## Instructions

You are encouraged to discuss on course materials and homework. However, you must write the final solutions alone and **understand** them fully. You can consult books, notes or other resources, but not copy from them. Also, make sure the scan of your homework submission should be very clean/understandable. Your solutions to the problems should be submitted in a single word/pdf document (following a logical sequence ) with your responses/arguments clearly presented. Supporting files such as the source codes should also be submitted if there's any programming assignment; and be well documented.

- Release Date: September 22, 2020
- Due Date: October 2, 2020

## A) Problems from the Textbook

### 0.1 VC Dimension, VC Dimension, VC Dimension

In the following exercises, you need to make your arguments convincing to get the points.

1. (5%) Do Exercise 2.2(b) of LFD.
2. (5%) Do Exercise 2.6 of LFD.
3. (10%) Do Problem 2.3(b) of LFD.
4. (10%) Do Problem 2.16 of LFD.
5. (10%) Do Problem 2.18 of LFD.

### 0.2 Perceptron Dimension versus VC Dimension

In the following exercises, you need to make your arguments convincing to get the points.

1. (10%) Do Exercise 2.4(a) of LFD.
2. (10%) Do Exercise 2.4(b) of LFD.

### 0.3 The Upper Bound

In the following exercises, you need to make your arguments convincing to get the points.

1. (10%) Do Exercise 2.7(a) of LFD.
2. (10%) Do Exercise 2.7(b) of LFD.
3. (10%) Do Problem 2.8 of LFD.

### 0.4 Pocket Algorithm

(10%) Do Exercise 3.2 of LFD.

1. Generate a data set of size 100 as directed by the exercise, and plot the examples $\{(x_n, y_n)\}$ as well as the target function $f$ on a plane. Be sure to mark the examples from different classes differently, and add labels to the axes of the plot. Generate a test set of size 1000 of the same nature.

2. Next, implement the pocket algorithm and run it on the data set for 1000 updates. Record $E_{in}(w(t))$, $E_{in}(w^*(t))$, $E_{out}(w(t))$, and $E_{out}(w^*(t))$ as functions of $t$ (where $E_out$ is estimated by the test set). Repeat the experiment for 20 times. Plot the average $E_{in}(w(t))$ and $E_{in}(w^*(t))$ as functions of t and briefly state your findings.