Week 6 Exercises

The questions below are due on Sunday October 15, 2017; 11:00:00 PM.

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- Videos
  - Week 6, Lecture 1 (https:///introml.mit.edu/lecture_videos/lec_week6.mp4)
- Class Notes for Week 6 (https://introml.mit.edu/__STATIC__/fall17/exercises/ex06/Wk6_notes.pdf)
- Required Exercises

1) Define $\phi(x) = [x_1, x_2^2, \ldots, x_d^d]$

a) What is $\phi([3, 2, 1])$?

Enter a Python list of numbers.

```
[3,4,1]
```

b) Consider the kernel k associated with feature function ϕ. What is $k([3, 2, 1], [5, 1, 2])$?

Enter a number. 27

2) Reconsider the first problem in HW 1.

Let's apply the perceptron algorithm (through the origin) to a small training set containing three points:

i	Data Points $x^{(i)}$	Labels $y^{(i)}$
1	$[1, -1]$	1
2	$[0, 1]$	-1
3	$[-1.5, -1]$	1

Given that the algorithm starts with $\theta^{(0)} = 0$, the first point that the algorithm sees is always a mistake. The algorithm starts with *some* data point (to be specified in the question), and then cycles through the

data until it makes no further mistakes.

a) If we run the perceptron algorithm on this data set starting with data point $x^{(1)}$, the final weight vector θ can be written as $\alpha_1 y^{(1)} x^{(1)} + \alpha_2 y^{(2)} x^{(2)} + \alpha_3 y^{(3)} x^{(3)}$. Provide values for α_1, α_2, and α_3.

Enter a Python list of 3 numbers corresponding to the α_i.

```
[1, 0, 1]  #number of misses per point
```

b) Now, change the data set so that $x^{(3)} = [-10, -1]$. Still start with data point $x^{(1)}$. Answer the same question as above.

Enter a Python list of 3 numbers corresponding to the α_i.

```
[5, 0, 1]
```