Experiment 1: 8 Queens Problem

Aim

To write a program to solve the 8 Queens problem using backtracking.

Procedure

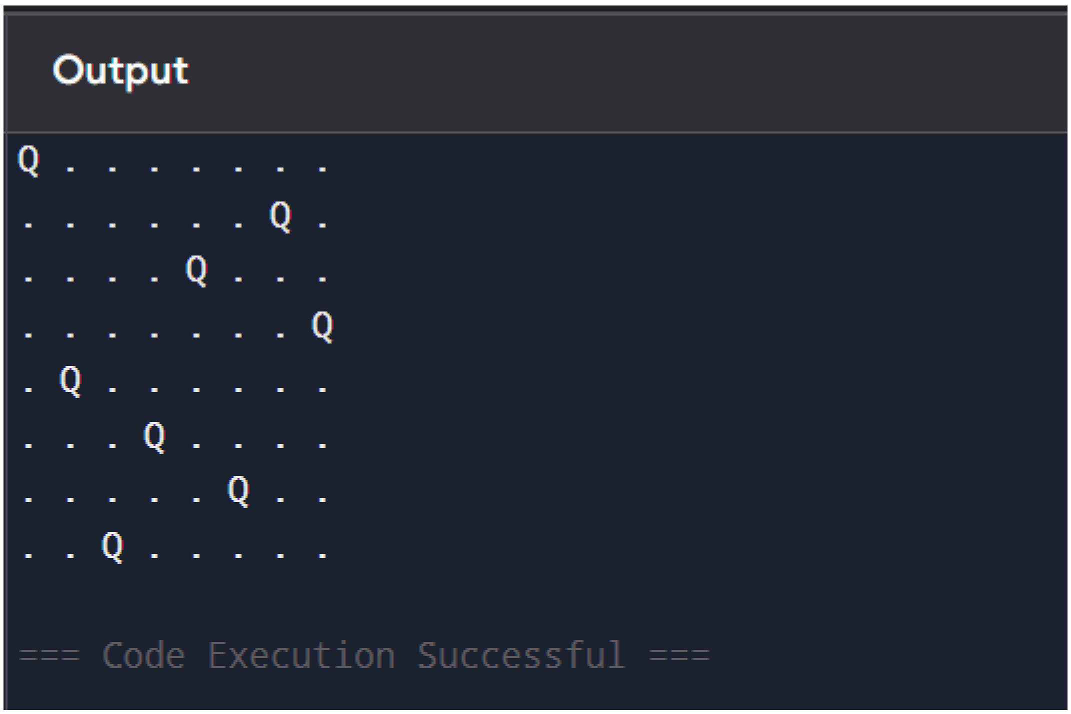
1. Place queens one by one in different columns, starting from the leftmost column.
2. When placing a queen in a column, check for row and diagonal conflicts.
3. If a conflict occurs, backtrack and try placing the queen in the next row.
4. Repeat the process until all queens are placed without conflict.

Code

```
def print_solution(board):
    for row in board:
        print(" ".join("Q" if col else "." for col in row))

def is_safe(board, row, col, n):
    for i in range(col):
        if board[row][i]:
            return False
    for i, j in zip(range(row, -1, -1), range(col, -1, -1)):
        if board[i][j]:
            return False
    for i, j in zip(range(row, n, 1), range(col, -1, -1)):
        if board[i][j]:
            return False
    return True

def solve_nqueens(board, col, n):
    if col >= n:
        return True
    for i in range(n):
        if is_safe(board, i, col, n):
            board[i][col] = 1
            if solve_nqueens(board, col + 1, n):
                return True
            board[i][col] = 0
    return False

def solve():
    n = 8
    board = [[0 for _ in range(n)] for _ in range(n)]
```

```
    if solve_nqueens(board, 0, n):
        print_solution(board)
    else:
        print("Solution does not exist")

solve()
```

Output



Experiment 2: Depth First Search (DFS)

Aim

To solve a problem using the Depth First Search algorithm.

Procedure

1. Start from the root node and push it to the stack.
2. Pop the top item from the stack and mark it as visited.
3. Push all adjacent unvisited nodes to the stack.
4. Repeat until the stack is empty.

