Multi-Agent Reinforcement Learning in Plant Growth

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Reinforcement learning (RL) [1] is an area of Machine Learning which originally developed for Markov Decision Processes (MDPs) [2]. It allows a single agent to learn a policy through trial-and-error interactions with its environment. By trying different actions, and receiving different reward values for those actions the agent aims to maximize the overall reward at the end. Vanilla reinforcement learning is concerned with a single agent. In Multi-agent reinforcement learning (MARL) [3] multiple agents interact in a common environment. These agents interact with the environment and one another to accomplish a particular task in a shared environment, and this might be beyond the MDP model.

These situations arise naturally in a variety of domains, such as robotics, self-driving cars, telecommunications, game playing, economics, distributed control, traffic light control, etc and we are interested to adopt this scenario in the use case of plant growth.

Plants are dynamic systems that are faced environmental changes and adapt over time to their surrounding conditions. Plant responses to an environmental stimulus are a good example of a real-world problem that can be approached within a reinforcement learning (RL) framework. Simulation of realistic virtual plants have been explored through different algorithms such as L-systems [4], Functional–Structural Models (FSMs) [5] and Space Colonization Algorithms (SCA) [6]. In GrowSpace [7] a plant growth model, based on the competition for the space was simulated with the objective of controlling a plant by moving the light source. There are some limitations in this approach and the objective of our project is to overcome some of them. In this project, we aim to develop a specific model to simulate the

growth of different plant species and increase the number of environmental conditions such as water supply, wind, nutrient availability, to have a better representation of the physical world.

The student must have a good communication and critical thinking skills and keen to learn new subjects. Having a knowledge of programming language such as python and basic of classical machine learning algorithms are essential. Being familiar with the game engine such as Unity for simulation and a 3D computer graphics software such as Blender is a bonus.

During this internship you will learn how to customized a Reinforcement Learning environment and work with multi-agent systems and strategic intelligent decision making scenarios that can be used in variety of domains.

References

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