



# Proposal bachelor thesis

**Title:** Learning with Deep Visual Features

**Promotor:** Ann Nowe

**Advisor:** Peter Vrancx

**Includes preparation course:** Yes

## Context

Deep learning is a relatively new research track within the field of machine learning. The main idea behind deep learning is to create architectures consisting of multiple layers of representations in order to learn high level abstractions. An example of this can be found in the deep neural network methods currently used in image processing. Starting from individual pixels, each successive layer of the network learns progressively more complex features until the highest layers are able to recognize objects in the image. These deep networks have achieved remarkable successes in object recognition, document classification and speech recognition tasks.

Reinforcement Learning (RL) is a machine learning technique that allows a learning agent to learn from trial-and error interactions with its environment. By observing the results of its actions, an agent can determine the optimal sequence of actions to take in order to reach some goal. Recently the combination of deep learning and reinforcement learning was proposed. Instead of using handcrafted features, deep reinforcement learning allows a learning agent to control a system based only on visual inputs, using a deep neural network to extract relevant features from the images.

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The goal of the thesis is to evaluate the use of general deep visual features in reinforcement learning. Previous approaches to deep RL have always relied on learning task specific deep features for each new problem. In this thesis we will look at a multi-task learning scenario, where we attempt to learn a single representation that can be used across multiple learning tasks. The resulting learning algorithm will then be compared with task specific deep RL, in order to determine the costs/benefits of general and task specific features. The evaluation will be performed using the the Arcade Learning Environment

(<http://www.arcadelearningenvironment.org/>), a learning environment consisting of emulated versions of Atari 2600 games.

## **Preparatory course bachelor thesis**

In order to complete the thesis, the student will first have to familiarize himself with a number of machine learning techniques, mainly deep neural networks and (batch) reinforcement learning. The preparation will consist mainly of studying relevant sections from the books “Learning deep architectures for AI” and “Reinforcement Learning and Dynamic Programming Using Function Approximators”, possibly complemented with some related research papers. During the preparatory course the student can also familiarize himself with RL techniques by implementing and evaluating the basic (non-deep) learning algorithms in the learning environment.