Sir Syed C@SE Institute of Technology, Islamabad

Midterm Exam – Spring 2024

AI 2303 Artificial Intelligence

Total Marks: 30 **Time Allowed: 60 min.**

Q Marks

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1 a) Shows the output of the following codes: [CLO1, C3] 10

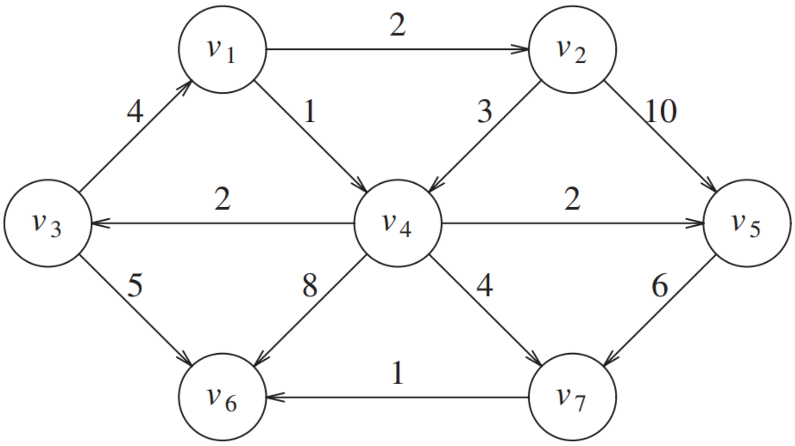
i.
```
a = {n:n*n for n in range(1,11)}
print(a)
```

Solution: {1: 1, 2: 4, 3: 9, 4: 16, 5: 25, 6: 36, 7: 49, 8: 64, 9: 81, 10: 100}

ii.
```
import numpy as np
a= np.array([(2,4,6),(3,6,9)])
print(a.sum(axis=1))
```

Solution: [12 18]

b) Consider the following graph and apply Depth First Search (DFS) on this. The starting node for the DFS is V_3. [CLO1, C3]



Solution: One of the solution is given below. The solution may different depending upon the order you push the nodes into the stack

Boolean Visited Array

V_1	V_2	V_3	V_4	V_5	V_6	V_7
T	T	T	T	T	T	T

Stack

	~~V_2~~	~~V_5~~	~~V_7~~
~~V_1~~	V_4	V_4	~~V_4~~
V_6	V_6	V_6	~~V_6~~

Output: V_3, V_1, V_2, V_5, V_7, V_4, V_6

2 a) Solve 8-puzzle problem by using A* search. The initial state and goal state is given below. [CLO1, C3] 10

