Problem Statement and Goals

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Table 1: Revision History

Date	Developer(s)	Change
Jan.22, 2025	Yuanqi Xue	First Draft
Jan.28, 2025	Yuanqi Xue	First Draft

1 Problem Statement

1.1 Problem

Identifying frequent and structurally related subgraphs (i.e., network motifs) is computationally challenging due to the NP-hard nature of subgraph search and matching. Traditional methods are often inefficient and suffer from this complexity. The paper *Approximate Network Motif Mining via Graph Learning* [1] introduces MotiFiesta, a machine learning-based approach that redefines motif mining as a node labeling task. Its fully differentiable framework enables efficient discovery of approximate motifs through graph representation learning.

1.2 Inputs and Outputs

The input is a synthetic graph dataset constructed according to the procedure described in the Appendix of [1]. The output is a trained model and the identified motifs (i.e., the frequent subgraphs) within the input graphs.

1.3 Stakeholders

Researchers or students interested in the reproducibility and validation of [1].

1.4 Environment

As stated in the original paper, training on the synthetic dataset was conducted using an NVIDIA GeForce GTX 1080 GPU, taking 4-8 hours, while decoding was performed on a personal laptop with a 1.6 GHz dual-core Intel Core i5 processor. For our implementation, we will use an NVIDIA GeForce RTX 3060

GPU for training and a personal laptop with a 2.80 GHz quad-core Intel Core i7 processor for decoding.

2 Goals

- Create a synthetic dataset using the procedure described in the original paper.
- Implement the proposed method MotiFiesta.
- Reproduce the paper's results by identifying motifs from the synthetic dataset with comparable quality to those reported in the original study.

3 Stretch Goals

Examine the reproducability of the paper [1] and validate its results.

4 Challenge Level and Extras

Challenge Level: Research Project
Extras: None

5 Reference

[1] C. Oliver, D. Chen, V. Mallet, P. Philippopoulos, and K. Borgwardt, "Approximate network motif mining via graph learning," arXiv:2206.01008, 2022.