Q1: Gaming with Min-Max Algorithm

The question refers to a two-player crossword puzzle game in which participants insert words into a grid one at a time. The main elements of the query are as follows:

1.Grid and Words:

- There is a 12x9 grid (a grid with 12 rows and 9 columns) initially filled with '#' characters.
- A list of words is provided, including words like "RABBIT," "CAT," "DOG," "ELEPHANT," and "MONKEY."

2. Game Rules:

- Words are selected from the list and entered the grid by each player in turn.
- The number of characters in each word determines its point value (for example, "CAT" is worth 3 points).
- A player loses 1 point if they put a word wrongly, such as in the wrong spot.
- Once every word has been appropriately positioned in the grid, the game is over.

3. Objective:

The goal is to arrange the words in the grid in such a way that they connect and make a full crossword puzzle. The players try to make as few errors as possible while maximizing their points.

4. Code Requirements:

- The code should be written in Python.
- The logic of the game, such as word placement, scoring, and alternating player turns, should be implemented.
- It should print the final grid state and both players' scores after 10 iterations (rounds).

How we play:

- Player 1 and Player 2(AI bot) are the two participants.
- Each participant has a list of words they can use to fill the grid.
- First-turn players select a word from their list and insert it into the grid.
- The other player then confirms that the word was positioned properly. The player receives the points for the word if it is. Otherwise, the player loses one point, and the word is eliminated from the grid.
- Once all the words have been properly positioned, the game resumes.
- At the conclusion of the game, the player with the most points win.

Here are the two best solutions after 10 iterations (example):

Solution 1:

* Rabbit (5D)

* Cat (6A)

* Dog (7B)

* Elephant (8E)

* Monkey (9F)

Player 1: 14 points

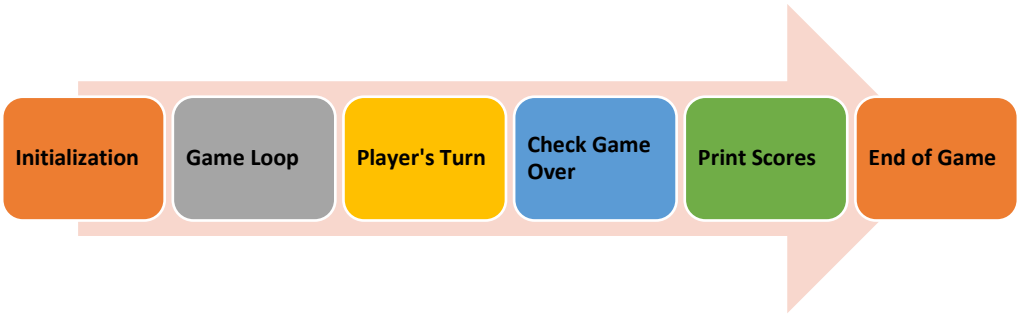
Player 2: 10 points

Solution 2:

* Cat (5D)
* Rabbit (6A)
* Dog (7B)
* Elephant (8A)
* Monkey (9A)

Player 1: 13 points

Player 2: 11 points



Screenshots of Gameplay:

- Main screen showcasing words list that can put into Crossword Puzzle grid and First turn of Player 1 (Human):

```
Crossword Puzzle Grid for game:

# # # # R # # # #
# # # # A # # # #
# # # # B # # # #
# # # # B # # # #
H # # # I # # # #
O # C A T # # # #
R # A # # # D O G
S # M # # # O # #
E L E P H A N T #
# # L # # # K # #
# # # # # # E # #
# M O N K E Y # #

Player1 : Human,
Player2 : AI Bot

Current score:
{'Player 1': 0, 'Player 2': 0}

Current Playing Player 1

 Choose a word from the list to place in puzzle ['RABBIT', 'CAT', 'DOG', 'ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']

Enter a word:
```

