Exp: 1 **Date :**

Study of PROLOG Using Turbo Prolog

Topics:

a) Basics of Turbo Prolog
b) Intro to Prolog programming
c) Running a simple program

- Prolog is a logical programming language and stands for Programming in logic • Created around 1972
- Preferred for AI programming and mainly used in such areas as:
  - o Theorem proving, expert systems, NLP, …
- Logical programming is the use of mathematical logic for computer programming. **MENU**

- Files – Enables the user to load programs from disk, create new programs, save modified programs to disk, and to quit the program.
- Edit – Moves user control to the Editor panel.
- Run – Moves user control to the Dialog panel ; compiles the user program (if not already done so) in memory before running the program.
- Compile – Provides the user with choices on how to save the compiled version of the program.
- Options – Provides the user with choices on the type of compilation to be used. • Setup – Enables the user to change panel sizes, colors, and positions.

Dialog
When a Prolog program is executing, output will be shown in the Dialog Panel **Message**
The Message Panel keeps the programmer up to date on processing activity. **Trace**
The Trace Panel is useful for finding problems in the programs you create.

Prolog Clauses

- Any factual expression in Prolog is called a clause.
- There are two types of factual expressions: facts and rules
- There are three categories of statements in Prolog:
  - ♣ **Facts**: Those are true statements that form the basis for the knowledge base.
  - ♣ **Rules:** Similar to functions in procedural programming (C++, Java…) and has the form of if/then.
  - ♣ **Queries**: Questions that are passed to the interpreter to access the knowledge base and start the program.

What is a Prolog program?
Prolog is used for solving problems that involve objects and the relationships between objects.

- A program consists of a database containing one or more facts and zero or more rules(next week).
- A fact is a relationship among a collection of objects. A fact is a one-line statement that ends with a full-stop.
  parent (john, bart).
  parent (barbara, bart).
  male (john).
  dog(fido). >> Fido is a dog or It is true that fido is a dog
  sister(mary, joe). >> Mary is Joe’s sister.

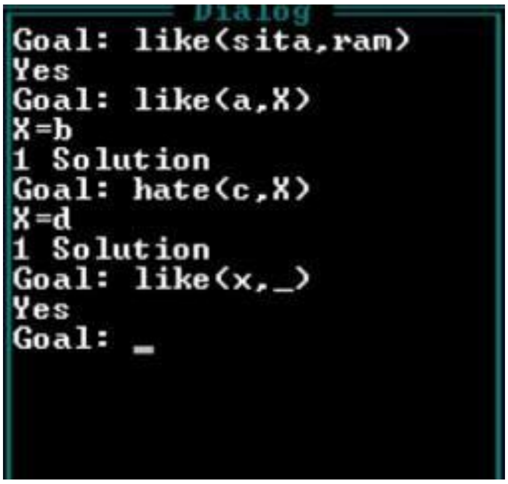
play (mary, joe, tennis). >> It is true that Mary and Joe play tennis.

- Relationships can have any number of objects.
- Choose names that are meaningful – because in Prolog names are arbitrary strings but people will have to associate meaning to them

1. **<u>Program to demonstrate a simple prolog program.</u>**

```
predicates
like(symbol,symbol)
hate(symbol,symbol)
clauses
like(sita,ram).
like(x,y).
  like(a,b).
hate(c,d).
  hate(m,n).
```

Outcome



2. Program to add two numbers.

predicates

add

clauses

```
add:-write("input first number"), readint(X),
write("input second number"), readint(Y),
Z=X+Y,write("output=",Z).
```

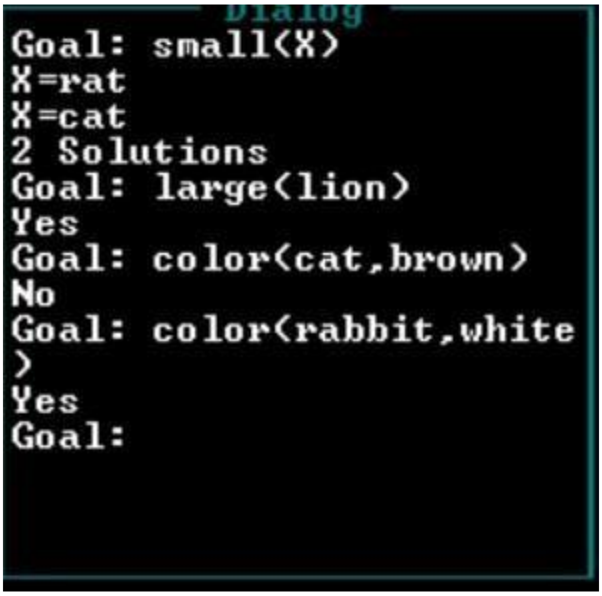
Outcome :

