Coach AI

BASKETBALL STRATEGIES

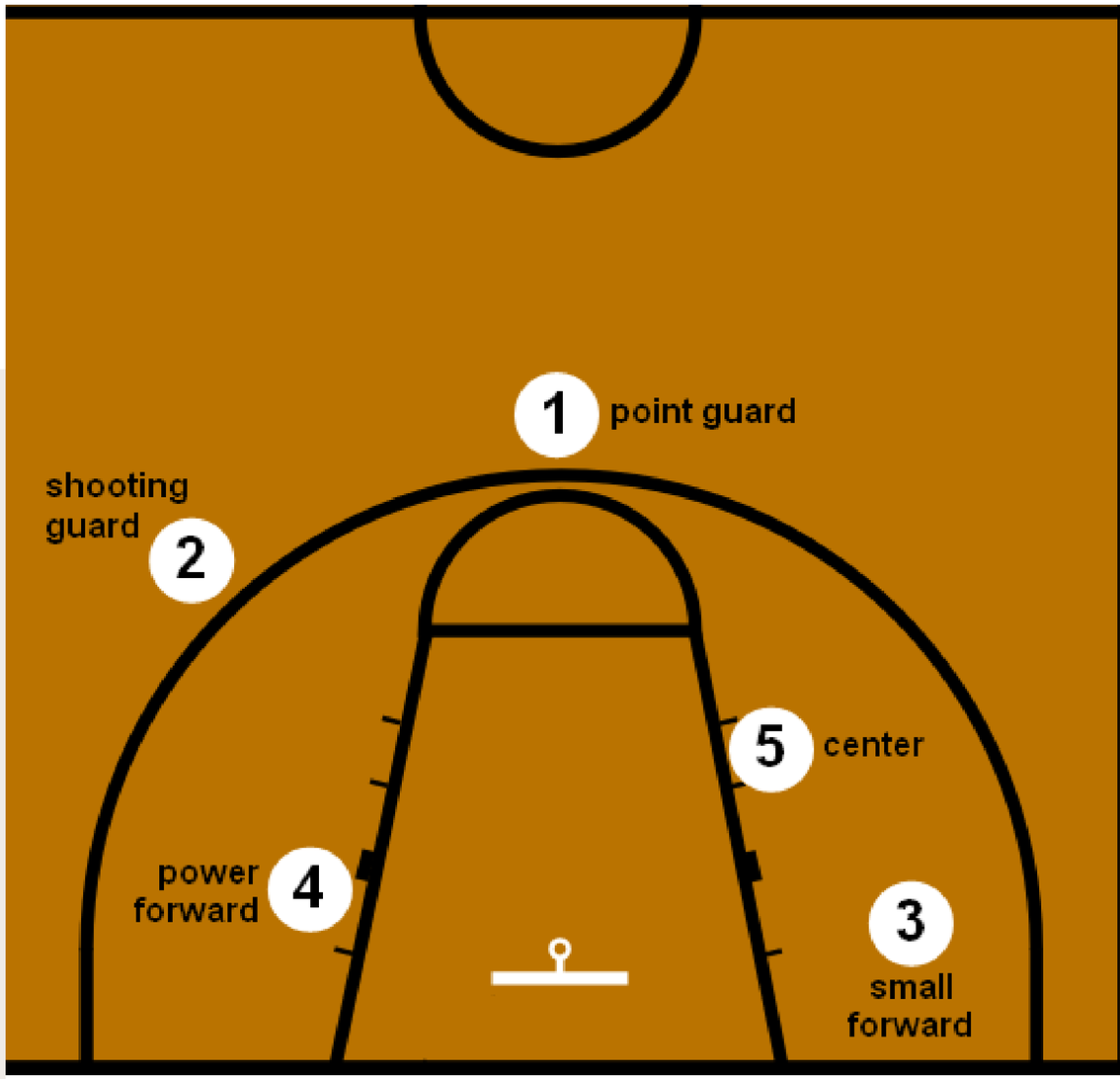
Revising strategies for a positionless game.

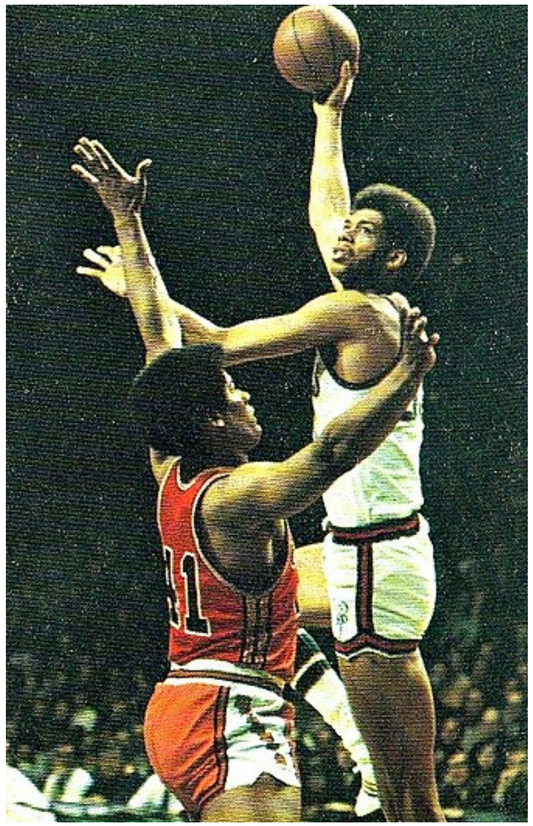
Background

Traditionally basketball has 5 different positions. One per player on the court.

TRADITIONAL POSITIONS:

