Bullying Detection through Graph Machine Learning

Applying Neo4j's Unsupervised Graph Learning Techniques to the Friends Dataset

Background

Research Questions

RQ1:

How can unsupervised GML techniques in Neo4j be applied to the Friends dataset to identify patterns or clusters that may indicate bullying behavior?

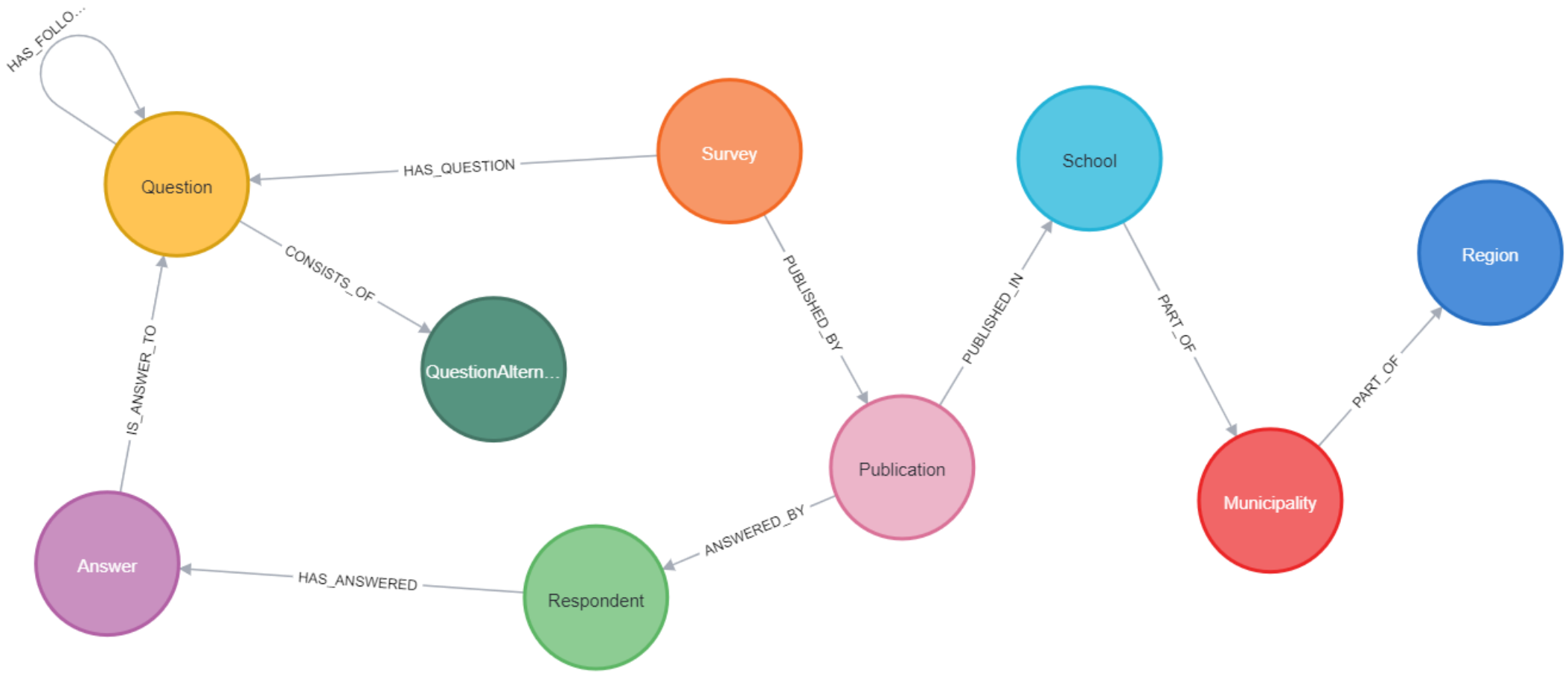
RQ2:

How can these patterns, combined with domain knowledge from behavior science, be used to reveal hidden relationships that can indicate a likelihood of bullying?

