

C++ Fundamentals – Regular Exam – 10 February 2024

Please submit your source code to all below-described problem in [Judge](#).

1. Space Travel

You're one of the science officers of a space carrier: a huge ship, which visits unknown solar systems and obtains astronomical data about them. You must write a program, which will analyze the live data of solar's system orbiting bodies and will be able to execute commands and return data results.

Input

Your program receives the following input data:

1. The names of the bodies of the system, each one on a single row. If the name equals "END", that means all the names of the solar system are received.
 - a. The first name is **always** the name of the Star of the solar system.
 - b. Names of the bodies will **never** contain a space.
 - c. There will be no more than 20 bodies in each solar system, including the main star.
2. After the names, you will receive a square matrix of integers, which gives the "time to travel" between each one of the bodies (in hours).
 - a. Due to specifics of the space travel, travelling from A to B may take 40 hours, but at the same time travelling from B to A may take 24 hours, e.g. the matrix is not symmetrical!
3. After the travel data, you will receive a number of rows with names of the bodies, each separated with space. Each row describes a path in the system, which passes around each one of the bodies.
4. If you read a row that says "END".

Output

1. After you read the travel time matrix (point 2 above), find out and print:
 - a. The shortest time to travel between two single points in the system, e.g. from which point to which point would take the least time to travel.
 - b. The longest time to travel between two single points in the system.
 - c. **Note:** there might be more then one shortest and/or longest routes. In this case you must print all of them.
2. After you read each row of travel itinerary (point 3 above), calculate the total time, needed to travel for the row, and print it out on a single row
3. After the input finishes (after the last END), print out the sum of all travel routes.

Hints:

1. You will need to remember the order, in which your bodies come.
2. You will need a square matrix of integers, in which the index of each element is the index of the body in the initial list. Remember how to find an element's index in a vector (the input vector of all bodies), and use that index in the matrix.

Example 1

Input	Explanation
<pre> Betelgeuse Planet1 Planet2 Planet3 END 0 2 5 7 2 0 4 9 3 1 0 5 9 4 3 0 Planet3 Planet2 Betelgeuse Planet1 Planet3 Planet3 Planet2 Planet3 Planet1 Betelgeuse END </pre>	<p>The system contains the star Betelgeuse and three planets Planet1, Planet2, Planet3.</p> <p>The time to travel is from Betelgeuse to each of the planets: 2 5 7 (the first row of the matrix), from Planet1 to each other body 2 4 9 (the second row of the matrix), etc.</p> <p>Please note the zeroes in the diagonal: this is because the time to travel from each body to itself is 0 (we're already there).</p> <p>After the time matrix we have three routes:</p> <ol style="list-style-type: none"> 1. "Planet3 Planet2" 2. "Betelgeuse Planet1 Planet3" 3. "Planet3 Planet2 Planet3 Planet1 Betelgeuse"
Output	Explanation
<pre> 1: Planet2 -> Planet1 9: Planet1 -> Planet3 9: Planet3 -> Betelgeuse </pre>	<p>The shortest route is from Planet2 to Planet1 (1).</p> <p>The longest routes (9) are from Planet1 Planet3, and from Planet3 to Betelgeuse.</p>
<pre> 3 11 14 28 </pre>	<p>The three routes have the following lengths:</p> <ol style="list-style-type: none"> 1. "Planet3 Planet2" is 3: <pre> 0 2 5 7 2 0 4 9 3 1 0 5 9 4 3 0 </pre> 2. "Betelgeuse Planet1 Planet3" is 2 + 9 = 11: <pre> 0 2 5 7 2 0 4 9 3 1 0 5 9 4 3 0 </pre> 3. "Planet3 Planet2 Planet3 Planet1 Betelgeuse" takes 3 + 5 + 4 + 2 = 14 <pre> 0 2 5 7 2 0 4 9 3 1 0 5 9 4 3 0 </pre> <p>After you receive the last END, the sum of all the routes is 3 + 11 + 14 = 28.</p>

Example 2

Input	Output
Tatoo	1: Planet3 -> Tatooine
Tatooine	11: PlanetX -> Planet3
Planet3	13
PlanetX	8
END	21
0 3 7 4	
2 0 4 2	
5 1 0 9	
3 8 11 0	
Tatooine Planet3 PlanetX	
PlanetX Tatooine	
END	

Example 3

Input	Output
Astra	1: Nebulo -> Astra
Nebulo	1: Nebulo -> Vortex
Quasar	1: Quasar -> Cosmos
Vortex	1: Pulsar -> Quasar
Pulsar	1: Galaxia -> Vortex
Galaxia	9: Nebulo -> Quasar
Cosmos	9: Vortex -> Nebulo
END	9: Pulsar -> Galaxia
0 4 8 5 7 3 7	9: Cosmos -> Nebulo
1 0 9 1 3 7 4	13
5 2 0 7 8 3 1	11
7 9 8 0 2 5 8	22
3 3 1 5 0 9 7	17
3 5 3 1 5 0 7	18
2 9 5 6 4 7 0	81
Astra Nebulo Quasar	
Vortex Pulsar Galaxia	
Cosmos Astra Nebulo Quasar Vortex	
Pulsar Cosmos Galaxia Astra	
Nebulo Quasar Cosmos Vortex Pulsar	
END	