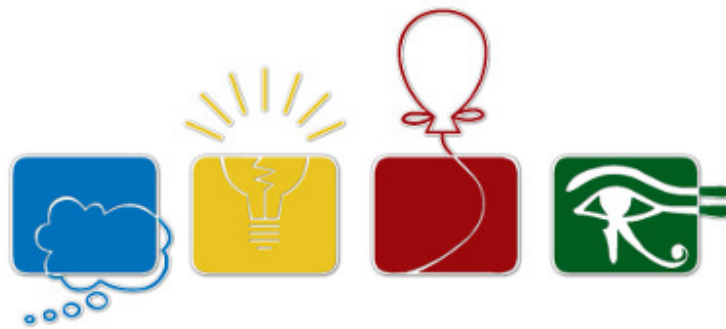


# Mid Year Contest – Winter 2009

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## Problem A Family Tree

family.cpp, family.in, family.out

I'm working on making a "family tree" for my family (an electronic family tree to be more specific) but as a developer, I want to add some feature to that e-family tree; I will make a program that, given the names of 2 individuals, it should output the relation between them depending on the given information.

Given the description of some relations between individuals in the form **X is Y's Z**

While **X** and **Y** are individuals names and **Z** is one of:

**Spouse** (husband or wife)

**Parent** (father or mother)

**Child** (son or daughter)

**Sibling** (brother or sister)

Also given some pairs of individuals names **A** and **B**, define the relation between **A** and **B** and output a line **A is B's C**

While **A** and **B** are individuals names given in input and **C** is one of:

**Spouse, Parent, Child, Sibling, GrandParent, GrandChild, Cousin.**

- **A** is a **Spouse** of **B** if explicitly specified so or if **B** is a **Spouse** if **A**.
- **A** is a **Parent** of **B** if explicitly specified so or if **B** is a **Child** of **A**.
- **A** is a **Child** of **B** if explicitly specified so or if **B** is a **Parent** of **A**.
- **A** is a **Sibling** of **B** if explicitly specified so or if **B** is a **Sibling** of **A** or if
  - **C** is a **Parent** of **A** and
  - **C** is a **Parent** of **B**.
- **A** is a **GrandParent** of **B** if there is a sequence of Individuals **I<sub>0</sub>, I<sub>1</sub>, I<sub>2</sub>, ..., I<sub>n</sub>** while **I<sub>k-1</sub>** is a **Parent** of **I<sub>k</sub>**, **A** is a **Parent** of **I<sub>0</sub>** and **I<sub>n</sub>** is a **Parent** of **B**.
- **A** is a **GrandChild** of **B** if there is a sequence of Individuals **I<sub>0</sub>, I<sub>1</sub>, I<sub>2</sub>, ..., I<sub>n</sub>** while **I<sub>k-1</sub>** is a **Child** of **I<sub>k</sub>**, **A** is a **Child** of **I<sub>0</sub>** and **I<sub>n</sub>** is a **Child** of **B**.
- **A** is a **Cousin** of **B** if
  - **C** is a **Parent** of **A**
  - **D** is a **Parent** of **B** and
  - **C** is a **Sibling** of **D**.

### Input:

Input consists of several test cases, each test cases begins with 2 integers  $0 < N, M < 100$ , while **N** is the number of relations between individuals and **M** is the number of queries. Each of next **N** lines is of the form **X is Y's Z**. Each of next **M** lines is of the form **A B**. Input terminates with a line having 2 zeros for **N** and **M**. This case should not be processed.

- Individual names are strings of length  $\leq 20$  with no spaces.

- Data will always be consistent, for example there won't be a case where A is B's Parent and A is B's Child.

**Output:**

For each query, output “**A is B's C**” if there is a relation **C** between **A** and **B** or “**A and B are not related**” otherwise. Output a new line after each test case.

