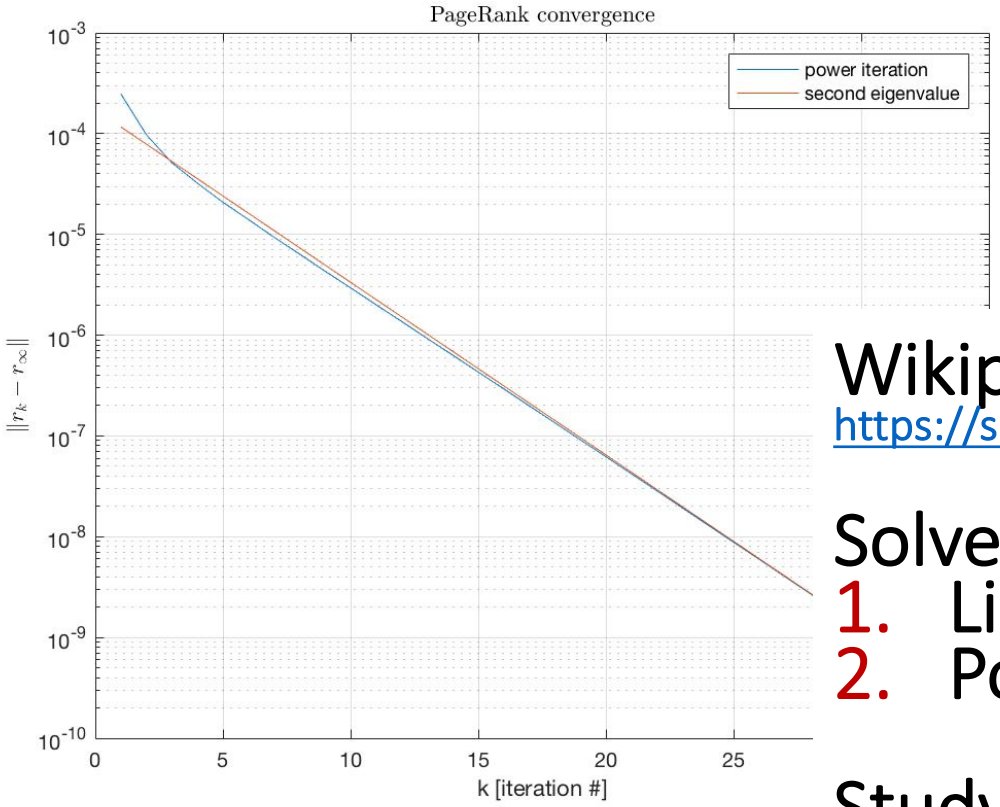
Network Science

Lab #4
Ranking

Timetable

- Lab 1 – Fri Oct 12
  - Scale free properties
- Lab 2 – Fri Oct 19
  - Albert-Baràbasi model
- Lab 3 – Fri Oct 26
  - Assortativity
- Lab 4 – Fri Nov 16
  - Ranking
- Lab 5 – Fri Nov 23
  - Community detection – Spectral
- Lab 6 – Fri Nov 30
  - Community detection – PageRank-Nibble
- Lab 7 – Fri Dec 7
  - Gephi

Lab 4 – PageRank



ASSIGNMENT a

Wikipedia voting dataset
https://snap.stanford.edu/data/wiki-Vote.html

Solve the PageRank equation by:

1. Linear system solution
2. Power iteration

Study:

- Speed (cpu time)
- Convergence of the power iteration (and its dependence on the eigenvalues of *M*)

