BLG435E
Assignment #3

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Part 1:

FOL

- All dogs are animal = $\forall x\ [\ dog(x) \rightarrow Animal(x)\ ]$
- Not All Robots carry a object = $\neg [\ \forall x\ (\ Robot(x)\ ) \rightarrow carry\ objec(x)\ ]$
- Every one who graduated from High school also graduated from Primary schall = $\forall x\ [\ grad(x, High School) \rightarrow grad(x, Prim Sch)\ ]$
- Some students did not take AI course = $\exists x\ \neg [takecourse(x, AI)]$
- There is only one table = $\exists w\ [\ Table(w) \wedge \forall x\ (x \neq w \rightarrow \neg Table(x$
- There is a teacher who only talks to other teacher that are teaching physs.

$\exists$

$\exists w\ \forall y\ [\ Teacher(w) \wedge Teach(y, Phys) \wedge (w \neq y \rightarrow Talks(w, y)\ ]$

Part 2

KNOWLEDGE - BASE

- Arda, Cihan and Gamze are students in the same Uni.

[StudentAt (Arda, x) ∧ StudentAt (Gamze, y) ∧ StudentAt (Cihan, z)] (→) (x = y = z)

- French, English, Russian, Turkish are languages.

Language (French) ∧ language (Russian) ∧ language (Turkish)

- Each student in the Uni speaks Turkish

StudentAt (x, y) → Speaks (x, Tur)

- Each student in the Uni speaks at least one of the foreign languages F, E, R.

StudentAt (x, y) → [Speaks (x, Eng) ∨ speaks (x, Fr) ∨ speaks (x, Rus)]

- Fish and hamburger belong to the food category.

Food (Fish) ∧ Food (Hamburger)

- Classic, jazz and Rock belong to music category.

Music (classic) ∧ Music (Jazz) ∧ Music (Rock)

- Students who speak French like jazz and dislike rock.

[Student (x, y) ∧ Speak (x, French)] → like (x, Jazz) ∧ ¬ like (x, rock)

- All student who speak Rus like rock.

[Student (x, y) ∧ speak (x, Rus)] → like (x, Rock)

- All students who like hamburger speak Eng.

[Student (x, y) ∧ like (x, hamburger)] → speak (x, Eng)

- Students who do not eat hamburger do not speak Eng.

[Student (x, y) ∧ ¬like (x, Hamburger)] → ¬ Speak (x, Eng)

Arda = likes (Ardo, jazz) ∧ likes (Arda , Fish) ∧ ¬ like (Arda, Classic)

∧ ¬ like (Ardo, rock) ∧ ¬ (Ardo, hamburger)

Note = ¬ Student At (x, y) ∨ ¬ Student At (x, y) = ¬ Student At (x, y)

! To perform These Operations we have to Transform Our Queries to CNF. In the slides Crimial (West) example It did not used 'ⱯX, ∃X' so I dropped them too..

1 • Student At (x, y) → (speaks (x, Eng) ∨ speaks (x, Fr) ∨ speak (x, Russ))

• ¬ StudenAt (x, y) ∨ speaks (x, Eng) ∨ speak (x, Fr) ∨ Speak (x, Russ)

• [Student At (x, y) ∧ speak (x, Fr)] → [like (x, jazz) ∧ ¬ like (x, Rock)]

• [like (x, jazz) ∨ ¬ Student (x, y) ∨ ¬ speak (x, Fr)] ∧

[¬ like (x, Rock ∨ ¬ student (x, y) ∨ ¬ speak (x, Fr)]

• [Student At (x, y) ∧ speak (x, Russ)] → like (x, Rock)

• ¬ student (x, y) ∨ ¬ Speak (x, Russ) ∨ like (x, Rock)

¬ studentAt (x, y) ∨ ~~speak (x, Fr)~~ ∨ speak (x, Eng) ∨ speak (x, Russ) | ¬ ~~speak (Ardo, Fr)~~

