QLearning For Videogames

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Github: stevenwalton/Retro-Learner

CIS 510: Multi-Agent Systems
3 June 2019

What is Q-Learning?

- Markov Decision Processes (MDPs) can represent decision making processes with random outcomes.

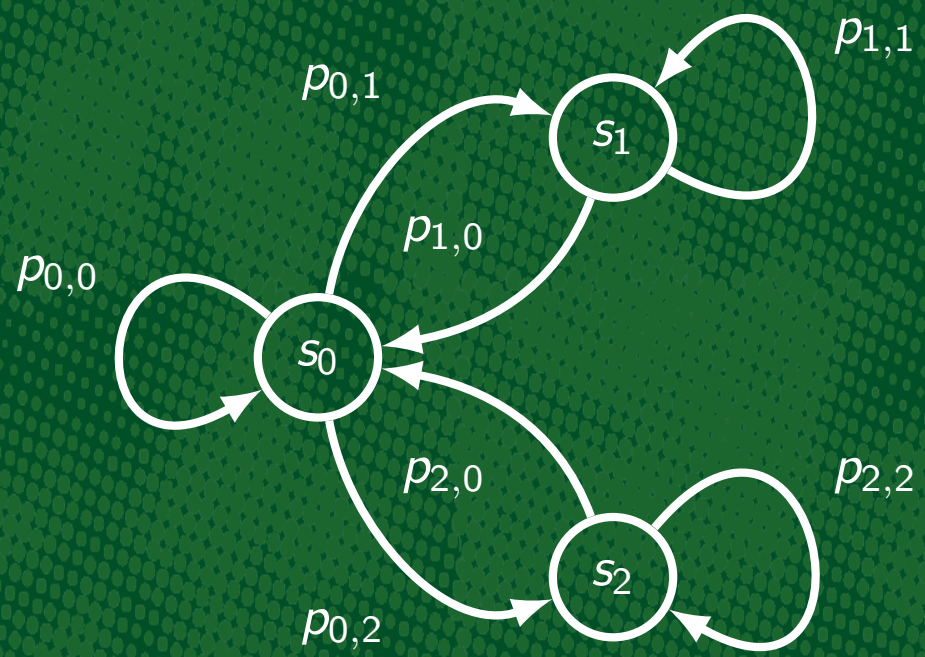

Figure: Sample Markov Decision Process

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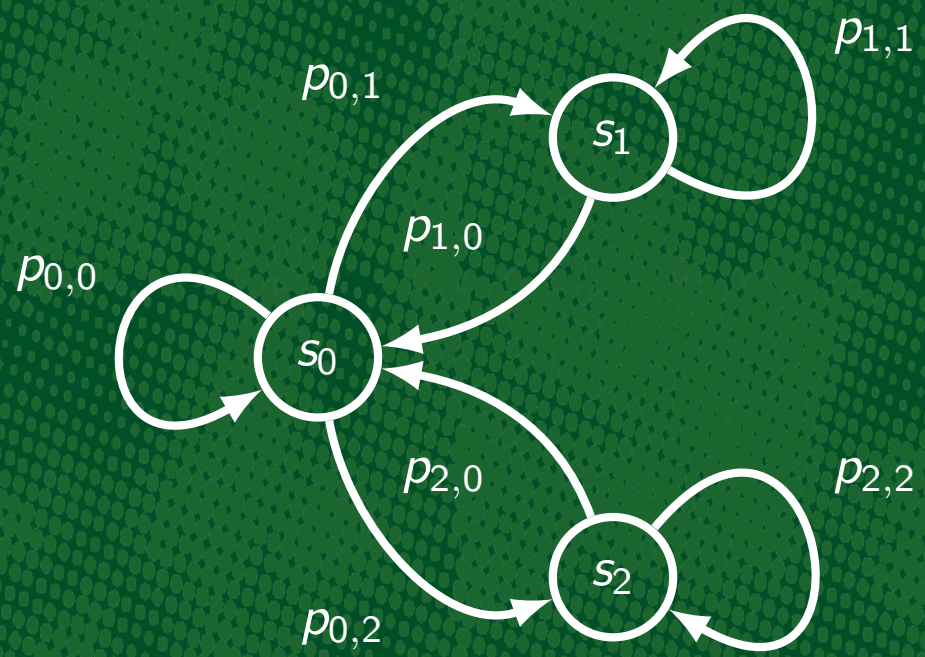
- We want to find an optimal policy (set of actions)



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What is Q-Learning?