Lab 4 – PageRank

PageRank equation

$$p = c\, M\, p + (1\text{-}c)\, q$$

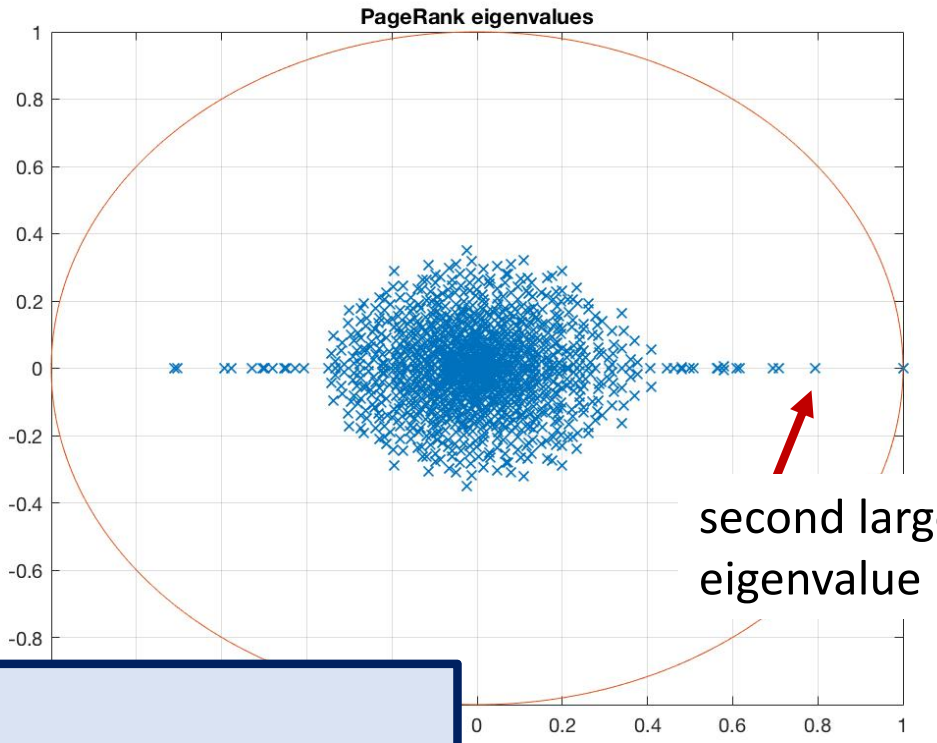
where

1. $M = A\ \mathrm{diag}^{-1}(d)$ weighted adjacency matrix
2. $d = A^{\mathsf{T}}\, 1$ output degree vector
3. c = 0.85 damping factor
4. q = 1/N teleportation vector

- Power iteration $p_{t+1} = c\, M\, p_t + (1\text{-}c)\, q$
- Linear system solution $(I - c\, M)\, p = (1\text{-}c)\, q$

MiME

Lab 4 – PageRank



second largest eigenvalue

Convergence speed of power iteration:

- proportional to $[c\ |\lambda_2(M)|]^t$
- $\lambda_2(M)$ second largest eigenvalue of M

