Psychology 209 – 2017

Homework #1 – Due Tuesday Jan 17, 2017 in class.

For this Homework, you will be working primarily from the part of the McClelland (2013) article assigned for Jan 12. Use this document as a template to answer the following questions. Open up as much space as you need for your answer after each question, or you can write your answers on a separate piece of paper.

You are welcome to work through this prior to class on Thursday, Jan 12. If you do you will be well-prepared for the discussion in class.

1. John woke up, looked out the window, and saw that the ground was wet. He wanted to figure out if it had rained overnight, given that the ground was wet. Call this p(R|W). If was January, and John believed that the base rate or prior probability of raining overnight in January p(R), is .25. John believed that the probability that the ground would be wet if it had in fact rained p(W|R) was .9, while the probability that the ground would be wet if there was no rain overnight p(W|NoR) would be about .2 (John’s neighbor had a sprinkler system that occasionally made the ground wet when it didn’t rain. John used Bayes formula to obtain an estimate of the probability that it had rained overnight, given that the ground was wet. Write down the formula John used to calculate this estimate, plug in the numbers, and show the resulting estimate. I am showing a notation below that doesn’t involve any fancy formatting but refers to the above quantities, places them in the right relationship, and shows all the work requested, so you can follow this model for subsequent questions, and see if you are on the right track.

P(R)\*P(W|R)/(P(R)\*P(W|R) + (1-P(R))\*P(W|NoR)) = .25\*.9/(.25\*.9 + .75\*.2) = .6

Note that we are not concerned about the notation itself and it is ok to write your answers by hand on a separate piece of paper.

2. John observed an additional piece of evidence – as he looked out his window, he noticed that the sun was shining. He estimated that the probability of sunshine in the morning given rain the night before, p(S|R) was only .1, whereas he estimated that the probability of sunshine in the morning given no rain the night before was .3. This led John to revise his estimate. John relied on the assumption that the two pieces of evidence he had observed were conditionally independent to calculate his new estimate. Again, write down the formula John used, plug in the numbers, and show the resulting estimate.

3. Note 2 aspects of John’s assumptions that one might question, and discuss how they might affect his conclusions. 3 sentences max for each point. There are deeper and more superficial aspects you could question. More credit for diversity and depth.

4. Let’s create a pool of two neurons, one for the hypothesis that it rained overnight and one for the hypothesis that it didn’t rain overnight. The neurons will calculate activations corresponding to the posterior probability of the hypothesis that they stand for, based on the activations of two input neurons, one that is on when the ground is wet, and another than is on when the sun is shining. Write down expressions for the biases and connection weights in the network that will lead the first neuron to calculate the result you got in question 2 and that will lead the second neuron to calculate the complement of this quantity. For each neuron, write down its bias and its weights, using br and bnr for the bias weights, wrw and wnrw for the weights to the rain and no rain units from the wet input unit, and nrs and wnrs for the weights to the rain and no ran units from the sun input unit.

5. Finally, let’s create a neuron that uses the logistic function to calculate its activation based on the activations of two input neurons, one that is on when the ground is wet, and another than is on when the sun is shining. Write down expressions for the biases and connection weights in the network that will lead the neuron to calculate the result you got in question 2. Call the bias B and call the connection weights Ww (weight from ‘wet’), and Ws (weight from ‘sun’). calculate and write down the numerical values of these weights. Then write down the net input to the unit. Using the exp function, calculate and display exp(net) and exp(-net). Then calculate the activation using both versions of the logistic function, as given at the bottom of page 12 and the top of page 13.