3. Program to categorise animal characteristics.

```
predicates
  small(symbol)
  large(symbol)
  color(symbol,symbol)

clauses
  small(rat).
  small(cat).
  large(lion).
  color(dog,black).
  color(rabbit,white).
  color(X,dark):-
  color(X,black);color(X,brown)
```

Outcome:



4. (a) Program to count number of elements in a list .

domains

```
x=integer
list=integer*
```

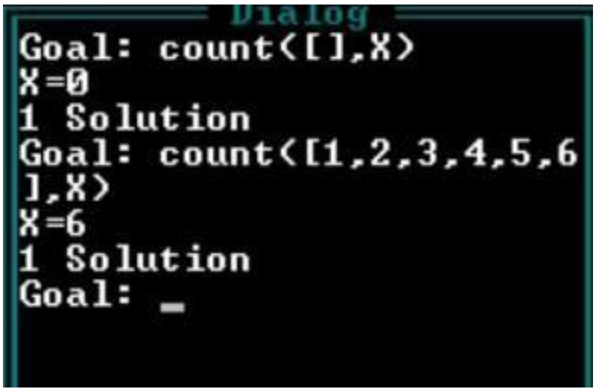
predicates

```
count(list,x)
```

clauses

```
count([],0).
count([_|T],N):-count(T,N1),N=N1+1.
```

Outcome :



4. (b) Program to reverse the list .

domains

x=integer

list=integer*

predicates

append(x,list,list)

rev(list,list)

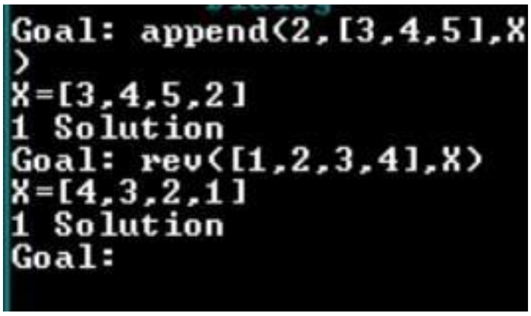
clauses

append(X,[],[X]).

append(X,[H|T],[H|T1]):-append(X,T,T1). rev([],[]).

rev([H|T,rev):-rev(T,L),append(H,L,rev).

Outcome :



4. (c) Program to replace an integer from the list .

domains

list=integer*

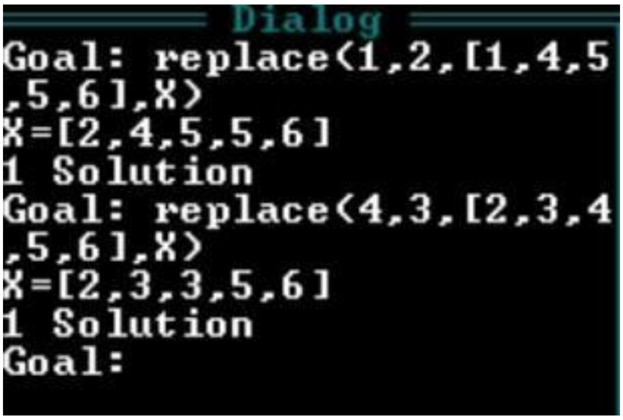
predicates

replace(integer,integer,list,list) **clauses**

replace(X,Y,[X|T],[Y|T]).

replace(X,Y,[H|T],[H|T1]):-replace(X,Y,T,T1).

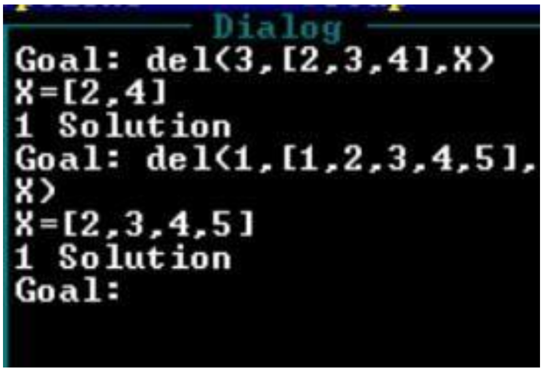
Outcome:



4. (d) Program to delete an integer from the list .

```
domains
list=integer*
predicates
del(integer,list,list)
clauses
del(X,[X|T],T).
del(X,[H|T],[H|T1]):-
del(X,T,T1).
```

