ARTIFICIAL INTELLIGENCE LAB
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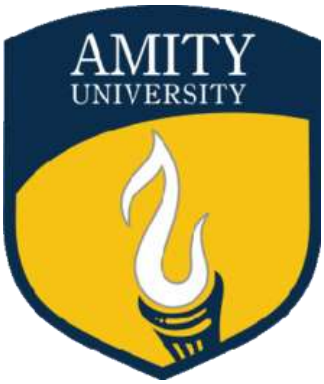

COURSE CODE- CSE 401
(B. TECH)

(Information Technology)

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EXPERIMENT – 1

Date – 19/01/2022

Aim: To implement a graph

Language Used: Python

Code:

```
n=int(input("enter the number of nodes:"))
mat=[]
for i in range (n):
    row1 = []
    for j in range(n):
        element = int(input("Press 1 if connected or Press 0 if not connected"))
        row1.append(element)
    mat.append(row1)
print(mat)
checka = 0
checkb = 0
checkc = 0
checkd = 0
checke = 0
checkf = 0
checkg = 0
for i in range(n):
    for j in range(n):
        if(mat[i][j]==1):
            if(i==0):
                node1='a'
                checka=checka+1
            elif(i==1):
                node1='b'
                checkb=checkb+1
```

```
elif(i==2):
    node1='c'
    checkc=checkc+1
elif(i==3):
    node1='d'
    checkd=checkd+1
elif(i==4):
    node1='e'
    checke=checke+1
elif(i==5):
    node1='f'
    checkf=checkf+1
elif(i==6):
    node1='g'
    checkg=checkg+1
if(j==0):
    node2='a'
elif(j==1):
    node2='b'
elif(j==2):
    node2='c'
elif(j==3):
    node2='d'
elif(j==4):
    node2='e'
elif(j==5):
    node2='f'
elif(j==6):
    node2='g'
print(node1 + "->" + node2)
```

```
print("number of edges from a =" + str(checka))
print("number of edges from b =" + str(checkb))
print("number of edges from c =" + str(checkc))
print("number of edges from d =" + str(checkd))
print("number of edges from e =" + str(checke))
print("number of edges from f =" + str(checkf))
print("number of edges from g =" + str(checkg))
```

Output:

```
[[0, 1, 1, 0, 0, 1, 0], [1, 0, 1, 0, 1, 0, 1], [1, 1, 0, 1, 0, 0, 0], [0, 0, 1, 0, 1, 1, 0], [0, 1, 0, 1, 0, 1, 1], [1, 0, 0,
1, 1, 0, 0], [0, 1, 0, 0, 1, 0, 0]]
a->b
a->c
a->f
b->a
b->c
b->e
b->g
c->a
c->b
c->d
d->c
d->e
d->f
e->b
e->d
e->f
e->g
f->a
f->d
f->e
g->b
g->e
number of edges from a =3
number of edges from b =4
number of edges from c =3
number of edges from d =3
number of edges from e =4
number of edges from f =3
number of edges from g =2
```

EXPERIMENT – 2

Date – 02/02/2022

Aim: To implement BFS search algorithm.

Language Used: Python

Code:

```
graph = {
  'A' : ['O','S','C'],
  'B' : ['F', 'P'],
  'O' : ['A','S'],
  'S' : ['A','O','F','R'],
  'C' : ['A','R','P'],
  'R' : ['S','C','P'],
  'P' : ['C','R','B'],
  'F' : ['S','B']
}

vlist = []
qlist = []

def bfs(vlist, graph, node):
    vlist.append(node)
    qlist.append(node)

    while qlist:
        s = qlist.pop(0)
        print (s, end = " ")

        for neighbour in graph[s]:
            if neighbour not in vlist:
                vlist.append(neighbour)
```

qlist.append(neighbour)

bfs(vlist, graph, 'A')

Output:

```
                vlist.append(neighbour)
                qlist.append(neighbour)


bfs(vlist, graph, 'A')
```

```
A O S C F R P B
```

EXPERIMENT – 3

Date – 02/02/2022

Aim: To implement DFS search algorithm

Language Used: Python

Code:

```
graph = {
  'A' : ['O','S','C'],
  'B' : ['F', 'P'],
  'O' : ['A','S'],
  'S' : ['A','O','F','R'],
  'C' : ['A','R','P'],
  'R' : ['S','C','P'],
  'P' : ['C','R','B'],
  'F' : ['S','B']
}
vset = set()
def dfs(vset, graph, node):
    if node not in vset:
        print (node)
        vset.add(node)
        if node=='B':
            print ("Reached the goal State")
        for neighbour in graph[node]:
                dfs(vset, graph, neighbour)
dfs(vset, graph, 'A')
```