- Point Guard
- Shooting Guard
- Small Forward
- Power Forward
- Center





Traditional NBA

Current NBA

Changes

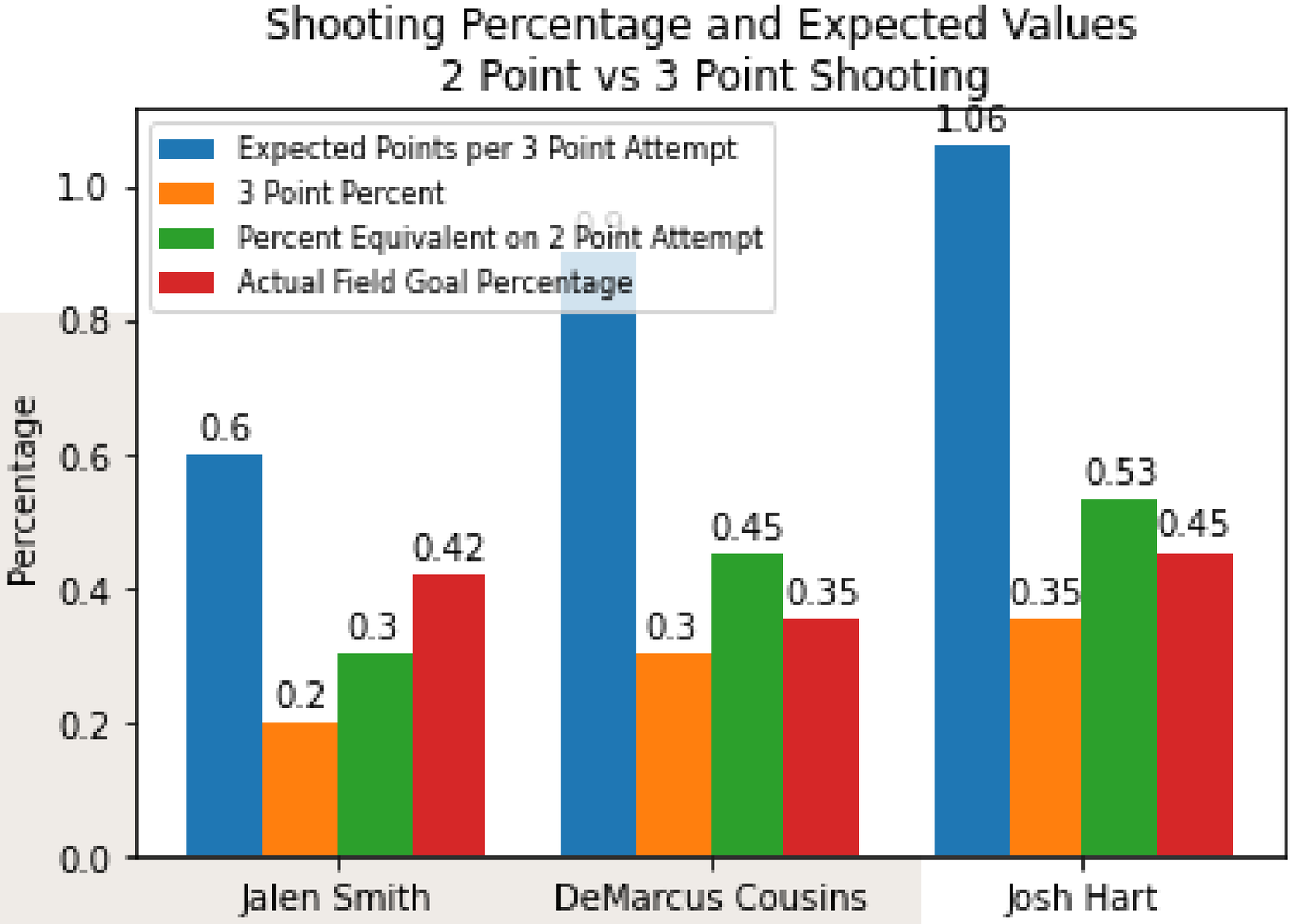
With the addition of data science into the NBA and the success of the Warriors, there have been major changes to basketball strategy.

Field Goal Percentage

Players need to shoot a high 2-point field goal percentage to equal the expected value of a 3-point shot taken.

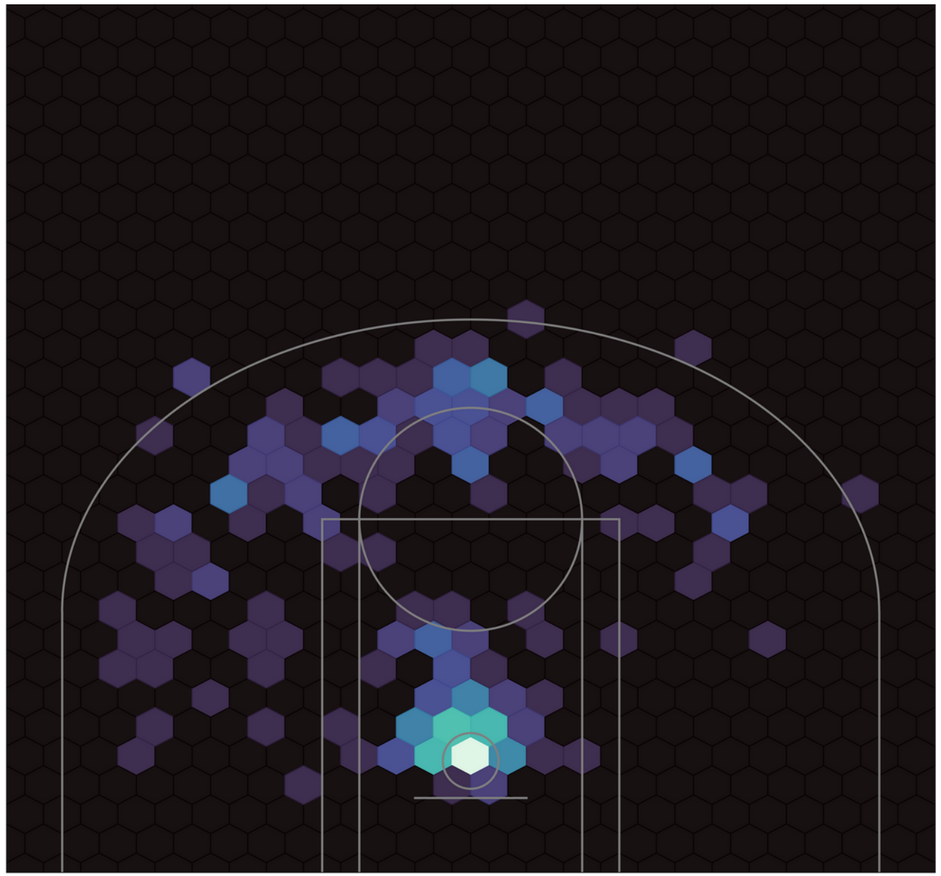
(3_PT %) * 3 = 2 * (2_PT %)

