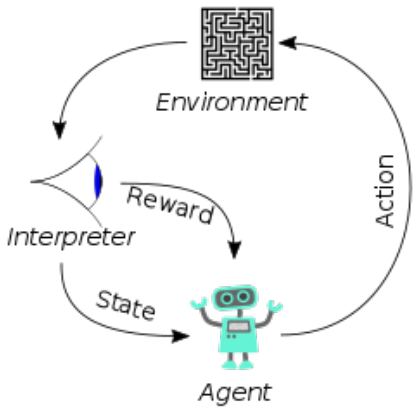
TECHNISCHE UNIVERSITÄT WIEN

Institut für Computertechnik
Institute of Computer Technology

Christian Doppler Forschungsgesellschaft

Master Thesis: Reinforcement Learning for Train Route Prediction

The Embedded Machine Learning (EML) team is part of the Christian Doppler Laboratory and does research on Deep Neural Networks (DNNs) in resource-constrained embedded devices. It studies how energy consumption and resource usage can be minimized while keeping high accuracy. The solution space is characterized by architecture parameters, DNN optimization and transformations, implementation platform configurations, and mapping options. This design space is huge, poorly understood, and rapidly evolving.



Reinforcement Learning (RL) is a type of machine learning in which an agent learns to make decisions and take actions in an environment to maximize a cumulative reward signal. The agent interacts with an environment by observing its current state, acting, and receiving feedback through rewards or punishments. The agent's goal is to learn a policy, which is a mapping from states to actions, that maximizes the expected cumulative reward over time. There are different types of RL: value-based, policy-based, model-free, model-based, Actor-Critic-based, Monte-Carlo-based, Temporal-difference-based, and deep-neural-network-based.

RL-based approaches are best suited when sequential decision-making is required and have therefore been applied to various applications, such as game-playing, robotics, marketing, trading, etc. However, applying RL-based approaches to predict a route for a train/tram is rarely investigated, especially when there is a switch with two possible forward routes.

This thesis project aims to benchmark RL-based approaches for train/tram route prediction, considering the possibility of switches along the route. This thesis project consists of the following steps:

- Select at-least three state-of-the-art RL-based approaches, such as Value-based, Policy-based, and DRL
- Select an open-source train/tram dataset, for example, RailSem19 or OSDAR2023
- Train/Evaluate the RL approaches to predict the route
- Optimize the selected approaches for embedded-hardware

This thesis offers you an excellent opportunity to get into the hot topic of deep learning. It allows you to become an expert in configuring neural networks. Moreover, you acquire critical skills in using neural networks in embedded systems and resource constraints.

Some of the M.Sc. projects may be combined with a part-time position.

For details, please consult the following:

- Maximilian Götzinger (maximilian.goetzinger@tuwien.ac.at)
- David Breuss (david.breuss@tuwien.ac.at)

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