Output:

```
A
O
S
F
B
Reached the goal State
P
C
R
```

EXPERIMENT – 4

Date – 09/02/2022

Aim: To implement Best First Search algorithm using priority queue

Language Used: Python

Code:

```
from queue import PriorityQueue
v = 14
graph = [[] for i in range(v)]
def best_first_search(source, target, n):
	visited = [False] * n
	pq = PriorityQueue()
	pq.put((0, source))
	while pq.empty() == False:
		u = pq.get()[1]
		print(u, end=" ")
		if u == target:
			break
		for v, c in graph[u]:
			if visited[v] == False:
				visited[v] = True
				pq.put((c, v))
	print()
def addedge(x, y, cost):
	graph[x].append((y, cost))
	graph[y].append((x, cost))
def prGraph(adj, V):
	for v in range(V):
		print("vertex " + str(v), end = ' ')
		for x in adj[v]:
			print("-> " + str(x), end = '')
```

```
                print()
        print()
addedge(0, 1, 3)
addedge(0, 2, 5)
addedge(0, 3, 6)
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)
source = 0
target = 13
best_first_search(source, target, v)
prGraph(graph,v)
```

Output:

```
0 1 0 2 3 8 9 11 13
vertex 0 -> (1, 3)-> (2, 5)-> (3, 6)
vertex 1 -> (0, 3)-> (4, 9)-> (5, 8)
vertex 2 -> (0, 5)-> (6, 12)-> (7, 14)
vertex 3 -> (0, 6)-> (8, 7)
vertex 4 -> (1, 9)
vertex 5 -> (1, 8)
vertex 6 -> (2, 12)
vertex 7 -> (2, 14)
vertex 8 -> (3, 7)-> (9, 5)-> (10, 6)
vertex 9 -> (8, 5)-> (11, 1)-> (12, 10)-> (13, 2)
vertex 10 -> (8, 6)
vertex 11 -> (9, 1)
vertex 12 -> (9, 10)
vertex 13 -> (9, 2)
```

EXPERIMENT – 5

Date – 16/02/2022

Aim: To implement Water Jug Problem

Language Used: Python

Code:

```
from collections import deque
def BFS(a, b, target):
    m = {}
    isSolvable = False
    path = []
    q = deque()
    q.append((0, 0))
    while (len(q) > 0):
        u = q.popleft()
        if ((u[0], u[1]) in m):
            continue
        if ((u[0] > a or u[1] > b or
            u[0] < 0 or u[1] < 0)):
            continue
        path.append([u[0], u[1]])
        m[(u[0], u[1])] = 1
        if (u[0] == target or u[1] == target):
            isSolvable = True
            if (u[0] == target):
                if (u[1] != 0):
                    path.append([u[0], 0])
            else:
                if (u[0] != 0):
                    path.append([0, u[1]])
            sz = len(path)
```

```
                for i in range(sz):
                        print("(", path[i][0], ",",
                                        path[i][1], ")")
                        break
                q.append([u[0], b]) # Fill Jug2
                q.append([a, u[1]]) # Fill Jug1
                for ap in range(max(a, b) + 1):
                        c = u[0] + ap
                        d = u[1] - ap
                        if (c == a or (d == 0 and d >= 0)):
                                q.append([c, d]
                        c = u[0] - ap
                        d = u[1] + ap
                        if ((c == 0 and c >= 0) or d == b):
                                q.append([c, d])
                q.append([a, 0])
                q.append([0, b])
        if (not isSolvable):
                print ("No solution")
if __name__ == '__main__':
        Jug1, Jug2, target = 4, 3, 2
        print("Path from initial state "
                "to solution state ::")
        BFS(Jug1, Jug2, target)
```

Output:

```
Path from initial state to solution state ::
( 0 , 0 )
( 0 , 3 )
( 4 , 0 )
( 4 , 3 )
( 3 , 0 )
( 1 , 3 )
( 3 , 3 )
( 4 , 2 )
( 0 , 2 )
```

