

# **CS 8803 PGM:Project 1 Part A**

**Submitted by:**

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# Predict Win

- In order to estimate the  $\text{Prob}(\text{win})$ , we are using a sampling based approach.
- Our approach is as follows:
  - Step 1: Given 2 of our hold cards and the 3 board cards(post flop stage of the game), we sample from the rest of the deck. We sample  $N*2$  cards for each of the  $N$  players and the rest of the board cards.  $N$  corresponds to the number of opponents playing.
  - Step 2: Compare our cards with the cards of the remaining active opponents and see if we win.
  - Step 3: Repeat steps 1 and 2 10,000 times.
  - Step 4:  $\text{Prob of win} = \text{Number of times won}/10000$
- This probability is used for making a decision.
- Few things we might consider changing in the above approach:
  - Currently we sample cards for all opponents( active and inactive ones). While counting the win, we consider only the active ones. One information we should use while sampling is that, the inactive players probably have bad cards( which is why they probably folded). At this stage, since we are not sure if the other agents are smart or just making random decisions, and we decided to incorporate this technique during the second stage.

# MakeDecisionPostFlop

- We take decisions according to equation (2) in the write up provided:

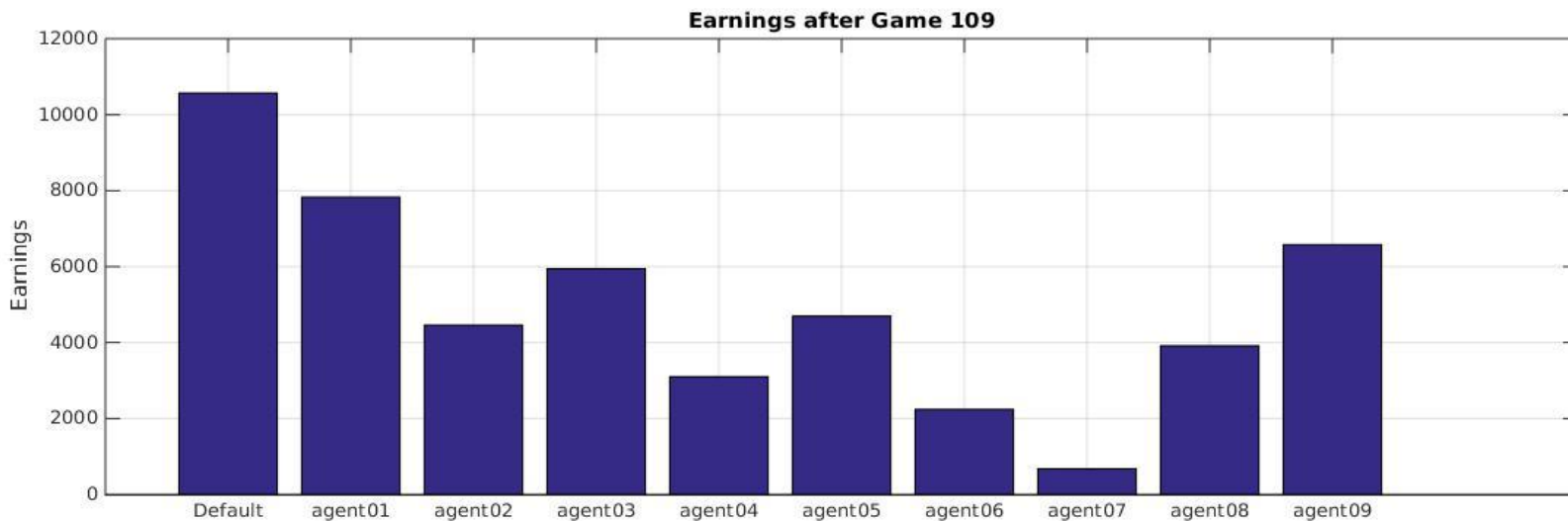
$$\text{Bet} = \begin{cases} \text{Raise} & \text{when } P(\text{Win} = 1) > \frac{B_T + 1}{M + N_A + B_T + 1} - T \\ \text{Call} & \text{when } P(\text{Win} = 1) > \frac{B_T}{M + B_T} - T \\ \text{Fold} & \text{otherwise} \end{cases}$$

- We control the parameter T as follows:
  - If position of play is  $< N/3$  ( N is the number of players), then  $T = -0.2$
  - Else,  $T = 0.2$  .

