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DIV: C/C2 Branch: Computer Engineering

AI EXPERIMENT 4 - Hill Climbing

Output :

```
PS D:\SEM-5\AI\EXPERIMENTS> python -u "d:\SEM-5\AI\EXPERIMENTS\hillCimbing.py"
Current State: [[], [], [], ['B', 'C', 'D', 'A']]
Heuristic value for [[], [], [], ['B', 'C', 'D', 'A']] is -6
Heuristic value for [['A'], [], [], ['B', 'C', 'D']] is -3
Child chosen for exploration: [['A'], [], [], ['B', 'C', 'D']]

Current State: [['A'], [], [], ['B', 'C', 'D']]
Heuristic value for [['A'], [], [], ['B', 'C', 'D']] is -3
Heuristic value for [[], ['A'], [], ['B', 'C', 'D']] is -3
Heuristic value for [[], [], ['A'], ['B', 'C', 'D']] is -3
Heuristic value for [[], [], [], ['B', 'C', 'D', 'A']] is -6
Heuristic value for [['A', 'D'], [], [], ['B', 'C']] is -2
Child chosen for exploration: [['A', 'D'], [], [], ['B', 'C']]

Current State: [['A', 'D'], [], [], ['B', 'C']]
Heuristic value for [['A', 'D'], [], [], ['B', 'C']] is -2
Heuristic value for [['A'], ['D'], [], ['B', 'C']] is -1
Child chosen for exploration: [['A'], ['D'], [], ['B', 'C']]

Current State: [['A'], ['D'], [], ['B', 'C']]
Heuristic value for [['A'], ['D'], [], ['B', 'C']] is -1
Heuristic value for [[], ['D', 'A'], [], ['B', 'C']] is -2
Heuristic value for [[], ['D'], ['A'], ['B', 'C']] is -1
Heuristic value for [[], ['D'], [], ['B', 'C', 'A']] is -3
Heuristic value for [['A', 'D'], [], [], ['B', 'C']] is -2
Heuristic value for [['A'], [], ['D'], ['B', 'C']] is -1
Heuristic value for [['A'], [], [], ['B', 'C', 'D']] is -3
Heuristic value for [['A', 'C'], ['D'], [], ['B']] is -1
Heuristic value for [['A'], ['D', 'C'], [], ['B']] is -1
Heuristic value for [['A'], ['D'], ['C'], ['B']] is 0
Child chosen for exploration: [['A'], ['D'], ['C'], ['B']]
```

```
Current State: [['A'], ['D'], ['C'], ['B']]
Heuristic value for [['A'], ['D'], ['C'], ['B']] is 0
Heuristic value for [[], ['D', 'A'], ['C'], ['B']] is -1
Heuristic value for [[], ['D'], ['C', 'A'], ['B']] is -1
Heuristic value for [[], ['D'], ['C'], ['B', 'A']] is -1
Heuristic value for [['A', 'D'], [], ['C'], ['B']] is -1
Heuristic value for [['A'], [], ['C', 'D'], ['B']] is -1
Heuristic value for [['A'], [], ['C'], ['B', 'D']] is -1
Heuristic value for [['A', 'C'], ['D'], [], ['B']] is -1
Heuristic value for [['A'], ['D', 'C'], [], ['B']] is -1
Heuristic value for [['A'], ['D'], [], ['B', 'C']] is -1
Heuristic value for [['A', 'B'], ['D'], ['C'], []] is 1
Child chosen for exploration: [['A', 'B'], ['D'], ['C'], []]

Current State: [['A', 'B'], ['D'], ['C'], []]
Heuristic value for [['A', 'B'], ['D'], ['C'], []] is 1
Heuristic value for [['A'], ['D', 'B'], ['C'], []] is 1
Heuristic value for [['A'], ['D'], ['C', 'B'], []] is 1
Heuristic value for [['A'], ['D'], ['C'], ['B']] is 0
Heuristic value for [['A', 'B', 'D'], [], ['C'], []] is -1
Heuristic value for [['A', 'B'], [], ['C', 'D'], []] is 0
Heuristic value for [['A', 'B'], [], ['C'], ['D']] is 1
Heuristic value for [['A', 'B', 'C'], ['D'], [], []] is 3
Child chosen for exploration: [['A', 'B', 'C'], ['D'], [], []]

Current State: [['A', 'B', 'C'], ['D'], [], []]
Heuristic value for [['A', 'B', 'C'], ['D'], [], []] is 3
Heuristic value for [['A', 'B'], ['D', 'C'], [], []] is 0
Heuristic value for [['A', 'B'], ['D'], ['C'], []] is 1
Heuristic value for [['A', 'B'], ['D'], [], ['C']] is 1
Heuristic value for [['A', 'B', 'C', 'D'], [], [], []] is 6
Child chosen for exploration: [['A', 'B', 'C', 'D'], [], [], []]

Current State: [['A', 'B', 'C', 'D'], [], [], []]
Heuristic value for [['A', 'B', 'C', 'D'], [], [], []] is 6
Heuristic value for [['A', 'B', 'C'], ['D'], [], []] is 3
Heuristic value for [['A', 'B', 'C'], [], ['D'], []] is 3
Heuristic value for [['A', 'B', 'C'], [], [], ['D']] is 3
No better heuristic value is obtained, declaring this as the goal state - [['A', 'B', 'C', 'D'], [], [], []]

PS D:\SEM 5\AI\EXPERIMENTS>
```