¬ student (x, y) ∨ speak (x, Eng) ∨ ~~speak (x, Russ)~~ | ¬ studentAt (x, y) ∨ ¬ ~~speak (x, Russ)~~ ∨ like (x, Rock)

Note 1 Note 1

¬ studentAt (x, y) ∨ speak (x, Eng) ∨ ~~like (x, Rock)~~ | ¬ ~~likes (Ardo, Rock)~~

¬ studentAt (x, y) ∨ ~~speak (x, Eng)~~ | ¬ student (x, y) ∨ likes (x, Hamburger) ∨ ¬ ~~speak (x, Eng)~~

¬ StudentAt (x, y) ∨ likes (x, hamburger | ¬ likes (Ardo, hamburger)

studentAt (x, y) | studentAt (Ardo, z)

with θ={ x/Ardo , y=z }

[ ]

Ardo speaks French.

Cihan = likes (Cihan, classic) ∧ likes (Cihan , rock) ∧ likes (cihan, fish)

¬ likes (chin , jazz) ∧ ¬ likes (Cihan, hamburger)

¬ studentAt(x, y) ∨ speaks (x, Eng) ∨ speaks (x, Fr) ∨ speaks (x, Russ) | ¬ speaks (cihan, Russ)

¬ studentAt (x, y) ∨ speaks (x, Fr) ∨ Speak (x , Eng) | ¬ student (x, y) ∨ likes (x, hamburger)

∨ ¬ Speak (x, Eng)

¬ Student At (x, y) ∨ speak (x, Fr) ∨ likes (x, Hamburger) I ¬ likes (Cihan , Hamburger)

with θ = { x = Cihan }

¬ Student At (x, y) ∨ Speak (x, Fr) I ¬ speak (x, Fr) ∨ ¬ Student (x, y)

∨ like (x, Jazz)

¬ Student At (x, y) ∨ like (x, jazz) I ¬ like (cihan, jazz)

with θ = { x = cihan }

¬ StudentAt (x, y) I StudentAt (Cihan , z)

with θ = { x = cihan ; z = y }

[ ] Cihan speaks Russian.

Gomze = likes (Gomze, Fish) ∧ likes (Gomze, hamburger)

∧ likes (Gomze, classic) ∧ ¬ likes (Gomze, jazz)

∧ ¬ likes (Gomze, rock)

¬StudentAt (x, y) ∨ speak (x, Eng) ∨ speak (x, Fr) ∨ speak (x, Russ) | ¬ speak (Gomze, Russ)

¬ StudentAt (x, y) ∨ Speak (x, Eng) ∨ speak (x, F) | likes (x, jazz) ∨ ¬ speak (x, Fr), ¬ Student (x, y)

¬ StudentAt (x, y) ∨ speak (x, Eng) ∨ likes (x, Jazz) | ¬ likes (Gomze, jazz)

with θ = { x = Gomze }

¬ Student At (x, y) ∨ Speak (x, Eng) | like (X, hamburger) ∨ ¬ speak (x, eng)

¬ Student At (x, y) ∨ like (x, hamburger) | ¬ like (x, hamburger) ∨ speak (x, eng)

¬ StudentAt (x, y) ∨ speak (x, eng) | StudentAt (Gomze, z)

with θ = { x = Gomze, y = z }

[speak (x, eng)]

Gomze can not speak Russian.

She can speak Eng.

