

Use of your own calculator allowed. No literature. You can keep this exam paper also after exam.

Perform all Problems 1-3 below. Each of them is worth of 4 points.

Problems:

1. Answer briefly to the following questions:

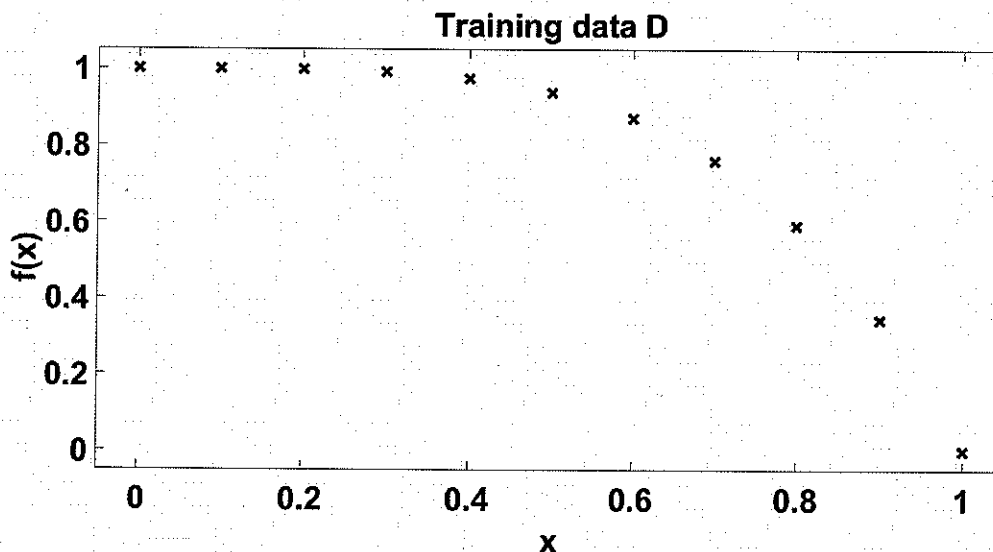
- (a) Mention five different real-world applications of machine learning. (1p.)
- (b) What kind of challenges/problems are there in designing and training of a machine? (You can consider just one particular example here, e.g. checkers playing machine, robotic vacuum, etc.) (1p.)
- (c) What is it meant by inductive bias? (1p.)
- (d) What is it meant by clustering? (1p.)

2. Consider a continuous function  $f(x)$  and the training data  $D$  below. Estimate the values  $y_1 = f(0.05)$ ,  $y_2 = f(0.6)$ , and  $y_3 = f(0.95)$  by

- (a) using the basic 3 nearest neighbors technique, (1p.)
- (b) fitting (by eye) the model  $f(x) \approx a + bx$  to the whole  $D$ , (1p.)
- (c) fitting (by eye) the model  $f(x) \approx a + bx$  to the 3 nearest neighbors only. (1p.)

Comment on the differences between the above estimators and the obtained estimate values. (1p.)

$$D = \{(x, f(x)) | (0.0, 1.0000), (0.1, 0.9999), (0.2, 0.9984), (0.3, 0.9919), (0.4, 0.9744), (0.5, 0.9375), (0.6, 0.8704), (0.7, 0.7599), (0.8, 0.5904), (0.9, 0.3439), (1.0, 0.0000)\}$$



3. Explain (using approx. 100-150 words) the following figure related to neural networks (a black-box machine). (3p.) In addition, describe briefly situations of machine learning in which a neural network is a good choice for a model. (1p.)

