

Round A China New Grad  
Test 2014

[A. Read Phone Number](#)

**B. Rational Number Tree**

[C. Sorting](#)

[D. Cross the maze](#)

[E. Spaceship Defence](#)

[Questions asked](#)

#### Submissions

##### Read Phone Number

6pt	Not attempted 1885/3058 users correct (62%)
13pt	Not attempted 1094/1837 users correct (60%)

##### Rational Number Tree

9pt	Not attempted 1193/1545 users correct (77%)
12pt	Not attempted 368/1037 users correct (35%)

##### Sorting

5pt	Not attempted 1666/1990 users correct (84%)
8pt	Not attempted 1551/1635 users correct (95%)

##### Cross the maze

10pt	Not attempted 134/370 users correct (36%)
13pt	Not attempted 119/132 users correct (90%)

##### Spaceship Defence

10pt	Not attempted 175/382 users correct (46%)
14pt	Not attempted 106/152 users correct (70%)

#### Top Scores

dreamoon	100
springegg	100
tckwok	100
cgy4ever	100
OR.Director	100
AlanC	100
Mochavic	100
jxwuyi	100
oldherl	100
Descent	100

## Problem B. Rational Number Tree

This contest is open for practice. You can try every problem as many times as you like, though we won't keep track of which problems you solve. Read the [Quick-Start Guide](#) to get started.

Small input  
9 points

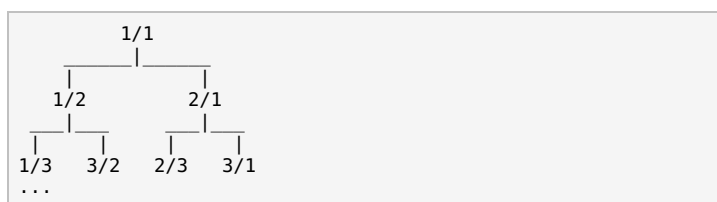
Solve B-small

Large input  
12 points

Solve B-large

### Problem

Consider an infinite complete binary tree where the root node is  $1/1$  and left and right childs of node  $p/q$  are  $p/(p+q)$  and  $(p+q)/q$ , respectively. This tree looks like:



It is known that every positive rational number appears exactly once in this tree. A level-order traversal of the tree results in the following array:

1/1, 1/2, 2/1, 1/3, 3/2, 2/3, 3/1, ...

Please solve the following two questions:

- Find the  $n$ -th element of the array, where  $n$  starts from 1. For example, for the input 2, the correct output is  $1/2$ .
- Given  $p/q$ , find its position in the array. As an example, the input  $1/2$  results in the output 2.

### Input

The first line of the input gives the number of test cases,  $T$ .  $T$  test cases follow. Each test case consists of one line. The line contains a problem id (1 or 2) and one or two additional integers:

- If the problem id is 1, then only one integer  $n$  is given, and you are expected to find the  $n$ -th element of the array.
- If the problem id is 2, then two integers  $p$  and  $q$  are given, and you are expected to find the position of  $p/q$  in the array.

### Output

For each test case:

- If the problem id is 1, then output one line containing "Case #x: p q", where  $x$  is the case number (starting from 1), and  $p$ ,  $q$  are numerator and denominator of the asked array element, respectively.
- If the problem id is 2, then output one line containing "Case #x: n", where  $x$  is the case number (starting from 1), and  $n$  is the position of the given number.

### Limits

$1 \leq T \leq 100$ ;  $p$  and  $q$  are relatively prime.

### Small dataset

$1 \leq n, p, q \leq 2^{16}-1$ ;  $p/q$  is an element in a tree with level number  $\leq 16$ .

### Large dataset

$1 \leq n, p, q \leq 2^{64}-1$ ;  $p/q$  is an element in a tree with level number  $\leq 64$ .

### Sample

Input	Output
4	Case #1: 1 2
1 2	Case #2: 2

2	1	2	Case #3:	3	2
1	5		Case #4:	5	
2	3	2			

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