**Homework 2 Node Similarity and Community Detection**

**10 points, Due: March 04 2016**

**Question 1 [1.5 pts]** Please use your own language to briefly explain the following concepts:

PageRank score:

Rooted PageRank:

Network community:

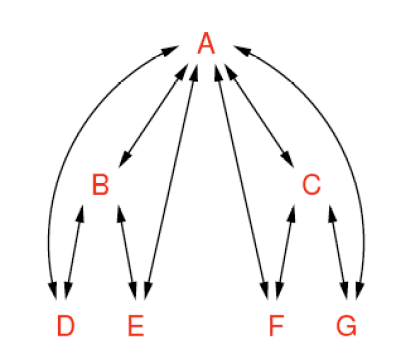
Clique:

k-Clique:

Low-rank approximation:

**Question 2 [2 pts]:** Given seven web pages with the following link structure,

1. Please use “Power Iteration” (a.k.a simple iteration) to calculate the PageRank scores for each website. (You only need to show the first and the second iterations results, with the initial PageRank scores for each node being set as 1/n=0.15) [1 pt].
2. Please also use Eigenvector based approach to calculate PageRank scores for each web page [1 pt] (please show your solutions.)



**Question 3 [1 pt]:** In Quesiton 2, please use rooted PageRank to calculate similarity between each pair of nodes. Each time, the random walker has a probability 1-*α*  (where *α=0.2*)to return back toan original node*.* (Please show your solutions).

**Question 4 [1.5 pts]:** The following networks show connections between 8 individuals in a small community. For node pairs (1, 7) and (1, 6), please use following measures to calculate their similarity (or distance) value and conclude which pair is more likely to form a link.

* 1. Jacarrd’s Coefficient (0.25 pt)
  2. Adamic/Adar (0.25 pt)
  3. Preferential attachment (0.25 pt)
  4. Katz (with β=0.05) (0.25 pt)
  5. SimRank score with C=1 (please show the SimRank score after the 1st iteration). (0.5 pt)

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**Question 5 [4 pts]:** In the following network,

1. Please find the complete set of communities by using 3-clquie [0.25pt], 3-club [0.25pt], and 3-core [0.25pt], respectively (If there are multiple sets, please just report the top three sets with the maximum number of nodes).
2. Please calculate the Geodesic distance between each pair of nodes, and use Multidimensional Scaling (MDS) to convert the network into a two dimensional space. Please report the values of all nodes in the two dimensional space and draw all nodes in the two dimensional space [1.25 pt].
3. Implement a k-means clustering algorithm (selecting k=2 and using node 18 and node 1 as the initial centers), and report the community structures after 10 iterations (You may use any other third party tools for k-means clustering. Or you can follow the k-means Excel implementation in the following URL to calculate the results) [2 pts]

k-means: <http://www.csse.monash.edu.au/courseware/cse5230/2004/assets/clustering.pdf>

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