- AI Bot Turn, it chose words using min-max algo with help of alpha-beta pruning:

```
Crossword Puzzle Grid for game:

# # # # R # # # #
# # # # A # # # #
# # # # B # # # #
# # # # B # # # #
H # # # I # # # #
O # C A T # # # #
R # A # # # D O G
S # M # # # O # #
E L E P H A N T #
# # L # # # K # #
# # # # # # E # #
# M O N K E Y # #

Player1 : Human,
Player2 : AI Bot

Current score:
{'Player 1': 0, 'Player 2': 0}

Current Playing Player 1

 Choose a word from the list to place in puzzle ['RABBIT', 'CAT', 'DOG', 'ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']

Enter a word: Cat
Enter a position (e.g., 5D): 6a
Player Player 1 placed 'CAT' and earned 3 points.

Current score:
{'Player 1': 3, 'Player 2': 0}

Current Playing Player 2

 Choose a word from the list to place in puzzle ['RABBIT', 'DOG', 'ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']
Player Player 2 placed 'RABBIT' and earned 6 points.
AI placed RABBIT at 5D

Current score:
{'Player 1': 3, 'Player 2': 6}

Current Playing Player 1

 Choose a word from the list to place in puzzle ['DOG', 'ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']

Enter a word:
```

- Ongoing word puzzle between Player1 and Player2(AI Bot)

```
 Choose a word from the list to place in puzzle ['RABBIT', 'CAT', 'DOG', 'ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']

Enter a word: Cat
Enter a position (e.g., 5D): 6a
Player Player 1 placed 'CAT' and earned 3 points.

Current score:
{'Player 1': 3, 'Player 2': 0}

Current Playing Player 2

 Choose a word from the list to place in puzzle ['RABBIT', 'DOG', 'ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']
Player Player 2 placed 'RABBIT' and earned 6 points.
AI placed RABBIT at 5D

Current score:
{'Player 1': 3, 'Player 2': 6}

Current Playing Player 1

 Choose a word from the list to place in puzzle ['DOG', 'ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']

Enter a word: Dog
Enter a position (e.g., 5D): 5d
Wrong placement! One point deducted from Player 1.

Current score:
{'Player 1': 2, 'Player 2': 6}

Current Playing Player 2

 Choose a word from the list to place in puzzle ['DOG', 'ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']
Player Player 2 placed 'DOG' and earned 3 points.
AI placed DOG at 7A

Current score:
{'Player 1': 2, 'Player 2': 9}

Current Playing Player 1

 Choose a word from the list to place in puzzle ['ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']

Enter a word:
```

- Result of Crossword Puzzle game

```
{'Player 1': 7, 'Player 2': 17}

Current Playing Player 1

 Choose a word from the list to place in puzzle ['MONKEY', 'DONKEY', 'CAMEL']

Enter a word: CAmel
Enter a position (e.g., 5D): 6d
Player Player 1 placed 'CAMEL' and earned 5 points.

Current score:
{'Player 1': 12, 'Player 2': 17}

Current Playing Player 2

 Choose a word from the list to place in puzzle ['MONKEY', 'DONKEY']
Player Player 2 placed 'MONKEY' and earned 6 points.
AI placed MONKEY at 12A

Current score:
{'Player 1': 12, 'Player 2': 23}

Current Playing Player 1

 Choose a word from the list to place in puzzle ['DONKEY']

Enter a word: Donkey
Enter a position (e.g., 5D): 7d
Player Player 1 placed 'DONKEY' and earned 6 points.

Current score:
{'Player 1': 18, 'Player 2': 23}

Final score:
{'Player 1': 18, 'Player 2': 23}
```

Screenshot with alpha beta:

- Main screen showcasing words list that can put into Crossword Puzzle grid and First turn of Player 1 (Human):

```
Crossword Puzzle Grid for game:

# # # # R # # # #
# # # # A # # # #
# # # # B # # # #
# # # # B # # # #
H # # # I # # # #
O # C A T # # # #
R # A # # # D O G
S # M # # # O # #
E L E P H A N T #
# # L # # # K # #
# # # # # # E # #
# M O N K E Y # #

Player1 : Human,
Player2 : AI Bot

Current score:
{'Player 1': 0, 'Player 2': 0}

Current Playing Player 1

 Choose a word from the list to place in puzzle ['RABBIT', 'CAT', 'DOG', 'ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']

Enter a word: cat
Enter a position (e.g., 5D): 6a
Player Player 1 placed 'CAT' and earned 3 points.

Current score:
{'Player 1': 3, 'Player 2': 0}

Current Playing Player 2

 Choose a word from the list to place in puzzle ['RABBIT', 'DOG', 'ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']
alpha---------->>> 3
alpha---------->>> 3
alpha---------->>> 3
alpha---------->>> 3
alpha---------->>> 3
alpha---------->>> 3
alpha---------->>> 3
beta---------->>> 3
alpha---------->>> 3
beta---------->>> 3
```

