Exercises for Machine Learning

Exercises 3

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Exercise 1

Consider a poker game consisting of two rounds, and where each player is initially dealt three cards. During the first round all three cards can be changed (FC), but during the second round at most two cards can be changed (SC). When deciding on whether to call or fold you can taken into account the number of cards changed by your opponent as well as your current hand (MH). After playing 20 games we have the results in Table 1, where BH shows who has the best hand.

Case number:	BH	MH	FC	SC
1	op	no	3	1
2	op	1a	2	1
3	draw	2 v	1	1
4	me	2 a	1	1
5	draw	fl	1	1
6	me	st	3	2
7	me	3 v	1	1
8	me	sfl	1	0
9	op	no	0	0
10	op	1 a	3	2
11	draw	2 v	2	1
12	me	2 v	3	2
13	op	2 v	1	1
14	op	2 v	3	0
15	me	2 v	3	2
16	draw	no	3	2
17	draw	2 v	1	1
18	op	fl	1	1
19	op	no	3	2
20	me	1 a	3	2

Table 1: Training data for constructing a poker classifier.

- Construct a naive Bayes classifier for the poker domain.
- Use the data cases to learn the maximum likelihood parameters in the model; if you feel comfortable with the estimation procedure, you only need to estimate the probabilities required for solving the exercise below.
- What class does your classifier assign to a case with *MH=1a*, *FC=1*, and *SC=1*?

Exercise 2 In the thumbtack experiment, let the nonnormalized prior distribution for θ be

$$f(\theta) = \begin{cases} \theta \text{ if } \theta \leq 1/2 \\ (1-\theta) \text{ if } 1/2 \leq \theta \leq 1 \end{cases}$$

(i) What is the normalization constant?

We have performed one experiment resulting in *up*.

(ii) What is the functional part of f_p, the posterior distribution for θ?

(iii) What is normalization constant for f_p?

(iv) What is the posterior Bayesian estimate?

Exercise 3 Consider the data in Table 2 and a Bayesian network consisting of two nodes T_1 and T_2, with T_1 being a parent of T_2. What are the maximum likelihood parameter estimates for the model given the data? What are the Bayesian parameter estimates for the model given the data?

		Last three letters							
		aaa	*aab*	*aba*	*abb*	*baa*	*bba*	*bab*	*bbb*
First two letters	*aa*	2	2	2	2	5	7	5	7
	ab	3	4	4	4	1	2	0	2
	ba	0	1	0	0	3	5	3	5
	bb	5	6	6	6	2	2	2	2

Table 2: The table shows the number of five-letter words ($T_1T_2T_3T_4T_5$) transmitted over a channel. For example, the word *abaab* has appeared four times, whereas *bbabb* has appeared six times.