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- We want to find an optimal policy (set of actions)
- We learn with the Bellman Equation, using an iterative process

$Q(s,a) = Q(s,a) + \alpha(r + \gamma \max_{a'} Q(s',a') - Q(s,a))$

$\alpha =$ learning rate

$r =$ reward

$\gamma =$ discount

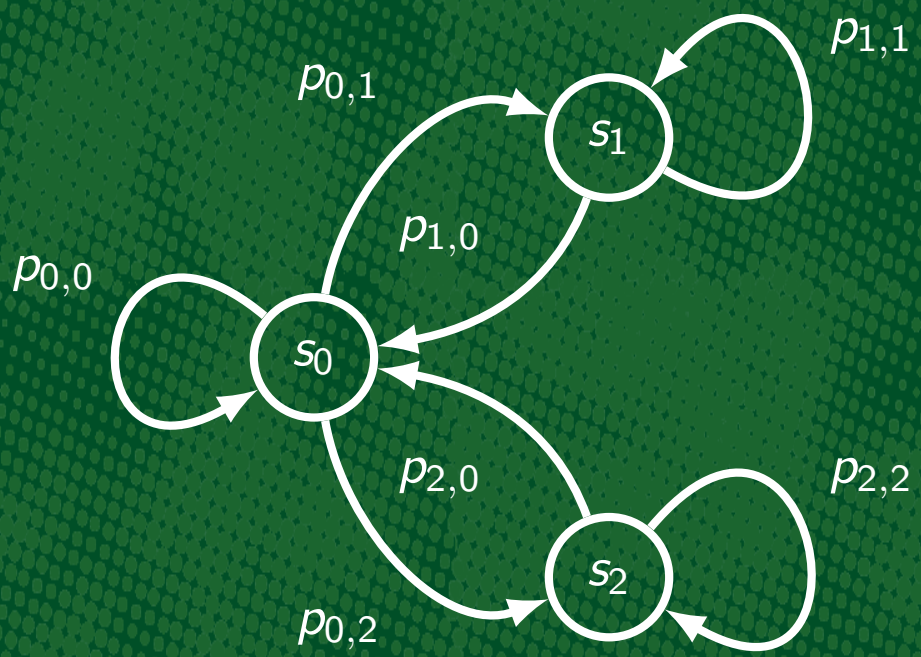


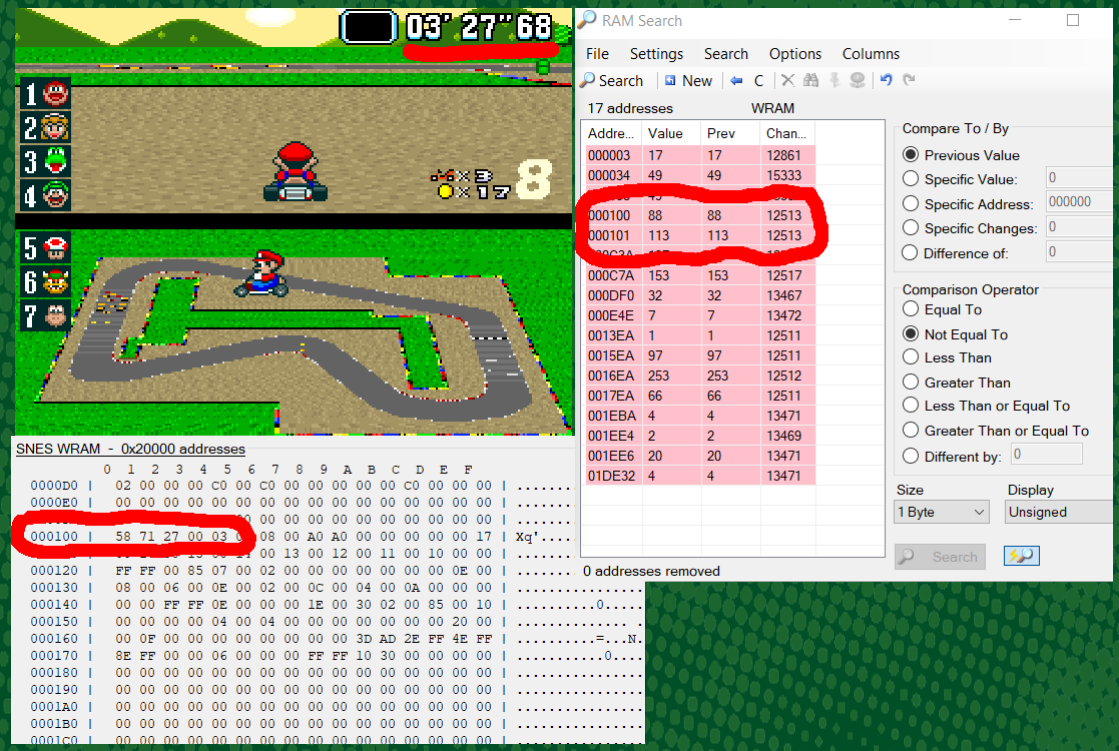
Figure: Sample Markov Decision Process

Framework

- OpenAI Gym: Allows for abstracts out environments and allows researchers to focus on creating algorithms.
- OpenAI Retro: Wrapps Gym framework to focus on retro videogames.
- Allows same code to be run on any game that is integrated.
- Creates an environment to (supposedly) allow for easy integration of new games

Integration

- Need to collect RAM values (used BizHawk).