- AI Bot Turn, it chose words using min-max algo with help of alpha-beta pruning:

```
beta---------->>> 3
alpha---------->>> 3
Player Player 2 placed 'RABBIT' and earned 6 points.
AI placed RABBIT at 5D

Current score:
{'Player 1': 3, 'Player 2': 6}

Current Playing Player 1

 Choose a word from the list to place in puzzle ['DOG', 'ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']

Enter a word: dog
Enter a position (e.g., 5D): 7a
Player Player 1 placed 'DOG' and earned 3 points.

Current score:
{'Player 1': 6, 'Player 2': 6}

Current Playing Player 2

 Choose a word from the list to place in puzzle ['ELEPHANT', 'MONKEY', 'DONKEY', 'HORSE', 'CAMEL']
alpha---------->>> 0
alpha---------->>> 0
alpha---------->>> 0
alpha---------->>> 0
alpha---------->>> 0
beta---------->>> 0
alpha---------->>> 0
beta---------->>> 0
alpha---------->>> 0
beta---------->>> 0
alpha---------->>> 0
beta---------->>> 0
alpha---------->>> 0
```

- Ongoing word puzzle between Player1 and Player2(AI Bot)

```
beta---------->>> 1
alpha---------->>> 1
alpha---------->>> 1
alpha---------->>> 1
alpha---------->>> 1
beta---------->>> 1
alpha---------->>> 1
beta---------->>> 1
alpha---------->>> 1
beta---------->>> 1
alpha---------->>> 1
alpha---------->>> 1
alpha---------->>> 1
alpha---------->>> 1
beta---------->>> 1
alpha---------->>> 1
alpha---------->>> 1
alpha---------->>> 1
alpha---------->>> 1
beta---------->>> 1
alpha---------->>> 1
Player Player 2 placed 'ELEPHANT' and earned 8 points.
AI placed ELEPHANT at 9A

Current score:
{'Player 1': 12, 'Player 2': 19}

Current Playing Player 1

 Choose a word from the list to place in puzzle ['DONKEY', 'CAMEL']

Enter a word:
```

- Result of Crossword Puzzle game

```
alpha---------->>> 1
alpha---------->>> 1
alpha---------->>> 1
beta---------->>> 1
alpha---------->>> 1
Player Player 2 placed 'ELEPHANT' and earned 8 points.
AI placed ELEPHANT at 9A

Current score:
{'Player 1': 12, 'Player 2': 19}

Current Playing Player 1

 Choose a word from the list to place in puzzle ['DONKEY', 'CAMEL']

Enter a word: Donkey
Enter a position (e.g., 5D): 7d
Player Player 1 placed 'DONKEY' and earned 6 points.

Current score:
{'Player 1': 18, 'Player 2': 19}

Current Playing Player 2

 Choose a word from the list to place in puzzle ['CAMEL']
alpha---------->>> -1
beta---------->>> -1
alpha---------->>> -1
Player Player 2 placed 'CAMEL' and earned 5 points.
AI placed CAMEL at 6D

Current score:
{'Player 1': 18, 'Player 2': 24}

Current score:
{'Player 1': 18, 'Player 2': 24}

Final score:
{'Player 1': 18, 'Player 2': 24}
```

Q2: Logic Pragyan Rover

Data from 10 sensors is used by the Chandrayan 3 Pragyan Rover to make decisions on which of the specific parameters from the moon (c0 or c1) to measure. To determine the parameter to measure for the given condition, use the decision tree below to generate Prolog rules. Obtain the attribute values from the user using appropriate user prompts, then decide on the parameter.

Below is the Prolog rules that are been created.

