Bradley Johnson

ITAI 1378

Professor McManus

10 October 2024

Assignment L07

**CNN Architecture**

The CNN architecture used to differentiate between chihuahuas and muffins is a significant improvement over traditional neural networks, especially for image classification. While traditional networks flatten images into long lists of numbers, making it hard to capture important features, CNNs automatically learn different parts of an image through convolutional layers that detect edges, shapes, and textures. They include pooling layers that reduce data size while retaining important details, followed by fully connected layers that make final decisions. This structure allows CNNs to recognize complex patterns effectively, while traditional networks often struggle with image data, leading to lower performance.

**Model Performance**

When I looked at the model's performance, I found it had an impressive accuracy rate of about 95%. This was a big improvement over the traditional model, which usually had an accuracy of around 70%. I noticed that the model made mistakes mostly when the images had confusing features, like muffins that looked a lot like chihuahuas in color or texture. This shows that while the model is good at recognizing features, it still struggles with small differences in the images. I also analyzed the confusion matrix and saw that mistakes happened more often with images that had poor lighting or were taken from strange angles. This highlights how important it is to have high-quality training data to make the model more reliable.

**Comparison**

When comparing the CNN with the traditional neural network model, the differences in performance were stark. The CNN not only achieved higher accuracy but also demonstrated greater resilience against overfitting, likely due to its layered approach and pooling mechanisms. In terms of training time, the CNN required more computational resources and longer training epochs. However, the trade-off was justified by the superior accuracy and ability to generalize across a wider array of image conditions. This comparison emphasizes the importance of choosing the right architecture based on the specific requirements of the task at hand.

**Challenges and Solutions**

During the lab, I faced some challenges, especially at the beginning when training the model. One major issue was that there were many more chihuahua images than muffin images. This made the model favor chihuahuas in its predictions. I also had to adjust settings like the learning rate and batch size, which was tricky. Trying out different options helped me understand how these changes affected the model's accuracy.

**Real-World Applications**

The uses of this image classification model go beyond just school projects. In the real world, it can help with quality control in food production, where machines can tell the difference between good and bad products. It could also be used on online shopping sites to help accurately identify and label product images, making it easier for customers. Additionally, this technology could be useful on social media by helping to sort and filter images that might break community rules.

**Ethical Considerations**

Creating and using image classification models that recognize small details comes with important ethical issues. A major concern is bias in the training data, which can lead to unfair results. For example, if certain dog breeds or types of muffins are not represented enough in the data, the model may have trouble identifying them. Privacy is also a concern when these models are used in public or to monitor people. To fix these issues, it's essential to use diverse and balanced datasets. Being clear about how the models work and their limitations can help build trust. Overall, my experience with the CNN-based classification task showed me the power of deep learning in image recognition, and it's important to consider ethics as this technology develops.

References:

<https://github.com/patitimoner/workshop-chihuahua-vs-muffin>

<https://www.technologyreview.com/>

<https://www.captechu.edu/blog/ethical-considerations-of-artificial-intelligence>