



Dynamics of Real-Time Competition



Adam Kunesh
PHY 256B Final Project
June 7, 2018



Overview

- Motivations and questions
- Framework for exploration
- Examples!
- (Tentative) conclusions
- Hanging questions

Big Questions

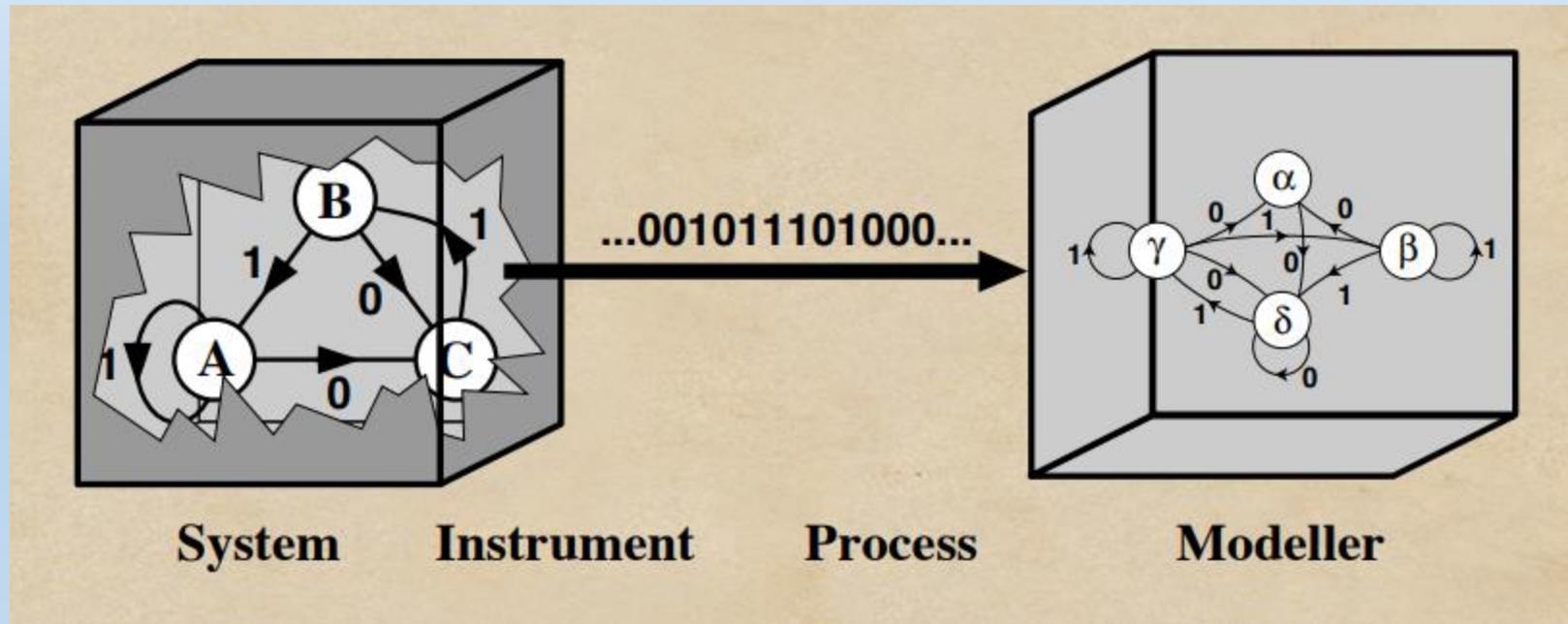
- What gives a game competitive potential?
- What does it take to be great?

Why bother?