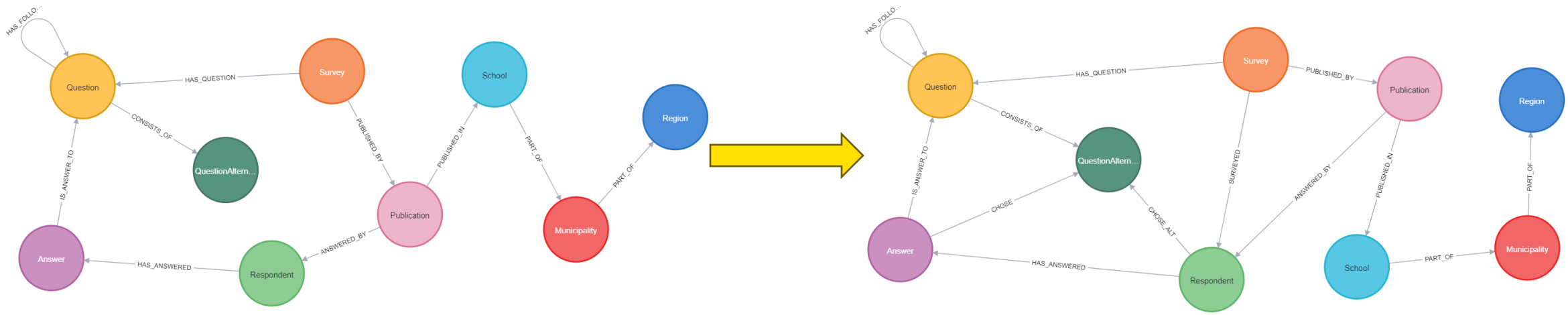
Methodology

Methodology – Collaboration

Methodology – Neo4j



Methodology – Data Preprocessing



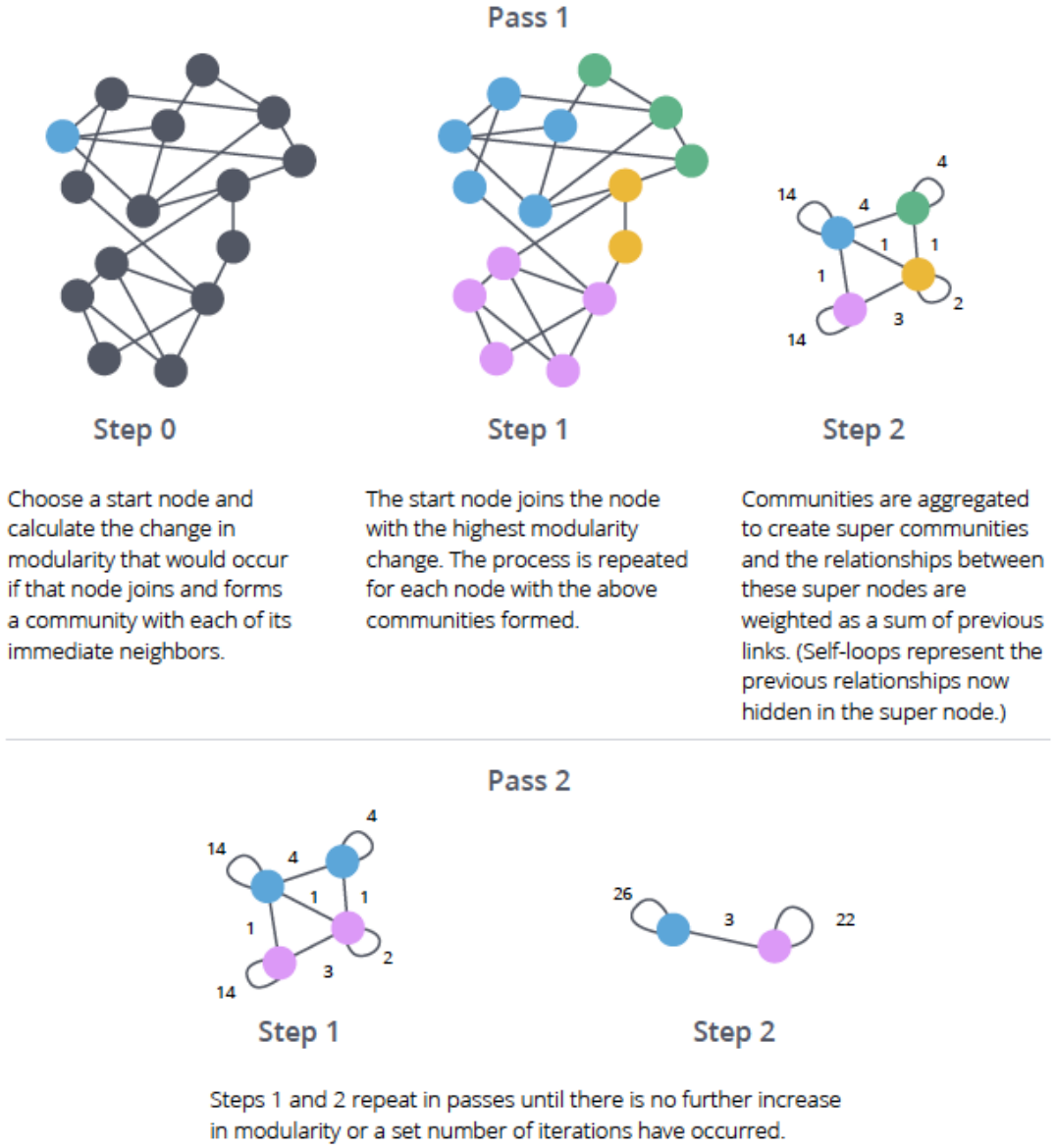
Methodology – Indices

$$\text{NormalityIndex}_\text{s} = \frac{\sum_{i=1}^{n} \frac{\text{a}_\text{i}}{\text{q}_\text{i}}}{\text{n}}$$

$$\text{PositivityIndex}_\text{s} = \frac{1}{n} \sum_{i=1}^{n} \begin{cases} 1 - \frac{position_i}{total\_positions_i}, & \text{if } is\_positive_i = 1 \\ \frac{position_i}{total\_positions_i}, & \text{otherwise} \end{cases}$$

