Homework 3 (Written)

Problem 1

Prove Eqn (6) in Lecture 5, i.e.,

$$F1 = \frac{\text{TP}}{\text{TP} + \frac{\text{FN}+\text{FP}}{2}}$$

Problem 2

Consider the linear decision function

$$s(\boldsymbol{x}) = \boldsymbol{w}^T \boldsymbol{x} + b$$

as defined in Lecture 6, which deals with binary classification problems.

(a) Show that $\boldsymbol{w}$ is perpendicular (orthogonal) to every vector lying within the decision boundary.

(b) Show that the distance from the origin to the decision boundary is given by

$$\frac{|b|}{||\boldsymbol{w}||_2}$$

(c) Let $\boldsymbol{x}$ be an arbitrary point. Show that the distance from $\boldsymbol{x}$ to the decision boundary is

$$\frac{|y(\boldsymbol{x})|}{||\boldsymbol{w}||_2}$$

(Hint: Use the figure below to visualize the geometry.)

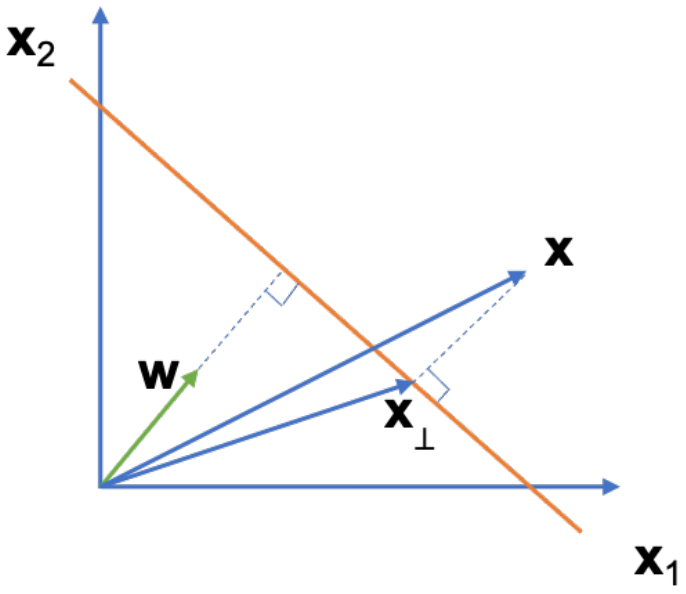

Figure 1: Illustration of Problem2

Problem 3

(a) What is t_i^2?

(b) Use Eqns. (8) and (12), and Part (a) to show Eqn. (13) in Lecture 6.

Problem 4 (MATH 5027 Only)

Show Eqn. (15) is the classification constraint, i.e., for any point $\boldsymbol{x}_i$, the inequality in Eqn. (15) holds.