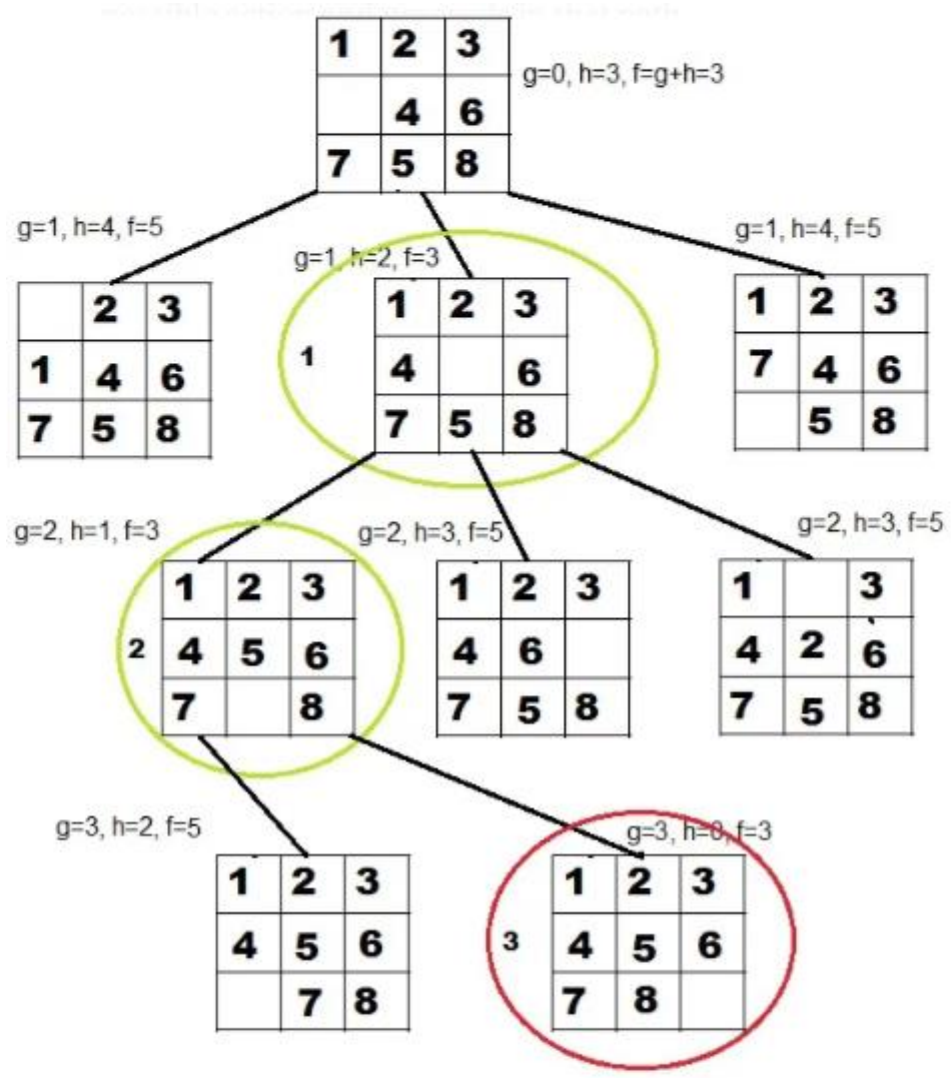
Initial State

1	2	3
	4	6
7	5	8

Goal State

1	2	3
4	5	6
7	8	

Solution:



Goal State

b) The table below gives the number of hours spent studying for a science exam (x) and the final exam grade (y).

X	2	5	1	0	4	2	3
Y	77	92	70	63	90	75	84

Compute a linear equation for the dataset and predict the exam grade of a student who studied for 6 hours. [CLO2, C3]

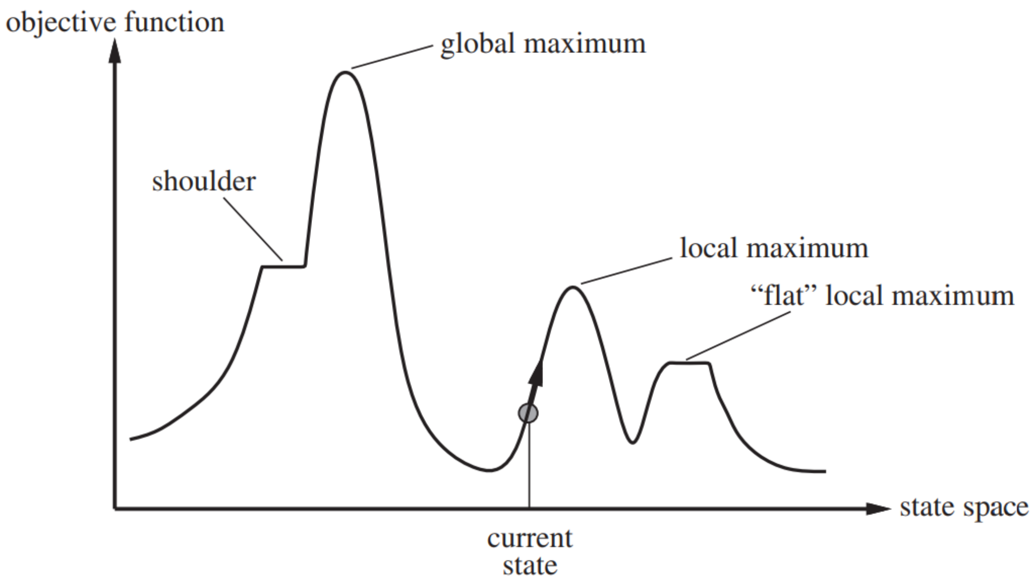
Solution:

Equation: $y = 6x + 64$ Grade expected: $y = 6(6) + 64 = 100$

3 a) Explain the hill climbing search. [CLO2, C3] 10

Solution:

The hill-climbing search algorithm (steepest-ascent version) is shown in below Figure. It is simply a loop that continually moves in the direction of increasing value that is, uphill. It terminates when it reaches a "peak" where no neighbor has a higher value. The algorithm does not maintain a search tree, so the data structure for the current node need only record the state and the value of the objective function. Hill climbing does not look ahead beyond the immediate neighbors of the current state. This resembles trying to find the top of Mount Everest in a thick fog while suffering from amnesia.



Unfortunately, hill climbing often gets stuck for the following reasons:

Local maxima: a local maximum is a peak that is higher than each of its neighboring states but lower than the global maximum.
Ridges: Ridges result in a sequence of local maxima that is very difficult for greedy algorithms to navigate.
Plateaux: a plateau is a flat area of the state-space landscape. It can be a flat local maximum, from which no uphill exit exists, or a shoulder, from which progress is possible.

b) Let $u = (-2, 1, 3, 0)$, $v = (0, -3, 1, -6)$ and $w = (-2, -4, 0, 2)$ are the set of vectors in R^4, Describe that theses vectors are orthogonal or not. [CLO2, C3]

Solution:

We say that a set of vectors $\{v_1, v_2, ..., v_n\}$ are mutually orthogonal if every pair of vectors is orthogonal.
i.e. $v_i.v_j = 0$, for all $i \neq j$.

$u.v = (-2, 1, 3, 0) \text{ x } (0, -3, 1, -6) = 0$

$v.w = (0, -3, 1, -6) \text{ x } (-2, -4, 0, 2) = 0$

$u.w = (-2, 1, 3, 0) \text{ x } (-2, -4, 0, 2) = 0$

** The End **