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Reflective Journal: Learning and Implementing CNNs

Learning Insights

During this lab, I gained a much better understanding of Convolutional Neural Networks (CNNs) and how they process image data. Before, I had a general idea that CNNs are good for image recognition, but now I see how they actually work step by step. The Conv2D layers extract features from images using filters, and pooling layers help reduce the complexity while keeping important details. I also learned how one-hot encoding is necessary for classification tasks and why flattening the data is required before connecting it to dense layers.

This lab also connected well to my previous knowledge of neural networks. I had worked with fully connected layers before, but CNNs are structured differently to handle spatial data more efficiently. The use of filters and pooling was new to me, but it made sense once I saw how it reduces computation while still capturing key features. One thing that surprised me was how effective max pooling is at reducing the size of feature maps without losing critical information. Another surprise was how small changes in parameters, like the number of filters or kernel size, can significantly impact the model's learning process.

Challenges and Growth

One of the challenges I faced while implementing the CNN was understanding how different hyperparameters affected training. For example, when I experimented with changing the kernel size or the number of filters, it sometimes led to overfitting or underfitting. At first, I wasn't sure why that was happening, but after testing different values and reading more about it, I realized that too many filters could cause the model to memorize the training data instead of generalizing well.

Another challenge was tuning the batch size and number of epochs. Initially, I used a small batch size, which made training slow, and the model didn't perform well. When I increased it, the training stabilized, and the accuracy improved. However, when I set the number of epochs too high, the model started overfitting. This taught me that finding a good balance is important.

To overcome these challenges, I relied on class notes, online resources, and trial and error. Reading about CNNs from different sources, like blogs and research papers, helped clarify concepts. Also, looking at visual representations of convolutions and pooling operations made it easier to understand how CNNs transform images. Discussing issues with

classmates was also helpful because they sometimes pointed out things I hadn't thought about.

Personal Development

This lab changed my understanding of deep learning by showing me how powerful CNNs are for image recognition. Before, I thought neural networks just processed numbers without much structure, but now I see how CNNs are specifically designed to work with spatial relationships in images. I also have a better appreciation for how layers interact and why certain components, like dropout layers, are necessary to prevent overfitting.

One area I'd like to explore further is transfer learning. Instead of training a CNN from scratch, I've read that we can use pre-trained models and fine-tune them for specific tasks. This seems like an efficient way to get high accuracy with less training time. I'd also like to learn more about advanced architectures like ResNet and how deeper networks improve performance.

If I had already been familiar with CNNs, this lab would have still given me a new perspective on hyperparameter tuning and optimization techniques. I now see why Adam is a popular optimizer—it adjusts learning rates dynamically, which makes training more efficient. Also, using categorical cross-entropy as a loss function makes sense because we're dealing with multi-class classification.

Overall, this lab was a great learning experience. I was able to build and train a CNN, test different configurations, and see firsthand how small changes impact performance. While my model performed well on the test set, I think there's always room for improvement, especially in optimizing the network for better generalization. With more practice and research, I hope to improve my understanding and application of CNNs in future projects.