Introduction

It is almost certain that we will ride in a car which will be controlled by AI (i.e. a self-driving car) at some point in our future and when that time comes the AI controlling the car just might have acuminated its skills by playing video games. Video games are a fantastic means for teaching learning algorithms which may power the next generation of advanced artificial intelligence. Teaching artificial intelligence how to understand and navigate in three-dimensional space through making it play video games like Doom, Minecraft, etc. is a way and means towards creating an AI that can interact with real world in complex ways.

It is easy to assume video games as mindless escapism but they generate such huge amounts of information and this information is apt for teaching an AI how to perceive the world and interact with it on complex ways. It is hard for a human to teach AI as it has no knowledge of the world whatsoever, you have to explain everything. Beyond a certain point, humans just don’t have the time and patience to teach AI but video game don’t have that problem as they generate tons of information well suited to teach AI.

In 2013, the Google DeepMind team published an interesting paper explaining a method for using reinforcement learning techniques to train an artificial intelligence agent to play Atari 2600 video games using only the screen’s raw pixel data and the game score as input [].The project described a new deep learning model (the Deep Q-Network i.e. DQN) that uses a variation of Q-learning to train a convolutional neural network (CNN) to make decisions on which actions to take in the game and develop the ability to learn and plan policies using high dimensional input data.

Deep reinforcement learning has proved to be very successful in mastering human-level control policies in a wide variety of tasks such as object recognition with visual attention (Ba, Mnih, and Kavukcuoglu 2014), high-dimensional robot control (Levine et al. 2016) and solving physics-based control problems (Heess et al. 2015).

However, there is a limitation in all of the above applications in their assumption of having the full knowledge of the current state of the environment, which is usually not true in real-world scenarios. In the case of partially observable states, the learning agent needs to remember previous states in order to select optimal actions. Recently, there have been attempts to handle partially observable states in deep reinforcement learning by introducing recurrence in Deep Q-networks. For example, Hausknecht and Stone (2015) use a deep recurrent neural network, particularly a Long-Short-Term-Memory (LSTM) Network, to learn the Q-function to play Atari 2600 games. Foerster et al. (2016) consider a multi-agent scenario where they use deep distributed recurrent neural networks to communicate between different agent in order to solve riddles. The use of recurrent neural networks is effective in scenarios with partially observable states due to its ability to remember information for an arbitrarily long amount of time. Previous methods have usually been applied to 2D environments that hardly resemble the real world. In this paper, we tackle the task of playing a First-Person-Shooting (FPS) game in a 3D environment. In this game environment states are partially observable, and the agent navigates a 3D environment in a first-person perspective, which makes the task more suitable for real-world robotics applications.

In this paper, we present an AI-agent for playing a level in FPS game DOOM using only the pixels on the screen. The AI-agent divides the problem into two phases: navigation (exploring the map to collect items and find enemies) and action (fighting enemies when they are observed) and uses separate networks for each phase of the game. Furthermore, the agent infers high-level game information, such as the presence of enemies on the screen, to decide its current situation and to improve its performance