Machine Learning – June 7, 2019

Time limit: **2 hours**.

Last Name   First Name   Matricola

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Note: if you are not doing the exam for ML 2018/19, write below name of exam, CFU, and academic year (when you were supposed to attend the course). Please specify also if you are an Erasmus student.

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EXERCISE 1

1. Describe with pseudo-code the K-Fold Cross Validation method to estimate the accuracy of a learning algorithm L on a dataset D.

2. Describe how the method can be extended to comparing two different learning algorithms L_A, L_B.

EXERCISE 2

Consider the following data set for binary classification, where the two classes are represented with white and black circles.

1. Draw in each of the diagrams below a possible solution for a method based on Perceptron with very small learning rate and a possible solution for a method based on SVM.

2. Describe the difference between the two solutions and briefly explain how these are obtained with the two methods.

3. Discuss which solution would you prefer and why.
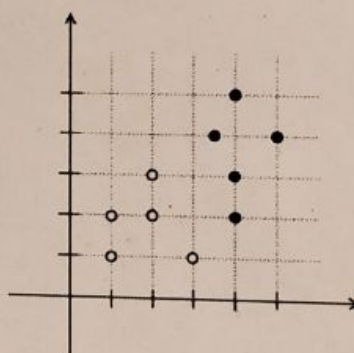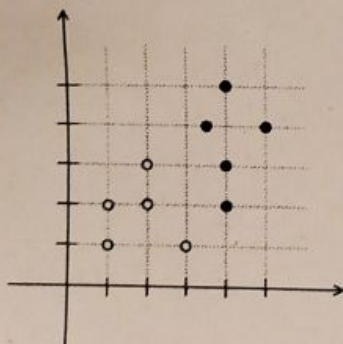
EXERCISE 3

1. Describe the k-armed bandit problem (also known as One-state MDP).

2. Describe the Reinforcement Learning procedure to compute the optimal policy in the k-armed bandit problem.

EXERCISE 4

Given a dataset D for a classification problem with classes $\{C_1, \ldots, C_n\}$.

1. Describe the difference between generative and discriminative probabilistic models for classification.

2. Draw a 2D dataset for a binary classification problem and show (also in a graphical form) a possible solution using a probabilistic generative model.

EXERCISE 5

1. Describe the convolution stage of a Convolutional Neural Network (CNN).

2. Discuss the properties of sparse connectivity and parameter sharing for CNN.

EXERCISE 6

Machine learning problems can be categorized in supervised and unsupervised.

1. Explain the difference between them providing a precise formal definition (not only explanatory text) in terms of input and output of the two categories of problems.

2. Describe an application problem that can be modelled and solved with an unsupervised learning method.