AI Basketball

Justice Code Team 39: AI Basketball

New Mexico SuperComputing Challenge

Final Report

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Executive Summary

Our purpose is to see if an artificial intelligence has the potential to play basketball as well as professional players. Specifically, we want to measure the three point shooting efficiency of an artificial intelligence as opposed to Steph Curry, Ja Morant and Lebron James. The AI will use Python to manipulate the database in order to attempt to beat the players.

We found our most reliable source by using NBA stats. We imported data from these sites to create our own database. We chose the below statistics because we believed that these are the players stats that the AI will need to beat the players. G, GS, FG, FGA, FG%, 3P, 3PA, 3P%, FT, FTA, FT%, ORB, DRB, TRB, AST, STL, BLK, TOV, 3 Point shot line position one - five. This data is what the AI will use to make decisions. These are games, games started, field goals, field goals attempted, field goal %, three point, three point attempts, three point %, free throws per game, free throw attempted, three point %, offensive rebounds, defensive rebounds, total rebounds, assist per game, steals per game, blocks per game, turnovers. We found shot charts for five of the different players, and included their accuracy for each position in our database.

We are going to pick specific basketball players or basketball teams to test it out. We are going for the shooting efficiency which is three pointers. We will use:

Experiment

Control - doesn't know basketball

Other variable - person who is experienced

Code machine (& create image) - that shoots a basketball in a target

Algorithm w/ math equation

Percentage chance of missing

Need realistic numbers

Research shooting average of real players (average or use all of the numbers)

We are in the process of learning python. We have thought out our pseudocode. This is a basic plan for our code. We plan on adding more variables. We expect the AI, through trial and error, to make accurate shots compared to the professional basketball players, when coded correctly.

Introduction

Problem Statement:

Our problem is determining whether an AI performs better, worse, or equal as well as a select roster of professional basketball players. Specifically, we want to measure the shooting efficiency of an artificial intelligence as opposed to players renowned for their three-pointers, such as Steph Curry. From this project, we predict that, if an artificial intelligence is programmed adequately, it can outperform a basketball player. We plan to work on this project by compiling information about the performance of specific basketball players and creating a computational model in which a computer plays basketball (through trial and error).

Background Research

We have researched the shooting average of some players and they are (Steph Curry, LeBron James, Kobe Bryant, Giannis Antetokounmpo, Kevin Durant, Ja Morant.

- Steph Curry: Not only has Curry averaged an elite true shooting percentage (62.6 percent) in his 14-year NBA career, but he has exceeded 60 percent in 10 of those seasons.
- LeBron James: LeBron James has a true shooting percentage of 58.8 in his career.
- Kobe Bryant: Kobe Bryant had a true shooting percentage of 55.0 in his career.

- Giannis Antetokounmpo: His average is 58.9%
- Kevin Durant: Kevin Durant has a true shooting percentage of 61.8 in his career.
- Ja Morant: Ja Morant has a true shooting percentage of 54.8 this season.

How an AI is used in sports is for boosting performance and health thanks to predictive analysis. Al can also help teams shape strategies, tactics, and maximize their strengths.
It helps measure the pass distances or even the player's speed. AI in basketball augments the work of coaches, players, and sports commentators. It also allows for a better understanding of the basketball game through so much new data. It also helps with creating Predictive Models of Player Performance, Personalized Training, and Better Sports Equipment.

Computational Model

Selection:

We do not have a Netlogo model. We are starting our code in Python. For now we are working on the pseudocode before we put it into the actual coding language. We've had some predictions, and done some test runs. We have the pseudocode for our basic functions like, positions on the map, players, and shooting percentage rate vs random(x). We are still not done adding different functions and modifications to make our code more realistic. We are using pseudocode to help see how our model will run, and make changes to it before we start our actual code. So far it has helped us not make mistakes while coding in Python, making it more efficient.