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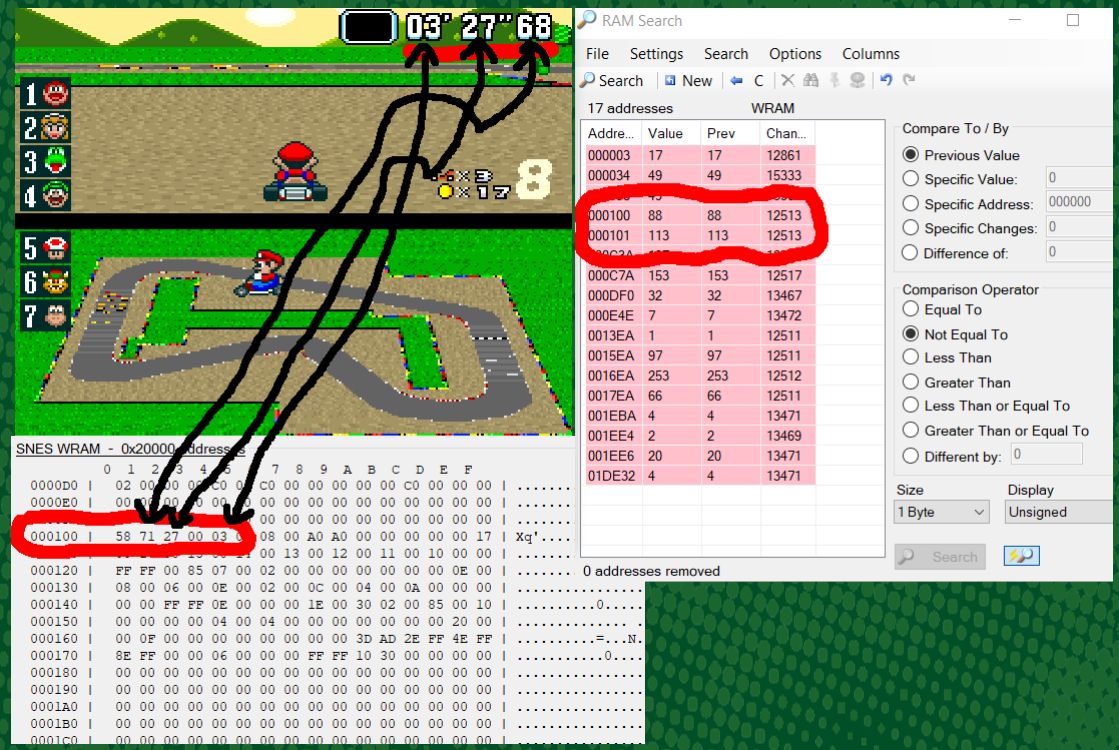

Integration

- Need to collect RAM values (used BizHawk).
- Convert Hex to decimal and add rambase number and integrate into scenario and data files

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            "address": 8257864,
            "type": "|u1"
        },
        "checkpoint": {
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        },
        "rank": {
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            "type": "|u1"
        },
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            "type": "|u1"
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            "type": "|u1"
        },
        "second": {
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            "type": "|u1"
        },
        "milisecond": {
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            "type": "|u1"
        }
    }
}
```

