Practice Questions

The Multi-Layer Perceptron

1. Consider a neuron with 2 inputs, 1 output, and a threshold activation function. If the two weights are $w_1 = 1$ and $w_2 = 1$, and the bias is $b = -1.5$, then what is the output for $(0, 0)$? What about for inputs $(1, 0), (0, 1)$, and $(1, 1)$?

   Draw the discriminant function for this function, and write down its equation. Does it corresponds to any particular logic gate?

2. Work out the Perceptrons that construct logical NOT, NAND, and NOR of their inputs.

3. The parity problem returns 1 if the number of inputs that are 1 is even, and 0 otherwise. Can a Perceptron learn this problem for 3 inputs? Design the network and try it.

Text Mining

4. Train a topic model on **Bag of Words** Data Set from UCI Machine Learning Repository:

   (a) Find some topics that match with your intuition

   (b) Change the model so you don't have to choose the number of topics in advance

5. Use this data set also for clustering. Interpret the results.

Evolutionary Learning

6. Consider the n-queens problem:

   Given an $n \times n$ chessboard where n queens are to be placed so that in any row, column or diagonal stands no more than one queen.

   (a) Design a genetic algorithm for solving the n-queens problem.
   Try to find at least two different variants, how we can represent a solution as a chromosomes. Which crossover and mutation operators can be used for each variant? How do you determine the fitness value of a solution?

(b) Discuss the advantages and disadvantages of your solution representations.

(c) Think about and describe other (non-genetic algorithms) solution methods for the n-queens problem and discuss the pros and cons.

7. Convert the GA to use real-valued chromosomes and search for a maximum of the function $f(x) = x^4$, where x can take values between 0 and 2.

Graphical Models

8. Compute the most likely path throught the Hidden Markov Model (HMM) with the transition probabilities a_{ij}:

	Easy	OK	Hard
Previous time			
Easy	0.6	0.2	0.2
OK	0.5	0.3	0.2
Hard	0.4	0.1	0.5

and the observation probabilities b_{jk}:

	A	B	C
Easy	0.7	0.1	0.2
OK	0.1	0.6	0.3
Hard	0.3	0.3	0.4