EXPERIMENT – 6

Date – 02/03/2022

Aim: To implement A* algorithm for a given diagram

Language Used: Python

Code:

```
from collections import deque
class Graph:
    def __init__(self, adjac_lis):
        self.adjac_lis = adjac_lis

    def get_neighbors(self, v):
        return self.adjac_lis[v]
    def h(self, n):
        H = {
            'S': 20,
            'A': 10,
            'B': 8,
            'C': 7,
            'D': 6,
            'E': 4,
            'F': 2,
            'G': 0
        }
        return H[n]
    def a_star_algorithm(self, start, stop):
        open_lst = set([start])
        closed_lst = set([])
        poo = {}
        poo[start] = 0
        par = {}
```

```
par[start] = start
while len(open_lst) > 0:
    n = None
    for v in open_lst:
        if n == None or poo[v] + self.h(v) < poo[n] + self.h(n):
            n = v;
    if n == None:
        print('Path does not exist!')
        return None
    if n == stop:
        reconst_path = []
        while par[n] != n:
            reconst_path.append(n)
            n = par[n]
        reconst_path.append(start)
        reconst_path.reverse()
        print('Path found: {}'.format(reconst_path))
        return reconst_path
    for (m, weight) in self.get_neighbors(n):
        if m not in open_lst and m not in closed_lst:
            open_lst.add(m)
            par[m] = n
            poo[m] = poo[n] + weight
        else:
            if poo[m] > poo[n] + weight:
                poo[m] = poo[n] + weight
                par[m] = n
                if m in closed_lst:
                    closed_lst.remove(m)
                    open_lst.add(m)
```

```
            open_lst.remove(n)
            closed_lst.add(n)
        print('Path does not exist!')
        return None
adjac_lis = {
    'S': [('A', 2), ('B',6 ), ('C', 3)],
    'A': [('B', 2), ('G',10 )],
    'B': [('D', 4)],
    'C': [('D', 8), ('E',9 )],
    'D': [('F', 1)],
    'E': [('G', 3)],
    'F': [('G', 2)]
}
graph1 = Graph(adjac_lis)
graph1.a_star_algorithm('S','G')
```

Output:

```
Path found: ['S', 'A', 'G']
Out[6]: ['S', 'A', 'G']
```

EXPERIMENT – 7

Date – 09/03/2022

Aim: To implement Knapsack problem using Hill Climbing search

Language Used: Python

Code:

```
w = [40
,54,10,40,12]
p = [35,50,8,20,3]
M=100
x=[]
Knapsack = []
Tprofit = 0
perprofit = 0
for i in range(0,5):
    x.append([p[i]/w[i],i])
x.sort(reverse=True)
print("list in decending order of profit/weight ratio:")
print(x)
for i in x:
    for j in i:
        if type(j) == float:
            continue
        else:
            if M>0:
                if M>w[j]:
                    Knapsack.append(j)
                    Tprofit=Tprofit+p[j]
                    M=M-w[j]
                    print(j)
                else:
```

```
            Knapsack.append([j,M])
            perprofit=(p[j]/w[j])*M
            Tprofit=Tprofit+perprofit
            M=0
        else:
            continue
print("total profit:", Tprofit)
print("item number and its weight that are included in the Knapsack:", Knapsack)
```

Output:

```
list in decending order of profit/weight ratio:
[[0.9901960784313726, 0], [0.9259259259259259, 1], [0.8, 2], [0.5, 3], [0.25, 4]]
total profit: 99.01960784313727
item number and its weight that are included in the Knapsack: [[0, 100]]
```

EXPERIMENT – 8

Date – 15/03/2022

Aim: To implement Tic-Tac-Toe Game

Language Used: Python

Code:

```
def Validate(list):
    s=0
    if list[0]=="" or list[1]=="" or list[2]=="" or list[3]=="" or list[4]=="" or list[5]=="" or list[6]=="" or list[7]=="" or list[8]=="":
        if list[0]==list[1]==list[2]=='X' or list[3]==list[4]==list[5]=='X' or list[6]==list[7]==list[8]=='X' or list[0]==list[3]==list[6]=='X' or list[1]==list[4]==list[7]=='X' or list[2]==list[5]==list[8]=='X' or list[0]==list[4]==list[8]=='X' or list[2]==list[4]==list[6]=='X':
            s=1
            return s
        elif list[0]==list[1]==list[2]=='O' or list[3]==list[4]==list[5]=='O' or list[6]==list[7]==list[8]=='O' or list[0]==list[3]==list[6]=='O' or list[1]==list[4]==list[7]=='O' or list[2]==list[5]==list[8]=='O' or list[0]==list[4]==list[8]=='O' or list[2]==list[4]==list[6]=='O':
            s=2
            return s
        else:
            s=3
            return s
    else:
        if list[0]==list[1]==list[2]=='X' or list[3]==list[4]==list[5]=='X' or list[6]==list[7]==list[8]=='X' or list[0]==list[3]==list[6]=='X' or list[1]==list[4]==list[7]=='X' or list[2]==list[5]==list[8]=='X' or list[0]==list[4]==list[8]=='X' or list[2]==list[4]==list[6]=='X':
            s=4
            return s
        elif list[0]==list[1]==list[2]=='O' or list[3]==list[4]==list[5]=='O' or list[6]==list[7]==list[8]=='O' or list[0]==list[3]==list[6]=='O' or list[1]==list[4]==list[7]=='O'
```

```
or list[2]==list[5]==list[8]=='O' or list[0]==list[4]==list[8]=='O' or
list[2]==list[4]==list[6]=='O':
            s=5
            return s
        else:
            s=6
            return s
import numpy as np
list = [" "," "," "," "," "," "," "," "," "]
for i in range(9):
    if i<3:
        j=0
        list[i]= input("enter X, O or space for postions ({},{}): ".format(j,i))
    elif i>=3 and i<6:
        j=1
        list[i]= input("enter X, O or space for postions ({},{}): ".format(j,i-3))
    elif i>=6 and i<9:
        j=2
        list[i]= input("enter X, O or space for postions ({},{}): ".format(j,i-6))
situation=Validate(list)
ttt= np.array(list).reshape(3,3)
if situation==1 or situation==4:
    print("Player X won! ")
elif situation==2 or situation==5:
    print("Player O won! ")
elif situation==3:
    print("Match is not complete ")
elif situation==6:
    print("Match Draw ")
print(ttt)
```

