Exercises: Algorithms Exam Preparation

This document defines the **in-class exercises** assignments for the "Algorithms" course @ Software University. Submit your solutions in this contest.

Problem 4. Fast and Furious

The ministry of interior recently deployed a system of **traffic cameras** on different locations on the roads. Some **pairs of cameras** are connected with direct road and you are given the **distance** and the **speed limit** between them.

You are given the **records from the traffic cameras** on the road. Each camera takes photos of car license plate numbers and **reports the numbers and the time of observation**. Your task is to find which cars are **speeding**.

A car travelling between two arbitrary cameras **A** and **B** on the road is **speeding** if it takes the distance between these cameras for **less time than the minimum possible** within the allowed speed limits. Note that many routes may exist between **A** and **B** and each of them can be passed for different times depending on the distances and speed limits for the roads in each route. We assume that the drivers always take the fastest route between two cameras.

Input

- The input is read from the console.
- At the first line the word "**`Roads:`**" stays.
- The next few lines hold **pairs of camera names**, the **distance** between them and the **speed limit** (in km/h) between them. The camera names and maximum speed are separated by a single space. Example:

  ```
  CameraSofia CameraPleven 133.35 140
  ```

- At the next line the word "**`Records:`**" stays.
- The next few lines hold a sequence of **camera records**. Each record consist of a **camera name**, a **license plate number** and a **time** in 24-hour format (**`hh:mm:ss`**), separated by a space. Example:

  ```
  CameraSofia CA1111AA 12:56:12
  ```

- The last line holds the word "**End**" only.

Output

- Print the **license plate numbers of all speeding cars** in alphabetical order, each on separate line. Example:

  ```
  CA1111AA
  CA1212BB
  CHY0L0428
  ```

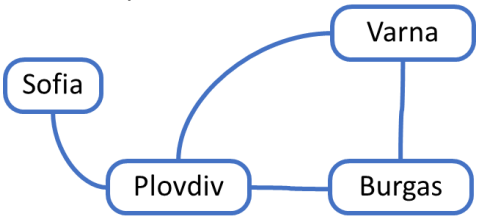
Constraints

- All **camera names** consist of letters and digits.
- All **license plate numbers** consist of letters and digits.
- The **distances** and **speed limits** are real numbers in the range [1…10 000].
  - The symbol "**`.`**" is used as decimal separator.
- The **number of roads** is in the interval [1; 1 000].
- The number of **camera records** is in the interval [1; 10 000].
- All data is collected on the **same day**.
- Cameras collect their records in unspecified order.

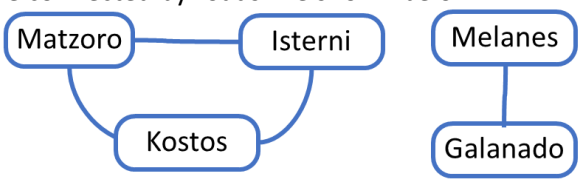
- Time limit: **200 ms**. Allowed memory: **24 MB**.

Sample Input and Output

Input	Visualization and Comments

Roads:
Sofia Plovdiv 145.4 90
Plovdiv Varna 361.4 120.5
Varna Burgas 114.95 30
Burgas Plovdiv 252.9 42
Records:
Varna CA1234AA 19:48:25
Burgas B4732AH 19:38:50
Sofia CA1234AA 08:32:18
Plovdiv A777777 15:28:56
Varna SP33D 02:24:18
Burgas A777777 18:42:15
Plovdiv CA1234AA 15:32:18
Sofia SP33D 04:32:51
Varna B4732AH 08:18:36
End
	The cameras are connected by roads like shown below:
	 
	
	Car "A777777" is speeding between Plovdiv and Burgas.
	• It takes the distance of 252.9 km from Plovdiv to Burgas for 3:13:19 hours (18:42:15 @ Burgas - 15:28:56 @ Plovdiv) ≈ 3.222 h.
	• The minimum time within the allowed maximum speed limits from Plovdiv to Burgas is 252.9 km / 42 km/h ≈ 6.02 hours.
	• The car was speeding because the driving time (3.222 hours) < the minimum possible time within the speed limits (6.02 hours).
	Car "SP33D" is speeding between Varna and Sofia.
	• It takes the distance between Varna and Sofia for 2:08:33 hours (04:32:51 @ Sofia - 02:24:18 @ Varna) ≈ 2.1425 hours.
	• Two routes exist from Varna to Sofia:
	  ○ For the route Varna → Plovdiv → Sofia the minimum time within the speed limit is 2.999 hours (Varna → Plovdiv) + 1.616 (Plovdiv → Sofia) ≈ 4.615 hours.
	  ○ For the route Varna → Burgas → Plovdiv → Sofia the minimum time within the speed limit is ≈ 11.469 hours.
	• The car was speeding because the driving time (2.1425 hours) < the minimum possible time within the speed limits (4.615 hours).

Output	
A777777 SP33D	

Input	Visualization and Comments
Roads: Matzoro Isterni 128.55 50 Matzoro Kostos 87.25 48.5 Isterni Kostos 100 40.52 Melanes Galanado 230.5 50 Records: Isterni AOM5973 13:20:11 Matzoro IBK5674 08:35:12 Matzoro AHI1278 08:35:12 Galanado IBK5674 18:20:35 Kostos COM1515 05:38:02 Galanado COM1515 08:40:15 Isterni IBK5674 14:28:30 Melanes COM1515 22:31:50 Kostos AOM5973 12:46:21 Kostos COM1515 18:56:10 End	The cameras are connected by roads like shown below:  Car "AOM5973" is speeding between Kostos and Isterni: • It takes the distance of 100 km from Kostos to Isterni for 0:33:50 hours (13:20:11 @ Isterni - 12:46:21 @ Kostos) ≈ 0.564 h. • The minimum time within the allowed maximum speed limits from Kostos to Isterni is 100 km / 40.52 km/h ≈ 2.468 hours. • The car was speeding because the driving time (0.564 hours) < the minimum possible time within the speed limits (2.468 hours).

Output	
AOM5973	