

Problem Solving Practice

Coding Problem #1

CSE4152
Sogang University



Finding Celebrities

A celebrity is defined as a person who is known by everybody but does not know anyone. How can you find any celebrities among N people?

You can freely ask anyone as follows: "Hey, you know Mr. (or Ms.) X?"

Suppose that there are N people. Design a method that

- a) determines whether there is some celebrities among the people
- b) if there is any celebrities, find them efficiently (minimizing the number of questions you make).

Finding Celebrities

In this problem, you will only be working within the main.cpp file. The following two functions are provided for you to interact with the problem:

- `ask_a_to_b(int a, int b) :`
 - Ask person A if they know person B.
 - return 1 if A knows B, otherwise return 0.
 - Never call `ask_a_to_b(i, i)` (i.e., do not ask if someone knows themselves)
- `answer(int x) :`
 - verifies if person x is a celebrity
 - if there is no celebrity, call -1

Your task is to implement the logic within the `main()` function in `main.cpp`

Finding Celebrities

Interaction

Your Output:

- You will print interactions using the provided `ask_a_to_know_b(a, b)` function to ask if one person knows another.
- Example: `? 1 2` asks if person 1 knows person 2.

Judge's Response:

- The judge will respond with `1` (Yes) or `0` (No) based on the relationship.
- Example: `0` means person 1 does not know person 2 if the question is “`? 1 2`”.

Final Answer:

- After determining the celebrity (or finding there is none), call `answer(x)` with the candidate's index or `-1`.
- Example: `! 1` means you believe person 1 is the celebrity. The judge will then confirm if this is correct.

Finding Celebrities

Steps to test your algorithm.

You should test your program by interacting with it by yourself.

Step 1. Create your own celebrity graph

- Before diving into the code, start by visualizing the relationships as a graph.

Step 2. Run the program and answer function `ask_a_to_know_b` by your hand.

- based on your graph, manually type the output of `ask_a_to_know_b(a, b)` for various pairs (a, b).
- For example, if Person 1 knows Person 2 (`ask_a_to_know_b(1, 2)`), draw an edge from 1 to 2.

Step 3. Type the response for `answer(x)`

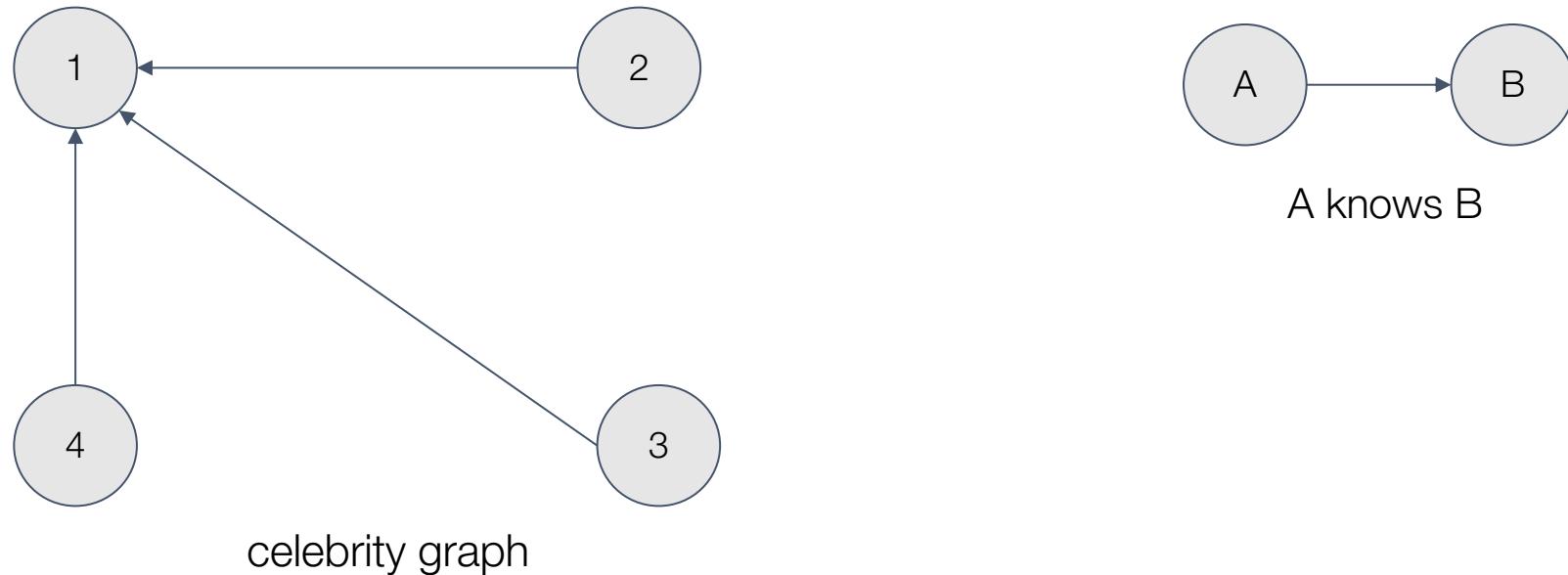
- Check if the celebrity identified in the code (`answer(x)`) matches the one you set in your created celebrity graph