AI EXPERIMENT 5 - Genetic Algorithm

Output :

```
------------------------------------------ GENERATION 0 ------------------------------------------
Initial Population      X Value         Fitness Value( f(x) )   Probability(Expected Count)     Actual Count
--------------------------------------------------------------------------------------------------
000000                  0               0                       0.0                             0
111111                  63              3969                    1.8181                          2
101011                  43              1849                    0.847                           1
110110                  54              2916                    1.3358                          1

------------------------------------------ New Population 0 ------------------------------------------
Mate Pool       Mate            Crossover Points        New Population          x value         f(x)
--------------------------------------------------------------------------------------------------
111111          3               5                       111110                  62              3844
111111          2               5                       111111                  63              3969
101011          1               5                       101011                  43              1849
110110          0               5                       110111                  55              3025

------------------------------------------ GENERATION 1 ------------------------------------------
Initial Population      X Value         Fitness Value( f(x) )   Probability(Expected Count)     Actual Count
--------------------------------------------------------------------------------------------------
111110                  62              3844                    1.2122                          1
111111                  63              3969                    1.2517                          1
101011                  43              1849                    0.5831                          1
110111                  55              3025                    0.954                           1

------------------------------------------ New Population 1 ------------------------------------------
Mate Pool       Mate            Crossover Points        New Population          x value         f(x)
--------------------------------------------------------------------------------------------------
111110          3               1                       110111                  55              3025
111111          2               4                       111111                  63              3969
101011          1               4                       101011                  43              1849
110111          0               1                       111110                  62              3844

------------------------------------------ GENERATION 2 ------------------------------------------
Initial Population      X Value         Fitness Value( f(x) )   Probability(Expected Count)     Actual Count
--------------------------------------------------------------------------------------------------
110111                  55              3025                    0.954                           1
111111                  63              3969                    1.2517                          1
101011                  43              1849                    0.5831                          1
111110                  62              3844                    1.2122                          1

------------------------------------------ New Population 2 ------------------------------------------
Mate Pool       Mate            Crossover Points        New Population          x value         f(x)
--------------------------------------------------------------------------------------------------
110111          1               4                       110111                  55              3025
111111          0               4                       111111                  63              3969
101011          3               5                       101010                  42              1764
111110          2               5                       111111                  63              3969

------------------------------------------ GENERATION 3 ------------------------------------------
Initial Population      X Value         Fitness Value( f(x) )   Probability(Expected Count)     Actual Count
--------------------------------------------------------------------------------------------------
110111                  55              3025                    0.951                           1
111111                  63              3969                    1.2477                          1
101010                  42              1764                    0.5545                          1
111111                  63              3969                    1.2477                          1

------------------------------------------ New Population 3 ------------------------------------------
Mate Pool       Mate            Crossover Points        New Population          x value         f(x)
--------------------------------------------------------------------------------------------------
110111          3               3                       110111                  55              3025
111111          2               2                       111010                  58              3364
101010          1               2                       101111                  47              2209
111111          0               3                       111111                  63              3969
PS D:\SEM 5\AI\EXPERIMENTS>
```

