Temporal Graph Embedding

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***Abstract*—**

***Index Terms*—**

I. Introduction

To start this paper out, let's first create a level playing field for all readers by laying out what exactly a Graph is, how it can change over time and what is meant when we talk about embedding.

A. Graphs

A graph is a mathematical construct which is used in a variety of tasks. It is often used to model relationships between entities, thus making it possible to operate on such structures to, for example, analyze them.

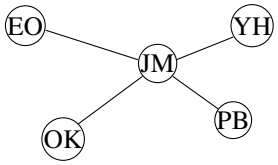

Fig. 1. part of the follower-relationship-graph of personal instagram account

Mathematically it is consisting of two sets $G = (V, E)$, where V consists of all the vertices of the Graph, and E of all the edges, represented through a tuple of two vertices. Our graph above would thus look like following:
$G_i = (\{E, O, Y, P, J\}, \{(J, E), (J, O), (J, P), (J, Y)\})$

B. Temporal Graphs

As we want to embed not just graphs, but temporal graph, lets bring in the temporal aspekt. Let's imagine a camera that makes a picture of the graph everytime a certain amount of time passed, so we get our Graphes G_1 after the first picture and so on. We then take all of our pictures and put them together into one construct, thus creating our temporal graph $G = \{G_1, G_2, \ldots, G_t\}$ consisting of many other graphs.[1]

C. Embedding

Our goal is, as previously mentioned, to analyze those temporal graphs, but graphs as mathematical structure are rather hard to compute with. Thus we want to transform it into a more accessable structure. For that we now try to transfer the information, that is modeled by the graph, into a vectorspace. Those Vectors have to capture the graph topology, the vertex-to-vertex relationship as well as other relevant informations.

II. Methods

A. tbGraphEmbed

Starting paper

B. sub2vec

Is used as comparison in starting paper -¿ Look into

C. Comparison

How do Methods differ -¿ nodelevel / Graphlevel?

D. Application

Why do we use Embedding

1) Similarity: Differences Between graphs (exp - google-trends)

2) Anomaly: Where does it differ

III. Conclusion

References

[1] George B. Mertzios and Hendrik Molter and Rolf Niedermeier and Viktor Zamaraev and Philipp Zschoche, *Computing Maximum Matchings in Temporal Graphs*, 37th International Symposium on Theoretical Aspects of Computer Science (STACS 2020), 2020

[2] Moran Beladev, Lior Rokach, Gilad Katz, Ido Guy, Kira Radinsky, *tdGraphEmbed: Temporal Dynamic Graph-Level Embedding*, CIKM '20: The 29th ACM International Conference on Information and Knowledge Management, Virtual Event, Ireland, October 19-23, 2020