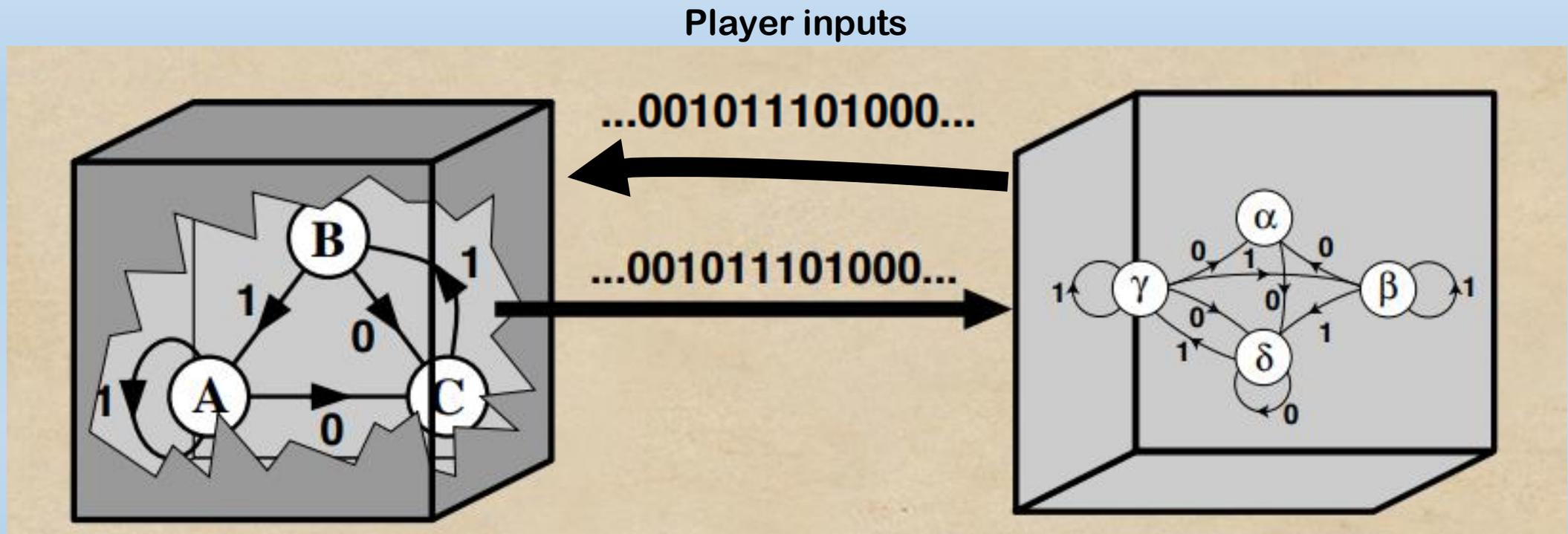
- Quantitative analysis of whether a game is interesting + guidance on how to make it better

- Player feedback: what's lacking in my playstyle?

Conceptualizing Competition



Slightly modified...



Opponent

Game

Sounds and images

Player (You!)

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What we're up against:



Game's Rules



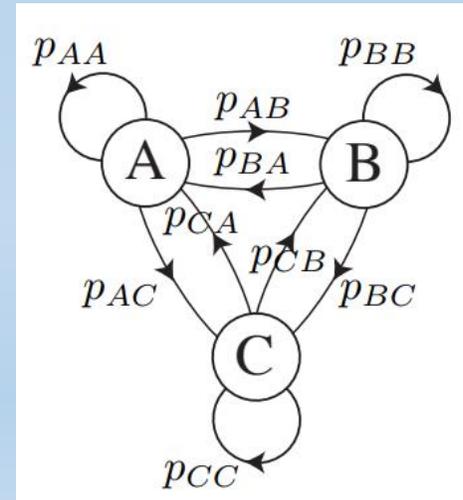
Opponent

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Analogy:



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Hypothesis

Once a player learns the ins and outs of a game, winning amounts to synchronizing with and exploiting the opponent's processes.

Let's explore!

