Final exam review

Ashwin Bhola

CDS, NYU

Dec 11th , 2019

Announcements

Office Hour: Thursday, 1-2 PM, Room 650, CDS

Monday, 2:30 PM, Open Space, CDS

Final Exam: 17th December, 2 - 3:50 PM

Review

1. We are interested in the solution x^* of the least squares problem: $\min_{x \in \mathbb{R}^n} ||Ax - y||^2, y \in \mathbb{R}^m, A \in \mathbb{R}^{m \times n}, m > n.$

   Suppose it is given to us that $A^T A = I$. If y is orthogonal to $Im(A)$, determine x^*

2. Minimize $x + y + z$ subject to $e^{-x} + e^{-y} + e^{-z} = 1$ assuming that this optimization problem has a minimizer

3. Which of the following sets S are convex:

   1. S = $\{x \in \mathbb{R}^n \mid ||x||_\infty \leq 1\}$

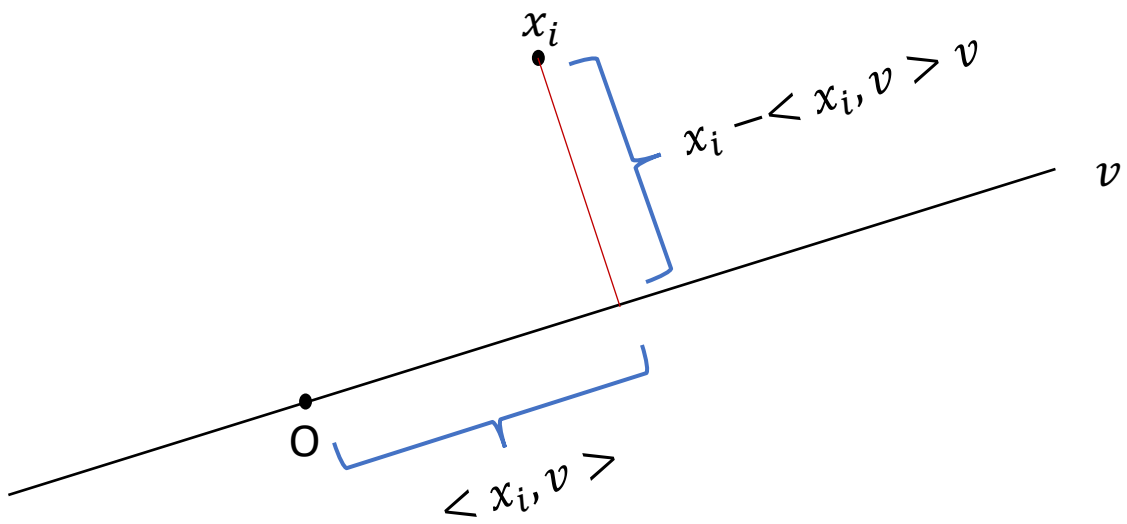
   2. S=$\{x \in \mathbb{R}^{2n} \mid \sum_{i=1}^{n} x_i^2 \leq \sum_{i=n+1}^{2n} x_i^2\}$

4. True or False: $h(x) = f(g(x))$ is convex if f, g are convex functions

Review

1. Suppose that we are performing PCA on n data points $a_1, \ldots, a_n \in \mathbb{R}^d$ and keep only the first $k < d$ principal components of each point. We store the dimensionally reduced dataset in a $n \times k$ matrix B, where $B_{i,j}$ is the projection of the point a_i on the j^{th} principal component. Show that the columns of B are orthogonal

PCA to Autoencoders



$$\min_{\substack{V \in \mathbb{R}^{d \times k} \\ V^T V = I_k}} \Sigma_i \left|\left| x_i - V V^T x_i \right|\right|^2$$

PCA to Autoencoders

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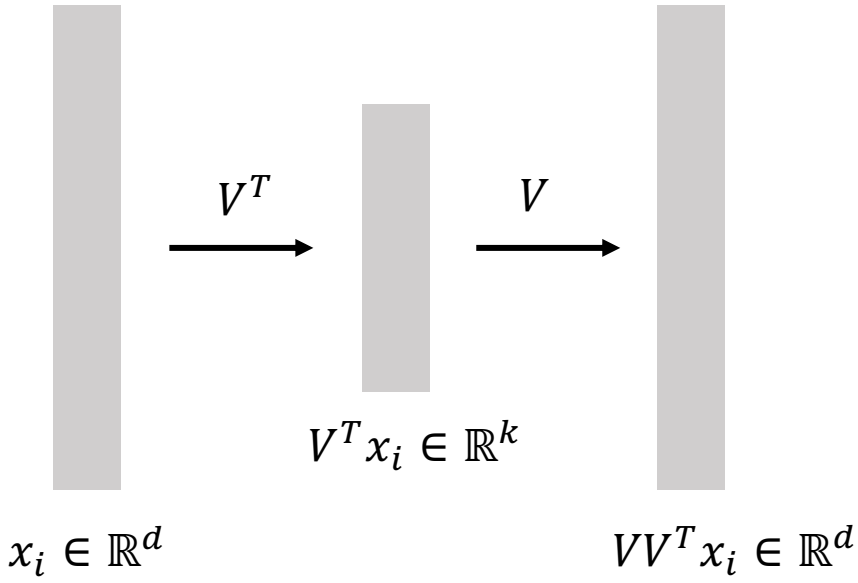

PCA to Autoencoders

$$\min_{U,V \in \mathbb{R}^{d \times k}} \Sigma_i \left|\left| x_i - UV^T x_i \right|\right|^2$$