AI EXPERIMENT 6 - Perceptron Learning

Output :

```
PS D:\SEM-5\AI\EXPERIMENTS> python -u "d:\SEM-5\AI\EXPERIMENTS\perceptron.py"
Iteration  1
W 0 [-2.   1.  -1.   0.7 -1.   1.   1.   4.   3. ]
W 1 [-3.   1.  -1.  -0.3 -1.   1.   0.   3.   2. ]
W 2 [-3.   1.  -1.  -0.3 -1.   1.   0.   3.   2. ]
W 3 [-4.   1.  -1.  -1.3 -1.   1.  -1.   2.   1. ]
W 4 [-3.   1.  -1.  -0.3 -1.   2.   0.   3.   2. ]
W 5 [-3.   1.  -1.  -0.3 -1.   2.   0.   3.   2. ]
W 6 [-2.   1.   0.   0.7  0.   2.   1.   3.   3. ]
W 7 [-3.   1.  -1.  -0.3  0.   1.   0.   3.   2. ]
W 8 [-3.   1.  -1.  -0.3  0.   1.   0.   3.   2. ]
W 9 [-3.   1.  -1.  -0.3  0.   1.   0.   3.   2. ]

W after  1  epochs  [-3.   1.  -1.  -0.3  0.   1.   0.   3.   2. ]
Iteration  2
W 0 [-3.   1.  -1.  -0.3  0.   1.   0.   3.   2. ]
W 1 [-4.   1.  -1.  -1.3  0.   1.  -1.   2.   1. ]
W 2 [-3.   2.  -1.  -0.3  0.   1.   0.   3.   2. ]
W 3 [-4.   2.  -1.  -1.3  0.   1.  -1.   2.   1. ]
W 4 [-3.   2.  -1.  -0.3  0.   2.   0.   3.   2. ]
W 5 [-3.   2.  -1.  -0.3  0.   2.   0.   3.   2. ]
W 6 [-2.   2.   0.   0.7  1.   2.   1.   3.   3. ]
W 7 [-3.   2.  -1.  -0.3  1.   1.   0.   3.   2. ]
W 8 [-3.   2.  -1.  -0.3  1.   1.   0.   3.   2. ]
W 9 [-4.   1.  -2.  -1.3  0.   0.  -1.   3.   1. ]

W after  2  epochs  [-4.   1.  -2.  -1.3  0.   0.  -1.   3.   1. ]
Iteration  3
W 0 [-3.   1.  -1.  -1.3  0.   0.   0.   4.   2. ]
W 1 [-4.   1.  -1.  -2.3  0.   0.  -1.   3.   1. ]
W 2 [-3.   2.  -1.  -1.3  0.   0.   0.   4.   2. ]
W 3 [-4.   2.  -1.  -2.3  0.   0.  -1.   3.   1. ]
W 4 [-3.   2.  -1.  -1.3  0.   1.   0.   4.   2. ]
W 5 [-3.   2.  -1.  -1.3  0.   1.   0.   4.   2. ]
W 6 [-2.   2.   0.  -0.3  1.   1.   1.   4.   3. ]
W 7 [-3.   2.  -1.  -1.3  1.   0.   0.   4.   2. ]
W 8 [-3.   2.  -1.  -1.3  1.   0.   0.   4.   2. ]
W 9 [-3.   2.  -1.  -1.3  1.   0.   0.   4.   2. ]
```

```
W after  3  epochs  [-3.   2.  -1.  -1.3  1.   0.   0.   4.   2. ]
Iteration  4