**Sample Input:**

3 1  
Asmaa is Muhammad's Sibling  
Magdi is Asmaa's Parent  
Ahmed is Magdi's Child  
Asmaa Ahmed

3 1  
A is B's Sibling  
B is C's Parent  
D is A's Child  
C D

2 2  
A is B's Sibling  
C is D's Parent  
A C  
B D

0 0

**Sample Output:**

Asmaa is Ahmed's Sibling

C is D's Cousin

A and C are not related  
B and D are not related

## Problem B

### A Simple Number

simple.cpp, simple.in, simple.out

We define a new function “Simplify” as following:

- Let **N** and **M** be positive integers.
- **N** consists of digits  $d_{n1}d_{n2}d_{n3}\dots d_{nk}$
- **M** is the result of Simplify(**N**) if:
  - § **M** consists of digits  $d_{m1}d_{m2}d_{m3}\dots d_{mk-2}$
  - §  $d_{mi} = (d_{ni} + d_{ni+1} + d_{ni+2}) \% 10, 0 \leq i \leq k-2$

For example:

Simplify(123456789) = 6925814

Simplify(567) = 8

A number is said to be simple if it can't be simplified anymore (i.e. has less than 3 digits).

A simple number **S** corresponding to a number can be obtained by continuously simplifying it till we get to a simple number.

#### **Input:**

Input consists of several test cases. Each test case has an integer  $0 < N < 10^{1000}$ . A zero value for **N** terminates the input. This case should not be processed.

#### **Output:**

For each integer **N** in the input, output the simple number **S** corresponding to **N**.

#### **Sample Input:**

123456789

567

0

#### **Sample Output:**

5

8

## Problem C

### Sorting, ain't that easy

sort.cpp, sort.in, sort.out

You know, sorting usually appears to be a piece of cake, but sometimes you may need to sort on some weird criteria. For instance, didn't you notice that your friends' list on facebook is sorted by the last name and not the first name? That's used because mostly people are known by their last names not their first ones to be able to differentiate between them and also to group members of the same family together. If the last names are the same so they should be sorted by first name then. So here is our problem. You will be given a list of names containing first and last names of different people and you should sort that list as mentioned above. However, to simplify the problem, the list shall consist of exactly two words "FirstName LastName" i.e. there will be no middle names or names of one word. Cases shall be ignored. i.e. "TeCnO yOtTa" is the same as "tEcNo YoTtA"

#### Input

Input consists of one or more test case, each test case begins with an integer  $N$  which specifies the number of names. Following that  $N$  lines each consists of exactly two words formed of alphabetical letters only A-Z & a-z, separated by a single space. An  $N$  of value equals to zero determines the end of input. This case should not be processed.

#### Output

For each test case, output the number of the test case on a single line followed by the sorted list of names. There should be a blank line between each two test cases. No extra new line should be added after the last test case though.

#### Sample Input

```
6
Aly Muhammad
Sarah Ibrahim
Yasser Karim
Basma Abdullah
Omar Salah
Mustafa Ismail
6
a ccc
b BBB
b CCC
a AAA
b aaa
a bbb
0
```

## **Sample Output**

1

Basma Abdullah  
Sarah Ibrahim  
Mustafa Ismail  
Yasser Karim  
Aly Muhammad  
Omar Salah

2

a AAA  
b aaa  
a bbb  
b BBB  
a ccc  
b CCC

## Problem D

### Submatrix Summation

sub.cpp, sub.in, sub.out

Imagine a matrix that its top left cell is zero  $(0,0) = 0$  –a zero indexed matrix- Each cell is greater than the one on its left by a constant value **k**, and each cell is greater than the one above by the same constant value **k**. So the first row shall be like:  $0, k, 2k, 3k, 4k \dots$ , the first column shall be like  $0, k, 2k, 3k, 4k \dots$ . Thus the second row and column shall be like  $k, 2k, 3k, 4k, 5k \dots$

0	k	2k	3k	4k	..
k	2k	3k	4k	5k	..
2k	3k	4k	5k	6k	..
3k	4k	5k	6k	7k	..
4k	5k	6k	7k	8k	..
..	..	..	..	..	..

