AASMA Project Proposal 2020
G46

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ABSTRACT
We were proposed to deepen and apply our knowledge about autonomous agents and multi-agent systems. The theme that we chose was a logistic/delivery simulation modeled by a multi agent system. It is intended to understand how agents can improve their common goal in a collaborative manner in the most efficient way.

Keywords
Autonomous Agents and Multi-Agent Systems; Collaboration; Cost efficient; Logistics;

1. INTRODUCTION
In this report we discuss what the problem studied consists of and suggest the proposal of our multi agent system and the environment.

2. PROJECT DEFINITION, RELEVANCE AND REQUIREMENTS
Our project consists of a simulation about a transport/delivery environment from the perspective that the **agents are the delivery stations** with the goal of delivering packages at the destination using the least amount of energy possible. In this environment, there are stations, routes, transportation methods and packages.

In each iteration of the simulation, each agent perceives a new package to deliver and proceeds in trying to deliver it.

Each station has different types of vehicles (transportation methods) it can use; there are restrictions in the routes, some stations don't have a direct connection between them or can only be accessed by a certain type of vehicle (simulating sea travel, for example); each route can have more than two stations; a route has an associated cost (energy spent) that depends on the decisions the stations that are present in it make such as the vehicles chosen.

The package reward is known. The agent can try to perceive a new route with collaboration with other stations or use the one's it already has; If the agent opts by collaborating, it has to divide the reward for all the stations that participate in the delivering route accordingly with the allocated efforts of every station.

The performance of each station is measured by gains - a package successfully delivered gives the agent rewards - divided by the allocated efforts.

The relevance of this project can be seen as both a simplification and a modification of a real world scenario of a multinational delivery company operating in various points.

3. PROPOSAL OF AN MULTIAGENT SYSTEM AND ITS ADEQUACY TO ANSWER/STUDY THE PROBLEM

3.1 Sensors
Each station can perceive the vehicles available, the packages to be delivered, the energy available and which stations are reachable.

3.2 Actuators
Stations act by choosing a route and the vehicle to deliver a package.

3.3 Environment
To model our project, we will use a map that is a simplified version of a planisphere, representing stations in each continent. Depending on the geography each station will have different constraints, some won't be able to have boats because they're landlocked and others won't have trucks, in islands. There is a network of route for each type of vehicle. These networks will be represented as graphs.

4. PROPERTIES OF THE AGENTS AND ENVIRONMENT IN THE PROPOSED INTELLIGENT SYSTEM

4.1 The Agent
It is **autonomous** because it can operate and decide actions without any interference of that ownership entity.

The goal of the stations is to **rationalize** a way to maximize a utility.

We intend to test and compare various types of agents: when learning by reinforcement learning, agents will be **adaptive**; we'll also implement **reactive** agents that do not keep a record of past deliveries and knowledge about the routes, so agents have to guess which station can be a proper intermediary to deliver when the destination does not have a direct path; and **deliberative** agents that record their past and are intentional systems which can improve their performance with the knowledge they gain from experience.

Agents have a **collaborative** trait since they need each other to accomplish their goals or to achieve them more efficiently, even though sometimes an agent can accomplish its goals efficiently all by himself, it has to make sure the collaboration is not worth it before acting individually. Even though the package came to the

station from another one, since all the participants in that delivery have a reward according to their effort made regarding it, the agent has no priority in saving energy to deliver its respective packages.

As a station only knows the route to its neighbour stations, it has to determine the path to distant stations in two ways, that use this collaborative traits:

- It can ask (some) its adjacent stations if they know the path to a destination. If they do not know a path, he explores and if he succeeds, it stores the consequent path.
- Intermediary stations, that help carry packages between origin and destination, can register (depending on the implementation) what route was used to get to them. Knowing this information, they know a route that can reach the origin station of that package. Eg. if a package from origin A (not my direct neighbor) reaches me using the route 1, then I know I can reach A using that route.

It is also **not believable** because it uses a very simple interface and representation of the world. Has **no mobility**: the station is at a fixed location.

Each station has **no personality**, besides its location and number; and **cannot lie** to its owner or other stations since they want to collaborate.

4.2 The Environment

According to the definition of our environment, it is **inaccessible**, because the agent does not know and cannot know (without asking other agents or travelling) the full extent of the world.

It is **deterministic** because, if the agent calculates a possible route to send a package, the package is successfully sent.

It is **dynamic** because, while some station is deciding the best route to take (and stations to pass through) at a given time, those intermediary stations may use and cut some options, as they have already spent too much energy to perform or used a required vehicle.

It is **discrete** because it has a finite number of possible actions and percepts.

It is **non-episodic** because the transportation means are limited and, if some are used before, it influences the rest of the simulation.

5. REFERENCES

[1] Wooldridge, M., 2009. An Introduction To MultiAgent Systems. *John Wiley & Sons Ltd.*