Lab 4 – MatLab hints

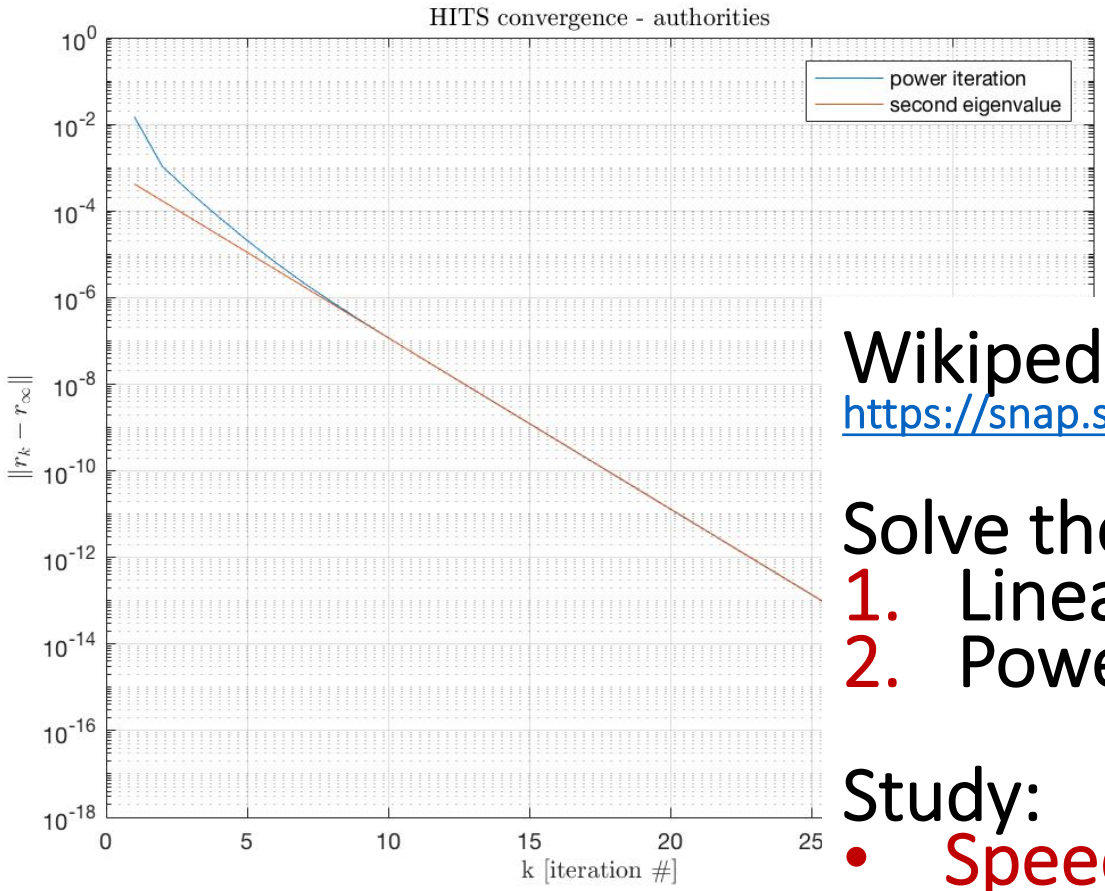
1. tic: starts the counter
2. toc: reads the counter

3. sparse(eye(N)) : sparse identity matrix
4. eigs: extracts (ordered) eigenvalues

5. B\c: solves the linear system B x = c

6. norm: evaluates the norm of a vector
7. semilogy: log plot in y axis only

Lab 4 – HITS authorities



ASSIGNMENT b

Wikipedia voting dataset
https://snap.stanford.edu/data/wiki-Vote.html

Solve the HITS equation by:

1. Linear system solution
2. Power iteration

Study:

- Speed (cpu time)
- Convergence of the power iteration (and its dependence on the eigenvalues of *M*)