Question 2

Optimal Player

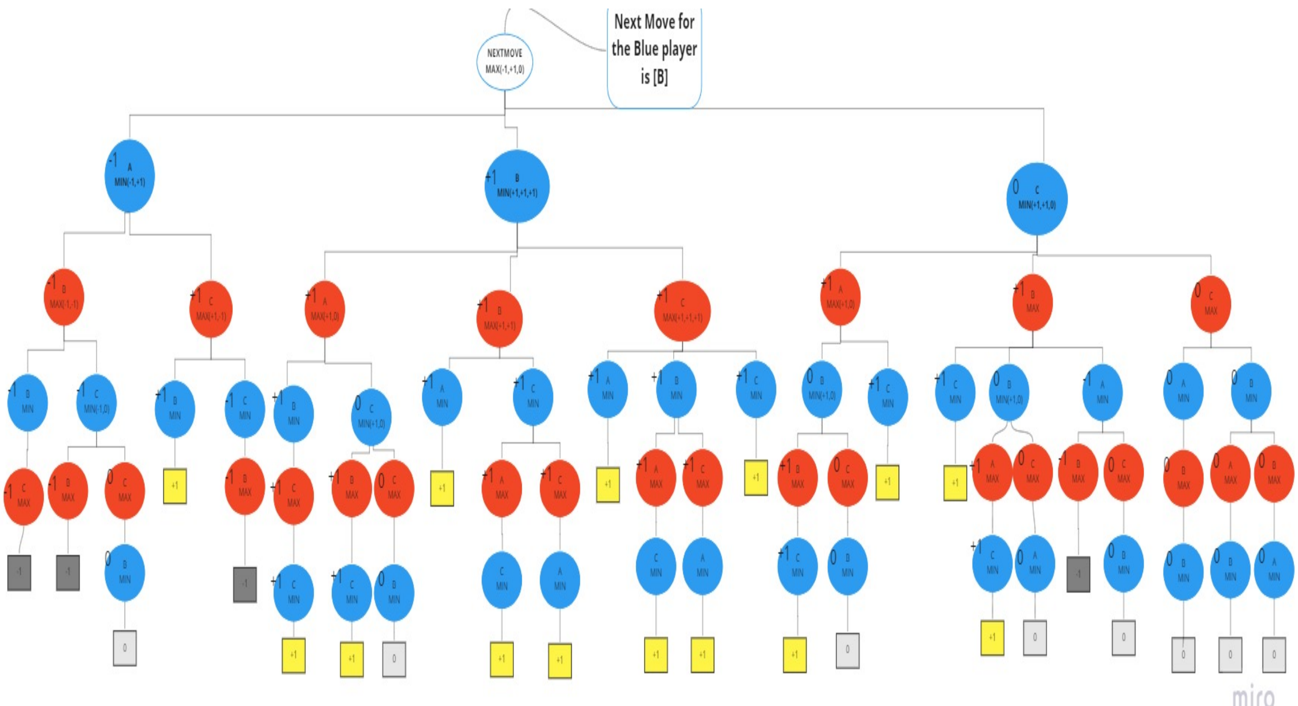

Figure 1: Minimax For the blue player

For the decision tree I write down every possible actions according to the optimal play.