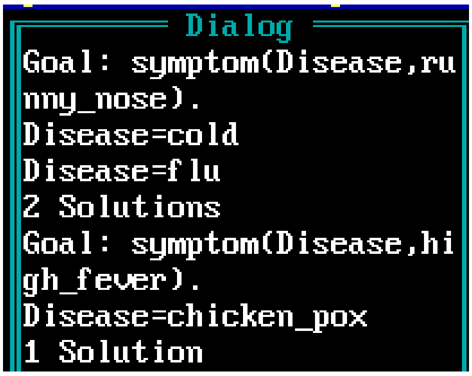
Outcome:



5. Write a program to classify diseases using prolog.

```
domains
disease,indication = symbol
predicates
symptom(disease, indication)
clauses
symptom(chicken_pox, high_fever).
symptom(chicken_pox, chills).
symptom(flu,  chills).
symptom(cold, mild_body_ache).
symptom(flu, severe_body_ache).
symptom(cold, runny_nose).
symptom(flu, runny_nose).
symptom(flu, moderate_cough).
```

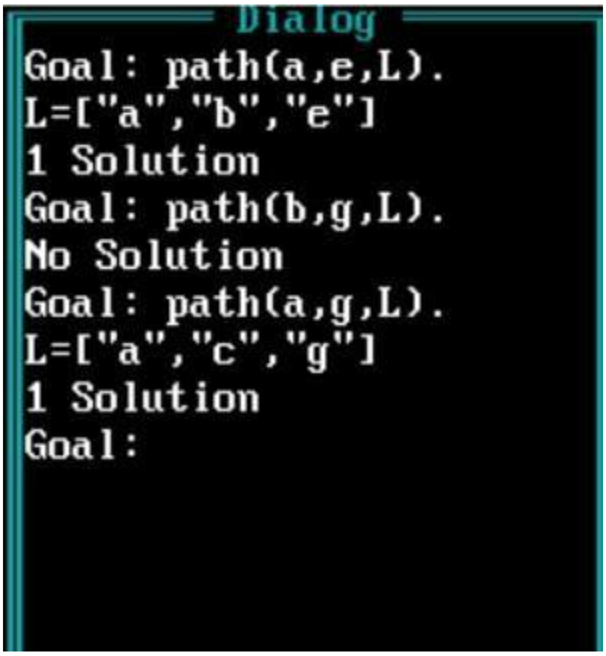
Outcome:



6. Write a program of depth first search

```
domains
X=symbol
Y=symbol*
predicates
child(X,X)
childnode(X,X,Y)
path(X,X,Y)
clauses
child(a,b). /*b is child of a*/
child(a,c). /*c is child of a*/
child(a,d). /*d is child of a*/
child(b,e). /*b is child of b*/
child(b,f). /*f is child of b*/
child(c,g). /*g is child of c*/
path(A,G,[A|Z]):- /*to find the path from root to leaf*/
childnode(A,G,Z).
childnode(A,G,[G]):- /*to determine whether a node is child of
other*/
child(A,G).
childnode(A,G,[X|L]):-
child(A,X),
childnode(X,G,L).
```

Outcomes:

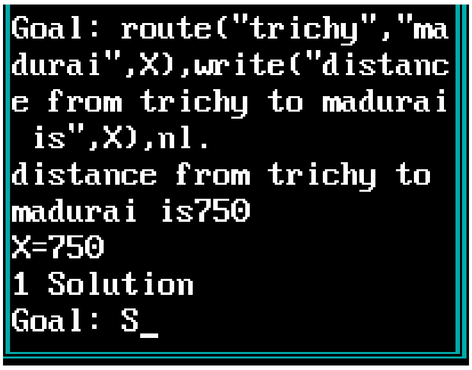


7. Write a program to solve traveling salesman problem.

```
Domains
 town = symbol
distance = integer
predicates
 nondeterm road(town, town, distance)
 nondeterm route(town, town, distance)

clauses
 road("coimbatore", "madurai", 950).
 road("trichy", "madurai", 750).
 road("coimbatore", "trichy", 250).
 road("trichy", "chennai", 300).
 road("coimbatore", "chennai", 500).
route(Town1, Town2, Distance) :-
road(Town1, Town2, Distance).
route(Town1, Town2, Distance) :-
road(Town1, X, Dist1),
 route(X, Town2, Dist2),
 Distance = Dist1 + Dist2.
```

Outcome:



```
Goal: route("trichy","ma
durai",X),write("distanc
e from trichy to madurai
 is",X),nl.
distance from trichy to
madurai is750
X=750
1 Solution
Goal: S_
```

