CS747: Intelligent and Learning Agents

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Final Project

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Team: NullPointerException

16305R005

16305R010

16305R007

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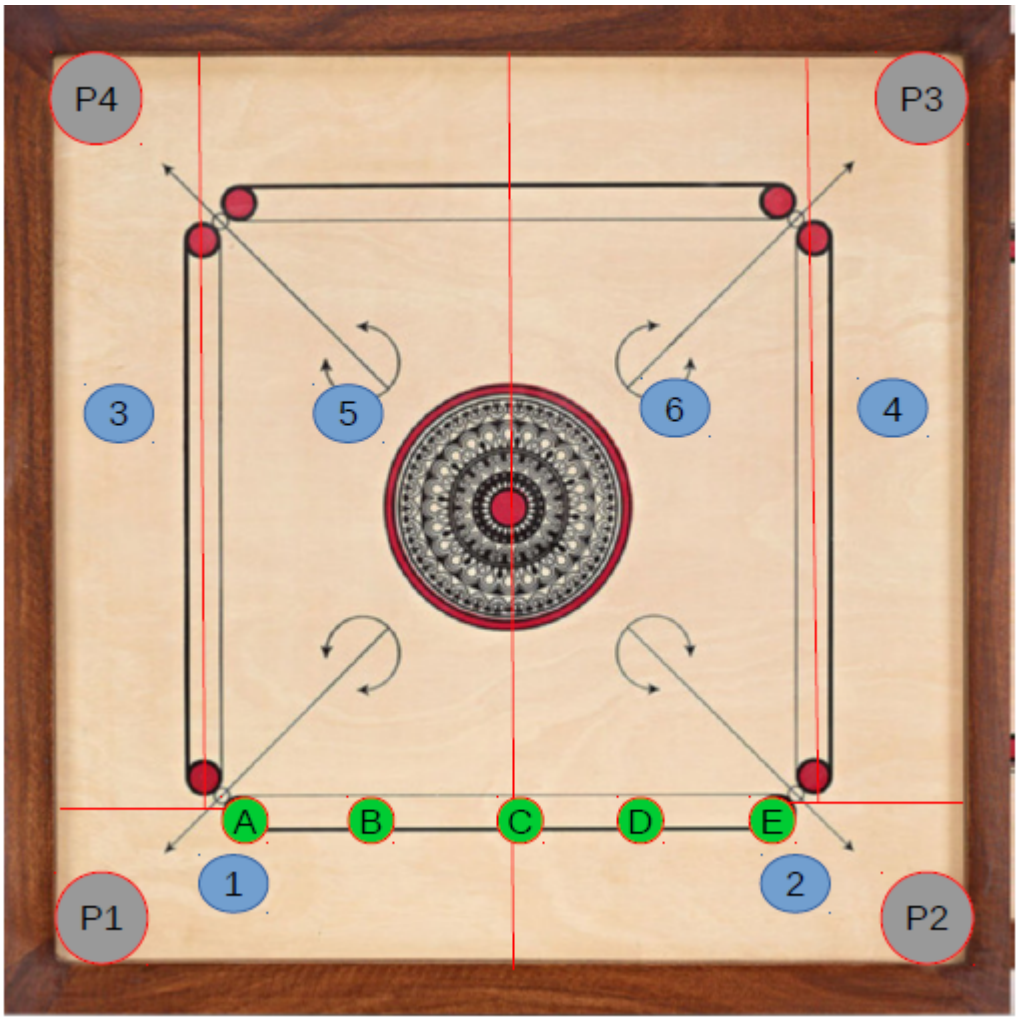
Problem Statement

For this project, we have to implement an agent to play the game of Carrom. The agent must demonstrate proficiency both in 1-player mode (to clear the board using a minimal number of strikes) and when playing an adversary in 2-player mode.

The Complete problem statement and environment can be found at the github page:

https://github.com/samiranrl/Carrom_r

Single Player Game



As depicted in the above figure, complete board is divided into 6 regions (1,2,3,4,5 and 6). Five positions namely A,B,C,D and E have been

considered for striker starting point such that AB = BC = CD = DE or A= 0, B = 0.25, C=0.5, D=0.75 and E=1.0.