Basic Structure: Rocket League

Top View

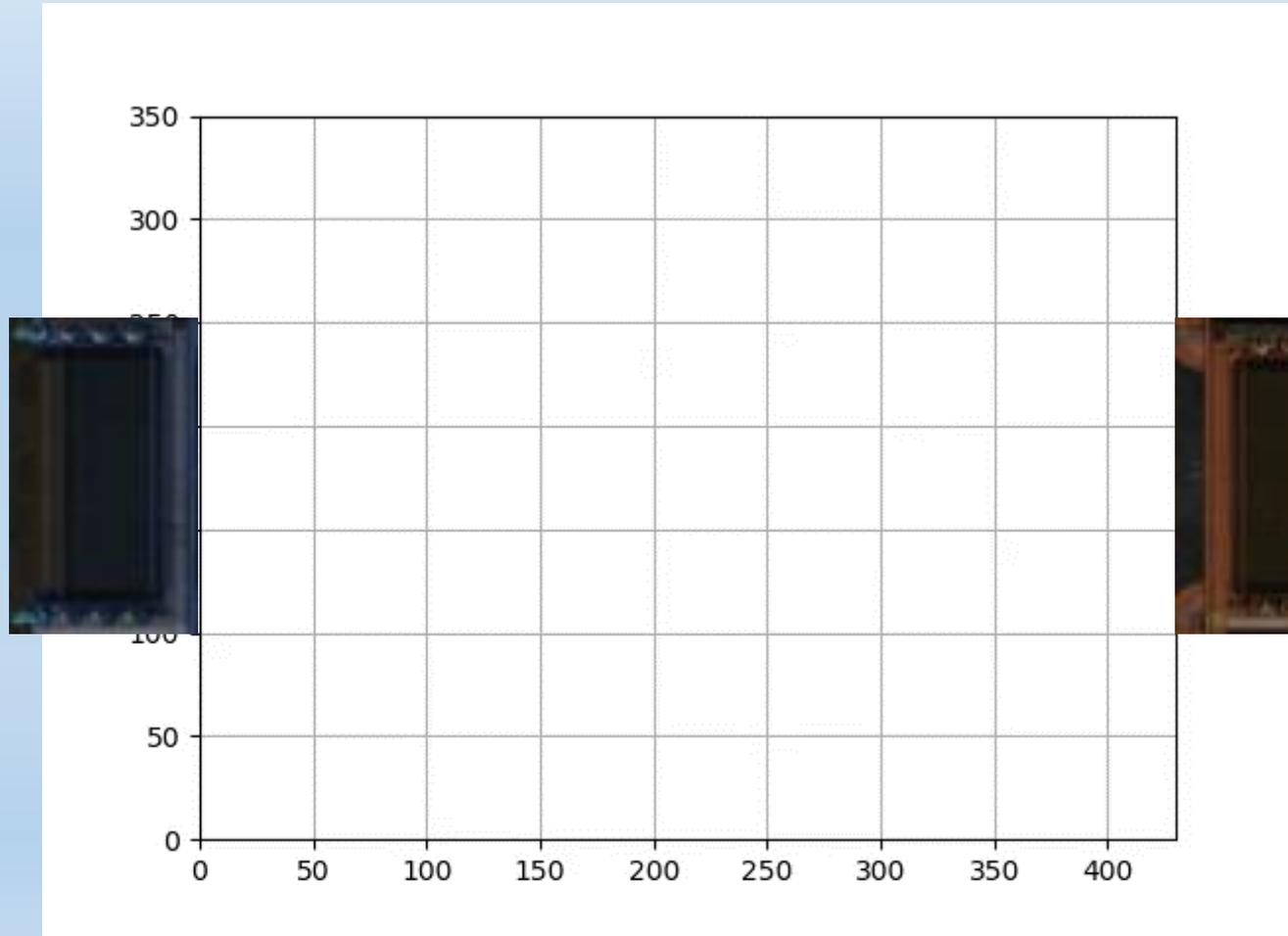
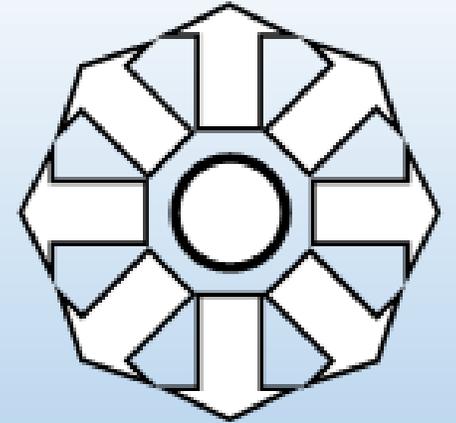


Player View



Setting the stage...