1. Start
2. Create a set of guidelines for class prediction (c0 or c1) based on the values of the attributes a5, a8, a9, a2, a0, a4, and a1.
3. Using the combination of attribute values specify a set of rules in Prolog. Each rule has a predict class value and condition of the attribute.
4. Once a rule with a given condition is satisfied Prolog stops searching for other matching rules which is denoted by ! operator.
5. A **predicate_class**(C) takes inputs from user (**A5**, **A8**, **A9**, **A2**, **A0**, **A4**, **A1**) which is been called based on the attribute values
6. End

Here is the complete set of Prolog rules for the Pragyan Rover to predict which parameter to measure for a given condition:

```
% Define the decision tree rules
predict_class(C, a5, a8, a9, a2, a0, a4, a1) :-
    a5 = false, C = c0, !.
predict_class(C, a5, a8, a9, a2, a0, a4, a1) :-
    a5 = true, a8 = false, a9 = false, a2 = false, C = c0, !.
predict_class(C, a5, a8, a9, a2, a0, a4, a1) :-
    a5 = true, a8 = false, a9 = false, a2 = true, a0 = false, C = c1, !.
predict_class(C, a5, a8, a9, a2, a0, a4, a1) :-
    a5 = true, a8 = false, a9 = false, a2 = true, a0 = true, C = c0, !.
predict_class(C, a5, a8, a9, a2, a0, a4, a1) :-
    a5 = true, a8 = false, a9 = true, C = c1, !.
predict_class(C, a5, a8, a9, a2, a0, a4, a1) :-
    a5 = true, a8 = true, a1 = false, a2 = false, a0 = false, C = c1, !.
predict_class(C, a5, a8, a9, a2, a0, a4, a1) :-
    a5 = true, a8 = true, a1 = false, a2 = false, a0 = true, C = c0, !.
predict_class(C, a5, a8, a9, a2, a0, a4, a1) :-
    a5 = true, a8 = true, a1 = false, a2 = true, a4 = false, C = c1, !.
predict_class(C, a5, a8, a9, a2, a0, a4, a1) :-
    a5 = true, a8 = true, a1 = false, a2 = true, a4 = true, C = c0, !.
predict_class(C, a5, a8, a9, a2, a0, a4, a1) :-
    a5 = true, a8 = true, a1 = true, C = c0, !.

% Define the class predictions
predict_class(C) :-
    write('Is a5 (true or false)? '), read(A5),
    write('Is a8 (true or false)? '), read(A8),
    write('Is a9 (true or false)? '), read(A9),
    write('Is a2 (true or false)? '), read(A2),
    write('Is a0 (true or false)? '), read(A0),
    write('Is a4 (true or false)? '), read(A4),
    write('Is a1 (true or false)? '), read(A1),
    predict_class(C, A5, A8, A9, A2, A0, A4, A1).

% Example usage:
% To predict the class, call predict_class(C) and provide input for attributes.
% For example, predict_class(Class).
```