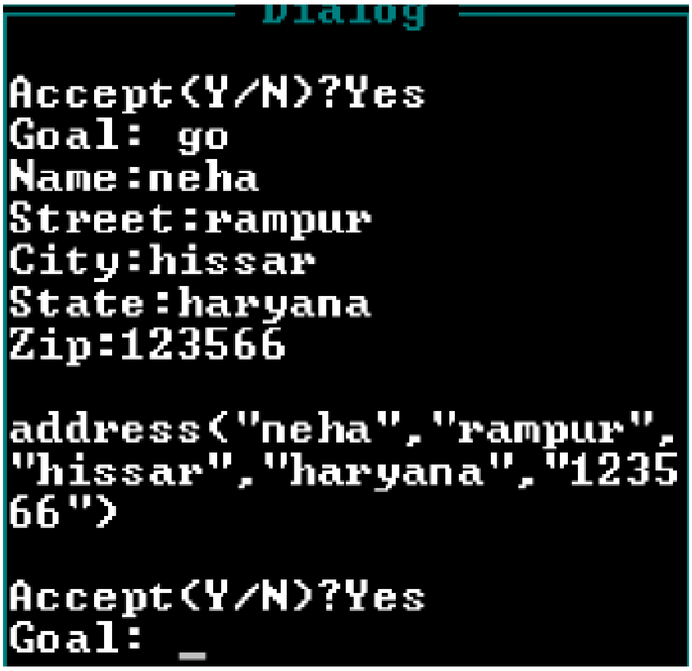
8. Program to read address of a person using compound variable .

```
domains
person=address(name,street,city,state,zip)
name,street,city,state,zip=String

predicates
readaddress(person)
go

clauses
go:-
readaddress(Address),nl,write(Address),nl,nl,
write("Accept(y/n)?"),readchar(Reply),Reply='y',!.
go:-
nl,write("please re-enter"),nl,go.
readaddress(address(N,street,city,state,zip)):-
write("Name:"),readln(N),
write("Street:"),readln(street),
write("City:"),readln(city),
write("State:"),readln(state),
write("Zip:"),readln(zip).
```

Outcome:

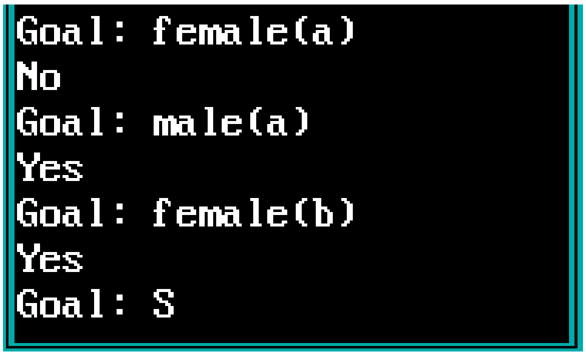


9. Program to demonstrate family relationship

```
predicates
parent(symbol,symbol)
child(symbol,symbol)
mother(symbol,symbol)
brother(symbol,symbol)
sister(symbol,symbol)
grandparent(symbol,symbol)
male(symbol)
female(symbol)

clauses
parent(a,b).
sister(a,c).
male(a).
female(b).
child(X,Y):-parent(Y,X).
mother(X,Y):-female(X),parent(X,Y).
grandparent(X,Y):-parent(X,Z),parent(Z,Y).
brother(X,Y):-male(X),parent(V,X),parent(V,Y).
```

Outcome:



```
Goal: female(a)
No
Goal: male(a)
Yes
Goal: female(b)
Yes
Goal: S
```

Result: Thus the Prolog and programs of Prolog is studied and executed successfully.

Exp: 2 **Date :**

Eight - Queens Problem

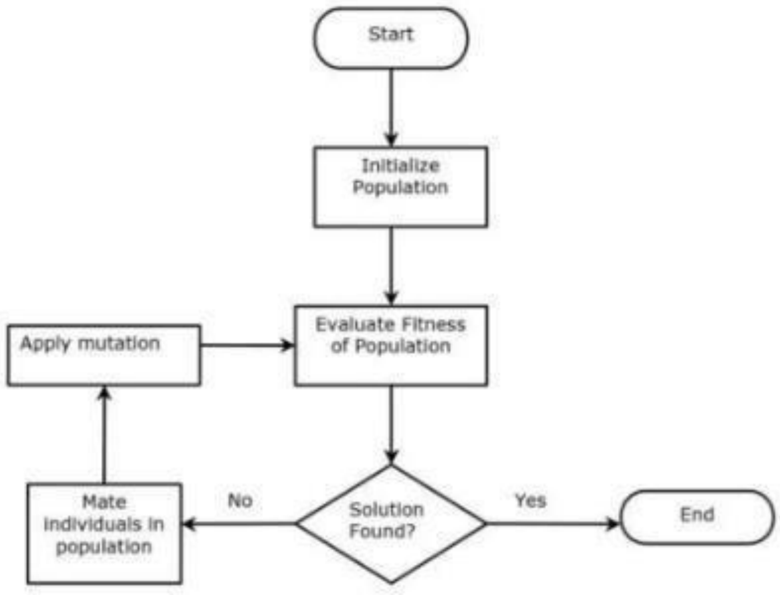
Aim :

To write a program to solve eight queens problem using python.

