Math 229: Applied Linear Algebra
Fall 2017

Professor Skardal
Trinity College

Computational Homework 4 Cover Page

Due Friday, December 1 (at the beginning of class)

Name (Print): _____

This assignment contains 2 problems. Write your name in the space above and put your initials on the top of every page, in case the pages become separated.

- Email me your code (`persebastian.skardal@trincoll.edu`) in a single `.zip`-file named `lastname##.zip` with the subject line `lastname homework##`. (Replace `##` with the assignment number, e.g., `02` for the second assignment.). Your code should be neatly written and well commented. Organize your code appropriately into different `.m`-files for different problems.
- If a written portion is required, complete it NEATLY on 8.5 x 11 white paper. Assignments completed on lined paper will not be accepted.
- If multiple sheets of paper are necessary, staple your assignment before coming to class. Unstapled assignments will not be accepted.
- Include this cover page at the front of your assignment. Assignments missing this cover page will not be accepted.
- If plots or figures are requires, print and include them in this packet. Assignments missing the required plots and figures will be considered incomplete.
- Organize your assignment in the proper order. Assignments in the wrong order will not be accepted.
- Late homework will not be accepted.

Do not write in the space below.

Problem	1	2(a)	2(b)	2(c)	2(d)	Total
Points						
Score						

1. Write a MATLAB *function* called `PowerMethod.m` that implements the power method to calculate the eigenvector, eigenvalue pair $v_{\max}$, $\lambda_{\max}$ of a square matrix A. Your code should take as an input the matrix A, an initial vector x_0 to start the power method, and the number of iterations k. Your code should output the eigenvector $v_{\max}$ and the eigenvalue $\lambda_{\max}$.

2. Now you will calculate the PageRank centrality of a set of $N = 1000$ webpages on the Notre Dame server:

   (a) On the course website is a dataset given in `NotreDame.txt`. This file represents a list of links in the network. For example, the top line, `1 870`, says that a link exists *from* node `1` *to* node `870`. Write a MATLAB *function* called `Adjacency.m` that takes as an input this 8732×2 matrix representing the list of link in the network and outputs the 1000×1000 adjacency matrix A. Recall that the entries of A are defined as

   $$A_{ij} = \begin{cases} 1 & \text{if } j \to i \\ 0 & \text{otherwise.} \end{cases}$$

   (b) Next, write a MATLAB *function* called `Transition.m` that takes as an input the adjacency matrix A from above, as well as a teleportation parameter α, and outputs a transition matrix Π associated PageRank.

   (c) Finally, write a MATLAB *script* called `PageRank.m` that imports the dataset, uses the functions `Adjacency.m` and `Transition.m` to build the transition matrix Π, then uses your function `PowerMethod.m` to compute the PageRank vector p^∞.

   Using a teleportation parameter of $\alpha = 0.1$, calculate the PageRank vector and find the *five* top-ranked webpages. What are their indices? What are their respective values (i.e., their respective entries in p^∞)?

   Note: To find the top ranked webpages, consider using the built-in `max` function in MATLAB. For instance, the command `[val,ind] = max(p);` will calculate the maximum entry of p, save it in the variable `val`, then save its index in the variable `ind`.

   (d) Do the same for a teleportation parameter of $\alpha = 0.05$ and $\alpha = 0.2$. How does the ranking of the top five webpages change?