W 0 [-3.   2.  -1.  -1.3  1.   0.   0.   4.   2. ]
W 1 [-4.   2.  -1.  -2.3  1.   0.  -1.   3.   1. ]
W 2 [-3.   3.  -1.  -1.3  1.   0.   0.   4.   2. ]
W 3 [-4.   3.  -1.  -2.3  1.   0.  -1.   3.   1. ]
W 4 [-3.   3.  -1.  -1.3  1.   1.   0.   4.   2. ]
W 5 [-3.   3.  -1.  -1.3  1.   1.   0.   4.   2. ]
W 6 [-2.   3.   0.  -0.3  2.   1.   1.   4.   3. ]
W 7 [-3.   3.  -1.  -1.3  2.   0.   0.   4.   2. ]
W 8 [-3.   3.  -1.  -1.3  2.   0.   0.   4.   2. ]
W 9 [-4.   2.  -2.  -2.3  1.  -1.  -1.   4.   1. ]

W after  4  epochs  [-4.   2.  -2.  -2.3  1.  -1.  -1.   4.   1. ]
Iteration  5
W 0 [-3.   2.  -1.  -2.3  1.  -1.   0.   5.   2. ]
W 1 [-4.   2.  -1.  -3.3  1.  -1.  -1.   4.   1. ]
W 2 [-3.   3.  -1.  -2.3  1.  -1.   0.   5.   2. ]
W 3 [-4.   3.  -1.  -3.3  1.  -1.  -1.   4.   1. ]
W 4 [-3.   3.  -1.  -2.3  1.   0.   0.   5.   2. ]
W 5 [-3.   3.  -1.  -2.3  1.   0.   0.   5.   2. ]
W 6 [-2.   3.   0.  -1.3  2.   0.   1.   5.   3. ]
W 7 [-3.   3.  -1.  -2.3  2.  -1.   0.   5.   2. ]
W 8 [-3.   3.  -1.  -2.3  2.  -1.   0.   5.   2. ]
W 9 [-3.   3.  -1.  -2.3  2.  -1.   0.   5.   2. ]

W after  5  epochs  [-3.   3.  -1.  -2.3  2.  -1.   0.   5.   2. ]
Iteration  6
W 0 [-3.   3.  -1.  -2.3  2.  -1.   0.   5.   2. ]
W 1 [-4.   3.  -1.  -3.3  2.  -1.  -1.   4.   1. ]
W 2 [-3.   4.  -1.  -2.3  2.  -1.   0.   5.   2. ]
W 3 [-4.   4.  -1.  -3.3  2.  -1.  -1.   4.   1. ]
W 4 [-3.   4.  -1.  -2.3  2.   0.   0.   5.   2. ]
W 5 [-3.   4.  -1.  -2.3  2.   0.   0.   5.   2. ]
W 6 [-2.   4.   0.  -1.3  3.   0.   1.   5.   3. ]
W 7 [-3.   4.  -1.  -2.3  3.  -1.   0.   5.   2. ]
W 8 [-3.   4.  -1.  -2.3  3.  -1.   0.   5.   2. ]
W 9 [-4.   3.  -2.  -3.3  2.  -2.  -1.   5.   1. ]

W after  6  epochs  [-4.   3.  -2.  -3.3  2.  -2.  -1.   5.   1. ]
Final W after  6 epochs:
[-4.   3.  -2.  -3.3  2.  -2.  -1.   5.   1. ]
Output for test input [1, 0, 1, 1, 0, 0, 1, 1, 0]: 0
Output for test input [1, 0, 0, 1, 1, -1, 1, 1, 1]: 1
PS D:\SEM-5\AI\EXPERIMENTS>
```