Algorithm:

1. Initialize Board:
    · Create an 8x8 board with all entries set to 0.
2. Define isSafe(board, row, col):
    · Check Row: No queens in the same row.
    · Check Column: No queens in the same column.
    · Check Diagonals: No queens on the same diagonals.
3. Define solve Queens (board, col):
    · Base Case: If col == 8, print the board and return true.
    · For each row r in column col:
    If isSafe(board, r, col):
    ▪ Place queen at (r, col).
    ▪ Recursively call solve Queens(board, col + 1).
    ▪ If recursion returns true, return true.
    ▪ Else: Backtrack (remove the queen) and try the next row.
4. Start Algorithm:
· Call solves Queens (board, 0) to begin placing queens from the first column.

Flowchart:



Program:

```
N = 8 # (size of the chessboard)
def solveNQueens(board, col):
if col == N:
print(board)
return True
for i in range(N):
if isSafe(board, i, col):
board[i][col] = 1
if solveNQueens(board, col + 1):
return True
board[i][col] = 0
return False
def isSafe(board, row, col):
for x in range(col):
if board[row][x] == 1:
return False
for x, y in zip(range(row, -1, -1), range(col, -1, -1)):
if board[x][y] == 1:
return False
for x, y in zip(range(row, N, 1), range(col, -1, -1)):
if board[x][y] == 1:
return False
return True
board = [[0 for x in range(N)] for y in range(N)]
if not solveNQueens(board, 0):
print(&quot;No solution found&quot;)
```

Output:

```
[1, 0, 0, 0, 0, 0, 0, 0]
[0, 0, 0, 0, 0, 0, 1, 0]
[0, 0, 0, 0, 1, 0, 0, 0]
[0, 0, 0, 0, 0, 0, 0, 1]
[0, 1, 0, 0, 0, 0, 0, 0]
[0, 0, 0, 1, 0, 0, 0, 0]
[0, 0, 0, 0, 0, 1, 0, 0]
[0, 0, 1, 0, 0, 0, 0, 0]
```

Result: Thus, the given 8 Queen python program was executed successfully and verified.

Expn: 3 **Date :**

Depth First Search

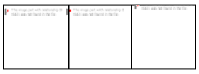
Aim:

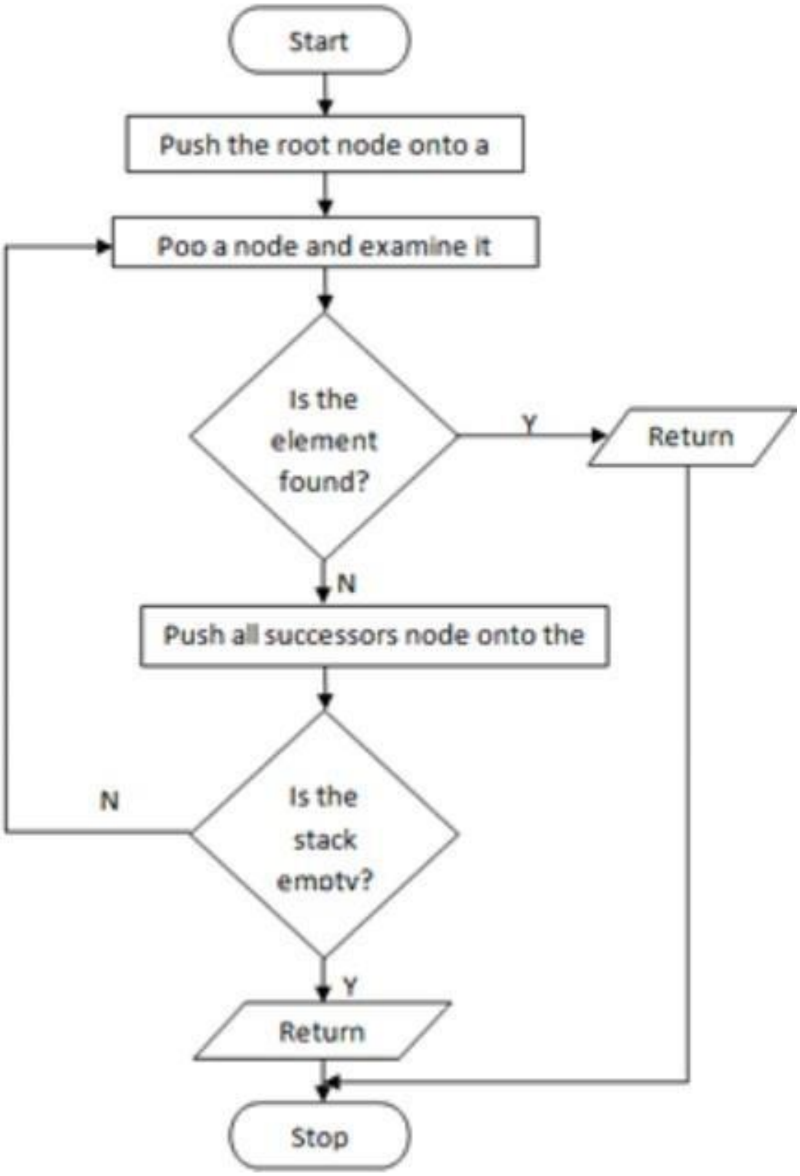
To write a program to solve Depth First search using python.