- 2 players, random walks: 8 “movement” states



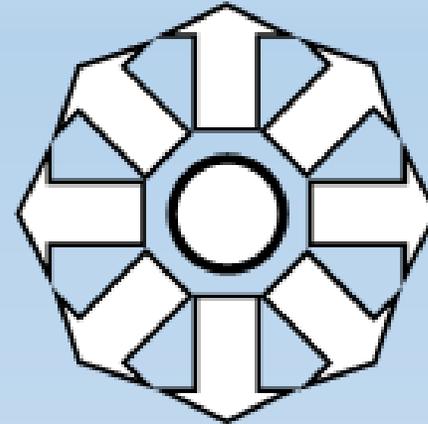
Archetypes

Movement ability:

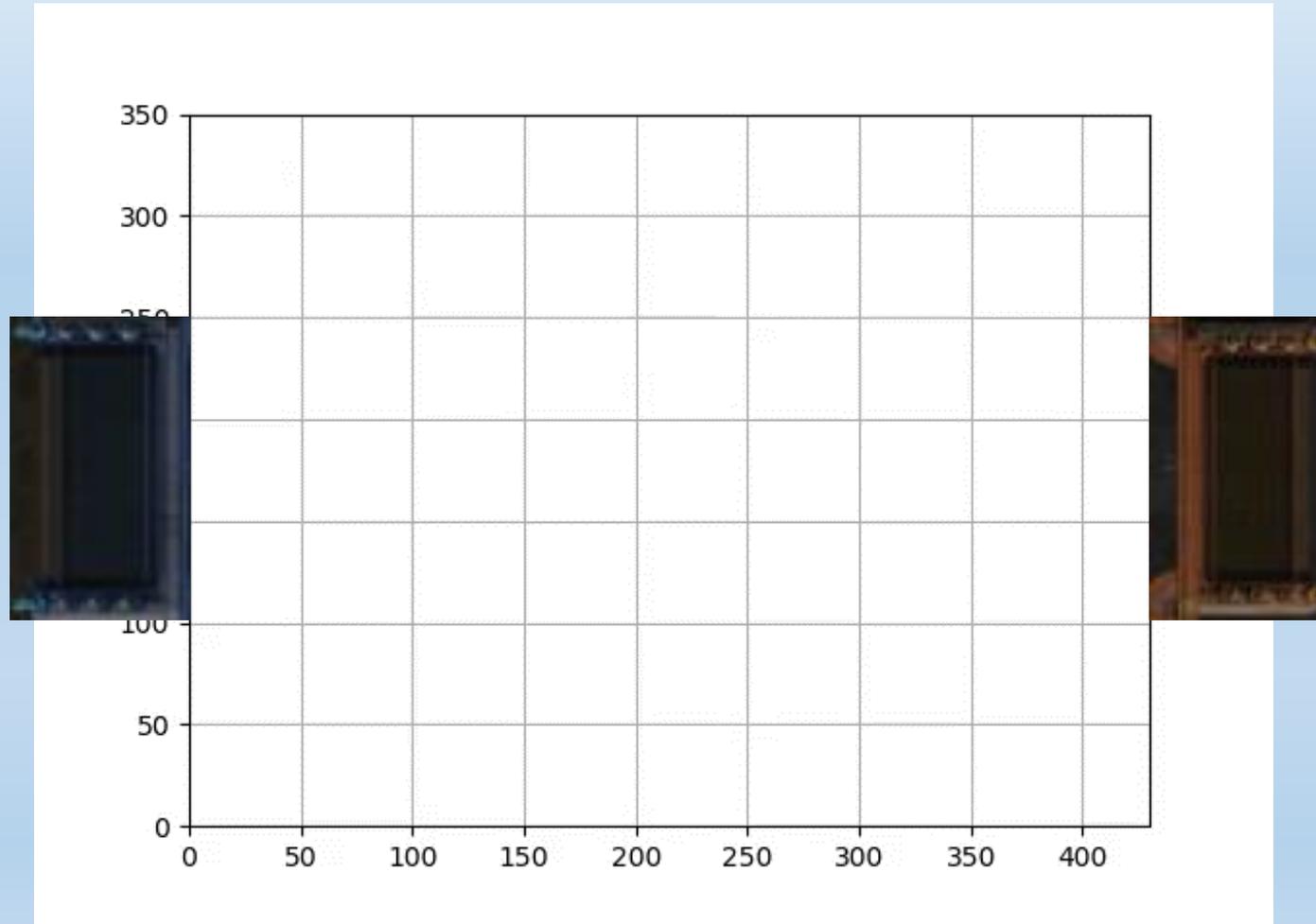
- Perfect
- Undertrained

Decision-making:

