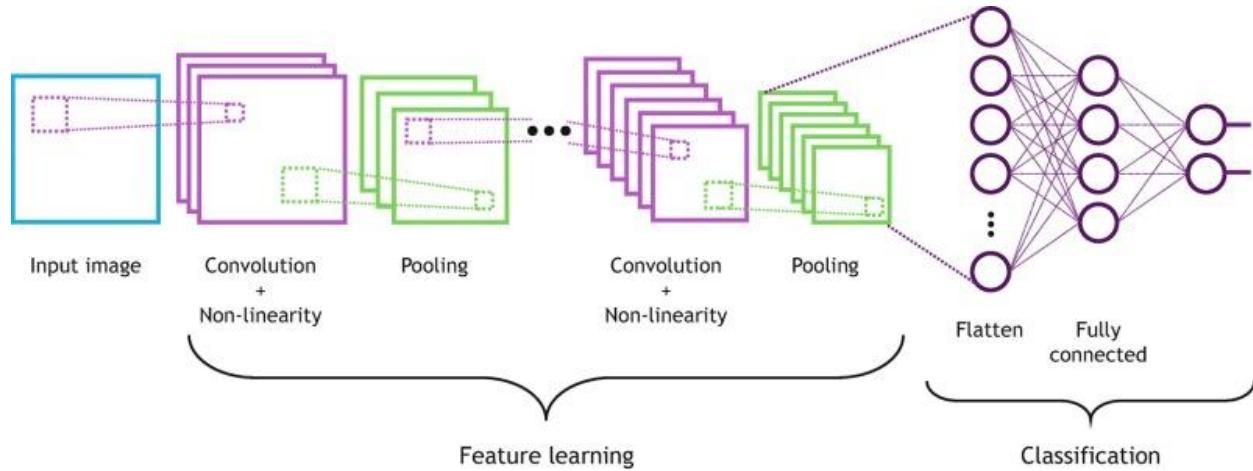


Lab 05 – Chihuahua or Muffin with CNN

ITAI 1378

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CNN Architecture



Convolutional Neural Networks (CNN) are an advanced version of the Traditional Neural Network (NN). CNN is well-suited for image classification tasks because it can learn spatial hierarchies of features directly from the image data. It is widely used in computer vision applications due to its effectiveness in processing visual data (GeeksforGeeks). CNN consists of the input layer that receives the raw data, a convolutional layer that extract features like edges and textures with kernels, an activation layer that adds nonlinearity to the network, pooling layer where the size is reduced to prevent overfitting, flattening converts the data into one-dimensional vector, fully connected layers is where the final classification is computed, and the output layer. The convolutional layers extract features (edges, textures, and patterns) from the images, and the pooling layers reduce dimensionality, making a model more efficient (Goodfellow, Bengio, and Courville).

The Traditional Neural Network (NN) is a model that stacks simple neurons in layers. It learns patterns and makes predictions based on those patterns. The layers of this model are “simpler”; it consists of the input layer that receives the raw data, the hidden layers where linear transformation occurs with the use of nodes, and the output layer where the final prediction takes place with the nonlinear activation function (LeCun, Bengio, and Hinton).

When comparing both workshops, I can conclude that Convolutional Neural Networks (CNN) are superior to Traditional Neural Networks (NN) in this instance because CNN was designed

specifically for image data, and it can learn spatial hierarchies of features, making it more effective for image recognition (Stanford University).

Model Performance

After working on both workshops, I can conclude that Convolutional Neural Networks (CNN) achieved significantly higher accuracy compared to the Traditional Neural Networks (NN).



On the left, we have the NN model; as we can observe, the model is not very accurate. On the right, we have the CNN model, which is more accurate and can distinguish between a chihuahua and a muffin. We can observe that misclassification occurred when the muffin images resembled the textures or shapes of the chihuahua faces.

I experimented with the model to see how different configurations would affect the performance. I adjusted the number of epochs; the original had 10 epochs, and I changed to 5, decreasing the number of times the dataset is passed through the network, leading to underfitting. I also modified the learning rate; the original learning rate was set to 0.001, and I set it to 0.0001, which is a lower learning rate resulting in a more stable convergence.

Comparison

When comparing the CNN with the Traditional Neural Network model, I can determine that the CNN is more accurate and can generalize. The traditional model has difficulty distinguishing between the chihuahuas and the muffins. When it comes to training time, the CNN model took longer to train because it is more complex than the traditional model. As we can see, even if the CNN model takes longer training time because of the convolutional operation, and the performance is better when we compare the results.

Challenges and Solutions

This workshop was more complicated than the one on Lab 4. A Convolutional Neural Network (CNN) model is more complex than the Traditional Neural Network (NN) model in my opinion. Some of the challenges that I encountered were understanding the train-test split where we basically need to do the same as the previous workshop but divide the data into two main subsets (training and testing datasets). The purpose is the same as we need to train the model to learn the general patterns and not only memorize the training data, or it won't perform well in a real-world application. Data preparation in CNN included Data Transformations which helps in data augmentation and normalization (Goodfellow, Bengio, and Courville).

Real-World Applications

Some of the potential real-world applications for Convolutional Neural Network (CNN) include medicine (it can distinguish between healthy and diseased tissue), self-driving vehicles (it can identify road signs, obstacles, and pedestrians), and facial recognition. CNN can extract features, making it well-suited for image classification (Litjens et al.).

Ethical Considerations

The ethical considerations regarding the development and deployment of a model like the one from Lab 05 include bias in datasets; the data must be diverse, or the model will perform poorly. Another issue that can arise is privacy and misuse; it can be applied for surveillance and compromise individuals' rights. An ideal model needs to focus on transparency, accountability, and fairness (Jobin, Ienca, and Vayena).

Reference

GeeksforGeeks. “Introduction to Convolution Neural Network.” *GeeksforGeeks*, 11 July 2025, www.geeksforgeeks.org/machine-learning/introduction-convolution-neural-network/.

Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. *Deep Learning*. MIT Press, 2016.

Jobin, Anna, Marcello Ienca, and Effy Vayena. “The Global Landscape of AI Ethics Guidelines.” *Nature Machine Intelligence*, vol. 1, no. 9, 2019, pp. 389–399.

LeCun, Yann, Yoshua Bengio, and Geoffrey Hinton. “Deep Learning.” *Nature*, vol. 521, no. 7553, 2015, pp. 436–444. <https://doi.org/10.1038/nature14539>.

Litjens, Geert, et al. “A Survey on Deep Learning in Medical Image Analysis.” *Medical Image Analysis*, vol. 42, 2017, pp. 60–88. <https://doi.org/10.1016/j.media.2017.07.005>.

Stanford University. *CS231n: Convolutional Neural Networks for Visual Recognition*. Stanford University, cs231n.stanford.edu.