

Probabilistic Models of the Visual Cortex

Fall 2019 Homework 4

Prof. Alan Yuille

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Due on Dec 5 before the class. Late homework will not be accepted unless permission is obtained well in advance in documented extenuating circumstances. Please start early on the coding part and make sure the software (i.e. the jupyter notebook) works for you. If you have any questions about the homework, email TA Hongru Zhu: hzhu38@jhu.edu.

Question 1. Multilayer Perceptron (14 points)

1. Describe the basic ideas and structure (you may want to sketch it!) of multilayer perceptrons – at level of detail of the handout. (4 points) Why are multilayer perceptron better than single layer perceptrons? (3points)
2. What does the backpropagation algorithm do? (3 points) Derive the backpropagation equation for the peceptrons with one hidden unit with a sigmoid activation function. (4 points)

Question 2. Deep networks (26 points)

1. Describe the idea and the structure (you may want to draw or sketch it too!) of a convolutional neural network. (5 points) What is the main difference between multi-layer perceptrons and convolutional networks? (3 points) How does the convolution layer help convolutional networks do a better job in a image classification task? (3 points)
2. What is max-pooling? (2 points) What is average-pooling? (2 points) Why do we need pooling in deep network? (3 points)
3. What is the potential problem of using a sigmoid activation function in a deep convolutional networks?(3 points) What is a ReLU function and how does the ReLU activation function help solve the problem? (5 points)

Question 3. Experimental Section: Neural network (15 points)

In this question, you will build your own neural network to finish a classification problem. This project will require you to install the Tensorflow package in order to run the deep neural network training. Before you open the iPython notebook, follow Tensorflow to install Tensorflow. IPython notebook is used for this project, download the material from:

<http://nbviewer.jupyter.org/github/ccvl/VisualCortexCourse/blob/master/HW5/DeepNetwork.ipynb>