If you are given the constant value **k**, can you find the sum of elements in the submatrix from  $x_1, y_1$  to  $x_2, y_2$  inclusive. Check the following example.

0	2	4	6	8	10	..
2	4	6	8	10	12	..
4	<u>6</u>	<u>8</u>	<u>10</u>	<u>12</u>	14	..
6	<u>8</u>	<u>10</u>	<u>12</u>	<u>14</u>	16	..
8	<u>10</u>	<u>12</u>	<u>14</u>	<u>16</u>	18	..
10	12	14	16	18	20	..
..	..	..	..	..	..	..

$k=2, x_1=1, y_1=2, x_2=4, y_2=4$ . Sum =  
 $(6+8+10+12)+(8+10+12+14)+(10+12+14+16) = 132$ .

#### Input

Will consist of one or more test case, each on a single line of five integers separated by a single space in the form: **k x<sub>1</sub> y<sub>1</sub> x<sub>2</sub> y<sub>2</sub>**.  $0 < k \leq 1000, 0 \leq x_1 \leq x_2, \leq 100'000, 0 \leq y_1 \leq y_2 \leq 100'000$ . To be terminated by the end of file. Remember, indices begin from zero.

#### Output

Print the sum of the given submatrix, each test case on a separate line.

#### Sample Input

```
2 1 2 4 4
1 0 0 10 10
1 0 1 0 1
```

#### Sample Output

```
132
1210
1
```

## Problem E Triangles

tri.cpp, tri.in, tri.out

“Happy birthday to you, Happy birthday to you, happy birthday to Sara Happy birthday to you” it’s little Sara’s 6<sup>th</sup> birthday today, thus she’s having a party. After a while, guests began to leave till the house is empty except of Sara and her family. As a little child, as soon as the last guest had left, she rushed towards her gifts checking what she had got at the end of the day. She grabbed the first one, opened it, then there was disappointment as she found it was just a Barbie doll. She had dozens of dolls in her closet anyway. The second one appeared to be some hair accessories. Her disappointment grew a level up higher. Then she noticed that big one prezzie hidden below some other ones. She managed to open it and yet this time her level of excitement grew up high. She found a rhombus board and lots of smaller triangles. Little Sara wasn’t a normal kid you know, her parents were both ex-ACMers. So what she came through her mind was not how to play the game, but how many small triangles should be needed to build a rhombus. And what’s the formula of growing it larger which can be achieved by adding rows of triangles. If you are given the number of levels for the rhombus, can you help little Sara find the number of triangles forming the rhombus?

### Input

Consists of one or more test case, each on a separate line containing a single positive even integer  $N$  which represents the number of levels, where  $N \leq 10^9$ . A value of  $N$  equals to zero means the end of input. This test case should not be processed.

### Output

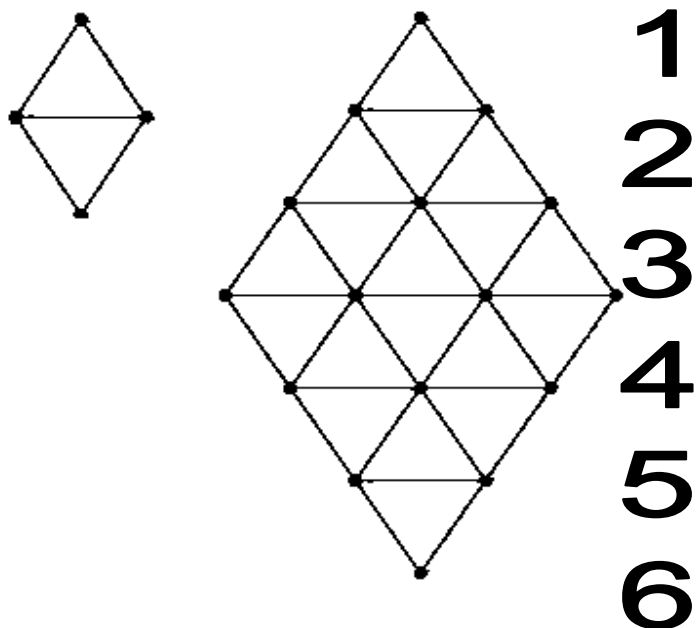
For each test case, output the number triangles forming the rhombus corresponding to the given number of levels  $N$ .