Lab 4 – HITS authorities

HITS authorities equation

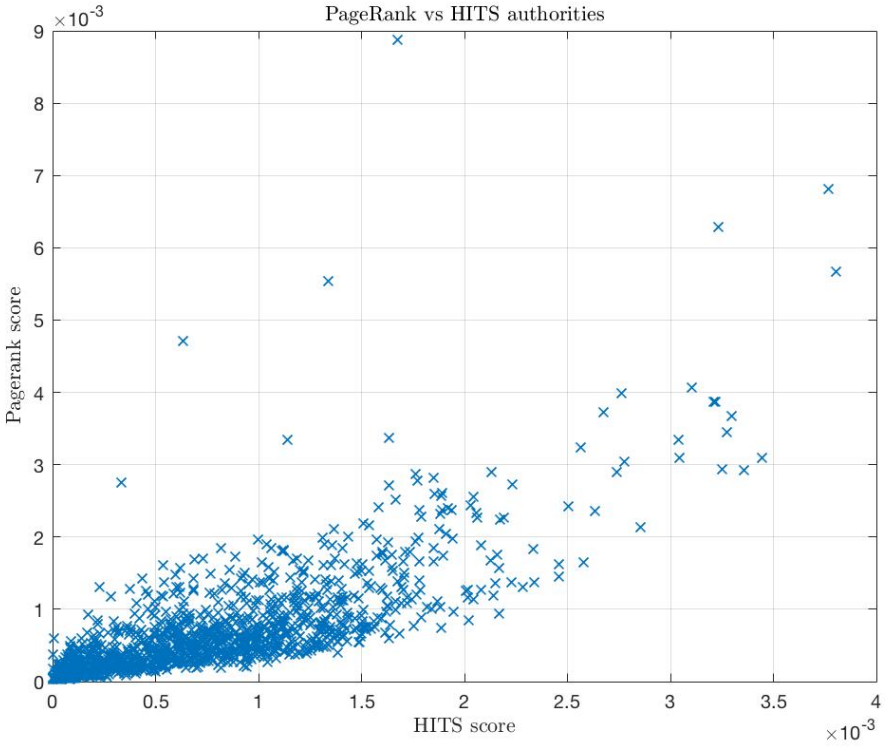
$$p = c\, M\, p, \qquad M = A\, A^{T}$$

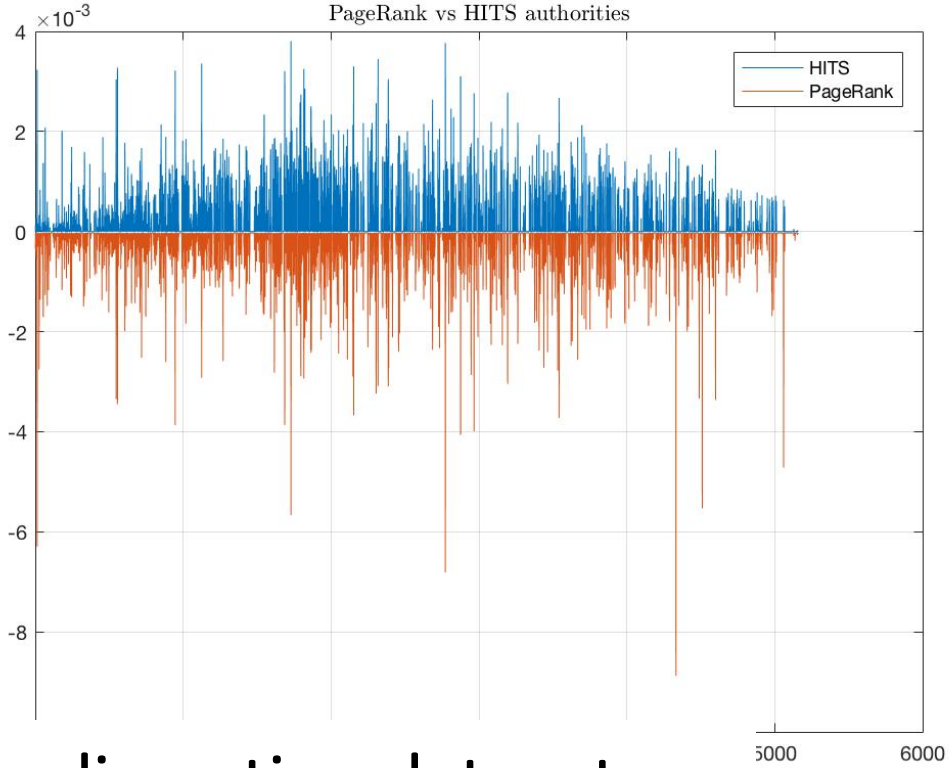
- Linear system solution: eigs(M,2)
- Power iteration: $p_{t+1} = c\, M\, p_t\,;\;\; p_{t+1} = p_{t+1} \,/\, |p_{t+1}|$

Convergence speed of power iteration:

- proportional to $|\lambda_2(M)/\lambda_1(M)|^t$
- $\lambda_1(M)$ largest eigenvalue of M
- $\lambda_2(M)$ second largest eigenvalue of M