AS A RESULT, MANY MORE 3-POINTERS ARE TAKEN



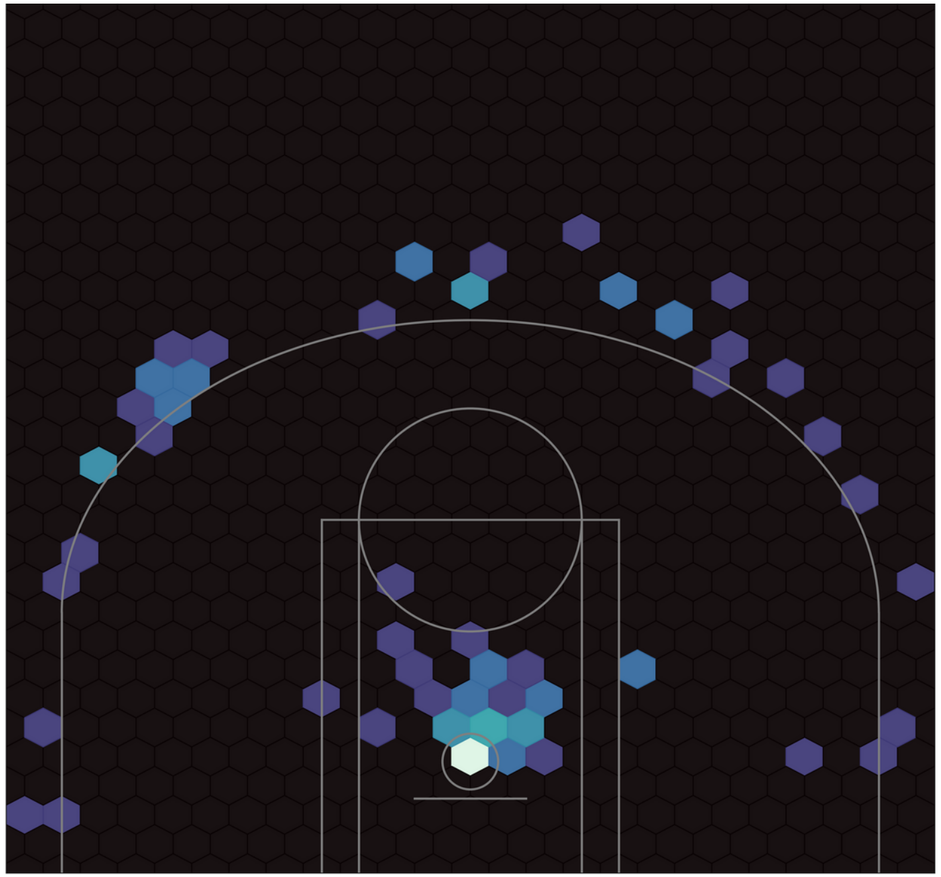
Shot Chart

BLAKE GRIFFIN

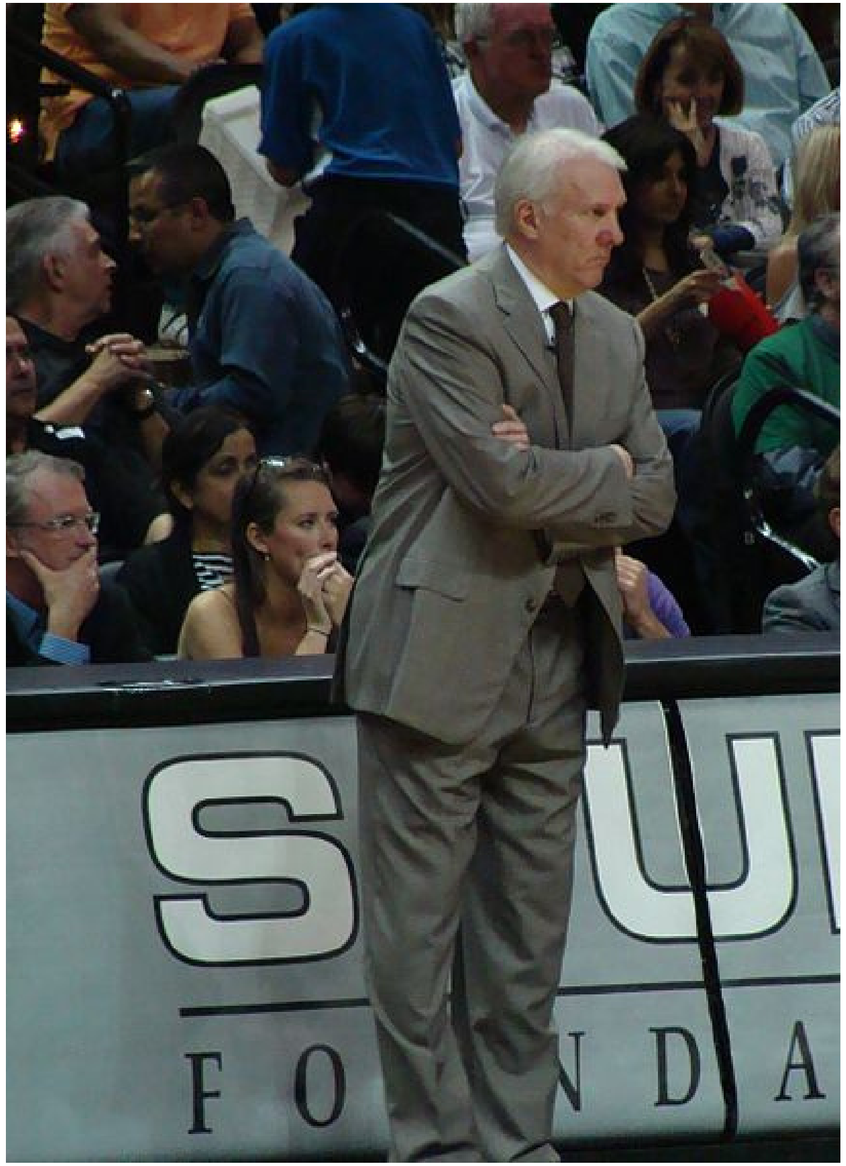


2015-2016

BLAKE GRIFFIN



2020-2021



Implementation

ARE TEAMS USING DATA WISELY TO FORM STRATEGIES?

There are many papers, TED Talks, conferences that use NBA data & statistics in order to provide insights and try to give a team an edge in competition.

This project aims to analyze the decision making process by training AI agents to play a simplified game of basketball.

1:

Examples:
Joe Harris (SG/SF), Michael Porter Jr (SF)

2:

Examples:
Nikola Jokic (C), Damian Lillard (PG)

3:

Examples:
Nerlens Noel (C, PF), Rudy Gobert (C)

