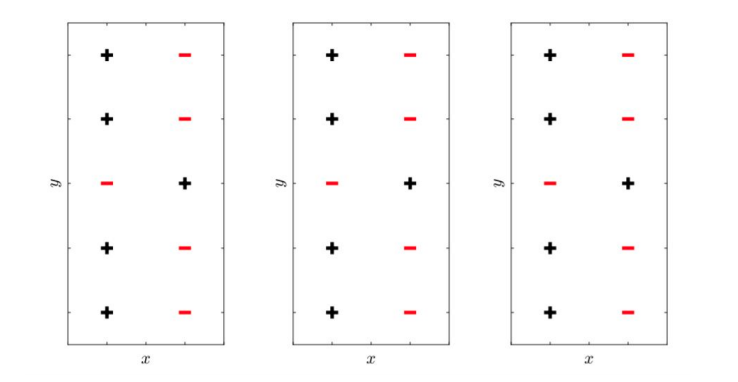
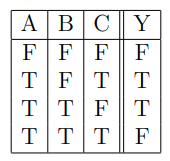
**Exercise 1** For the 2D data below, find and draw the decision boundaries for the best separation with

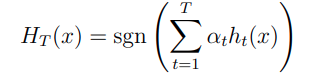
* a line,
* the nearest neighbor method and
* a decision tree of your choice.



**Exercise 2** Using the data table below, we want to construct a decision tree that classifies Y as True or False from the binary variables A, B, C. Compute the decision tree decision tree with entropy gain for this data and draw it.



**Exercise 3** ADABoost is a sequential aggregation method consisting in choosing classifiers in a pre-defined family to form a linear combination. After T steps, we obtain the classifier

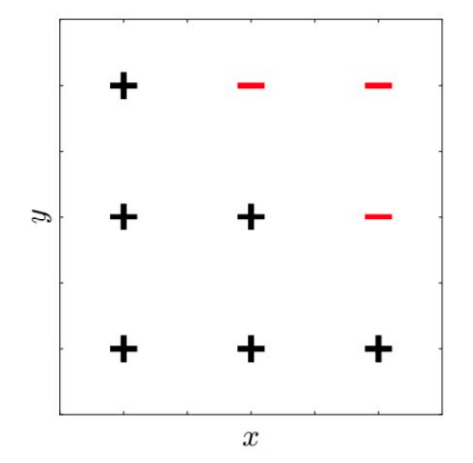


where the ht's have been chosen successively from the predefined family.

In this question, we will use as a predefined family decision trees of a certain depth, which classify a point into the category {1, -1} according to a sequence of thresholds on its coordinates, denoted x and y.

1. In this question we consider trees of depth 1.

(a) Propose an optimal depth-1 tree for the data in Figure 2.



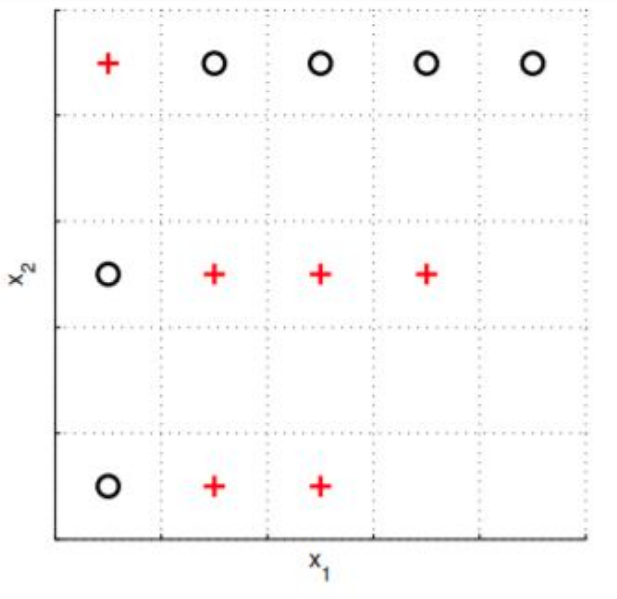
(b) Give an optimal tree for the second iteration of ADABoost and the H2 classifier composed of these first two trees.

(c) What is the error rate of H2?

(d) Draw the decision frontier for the H2 classifier.

2. Repeat the previous questions for trees of depth 2.

**Exercise 4** In this exercise we will analyze the behavior of ADABoost for the K-nearest neighbors. We consider the dataset of Figure 3 below. We restrict ourselves to classifiers of type K-nearest neighbors with K ≤ 5, i.e. our family of classifiers contains only 5 elements.



1. Give the first three steps of ADABoost and show the decision frontier of the resulting classifier obtained.

2. Give the frontier of the classifier with the highest weight among those obtained during the first 4 iterations.

**Exercise 5** Propose a way to extend ADABoost to the case of regression and show how it works on an example.