



Machine Learning Exercise (SS 22)

Assignment 1: k-nearest neighbors

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This assignment sheet consists of theoretical and programming tasks.

Submit your solution in ILIAS as a single PDF file.¹ Make sure to list full names of all participants, immatriculation number, study program and B.Sc. or M.Sc on the first page. Optionally, you can *additionally* upload source files (e.g. PPTX files). If you have any questions, feel free to ask them in the exercise forum in ILIAS.

Submission is open until Monday, 02 May 2022, 11:59 AM.

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¹Your drawing software probably allows to export as PDF. An alternative option is to use a PDF printer. If you create multiple PDF files, use a merging tool (like [pdfarranger](#)) to combine the PDFs into a single file.



K-Nearest Neighbors (Programming)

Task: Please download the Jupyter notebook `assignment1.ipynb`. Follow the instructions in the Jupyter notebook.

KNN (Theoretical) - Task 1

$$x_1 = \begin{bmatrix} 4 \\ 6 \end{bmatrix}, x_2 = \begin{bmatrix} 7 \\ 2 \end{bmatrix}, x_3 = \begin{bmatrix} 9 \\ 3 \end{bmatrix}, x_4 = \begin{bmatrix} 3 \\ 7 \end{bmatrix}, x_5 = \begin{bmatrix} 10 \\ 7 \end{bmatrix}, x_6 = \begin{bmatrix} 7 \\ 6 \end{bmatrix}$$

x_1 and x_2 in class C_1 x_3, x_4, x_5 in class C_2

Using squared Euclidean distance metric:

$$\text{Distance b/w } x_6 \text{ and } x_1 : [(7-4)^2 + (6-6)^2] = 3^2 = \underline{\underline{9}}$$

$$\text{Distance b/w } x_6 \text{ and } x_2 : [(7-7)^2 + (6-2)^2] = 4^2 = \underline{\underline{16}}$$

$$\text{Distance b/w } x_6 \text{ and } x_3 : [(7-9)^2 + (6-3)^2] = (-2)^2 + 3^2 = \underline{\underline{13}}$$

$$\text{Distance b/w } x_6 \text{ and } x_4 : [(7-3)^2 + (6-7)^2] = 4^2 + (-1)^2 = \underline{\underline{17}}$$

$$\text{Distance b/w } x_6 \text{ and } x_5 : [(7-10)^2 + (6-7)^2] = (-3)^2 + (-1)^2 = \underline{\underline{10}}.$$

With $K=1$: Distance b/w x_6 and x_1 is the smallest.
 $\therefore x_1$ is in class C_1 .
 \therefore x_6 is in class C_1 .

$K=3$: Distance b/w x_6 and x_1 ; x_6 and x_5 ;
and x_6 and x_3 is smaller.

x_1 is in class C_1 and x_5, x_3 are in class C_2

\therefore x_6 is in class C_2