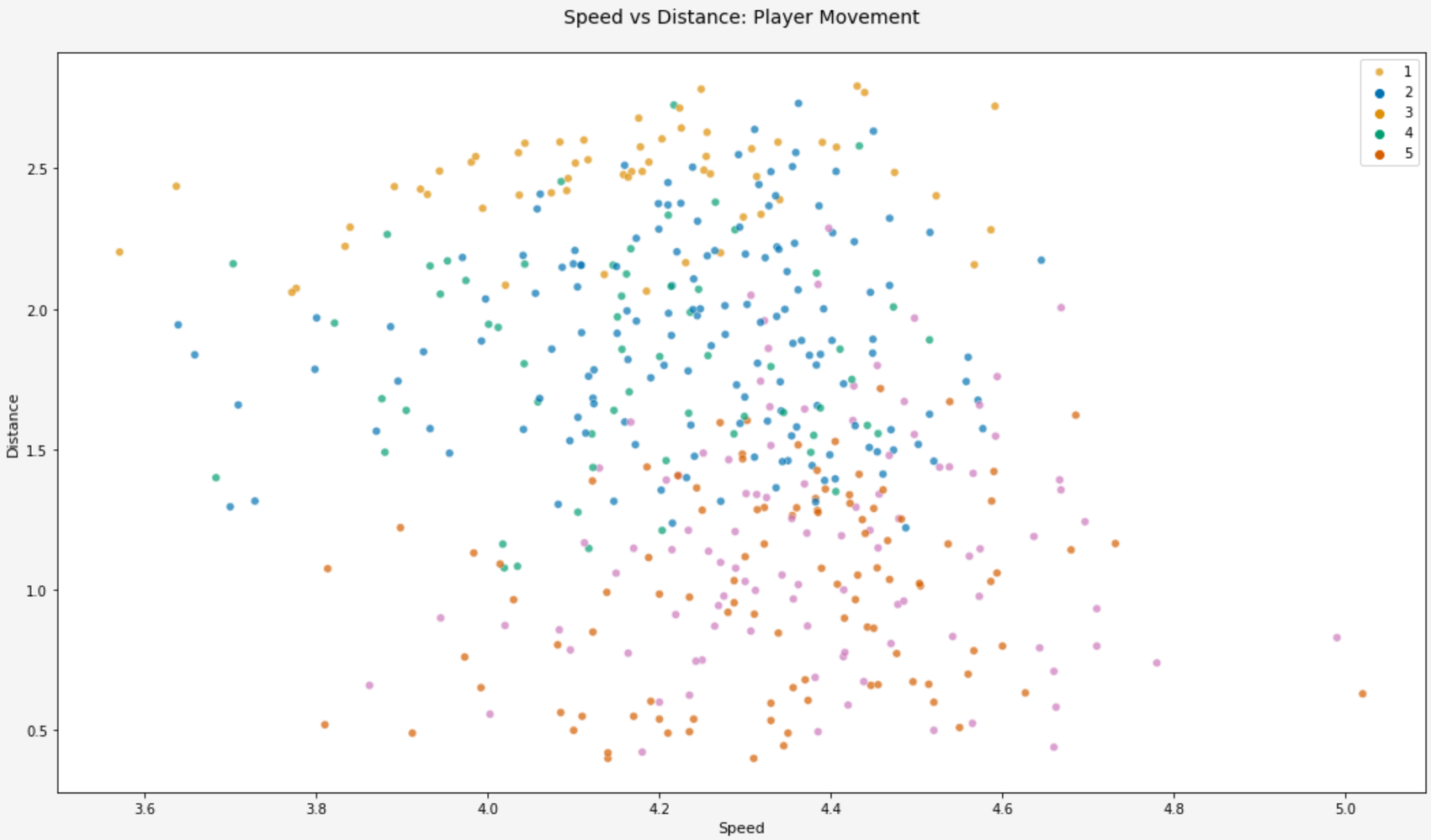
4:

Examples:
RJ Hampton (PG), Patrick Patterson (PF)

5:

Examples:
Jahlil Okafor (C) , Trey Lyles (PF)

KMEANS CLUSTERING



Inspiration

ALPHAGO & MUZERO

Researchers have developed chess playing models that play at a Grand Master level. These models played unconventional tactics and strategies that were later studied.

Reinforcement Learning

ENVIRONMENT CONCEPT

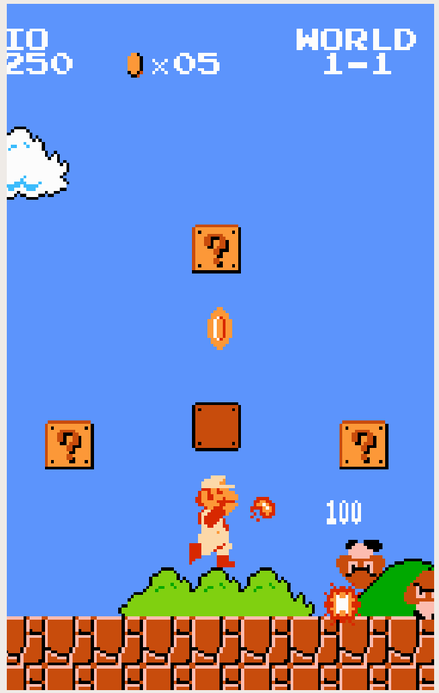
First we need an environment for our agents to operate in.

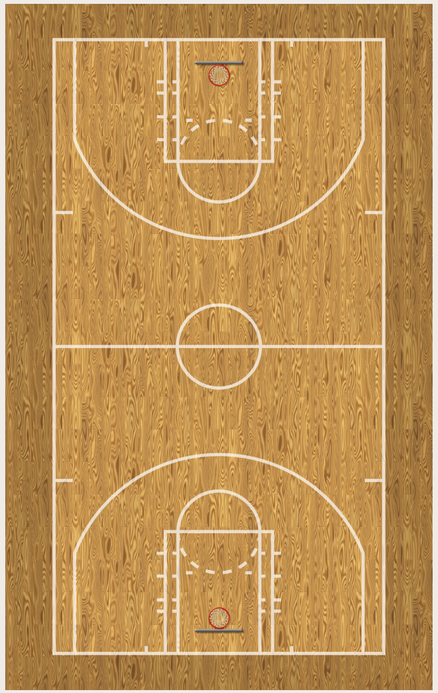
The environment defines the overall parameters, the legal actions an agent can take, and rewards for the agent's actions.

For example, the court size, moving on the court, or shooting the basketball and how much a made basket is worth.

Environment Modeling

Modeling Environment to train Agents





OBSERVATION SPACE

- X location for each player
- Y location for each player

ACTION SPACE

- Movement on x & y plane
- Shooting or Passing
- Steal or Block

Reinforcement Learning

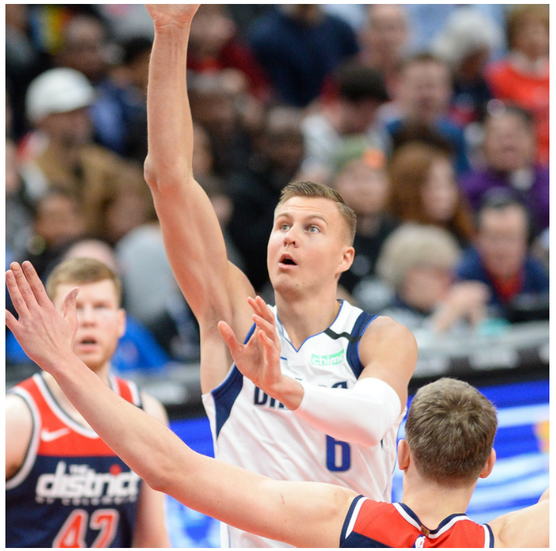
PLAYER CLASS

We also need to create a player class for the agents.

