RED-GCN: REVISIT THE DEPTH OF GRAPH CONVOLUTIONAL NETWORK

Anonymous authors
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A APPENDIX

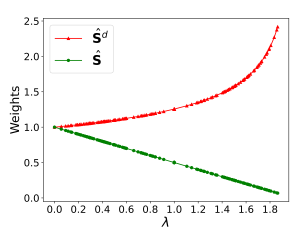
The statistics of datasets.

Table 1: The statistics of datasets.

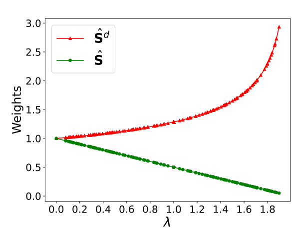
Datasets	Cora	Citeseer	Pubmed	DBLP	Texas	Wisconsin	Cornell	Actor	Chameleon	Squirrel	cornell5
#Nodes	2,708	3,327	19,717	17,716	183	251	183	7,600	2,277	5,201	18,660
#Edges	10,556	9,104	88,648	105,734	325	515	298	30,019	62,792	396,846	158,1554
#Features	1,433	3,703	500	1,639	1,703	1,703	1,703	932	2,325	2,089	4,735
#Classes	7	6	3	4	5	5	5	5	5	5	5

Implementation details. For all methods, we set the learning rate to 0.01, the decaying weight for the learning rate to $5e^{-4}$, the number of training epochs to 500. The K largest/smallest eigenvalues for RED-GCN-D is $\max\{1000, 0.1n\}$, where n is the number of nodes in the input graph. For all baselines, the parameters are set according to their original papers. All experiments are run on a Tesla-V100 GPU.

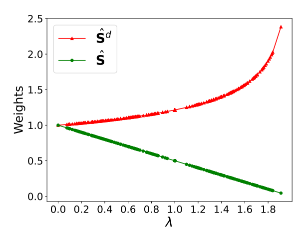
Graph augmentation and geometric insights. The observations and analyses for the following Figure 1 and Figure 2 are same with those in subsection 4.4.



(a) Texas ($d = -0.328$)

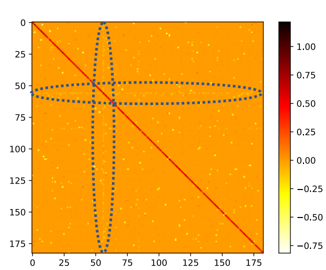


(b) Cornell ($d = -0.362$)

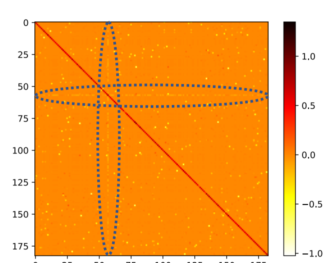


(c) Wisconsin ($d = -0.280$)

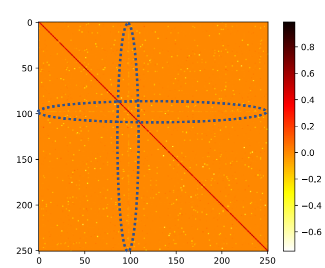
Figure 1: The weights of eigengraphs w.r.t. eigenvalues on the augmented diffusion matrix $\hat{\mathbf{S}}^d$ and original $\hat{\mathbf{S}}$.



(a) Texas



(b) Cornell

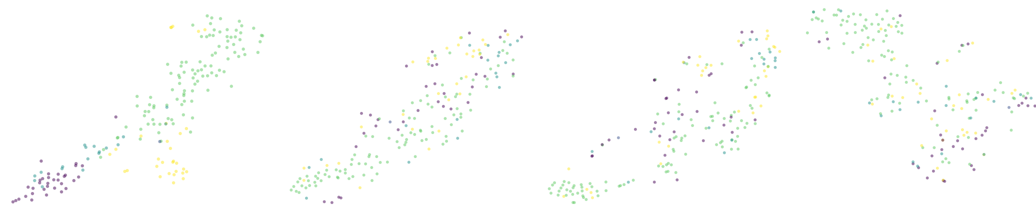


(c) Wisconsin

Figure 2: The difference between the augmented diffusion matrix and the original one $\hat{\mathbf{S}}^d - \hat{\mathbf{S}}$.

(a) $d = -2$, ACC=29.5% (b) $d = 0$, ACC=46.6% (c) $d = 5$, ACC=82.4% (d) GCN, ACC=81.0%

Figure 3: Visualization of node embeddings by t-SNE on Cora (homophilic)



(a) $d = -0.35$, ACC=80.0% (b) $d = 2$, ACC=59.0% (c) $d = 4$, ACC=50.0% (d) GCN, ACC=55.0%

Figure 4: Visualization of node embeddings by t-SNE on Texas (heterophilic).

We conduct a visualization of node embedding generated by ReD-GCN under different depths for homophilic (Cora) and heterophilic (Texas) graphs. As shown in Figure 3, for Cora, when $d = 5$, the nodes in different classes form clearly distinguishable clusters (ACC=82.4%). When the depth decreases from a positive value $d = 5$ (ACC=82.4%) to a negative value $d = -2$ (ACC=29.5%), the nodes belonged to different classes/colors mix with each other, and the clearly clustered structure does not exist anymore. However, for Texas shown in Figure 4, when decreasing the depth from $d = 4$ (ACC=50%) to $d = -0.35$ (ACC=80%), the clusters of different classes/colors become well-separated. Especially, the purple nodes spread randomly all over the embedding space when $d = 4$ but concentrate in one cluster when $d = -0.35$. The spatial distribution of the node embeddings reveals that ReD-GCN with positive and negative depths respectively models graph homophily and heterophily in a proper way.