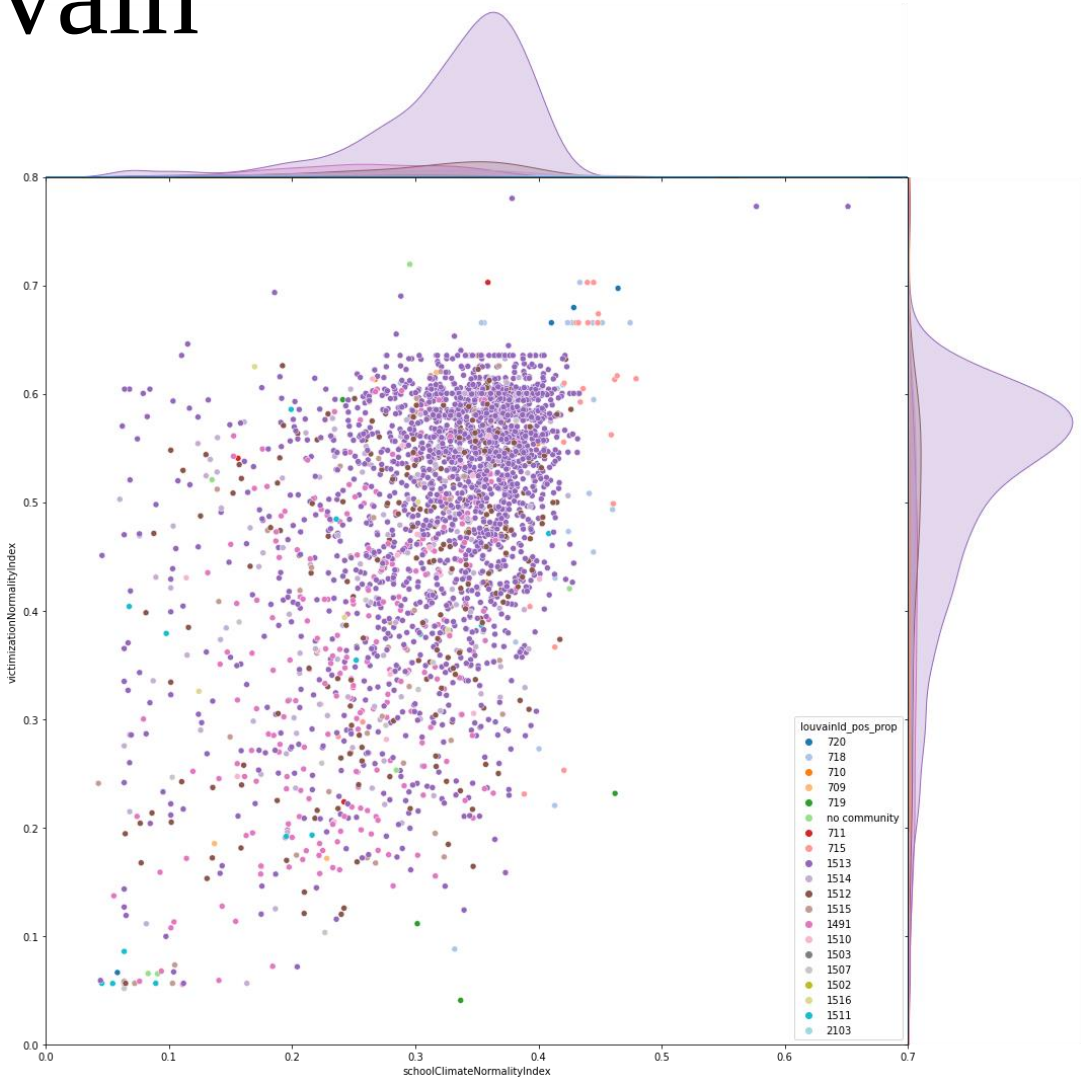
Implementation & Results

Implementation – Louvain

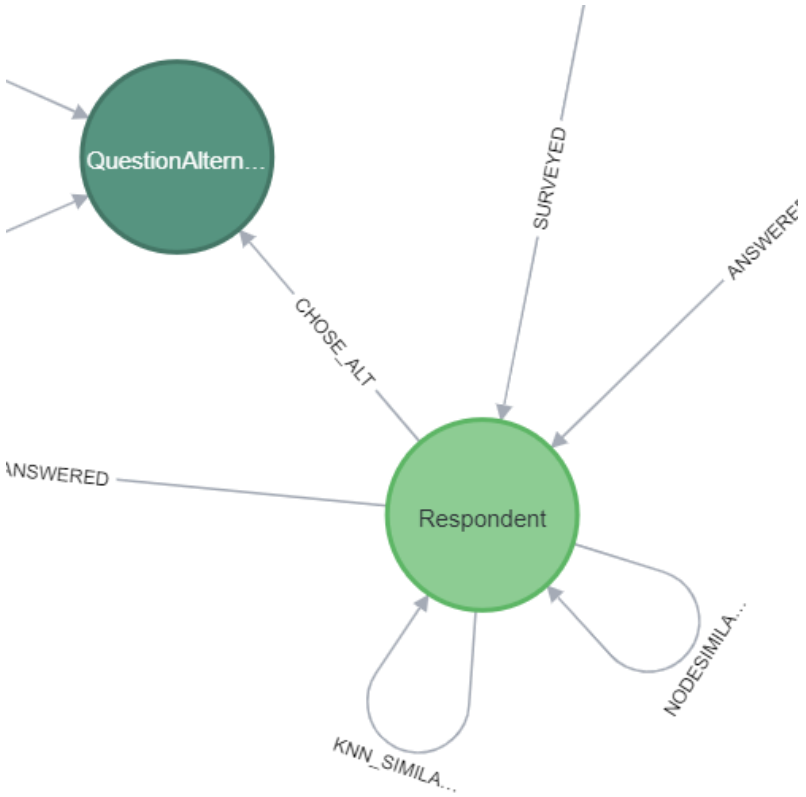


Source: Adapted from [3]

