Intellisys - Project Report

6th June 2021

Task Description

Problem Definition

The main task is to train a NN to control multiple vehicles at intersections simultaneously. The considered space is only one road crossing with N vehicles passing through over a time span T. The vehicles are considered as nodes in a graph, edges are created and maintained according to different distance thresholds. At each time step t, there might be different vehicles and edges in the graph (dynamic graph).

Progresses

- Literature search, see references.
- Reviewing GCN and Deep RL concepts.
- We tried to install SUMO, but it was problematic.
- MA in Carla should be also possible: at least according to one of the papers, it is enough to spawn vehicles randomly on a map, setting autonomous driving as True. Implementation started, but connection issues (also, need shared folder in the machines).

Issues/Questions

1. For input values we would consider: x, y, z, traffic light, waiting time, intention, yaw, pitch, roll, speed. Is this correct?
2. For the goal we would define: minimizing waiting time, minimizing number of cars in queue and avoid collisions. Should 'avoid collision' be a goal and if yes how should we model it, because while collecting data we do not observe collisions?
3. Conceptual: How GCN and RL are connected exactly.
   (a) Can we take as targets the (t+1) parameters?
   (b) Can the reward be formulated as function of: waiting time, multiple errors in parameters prediction, collision factor etc?
4. Are the features vectors really enough to capture the scene and teach a network to go through crossings? Could it be an alternative to have a bimodal approach taking both images and vehicle information per time step?
5. What kind of prediction should we have and why? Should be the throttle and speed of all the vehicles predicted (regression task)? Should be the next possible action of the vehicle (N,S,E,W) be predicted (classification task)? Should be the trajectories, meaning x, y, z be predicted (regression task)?
6. Do we have one main controller, meaning one agent or do we regard each vehicle as one agent, meaning we have multiple agents?
7. Should the upper limit of cars be reconsidered? How a model can generalize in wider crossings otherwise? Could the limit be on the highest number of edges that each node can create (as in a vehicle cannot be surrounded by more than 8 others)?
8. Practical: How to create a folder in the cremers server so that both of us can access the data and the code (or are we supposed to push everything in the gitlab?)
9. Practical: deadline?

Ref material

- articles:
  - Deep Reinforcement Learning meets Graph Neural Networks: exploring a routing optimization use case
  - Graph Convolutional Reinforcement Learning for Multi-Agent Cooperation
  - CoLight: Learning Network-level Cooperation for Traffic Signal Control
  - Multi-objective Optimization Based Deep Reinforcement Learning for Autonomous Driving Policy
  - Attention Is All You Need
- presentation: Deep Reinforcement Learning for Traffic Signal Control