Win	Lose	Tie
1	-1	-0

Choose A

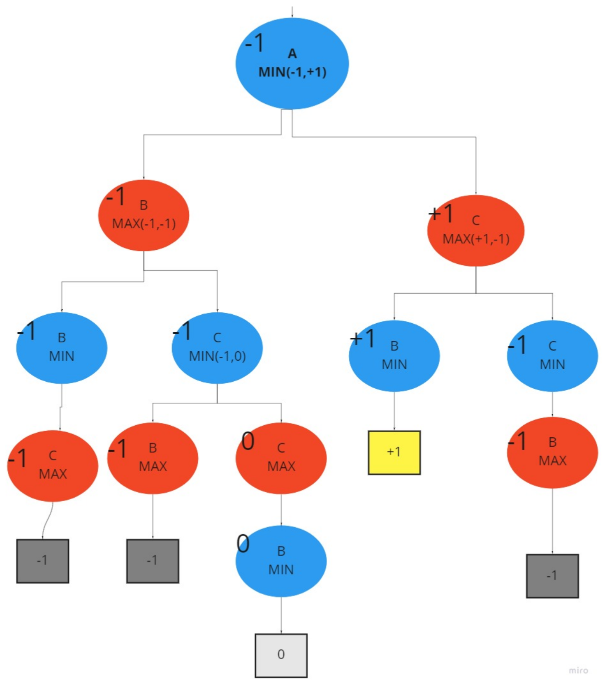

Figure 2: If choose A for the next action

If blue player chooses A for the first action then red player has 2 options B & C.It carries on like this, at every decision point it split into possible actions and inspects all of them. For this case lets inspect the outcomes. There is just one win case and because of the blue player the win action ca not be performed.So for the overall expected point is -1. Because In the root part it chooses min value and -1 is chosen.

Choose B

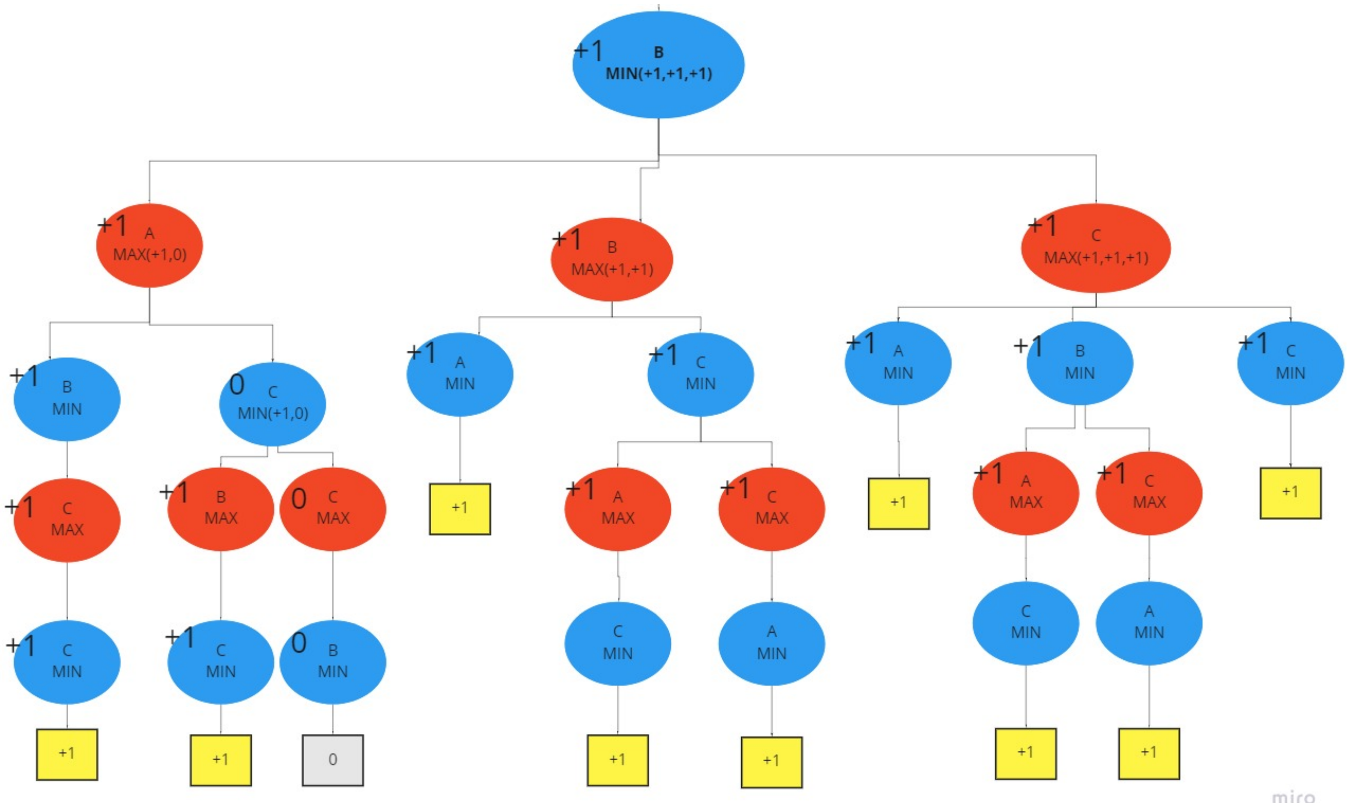

Figure 3: If choose B for the next action

AS we can see from the decision the win (yellow leaf) possibility is very high. For instance when we place the blue in the B then we can win with the 9/10 probability, or the game will be a tie with 1/10 probability. Blue player will not loose the game.