Code

```
def dfs(graph, start, visited=None):
    if visited is None:
        visited = set()
    visited.add(start)
    print(start, end=' ')
    for neighbor in graph[start]:
        if neighbor not in visited:
            dfs(graph, neighbor, visited)

graph = {
    'A': ['B', 'C'],
    'B': ['D', 'E'],
    'C': ['F'],
    'D': [],
    'E': ['F'],
    'F': []
}

dfs(graph, 'A')
```

Output

```
Output

A B D E F C
=== Code Execution Successful ===
```

Experiment 3: MINIMAX Algorithm

Aim

To implement the MINIMAX algorithm for decision making in game trees.

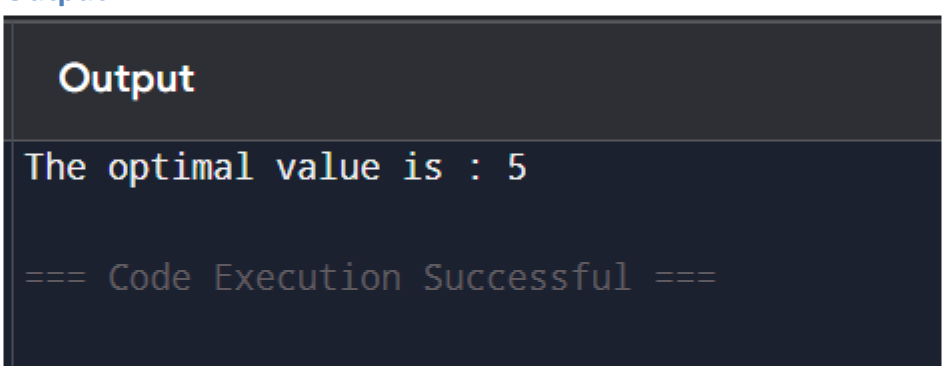
Procedure

1. Generate the game tree.
2. Assign a score to each leaf node.
3. Propagate scores back using MIN and MAX at alternate levels.
4. Choose the move with the optimal score.

Code

```
def minimax(depth, nodeIndex, isMax, scores, h):
    if depth == h:
        return scores[nodeIndex]
    if isMax:
        return max(minimax(depth+1, nodeIndex*2, False, scores, h),
                   minimax(depth+1, nodeIndex*2 + 1, False, scores, h))
    else:
        return min(minimax(depth+1, nodeIndex*2, True, scores, h),
                   minimax(depth+1, nodeIndex*2 + 1, True, scores, h))

scores = [3, 5, 6, 9, 1, 2, 0, -1]
h = 3
print("The optimal value is :", minimax(0, 0, True, scores, h))
```

Output



Experiment 4: A* Algorithm

Aim

To implement the A* algorithm for shortest path finding.

Procedure

1. Maintain open and closed lists.
2. Select the node with lowest f = g + h.
3. Move it to closed list, and update neighbors.
4. Repeat until goal is found.

Code

```
from queue import PriorityQueue

def a_star(start, goal, graph, heuristic):
    open_list = PriorityQueue()
    open_list.put((0, start))
    came_from = {}
    g_score = {node: float('inf') for node in graph}
    g_score[start] = 0

    while not open_list.empty():
        _, current = open_list.get()

        if current == goal:
            path = []
            while current in came_from:
                path.append(current)
                current = came_from[current]
            path.append(start)
            return path[::-1]

        for neighbor in graph[current]:
            temp_g = g_score[current] + graph[current][neighbor]
            if temp_g < g_score[neighbor]:
                came_from[neighbor] = current
                g_score[neighbor] = temp_g
                f = temp_g + heuristic[neighbor]
                open_list.put((f, neighbor))
    return None

graph = {
    'A': {'B': 1, 'C': 4},
```

```
    'B': {'D': 1},
    'C': {'D': 1},
    'D': {'E': 3},
    'E': {}
}
heuristic = {'A': 7, 'B': 6, 'C': 2, 'D': 1, 'E': 0}

print("Path:", a_star('A', 'E', graph, heuristic))
```

Output

```
Output

Path: ['A', 'B', 'D', 'E']

=== Code Execution Successful ===
```

Experiment 5: Backward Chaining

Aim

To implement backward chaining to prove a hypothesis.

Procedure

1. Start with the goal.
2. Search for rules that conclude the goal.
3. Recursively prove all conditions of those rules.
4. If all subgoals are proven, the goal is proven.