In this class we define attributes such as field goal percentages, or whether or not a player has the ball

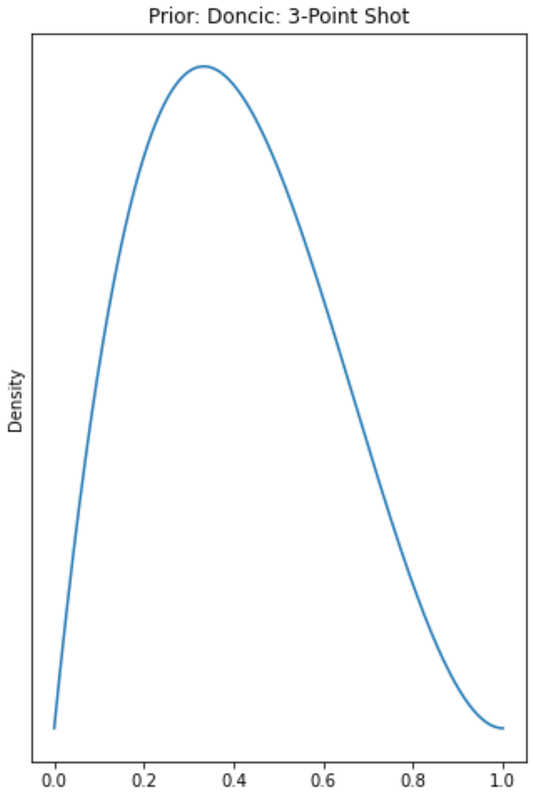
To simplify the process, I decided to model a 2v2 Half-court game. The success of any given action is based on probabilities.

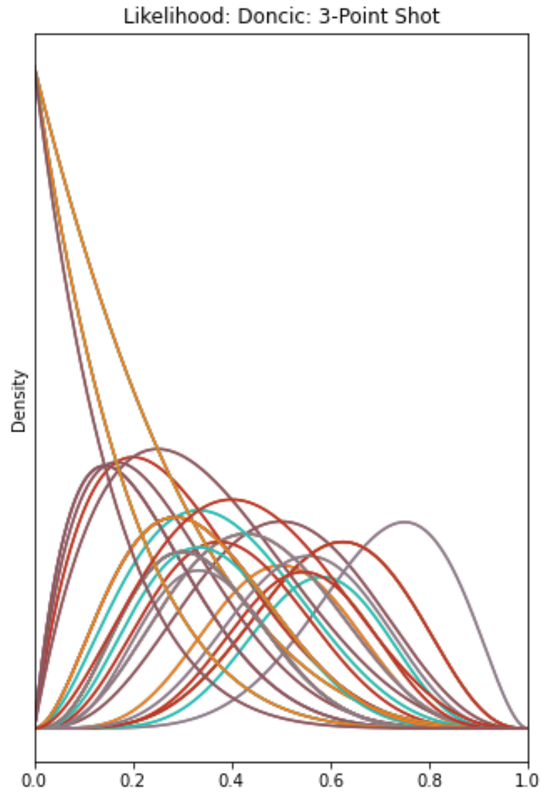
NYK VS DAL

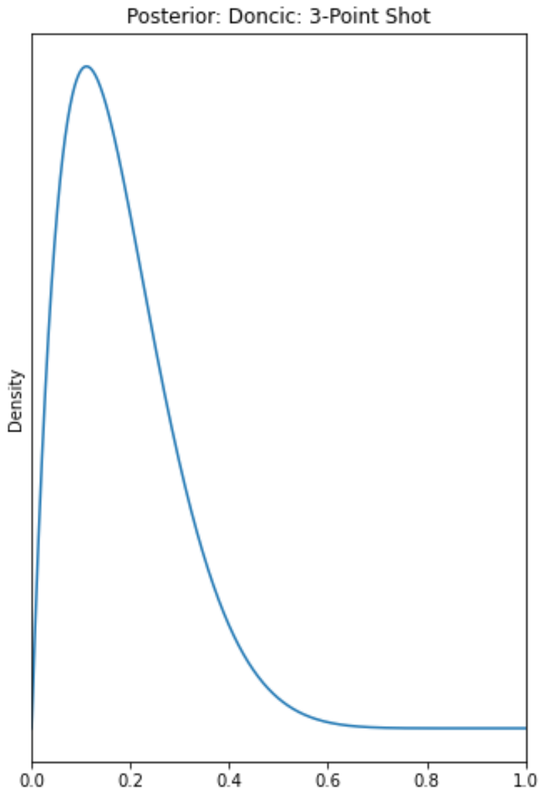


Using distributions of players shooting percentages to sample from in order to create a make probability in our environment.

