Shiv Nadar University, Chennai

School of Engineering

Department of Computer Science

CS1802 -- Programming in Python Lab Class: 2024-2028 B. Tech CSE (Cyber)

Date: 16/04/2025 Continuous Lab Evaluation – 11 (10 Marks)

Statement: The transportation problem is an optimization problem with a linear objective function and linear constraints.

History: People thought the transportation problem up early in the Second World War. It was used to determine how to move troops (located, for example, at training basis in different parts of the United States) to battlegrounds in Europe and Asia.

The Assignment Problem is a special case of the transportation problem in which there are equal numbers of supply and demand centres, and that all demands and supplies are equal to one.

Task: Develop a python program to find an optimal assignment between X variables and Y variables
Please refer sample.txt for sample inputs.
Make use of following functions accordingly.

```
import numpy as np
file_pointer = open('sample1.txt')
array = [[x for x in line.split()] for line in file_pointer]
print(array[0][0]);
....
....
....
....
....
```

Algorithm Steps:

First Case:

This is the original cost matrix:

71	84	12	24
65	75	39	43
63	4	21	84
48	56	39	50

Subtract row minima

We subtract the row minimum from each row:

59	72	0	12	(-12)
26	36	0	4	(-39)
59	0	17	80	(-4)
9	17	0	11	(-39)

Subtract column minima

We subtract the column minimum from each column:

50	72	0	8
17	36	0	0
50	0	17	76
0	17	0	7
(-9)			(-4)

Cover all zeros with a minimum number of lines

There are 4 lines required to cover all zeros:

50	**72**	**0**	**8**	**x**
17	**36**	**0**	**0**	**x**
50	**0**	**17**	**76**	**x**
0	**17**	**0**	**7**	**x**

The optimal assignment

Because there are 4 lines required, the zeros cover an optimal assignment:

50	72	**0**	8
17	36	0	**0**
50	**0**	17	76
0	17	0	7

This corresponds to the following optimal assignment in the original cost matrix:

71	84	**12**	24
65	75	39	**43**
63	**4**	21	84
48	56	39	50

The optimal value equals 107.

Second Case:

This is the original cost matrix:

30	67	58	75	93
85	8	16	95	74
54	22	66	80	98
91	16	12	51	32
99	25	92	87	15

Subtract row minima

We subtract the row minimum from each row:

0	37	28	45	63	(-30)
77	0	8	87	66	(-8)
32	0	44	58	76	(-22)
79	4	0	39	20	(-12)
84	10	77	72	0	(-15)

Subtract column minima

We subtract the column minimum from each column:

0	37	28	6	63
77	0	8	48	66
32	0	44	19	76
79	4	0	0	20
84	10	77	33	0
			(-39)	

Cover all zeros with a minimum number of lines

There are 4 lines required to cover all zeros:

0	**37**	**28**	**6**	**63**	x
77	**0**	8	48	66	
32	**0**	44	19	76	
79	**4**	**0**	**0**	**20**	x
84	**10**	**77**	**33**	**0**	x
	x				

Create additional zeros

The number of lines is smaller than 5. The smallest uncovered number is 8. We subtract this number from all uncovered elements and add it to all elements that are covered twice:

0	45	28	6	63
69	0	0	40	58
24	0	36	11	68
79	12	0	0	20
84	18	77	33	0

Cover all zeros with a minimum number of lines

There are 5 lines required to cover all zeros:

0	**45**	**28**	**6**	**63**	**x**
69	**0**	**0**	**40**	**58**	**x**
24	**0**	**36**	**11**	**68**	**x**
79	**12**	**0**	**0**	**20**	**x**
84	**18**	**77**	**33**	**0**	**x**

The optimal assignment

Because there are 5 lines required, the zeros cover an optimal assignment:

0	45	28	6	63
69	0	**0**	40	58
24	**0**	36	11	68
79	12	0	**0**	20
84	18	77	33	**0**

This corresponds to the following optimal assignment in the original cost matrix:

30	67	58	75	93
85	8	**16**	95	74
54	**22**	66	80	98
91	16	12	**51**	32
99	25	92	87	**15**

The optimal value equals 134.