32 Fast and cheap

20 points

Introduction

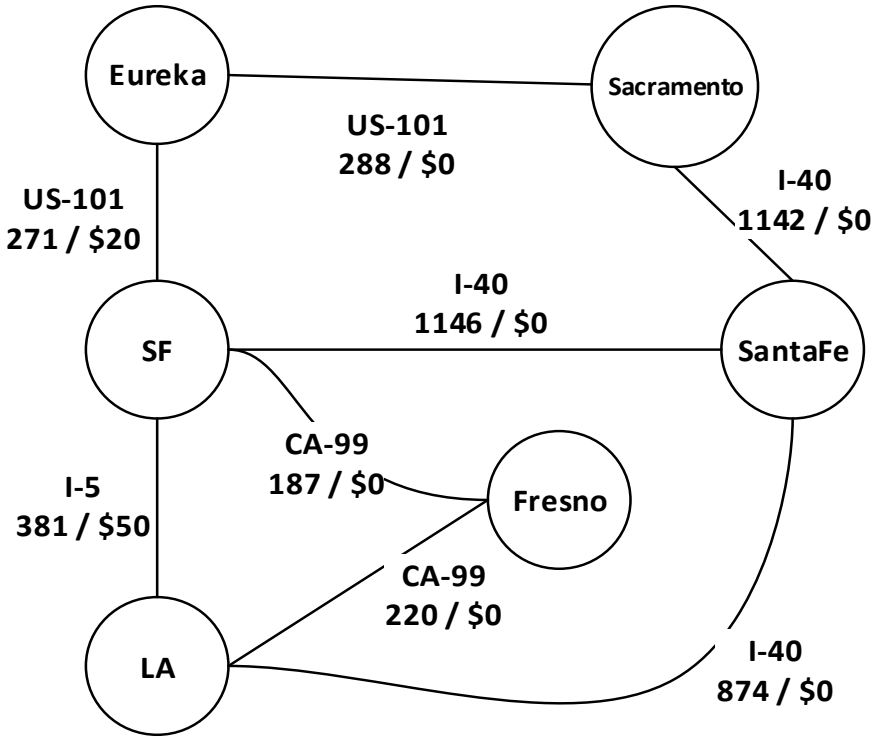
A transportation planner is interested in knowing the cheapest way (considering both fuel and the toll costs) to get between any two cities and wants you to develop a program to do so. The cost to travel between two cities is computed by the following formula:

$$Travel\ Cost = \frac{Distance}{Fuel\ Efficiency} * Gas + Toll$$

Where:

- Travel Cost is the final travel cost in US dollars.
- Distance is the distance between the places in miles.
- Fuel Efficiency is the car efficiency in miles per gallon.
- Gas is the cost is the cost of the gasoline in dollars per gallon.
- Toll is the cost in US dollars of the possible tolls the road may have.

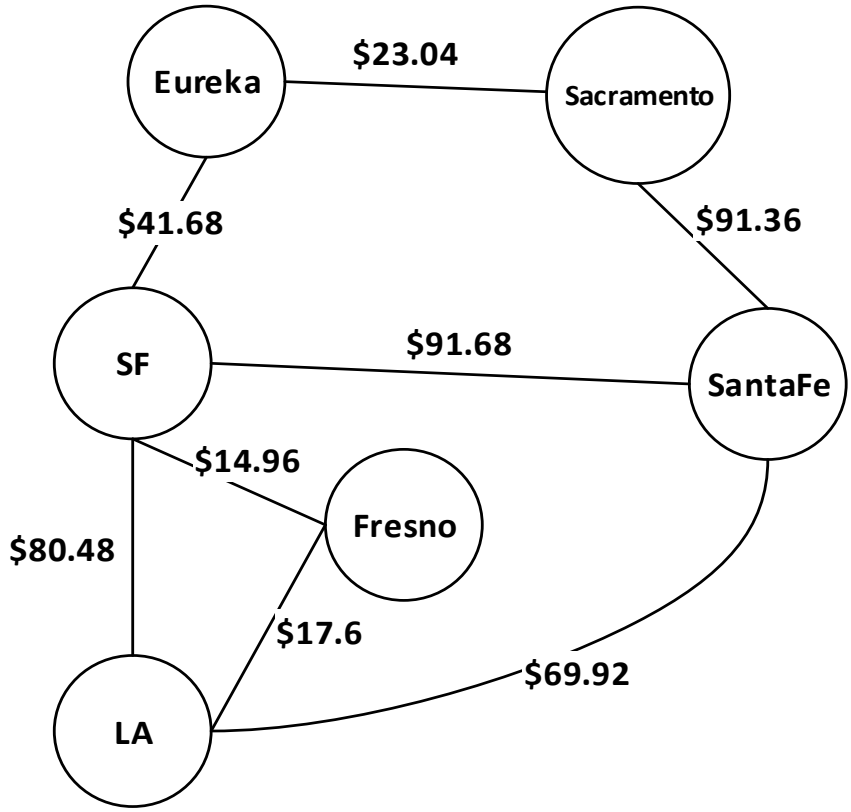
For example, consider this simple road system where the nodes represent a city and the edges joining them represent a bidirectional road. In each road segment you have, there is a distance in miles and a toll cost in dollars.



