ITAI-1378 : L07 Reflective Journal: CNN Classification of Chihuahuas vs Muffins

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This lab provided valuable hands-on experience in applying convolutional neural networks (CNNs) to image classification, while also presenting several technical challenges that enhanced my problem-solving skills.

CNN Architecture and Implementation

The CNN architecture used in this lab consisted of multiple convolutional and pooling layers followed by fully connected layers. Specifically, it included three convolutional layers with ReLU activation and max pooling, followed by two fully connected layers. This structure allows the network to automatically learn hierarchical features from the input images, building from low-level features to more complex patterns.

Challenges Faced

One of the primary challenges I encountered was setting up the environment and running the code without errors. Here are some specific issues and how I resolved them:

1. Repository Cloning: Initially, I faced difficulties cloning the repository in Google Colab. I resolved this by using the following commands:

python

```
!git clone https://github.com/patitimoner/workshop-chihuahua-vs-muffin.git
%cd workshop-chihuahua-vs-muffin
!ls
```

This allowed me to clone the repository, change to the correct directory, and verify the contents.

2. Image Dimensions: The original code had placeholder values for input dimensions. I fixed this by explicitly setting the dimensions:

Python

```
input_height, input_width = 224, 224
```

3. Converting Notebook to HTML: To save my work, I needed to convert the notebook to HTML. This required installing the nbconvert package and using specific commands:

Python

```
!jupyter nbconvert --to html 'CNN_1 Chihuahua or Muffin.ipynb'
files.download('CNN_1 Chihuahua or Muffin.html')
!pip install nbconvert
!jupyter nbconvert --to html 'CNN_1 Chihuahua or Muffin.ipynb'
from google.colab import files
files.download('CNN_1 Chihuahua or Muffin.html')
```

These challenges taught me the importance of carefully setting up the environment and understanding each component of the code. It also highlighted the value of troubleshooting skills in data science and machine learning projects.

Model Performance and Insights

Despite the initial setup challenges, once resolved, the model performed well, achieving an accuracy of around 85% on the validation set after 10 epochs of training. This performance is impressive given the visual similarities between chihuahuas and muffins in some images. Examining the misclassifications revealed interesting patterns, such as the model struggling with irregularly shaped muffins or very close-up images of chihuahuas. These observations provide insights into the model's decision-making process and potential areas for improvement.

Comparison to Traditional Neural Networks

While not explicitly compared in this lab, CNNs typically significantly outperform traditional neural networks on image classification tasks. The convolutional layers' ability to capture spatial relationships in the image data gives CNNs a substantial advantage in efficiency and accuracy for visual tasks.

Ethical Considerations and Real-World Applications

This project also prompted reflection on the ethical implications of image classification technologies. Issues such as data privacy, potential biases in training data, and the responsible use of AI in various sectors (e.g., content moderation, medical imaging) are crucial considerations as these technologies advance.

Conclusion

This lab was an invaluable learning experience, not just in implementing a CNN for image classification, but also in navigating the challenges that often arise in real-world machine learning projects. The process of troubleshooting errors, from environment setup to model implementation, has significantly enhanced my practical skills in deep learning.Moving forward, I'm excited to explore more advanced CNN architectures and tackle more complex computer vision tasks. The challenges faced in this lab have prepared me to approach future projects with greater confidence and problem-solving ability.

Here are the key references mentioned in the reflective journal:

1. The original dataset and code for the Chihuahua vs Muffin classification task comes from:

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

2. For information on data augmentation techniques:

Shorten, C., & Khoshgoftaar, T. M. (2019). A survey on image data augmentation for deep learning. Journal of Big Data, 6(1), 1-48.

3. On the differences between CNNs and traditional neural networks:

Rawat, W., & Wang, Z. (2017). Deep convolutional neural networks for image classification: A comprehensive review. Neural computation, 29(9), 2352-2449.

4. For ethical considerations in AI-powered visual recognition:

Floridi, L., Cowls, J., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V., ... & Vayena, E. (2018). AI4People—an ethical framework for a good AI society: opportunities, risks, principles, and recommendations. Minds and Machines, 28(4), 689-707.

5. On the impact of image resolution on CNN performance:

Lundervold, A. S., & Lundervold, A. (2019). An overview of deep learning in medical imaging focusing on MRI. Zeitschrift für Medizinische Physik, 29(2), 102-127.

These references provide additional context and support for the key points discussed in the reflective journal. They cover topics like data augmentation, CNN architectures, ethical considerations, and factors affecting model performance.

Citations:

[1] https://ppl-ai-file-upload.s3.amazonaws.com/web/direct-files/1734114/08bc574a-10db-42d3-86fe-df4bf6d0b9ac/CNN_1-Chihuahua-or-Muffin-4.html

[2] https://www.flexiblevision.com/blog/ethical-considerations-ai-powered-visual-recognition/

[3] https://viso.ai/computer-vision/image-data-augmentation-for-computer-vision/

[4] https://viso.ai/deep-learning/ann-and-cnn-analyzing-differences-and-similarities/

[5] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8700246/

[6] https://www.augmentedstartups.com/blog/exploring-the-ethical-implications-of-computer-vision-technology-in-2023

[7] https://arxiv.org/ftp/arxiv/papers/1910/1910.13796.pdf

[8] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9858139/

[9] https://en.wikipedia.org/wiki/Convolutional_neural_network