LEARNING TO DROP: ROBUST GRAPH NEURAL NETWORK VIA TOPOLOGICAL DENOISING

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This paper [1] proposed PTDNet (i.e., parameterized topological denoising network) to improve the robustness and generalization performance of GNNs by learning to drop task-irrelevant edges.

The PTDNet consists of two major components, the denoising networks and the GNNs. The denoising network is a multi-layer network that samples a subgraph from a learned distribution of edges, which is jointly optimized with GNNs guided by supervised downstream signals. For the ℓ-th GNN layer, we introduce a binary matrix $\mathbf{Z}^\ell$ denoting whether the edge is present. Then the adjacency matrix of the resulting subgraph is $\mathbf{A}^\ell = \mathbf{A} \odot \mathbf{Z}^\ell$. Two regularization on $\mathbf{Z}$ are considered, sparse and low-rank. To promote sparseness, attention coefficients are first computed via an MLP and then $\mathbf{Z}$ is obtained utilizing the concrete distribution along with hard sigmoid function (see more details in the paper). To promote low-rankness, the nuclear norm of $\mathbf{A}^\ell$ is used and a further relaxation to Ky Fan K-norm is applied (sum of top K largest singular values). The forward propagation regarding to Ky Fan K-norm is computed based on SVD and the backpropagation is conducted based on power iteration.

References

[1] Dongsheng Luo, Wei Cheng, Wenchao Yu, Bo Zong, Jingchao Ni, Haifeng Chen, and Xiang Zhang. Learning to drop: Robust graph neural network via topological denoising. In *Proceedings of the 14th ACM International Conference on Web Search and Data Mining*, pages 779–787, 2021.