Week 1 Exercises

The questions below are due on Sunday September 10, 2017; 11:00:00 PM.

- Videos
    - Week 1, Lecture 1 (https:///introml.mit.edu/lecture_videos/lec1.mp4)
    - Week 1, Lecture 2 (https:///introml.mit.edu/lecture_videos/lec2.mp4)
- Class Notes for Week 1 (https://introml.mit.edu/__STATIC__/fall17/exercises/ex01/Wk1_notes.pdf)
- Required Exercises

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

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

. Which of the following points are classified as positive?

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]
```

2) Consider another parameter vector

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

.

1. Does θ' represent a different hyperplane than θ does? no

2. Does θ' represent a different separator than θ does? yes

3) Does the fact that the training data are *linearly separable* mean:

1. There exists θ, θ_0 such that $\mathcal{E}(\theta, \theta_0) = 0$ no

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

3. A separator with 0 training error exists yes

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

5. There is an efficient computational algorithm for finding θ, θ_0 such that $\mathcal{E}_n(\theta, \theta_0) = 0$ yes

4) Provide 4 points in 2 dimensions that are linearly separable but not linearly separable through the origin.

Enter a Python list with one or more entries of the form `[[ x0, x1], label]` where label is 1 or -1 `[[[2,0], -1, [[4, 0], 1]]`

5) Give values for θ (two dimensions, no offset), x (two dimensions), and y ($+1$ or -1) such that:

- θ misclassifies the pair (x, y)
- after the perceptron update, the new θ value also misclassifies the pair (x, y)

Enter a Python list of the form `[[ th_1, th_2], [x_1, x_2], y]` where `[th_1, th_2]` are the components of θ, `[x_1, x_2]` are the components of x and `y` is a label (`1` or `-1`)

`[[-1,1], [1,-1], 1]`