

Multi-Agent Reinforcement Learning for Coordinated Block Transportation

Maikel Withagen (S1867733)^a Steven Bosch (S1861948)^a
Thomas Derksen (S2016346)^a

^a *University of Groningen, Faculty of Mathematics and Natural Sciences,
Nijenborgh 9, 9747 AG, Groningen*

Abstract

1 Introduction

One of the returning issues in machine learning is that it's often hard to decide which learning algorithm should be used for a certain application. Over the years, a lot of valid learning algorithms have emerged, each with their own advantages and disadvantages. Some algorithms might be faster, while others might be more precise, and an algorithm that is better in one area usually performs worse in another. Matching the right task with the right algorithm is not always a straightforward task.

In this paper we will look at the problem of box-transportation. For this task, two virtual robots will have to cooperate to transport a box to a certain goal area, while avoiding certain obstacles. This is a problem that has already garnered some attention in machine learning research. In 2006, Wang and de Silva tried to solve this problem with reinforcement learning techniques [4]. They compared the performance of a Q-learning algorithm with the performance of team Q-learning in a dynamic environment. In 2010, a team at the University of Deft also showed how you could use Q-learning, team Q-learning and the WoLF-PHC algorithm to accomplish a similar task in a static environment [1].

We will also compare the Q-learning and team Q-learning algorithm, since they seem most suitable for a task like this. For our initial task, two agents have to transport a box in a two dimensional static environment. We will compare the performance of our two reinforcement learning algorithms by looking at the time it takes for them to converge, and their final utility scores.

Secondly, we will also expand the task by adding another goal area or adding additional agents. **However, we still have to see if this is doable.**

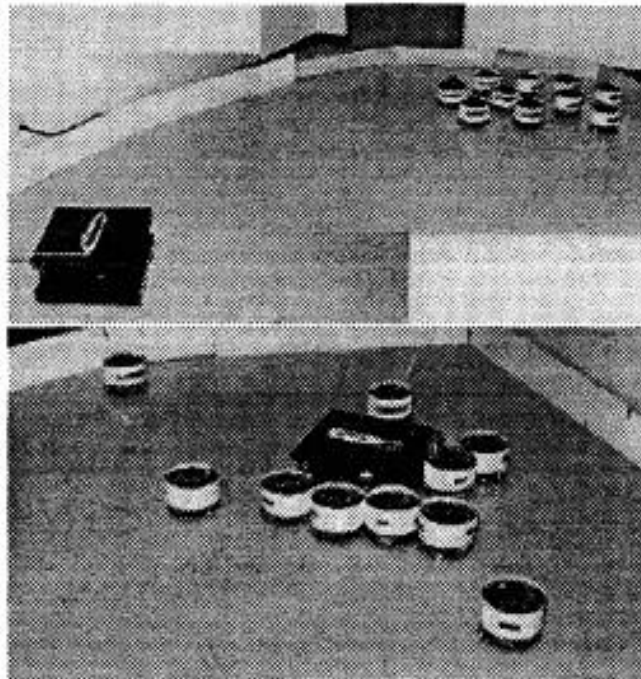
2 Application

The box pushing problem is significant in both the theoretical and practical domain. From a theoretical point of view, it is a relatively simple problem with clear boundaries. Although there are multiple versions of this problem, the basic idea is intuitively easy to understand. Because of its simplicity, it is not hard to extend it to more complicated, real-life situations. It's also a good task to observe the effects of different learning algorithms since, in the more

simple, stripped down versions of this task, there aren't a lot of parameters that influence the outcome. Finally, it's also an interesting way of studying cooperation between multiple autonomous agents.

Although we use a simulation in this paper, the task has also successfully been completed by physical robots. For example, in [2] a team of two Pioneer 2 mobile robots is used to physically push a box to a certain area while a third robot serves as an observer. In [3] they take a different approach, where they use a swarm of smaller custom robots to collectively move a box (as can be seen in figure 1).

Figure 1: Robots from [3] locating a lit box



It isn't hard to come up with practical applications for these kind of systems. In the future, they might for example be useful in construction, or to clear the rubble after a building has collapsed.

3 Method

4 Results

5 Discussion

References

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