

General Instructions.

- Solution of Programming Assignments(PA) are accepted on [Gradescope](#). Individual submissions via emails will not be graded.
 - Gradescope will accept solutions only in the following programming languages - C and C++.
 - The autograding process will evaluate your assignment against a predefined set of visible test cases immediately upon submission.
 - Following the deadline, the final version of your submitted code will undergo autograding with a set of hidden test cases.
 - Use of algorithm header file like `<algorithm.h>` and primitive functions for operations like sorting, searching and implementing data structures constitutes plagiarism. This course is on Data Structure and Algorithm; hence, we expect students to write their code rather than using predefined function.
 - Use of generative tools like ChatGPT is unacceptable and will lead to heavy penalties.
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Problem 1: Intern

Guidelines

- Please submit your singlefile solutions via Gradescope, ensuring that the filename is either `intern.c` or `intern.cpp`. The solution should consist of a single file and not multiple files.
- Number of test cases (visible and hidden): 14

Statement

Your friend, Piramal, is going to intern in Gurgaon in the coming summers. Since there are going to be interns from a lot of different colleges, he would like to know the closest room in

which one of his friends is staying. Unfortunately, he does not know his own room yet, but he does know the rooms of all his friends, and possible rooms he might be allotted. Here is everything he knows about the allotment as of now, please help him find the answer to his queries:

- The layout of the rooms can be represented as a Tree $T = (V, E)$, where each room is a vertex, and the corridor connecting two rooms is an edge.
- Each room has a unique ID in $[1, N]$, $N = |V|$. Some rooms have a friend living there, denoted by the set $V_f \subseteq V$.
- The “closeness” of a room from another is defined by the number of edges in the shortest path connecting them.
- He will provide a room’s ID, $v_q \in V$, to you in his queries, and will expect the ID of the closest room v_c , such that there is a friend living there, i.e., $v_c \in V_f$. If there are multiple v_c ’s closest to v_q , he expects you to return the smallest ID.

He knows that it might be easier to understand his expectations with the help of some samples, which he has graciously provided to you below with explanation. Please help your friend in need.

Input Format

The first line will denote N , the number of rooms. The following line has N numbers, with a_i meaning that the parent (in the tree representation) of the i^{th} room has the ID a_i for $2 \leq i \leq N$.

The third line has a single number, F , the number of rooms in which a friend of Piramal’s is living. The next line contains F unique room ID’s, $1 \leq v_f \leq N$ ($1 \leq f \leq F$). The fifth line has a single number, Q , the number of queries. Each of the next lines have a room ID, $1 \leq v_q \leq N$ ($1 \leq q \leq Q$)

Output Format

You should print one number per each line, with the i^{th} number representing the ID of the room, say r , such that r is closest to v_i and r is minimum.

Constraints

- $1 \leq N, Q \leq 10^5, 1 \leq F \leq N$
- $a_i < i \forall 2 \leq i \leq N, a_1 = 1$, i.e., 1 is the root node of the tree and is its own parent

Example

Input

```
8
1 1 1 1 3 3 5 5
3
2 4 8
3
2 3 7
```

Output

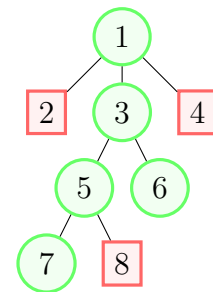
```
2
2
8
```

Explanation

The tree has been drawn on the right for reference. The rooms in which a friend is living have been made red/square, and others green/round.

- $2 \rightarrow 2$: Since 2 has a friend living there, it will be closest to itself.
- $3 \rightarrow 2$: There are 3 rooms at the same closest distance, with ID's 2, 4, and 8. Since 2 has the minimum value, we report it as the answer.
- $7 \rightarrow 8$: 8 is at a distance of 2 from 7, so it is the only node closest to 7, hence we report it as the answer.

The other rooms containing a friend, namely 2 and 4, are at a distance of 4.



Problem 2: Pearl

Guidelines

- Please submit your singlefile solutions via Gradescope, ensuring that the filename is either `pearl.c` or `pearl.cpp`. The solution should consist of a single file and not multiple files.

- Number of test cases (visible and hidden): 14

Statement

In the enchanting realm of Pandora, home to the Na'vi people, a special annual tradition known as Eywa's Circle unfolds. Na'vi warriors and explorers come together beneath the vibrant bioluminescent tree, where Eywa selects one among them and bestows a blessed pearl. The sacred spirit chooses through the following ritual:

1. Participants form a circle, N in total, each adorned with unique markings representing their connection to Pandora.
2. Eywa selects a number, K .
3. Starting with person 1, every K^{th} individual gracefully exits the circle after bowing to the holy spirit.
4. This process continues until only one person remains, now the keeper of the life-restoring pearl.

The possessor of the pearl gains the ability to bring back life. Neytiri aspires to attain it this year to revive her beloved son Neteyam. Jake has uncovered the number, K , chosen by Eywa this year from the sacred sages of the land. Your task is to assist them in determining the order in which the participants leave the circle.

Input Format

The first line contains N , the number of people participating in the ritual. The second line contains K , the number Jake found from the sages. Note that all numbers will be non-negative integers.

Output Format

Output N numbers in one line, where the i^{th} number is the unique marking of the i^{th} person to leave the circle.

Constraints

$$1 \leq K, N \leq 10^5$$

Example

Input

```
5
2
```

Output

```
2 4 1 5 3
```

Explanation

In the initial round, the individual positioned at the 2^{nd} place steps out of the ritual, followed by the 4^{th} position, then the 1^{st} position, and lastly the 5^{th} position. The person who remains at the end of the ritual occupies the 3^{rd} position.