```
{
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            }
        }
    },
    "reward": {
        "variables": {
            "rank": {
                "reward": 1.0
            }
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    },
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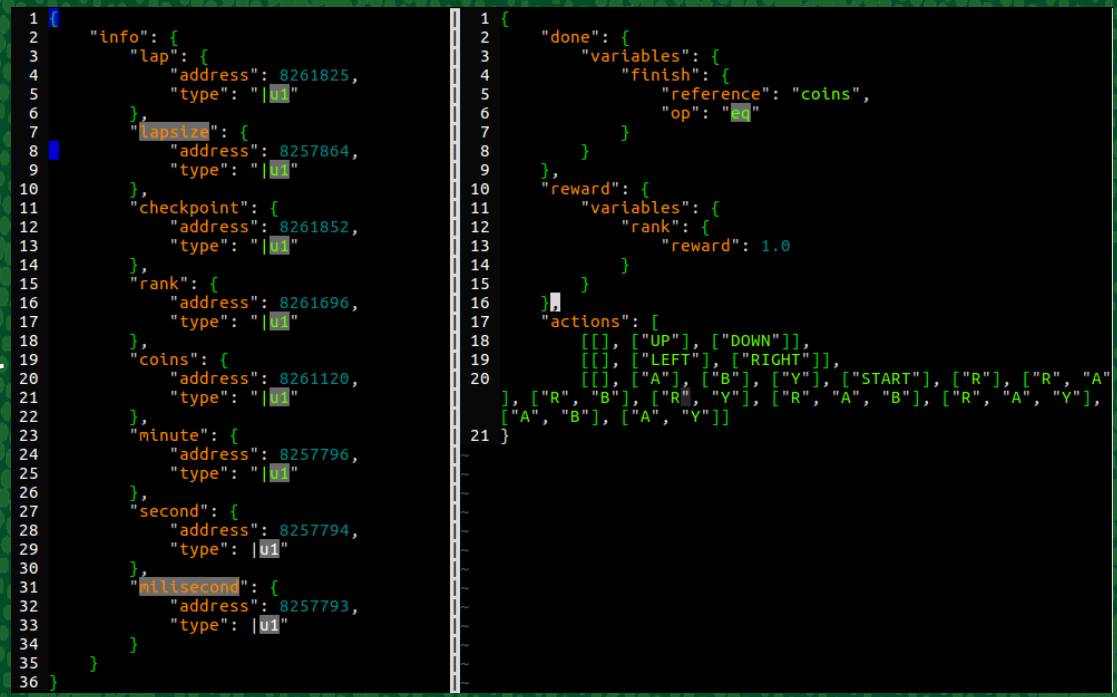
- Not all RAM values are so easy to get nor define. (Lua scripts)



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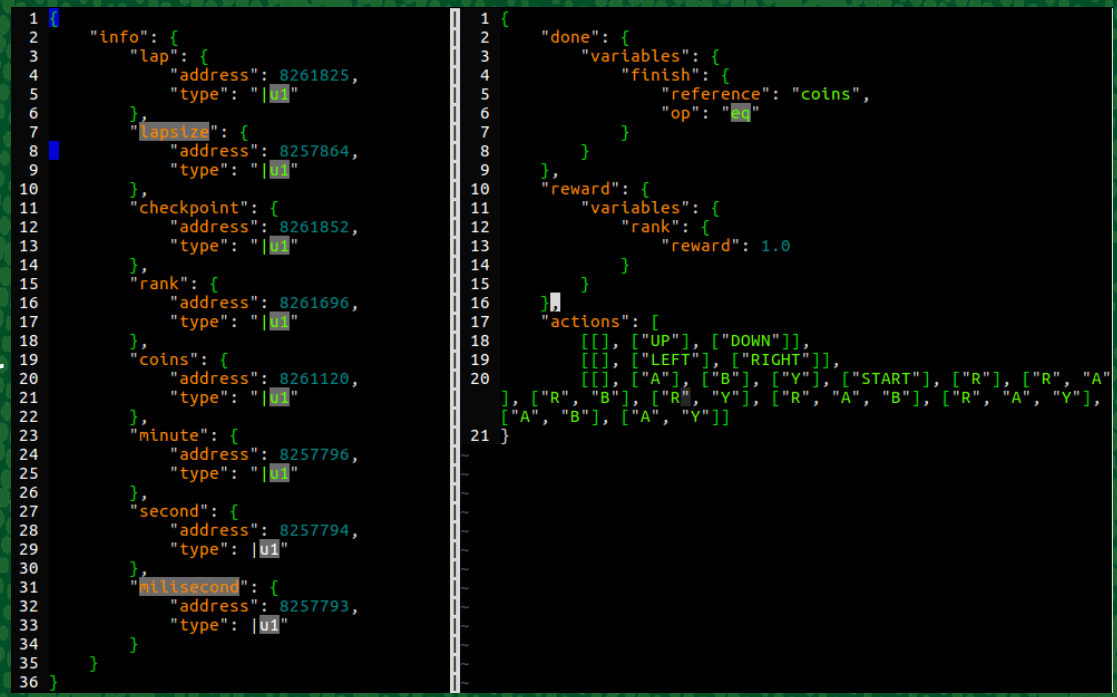

