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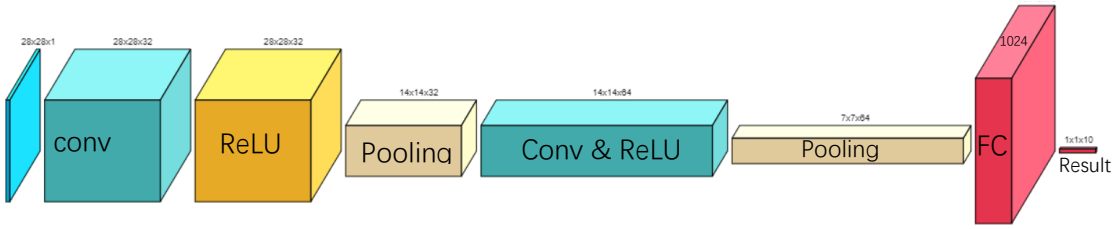
CNN Report

- **The structure and parameters of the CNN in cnn.ipynb are shown below:**

  I illustrated the first Convolution layer and ReLU layer explicitly, but I combined them together to save space. I trained the cnn 10000 times with batch size 50. Dropout was also used to avoid overfitting.



Layers	Output Size	Depth
Raw Image	28 * 28	1
Convolution1	28 * 28	32
ReLU1	28 * 28	32
Pooling1	14 * 14	32
Convolution2	14* 14	64
ReLU2	14 * 14	64
Pooling2	7 * 7	64
Fully Connected	1024 neurons, 1 layer	
Output layer	10 outputs	

- **The code is shown in cnn.ipynb and cnn2.ipynb**
- **Comparison and Analysis of CNN and NN**

The test accuracy of NN is 92.7%. However, CNN achieved 99.1%. This significant improvement showed that the architecture of Neural Network has huge impact on its performance. In NN, all pixels are considered same. In contrast, CNN encodes the knowledge that the input is an image by convolution process, which utilizes the spatial relationship of pixels. By sharing filter parameters of convolution layer, we can capture a feature wherever it appears in the image. We use different filters so that we can capture

different features in the image. Finally, we use a pooling layer to reduce the size of the output and parameters of the FC layer, which makes the CNN easier to train. This is the intuitive explanation of the performance improvement of CNN over NN.

I also explored smaller convolution depth and less FC layer nodes in cnn2.ipynb. As expected, the performance is a litter worse.

Reference:

1. https://mp.weixin.qq.com/s/ujw4_Ns6y6NaI1U2RuZfeQ