Week 2 Exercises: Perceptrons

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(1.0 / 1.0 points)

For these exercises, it will be helpful to review the notes on Linear Classifiers and the Perceptron. You may also find it helpful to write some test code with a local python installation or in a google colab notebook.

1) Classification

Consider a linear classifier through the origin in 4 dimensions, specified by

$$\theta = (1, -1, 2, -3)$$

Which of the following points x are classified as positive, i.e. $h(x;\theta) = +1$?

1. $(1, -1, 2, -3)$
2. $(1, 2, 3, 4)$
3. $(-1, -1, -1, -1)$
4. $(1, 1, 1, 1)$

Enter a Python list with a subset of the numbers 1, 2, 3, 4: [1, 3]

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2) Classifier vs Hyperplane

Consider another parameter vector

$$\theta' = (-1, 1, -2, 3)$$

Ex2a

Does θ' represent the same hyperplane as θ does? yes

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Ex2b

Does θ' represent the same classifier as θ does? no

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3) Linearly Separable Training

As discussed in lecture and in the lecture notes, note that $\mathcal{E}_n(\theta, \theta_0)$ refers to the training error of the linear classifier specified by θ, θ_0, and $\mathcal{E}(\theta, \theta_0)$ refers to its test error. What does the fact that the training data are *linearly separable* imply?

Select "yes" or "no" for each of the following statements:

Ex3a

There must exist θ, θ_0 such that $\mathcal{E}(\theta, \theta_0) = 0$ no

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Ex3b

There must exist θ, θ_0 such that $\mathcal{E}_n(\theta, \theta_0) = 0$ yes

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Ex3c

A separator with 0 training error exists yes

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Ex3d

A separator with 0 testing error exists, for all possible test sets no

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Ex3e

The perceptron algorithm will find θ, θ_0 such that $\mathcal{E}_n(\theta, \theta_0) = 0$ yes

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4) Separable Through Origin?

Provide two points, (x_0, x_1) and (y_0, y_1) in two dimensions that are linearly separable but not linearly separable through the origin. If you get stuck try drawing a picture and review the notes on offsets.

Enter a Python list with two entries of the form `[[ x0, x1], label]` where label is `1` or `-1`. (So each entry represents a point with 2 dimensions and its label) [[[1,2],-1], [[2,4], 1]]

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