Research plan

Graph neural networks for traffic estimation

Máth Benedek, Nemes Ádám

Supervisor: Dr. Varga Balázs

The goal of this research project is to further develop our previous work where we managed to gather data using SUMO to train a Graph Neural Network for traffic estimation, which estimates the traffic based on the limited measurements (only a fraction of the roads are covered with measuring sensors). All of our progress (codes, figures, etc) can be viewed at: https://github.com/Nemesaaa/Projectlab

In this semester we are aiming to:

1. Develop a strategy for the sensor placement replacing the previous method, which was completely random. For this we will research the current methods, and based on that we will use an ’ordered’ random choice, to limit the number of experiments we need to conduct (3,4,5)
2. Perform sensitivity analysis, the subject of this is the fraction of sensor-covered roads, determining that what sort of strategy works the best with a given number of sensors
3. We are also planning to delve deeper into the world of GNNs, and examine the performance of more complex models and the possibility of different loss functions. (1,2)

Our goal is to participate in the University’s Students’ Scientific Conference this year. In order to do this, we have to submit our paper by the latest of the end of October. This defines our timeline:

1. By the end of August, review the relevant papers about the sensor placement and come up with an algorithm for finding the best sensor placement given the number of sensors.
2. By the 15th of September code that algorithm, and using that, begin the sensitivity analysis as well. During this time we will research the topic of more complex GNN models.
3. By the end of September we will write the abstract for the University’s Students’ Scientific Conference and finish the sensitivity analysis. Also in this time period we will experiment with more complex models.
4. By the 13th of October we will finish the experiments, gather all of our results.
5. By the end of October we will write the paper, and submit it. Furthermore we will create our presentation for the conference.

A shortlist of the literature we are planning to review for our work:

1. Jiang, W. and Luo, J., 2022. Graph neural network for traffic forecasting: A survey. Expert Systems with Applications, 207, p.117921.
2. Li H, Yang S, Song Y, et al. Spatial dynamic graph convolutional network for traffic flow forecasting[J]. Applied Intelligence, 2022: 1-13.
3. Enrique Castillo, María Nogal, Ana Rivas & Santos Sánchez-Cambronero (2013) Observability of traffic networks. Optimal location of counting and scanning devices,Transportmetrica B: Transport Dynamics, 1:1, 68-102, DOI: 10.1080/21680566.2013.780987
4. Owais, Mahmoud. (2022). Traffic Sensor Location Problem: Three Decades of Research. Expert Systems with Applications. 208. 10.1016/j.eswa.2022.118134.
5. J. Ivanchev, H. Aydt and A. Knoll, "Information Maximizing Optimal Sensor Placement Robust Against Variations of Traffic Demand Based on Importance of Nodes," in *IEEE Transactions on Intelligent Transportation Systems*, vol. 17, no. 3, pp. 714-725, March 2016, doi: 10.1109/TITS.2015.2481928