Algorithm:

1. We will start by putting any one of the graph's vertex on top of the stack.
2. After that take the top item of the stack and add it to the visited list of the vertex.
3. Next, create a list of that adjacent node of the vertex. Add the ones which aren't in the visited list of vertexes to the top of the stack.
4. Lastly, keep repeating steps 2 and 3 until the stack is empty.

Flowchart:





Program:

```
graph = {
    '5': ['3', '7'],
    '3': ['2', '4'],
    '7': ['8'],
    '2': [],
    '4': ['8'],
    '8': []
}

visited = set() # Set to keep track of visited nodes of the graph.

def dfs(visited, graph, node):
    # Function for DFS
    if node not in visited:
        print(node)
        visited.add(node)
        for neighbour in graph[node]:
            dfs(visited, graph, neighbour)

# Driver Code
print("Following is the Depth-First Search")
dfs(visited, graph, '5')
```

Output:

```
Following is the Depth-First Search
5
3
2
4
8
7
```

Result: Thus, a program to solve Depth First search using python is executed successfully and verified.

Exp: 4 **Date :**

Best First Search

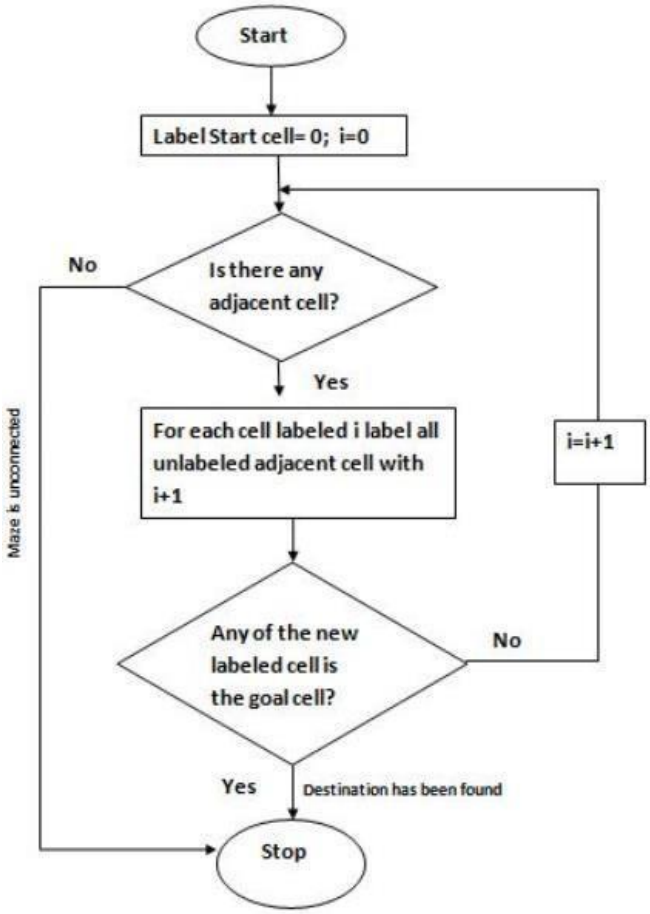
Aim:

To write a program to solve Best First search using python.