Lab 4 – Comparison



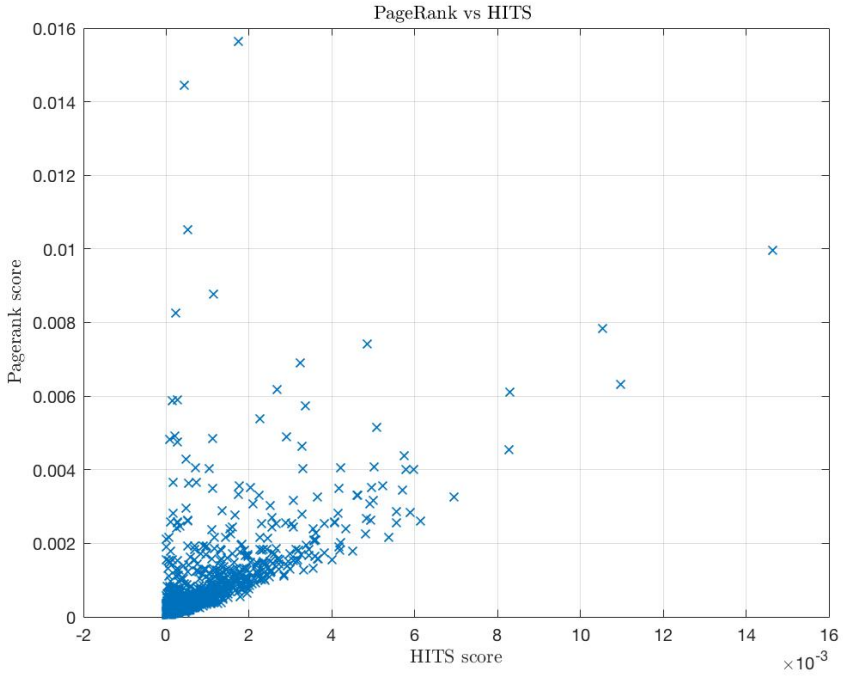


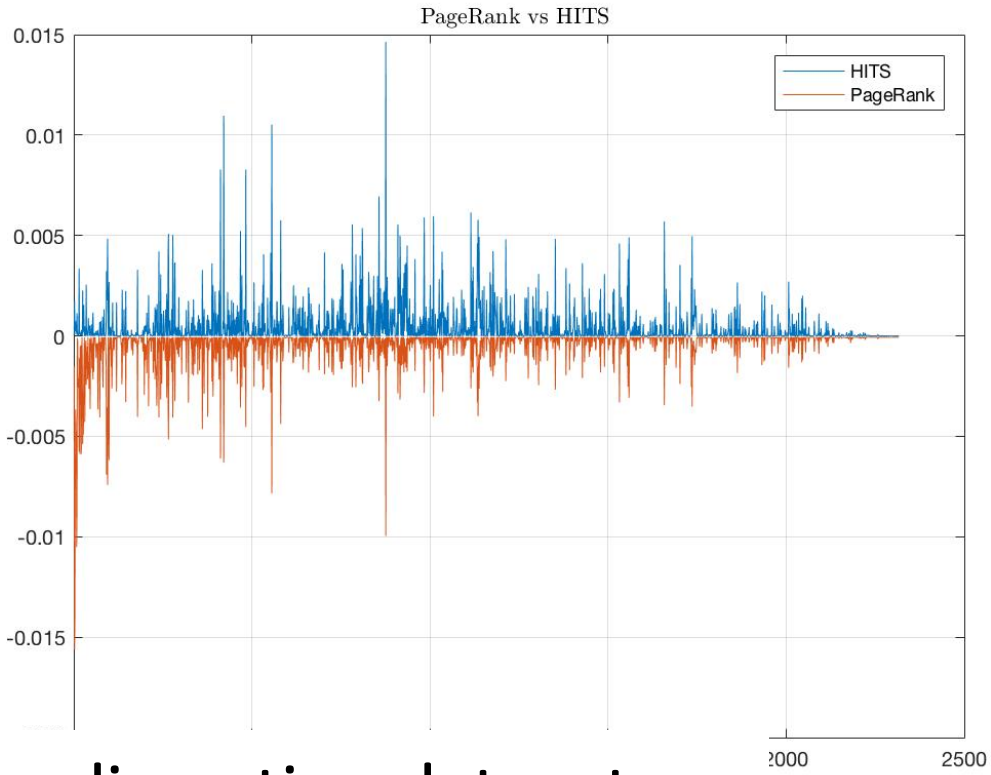
Wikipedia voting dataset
https://snap.stanford.edu/data/wiki-Vote.html

ASSIGNMENT c

Compare:
1. HITS authorities
2. PageRank

Lab 4 – Comparison





Wikipedia voting dataset
https://snap.stanford.edu/data/wiki-Vote.html

ASSIGNMENT d

Compare:
1. HITS hubs
2. PageRank (transposed)