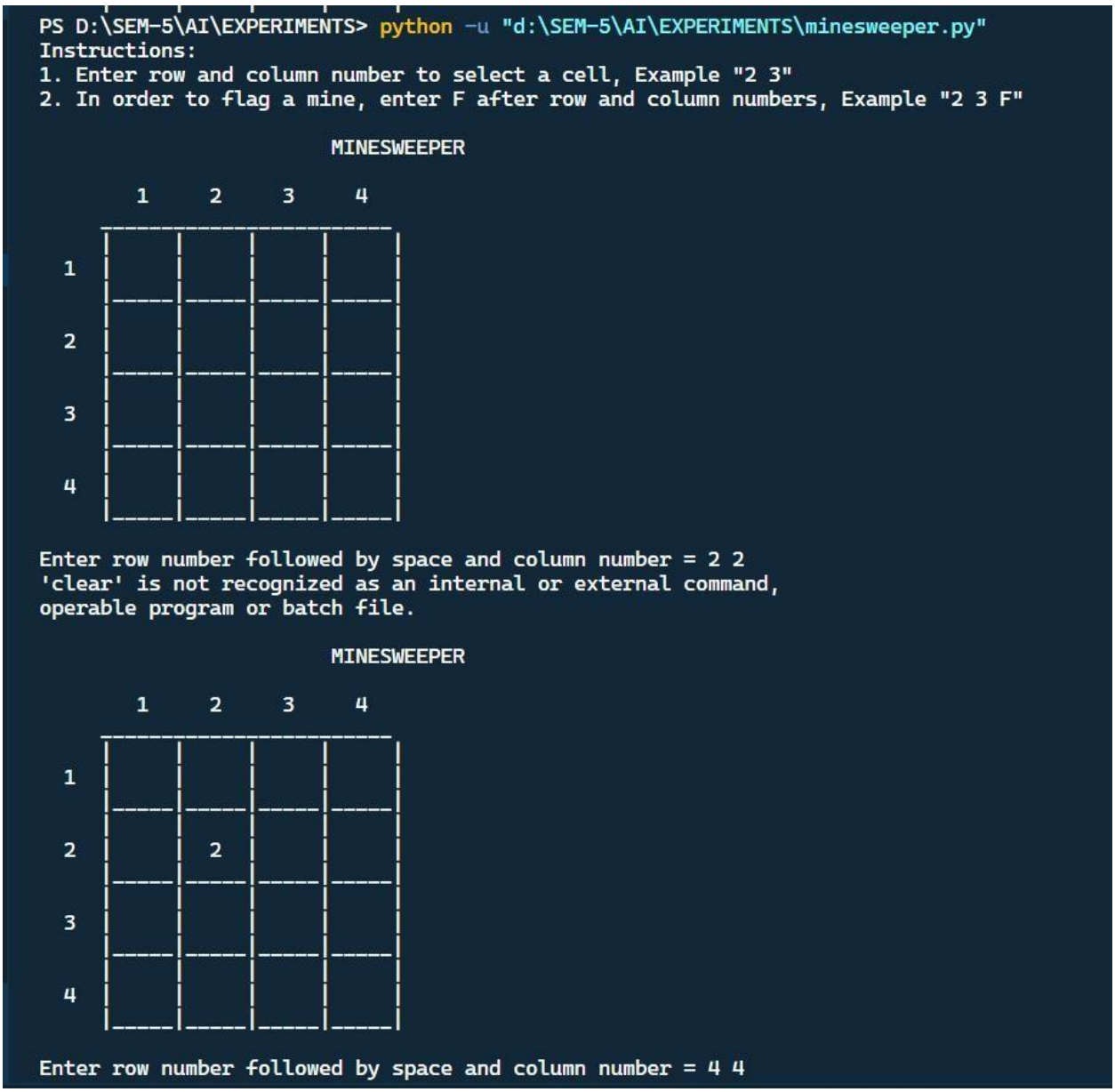
AI - EXPERIMENT 7 - Family Tree in PROLOG