Algorithm:

1) Create an empty PriorityQueue
    PriorityQueue pq;
2) Insert "start" in pq.
    pq.insert(start)
3) Until PriorityQueue is empty
    u = PriorityQueue.DeleteMin
    If u is the goal
    Exit
    Else
      Foreach neighbor v of u
      If v "Unvisited"
        Mark v "Visited"
        pq.insert(v)
     Mark u "Examined"

Flowchart :



Program:

```
from queue import PriorityQueue
# Number of vertices in the graph
v = 14
# Graph represented as an adjacency list
graph = [[] for i in range(v)]
# Function for implementing Best-First Search
# Outputs the path with the lowest cost
def best_first_search(actual_Src, target, n):
    visited = [False] * n
    pq = PriorityQueue()
    pq.put((0, actual_Src))
    visited[actual_Src] = True
    while not pq.empty():
        u = pq.get()[1]
        # Displaying the path with the lowest cost
        print(u, end=" ")
        if u == target:
            break
        # Explore all neighbors of u
        for v, c in graph[u]:
            if not visited[v]:
                visited[v] = True
                pq.put((c, v))
    print()
# Function to add edges to the graph
def addedge(x, y, cost):
    graph[x].append((y, cost))
    graph[y].append((x, cost))
# Adding edges with their respective costs
addedge(0, 1, 3)
addedge(0, 2, 6)
addedge(0, 3, 5)
addedge(1, 4, 9)
addedge(1, 5, 8)
addedge(2, 6, 12)
addedge(2, 7, 14)
addedge(3, 8, 7)
addedge(8, 9, 5)
addedge(8, 10, 6)
addedge(9, 11, 1)
addedge(9, 12, 10)
addedge(9, 13, 2)
# Define source and target nodes
source = 0
target = 9
```

```
# Execute the Best-First Search
print("Following is the Best-First Search path:")
best_first_search(source, target, v)
```

Output:

```
Following is the Best-First Search path:
0 1 3 2 8 9
```

Result: Thus a program to solve Best First search using python is executed successfully and verified.

Exp: 5 **Date:**

Robot Traversal Program using means End Analysis

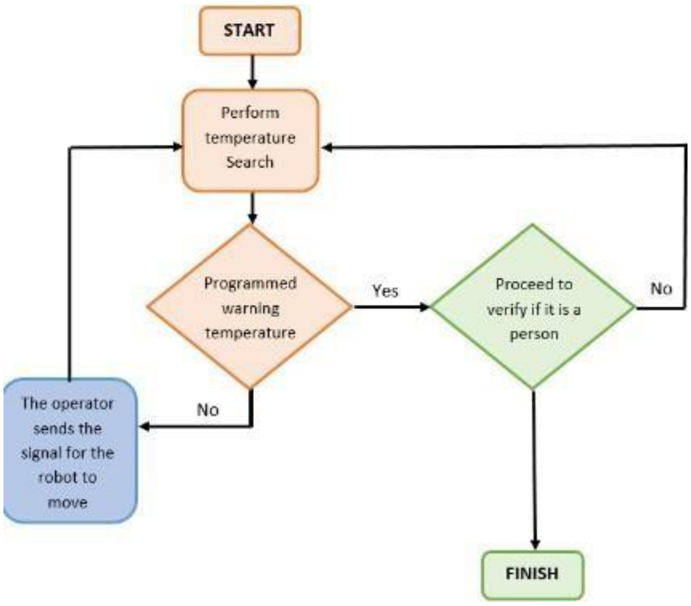
Aim:

The aim of this program is to solve a robot traversal problem on a grid using Means-End Analysis (MEA).

Algorithm:

1. Initialize:
   Define the starting position (x_start, y_start) and goal position (x_goal, y_goal) on a grid.
   Initialize the robot's current position to the starting position.
2. Define Heuristic:
   Calculate the heuristic distance between the current position and the goal
3. Identify Possible Moves:
   Define possible moves as up, down, left, and right on the grid:
   - (x+1, y): Move right
   - (x-1, y): Move left
   - (x, y+1): Move up
   - (x, y-1): Move down
4. Move Selection:
   For each possible move, calculate the heuristic distance to the goal.
   Select the move with the minimum heuristic distance (i.e., the move that brings the robot closer to the goal).
5. Update Position:
   Update the robot's position to the selected move.
6. Repeat Until Goal is Reached:
   Repeat steps 3-5 until the robot's current position matches the goal position.

