

## RouteNet - Deep Learning Network Performance Tool

### Abstract

Mobile communication networks are subject to dynamics in topology, transmission rates, and clients' demands (in terms of transmission rates and latency), In order to manage such complex network and allocate its resources to maximize end user quality of experience, we need an optimization tool that will be able to predict the traffic bandwidth or the latency performance once the network topology changes or a new application starts running. Developing such a 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 that are 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 latency.

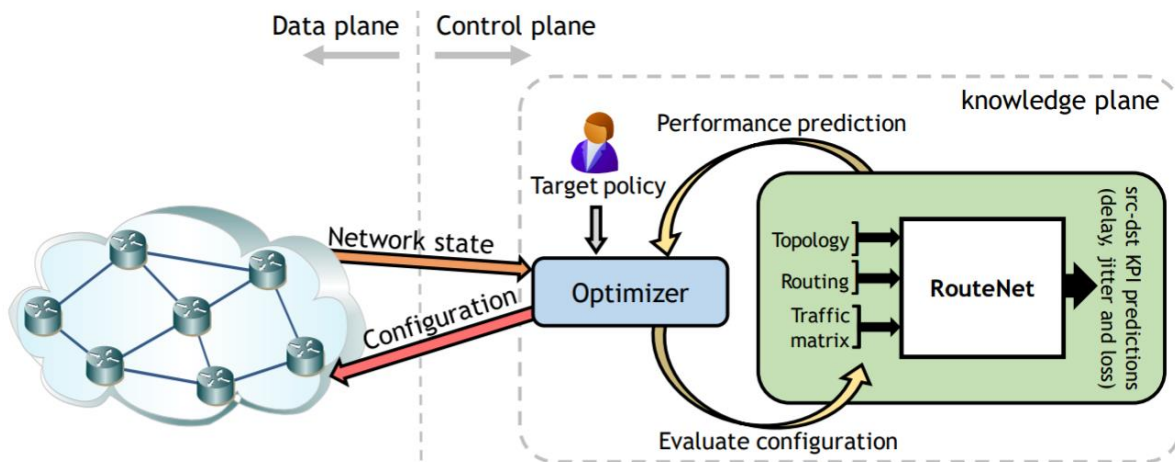
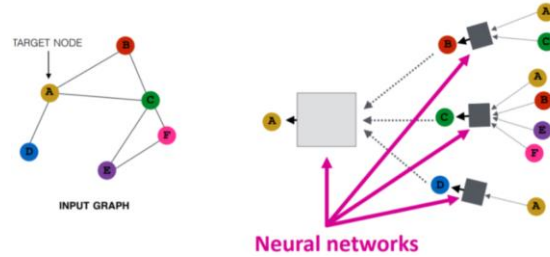


Fig.2: Architecture for network optimization in SDN [1]

Such an optimization tool is **RouteNet** [3], a novel network model based on **Graph Neural Network (GNN)** that is able to understand the complex relationship between **topology**, **routing**, and input **traffic** to produce accurate estimates of the per-source/destination per-packet delay distribution and loss.



## Objective

The Routenet project was proven on three topologies (All datasets available). The purpose of this project is to train RouteNet on a new dataset that will be generated using the Omnet++ simulation tool based on a tool developed last semester.

## Project Overview

1. Ramp-up on Deep Learning and Graph Neural Network theory background using [2] and other resources.
2. Install the RoutNet tool [3] and test it on a supplied data set.
3. Build a new dataset using Omnet++ (Project from last semester).
4. Train Routenet on the new dataset.
5. Define KPI (Key Performance Indicators), measure those KPIs and analyze the results.

General requirements for all LCCN projects are specified at the lab website:

<https://lccn.cs.technion.ac.il/lab-courses/>

## Notes

- The above list is an estimate. Goals and tasks might be modified during the first few weeks of the projects before the finalization of High Level Design Document.
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## Prerequisites

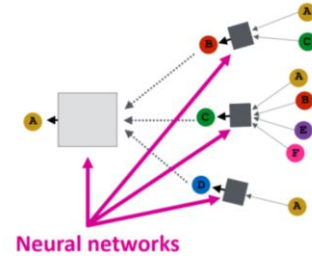
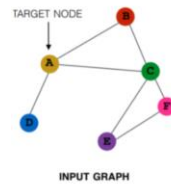
1. Introduction to computer networks (236334)
2. Internet Networking (236341) (nice to have)
3. Background in Neural Networks and Deep Learning (Very nice to have)

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## References

[1] RouteNet: Leveraging Graph Neural Networks for network modeling and optimization in SDN. IEEE Journal on Selected Areas in Communication (JSAC), vol. 38, no. 10, pp. 2260-2270, 2020

[2] <https://neptune.ai/blog/graph-neural-network-and-some-of-gnn-applications>



[3] "Knowledge-defined networking repository,"  
<https://github.com/knowledgedefinednetworking/Papers/wiki/RouteNet:-Leveraging-GNN-for-network-modeling-and-optimization-in-SDN>, 2019.