Project Proposal

Agente autónomos e Sistemas Multi-Agente

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ABSTRACT

Nowadays, ubers and taxis are an essential part of any major city, since they provide easy and quick transportation. With the rising of autonomous vehicles and being impossible for a company to design software specifically for each city it provides on, machine learning algorithms are the best solution to ensure a good service.

This project aims to create agents that have the objective of learning how to provide this kind of service using machine learning to allow the agents to create a model that would represent the best place to wait for potential client which would result a better service for a client and less cost for the company providing that service.

Naturally, it would be incredibly inefficient for a single agent to learn a city by itself so communication and cooperation with agents from the same company is necessary to guarantee a rapid adaptation to the city.

Our solution, although it's adapted for AI agents could also be helpful to human drivers who can apply our methods to create models of the city they work in and achieve higher performances and, consequentially, accomplish better profits. We plan to have an impact not only in the future but in the present as well.

KEYWORDS

Multi-agent system, Machine learning, self-driving, commercial driving, , reinforcement learning.

1 Introduction

In a high function city with multiple interest points (ex: commercial center, railway stations, etc.) transportation services are needed. These different points have different influx of people, so knowing where people will be and when is key to provide an optimal service while reducing costs like fuel and tires.

Nowadays, millions of commercial drivers face this problem every day but, in a future, where transportation will be mainly made by self-driving vehicles, those will also have to adapt to different cities so solving it will not only improve the present but create good roots for what's to come.

Our objective is to create a number of self-driving agents that would work for the same company and cooperate within that same company to provide clients with rides from one location to another. Since each agent belongs to a company and cooperate with its co-workers, many other companies can emerge to compete between them.

The goal of an agent is to catch the passenger at its location and deliver it at a location set by that same client without making it wait too long. With this goal in mind, the agents of the same company must communicate between each other so that every agent learns at the same rate and have the maximum information available when making a decision.

2 Approach

The environment will consist in a 2-D city with interest points, simple roads and parking lots near the points of interest. Each interest point will have a probability of generating a client that needs transportation. Each point will have a limited number of parking spots that will vary taking in consideration the probability supra-mentioned. The number of agents waiting for passenger in each point will be determined by the size of the parking. The agents cannot wait for passengers in the middle of the road. For that reason, the number of total parking spaces must be equal or higher than the number of agents.

When a customer requests a trip and there are agents in the corresponding parking lot the agent providing that ride is the one that has been parked longer. If no agent is there the closest agent that is free is called and if no one is free it is chosen, the one with destination closer to the passenger.

In order to achieve the agent's goal, our approach will consist of applying a grid. This grid will provide the agent with the optimal position to wait for clients. That position will be updated taking into consideration the number of clients that the agent picks up at a given point of interest and the information that is transmitted by agents from the same company. In this project two companies will be competing and each one will have a different process of developing the model. After gathering information about the environment, the agents must find the best parking lot to wait for a passenger if this park is already full the agent will go to the next park (second best optimal position), if it is also full the agent will look for the next one until he finds a free parking space. Even though it might seem that the agents after a long time in the environment have figured out the optimal positions, they should test other options as well as the city may change (for example restaurants closing, sporting events in a specific place, etc.).

The agents, when travelling (with a passenger or not), know their position and the path they must travel to reach the wanted destination (like having a GPS). They also have sensors that allows detection obstacles that may appear, for example, another agent dropping a passenger or passing a crossroad.

To summarize the agent's actions can be as followed:

- Stop at a parking lot, when it's not full, at the road, exclusively to drop a passenger, or when an obstacle is detected.
- Move forward when no obstacle is detected in the road.
- Change direction at curves and crossroads.
- Pick a passenger when the trip is assigned to itself.

All things considered the agents' architecture must allow them to learn not only with the things they experience but also with the communications they receive from agents of the same company. All these while receiving inputs from the sensors to safely drive in the city. Therefore, the architecture must a Hybrid between reactive (to face the obstacles that may appear) and learning (to learn which points are worthy waiting in).

This solution is ideal to face our problem because it focusses on only learn the city to evaluate the best position to benefit the costumers and the agent itself. With the 2-D environment we can easily define interested points and simple routes for the agents to go through which eliminates other problems self-driving agents face that are not addressed in our project.

3 Empirical Evaluation

To evaluate our solution, we take in consideration two factors, the time a passenger waits for a trip in each company and how many trips each company makes in the same amount of time.

Firstly, our objective is to reduce the amount of time it takes for a car to reach the passenger so that time reaching values close to zero after many iterations is a good indicator that the agent is learning where to be to reach passengers as fast as possible.

Although it may seem enough, if a car is just waiting for a passenger at a parking space for long periods of time, then it may be losing trips to other companies and that can damage the company it is associated with. So, having a lot of trips is also an important factor to take into consideration.

After various iterations, the average of time waited, and the number of each company will determine whether or not the approach was successful.

Evaluating each agent performance is also desirable as we can identify and resolve problems in the communication between agents. Not only we plan on achieving better results to a company as a whole, but the agents must have similar performances.