Exercise 1 :

Solve Exercise 10.1 in PM.

Exercise 2 :

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 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 3 :

You want to predict whether a person will pay back a loan based on the features *Income*, *Houseowner* and *Marital Status* of the person. Domains and distance functions on the domains of these features are defined as follows:

Income	*low*	*medium*	*high*
low	0	1	2
medium	1	0	1
high	2	1	0

Houseowner	*yes*	*no*
yes	0	1
no	1	0

Marital Status	*unmarried*	*married*	*divorced*
unmarried	0	1	1
married	1	0	1
divorced	1	1	0

Define the distance between two examples by the sum of the distances for the three features.

Your training examples are:

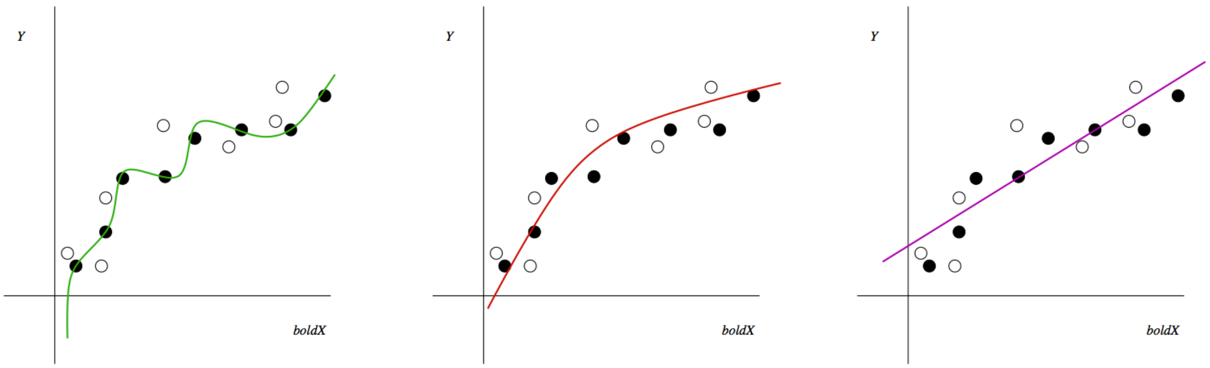
	Income	Houseowner	Marital Status	Pay back
1	high	yes	married	yes
2	high	yes	unmarried	yes
3	medium	no	divorced	no
4	low	yes	married	no
5	low	no	unmarried	no

Now you want to predict 'Pay back' for a new case with Income = high, Houseowner = no, Marital Status = divorced.

- What is the prediction obtained by the 1-nearest-neighbor rule?
- What is the prediction obtained by the 3-nearest-neighbor rule?
- What could be a sensible modification of the distance function such that you would get a different result from the 1-nearest-neighbor rule?

Exercise 4 :

The following graphs show three regression models learned from training examples (filled dots):



The open dots represent a set of future observations (or a validation set). Which of the three models has the smallest SSE on these future observations? No exact computations required – try to read it (approximately) off the graphs!

Exercise 5 :

Suppose you are working on a spam detection system. You formulated the problem as a classification task where "Spam" is the positive class and "not Spam" is the negative class. Your training set contains m = 1000 emails.

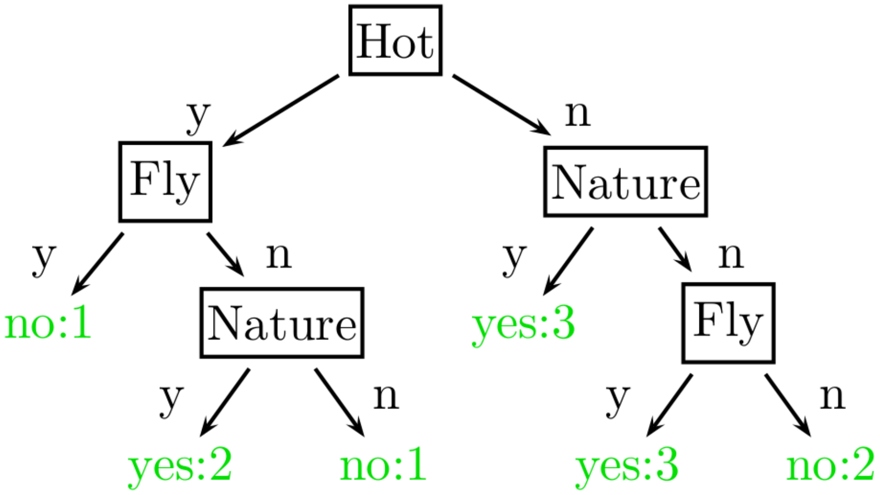
	Predicted Spam	Predicted not Spam
Actual Spam	8	2
Actual not Spam	16	974

Calculate the Accuracy, Recall, Specificity and Precision in this example.

How do your answers change if we now consider "Spam" the negative class and "not Spam" the positive class?

Exercise 6 :

Based on 12 training examples the following decision tree was learned:



Here, for example, the label "yes:2" at the end of the branch Hot=y, Fly=n, Nature=y means that there were two examples in the training set with Hot=y, Fly=n, Nature=y, and both examples had class label Likes=yes. Thus, the decision tree has 100% accuracy on the training data (all leaves are class pure).

Now suppose you have the following 5 examples (not used in the construction of the tree), which you want to use as a validation set:

Culture	Fly	Hot	Music	Nature	Likes
no	no	yes	yes	yes	no
no	no	yes	no	no	yes
yes	yes	no	no	no	yes
yes	no	yes	no	yes	yes
no	no	no	no	no	no

Based on these validation examples, we perform post-pruning of the decision tree:

- First check whether the ’Nature’ node reached by Hot=y, Fly=n should be pruned (eliminated)
- If yes, what does the new tree look like after pruning?
- Continue the pruning process by checking for other nodes whether they should be pruned (in a bottom-up order; the next candidate for pruning could be the ’Fly’ node reached by Hot=n, Nature=n).

Exercise 7 :

Look at this example, introduced in the lecture. Assuming the points are measurements from some experiment and the functions are fitting functions to predict further measurements. The left one is a linear function and the right one is a polynomial function. According to Ockham’s razor, which one of these functions is the better pick. Justify your answer briefly (in 2-3 sentences), highlighting why Ockhams razor prefers one of the functions and what the problem of overfitting would be in this case.

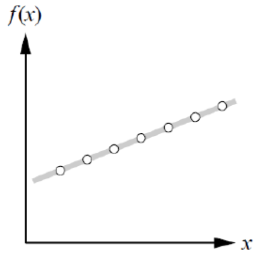


Figure 1: The linear function

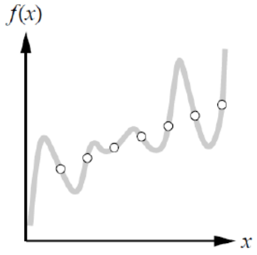


Figure 2: The polynomial function
