

HOMEWORK ASSIGNMENT 9

Name:

Due: Monday April 29, 4PM

PROBLEM 1:

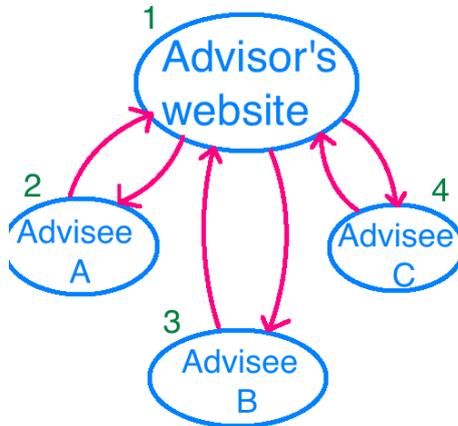
Part a. Find a basis for the plane (2d subspace) of best fit through the origin for the points $(1, 1, 1, 1)$, $(1, -1, 2, 1)$, $(1, 0, 3, 0)$, $(-2, 0, 0, 1)$, $(0, 0, 0, -1)$.

You are given part of the (approximate) SVD:

$$\begin{bmatrix} 1 & 1 & 1 & -2 & 0 \\ 1 & -1 & 0 & 0 & 0 \\ 1 & 0 & 3 & 0 & 0 \\ 1 & 1 & 0 & 1 & -1 \end{bmatrix} = \begin{bmatrix} .6 & -.7 & .4 & .1 \\ .1 & .1 & -.2 & .9 \\ .8 & .4 & .3 & -.2 \\ .1 & .6 & .8 & .1 \end{bmatrix} \Sigma V^T$$

Part b. Write the projection of each of the points onto the plane of best fit in terms of the basis you found above. Use this to plot these projections in a plane. (Hint: you may assume and use that the columns of U are orthonormal).

PROBLEM 2:



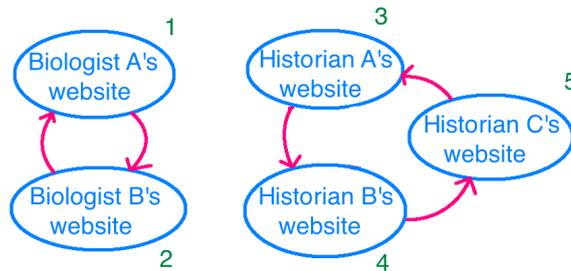
a) Write the naive transition matrix A for this graph (this would correspond to $\alpha = 0$), adhering to the numbering of nodes shown in the image.

b) Calculate the following four vectors:

$$A \begin{bmatrix} .25 \\ .25 \\ .25 \\ .25 \end{bmatrix}, \quad A^2 \begin{bmatrix} .25 \\ .25 \\ .25 \\ .25 \end{bmatrix}, \quad A^3 \begin{bmatrix} .25 \\ .25 \\ .25 \\ .25 \end{bmatrix}, \quad A^4 \begin{bmatrix} .25 \\ .25 \\ .25 \\ .25 \end{bmatrix}$$

- c) Why is there no steady state for the chain $A^k \begin{bmatrix} .25 \\ .25 \\ .25 \\ .25 \end{bmatrix}$? Note that you would **not** be able to determine a page rank here by iterating multiplication by A .
- d) What is the transition matrix B with damping $\alpha = .15$? What's the eigenspace of 1 for B ?
- e) Calculate the page rank with damping using part d).

PROBLEM 3:



- a) Write the naive transition matrix A for this graph (this would correspond to $d = 1$), adhering to the numbering of nodes shown in the image.
- b) Calculate the eigenspace of 1 for A . Explain how this would lead to multiple different page ranks.
- c) Calculate the transition matrix B with $\alpha = .15$, and find the eigenvector with eigenvalue 1 and entries summing to 1. What is the page rank with damping?

PROBLEM 4: CHALLENGE PROBLEMS FROM THE ZYBOOK

Do challenge activity 9.9.1 in the zyBook.

PROBLEM 5:

What were your thoughts on the zyBook this semester? Would you prefer it to a traditional textbook for this class?