Mining Spatio-Temporal Relations via Self-Paced Graph Contrastive Learning

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Introduction

Existing challenges in spatio-temporal forecasting using GNNs

• Explicitly pre-defined graph structure is indispensable. KNN-based and threshold-based methods are usually applied to generate the graph, if it is not available.

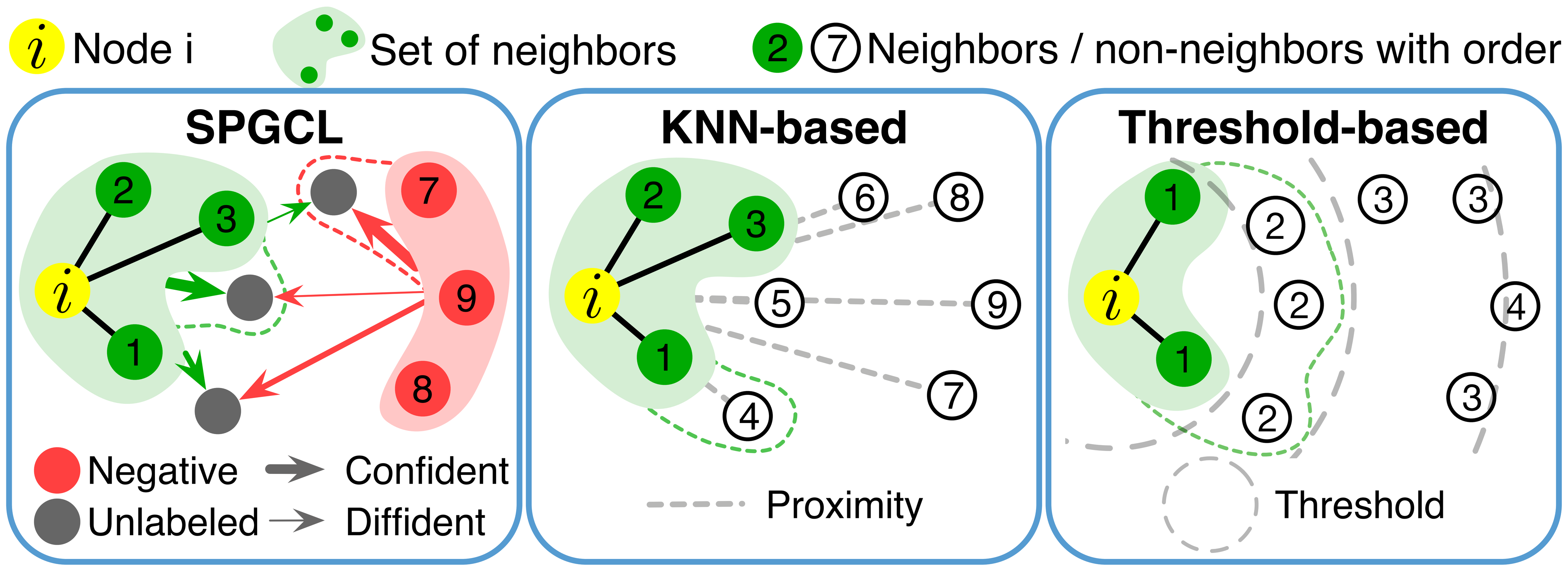
• Informative correlations between nodes are neglected using 1-dimensional adjacency and Laplacian matrices.

Contributions of SPGCL

• We train model to discriminate true neighbors so that the mutual information between each node and corresponding neighbors is maximized. (Below is the illustration)