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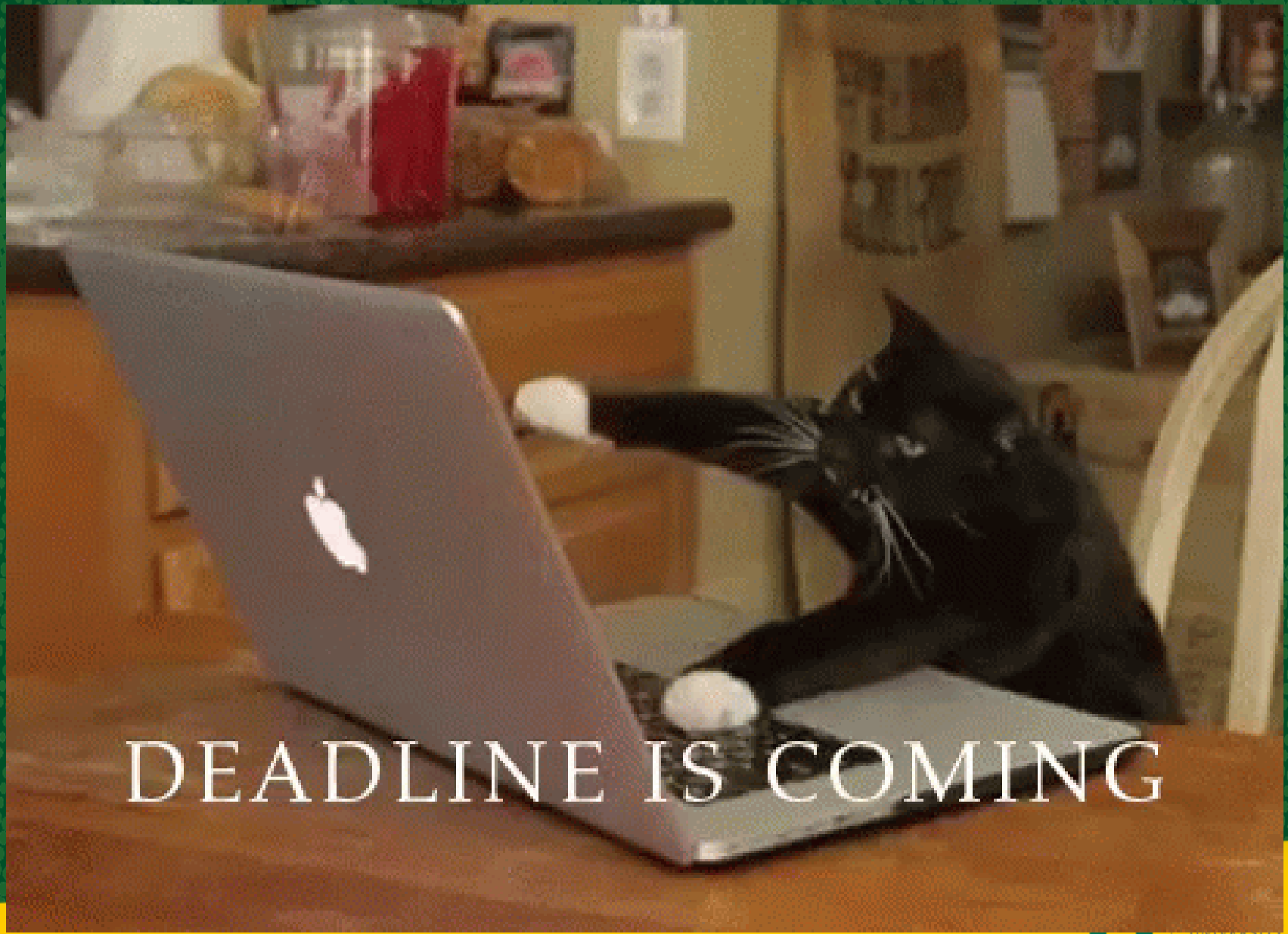
So Let's Make Something Work



So Let's Make Something Work

Goals

- Get a program to work nicely with retro.

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- Get a program to work nicely with retro.
- Enable easy parameterisation of variables.

So Let's Make Something Work

Goals

- Get a program to work nicely with retro.
- Enable easy parameterisation of variables.
- Test test test

Let's see some games!

(Airstriker Genesis)

Figure: Airstriker Genesis Random: Max 160

Figure: Airstriker Genesis Longer Run: Max 940

Let's see some games!

(Donkey Kong Country)

Figure: Donkey Kong Country with lookahead 100, 10x

Let's see some games!

(Super Mario Brothers)

reward: xscroll

Figure: Super Mario Bros, low training at 10x

Figure: Super Mario Bros, a weekend of training at 10x

Questions?

(Let's look at code)