Choose C

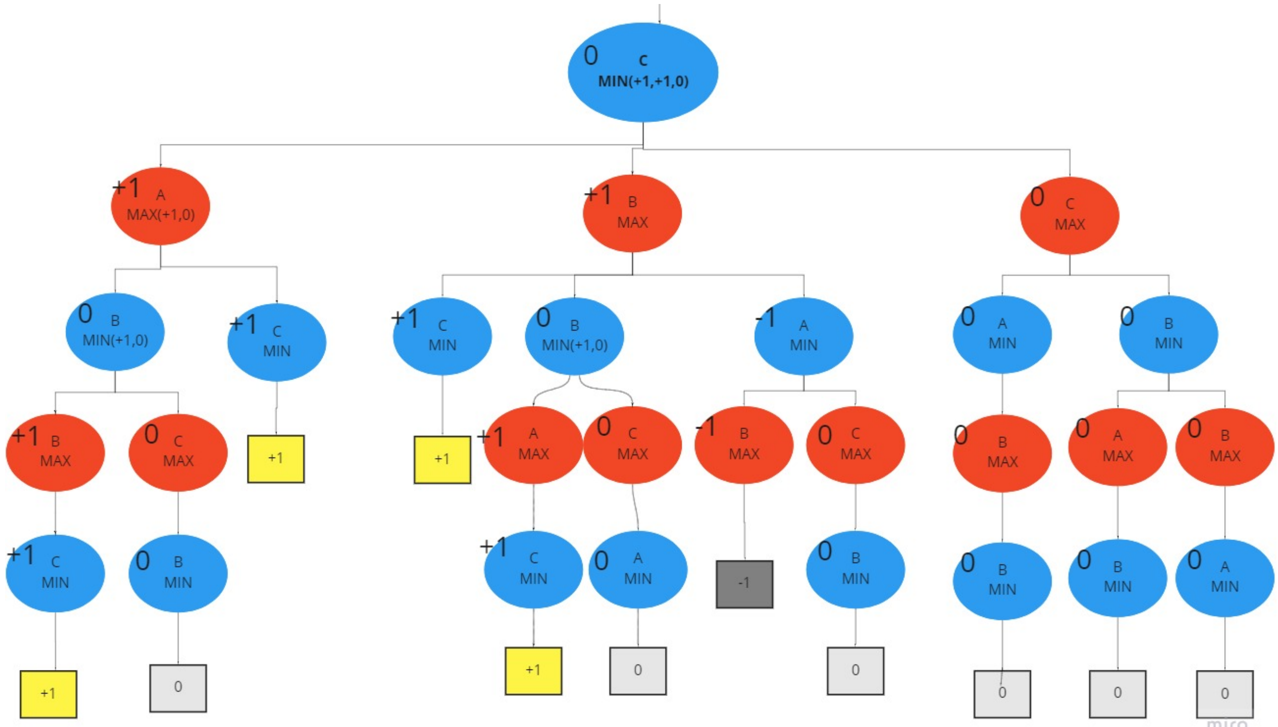

Figure 4: If choose C for the next action

For this case when we looked at the leaf values we can estimate that, with prob =4/11 blue can win,prob =1/11 blue can lose,prob =6/11 game will be a tie.Choosing C again will not be a wise for the BLUE player.