Modifications:

We have been working on our model and found that we needed some modification to our code in order for it to have realistic features. Our original code only had our basic functions. Our model is in Python, not Netlogo, and for that we do not have sliders. However, we have variables

that affect what happens to the players, AI, and model in general. Some of the modifications we have added to our model are:

- Speed - How quickly the players can move to the next position and/or how fast the AI can move and shoot.
- Force - How much force the players / AI need to shoot the ball and block.
- Jump - Distance (height), between floor and players shot (what level on y axis Player is shooting from.
- Height - Also a factor of the level of ball when being thrown
- Shooting Percentage - How often a player misses/makes a shot

What we already have:

- Participants - 3 players, 1 Artificial Intelligence
- Shooting Percentage - how often a player misses/makes a shot
- Map - 5 positions of the three point area

Visualization:

We found a map of a basketball court which shows us the 5 stops on the 3 point line where the basketball players and AI are going to be shooting from. So how this works is that if player one is on stop one and the AI is blocking them, they can move to the other stops and take that 3 point shot or they can drive to the basket and dunk it. For an action like jumping, the players elevate to a certain level for a specific time (due to gravity). For now we are still working in Python. Later we plan to transfer the code to netlogo to get visualization.

Limitations:

The field of artificial intelligence and data science is a completely complex and long process that engineers and scientists still haven't fully explored.Working on this project, we've

had some things we could and could not do. There are limitations to our characters and our model/data. For example, our first thought for this project was to create a full basketball game; but that would cause problems. One reason is that there are too many variables to keep track of, and many rules for the players to follow, and the AI to learn. This will take both our time and require a lot of stats on players that are not available to us. Ex: every single position each player had made, blocked, or got past the opponent's defense. Another reason is that because of too many variables, we won't have a clear and continuous outcome or result. There are rules players have to follow for the game to have more realistic traits. There is only so much we can do with a model.

Problem Solving Method

Verification & Corroboration

So far our model is running the way we planned. We translated the pseudocode into Python code/language, and ran the model. Our model is fully functional and running smoothly.

In the real world the things that support our model is the fact that it can help professional basketball players know their habits, strengths and their weaknesses so it can also help them improve on playing better and winning more games. Not only that, it can also analyze the data of each player and find where and where they need to improve. It also calculates the probability of various situations, and selects the best substitution list, the best tactical combination and other data. It helps coaches outmaneuver the opposing team and it can predict moves of both offensive and defensive players. It can show coaches and players how defenders are likely to react to new moves and how they should, in turn, change their tactics.

Conclusion

Results:

We have not completed our model but so far we have gotten the stats on our players and we used a spreadsheet to put the numbers in order that we needed. Next we found a map of a basketball court and we numbered the places we put our players. We put our players at the 3 point line because, again, we are measuring the 3 point shooting efficiency. Finally, we have our Pseudocode which talks about where we place the Al and the players and where they are shooting from and what side and all the other data we have.

Discussion:

Our next step will be to start coding and getting our model built so that we can put all the data and stats and Pseudocode that we have collected in our code system and apply all that to our model so it can show all things we have been talking about. We are planning on adding more modifications to our code to make our model more realistic. Such as, speed, force, and how high they can jump, so it is not easy for the AI to beat the players because it is an artificial intelligence and you can program it however you want with the right data.

Future Work:

We are planning on adding more modifications to our code to make our model more realistic, making it not easy for the AI to beat the players. Our next steps will be:

1) finding a formula to determine the flight of a basketball

2) create a 2D map of locations surrounding the goal

3) create two learning policies - one should alter the force the training player is using to push the ball toward the goal, another should alter the angle of the shot they are attempting

4) figure out how to translate the endpoint of their formula into an x,y location on their map

5) Using this x,y location, determine whether an attempt was successful

6) Based on whether the attempt was successful or not, select a learning policy

7) implement a jump ability (i.e. update the starting position of a basketball by a number of centimeters/inches)

Acknowledgments:

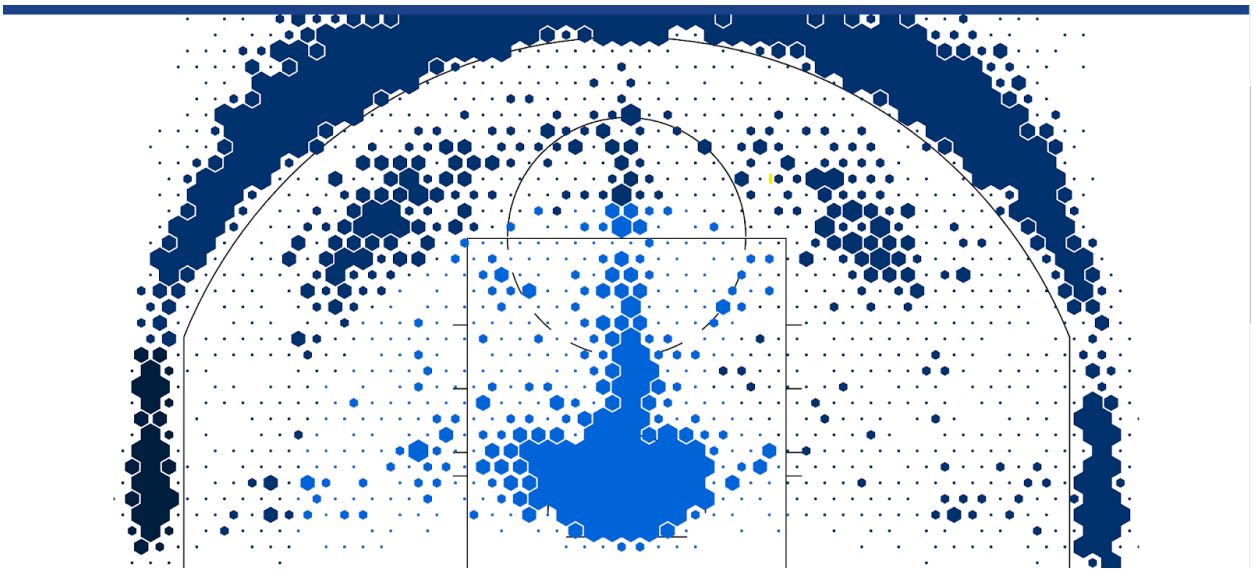
We want to say a big thank you to the people who have helped us all this way and helped us get to where we are right now. Those people are Ms. Patty, Ms. Caia Brown, Ms. Becky and our other mentors. We thank you for always being there and answering all of our questions and our late night calls and being able to correct our mistakes. So to that we say (THANK YOU).

References:

Basketball Statistics & History of Every Team & NBA and WNBA Players." Basketball, https://www.basketball-reference.com/.

"2022-23 NBA Stat Leaders." ESPN, ESPN Internet Ventures, https://www.espn.com/nba/stats.

2022-23 NBA Stat Leaders." ESPN, ESPN Internet Ventures, https://www.espn.com/nba/stats.



Appendix:

```
 """
   Pseudocode:
   score = 0
   loop over player(i) where i is Curry, James, and Morant
      loop over position j, where j is 1 through 5
         if player(i) is in position j and no one is blocking, shoot
         if shooting percent < random(x) and no one is blocking
            score[i] = score[i] + 3
"""
import random


def is_blocked():
   """Either 'blocked' or 'not blocked' returned"""
   return 'blocked' if random.randint(0, 1) else 'not blocked'


def main():
   """main function that drives basketball program"""
   # player: 3 point percentage
   players = {'curry': 42.7, 'james': 30.8, 'morant': 31.6}

   # set score to zero at the beginning
   score = [0, 0, 0]

   # create a list of the keys to iterate over
   i = players.keys()

   # perform these five shots 100 times
   for t in range(100):
      # for ever player in our dictionary
      for index, player in zip(range(len(i)), i):
         # for each of our five locations
         for shot in range(5):
            # determine random number to see if player
            # makes the shot
            r = random.random() * 100
            # determine if player is being blocked
            blocked = is_blocked()
            if r < players[player] and blocked != 'blocked':
               score[index] = score[index] + 3
```

```
                #print(f'score: {score[index]}, player: {player}')

    # print out aggregate results of 100 trials for each player
    for s, player in zip(score, i):
        print(f'{player}: {s}')


if __name__ == '__main__':
    main()
```