AI LAB OUTPUTS

Rahul Sah(1BM17CS139)

1. Tic Tac Toe

```
BOARD:
 1  |  2  |  3
----+-----+-----
 4  |  5  |  6
----+-----+-----
 7  |  8  |  9

Human goes first

GAME BEGIN:
Human's turn
Human enter option:4

GAME BOARD:

    |     |
----+-----+-----
 O  |     |
----+-----+-----
    |     |

Computer's turn

GAME BOARD:

    |     |
----+-----+-----
 O  |     |
----+-----+-----
 X  |     |

Human's turn
Human enter option:3
```

```
WELCOME TO A.I. TIC TAC TOE

GAME BOARD:

    |     |  O
----+-----+-----
 O  |     |
----+-----+-----
 X  |     |

Computer's turn

GAME BOARD:

    |     |  O
----+-----+-----
 O  |     |
----+-----+-----
 X  |     |  X

Human's turn
Human enter option:1

GAME BOARD:

 O  |     |  O
----+-----+-----
 O  |     |
----+-----+-----
 X  |     |  X

Computer's turn
```

```
GAME BOARD:

 O  |     |  O
----+-----+-----
 O  |  X  |
----+-----+-----
 X  |     |  X

Human's turn
Human enter option:2
Human won
 O  |  O  |  O
----+-----+-----
 O  |  X  |
----+-----+-----
 X  |     |  X

GAME OVER
```

2. **Vacuum Cleaner**

```
{'A': 1, 'B': 0}
Vacuum cleaner randomly placed at Location B.
Moving to Location A...
Location A is Dirty.
Location A has been Cleaned.
{'A': 0, 'B': 0}
Performance Measurement: 0
```

```
{'A': 1, 'B': 1}
Vacuum cleaner randomly placed at Location B.
Location B is Dirty.
Location B has been Cleaned.
Moving to Location A...
Location A is Dirty.
Location A has been Cleaned.
{'A': 0, 'B': 0}
Performance Measurement: 1
```

3. **8-Puzzle**

```
Please enter number from 0-8, no number should be repeated or be out of this range
Enter the 1 number: 0
Enter the 2 number: 1
Enter the 3 number: 2
Enter the 4 number: 3
Enter the 5 number: 4
Enter the 6 number: 5
Enter the 7 number: 6
Enter the 8 number: 7
Enter the 9 number: 8
The puzzle is solvable, generating path
Exploring Nodes
Goal reached
printing final solution
Move : None
Result :
[[0. 1. 2.]
 [3. 4. 5.]
 [6. 7. 8.]]    node number:0
```

```
Please enter number from 0-8, no number should be repeated or be out of this range
Enter the 1 number: 8
Enter the 2 number: 6
Enter the 3 number: 4
Enter the 4 number: 1
Enter the 5 number: 3
Enter the 6 number: 0
Enter the 7 number: 7
Enter the 8 number: 5
Enter the 9 number: 2
The puzzle is insolvable, still creating nodes
```

4. **A-Star**

```
                R               R               R
[5, 2, 6]       [5, 2, 6]       [1, 5, 2]       [1, 2, 0]
[7, 0, 8]       [1, 4, 8]       [4, 0, 6]       [4, 5, 3]
[4, 1, 3]       [7, 3, 0]       [7, 3, 8]       [7, 8, 6]

D               U               D               D
[5, 2, 6]       [5, 2, 6]       [1, 5, 2]       [1, 2, 3]
[7, 1, 8]       [1, 4, 0]       [4, 3, 6]       [4, 5, 0]
[4, 0, 3]       [7, 3, 8]       [7, 0, 8]       [7, 8, 6]

L               U               R               D
[5, 2, 6]       [5, 2, 0]       [1, 5, 2]       [1, 2, 3]
[7, 1, 8]       [1, 4, 6]       [4, 3, 6]       [4, 5, 6]
[0, 4, 3]       [7, 3, 8]       [7, 8, 0]       [7, 8, 0]

U               L               U
[5, 2, 6]       [5, 0, 2]       [1, 5, 2]
[0, 1, 8]       [1, 4, 6]       [4, 3, 0]
[7, 4, 3]       [7, 3, 8]       [7, 8, 6]

R               L               L
[5, 2, 6]       [0, 5, 2]       [1, 5, 2]
[1, 0, 8]       [1, 4, 6]       [4, 0, 3]
[7, 4, 3]       [7, 3, 8]       [7, 8, 6]

D               D               U
[5, 2, 6]       [1, 5, 2]       [1, 0, 2]
[1, 4, 8]       [0, 4, 6]       [4, 5, 3]
[7, 0, 3]       [7, 3, 8]       [7, 8, 6]
```

