CSCI 6600/7350 Homework 3

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1. We have collected a data set of 14 data objects representing 14 different mushrooms. Each mushroom is labeled by a domain expert whether it is edible or poisonous. We would like to learn Bayes classifiers that will help us determine for any mushroom we may find in the future whether it is edible or poisonous. The three attributes chosen for describing the mushrooms, together with the possible values for each attribute are shown below:
   - Cap Shape: bell, flat, or convex
   - Cap Color: brown, grey
   - Odor: almond, spicy, foul

   Data:

Object	**Cap Shape**	**Cap color**	**Odor**	**Class**
X1	bell	brown	almond	edible
X2	flat	grey	almond	edible
X3	convex	grey	spicy	poisonous
X4	bell	brown	almond	edible
X5	flat	grey	almond	edible
X6	flat	grey	spicy	edible
X7	convex	grey	almond	edible
X8	bell	brown	almond	edible
X9	convex	brown	foul	poisonous
X10	bell	brown	spicy	edible
X11	bell	grey	almond	edible
X12	convex	grey	spicy	poisonous
X13	flat	brown	almond	edible
X14	flat	grey	foul	poisonous

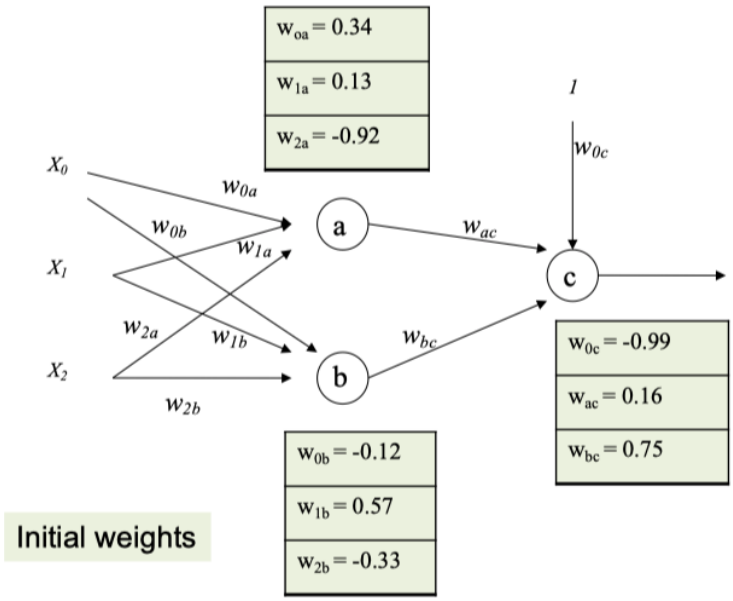
   a. Show the **naïve Bayes classifier** learned from this data
   Use Laplace smoothing for model parameter estimation:
   $\theta_{yi} = \frac{N_{yi}+1}{N_y+n}$, where $N_{yi} = \sum_{x \in T} x_i$ is the number of times feature *i* appears in a sample of class y in the training set *T*, $N_y = \sum_{i=1}^{n} N_{yi}$ is the total count of all features for class y, and n is the total number of data in the entire data set.

   b. Show the Bayes classifier with full joint density estimator learned from this data. Use 10^{-6} for probability of data not observed in the training set. Break ties consistently.

   c. Classify the following three mushrooms using the Bayes classifiers learned from problems a and b.
   Data:

Object	**Cap Shape**	**Cap color**	**Odor**	**class**
q1	bell	grey	almond	??
q2	convex	grey	spicy	??
q2	flat	brown	foul	??

2. Apply the **Back propagation** algorithm discussed in class to compute the weights of the ANN after training one example data $x_0=1$, $x_1=1$,$x_2=0$, and $y=1$. Assuming the current weights of the network are shown in the following network. Set the learning rate to 0.2.



3. Appy **Adaboost** for this problem.
   Given a data with 10 data objects, equally probable of being selected as training data:
   - at the first round, objects 2, 4, 6, 8, and 10 are selected as training data and objects 6 and 10 were misclassified by the resulting classifier, name this classifier C1;
   - at the second round, objects 1, 3, 5, 6, 10 were selected as training data, and objects 10 was misclassified by the resulting classifier, name this classifier C2;
   - at the third round, objects 2, 3, 5, 8 and 10 were selected as training data, and object 8 was misclassified by the resulting classifier, which is named C3.

Show:

- What is the probability of each object being selected as training example in the 4th round of the ensemble classifier construction?
- If a new data is classified to be class A by C1, to be class B by C2, and to be class A by C3. What should be the classification for this new data? Show your computations to support the answer.