This is because we want to have a tighter style of play if we are in an early position and a looser style of play if we are in a late position. This makes sense as if we are playing early, we are at a disadvantage of not knowing about the other players actions.

# Evaluation

- We evaluated our system by two methods:
  - In Method 1, we played many games against the other agents provided. Our agent did better than most of the agents:



# Evaluation(Cont.)

- As seen in the graph, our agent has done better than the other agents over a large number of games.
- In the worst case scenario that all the agents provided are random agents, we are assured that our agent is better than a random agent.
- In Method 2, we evaluated the performance of the sampler. We created the a separate test file (attached as part of the code), where we implemented the same sampling strategy as mentioned in the predict win slide. We then fed a partial hand to the function and generated the probability of all 8 hands. This was compared against the CPT provided in the code.

# Prior Probabilities:

## Prior Probabilities:

Busted	0.1787
One Pair	0.4396
Two Pairs	0.2319
3 of a Kind	0.0516
Straight	0.0403
Flush	0.0311
Full House	0.0258
4 of a Kind	0.0010
Straight Flush	0

# N of a Kind Probabilities:

N of a Kind Probabilities from Flop (2 draws):

	Junk	K2	K2K2	K3	K3K2	K4
Junk	0.4107	0.4911	0.0839	0.0143	0	0
K2	0	0.5274	0.3785	0.0694	0.0239	0.0008
K2K2	0	0	0.8328	0	0.1654	0.0018
K3	0	0	0	0.6670	0.2923	0.0407
K3K2	0	0	0	0	0.9578	0.0422
K4	0	0	0	0	0	1.0000

N of a Kind Probabilities from Turn (1 draw):

	Junk	K2	K2K2	K3	K3K2	K4
Junk	0.6036	0.3965	0	0	0	0
K2	0	0.6962	0.2588	0.0450	0	0
K2K2	0	0	0.9105	0	0.0895	0
K3	0	0	0	0.7823	0.1950	0.0227
K3K2	0	0	0	0	0.9786	0.0214
K4	0	0	0	0	0	1.0000

# Straight and Flush Probabilities:

## Straight and Flush Probabilities from Flop (2 draws):

	SF	Flush	Straight		SF	Flush	Straight
Junk	0	0	0	SFO3 & F4	0.0008	0.3497	0.0084
SF	0.4627	0.5373	0	SFO3 & SI4	0.0014	0.0410	0.1659
SFO4	0.0562	0.2935	0.1898	SFO3 & SO4	0	0.0425	0.0139
SFO3	0	0.0408	0.0423	SI4 & F3	0	0.0403	0.1552
SFI4	0.0299	0.3239	0.1085	SI4 & F4	0	0.3453	0.1070
F	0.0017	0.9983	0	SO3 & F3	0	0.0403	0.0394
F4	0	0.3519	0	SO3 & F4	0	0.3493	0.0255
F3	0	0.0411	0.0136	SO4 & F3	0	0.0440	0.2980
S	0	0	1.0000	SO4 & F4	0	0.3538	0.1885
SO4	0	0	0.3144				
SO3	0	0	0.0459				
SI4	0	0	0.1640				

## Straight and Flush Probabilities from Turn (1 draw):

	SF	Flush	Straight
SF	0.6683	0.3317	0
SFO4	0.0224	0.1700	0.1336
SFI4	0.0204	0.1763	0.0640
F	0	1.0000	0
F4	0	0.1975	0
S	0	0.1928	0.8073
SO4	0	0	0
SI4	0	0	0



# Contribution of each team member

- Both team members contributed equally at this stage of the project.
- The code and strategy was developed after thorough discussions.
- The report was jointly written by both team members.