- Perfect
- Random



Perfect vs. Perfect

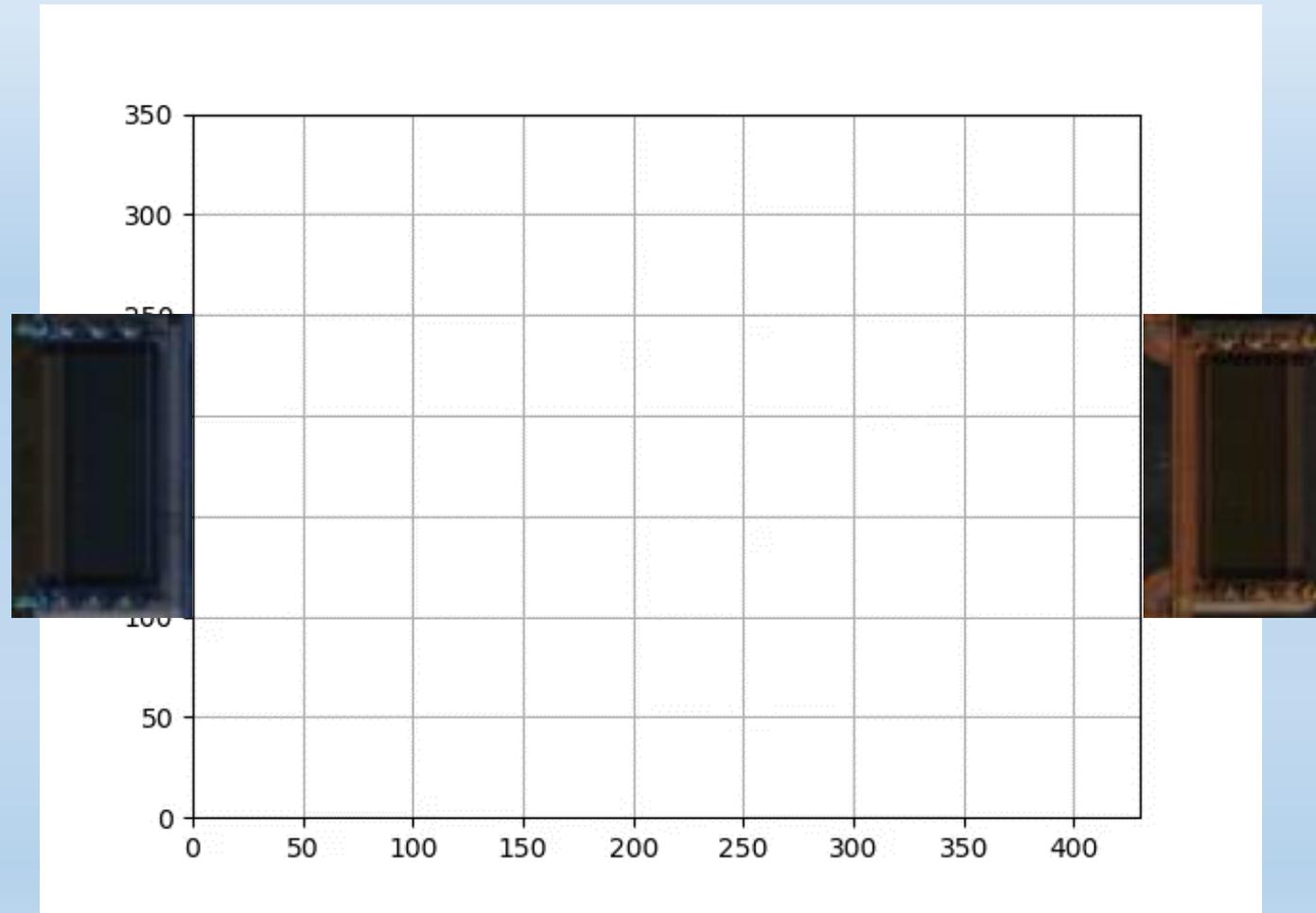


