

# Exam Machine Learning Techniques and Applications

90 minutes

12/14/2022

Use a different sheet for each part.

## 1 Deep learning - the basics (7 points)

**Question 1 (4 pts) :** Let's consider the following classification problem (each symbol represents a different class):

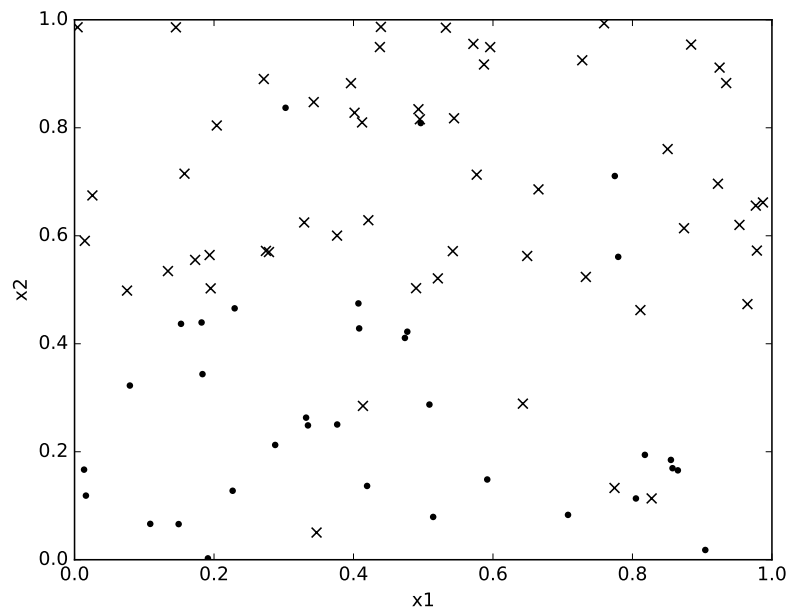


Figure 1: Data to classify

- What model is appropriate to learn from these data? Justify.
- You have at your disposal the dataset shown on figure 1, i.e. the set of couples  $\{(x_1, x_2), label\}$ . Describe precisely all the necessary steps to go from these data to the (best) learned model.
- Illustrate on figure 1 the separations between classes that your model will learn.

**Question 2 (2 pts) :** The class '.' of the previous example is now split in two classes (see figure 2). Same questions as before (explain only what changes).

**Question 3 (1 pt) :** Now data as images. For instance,  $x_1$  may represent the orientation of a “circle” (see figure 3a) and  $x_2$  the “middle width” of this “circle” (see figure 3b). Then the 3 classes would correspond to 0 ( $\times$ ), 8 ( $\blacksquare$ ) and  $\infty$  ( $\cdot$ ). What kind of model should you use for this problem? Justify.

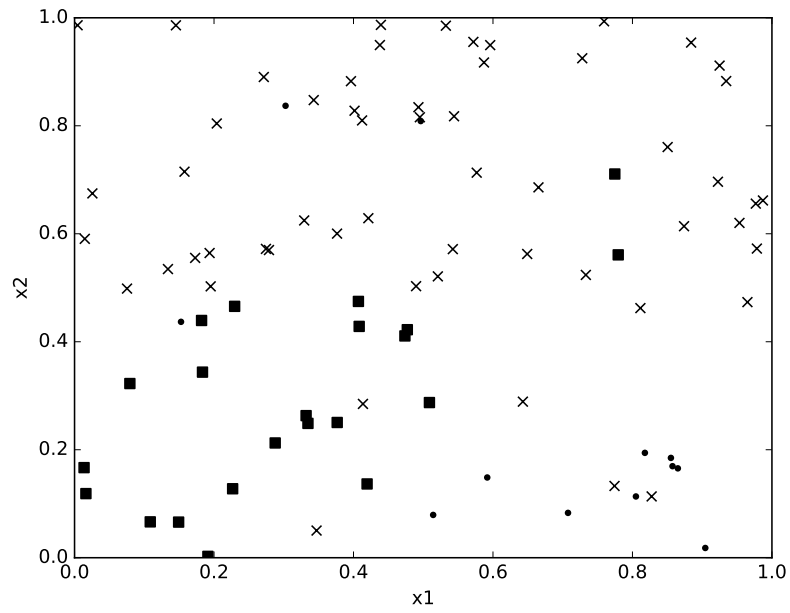


Figure 2: Data to classify



(a) For a given (low)  $x_2$ , from left to right, varying  $x_1$  from a low to a high value.



(b) For a given (low)  $x_1$ , from left to right, varying  $x_2$  from a low to a high value.