ICCOS

REINFORCEMENT LEARNING IN THE LOGISTICS SECTOR – FROM PROOF OF CONCEPT TOWARDS IMPLEMENTATION

WHY

Reinforcement learning (RL) is a technique within Artificial Intelligence (AI) that is able to learn by simulation, instead of historical data such as (un)supervised learning. This means that having a huge amount of qualitative data is not a requirement. Because RL learns based on experience instead of historic data, this approach has the potential to learn new things and outperform the human. The drawback of this technique however is that implementation is not that straight forward and not all problems are suitable for RL.

The aim

Within the ICCOS project our aim and focus was to identify (generalizable) problems logistic organisations face when trying to implement RL and gain insights in how to tackle these problems.

WHAT

In the ICCOS project and consortium we have had the opportunity to develop a proof of concept for RL using data from Emons.

AI workshop

Together with Sebastian Piest of the University of Twente and Marcel Wouterse of Deltago, we organised a workshop to gather ideas for a problem that could be solved with RL. The best ideas were conceptualized using a design canvas and discussed in more detail.

Smart tendering

We picked the idea for “smart tendering”, where an RL agent can propose lanes to a commercial planner to reduce empty kilometres. We want the agent to support the employee, also called intelligence amplification.

AI Design workshop at Emons

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HOW

Gathering data

Using over one thousand possible lanes for tender, we selected features such as the frequency of the lane, the locations and the type of load.

Pre-processing

Before the data could be used by the agent, the following steps were performed:

- The locations were converted to coordinates.
- These locations were clustered to optimize the state space. See figure 1.

Developing the agent

The agent is able to select one of the clusters to drive to next and is rewarded a score based on how well the routes matches earlier steps. A good score means that the agent learns to take that step in a similar situation.

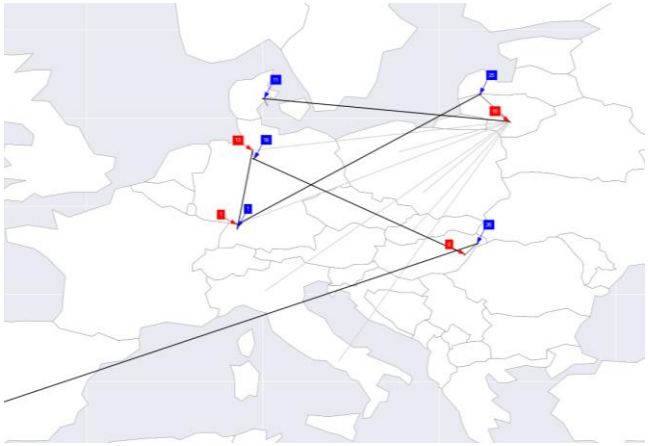

Figure 1. The environment in which the agent operates.

RESULT

After (hyper)parameter training the agent was able to take more logical routes, match frequencies and locations to reduce empty kilometres. See figure 2.

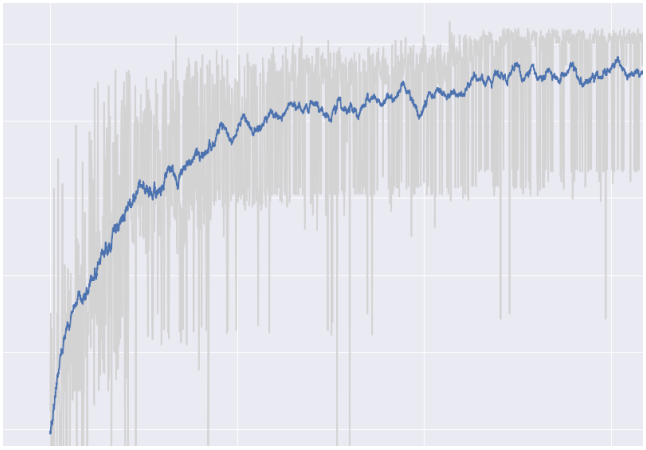

Figure 2. The training results of the agent.

Findings

During development of this proof of concept we discovered the following things when trying to implement an RL agent at Emons:

- There are a lot of use cases for RL in logistics.
- Most time went into the pre-processing of data and creating the simulation environment.
- The RL agent is able to learn a complex puzzle and to find a local optimum in selecting lanes.
- Implementing this proof of concept in day to day operations requires knowledge, infrastructure and data science skills.

HOW TO CONTINUE

Data scientists spent most of their time on preparing and gathering data before they can develop their models and intelligent agents. Relieving data scientist from these tedious and time consuming tasks, creates more time and resources for modelling, experimenting, and learning to utilize RL. Therefore, we want to alleviate the problem by creating a platform to deliver data driven logistics. This platform is designing around unified data model (e.g. OTM), so that organisations are able to quickly test their ideas and we can develop re-usable algorithms and intelligent agents.

What's next

We have successfully applied for an the NWO Accelerator call entitled: "Reinforcement LeArning Platform for SMEs in Logistics" (ReAL). Together with the University of Twente, Emons, Deltago, and Port of Twente. we are developing a RL platform, implementation guidelines and supporting training programs to make implementation of RL broader accessible for the logistics industry.

We are looking forward continuing working with these partners and continue our journey towards implementation of RL in logistic organisations.

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