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CS 579: Online Social Network Analysis

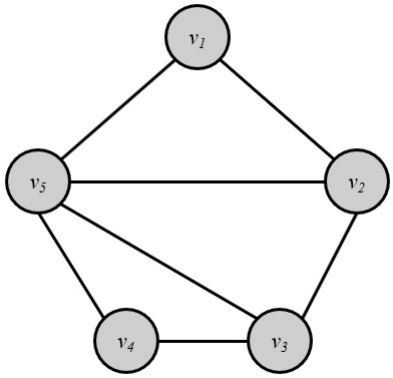
Homework II - Network Measures, Network Models and Clustering

Prof. Kai Shu
Due at 2022 Feb. 21, 11:59 PM

This is an ***individual*** homework assignment. Please submit a digital copy of this homework to **Blackboard**. For your solutions, even when not explicitly asked you are supposed to concisely justify your answers.

1. [**Network Measures**] Based on the following network answer the questions,

   (a) Fill the adjacency matrix.



	v_1	v_2	v_3	v_4	v_5
v_1					
v_2					
v_3					
v_4					
v_5					

   (b) Calculate the "Degree Centrality" (normalized by the maximum degree) values and "Katz Centrality" values with $\alpha = 0.3$ and $\beta = 0.2$, and rank the nodes based on Katz Centrality (you can use Matlab or other mathematical software to calculate the eigenvalues).

	Degree Centrality	**Katz Centrality**	**Ranks (Katz)**
v_1			
v_2			
v_3			
v_4			
v_5			

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(c) Is the above alpha value a good choice for Katz centrality? Why?

(d) Discuss what would happen if we set $\alpha = 0$?

(e) Calculate the global clustering coefficient of the graph.

(f) Compute the similarity between nodes v_2 and v_5 using cosine similarity.

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2. **[Network Models]**

(a) Why are random graphs incapable of modeling real-world graphs?

(b) Show that in a regular lattice for small-world model, local clustering coefficient for any node is $\frac{3(c-2)}{4(c-1)}$, where c is the average degree.
Hint: See problem 5 in the textbook.

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3. **[Unsupervised Learning]**

   (a) What is the usual shape of clusters generated by k-means? Why is this the case? Justify your answer by referencing the algorithm.

   (b) Give (or draw) an example of the case where k-means is unable to correctly classify data instances due to the pattern of these instances.
   Hint: use your answer from part (a).

Good Luck