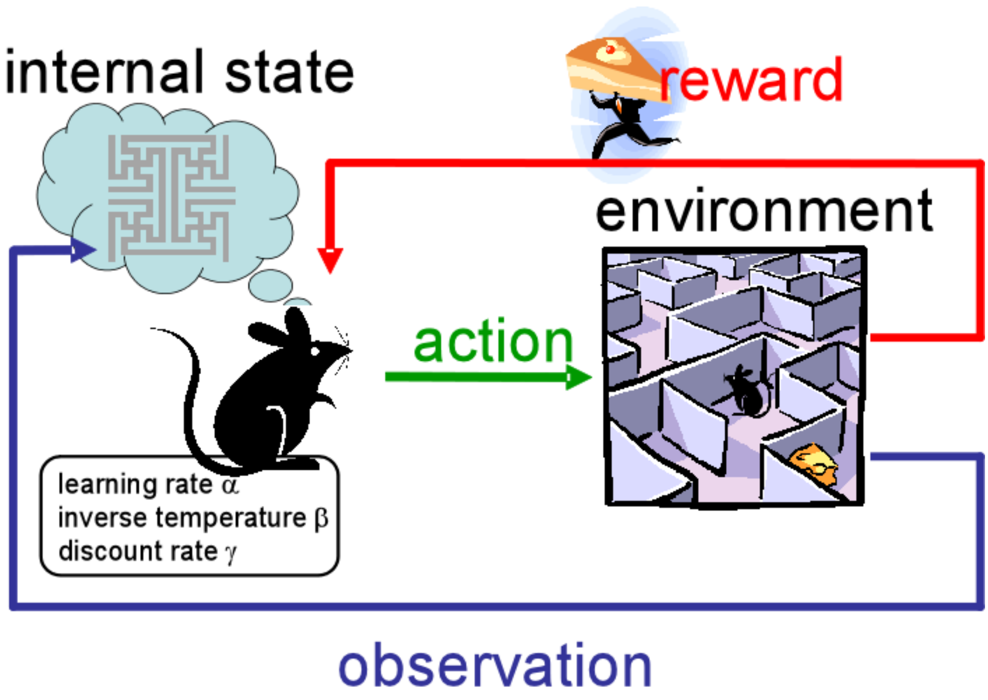
Aarhus University Department of Engineering 2017

Thesis

Title of project



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Project title:

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Contents

Chapter 1

Introduction

Getting in touch with the most promising and hottest topic in artificial intelligence represents a challenge

To be continued...

Chapter 2

Theoretical Background and State of the Art

2.1 Theoretical Background in Reinforcement Learning

Reinforcement learning is an approach in artificial intelligence for goal-directed learning from interaction and experience, that makes it different from the other approaches in machine learning in which the agent is told what to do. In reinforcement learning the agent tries out different actions in order to understand which of them generates the most reward. The reward is a notion specific to reinforcement learning which describes the goal in a Markov decision process (MDP) model. Roughly speaking, the MDP model would very well characterize the agent's view of the world, the actions that it can take in the world and its goal.

Machine learning distinguishes supervised from unsupervised learning paradigms by having the supervisor indicating the correct behavior in certain generalized situations for the supervised learning and finding hidden structure in unlabeled data for the unsupervised learning. Reinforcement learning is sometimes classified as an unsupervised learning problem, because it doesn't make use of labeled data, however it doesn't look for structure, but tries to maximize the reward. Therefore, reinforcement learning is considered another paradigm in machine learning, according to the opinion and points of the authors R. S. Sutton and A. G. Barto of the book "An introduction to Reinforcement Learning" [1]. The diagram in Figure 2.1 illustrates the relationship between machine learning and reinforcement learning.

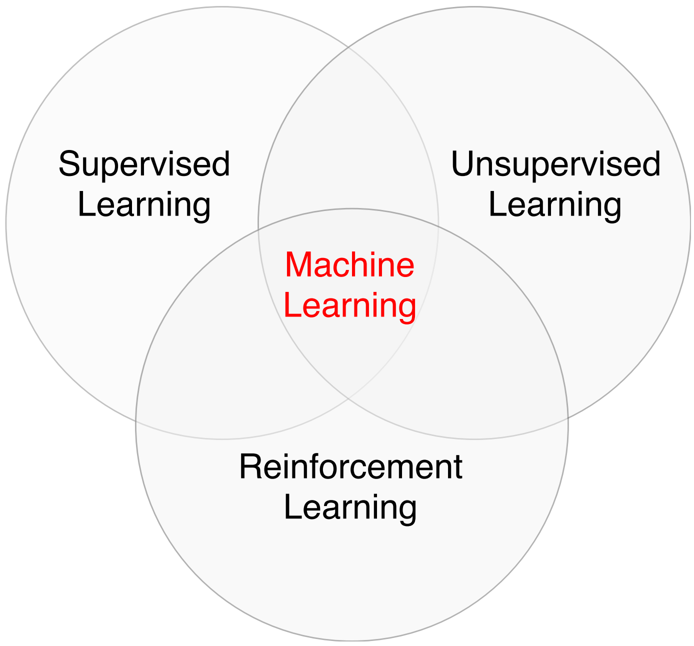

Figure 2.1: *Reinforcement Learning and Machine Learning*

Reinforcement learning considers the problem of planning in real time decision making and the models for prediction related to planning. The interactive goal-directed agent is able to operate in an uncertain set up, make decisions despite uncertainty and predict future events. The agent is not necessarily a robot; it can be any component in a larger system in which it interacts directly with the system and indirectly with the system's environment.

