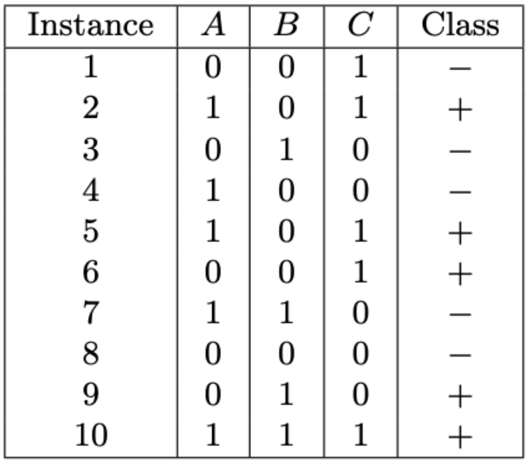
HW3
Deadline: 12/11

1. Consider the data set shown in Table 1.

Table 1. Data set.

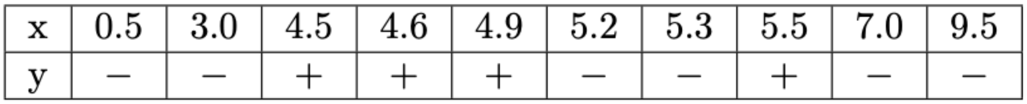


Instance	A	B	C	Class
1	0	0	1	$-$
2	1	0	1	$+$
3	0	1	0	$-$
4	1	0	0	$-$
5	1	0	1	$+$
6	0	0	1	$+$
7	1	1	0	$-$
8	0	0	0	$-$
9	0	1	0	$+$
10	1	1	1	$+$

   a) (18%) Estimate the conditional probabilities for P(A = 1|+), P(B = 1|+), P(C = 1|+), P(A = 1|−), P(B = 1|−), and P(C = 1|−).
   b) (10%) Use the conditional probabilities in part (a) to predict the class label for a test sample (A = 1, B = 1, C = 1) using the na¨ive Bayes approach.

2. Consider the one-dimensional data set shown in Table 2.

Table 2. Data set.



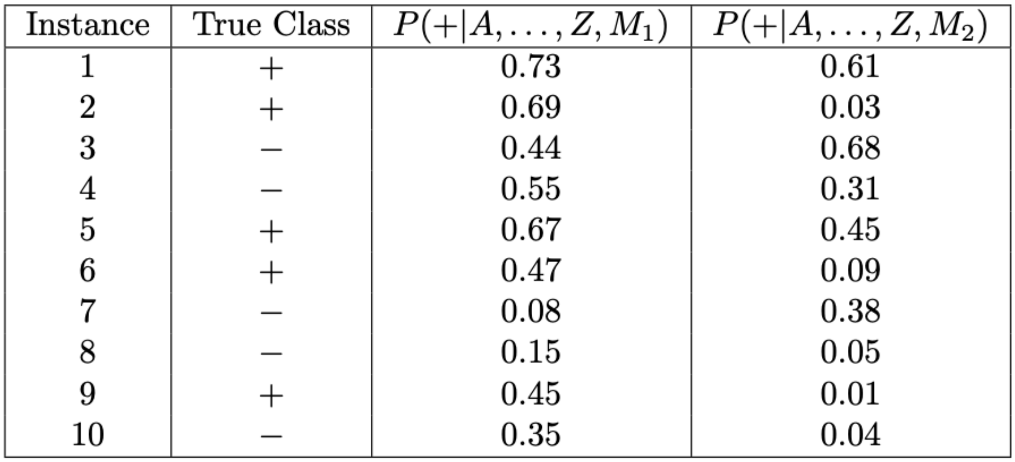
x	0.5	3.0	4.5	4.6	4.9	5.2	5.3	5.5	7.0	9.5
y	$-$	$-$	$+$	$+$	$+$	$-$	$-$	$+$	$-$	$-$

   a) (12%) Classify the data point x = 5.0 according to its 1-, 3-, 5-, and 9-nearest neighbors using **majority voting**.
   b) (12%) Classify the data point x = 5.0 according to its 1-, 3-, 5-, and 9-nearest neighbors using the **distance-weighted voting** approach.

3. You are asked to evaluate the performance of two classification models, M1 and M2. The test set you have chosen contains 26 binary attributes, labeled as A through Z.

   Table 3 shows the posterior probabilities obtained by applying the models to the test set. (Only the posterior probabilities for the positive class are shown). As this is a two-class problem, P(−) = 1−P(+) and P(−|A,...,Z) = 1−P(+|A,...,Z). Assume that we are mostly interested in detecting instances from the positive class.

Table 3. Posterior probabilities.



Instance	True Class	$P(+\|A,\ldots,Z,M_1)$	$P(+\|A,\ldots,Z,M_2)$
1	+	0.73	0.61
2	+	0.69	0.03
3	−	0.44	0.68
4	−	0.55	0.31
5	+	0.67	0.45
6	+	0.47	0.09
7	−	0.08	0.38
8	−	0.15	0.05
9	+	0.45	0.01
10	−	0.35	0.04

a) (12%,3%) Plot the ROC curve for both M1 and M2. (You should plot them on the same graph.) Which model do you think is better? Explain your reasons.

b) (15%) For model M1, suppose you choose the cutoff threshold to be t = 0.5. In other words, any test instances whose posterior probability is greater than t will be classified as a positive example. Compute the precision, recall, and F-measure for the model at this threshold value.

c) (15%,2%,1%) For model M2, suppose you choose the cutoff threshold to be t = 0.5. Compute the precision, recall, and F-measure for model M2 at this threshold value. Compare the F-measure results for both models. Which model is better? Are the results consistent with what you expect from the ROC curve?