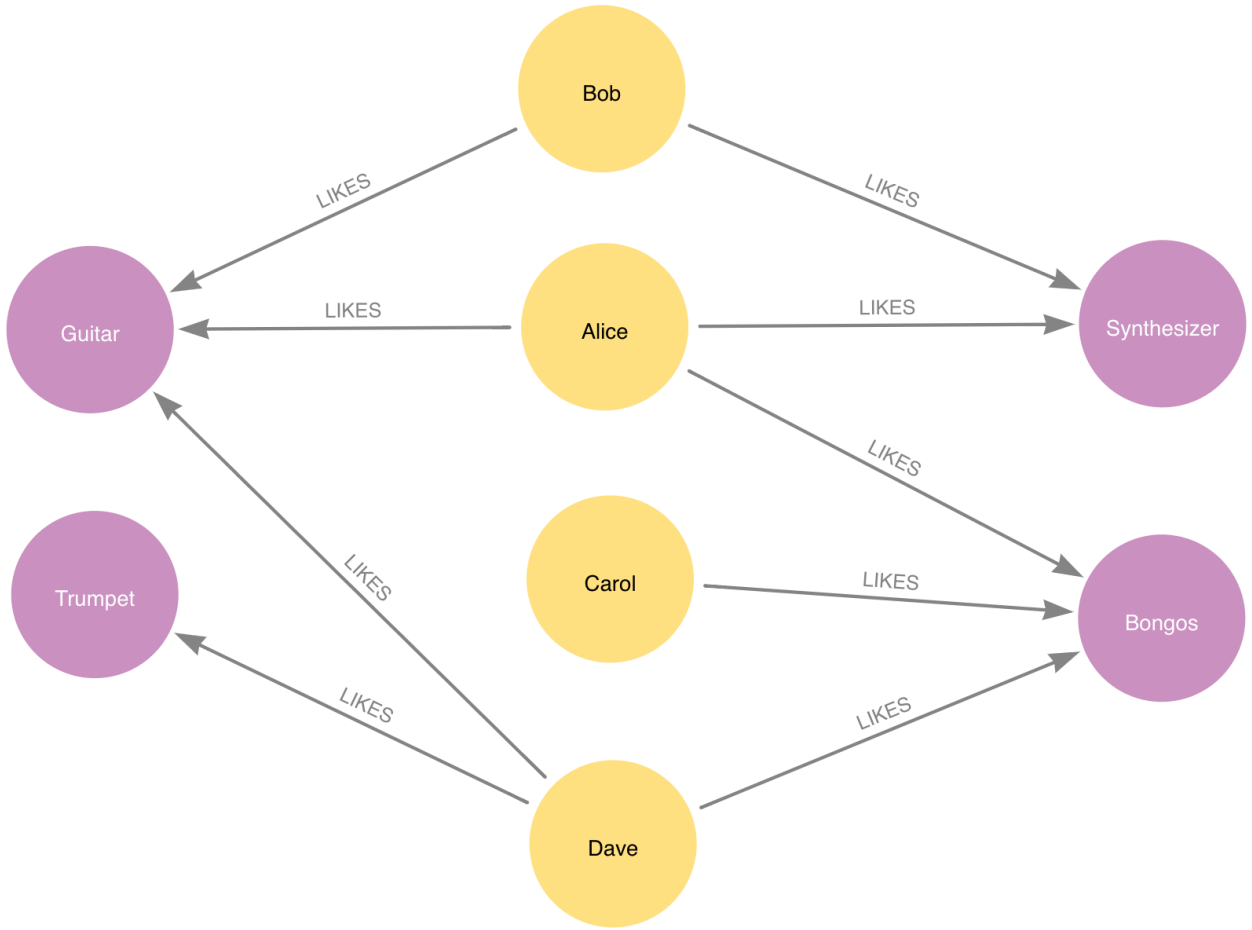
Results – Louvain



Implementation – Similarity

