Problem 131: Let's Ship

Difficulty: Hard

Author: Jonathan Brown, Fort Worth, Texas, United States

Originally Published: Code Quest Australia 2019

Problem Background

Shipping has been around since the beginning of time. Moving objects from one location to another is the basis for economies and corporations around the world. Although the mode of transportation has changed greatly, the general concept has not. In this problem, you will need to write a program to determine the quickest or cheapest route for an item to be shipped from one location to another.

Problem Description

Your program will be given information about a list of shipping routes offered by several approved logistics companies, as well as a list of shipping orders that need to be fulfilled. Your program must identify the best route to use for each shipping order based on whether the order needs the fastest or cheapest route.

Your company uses six different logistics companies to handle its shipping. Each company can handle air and ground transportation, but each company has different costs, speeds, and weight limits for each mode of transportation. This information is summarized in the table below.

- Cost is dollars per mile shipped per pound of weight
- Speed is the number of minutes needed to travel one mile
- Weight (Wt.) Limit is in pounds; a carrier cannot transport a package in excess of this limit by this method. A blank cell indicates the carrier has no weight limit for that mode of transportation.

Company	Air			Ground		
	Cost	Speed	Wt. Limit	Cost	Speed	Wt. Limit
A	$0.0105	0.16	500	$0.003	1.1	5000
B	$0.012	0.125	1000	$0.0035	1.0	2000
C	$0.095	0.165	100	$0.002	1.05	
D	$0.025	0.15		$0.0025	1.25	2500
E	$0.040	0.13	750	$0.004	1.15	
F	$0.067	0.145		$0.0015	0.95	3000

Your program will receive a list of shipping routes provided by each company. Each route will specify the company offering the route, the cities the route serves, the distance between those cities, and

whether items shipped by that route can travel by air, ground, or both. Several companies may offer the same route. All routes are bidirectional - if Company A offers a route from Denver to New York City, they will ship items from Denver to New York City or from New York City to Denver.

After the list of available routes, your program will receive a list of shipping orders that must be fulfilled. Shipping orders will specify the package's weight, its origin and destination cities, and whether the package should travel by the fastest or cheapest route. Since it will not always be possible to find a carrier to deliver directly from the origin to the destination, it is perfectly reasonable to switch carriers between cities. You may assume there is no time or cost penalty for switching carriers.

For example, if the following routes are available:

- Company A - Orlando to Fort Worth - Air or Ground
- Company B - Fort Worth to Denver - Air

In order to ship a package from Orlando to Denver, you would need to switch from Company A to Company B in Fort Worth. If you are looking for the fastest route, you would take Company A's air option for the first leg of the journey; if cheapest, you would travel by ground first.

Sample Input

The first line of your program's input, received from the standard input channel, will contain a positive integer representing the number of test cases. Each test case will include the following lines of input:

- A line containing two positive integers, separated by spaces:
    - The first integer, R, represents the number of routes available in this test case.
    - The second integer, O, represents the number of shipping orders in this test case. All shipping orders within a test case use the same route map.
- A total of R lines containing the following information about shipping routes. Each piece of information is separated by spaces.
    - An uppercase letter, A through F, representing the shipping company that offers this route.
    - Three uppercase letters representing the airport code of the first city on this route.
    - Three uppercase letters representing the airport code of the second city on this route. (Remember that all routes go in both directions)
    - An uppercase letter A, G, or B, indicating that items may be shipped on this route via air only, ground only, or by both methods, respectively.
    - A positive decimal number, representing the distance between the two cities in miles.
- A total of O lines containing the following information about shipping orders. Each piece of information is separated by spaces.
    - Three uppercase letters representing the airport code of the origin city
    - Three uppercase letters representing the airport code of the destination city

- o A positive integer representing the weight of the package in pounds
- o An uppercase letter C or F, indicating that the package should travel by the cheapest or fastest available route, respectively.

```
1
5 2
A MCO FTW B 1118.8
B FTW DEN A 768.6
C FTW DEN G 768.6
C FTW BWI B 1397.3
D DEN BWI G 1663.6
MCO DEN 100 C
DEN BWI 200 F
```

Sample Output

For each test case, your program must output the complete route to be used for each shipping order in the following format:

- A line for each leg of your package's journey, to include the following values, separated by spaces:
  - o The three-uppercase-letter airport code of the origin city
  - o The word "to"
  - o The three-uppercase-letter airport code of the destination city
  - o The words "by air" or "by ground", indicating the mode of travel used
  - o The words "with Company X", where X is the letter of the company used
- A line reading "Total Hours: ", followed by the total number of hours required to ship the package by that route.
- A line reading "Total Cost: $", followed by the total cost required to ship the package by that route. Remember that costs are calculated by package weight and distance.

Both hours and costs must be rounded to the nearest hundredth value (two decimal places). Include any trailing zeros (e.g. 2.00 is correct; 2 is not).

```
MCO to FTW by ground with Company A
FTW to DEN by ground with Company C
Total Hours: 33.96
Total Cost: $489.36
DEN to FTW by air with Company B
FTW to BWI by ground with Company C
Total Hours: 26.05
Total Cost: $2403.56
```