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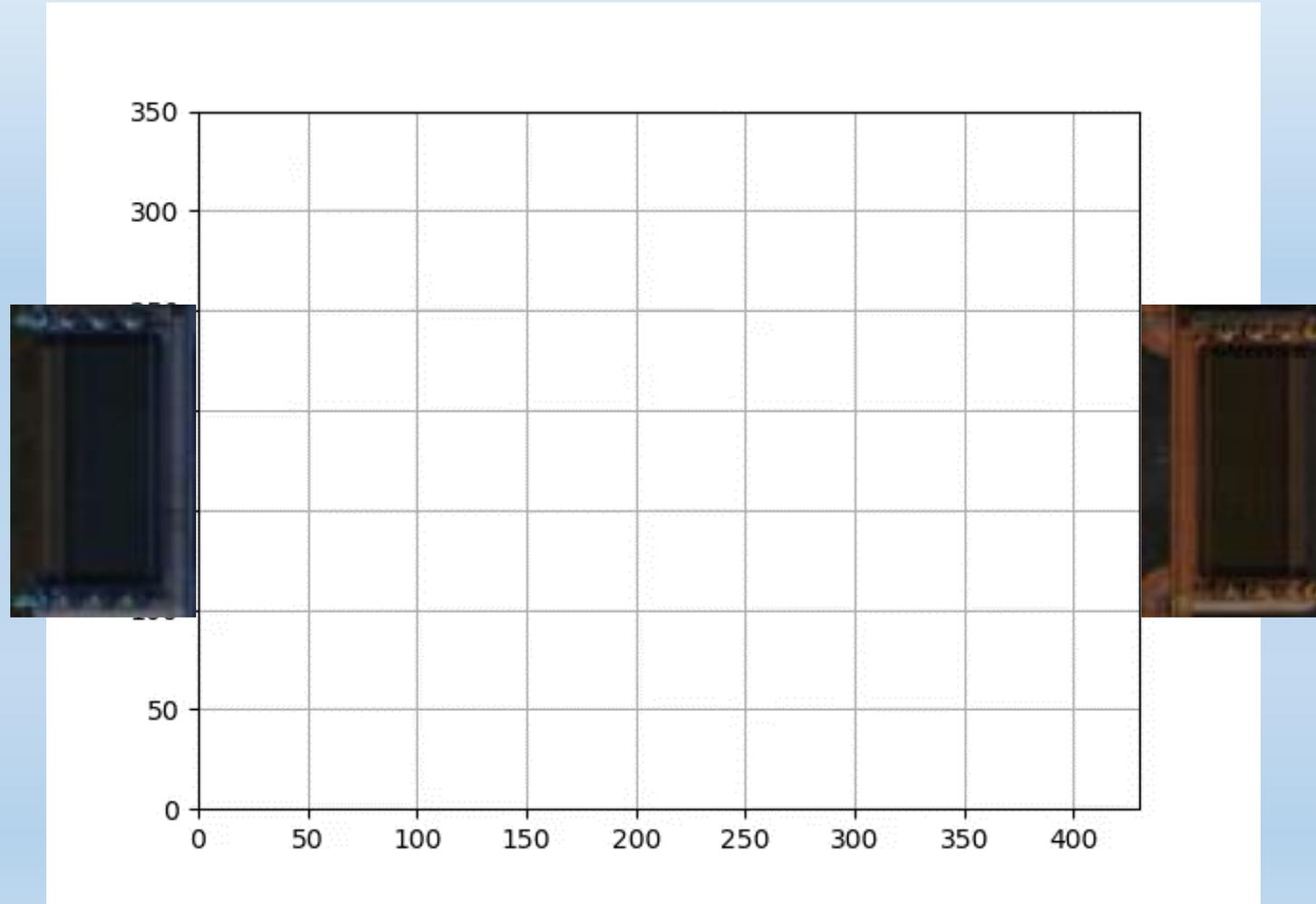
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