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CSE 472: Social Media Mining

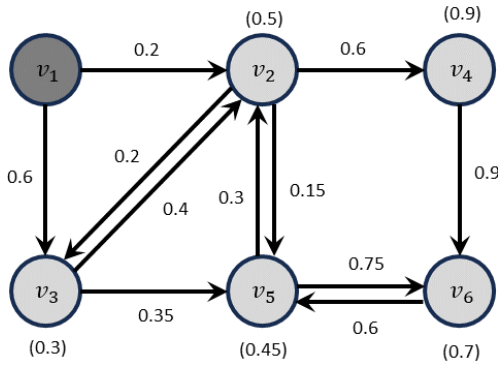
Homework IV - Influence and Homophily, Recommender System

Prof. Huan Liu
Due at 2023, November 22^{nd}, 11:59 PM

This is an ***individual*** homework assignment. Please submit a digital copy of this homework to **Gradescope**. This is a fillable PDF and you are able to type into answer boxes provided for each question.

1. [**Influence and Homophily**]

   (a) Apply the procedures of the Linear Threshold Model (LTM) to the given graph until convergence. During each step, identify the activated node(s) and explain the reasons behind their activation. Assume that node v_1 is initially activated at time 0. Traverse the nodes in numerical order and explain all steps.



Linear Threshold Model says, if summation of weights of node connected to currently active node is greater than the threshold, then that node gets activated.

Hence, applying the same here,
A_i = [v1] - Active Node list
IA_i = [v2, v3] - inactive nodes connected to active nodes
Nin(vi) - Number of connected active nodes vi

---------- Step 1 ----------
Threshold of v2 is 0.5
Summartion of weights of Nin(V2) = 0.2

Threshold of v3 is 0.3
Summartion of weights of Nin(V3) = 0.6

(b) The graphs provided illustrate two snapshots: the graph on the left represents the state at time t_1, and the graph on the right represents the state at time t_2. Each node v_i is associated with an ordinal attribute value denoted by x_i, which can be found in Table 1. Calculate the homophily index of the graph.

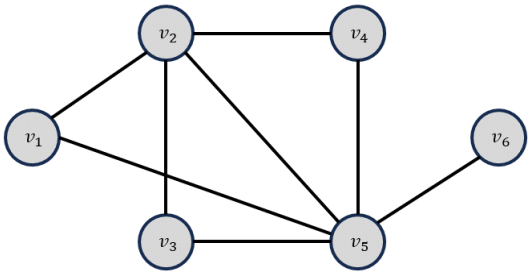


Figure 1: Snapshot at $t = 1$

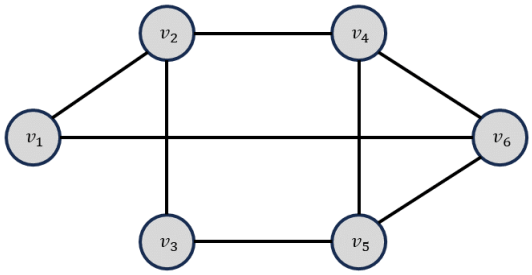


Figure 2: Snapshot at $t = 2$

Vertex	v_1	v_2	v_3	v_4	v_5	v_6
Value	19	13	21	18	22	14

Table 1: Ordinal Values of Vertices in the Graph

2. **[Recommender System]**

(a) Compute the missing rating of these sports using **item-based** collaborative filtering (CF) where the rows denote the athletes and the columns denote the sports. When finding nearest neighbors, use Cosine similarity as your similarity measure (*Hint*: $sim(u, v) = \frac{u \cdot v}{||u|| \cdot ||v||}$).

	Basketball	Soccer	Tennis	Swimming
Ron	3	2	5	4
Ginny	2	?	4	3
George	1	4	2	3
Fred	3	4	3	5
$\overline{r}_i$		3.33		

Predict the missing rating by completing the following tasks (Rounded your answers to two decimal digits.):

- Calculate $\overline{r}_i$ values for every sport (Soccer is given). Write down the final values in the table (last row).

- Calculate the similarity value between Soccer and Basketball (all others are provided in the following table).

	Basketball	Tennis	Swimming
Soccer		0.676	0.943

Write down your calculation in the following box.

- Identify the two nearest neighbors of Soccer.

1.	2.

- Calculate the Soccer rating for "Ginny". *Hint*: $r_{u,i} = \overline{r}_i + \frac{\sum_{j \in N(i)} sim(i,j)(r_{u,j} - \overline{r}_j)}{\sum_{j \in N(i)} sim(i,j)}$. Assume that we consider 2 nearest neighbors for computing the rating.

(b) Consider a set of six items $I = i_1, i_2, i_3, i_4, i_5, i_6$ for which the predicted and true rankings are as follow:

	Predicted Rank	True Rank
i_1	1	1
i_2	2	4
i_3	3	3
i_4	4	6
i_5	5	2
i_6	6	5

Compute Kendall's Tau:

Good Luck