Game Theory. Assignment II

Nikita Nigmatullin
Innopolis University
Innopolis, Russia
n.nigmatullin@innopolis.ru
Security and Blockchain

Abstract—This document describes the process of designing and evaluating player agents for the Moose game tournament. The evaluation was made by holding multiple tournaments of 100000 distribution of player types between 150 players. The best results gives the Random player.

Index Terms—game theory, java

I. INTRODUCTION

The Moose game is a non-cooperative, fully-observable, simultaneous, non-zero sum, symmetric game between two players. The game has environment of 3 fields: A, B, C. Each field has it's own integer value, greater than or equal to 0. At the each step of the game both players choose the field, if they chose different fields each of the players get score of the field they have chosen and the chosen fields values decreased by 1. If they chose the same field the players do not score any points, the field's value is decreased by 1. The fields that was not chosen increase their value by 1.

II. PLAYER TYPES

For such rules of the game we should design the players agent to find the best one. During the assignment was created 6 types of the players, such that:

A. Greedy player

The player chooses the best field in the environment.

B. Medium player

The player chooses the medium field in the environment.

C. Pacific player

The player chooses the worst field in the environment.

D. Random player

The player chooses the random field in the environment.

E. Copycat player

The player chooses the opponent's last move. Player's first move is random.

F. Slightly clever player

The player plays as a Greedy player first 5 rounds. During that time it tracks opponents moves and based on them decide if the opponent is the Greedy player. If so, switch to Pacific player, otherwise stay Greedy.

III. EVALUATION OF THE PLAYER TYPES

The evaluation of the player types is important due to competitive side of the subject. During the assignment testing options were invented.

A. Player of each type plays with each other

The naive approach. Create the player of each type and play game between all players and store the total score after the tournament. After tournament the following results were received:

TABLE I
NAIVE APPROACH TOURNAMENT

Player type	Score
Greedy player	157.4
Medium player	130.4
Pacific player	132.0
Random player	135.8
Copycat player	118.8
Slightly clever player	89.9

During this tournament we see that the best result gives the Greedy player, then the Random player. But this tournament is not very representative due to facts described in the following section.

B. More accurate tournament

To build more accurate tournament we should take the following in assumption:
- The games will be with players of other students, thus, their strategies can be very different.
- The number of players will be around 150. One player per each student of the Game Theory course.

As we can see the naive tournament has only 6 players, when real tournament will have 150 players. Thus the results of the naive tournament are not good enough to make any conclusions about the best player type. That's why we need to use another tournament type for player types evaluation.

The first idea that came to my mind was sum scores of all of the distribution of 150 between 6 classes. The problem is that the number of such distributions is roughly $150^6 \approx 10^{12}$. Each of the play session has 150^2 games, thus the total complexity is 10^{16}. It is very big for my PC.

To overcome this problem, I decided to randomly generate limited amount of distribution, and based on them calculate the average scores of the player types.

IV. Tournament algorithm

The tournament algorithm consists of 2 main parts: random distribution generator, game between all players. First let's define the algorithm of random distribution generator.

Algorithm 1 Generate random distribution

0: **function** GENERATE($nPlayers$, $nPlayerTypes$)
0:     $dist = [0 \, for \, i \, in \, 1, 2, \ldots, nPlayerTypes]$
0:     $total = 0$
0:     **for** $i = 1, 2, \ldots, nPlayerTypes$ **do**
0:         $dist[i] = getRandomIntUpTo(nPlayers - total)$
0:         $total + = dist[i]$
0:     **end for**
0:     $dist[N] = nPlayers - total$
0:     **return** $dist$
0: **end function**=0

As we can see it divide $nPlayers$ players among $nPlayerTypes$ class, in my case divide 150 players into 6 player types. So the tournament algorithm is to generate multiple distribution, play games with such distribution, save scores.

Algorithm 2 Tournament

0: **function** PLAYTOURNAMENT($nDistribution$)
0:     $score = [i \text{ for } i \text{ in } 1, 2, \ldots, 6]$
0:     **for** $i = 1, 2, \ldots, nDistribution$ **do**
0:         $distribution = Generate(150, 6)$
0:         Play among all players with given distribution
0:         update $score$ for each player type
0:     **end for**
0:     **return** $score$
0: **end function**=0

V. Tournaments results

The evaluation of player types in 100, 1000, 10000, 100000 random distributions. The score is decreased in 1000 times for readability.

A. 100 Random distributions

The best results gives the Random player and Copycat player. But 100 random distributions is too small for representative sample.

TABLE II
SCORES OF 100 RANDOM DISTRIBUTIONS

Player type	Score
Greedy player	255.3
Medium player	243.7
Pacific player	248.4
Random player	307.1
Copycat player	289.0
Slightly clever player	203.8

B. 1000 Random distributions

The best results have Random player, Greedy player and Copycat player.

TABLE III
SCORES OF 1000 RANDOM DISTRIBUTIONS

Player type	Score
Greedy player	2895.3
Medium player	2457.5
Pacific player	2414.0
Random player	3042.1
Copycat player	2621.7
Slightly clever player	2116.6

C. 10000 Random distributions

The best results gives the Random player and Greedy player.

TABLE IV
SCORES OF 10000 RANDOM DISTRIBUTIONS

Player type	Score
Greedy player	28423.9
Medium player	24060.0
Pacific player	24116.7
Random player	30049.0
Copycat player	25557.2
Slightly clever player	20527.2

D. 100000 Random distributions

The best result have Random Player and Greedy Player.

TABLE V
SCORES OF 100000 RANDOM DISTRIBUTIONS

Player type	Score
Greedy player	285813.3
Medium player	238438.5
Pacific player	241417.8
Random player	298484.6
Copycat player	257930.6
Slightly clever player	208377.6

VI. Conclusion

Based on the results of the tournament, the best type of player of my types is Random Player. It wins in all number of distribution in a tournament. Thus, I have chosen Random Player.