

Problem Set 4

1. Artificial Intelligence (7 points)

- (a) Describe what is computer vision and how it relates to machine learning.
- (b) Describe what are low-level, mid-level, and high-level vision features and give two examples for each (6 examples in total).

2. Artificial Neurons (10 points)

- (a) Describe what is Perceptron and Adaline and discuss what makes them similar as well as what makes them different.
- (b) Show the mathematical steps of learning a Perceptron model over two epochs, using the training data shown in Table 1, model weights initialized to 0, and learning rate of 0.2. For full credit, you must include the mathematical steps used to derive the weights and two tables showing weights at each training update round (4 rows per table) that indicate all weights used for each epoch.

| Sample | X_1 | X_2 | X_3 | Y |
|--------|-------|-------|-------|----|
| 1 | 0 | 0 | 0 | -1 |
| 2 | 1 | 1 | 0 | 1 |
| 3 | 1 | 0 | 1 | 1 |
| 4 | 0 | 1 | 0 | -1 |

Table 1: Data.

3. Gradient Descent (8 points)

- (a) Describe what is stochastic gradient descent, batch gradient descent, and mini-batch gradient descent and identify what makes them different from each other.
- (b) What gradient descent approach does Perceptron use?
- (c) What gradient descent approach does Adaline use?