Use Machine Learning to Play Mario

Course: CMPE 130

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Group: 6

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Abstract

Problem statement

Playing modern video games can be a difficult task for novices; mastering a game as simple as Super Mario Bros is more difficult even for people with many experiences. Due to its complex nature, using traditional algorithms to play video games is difficult. However, machine learning, algorithms that improve automatically through experience and using data, can accomplish such tasks rather easily. In this project, we will implement a machine learning model that let the computer learn how to play Super Mario Bros.

Algorithm

According to Wikipedia, Reinforcement learning (RL) is an area of machine learning concerned with how intelligent agents ought to take actions in an environment to maximize the notion of cumulative reward. Reinforcement learning differs from supervised learning in not needing labelled input/output pairs be presented, and in not needing sub-optimal actions to be explicitly corrected. Instead, the focus is on finding a balance between exploration (of uncharted territory) and exploitation (of current knowledge).

Basic reinforcement is modeled as a Markov decision process (MDP):

- A set of environment and agent states, S
- A set of actions, A, of the agent
- $P_a(s, s') = \Pr\left(s_{t+1} = s' \,|s_t = s,\ a_t = a\right)$ is the probability of transition (at time t) from state s to state s' under action a.
- $R_a(s, s')$ is the immediate reward after transition from s to s' with action a.

In this specific case, we are using Q-learning. Q-learning is a model-free reinforcement learning algorithm to learn quality of actions telling an agent what action to take under what

circumstances. It does not require a model (hence the connotation "model-free") of the environment, and it can handle problems with stochastic transitions and rewards, without requiring adaptations.

Approach

We plan to use a Python library that provides a set of environments for reinforcement learning. We also refer to various existing projects for direction.