Rules for different regions

- *Region 1 :* If a coin is lying in this region, striker is held at position D. Angle between coin and striker at position D is measured and hit with full force.
- *Region 2 :* If a coin is lying in this region, striker is held at position B. Angle between coin and striker at position B is measured and hit with full force.
- *Region 3 :* Striker is placed at position A and a coin lying in this region is aimed and hit with full force.
- *Region 4 :* Striker is placed at position E and a coin lying in this region is aimed and hit with full force.
- *Region 5 :* Coin lying in this region is aimed with striker at position C and hit with full force.
- *Region 6 :* Coin lying in this region is aimed with striker at position C and hit with full force.

Algorithm

1. Take six empty lists : l1[],l2[],l3[],l4[],l5[],l6[]
2. Take an array of size six count[]=0 that will maintain the count of coins in each region.
3. Loop through the complete list of the coin i.e. white coins + black coins + red coins
4. If a coin lies in region k, increase the count of region k and append this coin in the list of region k.
5. Find the region with the maximum number of coins.
6. Pick a coin from the region with the maximum number of coins.
7. Pass position, angle and force to the server according to the above rule depending on the region in which this coin is lying.

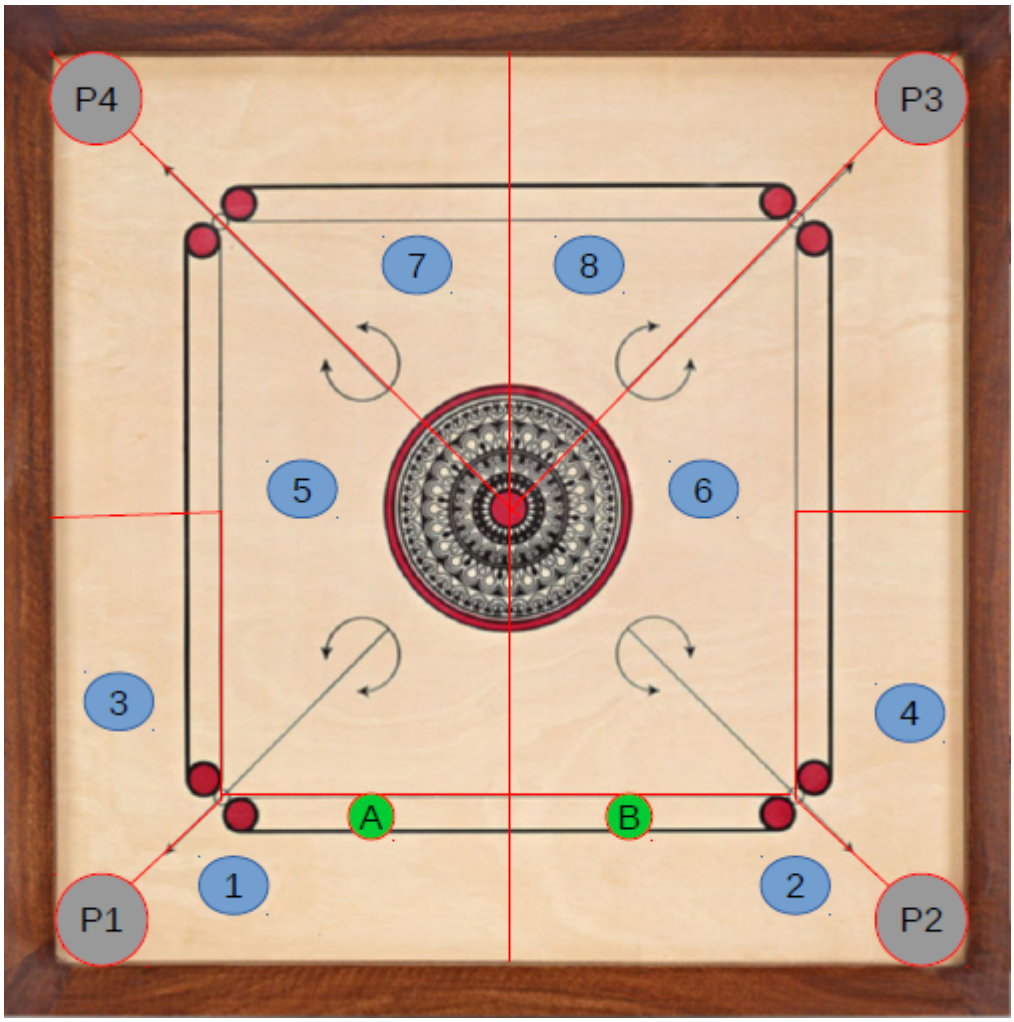
Analysis

There are two variations of the above algorithm:

1. Hit with full force every time. With this approach, average number of turns (Averaged over 1000 experiments) required to complete the game is 23.62.