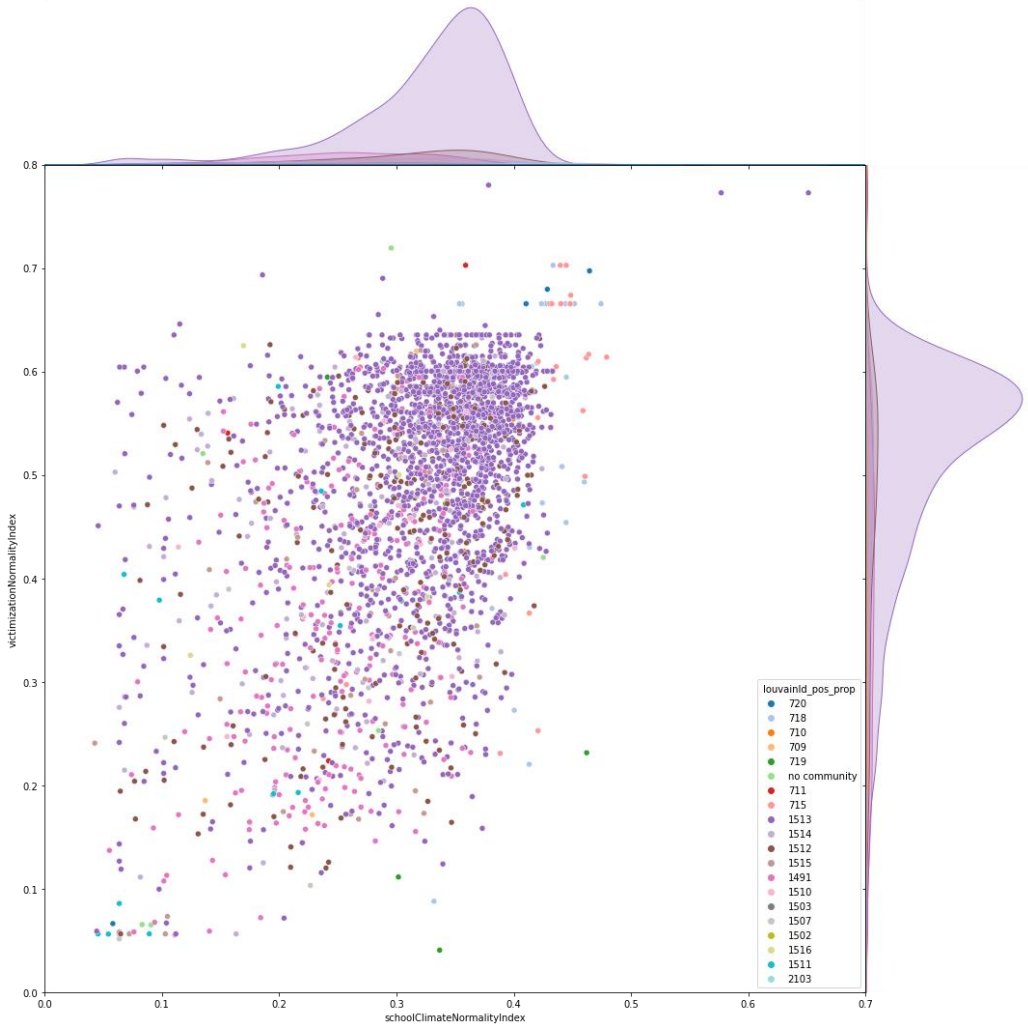


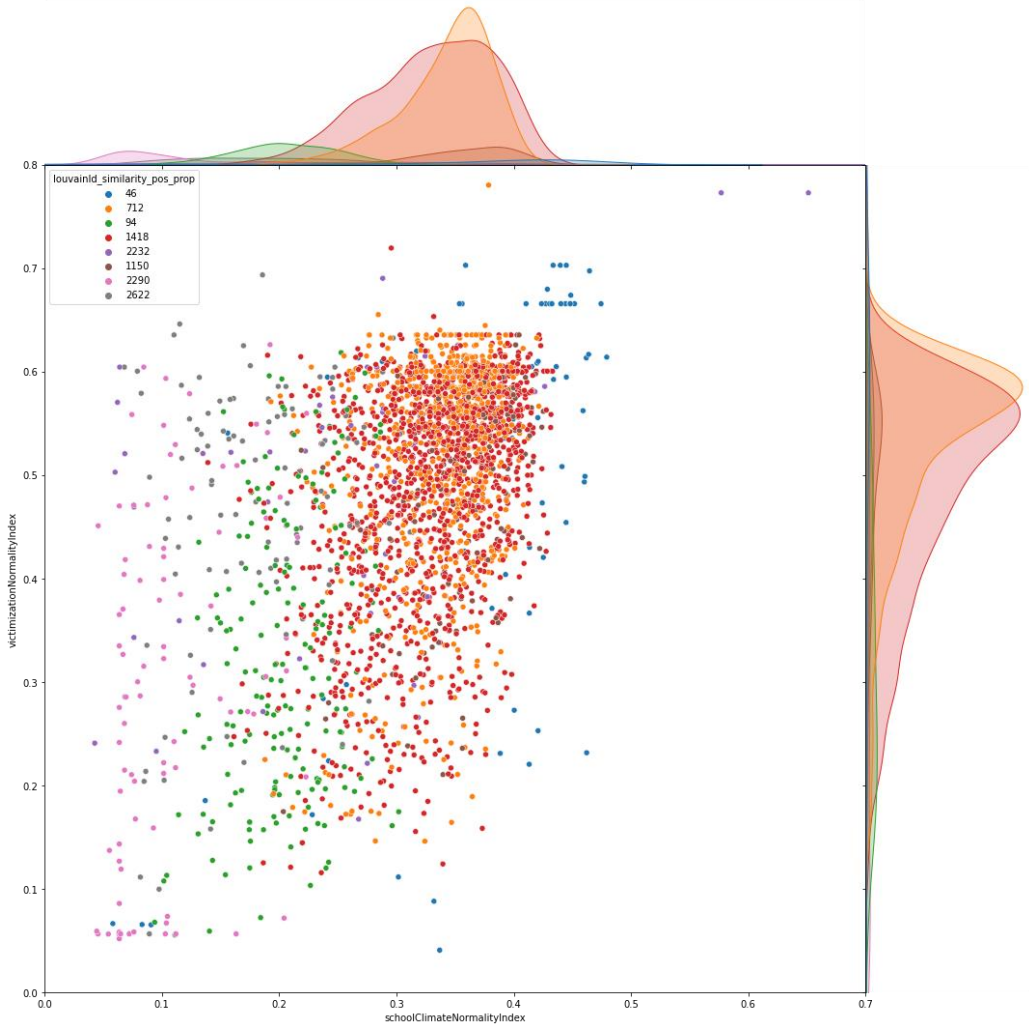