Flowchart:



Program:

```
class RobotTraversal:
def __init_(self, start, goal):
self.start = start
self.goal = goal
self.current_position = start
def heuristic_distance(self, pos):
# Calculate Manhattan distance as the heuristic
return abs(self.goal[0] - pos[0]) + abs(self.goal[1] - pos[1])
def get_possible_moves(self):
x, y = self.current_position
# Define possible moves: up, down, left, right
moves = [(x + 1, y), (x - 1, y), (x, y + 1), (x, y - 1)]
return moves
def move_robot(self):
# Loop until robot reaches the goal
while self.current_position != self.goal:
possible_moves = self.get_possible_moves()
# Select the move with the minimum heuristic distance to the goal
next_move = min(possible_moves, key=self.heuristic_distance)
# Update the robot&#39;s current position
self.current_position = next_move
print(f&quot;Moving to {self.current_position}, Distance to goal:
{self.heuristic_distance(next_move)}&quot;)
# Define start and goal positions
start_position = (0, 0)
goal_position = (3, 3)
# Initialize the robot traversal
robot = RobotTraversal(start_position, goal_position)
robot.move_robot()
```

Output:

```
Moving to (1, 0), Distance to goal: 5
Moving to (2, 0), Distance to goal: 4
Moving to (3, 0), Distance to goal: 3
Moving to (3, 1), Distance to goal: 2
Moving to (3, 2), Distance to goal: 1
Moving to (3, 3), Distance to goal: 0
```

Result: Thus, program is to solve a robot traversal problem on a grid using Means-End Analysis is executed successfully and verified.

Exp: 6 **Date :**

Travelling Salesman Problem

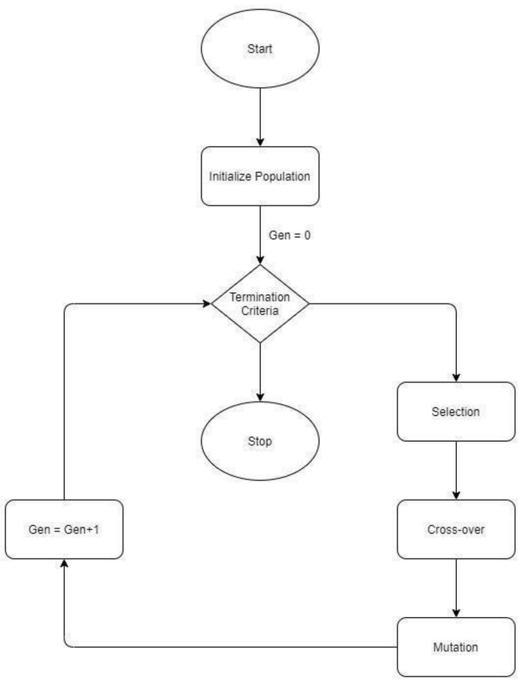
Aim:

The aim of this program is to solve the Traveling Salesman Problem (TSP) using a naive (brute-force) approach in Python.

Algorithm:

1. Define Parameters:
   The graph representing distances between cities is given as an adjacency matrix.
   s: The starting city (in this case, city 0).
2. Generate All Possible Routes:
   Create a list vertex of all cities except the starting city s.
   Use Python's itertools.permutations to generate all permutations of these cities, representing all possible routes the salesman can take.
3. Calculate Path Weights:
   For each permutation (possible route) of cities:
   Initialize current_pathweight to store the cost of the current route.
   Iterate through the cities in the current route, summing up the distances from one city to the next in current_pathweight.
   Finally, add the distance from the last city in the route back to the starting city to complete the cycle.
4. Find the Minimum Path:
   Keep track of the minimum path cost (min_path) by comparing current_pathweight of each route with the current min_path value.
   Update min_path whenever a smaller path cost is found.
5. Return the Result:
   After evaluating all routes, return the minimum path cost found.

Flowchart:



Program:

```
# Python3 program to implement traveling salesman
# problem using naive approach.
from sys import maxsize
from itertools import permutations
V = 4
# implementation of traveling Salesman Problem
def travellingSalesmanProblem(graph, s):
# store all vertex apart from source vertex
vertex = []
for i in range(V):
if i != s:
vertex.append(i)
# store minimum weight Hamiltonian Cycle
min_path = maxsize
next_permutation=permutations(vertex)
for i in next_permutation:
# store current Path weight(cost)
current_pathweight = 0

# compute current path weight
k = s
for j in i:
current_pathweight += graph[k][j]
k = j
current_pathweight += graph[k][s]
# update minimum
min_path = min(min_path, current_pathweight)
return min_path

# Driver Code
if__name___== &quot;_main_&quot;:
# matrix representation of graph
graph = [[0, 10, 15, 20], [10, 0, 35, 25],
[15, 35, 0, 30], [20, 25, 30, 0]]
s = 0
print(travellingSalesmanProblem(graph, s))
```

Output:

```
p/mutli agent/trave
80
```

Result: Thus, program is to solve the Traveling Salesman Problem (TSP) using a naive(brute-force) approach in Python is executed successfully and verified.