2. If number of coins on the board is greater than 10 apply full force else apply 0.5 force. With this approach, average number of turns (Averaged over 1000 experiments) required to complete the game is 26.5.
3. If red coin is still on the board, hit the red coin with full force else follow the strategy of hitting the coin in the region with maximum number of coins.
4. If red coin is still on the board, pick a coin from the region with the maximum number of coins and calculate it's distance from the queen. Hit the coin which is closest to the queen. Else if queen is not on the board, just hit any coin in this region.

Double Player Game



For two player game, the complete board is divided into 8 regions numbered 1,2,3,4,5,6,7 and 8. There is no fixed position for the striker unless a coin lies in region 1 or 2.

Rules for different regions

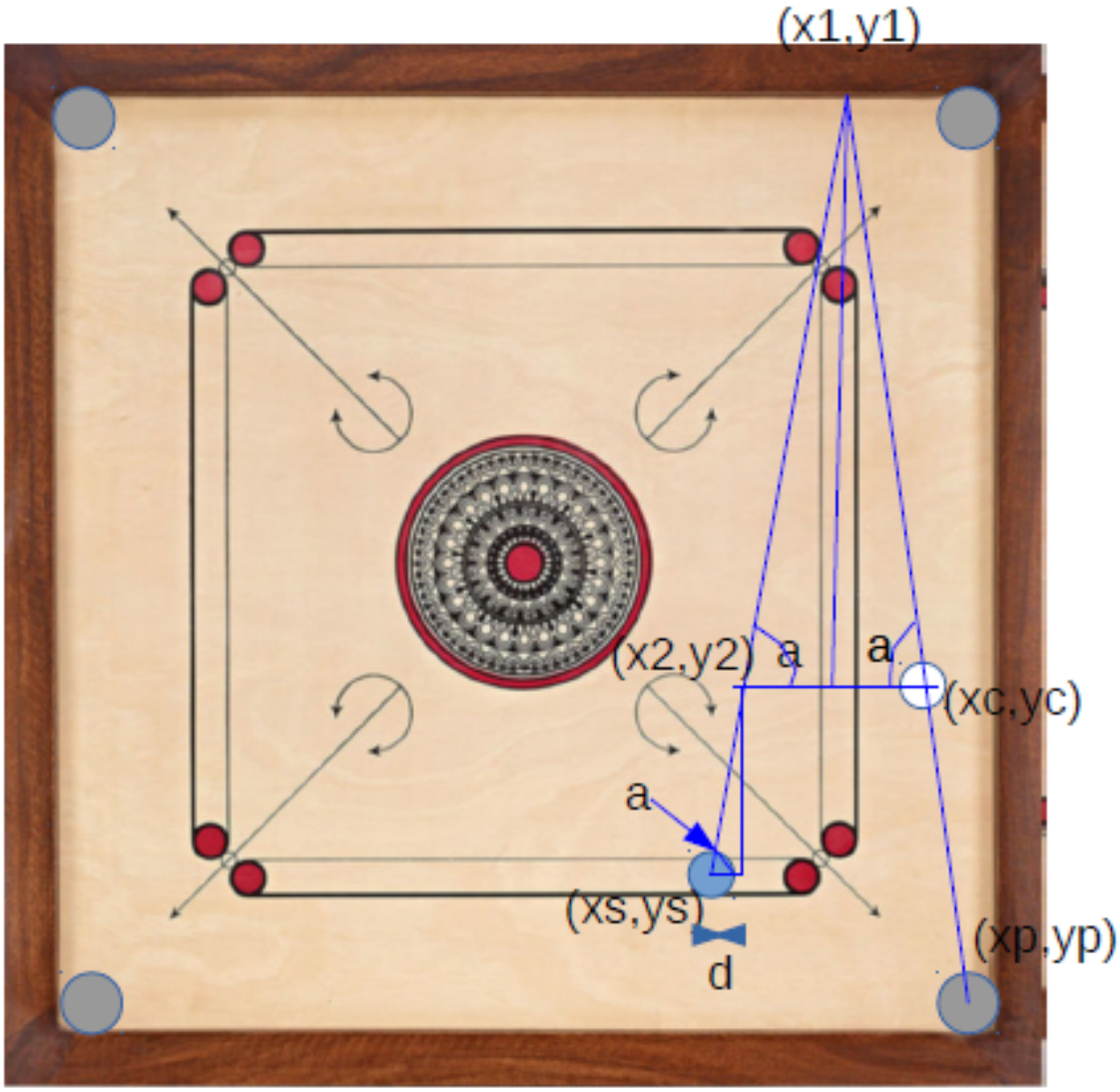
Region 1

- If a coin is lying in this region, striker is placed at position B and hit the coin with force of 0.1.
- **Another approach for region 1** : Calculate the angle (say P) between pocket 1 and the coin . Place the striker at position with x coordinate equal to that of the coin. Calculate the angle (say Q) between coin and the striker. Calculate the difference between P and Q. Now place the striker at x = x + i*r (x : x coordinate of the coin and r = radius of the coin, i=1,2,3 ...) and calculate the angle (Q) between coin and the striker. Find the position of the striker when difference between P and Q is minimum. Now, repeat the same method for x = x-r to x+r with step size of 2. This is done to minimize the difference between P and Q. Hit the coin with 0.1 force. But this method does not work as it leads to foul. So, we removed this method in implementation.

Region 2

- If a coin is lying in this region, striker is placed at position A and hit the coin with force of 0.1.
- **Another approach for region 2** : Calculate the angle (say P) between pocket 2 and the coin . Place the striker at position with x coordinate equal to that of the coin. Calculate the angle (say Q)
  between coin and the striker. Calculate the difference between P and Q. Now place the striker at x = x - i*r (x : x coordinate of the coin and r = radius of the coin, i=1,2,3 ...) and calculate the angle (Q) between coin and the striker. Find the position of the striker when difference between P and Q is minimum. Now, repeat the same method for x = x-r to x+r with step size of 2. This is done to minimize the difference between P and Q. Hit the coin with 0.1 force. But this method does not work as it leads to foul. So, we removed this method in implementation.