So we can conclude that Choosing B will be the decision of the BLUE AGENT, according to the algorithm

Random Player

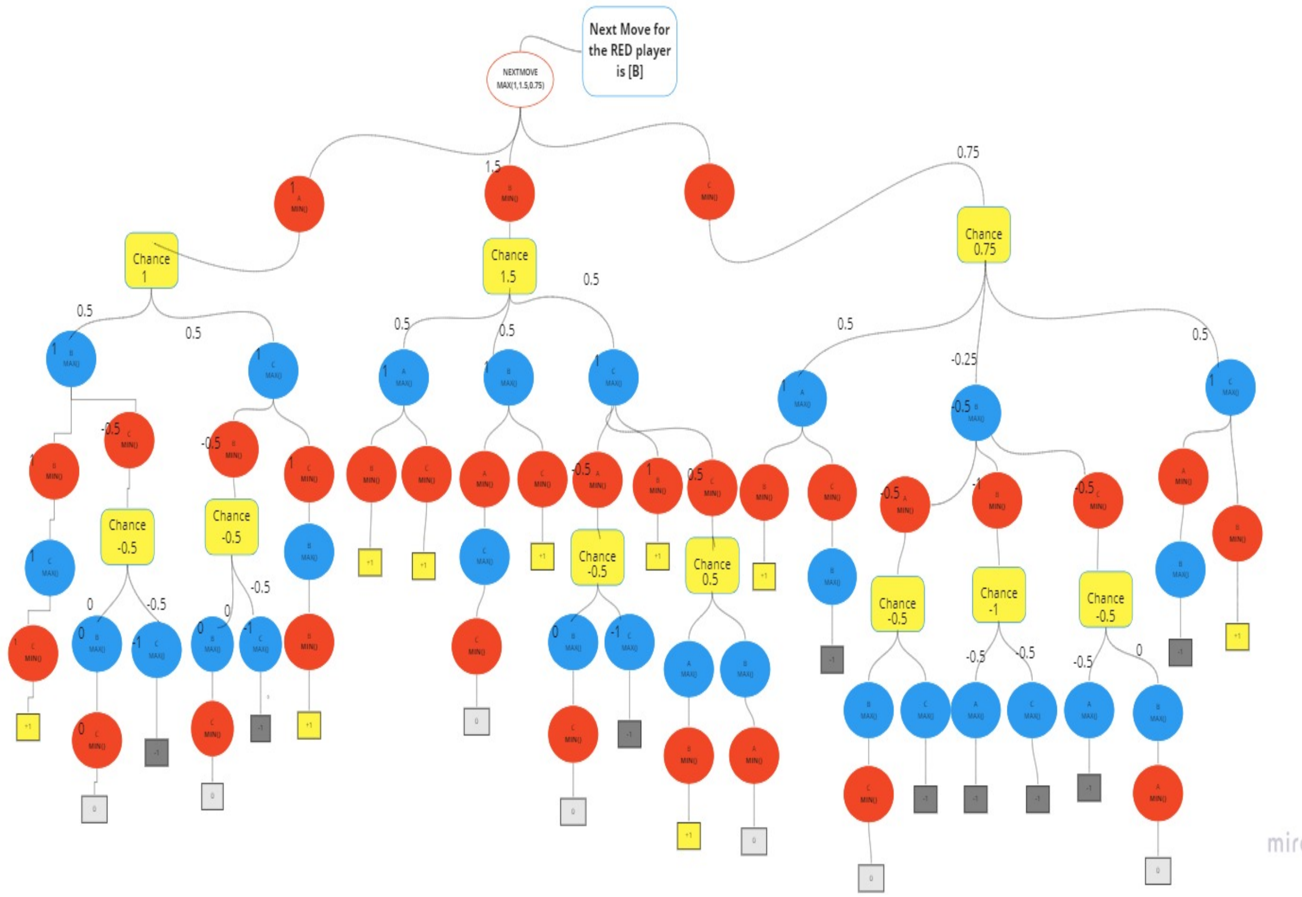

Figure 5: Minimax For the RED player

For this question I used the coin flipping chance.Also the opponent(min) will be playing in random mode so I added chance nodes for the **min player**. When we calculated the chance nodes the final values will be 1 for A ,1.5 for B, 0.75 for C.So the red agents next move will be B.

