

Machine Learning Homework 3

1. **Briefly** answer the following questions:

- (1) Why do neural networks need activation functions?
- (2) Briefly describe the influence of the value of the learning rate on the training of the neural network.
- (3) What advantages does CNN have over fully connected DNN in image classification?

2. The input size of AlexNet is $227 \times 227 \times 3$. Given CONV1:

(CONV1): 96 11×11 filters at stride 4, pad 0

What is the output size after CONV1? Write out the calculation process.

3. Convolution and Pooling Operations:

(1) The 4×4 feature map is convolved with a 3×3 convolution kernel (stride = 1). Calculate feature maps output in both cases respectively:

a) No padding;

b) 0 is padded around the feature map to keep the output feature size unchanged

1	2	3	0
0	1	2	3
3	0	1	2
2	3	0	1

Feature Map

2	0	1
0	1	2
1	0	2

Kernel

(2). The given feature maps are max-pooled and average-pooled respectively using a 2×2 pooling layer (stride = 2). Calculate the output feature map.

1	4	2	1
5	8	3	4
7	6	4	5
1	3	1	2

Feature Map