
Artificial Intelligence II

Exercise 8

Q1. Naive Bayes

Your friend claims that he can write an effective Naive Bayes spam detector with only three features: the hour of the day that the email was received ($H \in 1, 2, \dots, 24$), whether it contains the word 'viagra' ($W \in yes, no$), and whether the email address of the sender is Known in his address book, Seen before in his inbox, or Unseen before ($E \in K, S, U$).

- (a) Flesh out the following information about this Bayes net:

Graph structure

Parameters:

Suppose now that you labeled three of the emails in your mailbox to test this idea:

spam or ham?	H	W	E
spam	3	yes	S
ham	14	no	K
ham	15	no	K

- (b) Use the three instances to estimate the maximum likelihood parameters.

- (c) Using the maximum likelihood parameters, find the predicted class of a new datapoint with $H = 3, W = no, E = U$.
- (d) Now use the three to estimate the parameters using Laplace smoothing and $k = 2$. Do not forget to smooth both the class prior parameters and the feature values parameters.
- (e) Using the parameters obtained with Laplace smoothing, find the predicted class of a new datapoint with $H = 3, W = no, E = U$.
- (f) You observe that you tend to receive spam emails in batches. In particular, if you receive one spam message, the next message is more likely to be a spam message as well. Explain a new graphical model which most naturally captures this phenomena.

Graph structure

Parameters: