

SVMs

Q1-Build SVM. [4pts] Suppose we are given tiny two class data set (dots and squares) shown on fig. 1. Build SVM for this set.

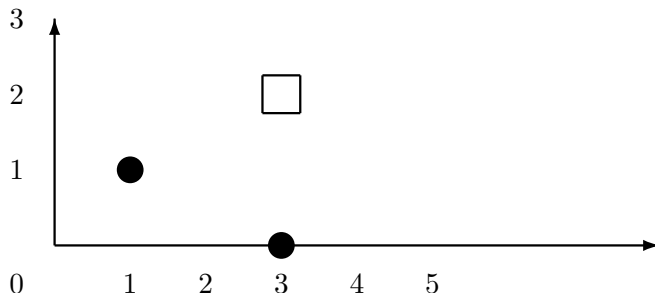


Figure 1: Tiny Data Set

You should do it all without any optimization steps (unnecessary in this case). You need to

- (2pts) Determine supporting vectors and prove that they are indeed supporting vectors
- (2pts) Give the construction of your hyperplane based on your supporting vectors

Q 2 - SVM properties. [4pts] Suppose we have a data set $\mathcal{D} \subset \mathbb{R}^n$ and $|\mathcal{D}| > n$.

1. Consider linearly separable case.

- (2pt) What is the maximum possible number of support vectors we can have in \mathcal{D} ?
- (2pt) What is the minimum possible number of support vectors in this case?

Bonus

Q 3 - VC – dim of class of ellipses in \mathbb{R}^2 . [3pts] Recall that the VC dimension of a family \mathcal{H} of classifiers is the largest number d such that there exists a set S of datapoints that has size d that can be shattered by \mathcal{H} (i.e. for any partitioning of the set S into $+$ and $-$ there is $h \in \mathcal{H}$ that separates them), but no set of size $d + 1$ can be shattered by members of \mathcal{H} . What is the VC dimension of the class of circles on the plane?

- (2pts) Show d points that are shattered by ellipses
- (3pts) Prove that no $d + 1$ points are shattered by ellipses.