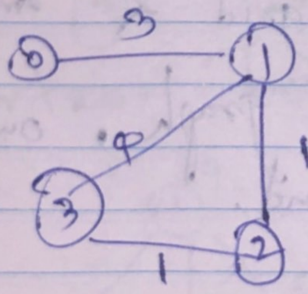
*Find the City With the Smallest Number of Neighbors at a Threshold Distance



use Floyd-Warshall's algorithm
(a shortest path / minimum distance algorithm)

$$\text{graph}^{\text{'initial'}} = \begin{array}{c|c} & \begin{matrix} 0 & 1 & 2 & 3 \end{matrix} \\ \hline \begin{matrix} 0 \\ 1 \\ 2 \\ 3 \end{matrix} & \begin{bmatrix} 0 & 3 & \alpha & \alpha \\ 3 & 0 & 1 & 4 \\ \alpha & 1 & 0 & 1 \\ \alpha & 4 & 1 & 0 \end{bmatrix} \end{array}$$

$$\text{graph}[i,j] = \min\{\text{graph}[i,j],\ \text{graph}[i,k] + \text{graph}[k,j]\}$$

$$\text{graph}^0 = \begin{array}{c|c} & \begin{matrix} 0 & 1 & 2 & 3 \end{matrix} \\ \hline \begin{matrix} 0 \\ 1 \\ 2 \\ 3 \end{matrix} & \begin{bmatrix} 0 & 3 & \alpha & \alpha \\ 3 & 0 & 1 & 4 \\ \alpha & 1 & 0 & 1 \\ \alpha & 4 & 1 & 0 \end{bmatrix} \end{array}$$

same

same

0

$\text{graph}[0,2] = \min(\text{graph}[0,2],$
$\text{graph}[0,0] + \text{graph}[0,2])$

$\text{graph}[1,2] = \min(\text{graph}[1,2],$
$3 + \alpha)$

$$\text{graph}^1 = \begin{array}{c|c} & \begin{matrix} 0 & 1 & 2 & 3 \end{matrix} \\ \hline \begin{matrix} 0 \\ 1 \\ 2 \\ 3 \end{matrix} & \begin{bmatrix} 0 & 3 & 4 & 7 \\ 3 & 0 & 1 & 4 \\ 4 & 1 & 0 & 1 \\ 7 & 4 & 1 & 0 \end{bmatrix} \end{array}$$

$g(0,3) = \min(g(0,3),$
$g(0,1) + g(1,3))$

$$\text{graph}^2 = \begin{bmatrix} 0 & 3 & 4 & 5 \\ 3 & 0 & 1 & 2 \\ 4 & 1 & 0 & 1 \\ 5 & 2 & 1 & 0 \end{bmatrix}$$

threshold $= 4$

count

$$\text{graph}^3 = \begin{bmatrix} 0 & 3 & 4 & 5 \\ 3 & 0 & 1 & 2 \\ 4 & 1 & 0 & 1 \\ 5 & 2 & 1 & 0 \end{bmatrix} \begin{matrix} \to 2 \\ \to 3 \\ \to 3 \\ \to 2 \end{matrix}$$

Floyd-warshall's → find shortest distance between every pair of vertices

$O(n^2 \times n) = O(n^3)$

$O(n^2)$

No. .... Date. ....

- Or we can use dijkstra algorithm. from each vertex calculate min distance to each other. Then count the # ~~of~~ of less than threshold.

$O(v^3)$ $O(v^2)$