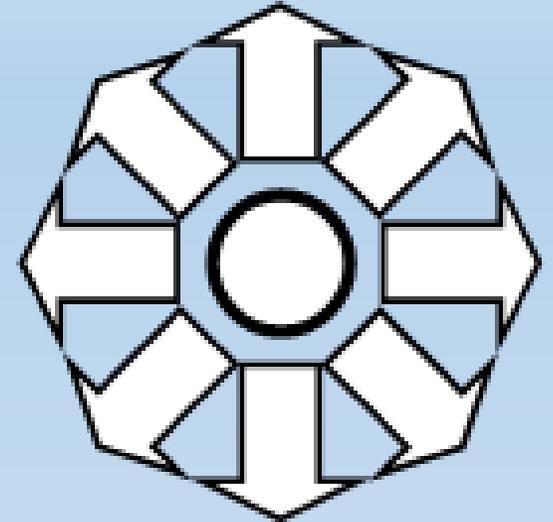
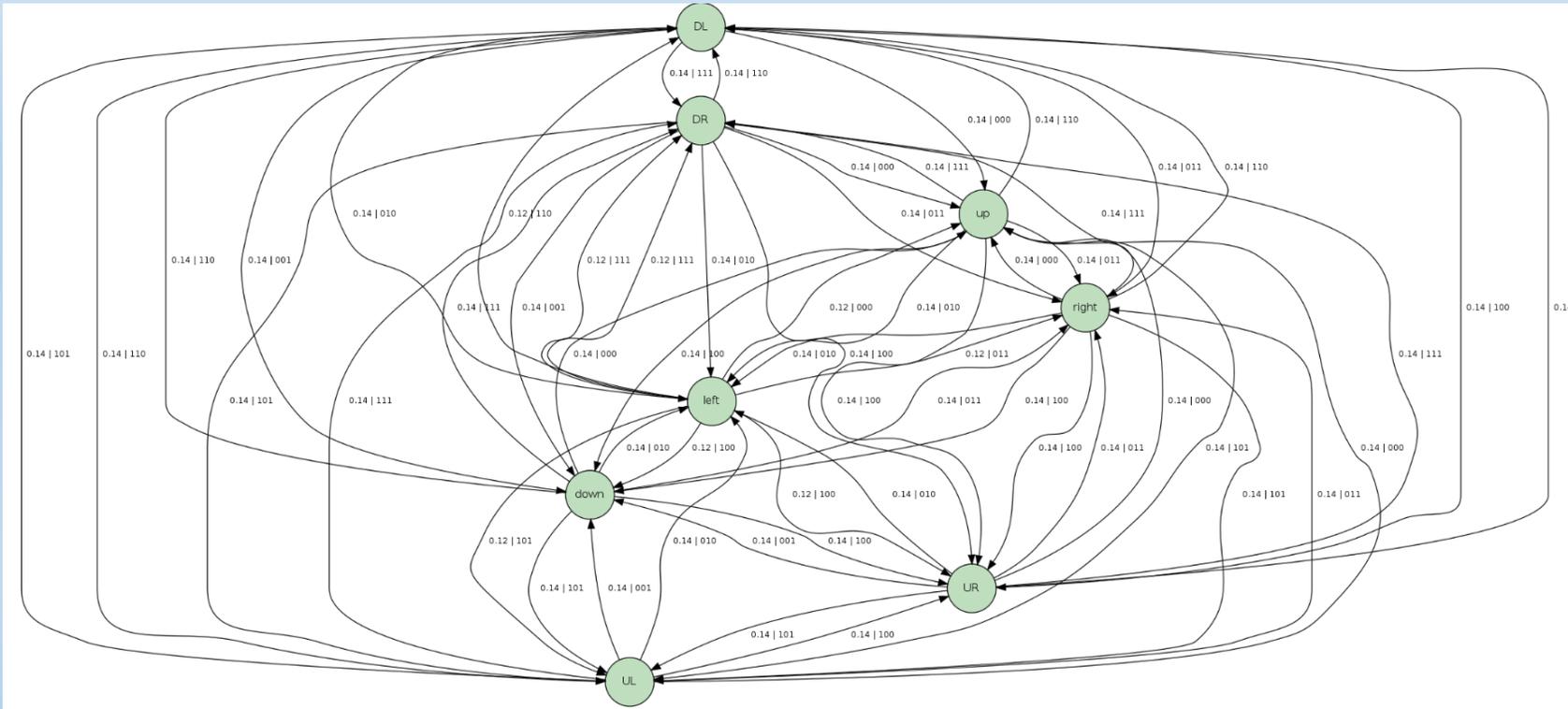
Random vs Perfect



