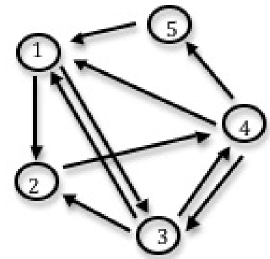
1. Find the PageRank vector for the webpages depicted in the following graph:



2. Use the power method to find the PageRank vector associated with the Stanford web. Use the file 'stanford.jld' (along with the JLD package) to import the data into Julia. List the ten highest ranking pages along with their corresponding entries in the PageRank vector. (*You need to use the version of the power method adapted for sparse matrices.*)

3. (*QR Algorithm*)

   (a) Write a MATLAB script to implement the QR algorithm to find the eigenvalue of a matrix A by constructing the sequence given by

   $$A_o = A, \qquad A_{k+1} = R_k Q_k \quad \text{where} \quad A_k = Q_k R_k.$$

   Include your code with the project.

   (b) Use your code to find the eigenvalues of

   $$A = \begin{bmatrix} 9 & -7 & -6 & -13 & -5 \\ -7 & 5 & -14 & -8 & -9 \\ -6 & -14 & 5 & -5 & -1 \\ -13 & -8 & -5 & 13 & 5 \\ -5 & -9 & -1 & 5 & 13 \end{bmatrix}$$

   Display the last matrix of the sequence of matrices you constructed. How many iterations did you use, and how did you decide when to stop?

4. (*Information Retrieval*) Download the file 'shake.jld', and load the corresponding data into Julia. It contains a Term-Document Matrix for 33 of Shakespeare's plays.

   (a) Construct a query using three words from the 'dictionary', and return all relevant documents. You may decide what 'relevant' means, but find a query that returns at least one document.

   (b) Repeat with a query using five words.

   (c) Construct a rank-10 approximation of the Term-Document Matrix, and repeat the queries from part (a) and (b) using this matrix. (This matrix is much too big to use the 'svd' command. You need to construct the approximation by first finding the eigenvalues and eigenvectors of $A^T A$.)

5. A Monopoly board has forty squares. Let A be the matrix such that the entires a_{ij} represent the probability of moving from square i to square j on one roll of a pair of dice. Find the matrix A and use the power method to rank the squares in order of the most likely to be landed on in the long run.

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