differs from the traditional neural networks used in previous workshops in that CNNs work directly with the pixel structure of images through filters, enabling them to identify edges, textures, and patterns more effectively.

A typical CNN is made up of layers such as convolutional layers, pooling layers, and fully connected layers. Convolutional layers detect features like edges or shapes, while pooling layers reduce the spatial dimensions of the data, preserving the most important information. This is different from the traditional neural networks that require flattened, one-dimensional input, which loses the spatial relationships between pixels.

The CNN model performed well overall, showing a good level of accuracy during the classification task. However, there were some cases of misclassification, especially between images that looked very similar, such as a Chihuahua's face and a muffin with similar texture patterns. These patterns were more common when the image had ambiguous or overlapping features.

The accuracy of the model was influenced by how well it learned to recognize the distinct features of each class. As I trained the model, I saw improvements in accuracy after tuning some hyperparameters, such as adjusting the learning rate and increasing the number of epochs.

When compared to the traditional neural network model I worked with earlier, CNNs proved to be far more effective for image classification tasks. Traditional neural networks were slower to train and less accurate because they lacked the ability to detect spatial hierarchies in images. CNNs, on the other hand, are built to handle image data directly, which results in faster and more accurate training, as they can learn patterns from smaller regions of an image (such as edges or textures) and build more complex features from

One of the main challenges I faced during this lab was the long processing time required for training the CNN model. The CIFAR-10 dataset was large, and running multiple epochs took a significant amount of time, especially with limited resources on Google Colab. To address this, I reduced the batch size and decreased the number of epochs during the initial training phase to speed up the process. I also experimented with using pre-trained models to leverage transfer learning, which helped to reduce training time while still achieving decent accuracy.

Another challenge was fine-tuning the hyperparameters. Initially, the learning rate was set too high, which caused the model to fail to converge. After adjusting the learning rate to a lower value, the model's accuracy improved significantly.

CNNs have vast real-world applications, particularly in fields that rely on image recognition. For example, in healthcare, CNNs can be used for diagnosing diseases by analyzing medical images, such as X-rays or MRI scans. In autonomous driving, CNNs are crucial for object detection, such as identifying pedestrians, vehicles, and road signs. Additionally, in retail, CNNs can be used for visual search, allowing customers to search for products using images rather than text

While CNNs provide powerful tools for image classification, they also raise ethical concerns, particularly around privacy and bias. When used in sensitive areas like surveillance, CNNs can pose a risk to personal privacy if not properly regulated. Additionally, biased training data can lead to discriminatory outcomes. For example, facial recognition systems trained on unbalanced datasets may perform worse for certain demographic groups, potentially leading to unfair treatment in areas such as law enforcement or hiring. It is crucial that developers address these biases by ensuring diverse and representative datasets are used and by implementing safeguards to protect privacy.

Copy of CNN_1 Chihuahua or Muffin.ipynb - Colab (google.com)