5. 8-Puzzle (Iterative)

```
Enter the puzzle :
Enter the 1 number: 0
Enter the 2 number: 1
Enter the 3 number: 2
Enter the 4 number: 3
Enter the 5 number: 4
Enter the 6 number: 5
Enter the 7 number: 6
Enter the 8 number: 7
Enter the 9 number: 8
The puzzle is solvable, generating path
Exploring Nodes
[[0.0, 1.0, 2.0], [3.0, 4.0, 5.0], [6.0, 7.0, 8.0]]
printing final solution
Move : None
Result :
[[0. 1. 2.]
 [3. 4. 5.]
 [6. 7. 8.]]    node number:0
```

```
Enter the puzzle :
Enter the 1 number: 0
Enter the 2 number: 8
Enter the 3 number: 5
Enter the 4 number: 2
Enter the 5 number: 6
Enter the 6 number: 4
Enter the 7 number: 1
Enter the 8 number: 3
Enter the 9 number: 7
The puzzle is insolvable, still creating nodes
Exploring Nodes
Goal State could not be reached
```

6. **Knowledge base using Prepositional Logic (Entailment)**

```
Enter rule  :pvq
Enter the Query : p
**********Truth Table Reference**********
kb alpha
**********
True True
----------
False False
----------
True False
----------
The Knowlege Base does not entail query
```

```
Enter rule  :p^q
Enter the Query : p
**********Truth Table Reference**********
kb alpha
**********
True True
----------
False False
----------
False False
----------
False True
----------
The Knowlege Base entails query
```

7. Conjunctive Normal Form (CNF)

```
AND : & ; OR: | ; NOT: ~ ; IMPLIES : ==> ; EQUIVALENCE : <=>
Enter the propositional logic  :  A==>B
Eliminated Implications : (~A | B)
After DeMorgans Law : (~A | B)
After Distributivity Law : (~A | B)
CNF : (~A | B)
```

```
AND : & ; OR: | ; NOT: ~ ; IMPLIES : ==> ; EQUIVALENCE : <=>
Enter the propositional logic  :  A|B
Eliminated Implications : (A | B)
After DeMorgans Law : (A | B)
After Distributivity Law : (A | B)
CNF : (A | B)
```

8. Unification in First Order Logic

```
=========PROGRAM FOR UNIFICATION=========
Enter Number of Predicates:2
Enter Predicate  1  :
p
Enter No.of Arguments for Predicate  p  :
2
Enter argument  1  :
a
Enter argument  2  :
b
Enter Predicate  2  :
p
Enter No.of Arguments for Predicate  p  :
2
Enter argument  1  :
c
Enter argument  2  :
b
=======PREDICATES ARE======
p (a,b)
p (c,b)
======SUBSTITUTION IS======
c / a
Do you want to continue(y/n):
```

9. **Forward Reasoning**

Hostile?
{x: Coco}

Criminal?
{x: West}

10. Decision Tree Learning

```
Dataset Length:  625
Dataset Shape:  (625, 5)
Dataset:     0  1  2  3  4
0  B  1  1  1  1
1  R  1  1  1  2
2  R  1  1  1  3
3  R  1  1  1  4
4  R  1  1  1  5
Results Using Entropy:
Predicted values:
['R' 'L' 'R' 'L' 'R' 'L' 'R' 'L' 'R' 'R' 'R' 'R' 'L' 'L' 'R' 'L' 'R' 'L'
 'L' 'R' 'L' 'R' 'L' 'L' 'R' 'L' 'R' 'L' 'R' 'L' 'R' 'L' 'R' 'L' 'L' 'L'
 'L' 'L' 'R' 'L' 'R' 'L' 'R' 'L' 'R' 'R' 'L' 'L' 'R' 'L' 'L' 'R' 'L' 'L'
 'R' 'L' 'R' 'R' 'L' 'R' 'R' 'R' 'L' 'L' 'R' 'L' 'L' 'R' 'L' 'L' 'L' 'R'
 'R' 'L' 'R' 'L' 'R' 'R' 'R' 'L' 'R' 'L' 'L' 'L' 'L' 'R' 'R' 'L' 'R' 'L'
 'R' 'R' 'L' 'L' 'L' 'R' 'R' 'L' 'L' 'L' 'R' 'L' 'L' 'R' 'R' 'R' 'R' 'R'
 'R' 'L' 'R' 'L' 'R' 'R' 'L' 'R' 'R' 'L' 'R' 'R' 'L' 'R' 'R' 'R' 'L' 'L'
 'L' 'L' 'L' 'R' 'R' 'R' 'R' 'L' 'R' 'R' 'R' 'L' 'L' 'R' 'L' 'R' 'L' 'R'
 'L' 'R' 'R' 'L' 'L' 'R' 'L' 'R' 'R' 'R' 'R' 'R' 'L' 'R' 'R' 'R' 'R' 'R'
 'R' 'L' 'R' 'L' 'R' 'R' 'L' 'R' 'L' 'R' 'L' 'R' 'L' 'L' 'L' 'L' 'L' 'R'
 'R' 'R' 'L' 'L' 'L' 'R' 'R' 'R']
Confusion Matrix:  [[ 0  6  7]
 [ 0 63 22]
 [ 0 20 70]]
Accuracy :  70.74468085106383

Report :               precision    recall  f1-score   support

           B       0.00      0.00      0.00        13
           L       0.71      0.74      0.72        85
           R       0.71      0.78      0.74        90

    accuracy                           0.71       188
   macro avg       0.47      0.51      0.49       188
weighted avg       0.66      0.71      0.68       188
```