Output :

```
% c:/users/jsidd/dropbox/pc/desktop/exp7 compiled 0.00 sec, 0 clauses
|
|    parent(X,luffy).
false.

?-
|    parent(X,zoro).
X = nami ;

?-
|    mother(X,Y).
X = nami,
Y = zoro ;

?- haschild(X).
X = nami ;

?- sister(X,Y).
X = hancock,
Y = otama
```

AI EXPERIMENT 8 - AI based game

Output :

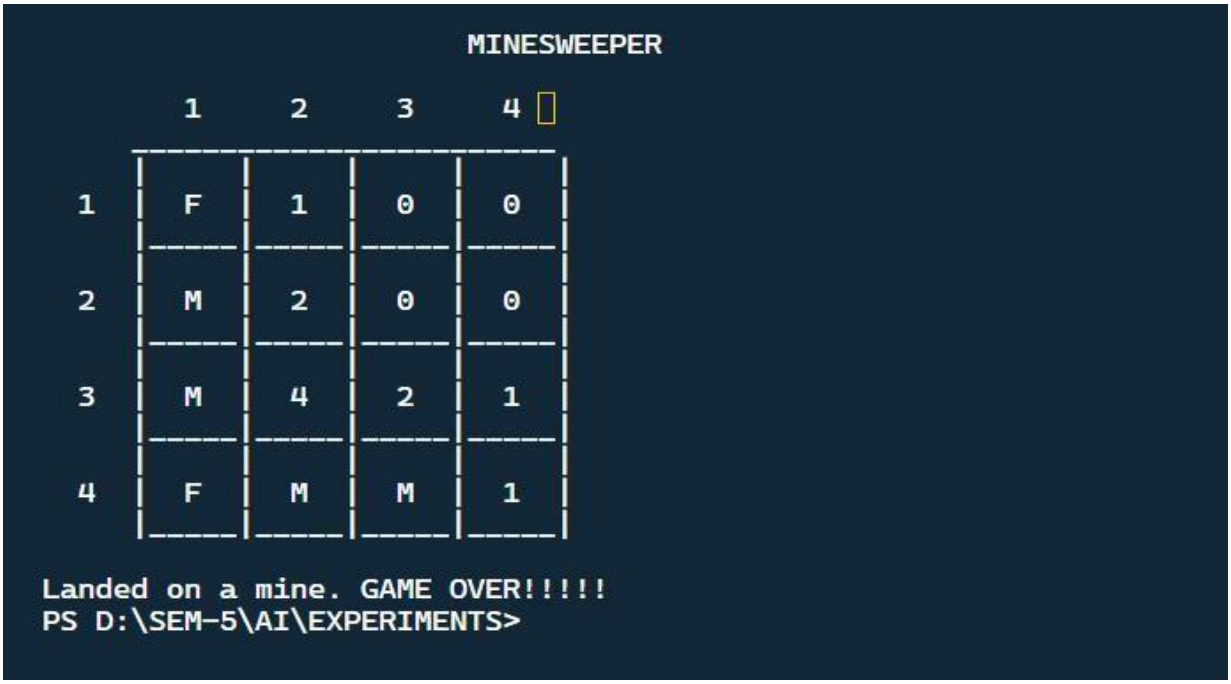


```
                        MINESWEEPER

        1     2     3     4
      _____________________
     |     |     |     |     |
   1 |     |     |     |     |
     |_____|_____|_____|_____|
     |     |     |     |     |
   2 |     |  2  |     |     |
     |_____|_____|_____|_____|
     |     |     |     |     |
   3 |     |     |     |     |
     |_____|_____|_____|_____|
     |     |     |     |     |
   4 |     |     |     |  1  |
     |_____|_____|_____|_____|

  Enter row number followed by space and column number = 3 2
  'clear' is not recognized as an internal or external command,
  operable program or batch file.

                        MINESWEEPER

        1     2     3     4
      _____________________
     |     |     |     |     |
   1 |     |     |     |     |
     |_____|_____|_____|_____|
     |     |     |     |     |
   2 |     |  2  |     |     |
     |_____|_____|_____|_____|
     |     |     |     |     |
   3 |     |  4  |     |     |
     |_____|_____|_____|_____|
     |     |     |     |     |
   4 |     |     |     |  1  |
     |_____|_____|_____|_____|

  Enter row number followed by space and column number = 1 4
  'clear' is not recognized as an internal or external command,
  operable program or batch file.
```

```
                        MINESWEEPER

        1     2     3     4
      _____________________
     |     |     |     |     |
   1 |     |  1  |  0  |  0  |
     |_____|_____|_____|_____|
     |     |     |     |     |
   2 |     |  2  |  0  |  0  |
     |_____|_____|_____|_____|
     |     |     |     |     |
   3 |     |  4  |  2  |  1  |
     |_____|_____|_____|_____|
     |     |     |     |     |
   4 |     |     |     |  1  |
     |_____|_____|_____|_____|

Enter row number followed by space and column number = 4 1 F
'clear' is not recognized as an internal or external command,
operable program or batch file.
Flag set

                        MINESWEEPER

        1     2     3     4
      _____________________
     |     |     |     |     |
   1 |     |  1  |  0  |  0  |
     |_____|_____|_____|_____|
     |     |     |     |     |
   2 |     |  2  |  0  |  0  |
     |_____|_____|_____|_____|
     |     |     |     |     |
   3 |     |  4  |  2  |  1  |
     |_____|_____|_____|_____|
     |     |     |     |     |
   4 |  F  |     |     |  1  |
     |_____|_____|_____|_____|

Enter row number followed by space and column number = 4 2 F
'clear' is not recognized as an internal or external command,