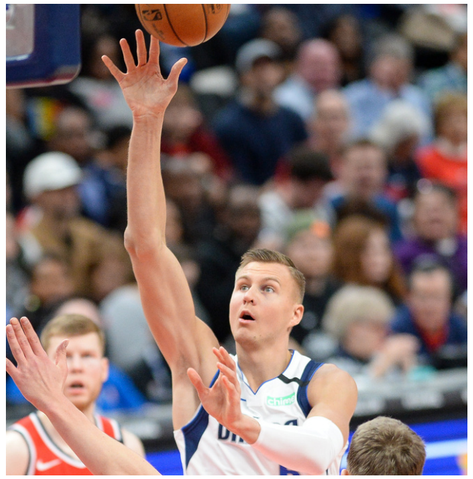
LUKA DONCIC: 3 POINT SHOOTING PERCENTAGE 2020-21 SEASON



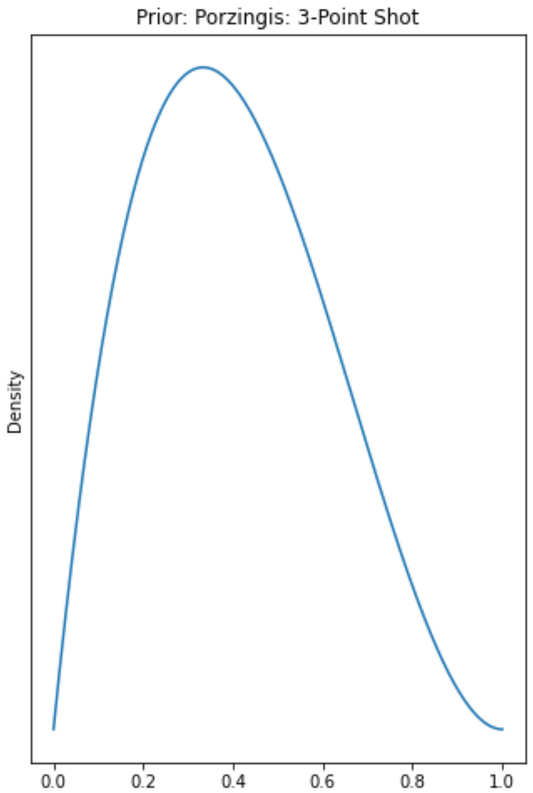


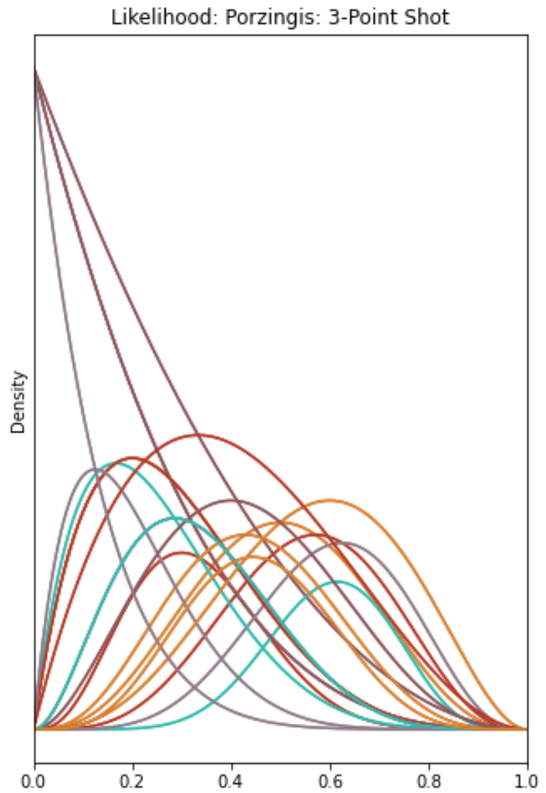


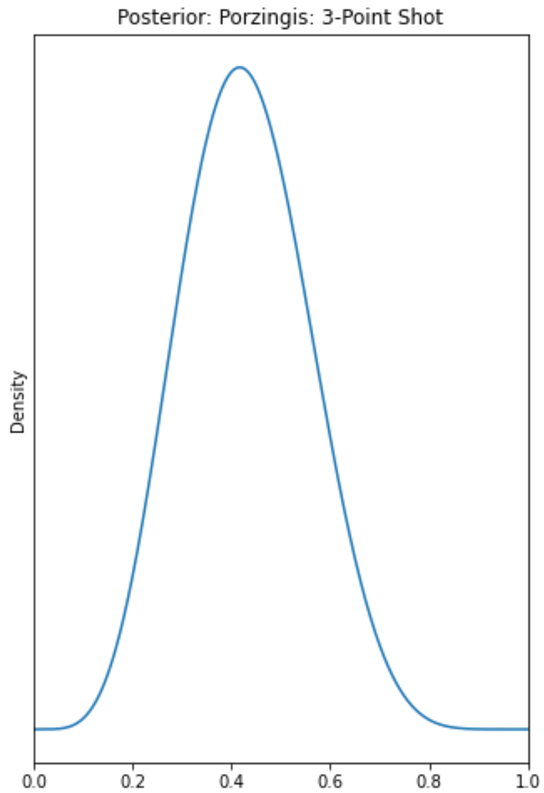
KRISTAPS PORZINGIS: 3 POINT SHOOTING PERCENTAGE 2020-21 SEASON



Using distributions of players shooting percentages to sample from in order to create a make probability in our environment.







RJ BARRETT: 3 POINT SHOOTING PERCENTAGE 2020-21 SEASON

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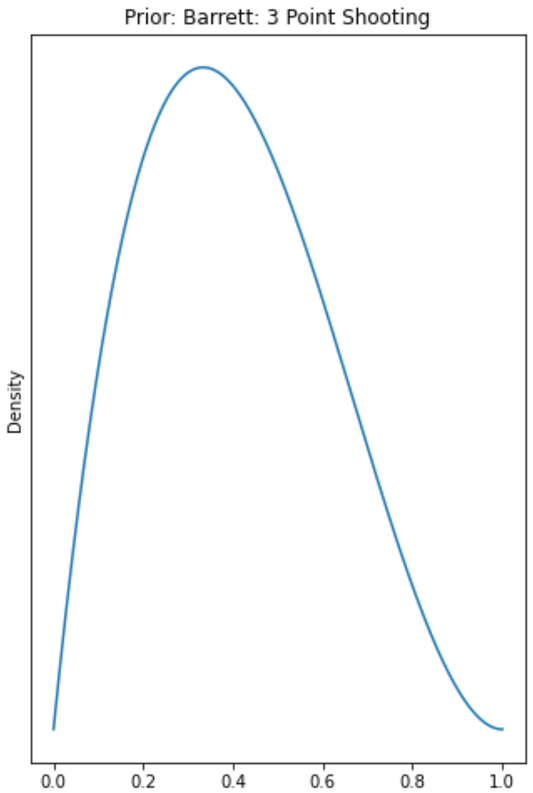
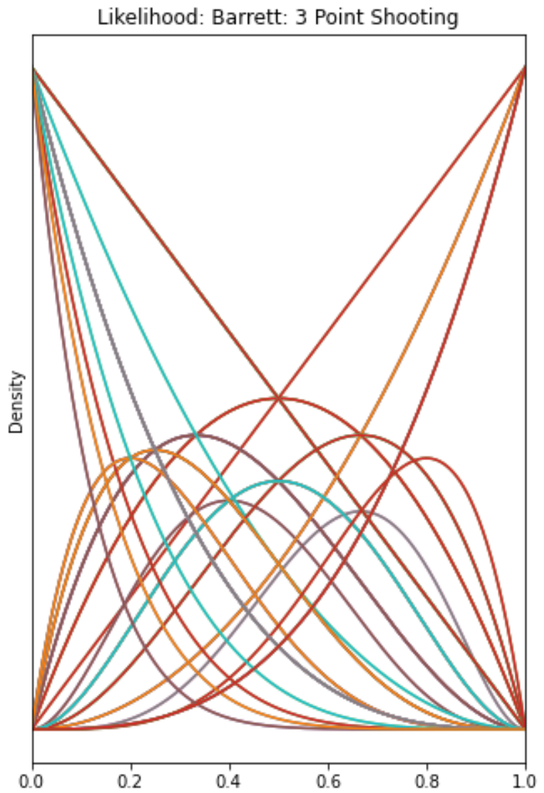
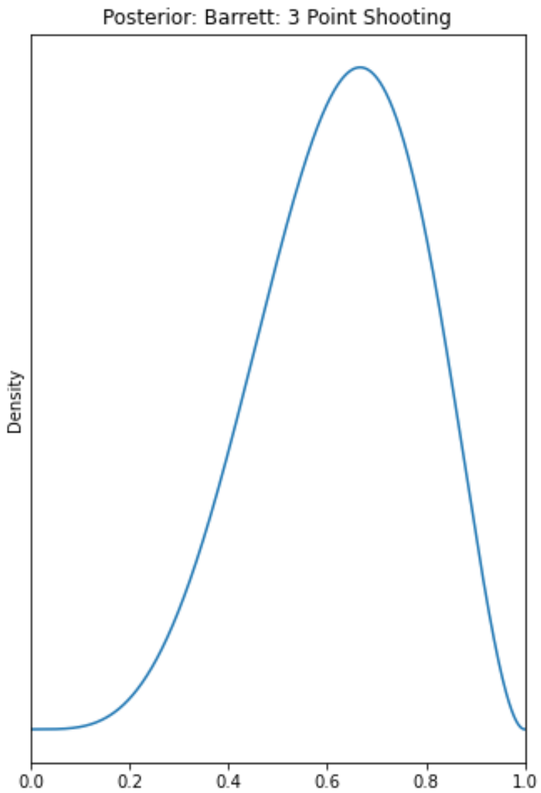
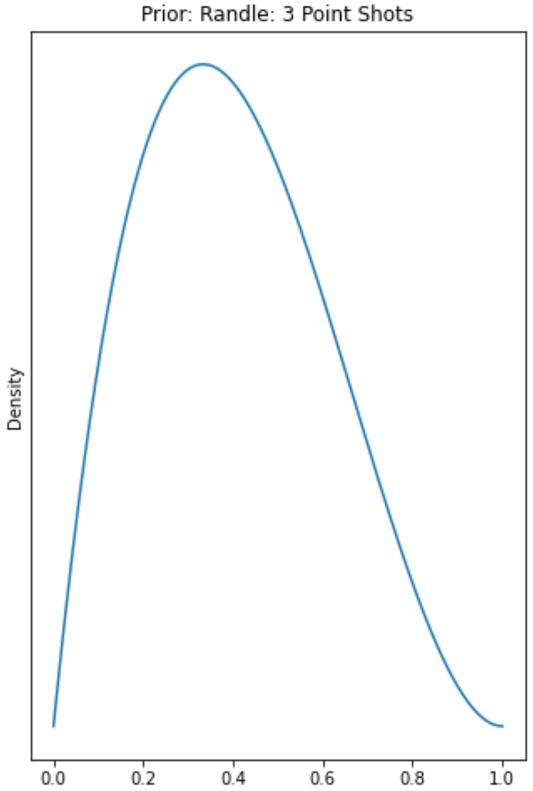


