# Data Structure

(Semester One, 2015-2016)

# Laboratory 04

Prepared by Dr. Patrick Chan
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1. There are many stars in the space. The star has different brightness represented by a value (b) from 1 to N. Larger b value means a brighter star. We would like to know the $i^{th}$ brightness star.

   First line of input contains the number of cases (n), where $1 \leq n \leq 10$. For each case, the first line contains two numbers S and Q, where $1 \leq S, Q \leq 20000$. S and Q represent the number of stars and the number enquiries respectively. In next line, S numbers of integers represent the brightness of each star, i.e. the $i^{th}$ value represents the brightness of the $i^{th}$ star. In each next Q lines show the position of the star. By assume there is no tie situation, you need to output the ranks of the given stars for each enquiry.

   Example:
   Input:

```
2
5 3
5 2 6 8 1
1
3
2
11 1
1 8 7 6 5 100 2 9 12 11 99
11
```

   Output:

```
3
2
4
2
```

2. Mary collected n number of stones, where $1 \leq s \leq 6000$. She would like to organize them into one group. Assume that there are s stone groups at first and each of them has an integer e, which indicate the energy needed by Mary to move that stone group. In each merging, the energy for each merging is the sum of two e of the two stone groups. After merging, two stone groups will be combined as one stone group and its e is the sum of the e of the previous groups. We would like to know the minimum energy for Mary to merge all the stone groups into one.

   For example
   Given s = 5 and their e are : 1 2 3 4 5. The answer is 33. The detail calculation is as follows:

| Original Group | Selected Groups | After Merging | Energy used |
|---|---|---|---|
| 1 2 3 4 5 | 1 2 | 3 4 5 | 1 + 2 = 3 |
| 3 3 4 5 | 3 3 | 6 4 5 | 3 + 3 = 6 |
| 6 4 5 | 4 5 | 6 9 | 4 + 5 = 9 |
| 9 6 | 9 6 | 15 | 9 + 6 = 15 |

   Therefore, total energy is 33

   First line contains the number of cases (n), where $1 \leq n \leq 10$. Every case contains two lines. First line is s ($1 \leq n \leq 6000$), means there are s stone groups. Second line is s required energy (e), where $1 \leq e \leq 10000$. You need to output the answer of the minimum energy needed by Mary for each case.

   Example:
   Input:

```
2
5
1 2 3 4 5
3
4 6 7
```

   Output:

```
33
27
```

3. An ascending sorted sequence of distinct values is one in which some form of a less-than operator is used to order the elements from smallest to largest. For example, the sorted sequence A, B, C, D implies that A < B, B < C and C < D. in this problem, we will give you a set of relations of the form A < B and ask you to determine whether a sorted order has been specified or not.

   Input consists of multiple problem instances. Each instance starts with a line containing two positive integers n and m. the first value indicated the number of objects to sort, where $2 \leq n \leq 26$. The objects to be sorted will be the first n characters of the uppercase alphabet. The second value m indicates the number of relations of the form A < B which will be given in this problem instance. Next will be m lines, each containing one such relation consisting of three characters: an uppercase letter, the character "<" and a second uppercase letter. No letter will be outside the range of the first n letters of the alphabet. Values of n = m = 0 indicate end of input.

   For each problem instance, output consists of one line. This line should be one of the following three:

   Sorted sequence determined after xxx relations: yyy...y.
   Sorted sequence cannot be determined.
   Inconsistency found after xxx relations.

   where xxx is the number of relations processed at the time either a sorted sequence is determined or an inconsistency is found, whichever comes first, and yyy...y is the sorted, ascending sequence.

   Example:
   Input:

```
4 6
A<B
A<C
B<C
C<D
B<D
A<B
3 2
A<B
B<A
26 1
A<Z
0 0
```

   Output:

```
Sorted sequence determined after 4 relations: ABCD.
Inconsistency found after 2 relations.
Sorted sequence cannot be determined.
```

4. Given a function:

$f(x, y) = 6*x^7+9*x^6+5*x^3+2*x^2-y*x$

By given a particular y value, you should output the minimum value of $f(x, y)$ when x is between 0 and 200.

The first line of the input contains the number of cases (n), where $1 \leq n \leq 100$. Each next n lines has one real numbers y, where $0 < y < 100000000$). You should output the x with 4 decimal points which cause $f(x, y)$ is minimum in the range of $1 \leq x \leq 200$.

Example:
Input:

```
3
100
200
17198
```

Output:

```
-78.2106
-183.4391
-37078.9130
```