HOMEWORK ASSIGNMENT 8

Name: **Due:** Friday April 19, 4pm

Problem 1:

Compute $A^T A$ and AA^T and their eigenvalues and unit eigenvectors for V and U.

$$A = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix}.$$

Check $AV = U\Sigma$ (this decides $\pm$ signs in U). Σ has the same shape as A: 2 by 3.

Problem 2:

Suppose A has orthogonal columns $\mathbf{w}_1, \mathbf{w}_2, \ldots, \mathbf{w}_n$ of lengths $\sigma_1, \sigma_2, \ldots, \sigma_n$. What are U, Σ and V in the SVD?

Problem 3:

Compute $A^T A$ and AA^T and their eigenvalues and unit eigenvectors when the matrix is $A = \begin{bmatrix} 3 & 4 & 0 \end{bmatrix}$. What are the singular values of A?

Problem 4:

Calculate the singular value decomposition of A:

$$A = \begin{bmatrix} 3 & 4 & 0 \end{bmatrix} = \begin{bmatrix} \mathbf{u}_1 \end{bmatrix} \begin{bmatrix} \sigma_1 & 0 & 0 \end{bmatrix} \begin{bmatrix} \mathbf{v}_1 & \mathbf{v}_2 & \mathbf{v}_3 \end{bmatrix}^T.$$

Write out the pseudoinverse $V\Sigma^+U^T$ of A. Compute AA^+ and A^+A:

Problem 5:

Find A^+ and A^+A and AA^+ and $\mathbf{x}^+$ (shortest length least square solution) for this matrix $A = U\Sigma V^T$ (the SVD is given below) and these $\mathbf{b}$:

$$A = \begin{bmatrix} 3 \\ 4 \end{bmatrix} = \begin{bmatrix} .6 & -.8 \\ .8 & .6 \end{bmatrix} \begin{bmatrix} 5 \\ 0 \end{bmatrix} \begin{bmatrix} 1 \end{bmatrix} \qquad \mathbf{b}_1 = \begin{bmatrix} 3 \\ 4 \end{bmatrix} \text{ and } \mathbf{b}_2 = \begin{bmatrix} -4 \\ 3 \end{bmatrix}$$

Problem 6: Challenge Problems from the zyBook

Challenge activity 8.1.1 of the zyBook. This is not optional.

Problem 7:

Read Section 9.1 from the zyBook (Markov chains) and do all of the participation exercises therein. Which concept was most confusing for you?