

# AI Domination - Machine learning for cooperative behavior in Computer games

Degree programme : BSc in Computer Science | Specialisation : Computer Perception and Virtual Reality  
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Using Reinforcement learning and neural networks together with Unity Game Engine we set out to train AI's to play the game mode known as „Domination“ inspired by the widely popular video game Call of Duty. The focus of the training is on adversarial and dynamic team behaviour.

The video game industry has grown immensely over the past decade. Not only is the video game industry worth billions of dollars but video games have begun to be widely recognized as a true art form. The industry's growth is a testament to the widespread appeal of these simulated worlds which are often wonderfully creative and other times frighteningly realistic. Games are not only to be looked at as an art form or entertainment: they are often a driving force behind innovation and pushing the boundaries of technology. In the past, game publishers and producers have spoken often of the AI in their games.

However, often these AIs were nothing more than clever variations of traditional algorithms with decision trees and steering behaviour at their core and when pushed to their limits the AI would show signs of their lack of intelligence. In games, often the enemies have a very predictable movement pattern. This can lead to a rather boring experience after you have fought the enemies numerous times or when you have defeated a game's boss for the first time. Machine-learning is at the forefront of innovation and research, and it seems that the marriage of AI and video games would be perfect.

We set out to try our hand at creating an intelligent AI which would be able to play the popular game mode „Domination“. In Domination the objective is to capture as many control points on the map as possible. When a team is in possession of the majority of the control points the enemy team begins to „bleed“ points. If a team manages to reduce the opposition team's points to zero, they have won the game. In order to achieve this, we have employed the use of two technologies: ML-Agents and the Unity Game Engine. ML-Agents is an open-source toolkit for training neural networks on the basis of TensorFlow and Reinforcement Learning and has direct integration to Unity. The Unity Game Engine is used by us to model the playing field and the agents we want to train.

We passed through different stages of training the juvenile agents from basic movement and seeking to more complex teamwork-based behaviour to create a mature agent. Along the way we were faced with many challenges involving reward functions, neural network configurations and game design. The nature of Machine Learning is often one of trial-and-error and requires many iterations and training runs of millions of experiences. It is this implicit nature that made this project as interesting as it was. We feel as if we have learned as much along the way, if not more, as our agents have.

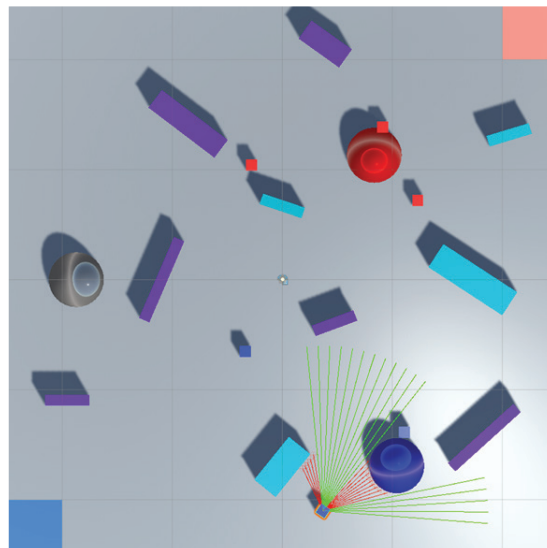
AI Domination is a blend of the challenges of modern neural network training and the exciting world of video games. Although aspects of our framework is still in its infancy, we were able to create agents that behaved in a team-driven way.



Christian Kocher



Nadine Siegfried



An automated game of Domination