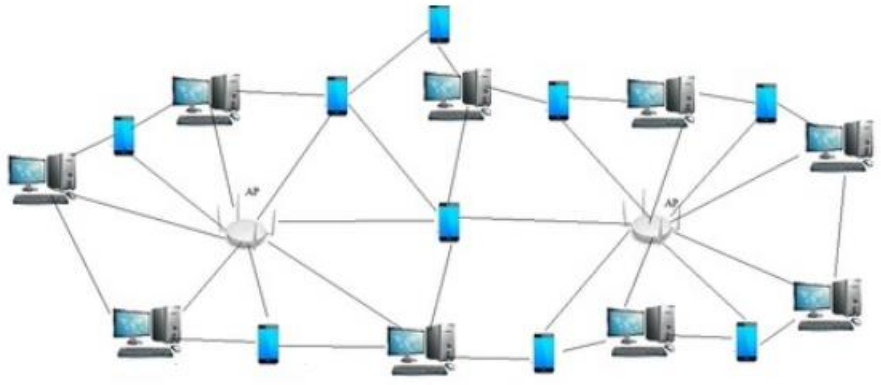
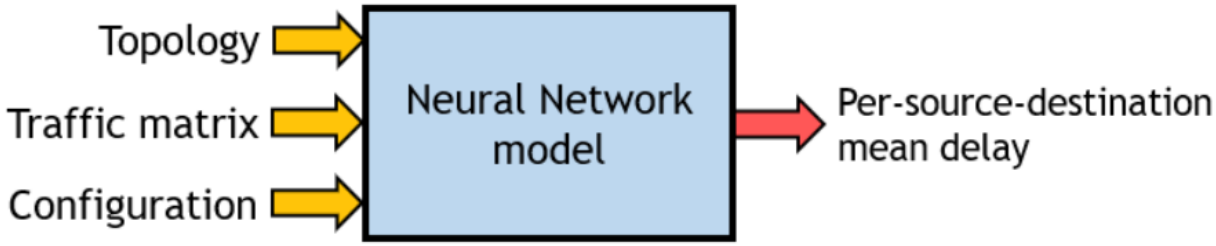
MANET Traffic Performance Prediction Machine Learning based Tool

Abstract:

Mobile Ad-hoc NETworks (MANET) is a communication platform for wireless first response units that creates a temporary network without any help of any centralized support. MANET is characterized by its rapidly changing connectivity and bandwidth over the communication links.
Mobile Ad Hoc Network is a collection of wireless hosts that creates a temporary network without any help of any centralized support. At the same time, the application runs on the units often requires strict availability of end to end bandwidth and delay.



It is essential to be build an optimization tool that will be able to predict the traffic bandwidth or the delay performance once the network topology changes or a new application starts running. Developing such tool requires network modeling. Nowadays, network models are either based on packet-level simulators or analytical models (e.g., queuing theory). Packet–level simulators are very costly computationally, while the analytical models are fast but not accurate. Hence, Machine Learning (ML) arises as a promising solution to build accurate network models able to operate in real time and to predict the resulting network performance according to the target policy, i.e maximum bandwidth or minimum end-to-end delay.



Recently, Graph Neural Networks (GNN) have shown a strong potential to be integrated into commercial products for network control and management. Early works using GNN have demonstrated capability to learn from different network characteristics that are fundamentally represented as graphs, such as the topology, the routing configuration, or the traffic that flows along a series of nodes in the network. In contrast to previous ML-based solutions, GNN enables to produce accurate predictions even in networks unseen during the training phase.

The main project target is to adjust GNN to MANET and test its prediction accuracy for such network.

Goals:

1. Refer to ITU Challenge: https://bnn.upc.edu/challenge2020
2. As baseline – use RouteNet GNN Open Source project from https://github.com/knowledgedefinednetworking/RouteNet-challenge
3. Install RouteNet on CS Rishon Server. Refer to https://gitlab.cs.technion.ac.il/lccn/s2020-deep-learning-based-traffic-classification-new for environment install instructions .
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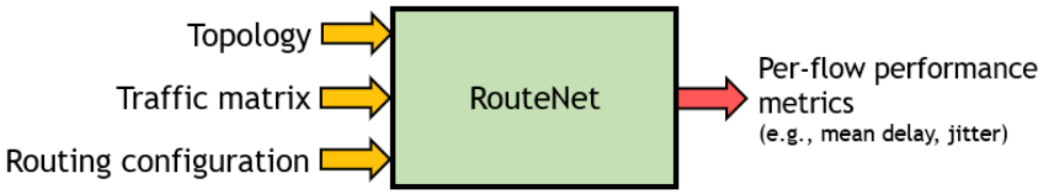


4. Download Training and validation data sets from https://challenge.bnn.upc.edu/dataset and use them for training and validating the model.
5. Raise MANET topology (OLSR based) using Mininet-Wifi. Refer to: https://mininet-wifi.github.io/manet/, https://www.youtube.com/watch?v=ZcaKRJIQXrQ
6. Get Traffic Matrix in the following format:

Stream#	Priority (ToS value)	Requested BW (Mbps)
1	0	1
2	0	0.5
3	10	2
4	0	1

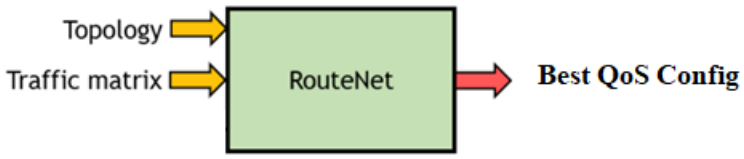
7. Get the Router QoS configuration template. Should be like the following:

WRR profile	ToS = 0	ToS = 1	ToS = 10
1	95%	5%	0%
2	90%	10%	0%
3	85%	15%	0%
4	80%	20%	0%

5	75%	25%	0%
6	70%	30%	0%
7	65%	35%	0%
8	80%	5%	15%
9	70%	10%	20%
10	60%	10%	30%

ToS 0: User traffic with normal priority
ToS 1: Routed traffic with normal priority
ToS 10: User traffic in high priority

8. In each run iteration Configure the routers with one of the WRR config , run the traffic according to the traffic matrix (Using poison distribution with packet size binomial distribution) and find the QoS config that results with the highest BW score.
9. Create data sets that include the traffic matrix and its label (best QoS Config).
10. Train and validate the GNN model with these data sets.



11. Test the GNN model with a new MANET topology .

Requirements:

Introduction to Networking (Must), Internet Networking (Optional),

Introduction to Artificial Intelligence (Must)

or

Introduction to Machine Learning (Must)

Programming Language:
Python

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Itzik Ashkenazi

Contribute to:
WIN