Perfect vs. Undertrained:



Models/outcomes



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Analysis (to be completed):

	Perfect strategy (optimal positioning)	Random strategy (random inputs)
Trained (unrestricted controls)	$h_{\mu}=?$ $C_{\mu}=?$	$h_{\mu}=?$ $C_{\mu}=?$
Undertrained (restricted controls)	$h_{\mu}=?$ $C_{\mu}=?$	$h_{\mu}=?$ $C_{\mu}=?$

Educated Guesses

	Perfect strategy (optimal positioning)	Random strategy (random inputs)
Trained (unrestricted controls)	<i>TP</i> $h_{\mu}=\text{low}$ $C_{\mu}=\text{high}$	<i>TR</i> $h_{\mu}=\text{highest}$ $C_{\mu}=?$
Undertrained (restricted controls)	<i>UP</i> $h_{\mu}=\text{lowest}$ $C_{\mu}=\text{low}$	<i>UR</i> $h_{\mu}=\text{higher than UP, lower than TR}$ $C_{\mu}=\text{lowest}$

What I hoped to exemplify:

Pros are really mechanically skilled AND able to predict their opponent's motions. (Synchronization when mechanical superiority fails.)

What I'm finding:

Being able to move optimally isn't (in general) sufficient to dominate.

For RL, brains $>$ mechanics.

Progress!

Other Avenues to Explore

- Can we find how characteristics of the game and opponent interact to generate preferable behaviors?
- Pro play: how much is mechanical, how much analytical?
- Quantify a game's "competitive potential"
 - "Skill ceiling"/complexity too high to play a perfect game?

Image Credit

Modelling processes: PHY 256 Lecture 1

“10 commandments”: https://secure.tct.tv/product_p/10comrep.htm

Fearsome opponent: <https://liquipedia.net/smash/Mew2King>

Alphabet: <https://thesmallfolk.com.au/products/alphabet>

Gameplay examples

SquishyMuffinz (World Champion):



Leadi1989 (not World Champion):



So what (maybe) makes a pro?

- 1) Know your alphabet
- 2) Synchronize to your opponent