Implementation – Node Similarity



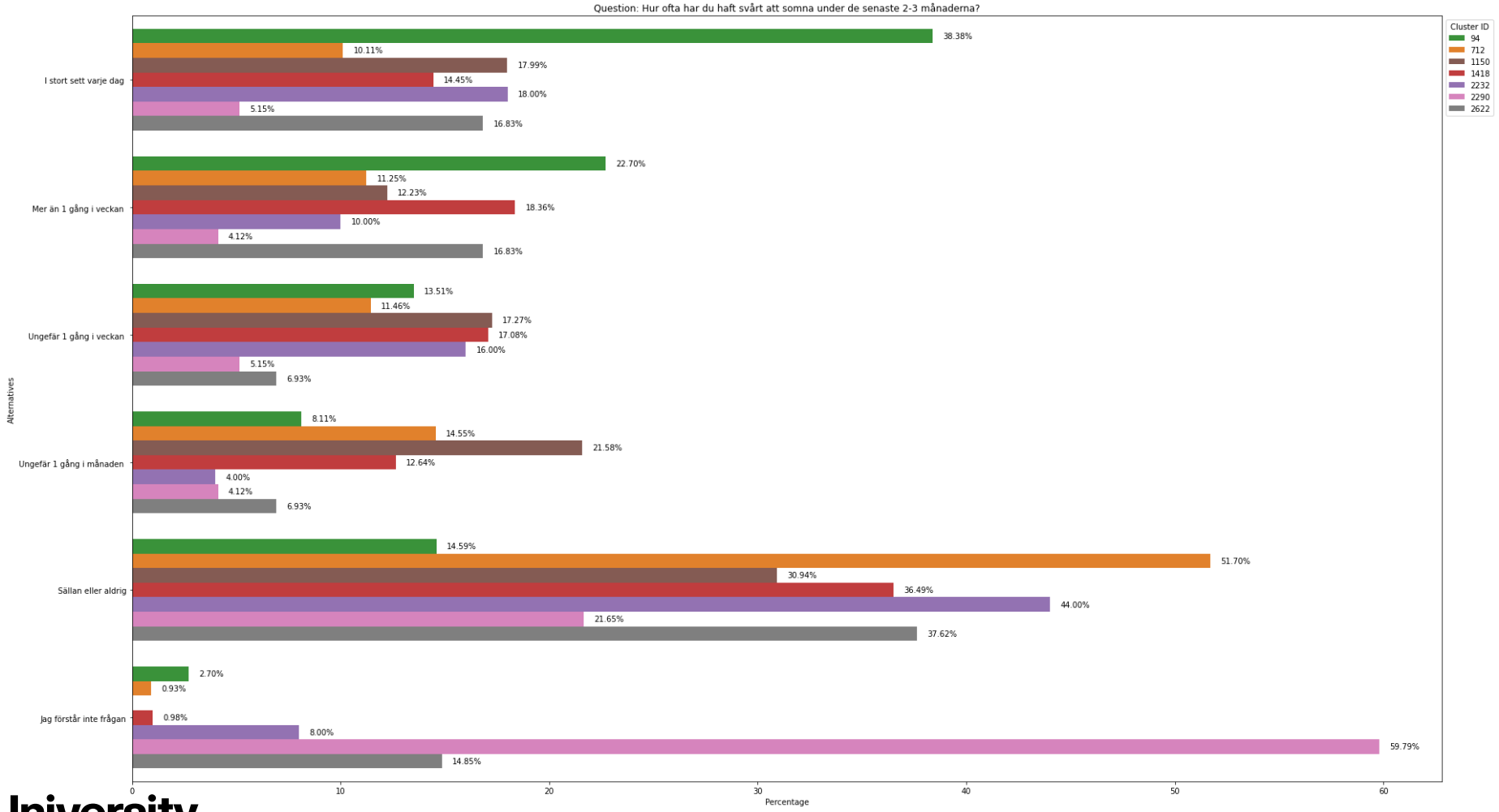
Source: Adapted from [1]