operable program or batch file.
Flag set
```

```
                    MINESWEEPER

      1     2     3     4
    _____________________
   |     |     |     |     |
 1 |     |  1  |  0  |  0  |
   |_____|_____|_____|_____|
   |     |     |     |     |
 2 |     |  2  |  0  |  0  |
   |_____|_____|_____|_____|
   |     |     |     |     |
 3 |     |  4  |  2  |  1  |
   |_____|_____|_____|_____|
   |     |     |     |     |
 4 |  F  |  F  |     |  1  |
   |_____|_____|_____|_____|

Enter row number followed by space and column number = 4 3 F
'clear' is not recognized as an internal or external command,
operable program or batch file.
Flag set

                    MINESWEEPER

      1     2     3     4
    _____________________
   |     |     |     |     |
 1 |     |  1  |  0  |  0  |
   |_____|_____|_____|_____|
   |     |     |     |     |
 2 |     |  2  |  0  |  0  |
   |_____|_____|_____|_____|
   |     |     |     |     |
 3 |     |  4  |  2  |  1  |
   |_____|_____|_____|_____|
   |     |     |     |     |
 4 |  F  |  F  |  F  |  1  |
   |_____|_____|_____|_____|

Enter row number followed by space and column number = 1 1 F
'clear' is not recognized as an internal or external command,
operable program or batch file.
Flag set
```

```
                    MINESWEEPER

      1     2     3     4
    _____________________
   |     |     |     |     |
 1 |  F  |  1  |  0  |  0  |
   |_____|_____|_____|_____|
   |     |     |     |     |
 2 |     |  2  |  0  |  0  |
   |_____|_____|_____|_____|
   |     |     |     |     |
 3 |     |  4  |  2  |  1  |
   |_____|_____|_____|_____|
   |     |     |     |     |
 4 |  F  |  F  |  F  |  1  |
   |_____|_____|_____|_____|

Enter row number followed by space and column number = 2 1 F
'clear' is not recognized as an internal or external command,
operable program or batch file.
Flags finished

                    MINESWEEPER

      1     2     3     4
    _____________________
   |     |     |     |     |
 1 |  F  |  1  |  0  |  0  |
   |_____|_____|_____|_____|
   |     |     |     |     |
 2 |     |  2  |  0  |  0  |
   |_____|_____|_____|_____|
   |     |     |     |     |
 3 |     |  4  |  2  |  1  |
   |_____|_____|_____|_____|
   |     |     |     |     |
 4 |  F  |  F  |  F  |  1  |
   |_____|_____|_____|_____|

Enter row number followed by space and column number = 2 1
```


MINESWEEPER
1 2 3 4
1 F 1 0 0
2 M 2 0 0
3 M 4 2 1
4 F M M 1
Landed on a mine. GAME OVER!!!!!
PS D:\SEM-5\AI\EXPERIMENTS>

AI EXPERIMENT 9 - Rule Based Expert System

Output :

```
PS D:\SEM-5\AI\EXPERIMENTS> python -u "d:\SEM-5\AI\EXPERIMENTS\EXP9.py"

Total Order Plan for Homemade Pizza:
Buy Pizza Dough
Preheat Oven
Roll Out Dough
Spread Pizza Sauce
Grate Cheese
Add Cheese to Dough
Chop Vegetables
Add Vegetables to Pizza
Bake Pizza


PS D:\SEM-5\AI\EXPERIMENTS>
```