

Test	Semester 2
Subject: Foundations of Artificial Intelligence	Classe : GLSI 2 EN
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<u>Unauthorized documents</u>	Duration: 1h30

Questions (6 marks)

1. What answers do you get for below queries for given program in Prolog.

Program :

```

vegetarian(jose).
vegetarian(james).
vegetable(carrot).
vegetable(egg_plant).
likes(jose, X) :- vegetable(X).
loves(Who, egg_plant) :- vegetarian(Who).

```

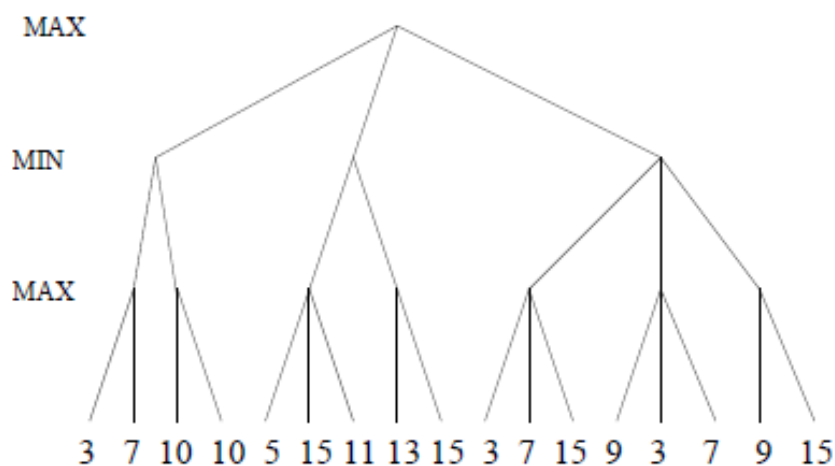
Queries :

```

?- vegetable(X).
?- vegetable(potato).
?- vegetarian(_).
?- likes(jose, What).
?- likes(Who, egg_plant).
?- loves(Who, egg_plant).

```

2. We consider the diagram below :



- Apply the Min-Max algorithm to this game . What is the first player's best move?
- Apply the $\alpha - \beta$ algorithm to this game.

Exercise 1 (8 marks)

Let the CSP be composed of 3 variables X, Y and Z of domains: $D_x = \{3,4\}$, $D_y = \{4,5,6,7,8\}$ et $D_z = \{5,6,7,8,9\}$ and the following constraints: $2X=Y$, $Y \leq Z$ et $X+2 < Z$

1. a. Calculate the satisfiability rate S_{ij} of each constraint C_{ij}

b. Give the orderings of variables associated with the following heuristics:

H1: the variable with the smallest domain first

H2: the variable on which the least satisfiable constraint relates first

2. We choose to instantiate the variables in the order X,Y,Z with the values taken in ascending order. Apply the backtrack. Give the number of nodes and leaves that will be explored to find all the solutions.
3. Apply forward-checking. Indicate the domain of values of each variable at the end of forward-checking. Give the number of nodes and leaves that will be explored to find all the solutions.
4. Apply the arc consistency then the backtrack. Give the number of nodes and leaves that will be explored to find all the solutions

Exercise 2 (6 marks)

Soit le principe du jeu othello décrit ci-dessous :

Othello is a two-player strategy game: Black and White. They play on a one-color board of 64 squares, 8x8, called othellier. These players have 64 two-color pawns, black on one side and white on the other. For convenience, each player has 32 pawns in front of him. A pawn is black if its black face is visible and white if its white face is on top.

Goal of the game: To have more pawns of its color than the opponent at the end of the game.

This ends when neither player can make a legal move. This usually occurs when all 64 squares are occupied.

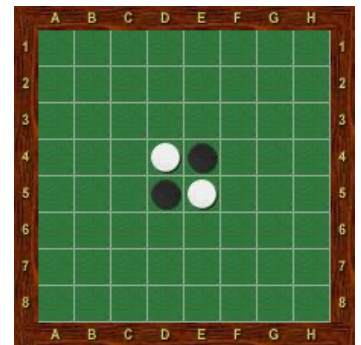


fig.1: Starting position

Starting position

At the start of the game, two black pawns are placed on e4 and d5 and two white pawns are placed on d4 and e5 (see figure 1). Black always starts and the two opponents then take turns.

The pose of a pawn

On his turn, the player must place a pawn of his color on an empty square of the othellier, adjacent to an opposing pawn. He must also, when placing his pawn, surround one or more opposing pawns between the pawn that he is placing and a pawn in his color, already placed on the othellier. He then flips over the pawn(s) he has just framed with his color. The pawns are neither removed from the othellier nor moved from one space to another.

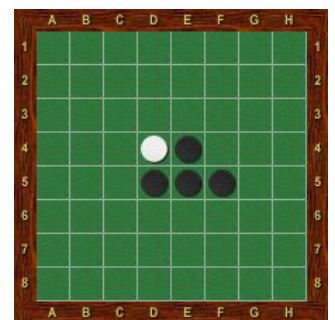


fig.2: First move

Black's first move is, for example, on f5. By playing f5, he frames the white pawn e5 between the pawn that he is placing and a black pawn already present (here d5); he then turns over this pawn (see figure 2). Black could also have played on e6, c4 or d3. Note that these four Black moves are perfectly symmetrical; Black therefore does not have to think about choosing his first move.

It is now up to White to play. He has three possible moves. Indeed, it is mandatory to turn over at least one opposing pawn with each move. White can therefore play f4, f6 or d6.

Questions :

We want to establish the state tree corresponding to a situation, we then use a grid evaluating the value of a box, adapted to the game (equivalent to a heuristic).

500	-150	30	10	10	30	-150	500
-150	-250	0	0	0	0	-250	-150
30	0	1	2	2	1	0	30
10	0	2	16	16	2	0	10
10	0	2	16	16	2	0	10
30	0	1	2	2	1	0	30
-150	-250	0	0	0	0	-250	-150
500	-150	30	10	10	30	-150	500

1. Give the state tree to a depth of 2 (one move: black and white play once each) corresponding to situation A (see figure 3: situation A).

2. Apply the Min-Max algorithm to decide which move Black should play.

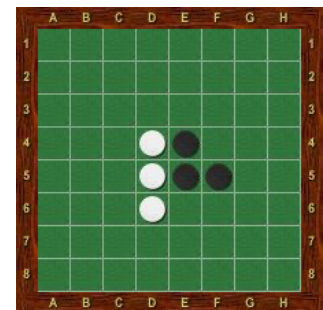


fig.3: situation A