TIMUS 1082. Ivan the Fool

TIME LIMIT: 1.0 SECOND
MEMORY LIMIT: 64 MB

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Source: Third Sverdlovsk Region School Programming Team Competition, March 4, 2001
Tags: task for beginners (hide tags for unresolved tasks)

Difficulty: 118   Print version   Send to check   Forum discussion (19)
✔ My attempts   All attempts (16173)   All successful attempts (11545)   Rating of solutions (10090)

Question

► In a certain kingdom, in a certain state, there was a king, and he had a daughter - Vasilisa the Beautiful. Many wanted to marry her, but she refused to everyone. Tired of the tsar, he became angry and ordered: "The first one to solve my problem will get Vasilisa the Beautiful as a wife." Then Ivan, the fool of happiness, decided to try. He came to the king, and he said to him: "Here is a program for you, enter N numbers for her, she will tell you whom to marry. I give you a day to think." Ivanushka looked at the program and became sad: letters are somehow incomprehensible, all sorts of badges, here not only a fool, but also an intelligent head will break. Meanwhile, time is running out. So Ivanushka didn't come up with anything.

And that program was like this:

In C language	In Pascal
| ```c
#include <stdio.h>
long c;
long A [N];

long P (long l, long r)
{
 long x = A [l],
        i = l-1,
        j = r + 1,
        t;
 while (1)
 {
  do {- j; ++ c;}
  while (A [j]> x);
  do {++ i; ++ c;}
  while (A [i] <x);
  if (i <j)
  {
   t = A [i];
   A [i] = A [j];
   A [j] = t;
  }
  else return j;
 }
}

void Q (long l, long r)
{
 long n;
 if (l <r)
 {
  n is P (l, r);
  Q (l, n);
  Q (n + 1, r);
 }
}

int main (void)
{
 c is 0;
 for (long i = 0; i <N; ++ i)
  scanf ("% ld", & A [i]);
 Q (0, N-1);
 if (c == (N * N + 3 * N-4) / 2)
  printf
  ("Vasilisa the Beautiful");
 else printf
  ("Koschei the Deathless");
 return 0;
}
``` | ```pascal
 var A: array [1..N] of
longint;
     c: longint;
     i: integer;
 function
P (l, r: longint): longint;
 var i, j, t, x: longint;
 begin
  x: = A [l]; i: = l-1; j: = r + 1;
  while true do
  begin
   repeat dec (j); inc (c)
   until A [j] <= x;
   repeat inc (i); inc (c)
   until A [i]> = x;
   if i <j then
   begin
    t: = A [i];
    A [i]: = A [j];
    A [j]: = t
   end
   else
   begin P: = j; exit end
  end
 end;

 procedure Q (l, r: longint);
 var n: longint;
 begin
  if l <r then
  begin
   n: = P (l, r);
   Q (l, n);
   Q (n + 1, r)
  end
 end;

 begin
  c: = 0;
  for i: = 1 to N do
read (A [i]);
  Q (1, N);
  if c = (N * N + 3 * N-4) div 2
then
   writeln
   ('Vasilisa the Beautiful')
  else writeln
   ('Koschei the Deathless');
 end.
``` |

INPUT

▶ The first line contains a positive number $N \leq 1000$.

OUTPUT

▶ You must print N numbers on one line such that if you enter them in the program given by the king, then it will give out "Vasilisa the Beautiful". Numbers must be separated by spaces. If several options are possible, print any.

Example

initial data	result
3	3 7 19

First, understand the code

- If you combine function P and q its is a quicksort function

```
long P (long l, long r)
{
 long x = A [l],
      i = l-1,
      j = r + 1,
      t;
 while (1)
 {
  do {- j; ++ c;}
  while (A [j]> x);
  do {++ i; ++ c;}
  while (A [i] <x);
  if (i <j)
  {
   t = A [i];
   A [i] = A [j];
   A [j] = t;
  }
  else return j;
 }
}
```

```
void Q (long l, long r)
{
 long n;
 if (l <r)
 {
  n is P (l, r);
  Q (l, n);
  Q (n + 1, r);
 }
}
```

Main function

- The tsar's program is quicksort algorithm it sorts input array and counts in how many swaps it was done (variable c) (not exact value but represents it)

- In the IF condition "if (c == (N * N + 3 * N-4) / 2)", you will see that with any nonnegative value of "c" the program will print out

- " Vasilisa the Beautiful "

```
int main (void)
{
  c is 0;
  for (long i = 0; i <N; ++ i)
   scanf ("% ld", & A [i]);
  Q (0, N-1);
  if (c == (N * N + 3 * N-4) / 2)
   printf
   ("Vasilisa the Beautiful");
  else printf
   ("Koschei the Deathless");
  return 0;
}
```

Conclusion

▶ So basically, We just need to print any of array of length N the program, we will get " Vasilisa the Beautiful "

▶ Because we have a sorted array function P() will partition him into part consisting of 1 element and part consisting of l-r elements. The part consisting of 1 element will be ignored and there won't be any increase of c.

▶ In the part with l-r elements it will do the same - partitioned it into 1 and l-r-1.So let begin with l-r+1=N. Then the function Q() will go to l-r+1=N-1 and so on to l-r+1=2.

▶ For those calls of function Q() c will be increased with:

▶ N+1 + N + N-1 + ... + 5 + 4 + 3 = (N+1)*(N+1+1)/2 - 1 - 2 = N*N + 3*N + 2/2 – 3 = N*N + 3*N + 2 - 3*2/2 = N*N + 3*N - 4 / 2.

▶ So if we give a sorted array to the tsar's program it will print what we want.

Answer Code

```python
n = int(input())

for i in range(n):
    print(i,end=" ")
```

`testos.py`

ID	date	Author	Task	Tongue	Result of checking	Test number	Working hours	Memory allocated
8657068	03:08:13 Nov 28, 2019	Perawat wongkrit	1082 . Ivan the Fool	Python 3.6	Accepted		0.078	396 KB

References

- https://acm.timus.ru/forum/?space=1&num=1082 – **Fokysnik**

- https://www.geeksforgeeks.org/quick-sort/

- https://github.com/shahed-shd/Online-Judge-Solutions/blob/master/Timus-Online-Judge/1082%20-%20Gaby%20Ivanushka.cpp