Choosing A

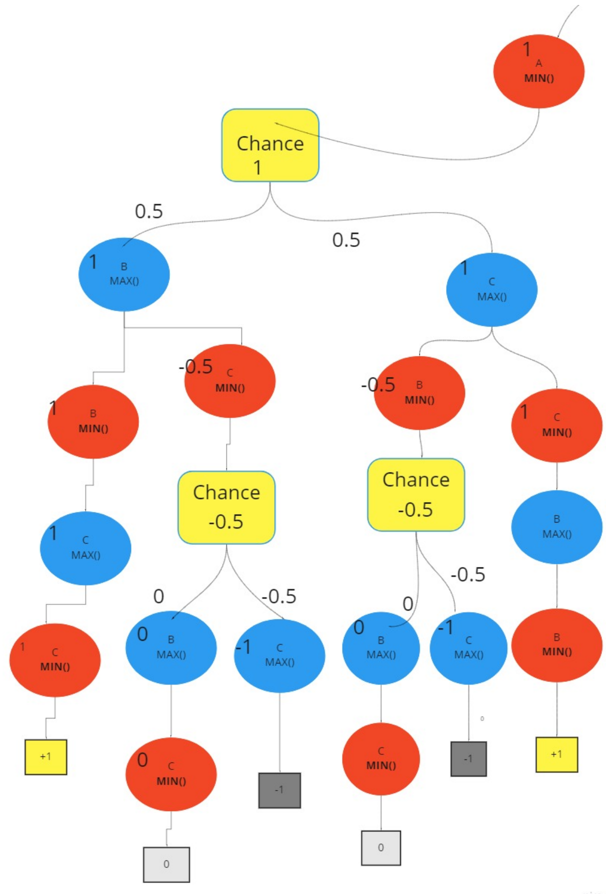

Figure 6: Choose A

When we inspect the leaf values we can sense that each values separated equally like 2 win 2 lose 2 tie.In here because min player chooses random actions,I calculated the expected values of the junction point. If the node value is 1 then the expected value is 0.5, if the other node's value is 0 then expected value is 0 so the total expected value for the min player is 0.5.Then max player can choose among them.

