BONUS QUESTION:

3.5

(i) No, our MLP model does not do well on the new test set.
Accuracy = 0.11400000005960464

(ii) Convolution Neural Network Parameter Calculation:

Layer	Output Shape	Parameters
Input	28, 28, 1	0
Convolution Layer	22, 22, 64	(7*7*1+1)*64 = 3200
Max-Pooling	11, 11, 64	0
Flatten	7744	0
Fully Connected Layer	10	(7744*10+10) = 77450

Total Parameters = 80650

Multilayer Perceptron Parameter Calculation:

Layer	Output Shape	Parameters
Fully Connected Layer 01	128	(784+1)*128 = 100400
Fully Connected Layer 02	10	(128+1)*10 = 1290

Total Parameters = 101770

(iii) The in-domain accuracy = 0.878600001335144
The translated test-accuracy = 0.5479999780654907

(iv) Deeper Convolution Neural Network Paramter Calculation:

Layer	Output Shape	Parameters
Input	28, 28, 1	0
Convolution Layer 01	22, 22, 64	(7*7*1+1)*64 = 3200
Max-Pooling	11, 11, 64	0
Convolution Layer 02	10, 10, 128	(2*2*64+1)*128 = 32640
Max-Pooling	5, 5, 128	0
Flatten	3200	0
Fully Connected Layer	10	(3200*10+10) = 32010

Total Parameters = 67850

2-Layer CNN Paramters > 3-Layer CNN Parameters

(v) The in-domain accuracy = 0.8514000177383423
The translated test-accuracy = 0.5892000198364258

(vi) For degree = 90:
2-Layer MLP Accuracy = 0.045499999076128006
2-Layer CNN Accuracy = 0.05609999969601631

3-Layer CNN Accuracy = 0.053599998354911804

For degree = 180:
2-Layer MLP Accuracy = 0.10480000078678131
2-Layer CNN Accuracy = 0.20630000531673431
3-Layer CNN Accuracy = 0.054499998688697815

For degree = 270:
2-Layer MLP Accuracy = 0.06889999657869339
2-Layer CNN Accuracy = 0.053199999034404755
3-Layer CNN Accuracy = 0.054499998688697815

The 2-Layer and 3-Layer CNN do well on the initial two rotations but not on the third one.