A17 – Convolutional Neural Networks

Introduction

Classifying images without needing to derive "hand-crafted" or extracted features such as color, eccentricity, area, etc. from the image set is the most notable ability of a convolutional neural network or CNN. The CNN derives the features of the images through a series of filters which learns abstractions about the image. Filtering is essentially convolution. If you recall our Fourier Transform activity back in Physics 165 we performed convolution many times using apertures of different sizes and 3x3 patterns. The effect of convolving an image with a pattern is that the output image looks like a smeared (abstracted) image of the pattern . This is where CNN gets its name. You can read the breakthrough CNN paper that won the ImageNet competition here [1] and learn about the history of deep learning in [2].

Detailed discussions about CNN can be found in the net but my favorite is the lecture notes from Stanford University. A PDF version is provided in the UVLE link.

There will be a lot more weights that need to be learned when you are using CNN. This means that the CNN will need a huge data set (order of 10^3 to 10^6) of labeled sample images for training. Fortunately, there are now many datasets freely available. However, a more complicated network will mean more computational resources need (RAM) and longer training times.

Procedure

1. Try the cats vs dogs challenge! The Kaggle website gives out machine learning challenges with prize money. You can form a team or go solo to enter their competitions. They have several huge datasets which you can freely use. In this activity, we will use their dogs and cats dataset. Warning : nearly 1GB.

2. Follow this step by step tutorial to continuously improve your classification with CNN beyond what the author achieved.

Reference

1. Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2012). Imagenet classification with deep convolutional neural networks. In Advances in neural information processing systems (pp. 1097-1105).

2. LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *nature*, *521*(7553), 436-444.

