Cpts 570 Machine Learning: Project Report

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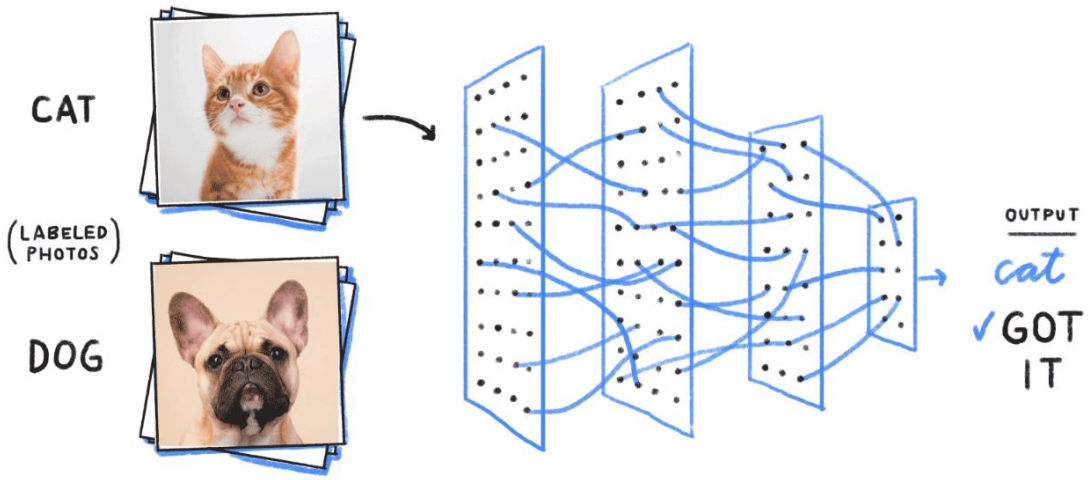
(1) Abstract

The report shows how to use the deep learning algorithm CNN to classify a set of images as cats or dogs. Although the problem sounds simple, it was only effectively addressed in the last few years using deep learning convolutional neural networks. So, the goal of this report is to introduce and reveal the outcome and drawback for Convolutional Neural Networks on classified dogs and cats. Moreover, it can be used as the basis for learning and practicing how to develop, evaluate, and use Convolutional deep learning Neural Networks for image classification from scratch.

(2) Introduction

In nowadays, when it comes to Machine Learning, Artificial Neural Networks perform really well. Artificial Neural Networks are used in various classification tasks like image, audio, words. Different types of Neural Networks are used for different purposes. Convolutional Neural Networks are a kind of Neural Network Architecture that is mostly used in Image Classification and suited for analyzing visual imagery. They are heavily influenced by how we humans, see the surrounding world, which was inspired by the Human Visual Cortex. Therefore, this report uses " Dogs vs. Cats Classification" on Kaggle competition as an experimental target to create a Convolutional Neural Networks algorithm to distinguish dogs from cats.



For this Machine Learning project, I use 4000 dog pictures and 4000 cat pictures as training samples, and 1000 dog pictures and 1000 cat pictures as testing samples. And, I will train this CNN model which hope can reach a high accuracy for distinguishing the new dataset.

(3) Problem Setup

Given a total of 10000 pictures for both dogs and cats. We need to create a CNN algorithm to distinguish dogs from cats.

(4) Solution Approach

Since my project only require binary class (dog and cat), so CNN is already able to learn efficiently and produce a high accuracy model. However, there still exist different solution approach within this topic. The naive solution approach is that using a CNN model with small amount (ex: 20) iterations and only one convolutional layer to work on this dog and cat datasets, and the drawback may be lower accuracy. We know that in Convolution Layer Formula, which accepts an input volume of size W1×H1×D1 (Weight x High x Dimension) requires four hyperparameters, which are number of filters: K; the filter size: F; the Stride Length: S; the amount of Zero Padding: P. They will produce an output volume of size W2×H2×D2 where: W2 = (W1 − F + 2*P)/S + 1; H2 = (H1 − F + 2*P)/S + 1; D2 = K. Therefore, each image in the convolutional layers will be filtered into several new images in order to extract significant information from the original image. We can try to add more convolutional layers and more iterations times (ex: 30, 50) in our CNN model to hope we can result in higher accuracy.

(5) Experiments and Results

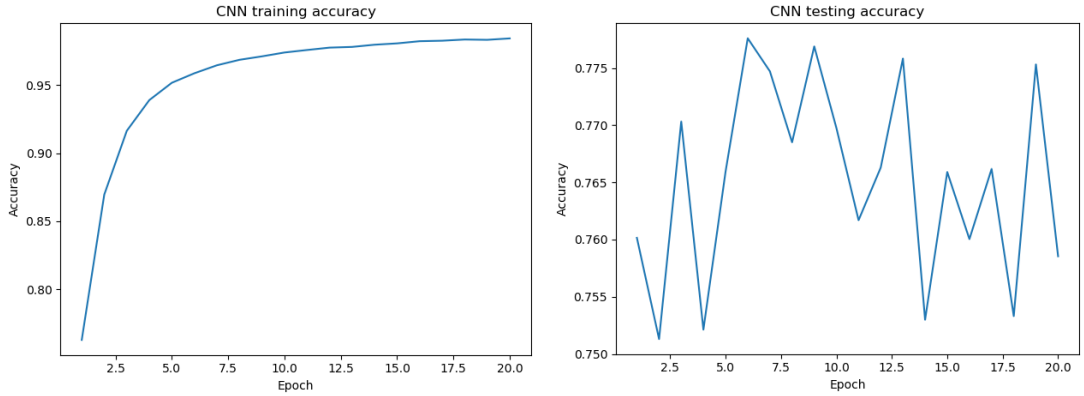
For the experiments, I have total 10000 image samples for my project with 5000 for dogs and 5000 for cats, and I randomly select 20% of the image as the testing dataset for each dogs and cats.