Assuming that a car has a fuel economy of 25 miles per gallon and the cost of the fuel is $2 per gallon, we can compute the travel cost to travel from San Francisco (SF) to Los Angeles (LA) as:

$$Travel\ Cost = \frac{381}{25} * 2 + 50 = 80.48\ dollars$$

Now we can compute the cost of each segment in the previous road system that will be



The minimum cost to travel from Eureka to LA would be 74.24 dollars travelling through the following roads:

1. $41.68 using US-101 from Eureka to SF.
2. $14.96 using CA-99 from SF to Fresno.
3. $17.6- using CA-99 from Fresno to LA.

Important Considerations:

- If there are two solutions that have the same exact cost you need to choose the one according to the following rule:
  i. Pick first the trip that has the minimal distance travelled.
  ii. If the distance travelled is the same, pick the one that visits less cities.
  iii. If the number of cities visited are the same, pick the trip that has a total lower toll cost.
- All the inputs and outputs to the programs will be correct, so there is no need to check that cities are defined or duplicated, check for white spaces or strange characters in the city names, negative mileages or toll costs…

Input

The input to your program will consist of one data set of in the following format:

1. A floating point number that indicates the fuel efficiency in miles per gallon.
2. A floating point number that indicates the gas cost in dollars per gallon.
3. An integer `N` that indicates the number of cities in the system, followed by the `N` names of the cities, each of them placed in a different line.
4. An integer `M` that indicates the number of roads in the system follow by `M` road definitions containing 5 items:
   i. The road city of origin as string.
   ii. The road city of destination as a string.
   iii. The road name as a string.
   iv. The road mileage as a floating point number.
   v. The road toll as a floating point number.
5. An integer `T` that indicates the number of trips to compute, followed by the `T` names of the origin and destination cities placed in a different line each.

```
25.0                                    ← fuel efficiency in miles per gallon.
2.0                                     ← fuel cost dollars per gallon.
6                                       ← 6 cites followed its names.
Eureka
Sacramento
SF
SantaFe
Fresno
LA
8                                       ← 8 roads segments.
Eureka Sacramento US-101 288.0 0.0      ← origin destination name mileage toll
Eureka SF US-101 271.0 20.0
Sacramento SantaFe I-40 1142.0 0.0
SF LA I-5 381.0 50.0
SF SantaFe I-40 1146.0 0.0
SF Fresno CA-99 187.0 0.0
Fresno LA CA-99 220.0 0.0
LA SantaFe I-40 874.0 0.0
3                                       ← number of trips.
Eureka LA                               ← first trip.
Eureka SF                               ← second trip.
```

```
Fresno SantaFe                          ← third trip.
```

Output

1. The total trip cost in US dollars and the total mileage travelled using a precision of 2 decimals.
2. The roads visited during the trip containing:
    i. The road name.
    ii. The road mileage using a precision of 2 decimals.
    iii. The road segment cost in dollars using a precision of 2 decimals.
    iv. The city of origin.
    v. The city of destination.

```
74.24 678.00                            ← first trip cost.
US-101 41.68 Eureka SF                  ← the 3 trip steps.
CA-99 187.00 29.92 SF Fresno
CA-99 220.00 17.60 Fresno LA
41.68 271.00                            ← second trip cost.
US-101 4271.00 1.68 Eureka SF           ← the single trip steps.
87.52 1094.00                           ← third trip cost.
CA-99 220.00 17.60 Fresno LA            ← the 2 trip steps.
I-40 874.00 69.92 LA SantaFe
```