### Sample Input

2  
6  
0

### Sample Output

2  
18



## Problem F

### Diagonally Dominant Or Not ☺?!!

DD.cpp, DD.in, DD.out

In this problem you will be given a square matrix and you will have to determine whether it's diagonally dominant or not.

Let's say that the matrix name is M and its size is S. Now to determine that this matrix is diagonally dominant it must have the following properties:-

- 1- For all i,  $|M[i][i]| \geq \text{summation } |M[i][j]|$  where  $0 \leq i, j < S$  and  $j \neq i$ .
- 2- There is at least one row in the matrix where this relation is  $>$  not  $\geq$ .

As an example, consider this matrix of size 3,

10    -3    -4    ,  $10 > 4 + 3$

2      -5    -3    ,  $5 \geq 2 + 3$

-1    -1    2     ,  $2 \geq 1 + 1$

The previous matrix is diagonally dominant.

#### **Input:**

You will be given a positive number T in the first line, then T test cases will follow, each test case begins with the matrix size which is a positive number S between 2 and 10 inclusive, then S lines follow, each line consists of S numbers separated by one white-space, every number is in the range  $[-32767, 32767]$ .

#### **Output:**

For each test case you must print "Yes." if the matrix for this test case is diagonally dominant and "No." otherwise.

#### **Sample input:**

```
2
3
10 -3 -4
2 -5 -3
-1 -1 2
3
10 -3 7
2 -5 -3
-1 -1 2
```

#### **Sample output:**

```
Yes.
No.
```

## Problem G

### How many UMCDs?

UMCD.cpp, UMCD.in, UMCD.out

An UMCD number is a number that can be divided into a sequence of numbers that are represented as a uni-modal graph, and the sum of this sequence numbers equal their original number, also the difference between each two consecutive numbers in the sequence equals one. The first and last numbers in the sequence equals one. The length of the sequence is odd.

To make things more clear, consider the number 81, the sequence for this number will look like this,  $1+2+ \dots +7+8+9+8+7+ \dots +2+1 = 81$ .

You will be given two numbers A, B where  $1 \leq A, B \leq 100000$ , all you have to do is to count how many UMCD numbers that belong to the interval [A, B].

Very simple task, isn't it☺?

#### **Input:**

You are supposed to read a sequence of lines, every line consists of two numbers A, B separated by one white-space, the input is terminated by two 0's.

#### **Output:**

For each test case, print the result in a line by itself.

#### **Sample input:**

```
1 3
101 110
0 0
```

#### **Sample output:**

```
1
0
```

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**Special Thanks to: Ahmed Saqr**

## Problem H Height Round

height.cpp, height.in, height.out

There are several people that will sit around the same table in a circular fashion. Since all these people are very self-conscious about their height, you don't want to sit any short person next to a tall one. To formalize this, we want to minimize the maximum height difference between 2 adjacent persons.

You will be given the heights of  $N$  people. Output  $N$  numbers representing the heights of each individual in clockwise order of a seating arrangement that follows the above rule. If there are several solutions, output the lexicographically first one.

### Input:

Input consists of several test cases. Each test case begins with a number  $N$  specifying the number of people.  $N$  numbers follow specifying heights. Input terminates with  $N = 0$ . This case should not be processed.

### Output:

For each test case, output the arrangement of people in clockwise direction.

### Sample Input:

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

### Sample Output:

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