Results – Louvain with Node Similarity

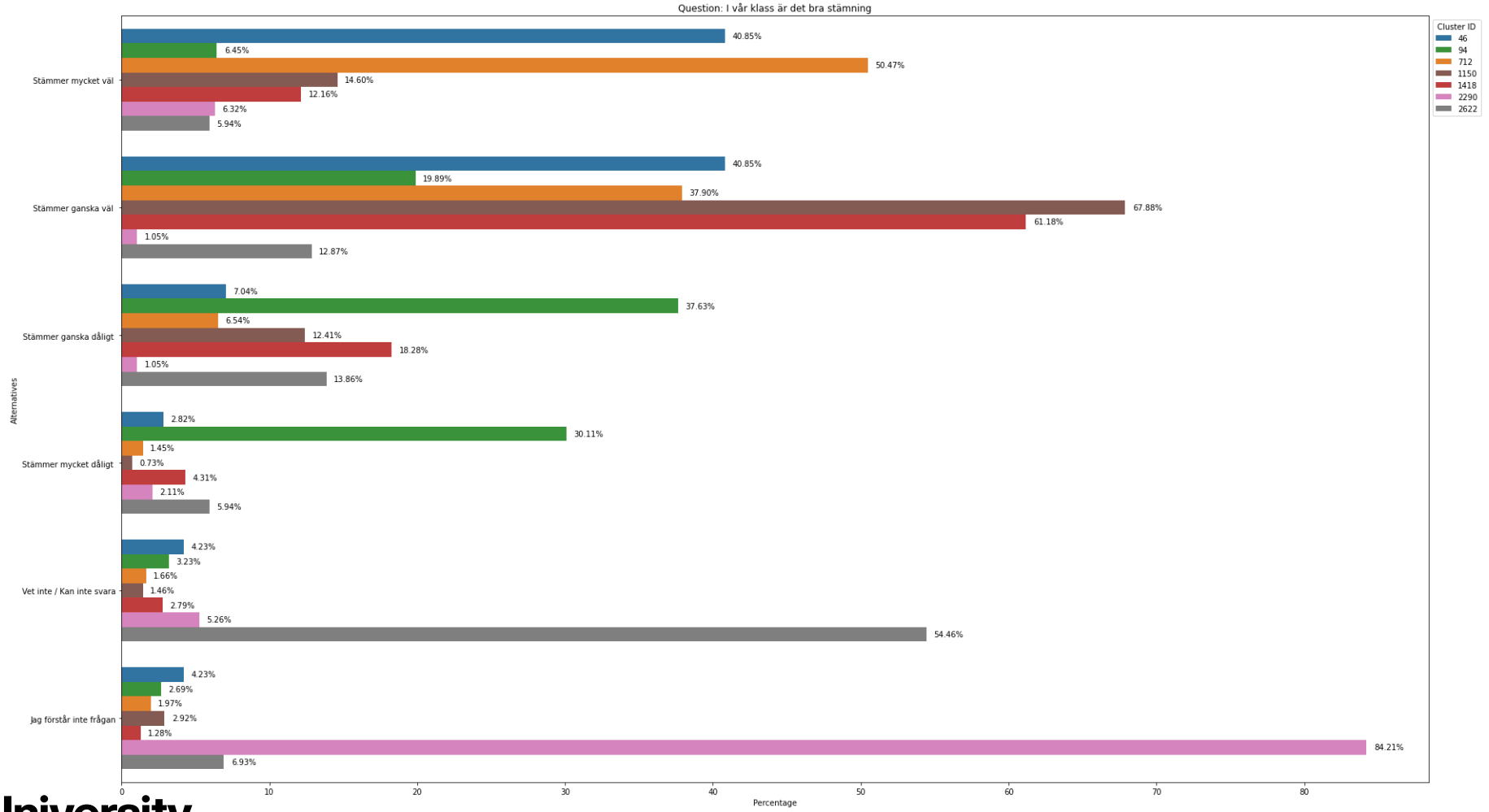




Results – Louvain – Victimization



Results – Louvain – School Climate



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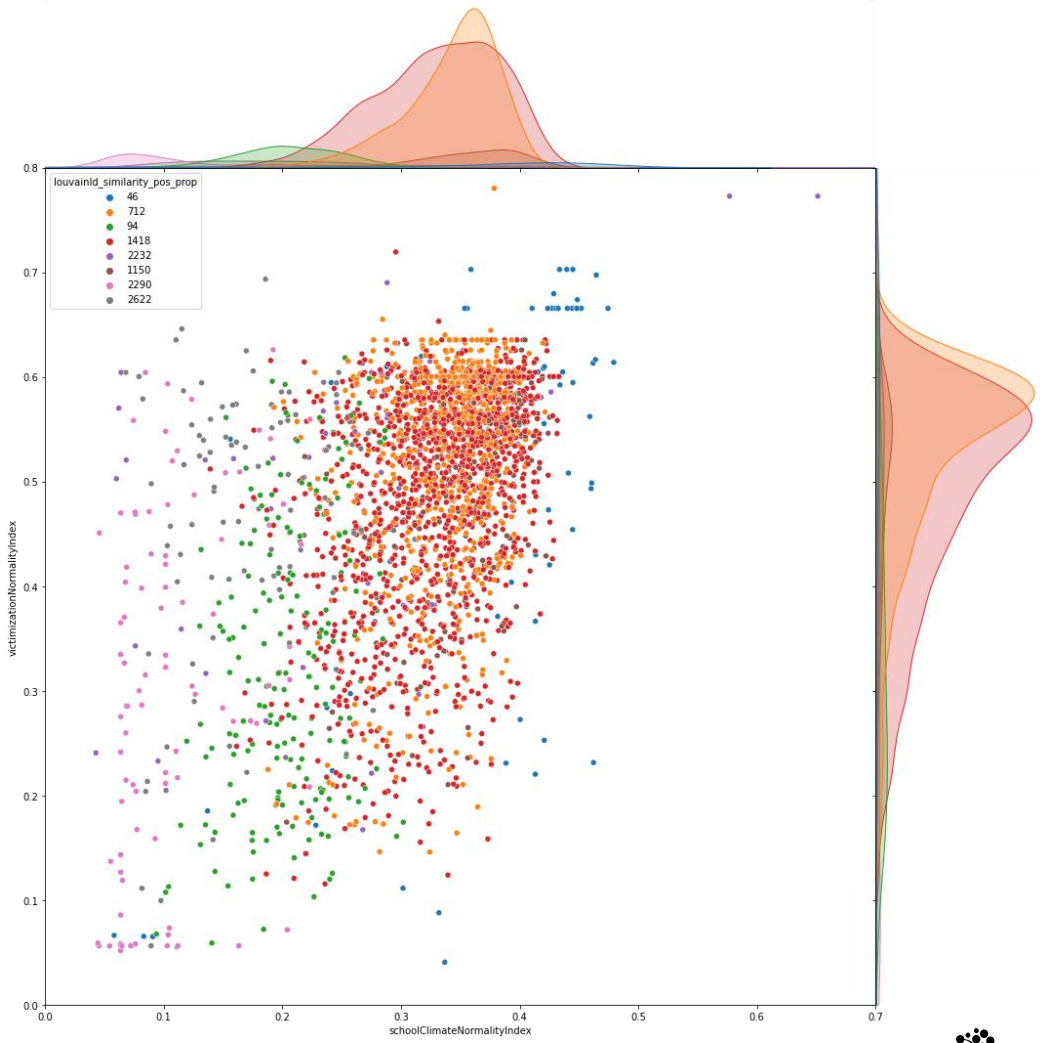
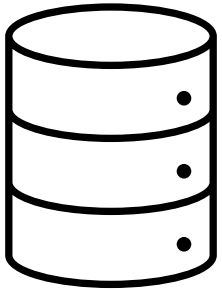
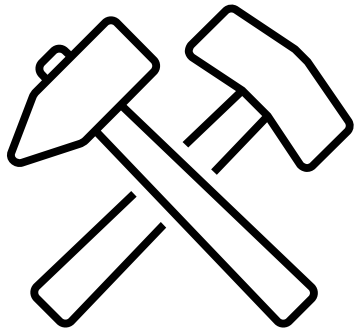
Results – Simulated Expert Predictions



Future Work





References

[1] Neo4j, “Node Similarity” [Online]. Available: https://neo4j.com/docs/graph-data-science/current/algorithms/node-similarity/ [Accessed: 2023-05-22]

[2] M. Needham and A. Hodler, “Graph Algorithms in Neo4j: Label Propagation” [Online]. Available: https://neo4j.com/blog/graph-algorithms-neo4j-label-propagation/ [Accessed: 2023-05-22]

[3] M. Needham and A. Hodler, “Graph Algorithms in Neo4j: Louvain Modularity” [Online]. Available: https://neo4j.com/blog/graph-algorithms-neo4j-louvain-modularity/ [Accessed: 2023-05-22]

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