PES UNIVERSITY

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GRAPH THEORY AND ITS APPLICATIONS

UE20CS323

ASSIGNMENT-CODE REPORT

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SECTION : 'F'

TITLE : PROBLEM 11

PROBLEM STATEMENT : There are m vacant positions and m applicants for these vacant positions. Salary expectations and proficiency in executing a job of every applicant is taken as input. It is not mandatory that every applicant is suitable for available vacant posts. Model the problem and apply Hungarian method to find the optimal assignment.

ALGORITHM

1. Take the number of job applicants which is same as number of jobs as input.
2. Now take m salary expectations and m proficiency inputs for each applicant, till the m^{th} applicant, after which we get a Salary Expectation matrix S and Proficiency matrix P
3. Create a cost matrix C by taking an element-wise division of proficiency and salary expectation, i.e.
   C[i][j] = P[i][j] / S[i][j] , this is to give importance to the proficiency of the applicant.
4. Reduce the rows by subtracting the minimum value of each row from that row of the Cost matrix.
5. If there are columns without a zero, reduce the columns by subtracting the minimum value of each column from that column of the Cost matrix.
6. Cover the zero elements with the minimum number of lines it is possible to cover them with. For this line, create a Boolean matrix for the number of minimum zeros available and label them as true. (If the number of lines is equal to the number of rows then go to step 10)
7. Add the minimum uncovered element to every covered element. If an element is covered twice, add the minimum element to it twice.
8. Subtract the minimum element from every element in the matrix.
9. Cover the zero elements again. If the number of lines covering the zero elements is not equal to the number of rows, return to step 7.
10. Select a matching by choosing a set of zeros so that each row or column has only one selected.
11. Apply the matching to the original matrix, disregarding dummy rows. This shows who should do which activity, and adding the costs will give the total minimum cost.

12. Now with the help of networkx we draw a bipartite graph of applicants on the left and jobs on the right and show the matching.

OUTPUT SCREENSHOTS

- The input matrices for the problem:

```
The Salary Expectation Matrix is:

[[300. 100. 150.]
 [200. 350. 250.]
 [400. 200. 100.]]

The Proficiency Matrix is:

[[10.  6.  4.]
 [ 5.  8.  2.]
 [ 4.  9.  7.]]
```

- The intermediate cost matrix generated:

```
The Cost Matrix is:

[[0.03333333 0.06       0.02666667]
 [0.025      0.02285714 0.008     ]
 [0.01       0.045      0.07      ]]
```

- The assignment obtained after the Hungarian method:

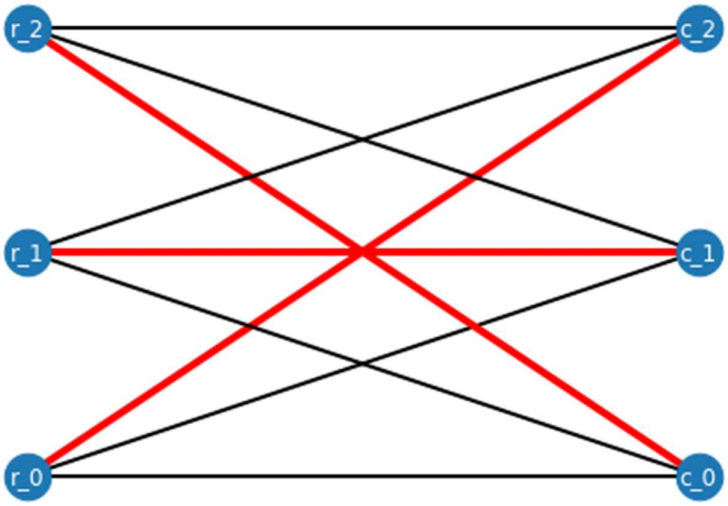
```
The final assignment is: [(0, 2), (1, 1), (2, 0)]
[[0.03333333 0.06       0.02666667]
 [0.025      0.02285714 0.008     ]
 [0.01       0.045      0.07      ]]
```

- The total cost for the assignment:

```
The total cost of the assignment is 0.05952380952380953
```

- Plotting the assignment obtained with a bipartite graph using network

```
The final assignment is (0, 2), (1, 1), (2, 0)
The total cost of the assignment is 0.05952380952380953.
```



THANK YOU