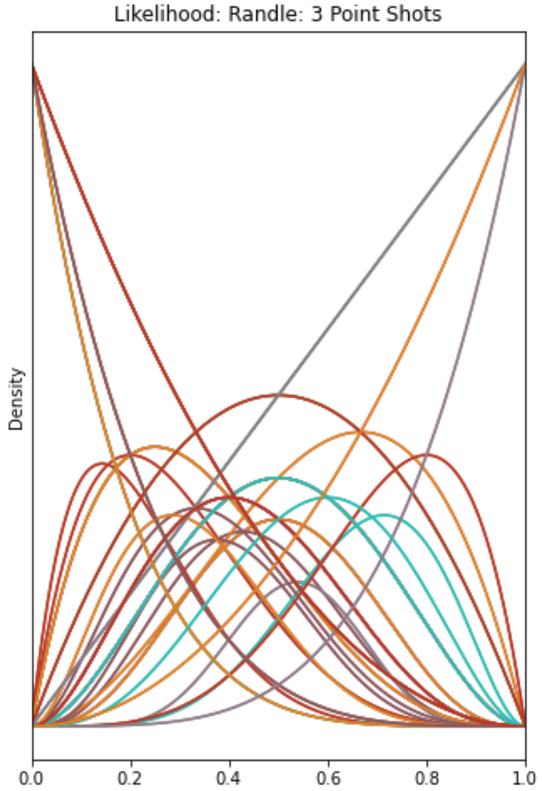


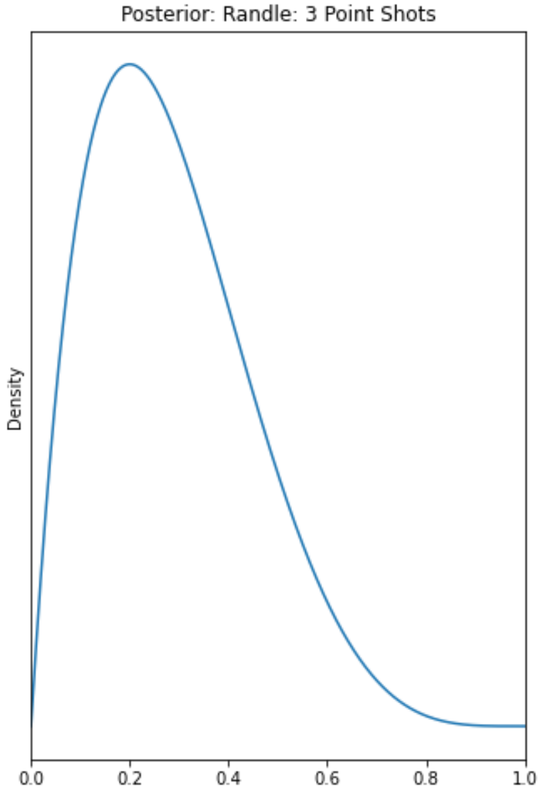


JULIUS RANDLE: 3 POINT SHOOTING PERCENTAGE 2020-21 SEASON

Using distributions of players shooting percentages to sample from in order to create a make probability in our environment.







Reinforcement Learning

AGENT CLASS

The agent class is where we actually define how the agents will learn.

To establish a baseline, we begin with the agents taking random decisions and output the reward.

We also want to make sure that the game is not too hard for the agents to score, but not too easy either.

Reinforcement Learning

Q LEARNING

Q-Learning is an off-policy algorithm. 'Q' stands for quality, and the algorithm tries to learn the policy that maximizes reward.

A q-table is created with the states and actions as a reference table of the best actions to take (learned over many iterations.)

