FIFA playing Agents

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1. **Problem Statement**
   Train an agent to play skill games for FIFA 18. Agents have been demonstrated to take free-kicks in FIFA 18 using deep Q-learning with an average score per kick to be 0.5. We plan to demonstrate the performance of an agent on other types of skill games such as dribbling, passing and increasing the baseline score by at least 10%.

2. **Proposed Approach**
   Skill games are part of the training mode section of FIFA 18 where one can practice passing, dribbling, shooting etc for perfecting the art. This provides a perfect training ground for our agent as it provides a numeric reward for each action taken.
   For example, scoring a goal results in a positive increment in a performance index,
   Scoring a goal thus can be easily used as a reward function by simple Optical Character Recognition. Since we do not have direct access to the game API, we need to inspect screenshots and provide action outputs via keystrokes to the running game.

   Our approach will be based on a related work done by Chintan Trivedi to play free kicks[5(c)]. This project uses a **CNN** to extract features from game screenshots and the performance indicator as the reward function which are fed to a Q-learning model to produce keystrokes as output to the game. As a feasibility study, we have implemented this project and found some of the results to corroborate with the author's claims

   We will train our agent for a subset of the below mentioned skill games:

CATEGORY	DRILLS
BASICS	**Movement** (Basics) **Dribbling** (Basics) **Passing** (Basics) **Shooting** (Basics)
PASSING	**Ground Pass** (Bronze, Silver, Gold & Skill Challenge) **Advanced Ground Pass** (Bronze, Silver, Gold & Skill Challenge) **Lob Pass** (Bronze, Silver, Gold & Skill Challenge) **Crossing** (Bronze, Silver, Gold & Skill Challenge)
DRIBBLING	**Dribbling** (Bronze, Silver, Gold & Skill Challenge) **Advanced Dribbling** (Bronze, Silver, Gold & Skill Challenge)

DEFENDING	• **Defending** (Bronze, Silver, Gold & Skill Challenge) • **Advanced Defending** (Bronze, Silver, Gold & Skill Challenge) • **Goalkeeper** (Bronze, Silver, Gold & Skill Challenge)
SHOOTING	• **Shooting** (Bronze, Silver, Gold & Skill Challenge) • **Advanced Shooting** (Bronze, Silver, Gold & Skill Challenge) • **Free Kicks** (Bronze, Silver, Gold & Skill Challenge) • **Penalties** (Bronze, Silver, Gold & Skill Challenge)

3. **Project plan**
   a. **Stage I:** Use Deep Q-learning to train different agents for each skill game. Different difficulty levels of a certain skill game will be played by a single agent.

   b. **Stage II**: Try an alternative approach to solving the problem as suggested by Chintan Trivedi using a mixture of supervised and reinforcement learning.
      i. Train a CNN separately to detect distinct objects on the field such as players, goal, ball.
      ii. Use a custom function to map these to a state feature vector and then use function approximation techniques to find a policy.
      iii. Compare this result with those achieved in Stage I.

   c. **Stage III (Experimental):**
      i. Implement A3C[5(b)] and compare and contrast with the deep Q learning approach for best performance.
      ii. We will attempt to use trained agents on individual skill games and use transfer-learning inspired approach to play games requiring multiples skills.

4. **Challenges**
   a. Train the agent for adversarial tasks like scoring against a goalkeeper instead of just an empty goal.
   b. Take complex actions such as pressing multiple keys simultaneously which lead to different outcomes in FIFA.
   c. Test the agent in a full game where there are no intermediate rewards. Only when a goal has been scored will a reward be given by the game engine.

5. **References**
   a. Human level control using deep reinforcement learning (https://deepmind.com/research/dqn/)
   b. Asynchronous methods for deep reinforcement learning(https://arxiv.org/abs/1602.01783)
   c. https://medium.com/@chintan.t93/using-deep-q-learning-in-fifa-18-to-perfect-the-art-of-free-kicks-f2e4e979ee66
   d. https://github.com/ChintanTrivedi/DeepGamingAI_FIFA

6. **Feasibility Study**
   Find video of the feasibility study of our approach here: https://youtu.be/ocE8ZR3YhlA