OUTPUTS

Below are the two screenshots from output from the above

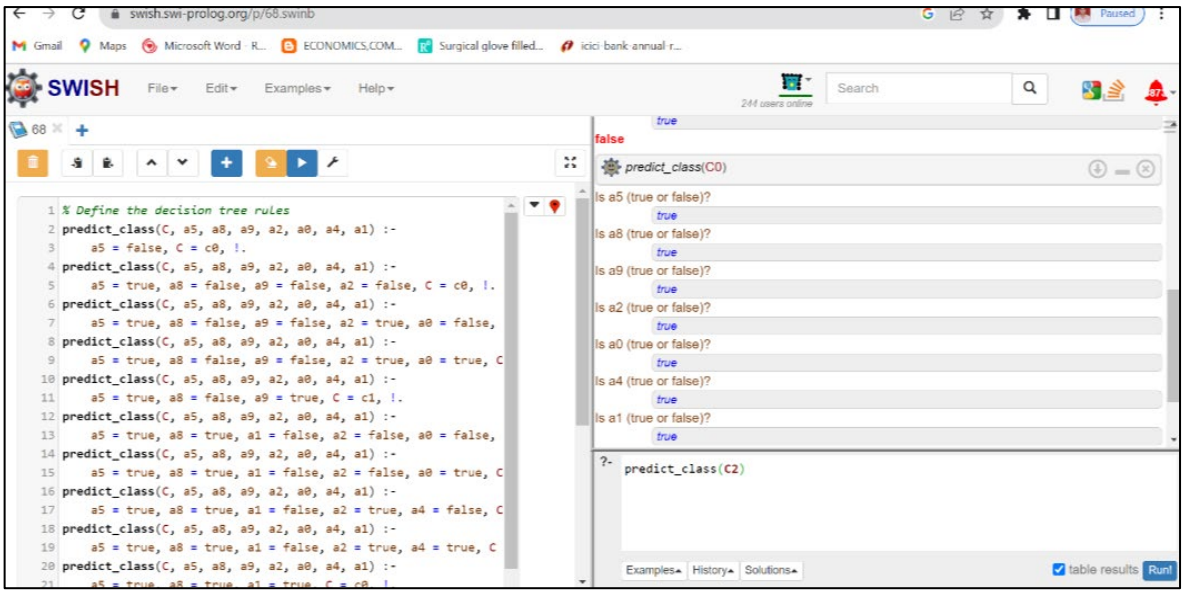


Fig1

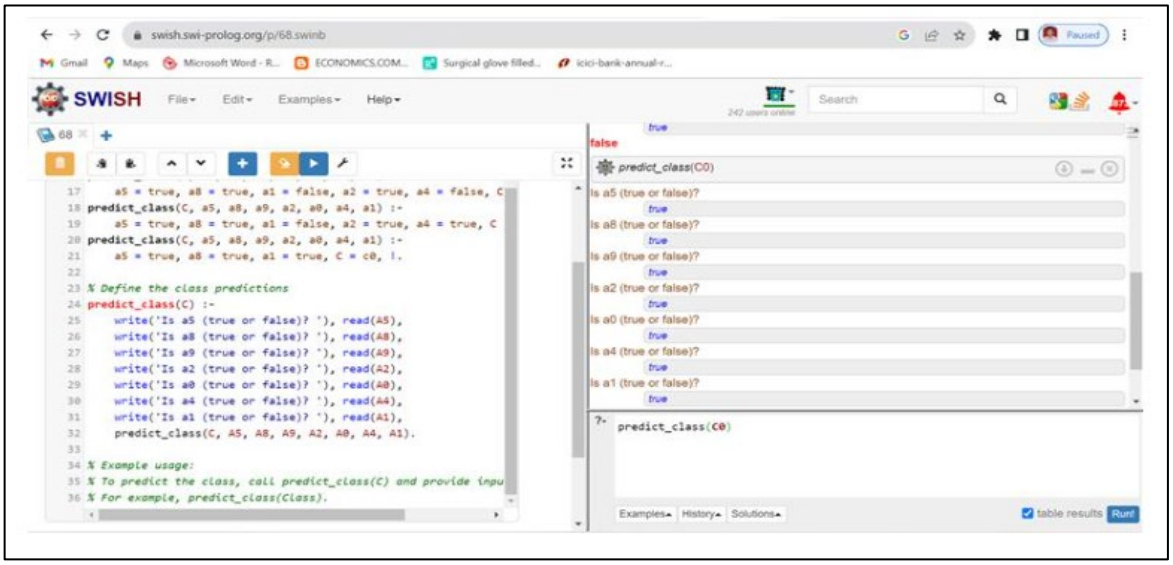


Fig2

This Prolog code defines decision tree rules for predicting a class (**`c0`** or **`c1`**) based on the values of seven binary attributes (**`a5`**, **`a8`**, **`a9`**, **`a2`**, **`a0`**, **`a4`**, **`a1`**). The rules are defined as a series of **`predict_class`** clauses, each corresponding to a specific combination of attribute values. The code uses backtracking to find the first matching rule and returns the predicted class.

- The first clause predicts **`c0`** when **`a5`** is false.
- The subsequent clauses handle various combinations of attribute values to predict either **`c0`** or **`c1`**.

The **`predict_class(C)`** predicate is provided to interact with the user. It asks the user for input values for the seven attributes and then invokes the appropriate **`predict_class`** clause to determine the class.