Code

```
class BC:
    def __init__(self, rules, facts):
        self.rules = rules  # {conclusion: [premises]}
        self.facts = set(facts)
    def prove(self, goal):
        if goal in self.facts:
            return True
        for conc, prem in self.rules.items():
            if conc == goal:
                if all(self.prove(p) for p in prem):
                    self.facts.add(goal)
                    return True
        return False
rules = {
    'flies': ['has_wings', 'is_bird'],
    'is_bird': ['has_feathers']
}
facts = ['has_feathers']
bc = BC(rules, facts)
print(f"Can 'flies' be proven? {bc.prove('flies')}")
print(f"Known facts after proving: {bc.facts}")
```

Output

Output

```
Can 'flies' be proven? False
Known facts after proving: {'has_feathers'}

=== Code Execution Successful ===
```

Experiment 6: Forward Chaining

Aim

To implement forward chaining to infer new facts.

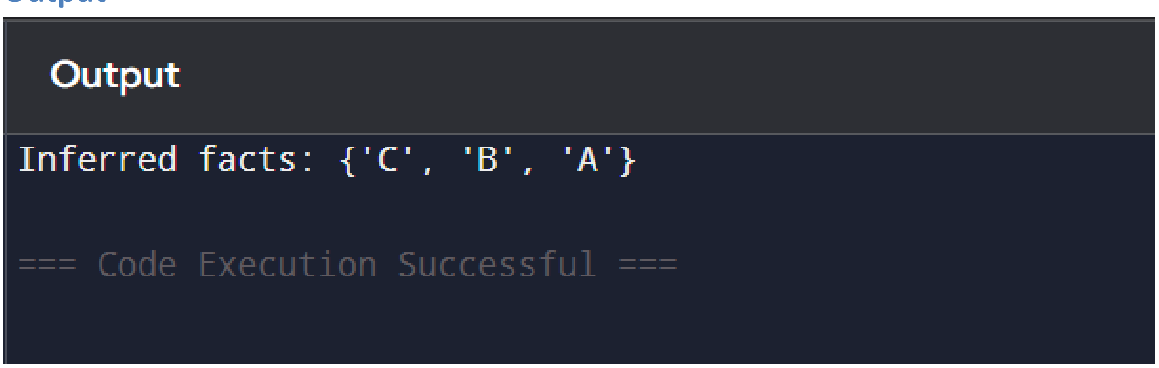
Procedure

1. Start with known facts.
2. Apply rules to infer new facts iteratively.
3. Stop when no more facts can be inferred or the goal is achieved.

Code

```
facts = {'A'}
rules = {
  'A': ['B'],
  'B': ['C']
}
inferred = set(facts)
while True:
  added = False
  for key, values in rules.items():
    if key in inferred:
      for value in values:
        if value not in inferred:
          inferred.add(value)
          added = True
  if not added:
    break
print("Inferred facts:", inferred)
```

Output



Experiment 7: Decision Tree

Aim

To implement a decision tree classifier.

Procedure

1. Import dataset and split into training/testing.
2. Train decision tree classifier.
3. Visualize the tree and evaluate accuracy.

Code

```
from sklearn import tree
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split

iris = load_iris()
X_train, X_test, y_train, y_test = train_test_split(iris.data, iris.target)
clf = tree.DecisionTreeClassifier()
clf.fit(X_train, y_train)
print("Accuracy:", clf.score(X_test, y_test))
```

Output

```
Accuracy: 0.9736842105263158
```

Experiment 8: K-means Algorithm

Aim

To implement K-means clustering algorithm.

Procedure

1. Initialize k centroids.
2. Assign points to the nearest centroid.
3. Update centroids based on mean of points.
4. Repeat until convergence.

Code

```
from sklearn.cluster import KMeans
import numpy as np

X = np.array([[1,2],[1,4],[1,0],
        [10,2],[10,4],[10,0]])
kmeans = KMeans(n_clusters=2)
kmeans.fit(X)
print("Centroids:", kmeans.cluster_centers_)
print("Labels:", kmeans.labels_)
```

Output

```
Centroids: [[ 1.  2.]
 [10.  2.]]
Labels: [0 0 0 1 1 1]
```