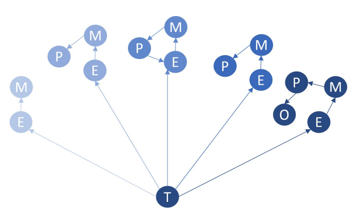
TEMPO

Management and Processing of Temporal Networks

H.F.R.I. Project No. 03480

D5.3: Library for Outlier Detection Algorithms in MAGMA and Experimental Verification



Computer Engineering & Informatics Department
University of Patras
Greece

30/11/2025

D5.3: Library for Outlier Detection Algorithms in MAGMA and Experimental Verification

Konstantinos Christopoulos and Kostas Tsichlas

November 30, 2025

This document contains a small description as well as the links to the libraries developed for outlier detection. We adopted two approaches for anomaly detection in dynamic graphs, one that is local community-based in a streaming environment (which is not a temporal network) and another one that is based on a deep learning approach over temporal networks. The libraries have not been developed as integral parts of the system but as standalone libraries for the following reasons:

1. The project's timeframe and resource constraints imposed us to focus on community detection (which as demonstrated in [1] can be used for anomaly detection).
2. The delay in developing T-JanusGraph and T-Gremlin.
3. The major breakthroughs that would be required to integrate heavy analytics (OLAP queries) in the transactional kernel of T-JanusGraph.

There is an extensive justification in Deliverable D1.5 (Final Project Report) regarding all these reasons. As a result, we opted for libraries that are standalone, which can only retrieve data in batches from T-JanusGraph.

1 Local Community-Based Anomaly Detection in Graph Streams

In this work, our contribution primarily revolves around integrating an existing dynamic local community detection algorithm into the framework for detecting anomalies (see deliverable D5.2 for details). We significantly contributed to adapting and enhancing this algorithm to effectively identify instant and sustained community changes within temporal networks. The code is freely available[1]. Experimental evaluation of the proposed method was carried out with promising results. Further information can be found in [1] as well as in Deliverable D5.2.

2 Detecting Anomalies in Dynamic Graphs Using Deep Learning Methods

This is a recent work that has not been published yet and it concerns deep learning methods that have stormed almost all fields of science. Our work was based on a state-of-the-art framework, called DyGED [2]. Although not published yet, the project's code is publicly available in github[2]. Our main goal, when we decided to adopt such an approach, was to look at deep learning methods for anomaly detection in dynamic/temporal graphs aiming at integrating in the future such methods with our distributed graph database system, although making this method work in a distributed environment may require serious extra work. Further information can be found in Deliverable D5.2.

References

[1] Konstantinos Christopoulos and Konstantinos Tsichlas. Local community-based anomaly detection in graph streams. In Ilias Maglogiannis, Lazaros Iliadis, John Macintyre, Markos Avlonitis,

[1] `https://github.com/kostasada7/Local-Community-Based-Anomaly-Detection-in-Graph-Streams`
[2] `https://github.com/kostasada7/Anomaly-Detection-in-Dynamic-Graphs-Using-Deep-Machine-Learning-Methods`

and Antonios Papaleonidas, editors, *Artificial Intelligence Applications and Innovations*, pages 348–361, Cham, 2024. Springer Nature Switzerland.

[2] Mert Kosan, Arlei Silva, Sourav Medya, Brian Uzzi, and Ambuj Singh. Graph macro dynamics with self-attention for event detection. In *Deep Learning on Graphs: Methods and Applications (DLG-AAAI'23)*, 2023. Workshop paper.