There is a special concern in reinforcement learning which is not present in the other machine learning approaches. It is the issue of balancing exploitation of the knowledge that the agent has and exploration of new information in order to improve the current knowledge base.

A variety of different scientific fields intersect with reinforcement learning, especially mathematics, namely, statistics and optimization, which have an important background contribution to the reinforcement learning methods. "For example, the ability of some reinforcement learning methods to learn with parameterized approximators addresses the classical "curse of dimensionality" in operations research and control theory." [1] Reinforcement learning is also part of the engineering and computer science subjects. The related algorithms have a close resemblance to the biological brain systems of animals and humans due to the reward factor involved, therefore it also binds with the psychology and neuroscience fields. The diagram in Figure 2.2 illustrates the relationship between reinforcement learning and other scientific disciplines.

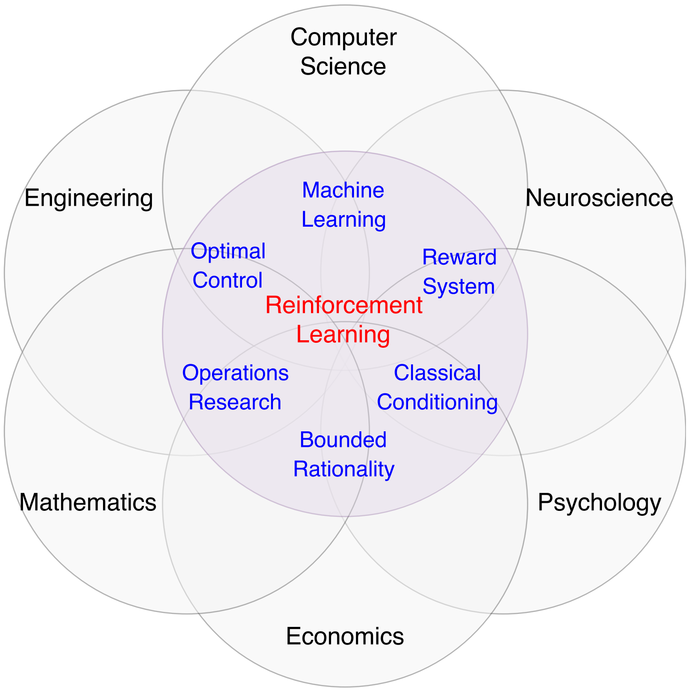

Figure 2.2: *Reinforcement Learning and other disciplines*

2.2 Previous Research

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2.2.1 Atari 2013

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2.2.2 Go 2016

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2.2.3 A3C 2016

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2.2.4 Framework 2017

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Chapter 3

Project Framework

This project is about learning a car or robot to control and navigate it self. This should be done so the robot don't hit walls or obstacles. To do this a system is created. This system is created as inspiration from [2]
Can be seen on Figure 3.1.

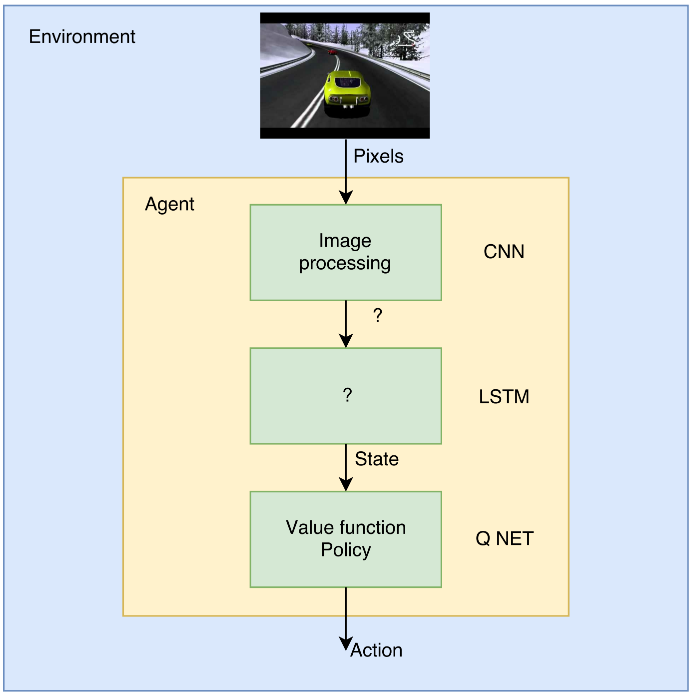

Figure 3.1: *The block diagram of the system*

3.1 Convolution Neural Networks

CNN is here

3.2 Recurrent Neural Networks

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3.2.1 Long Short Term Memory

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Bibliography

[1] R. S. Sutton and A. G. Barto, *Introduction to Reinforcement Learning*, Draft, 2nd ed., 2016. [Online]. Available: https://webdocs.cs.ualberta.ca/~sutton/book/bookdraft2016sep.pdf

[2] V. Mnih, A. P. Badia, M. Mirza, A. Graves, T. P. Lillicrap, T. Harley, D. Silver, and K. Kavukcuoglu, “Asynchronous methods for deep reinforcement learning,” *CoRR*, vol. abs/1602.01783, 2016. [Online]. Available: http://arxiv.org/abs/1602.01783