4. Feature Vectors

Ungrading Note: The problems on this page should be placed after lecture 5. Hence, **all problems on this page are ungraded, and will reappear in Homework 3.** Feel free to work on these for fun now, especially parts (a) to (d).

Consider a sequence of n-dimensional data points, $x^{(1)}, x^{(2)}, \ldots$, and a sequence of m-dimensional feature vectors, $z^{(1)}, z^{(2)}, \ldots$, extracted from the x's by a linear transformation, $z^{(i)} = Ax^{(i)}$. If m is much smaller than n, you might expect that it would be easier to learn in the lower dimensional feature space than in the original data space.

4. (a)

0 points possible (ungraded)
Suppose $n = 6$, $m = 2$, z_1 is the average of the elements of x, and z_2 is the average of the first three elements of x minus the average of fourth through sixth elements of x. Determine A.

Note: Enter A in a list format: $[[A_{11}, \ldots, A_{16}], [A_{21}, \ldots, A_{26}]]$

[[1/6,1/6,1/6,1/6,1/6,1/6]] ✔

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4. (b)

0 points possible (ungraded)
Using the same relationship between z and x as defined above, suppose $h(z) = sign(\theta_z \cdot z)$ is a classifier for the feature vectors, and $h(x) = sign(\theta_x \cdot x)$ is a classifier for the original data vectors. Given a θ_z that produces good classifications of the feature vectors, determine a θ_x that will identically classify the associated x's.

Note: Use `trans(...)` for transpose operations, and assume A is a fixed matrix (enter this as `A`).

Note: Expects θ_x (an $[n \times 1]$ vector), not $\theta_x^\top$.

$\theta_x =$ trans(A)*theta_z ✔

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4. (c)

0 points possible (ungraded)
Given the same classifiers as in (b), if there is a θ_x that produces good classifications of the data vectors, will there **always** be a θ_z that will identically classify the associated z's?

Note: A is a fixed matrix.

- ○ Yes
- ◉ No ✔

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4. (d)

0 points possible (ungraded)

Given the same classifiers as in (b), if there is a θ_x that produces good classifications of the data vectors, will there **always** be a θ_z that will identically classify the associated z's?

Note: Now assume that $\boxed{\text{you can change the } m \times n \text{ matrix } A.}$

- (•) Yes ✔
- ( ) No

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4. (e-1)

0 points possible (ungraded)

If $m < n$, can we find a more accurate classifier by training in z-space, as measured on the training data?

- ( ) Yes
- (•) No ✔
- ( ) Depends

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4. (e-2)

0 points possible (ungraded)

How about on unseen data?

- ( ) Yes
- ( ) No
- (•) Depends ✔

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Discussion

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Topic: Unit 1 Linear Classifiers and Generalizations (2 weeks):Homework 1 / 4. Feature Vectors