

# Machine Learning – February 12, 2019 - B

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 the principle of maximal margin used by SVM classifiers. Illustrate the concept with a geometric example.
2. Draw a linearly separable dataset for binary classification of 2D samples. Draw two solutions (i.e., two separation lines): one corresponding to the maximum margin, the other one can be any other solution.
3. Discuss why the maximum margin solution is preferred for the classification problem.

## EXERCISE 2

Given an unsupervised dataset  $D = \{\mathbf{x}_n\}$

1. Define the Gaussian Mixture Model (GMM) and describe the parameters of the model.
2. Draw an example of a 2D data set (i.e.,  $D \subset \mathbb{R}^2$ ) generated by a GMM with  $K = 3$ , qualitatively showing in the picture also the parameters of the model.
3. Determine the size of the model (i.e., number of independent parameters) for the dataset illustrated above.

## EXERCISE 3

1. Discuss the following statement: *“Accuracy is not always a good performance metric for classification”*.
2. Provide a numerical example to motivate your answer.

#### EXERCISE 4

Describe the typical stages of a single Convolutional layer in Convolutional Neural Networks (CNN).

#### EXERCISE 5

1. Describe the difference between exploitation and exploration in reinforcement learning and discuss why it is important to properly balance between the two strategies.
2. Describe how exploitation and exploration are generally implemented in RL algorithms. Illustrate this step with an abstract pseudo-code.

#### EXERCISE 6

1. Describe the K-nearest neighbors (K-NN) algorithm for classification.
2. Given the dataset below for the two classes  $\{star, plus\}$ , determine the answer of K-NN for the query point indicated with symbol o for  $K=1$ ,  $K=3$ , and  $K=5$ . Motivate your answer, showing (with a graphical drawing) which instances contribute to the solution.