Output:

```
enter X, O or space for postions (0,0): X
enter X, O or space for postions (0,1): X
enter X, O or space for postions (0,2): X
enter X, O or space for postions (1,0): O
enter X, O or space for postions (1,1): O
enter X, O or space for postions (1,2): X
enter X, O or space for postions (2,0): O
enter X, O or space for postions (2,1): X
enter X, O or space for postions (2,2): O
Player X won!
[['X' 'X' 'X']
 ['O' 'O' 'X']
 ['O' 'X' 'O']]
```

EXPERIMENT – 9

Date – 30/03/2022

Aim: To implement natural language processing using natural language toolkit (nltk)

Language Used: Python

Code:

Importing the nltk toolkit

```
import nltk
nltk.download("book")
```

Tokenizer

```
sentence="educator is educating the students in educational institute educator"
tokens = nltk.word_tokenize(sentence)
print(tokens)
tagged = nltk.pos_tag(tokens)
print(tagged)
```

Stemming

```
from nltk.stem import PorterStemmer
from nltk.tokenize import word_tokenize
ps = PorterStemmer()
for t in tokens:
    print(t, " : ", ps.stem(t))
```

Lemmatizer

```
from nltk.stem import WordNetLemmatizer
lemmatizer = WordNetLemmatizer()
for t in tokens:
    print(t, " : ",lemmatizer.lemmatize(t))
```

Word Count

```
wordCount=0
for t in tokens:
  for t1 in tokens:
    if t==t1:
      wordCount=wordCount+1

  print("the word " + t + " has a count = {}".format(wordCount))
  wordCount=0
```

Output:

i. Tokenizer

```
['Educator', 'is', 'educating', 'the', 'students', 'in', 'educational', 'institute', 'Educator']
[('Educator', 'NN'), ('is', 'VBZ'), ('educating', 'VBG'), ('the', 'DT'), ('students', 'NNS'), ('in', 'IN'), ('educational', 'J
J'), ('institute', 'NN'), ('Educator', 'NN')]
```

ii. Stemmer

```
Educator  :  educ
is  :  is
educating  :  educ
the  :  the
students  :  student
in  :  in
educational  :  educ
institute  :  institut
Educator  :  educ
```

iii. Lammatizer

```
Educator  :  Educator
is  :  is
educating  :  educating
the  :  the
students  :  student
in  :  in
educational  :  educational
institute  :  institute
Educator  :  Educator
```

iv. Word Count

```
the word Educator has a count = 2
the word is has a count = 1
the word educating has a count = 1
the word the has a count = 1
the word students has a count = 1
the word in has a count = 1
the word educational has a count = 1
the word institute has a count = 1
the word Educator has a count = 2
```

EXPERIMENT – 10

Date – 06/04/2022

Aim: To implement Constraint Satisfaction Problem (Graph colouring)

Language Used: Python

Code:

```
class Graph:
    def __init__(self, edges, n):
        self.adjList = [[] for _ in range(n)]
        for (src, dest) in edges:
            self.adjList[src].append(dest)
            self.adjList[dest].append(src)


def colorGraph(graph, n):
    result = {}
    for u in range(n):
        assigned = set([result.get(i) for i in graph.adjList[u] if i in result])
        color = 1
        for c in assigned:
            if color != c:
                break
            color = color + 1
        result[u] = color
    for v in range(n):
        print(f'Color assigned to vertex {v} is {colors[result[v]]}')




if __name__ == '__main__':
    colors = ['', 'BLUE', 'GREEN', 'RED']
    edges = [(0, 1), (0, 2), (0, 4), (0, 5), (1, 3), (2, 3), (2, 6), (3, 4),(4,5)]
```

```
n = 7
graph = Graph(edges, n)
colorGraph(graph, n)
```

Output:

```
Color assigned to vertex 0 is BLUE
Color assigned to vertex 1 is GREEN
Color assigned to vertex 2 is GREEN
Color assigned to vertex 3 is BLUE
Color assigned to vertex 4 is GREEN
Color assigned to vertex 5 is RED
Color assigned to vertex 6 is BLUE
```