The structure and setup for Convolutional Neural Networks:

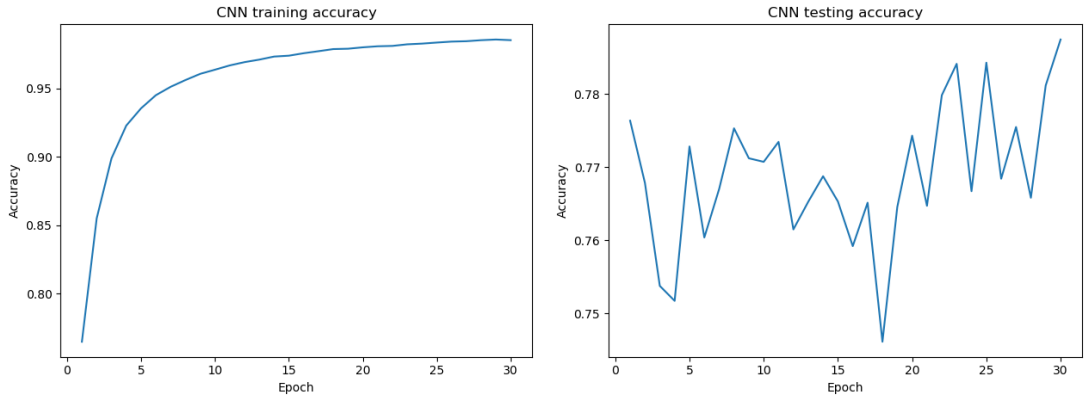
- epochs: 20, 30, 50
- image size: 64 x 64
- rescale: 1. / 255
- dropout: 0.2

- activation function: relu
- pooling: MaxPooling, pool_size = (2, 2)
- last activation function: sigmoid

For naive solution approach with training 20 iterations:
(472s 94ms/step)
- loss: 0.0436
- accuracy: 0.9844
- val_loss: 1.1159
- val_accuracy: 0.7585

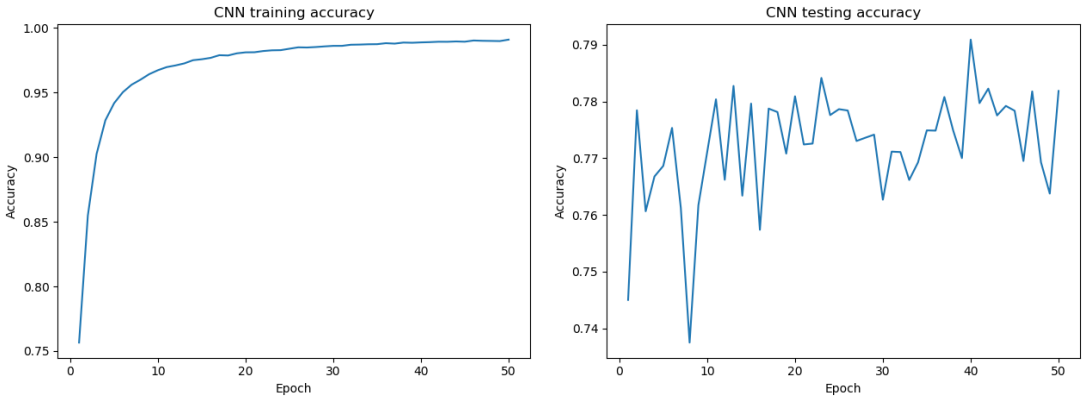


For another solution approach with training 30 iterations:
(476s 95ms/step)
- loss: 0.0413
- accuracy: 0.9854
- val_loss: 1.2567
- val_accuracy: 0.7875



For another solution approach with training 50 iterations:
(606s 121ms/step)
- loss: 0.0282
- accuracy: 0.9909

- val_loss: 3.7706
- val_accuracy: 0.7818



From the experiments and result above, we can observe that when the training iteration increase, the validation accuracy will also increase. However, the training iterations should not be too large, or it will become “overfitting”, just like training 50 iterations which validation accuracy is lower than training 30 iterations. So, for this simple binary classifier (dogs and cats), the training iterations and the CNN model parameters should be just the right amount.

(6) Conclusions and Future Work

In summary, I spend a lot of training time for this project and also spend a lot of time to adjust the parameters to make sure the validation accuracy is higher. I briefly explained my motivation and multiple solution approach for this project and also showed some background setup. For the build on my current work, I think we can use transfer learning in the future, even though my project only contains binary class. However, if we use transfer learning, maybe the validation accuracy can reach to 100%.

(7) Acknowledgments

https://www.kaggle.com/c/dogs-vs-cats/overview/description

https://medium.com/@phidaouss/convolutional-neural-networks-cnn-or-convnets-d7c688b0a207

https://keras.io/

Project Code:

https://github.com/hung-weiLee/Cpts-570-Machine-Learning-Final-project