

## Paper Review

### <Introduction>

The essay “A Comprehensive Survey of Graph Embedding: Problems, Techniques, and Applications” introduces a new technique classifying data in graph embedding. The paper categorizes the application of graph embedding by proposing the classification method of graph embedding. Therefore, the rest of the paper will analyze graph embedding based on the problems that the author drives.

### <Summary>

Based on the paper, the essence of graph embedding is to convert it to a low-dimensional space while retaining the graph information (Cai, 2018). However, because of the large amount of calculation and large space consumption during the data training period, graph embedding is usually a time-consuming work. Thus, in order to solve those challenges, the author proposed five different graph embedding techniques: Matrix Factorization, Deep Learning, Edge Reconstruction Based Optimization, Graph Kernel and Generative Model (Cai, 2018). For Matrix Factorization, it is a statistical expression of global pairwise similarity, because of that, it yields better accuracy results than GE's deep learning in some specified tasks (GE deep learning is based on a separate local context window). Deep learning is related with reinforcement learning in the data training period, it is an algorithm built on random and non-random walk, so that it could recognize complex graph structure. Edge Reconstruction Based Optimization is a technique that best suits local optimization, it optimizes objective function based on ranking triplet (which training is based on local information). Graph kernel method is similar with word embedding, it converts the information in a graph to many single vectors (similar with graph dimensions), so that during the analyzing period, the developer only needs to observe each

dimension of the graph. Generative Model is a technique that works better in large graphs, it analyses data from different perspectives (so that it needs large amounts of data) and yields its predictions.

#### < Graph Embedding Applications>

Like the author mentions in the paper, graph embedding could be used in advertisements. For example, programmers could generate the representation vector of the product using word embedding method and calculate the similarity between the products. After that, developers could recall the most similar products for each product based on users searching behavior. In addition to that, graph embedding could also be used in graph classifications. Since the core of graph embedding is word to vertex. After each part of the graph is vectorized, developers could use those embedded data to train/test graphs.

To conclude, in the paper, the author introduces 5 methods to solve the challenges that graphing embedding faces. Since graph embedding could be applied in so many different areas, it is essence to apply those techniques.

#### Reference

1. Cai, H., Zheng, V. W., & Chang, K. C. C. (2018). A Comprehensive Survey of Graph Embedding: Problems, Techniques, and Applications. *IEEE Transactions on Knowledge and Data Engineering*, 30(9), 1616-1637. [8294302].  
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