Region 3 and 4



- With (xp,yp) and (xc,yc), we have
  - y-yp = (yp-yc)/(xp-xc)(x-xp) ... (1)
- Equation (1) is satisfied by the line y = 755.9 and hence we can get
  - (x1,y1) = ((y-755.9)*(xp-xc)/(yp-yc) + xp , 755.9)
- Since, angle of incidence and angle of reflection is equal, it forms an isosceles triangle. Hence,
  - x2 = xc – 2*(xc-x1) = 2*x1-xc
- Since, tan(a) = (y1-yc)/(x1-x2) = (yc-145)/d, we can obtain the value of d.
- And finally, we can get xs = x2-d and ys = 145
- Hence, we can aim for (x1,y1) from (xs,ys) with 0.5 force at calculated angle.

Region 5

Angle (P) between coin lying in this region and pocket 4 is calculated. Striker is held at different positions such that x coordinate of striker = (145+30) + i*r, where i = 1,2,3 ... and r is the radius of coin and y coordinate of the striker is fixed at 145+20. Angle (Q) between coin and the striker is calculated. Finally, striker is positioned at a place such that difference between P and Q is minimum. Striker is then hit with a force of 0.3 at an angle Q.

Region 6

Same as region 5.

Region 7

Let position of coin is (xc,yc). Place the striker at a position of (xc+r,145+20), where r is the radius of the coin. Hit the coin with 0.5 force. There is a high probability of pocketing the coin in pocket p4.

Region 8

Let position of coin is (xc,yc). Place the striker at a position of (xc-r,145+20), where r is the radius of the coin. Hit the coin with 0.5 force. There is a high probability of pocketing the coin in pocket p3.

Algorithm

i. Take eight empty lists : l1[],l2[],l3[],l4[],l5[],l6[],l7[],l8[]
ii. Take an array of size eight rival_count[]=0 that will maintain the count of black coins in each region.
iii. Take an array of size eight my_coin_count[]=0 that will maintain the count of white coins in each region.
iv. Take an array of size eight diff[]=0 that will maintain the difference count (rival_countmy_coin_count) of each region.
v. Loop through the complete list of the coin i.e. white coins + black coins + red coins
vi. If a white coin lies in region k, increase the my_coin_count of region k and append this coin in the list of region k else if a black coin lies in region k, increase the rival_count of region k.

vii. Calculate the difference count.
viii. Find the region with the maximum difference.
ix. Pick a coin from the region with the minimum difference count.
x. Pass position,angle and force to the server according to the above rule depending on the region in which this coin is lying.