Choosing B

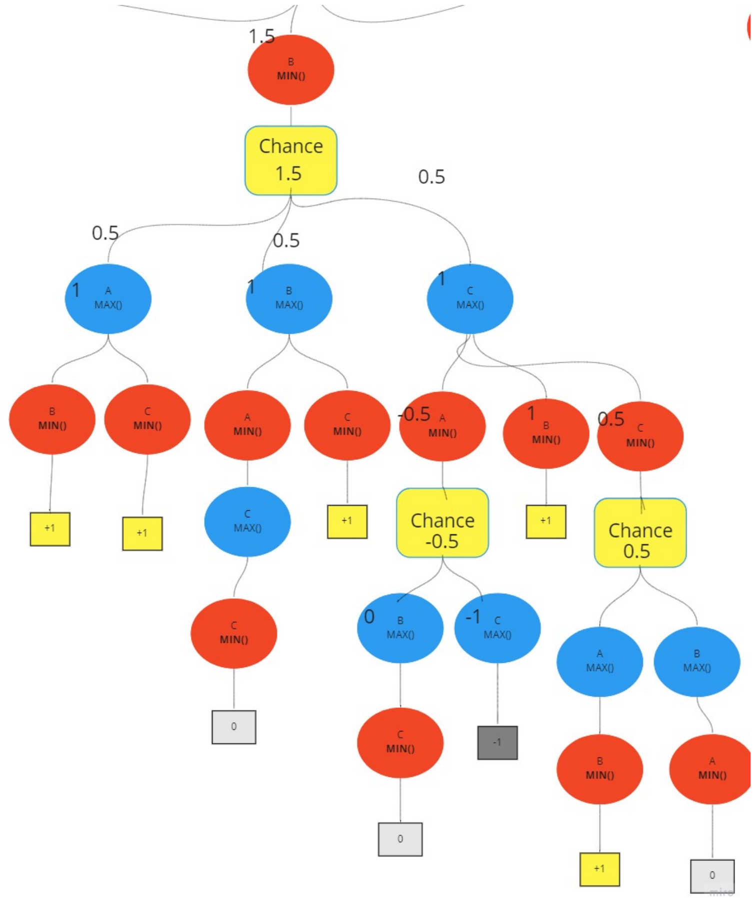

Figure 7: Choose B

As we can see from the figure 7 , win prob=5/9, lose prob=1/9 and tie=3/9.If we choose B most probably the red player will win.

Choosing C

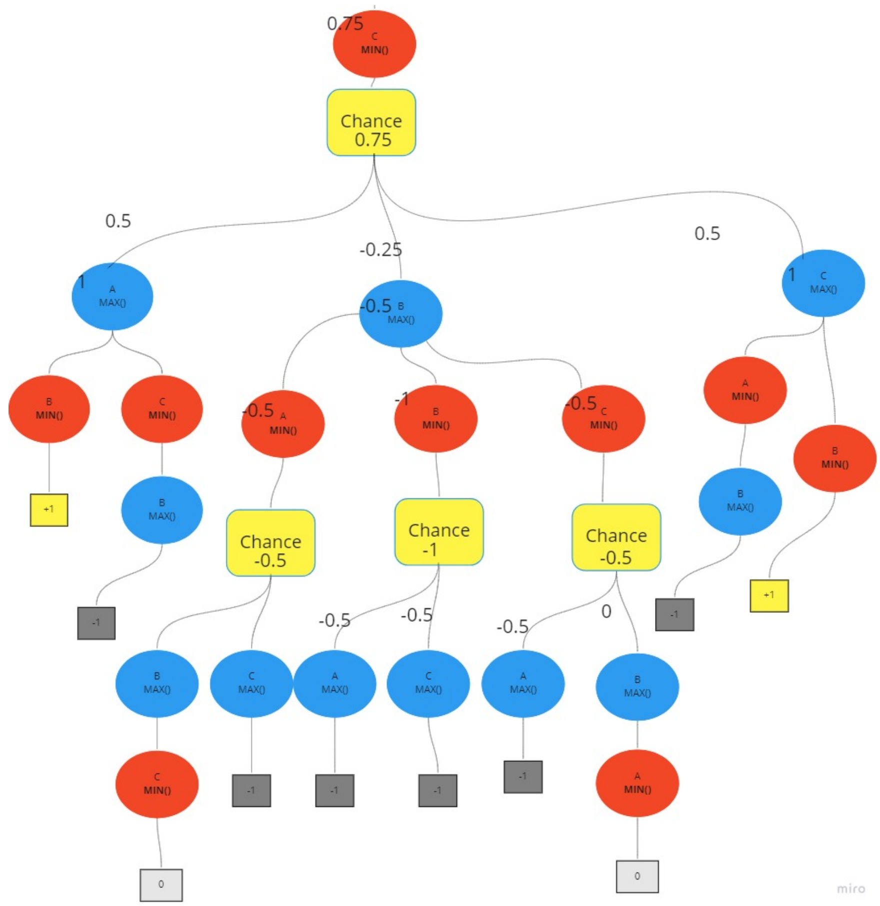

Figure 8: Choose C

As we can see from the figure 8 , win prob=2/10, lose prob=6/10 and tie=2/10.If we choose C most probably the red player will end up Losing, it is not a wise decision.
So if the blue player(min) plays randomly then, the next move of the RED player will be B.