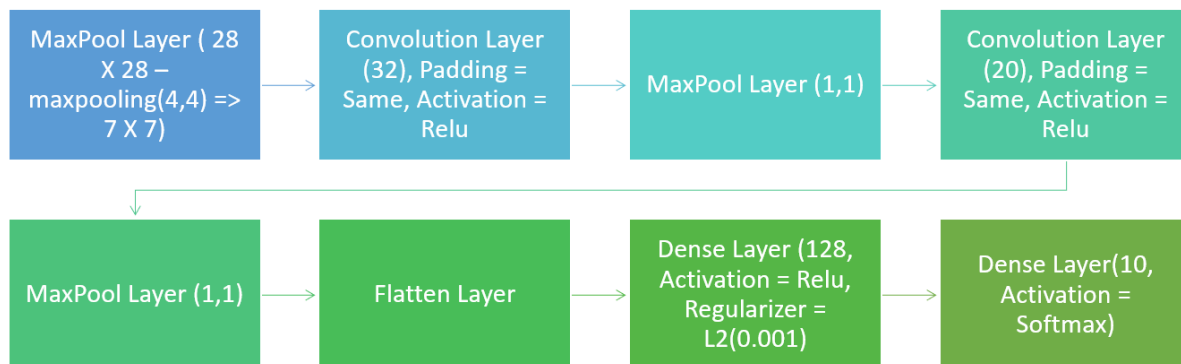


Project 2: Convolutional Neural Network - MNIST-fashion dataset

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Model Design



<u>Epochs</u>	<u>15</u>
<u>Training Accuracy</u>	<u>83.9%</u>
<u>Testing Accuracy</u>	<u>79.7%</u>

Design Description

As we applied the maxpooling layer on the original image from 28 x 28 to 7 x 7, we lost many of the features in the input image. Thus, I was able to achieve only 79.7% accuracy in the test data. However, I achieved 79.9% from original accuracy by adding more max pooling layer after convolutional layer.

Though the training data performed well by increasing more epoch (96% Training accuracy with 25 epochs), the model did not perform well on the testing data (Achieved only 77%) because of the model overfitting. To reduce the overfitting, I added L2 Regularization to the Dense layer to control the overfit.

By Hyperparameter Tuning, NADAM (Nesterov-accelerated Adaptive Moment Estimation) , employed for noisy gradients or for gradients with high curvatures, overperformed ADAM with learning rate 0.001

I experimented with Dropout layer, Batch Normalization Layer, and other optimizers, but the above setup performed well.

Model Summary

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
max_pooling2d (MaxPooling2D)	(None, 7, 7, 1)	0
conv2d (Conv2D)	(None, 7, 7, 32)	320
max_pooling2d_1 (MaxPooling2D)	(None, 7, 7, 32)	0
conv2d_1 (Conv2D)	(None, 7, 7, 20)	5780
max_pooling2d_2 (MaxPooling2D)	(None, 7, 7, 20)	0
flatten (Flatten)	(None, 980)	0
dense (Dense)	(None, 128)	125568
dense_1 (Dense)	(None, 10)	1290

Total params: 132,958
Trainable params: 132,958
Non-trainable params: 0

Epoch Result:

```
Epoch 1/15
188/188 [=====] - 2s 6ms/step - loss: 1.5791 - accuracy: 0.4902
Epoch 2/15
188/188 [=====] - 1s 6ms/step - loss: 0.9087 - accuracy: 0.6930
Epoch 3/15
188/188 [=====] - 1s 6ms/step - loss: 0.7984 - accuracy: 0.7369
Epoch 4/15
188/188 [=====] - 1s 6ms/step - loss: 0.7294 - accuracy: 0.7553
Epoch 5/15
188/188 [=====] - 1s 6ms/step - loss: 0.6861 - accuracy: 0.7710
Epoch 6/15
188/188 [=====] - 1s 6ms/step - loss: 0.6577 - accuracy: 0.7874
Epoch 7/15
188/188 [=====] - 1s 6ms/step - loss: 0.6454 - accuracy: 0.7845
Epoch 8/15
188/188 [=====] - 3s 13ms/step - loss: 0.6198 - accuracy: 0.8007
Epoch 9/15
188/188 [=====] - 2s 10ms/step - loss: 0.5769 - accuracy: 0.8105
```

```
Epoch 10/15
188/188 [=====] - 2s 9ms/step - loss: 0.5741 - accuracy: 0.8109
Epoch 11/15
188/188 [=====] - 2s 11ms/step - loss: 0.5689 - accuracy: 0.8106
Epoch 12/15
188/188 [=====] - 2s 8ms/step - loss: 0.5421 - accuracy: 0.8264
Epoch 13/15
188/188 [=====] - 2s 9ms/step - loss: 0.5238 - accuracy: 0.8261
Epoch 14/15
188/188 [=====] - 2s 9ms/step - loss: 0.5224 - accuracy: 0.8296
Epoch 15/15
188/188 [=====] - 2s 8ms/step - loss: 0.5042 - accuracy: 0.8392
Reading testing data
Pre processing testing data
evaluate
313/313 [=====] - 1s 3ms/step - loss: 0.6298 - accuracy: 0.7947
```