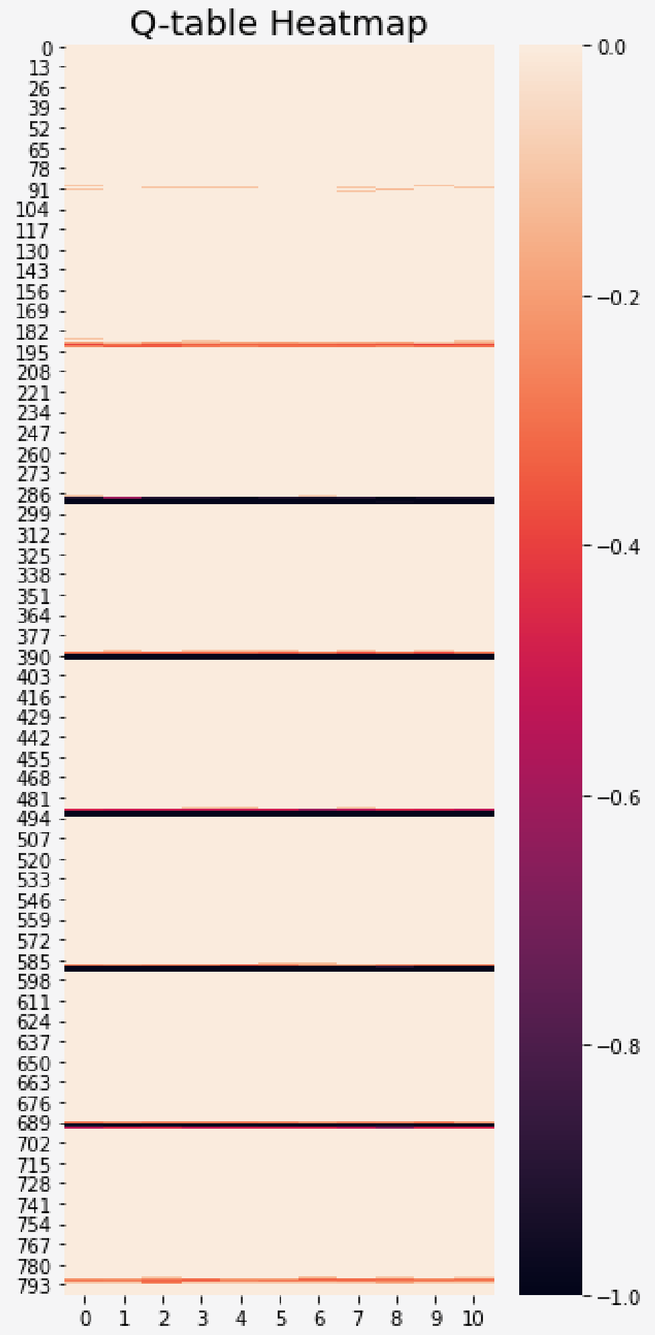
Our agent acts by refrencing the table, or by exploring a random action and thus learning a bit more about the environment.

ROWS:

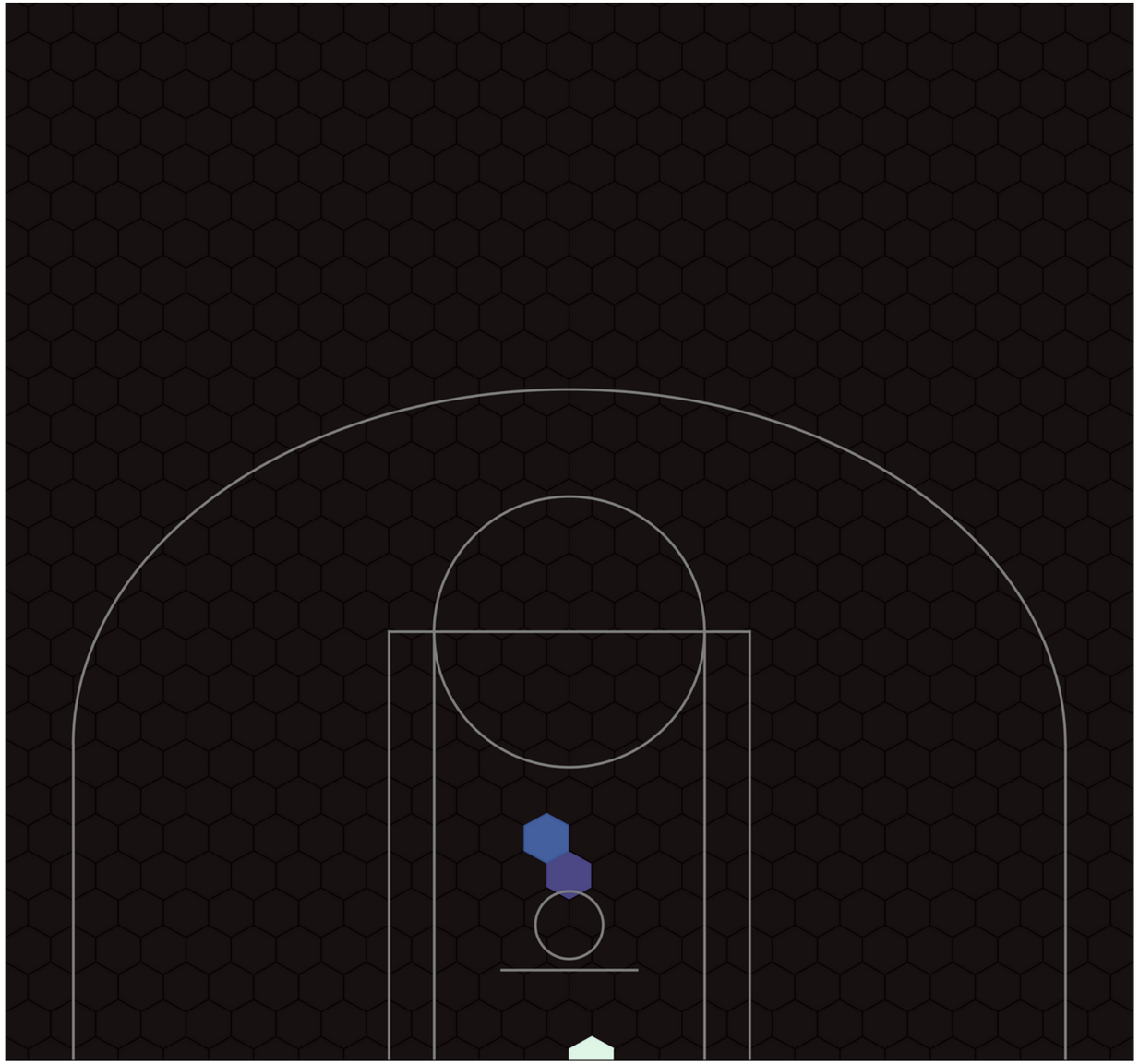
Observation Space:
100 x 94

COLUMNS:

Action 0: Do Nothing
Action 1: Up
Action 2: Up Right
Action 3: Right
Action 4: Down Right
Action 5: Down
Action 6: Down Left
Action 7: Left
Action 8: Up Left
Action 9: Pass / Steal
Action 10: Shoot / Block



AI Shot Chart



Next Steps

EXPANSION

I would like to expand the exploration parameter in order to see if the AI would take a wider variety of shots.

Ideally the model would be expanded to 5v5 and could run through different scenarios, such as half court sets, out of bounds plays, or end of game scenarios.

THANK YOU