Project Proposal

Reinforcement Learning in Mario Kart Wii

## Project Aim

* The aim of the project is to train a model to beat the CPU characters in a race in Mario Kart Wii, using Reinforcement Learning techniques. This can be used as an interactive way of educating others on key concepts of RL

## Related Literature

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## Central Literature

* **Hands-On Reinforcement Learning with Python (Sudharsan Ravichandaran)**
  + Reinforcement Learning Basics – Policy Function, Value Function, Agent-Environment Interface, Q Function, MDP, Bellman Equation, Monte Carlo Methods
  + Policy Optimisation
  + Feature exploitation vs Feature exploration
* **Hierarchical Reinforcement Learning for Self‐Driving Decision‐Making Without Reliance on Labelled Driving Data (J. Duan Et Al)**

Outlines strategies of Hierarchical-RL applied to driving, through this, training time is reduced by ~25% when compared with non-hierarchical RL.

* + Independent Manoeuvre Selection and Motion Control
  + APRL – Asynchronous Parallel RL – Each learner has own policy network, average is taken at each iteration, learners synchronise form shared network before making new decisions

## General Literature

* **Lightweight 3D Hand Pose Estimation by Cascading CNNs with Reinforcement Learning (Mingqi Chen et al)**
  + CNN and feature extraction
  + Feature exploitation vs Feature exploration
* **Deep Learning, Reinforcement Learning and World Models (Yutaka Matsuo et al)**
  + Generalised Policy Updates
  + World Models

## Methodology

* I will be using the open-source Wii emulator Dolphin to run my learning process.
* I will be extracting data from the emulator’s memory such as speed, steering angle, checkpoint value and time to act as a real-time model of the game state.
* I will be using python to program the learning process, because of my previous experience with the language and the large number of relevant libraries that can assist the process.

## Plan

1. Research
2. Problem Formulation
3. Formalisation
4. Emulator Interaction/Configuration
5. Programming
6. Learning Process
7. Data Analysis

## Key Memory Locations

|  |  |  |
| --- | --- | --- |
| Location | Offset | Description |
| 0x809BD70C | 0x61 | Moving Direction  (1: forward, 2: backward) |
| 0x809BD70C | 0x3C | Steering Direction  (0: left, 7: straight, 14: right) |
| 0x809BD730 | 0xF8 | Current Lap Completion  (float 0-3) |
| 0x809BD730 | 0x1B9 | Minutes |
| 0x809BD730 | 0x1BA | Seconds |
| 0x809BD730 | 0x1BC | Third-Seconds |
| 0x809C2EF8 | 0x40 + 0x0 | X Position (float) |
| 0x809C2EF8 | 0x40 + 0x4 | Y Position (float) |
| 0x809C2EF8 | 0x40 + 0x8 | Z Position (float) |

Source - <https://github.com/JackWBoynton/mariokart-rl/README.md>

TODO:

Test Memory locations with controller

Roughly Formalise reward function

Decide to use screengrabs or not

Decide to use xyz or not