Finding Celebrities

Example

Step 1. Create your own celebrity graph

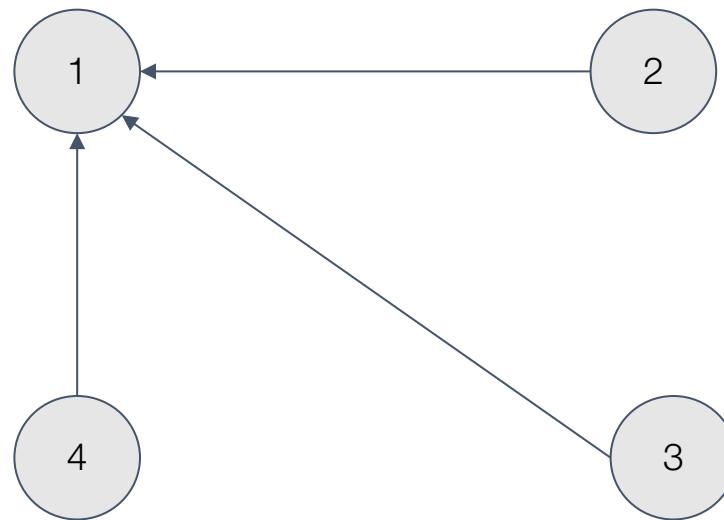
- Before diving into the code, start by visualizing the relationships as a graph.



Finding Celebrities

Example

Step 2. Reply to every call `ask_a_to_know_b` called by your program.



celebrity graph

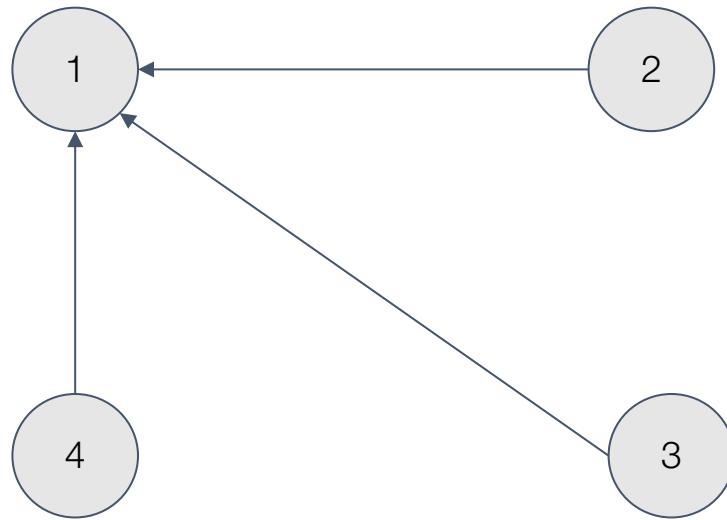
Your Output	Judge	Explanation
	4	$N = 4$.
? 1 2		Does 1 know 2?
	0	1 does not know 2.
? 2 1		Does 2 know 1?
	1	2 does know 1.
? 1 3		Does 1 know 3?
	0	1 does not know 3.
? 3 1		Does 3 know 1?
	1	3 does know 1.
? 1 4		Does 1 know 4?
	0	1 does not know 4.
? 4 1		Does 4 know 1?
	1	4 does know 1.
! 1		Is 1 the celebrity?
	1	1 is the celebrity.

Interaction

Finding Celebrities

Example

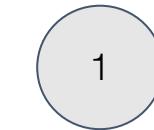
Step 3. Reply to `answer(x)` function



celebrity graph

Your Output	Judge	Explanation
	4	N = 4.
? 1 2		Does 1 know 2?
	0	1 does not know 2.
? 2 1		Does 2 know 1?
	1	2 does know 1.
? 1 3		Does 1 know 3?
	0	1 does not know 3.
? 3 1		Does 3 know 1?
	1	3 does know 1.
? 1 4		Does 1 know 4?
	0	1 does not know 4.
? 4 1		Does 4 know 1?
	1	4 does know 1.
? 1		Is 1 the celebrity?
	1	1 is the celebrity.

Interaction



call `answer(1)`

answer

Finding Celebrities

Scoring

- The fewer questions you ask to identify the celebrity, the higher your score will be. Therefore, it's a good idea to design your code with an algorithm that finds the answer using as few questions as possible.
- The exact scoring formula is available on ELICE, so please refer to it for details.

Minimum calculation

Imagine an electric calculator which has only two arithmetic operations, i.e., assignment operation ($:=$) and multiplication operation (\times). We want to let this machine compute $b = a^n$ for given numbers a and n . Design a method that produce a code for this machine, minimizing the number of multiplications.

Minimum calculation

Input

16

Output

4 1 2 4 8 16

Minimum calculation

Scoring

- The closer your solution is to the minimum number of steps, the higher your score will be. To achieve a higher score, please consider developing an algorithm that can produce the solution with the minimum number of steps
- The exact scoring formula is available on ELICE, so please refer to it for details.

Submission

- Please submit your solution to this coding problem on the Elice platform by **Monday, September 23rd**.
- Late submissions will not be accepted, so make sure to submit on time
- Feel free to post any questions in the Q&A section on the Cyber Campus