CS 188 HW 9 Challenge Question

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Collaborator: None

1 Naive Bayes and Perceptron

7.1) C,D,E,F

$$P(Y = spam|W = \{berkeley, rules\}) = P(Y = spam)(1/6)(1/8) = \frac{P(Y=spam)}{48}$$
$$P(Y = ham|W = \{berkeley, rules\}) = P(Y = ham)(1/8)(1/12) = \frac{1-P(Y=spam)}{96}$$
$$\implies P(Y = spam) > 1/3 \text{ to be classified as spam}$$

7.2) F,F,A,E

$$N_{spam} = 12$$
$$N_{ham} = 14$$
$$P(W = warning|Y = spam) = 1/12$$
$$P(W = social|Y = ham) = 1/14$$
$$P(W = office|Y = ham) = 0$$
$$P(Y = ham) = 2/3$$

7.3)

$$P(W = warning|Y = spam) = \frac{3}{12 + 2V}$$
$$P(W = social|Y = ham) = \frac{3}{14 + 2V}$$
$$P(Y = ham) = \frac{4}{7}$$

7.4) B. 0.7 is the only likely one in the list because increasing k to fix overfitting, which naturally will decrease the accuracy of model, but not to an extreme as increasing k causes all probabilities to converge uniformly (i.e., half-half split between spam and ham; hence 0.1 is not possible).

7.5) i) D. 2 choices for Y, V choices for W_i and W_{i-1}

ii) C. The new model will have more accuracy on the test data because it has more evidence variables it can use for determination.

7.6) Since the perceptron will classify the data correctly as A (due to highest activation score of 3), no changes will be made to the weights.

$$w_A = [1, 2]$$
$$w_B = [2, 0]$$
$$w_C = [2, -1]$$

7.7) The perceptron will classify the data entry as B (activation score of 2), which is incorrect given the real label. Therefore, w_B and w_C will be updated

$$w_A = [1, 2]$$
$$w_B = [-1, 0] - [-2, 1] = [1, -1]$$
$$w_C = [2, -2] + [-2, 1] = [0, -1]$$

7.8) C. Only w_B will converge by not changing throughout the training, whereas w_A and w_C will alternate between values. This can be seen by performing 1 iteration of training on the dataset

(a) $w_A = [1, 0], w_B = [1, 1], w_C = [3, 0]$ (initial condition)

(b) $w_A = [2, 1], w_B = [1, 1], w_C = [2, -1]$ (incorrectly identified A as C)

(c) $w_A = [2, 1], w_B = [1, 1], w_C = [2, -1]$ (correctly identified B)

(d) $w_A = [2, 1], w_B = [1, 1], w_C = [2, -1]$ (correctly identified C)

(e) $w_A = [1, 0], w_B = [1, 1], w_C = [3, 0]$ (incorrectly identified A as C; return to initial condition)