

In your network security term project, you are tasked with planning a network attack. You propose a method to your friends that aims to maximize the speed of infecting the whole network. Given a network, you will first calculate the *infection_score* for each node, which represents *how fast the whole network will be infected if you only infect the selected node*.

The network is represented as a directed, weighted graph, where the weights of each edge represent how long it takes the network to deliver a package between the two nodes, i.e. the vertices of that edge. For node count N , and the maximum shortest path distance in the graph between any pair (i,j) as $MaxDist$, *infection_score* "IS" is defined as follows:

Infection score (IS) for node i:

$$IS(i) = \frac{1}{AIS(i)}$$

Average infection speed (AIS) for node i:

$$AIS(i) = \frac{\sum_{j=0, j \neq i}^N SP(i, j)}{N - 1}$$

Definition of $SP(i, j)$:

$$SP(i, j) = \begin{cases} MaxDist + 1 & \text{if there is no path between } (i, j) \\ \text{shortest distance between } (i, j) & \text{otherwise} \end{cases}$$

Problem

In this exam, you are asked to calculate the *infection_scores* given the *network* as a directed, weighted graph by completing the *get_infection_scores()* function defined below.

```
void get_infection_scores(const std::vector< std::vector<std::pair<int,
int>>> &network, std::vector<double> infection_scores);
```

- *network*: Graph adjacency list
- *infection_scores*: Calculated infection scores (IS) of each node, ordered by node ID.

Constraints and Hints:

- Carefully examine the definition of $SP(i,j)$. SP returns the shortest directed path distance between two nodes (i,j) . If there is no directed path between (i,j) , instead, it returns the maximum shortest distance in the network between any two pairs + 1. This way, nodes are penalized for not having a connection to other nodes.
- Be careful when calculating the average infection speed AIS . You should not include a self-path for a node in your calculation, and hence, you should divide the sum of $SP(i,j)$ by $N-1$.
- Limits for N where $1 < N \leq 500$.
- The weight w of each edge is between $1 \leq w \leq 50$