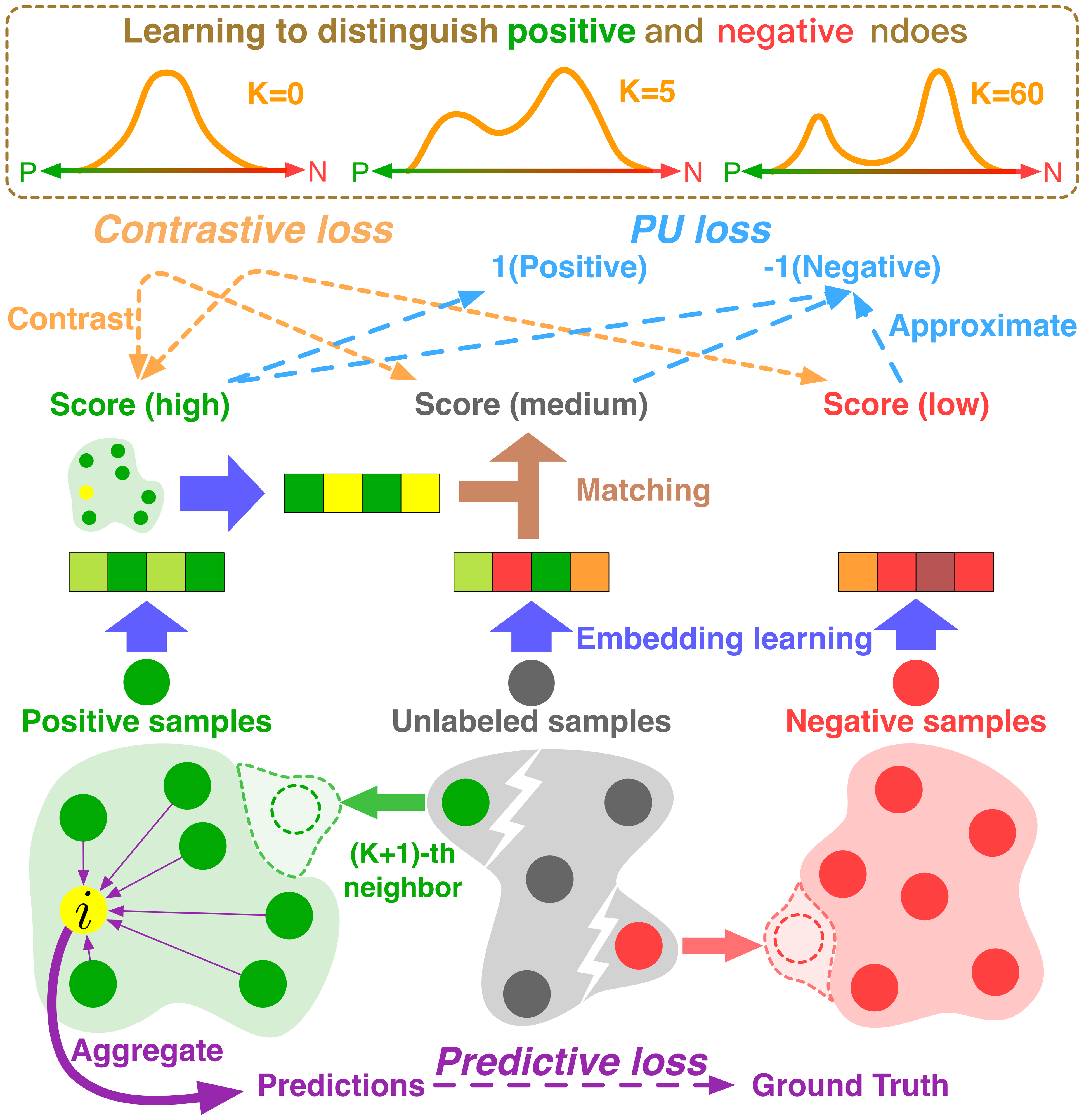
• We theoretically prove that the global mutual information objective can be optimized via minimizing local contrastive loss of multiple steps.

• We facilitate the model convergence under positive-unlabeled learning paradigm.



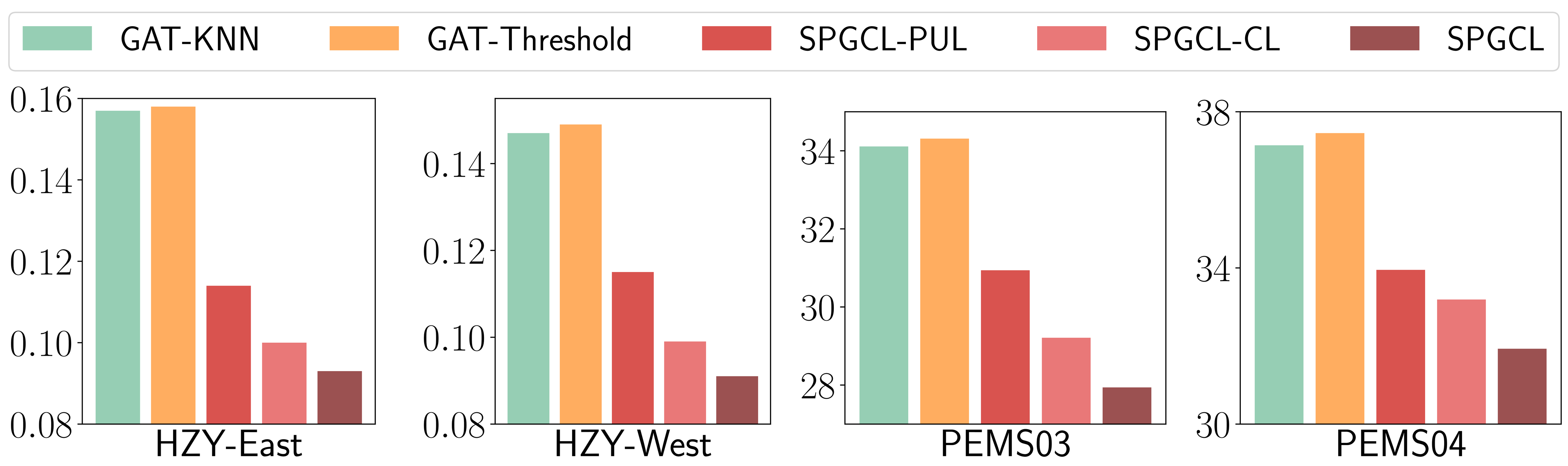
Methodology

1. Learning embedding from different measurements, i.e., spatial distance, DTW and sequential distance.
2. Obtain matching score between given node pairs.
3. Minimizing the hybrid loss composed by contrastive loss and PU loss.



Experiments

We verify the effectiveness of the proposed hybrid loss and investigate different adjacency construction strategies in the following ablation experiments.



After model converged, we draw the distribution of scores. The obtained symmetrical unimodal distribution confirms our conjecture above.