

**2002/2003 SOUTHERN CALIFORNIA REGIONAL
ACM INTERNATIONAL COLLEGIATE PROGRAMMING CONTEST**

**Problem 4
Skew Binary**

It had been a year since Swamp County Computing established a functional programming group. Your (non-functional programming) group is going to throw a surprise party for the anniversary. Now the functional folks really like skew binary numbers for some reason. “Easy to increment and decrement!” they say.

Your task is to write a program to convert decimal integers to skew binary in the format they like. This will help in making banners and other party material.

Number representations are made up of a list of digits. Call the lowest order digit the rank 0 digit, the next, rank 1, etc. In decimal, digits are 0-9, the rank 0 digit has weight 1, the rank 1 digit has weight 10, and the rank i digit has weight 10^i . In binary, the digits are 0 and 1, and the rank i digit has weight 2^i .

In skew binary, the digits are 0, 1, and 2, and the rank i digit has weight $2^{i+1} - 1$.

<i>rank</i>	<i>weight</i>
0	1
1	3
2	7
3	15
4	31
5	63
6	127
7	255
⋮	⋮

Allowing the digit 2 means that there are several ways to represent a given number. However the convention is that a 2 may only appear as the lowest rank non-zero digit. This makes the representation unique.

There are several ways to write binary or skew binary numbers: a list of digits; a list of ranks of non-zero digits; a list of weights of non-zero digits. You will be using a list of ranks, smallest first. Each rank is a decimal integer, and is separated from the next rank by a ‘;’. The digit 2 is represented by the rank of the digit appearing twice in the list. Note that this means that *only* the first two ranks in the list may be equal. A list is started by a ‘[’ and ended by a ‘]’. For example, the decimal number 5 is: [0,0,1]. Decimal 0 is an empty list: [].

Input consists of decimal numbers, one per line, with no leading or trailing whitespace. Each number will be in the range 0–100663270. Input is terminated by end-of-file.

For each number, produce a single line of output consisting of the input decimal number, with no leading zeros or spaces, a single space, and the skew binary equivalent in list format with no leading or trailing spaces. Within the list each rank should have no extra leading zeros or leading or trailing spaces.

Problem 4
Skew Binary (continued)

Sample Input

```
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
100663270
512
513
62086533
1000000
2
455
27374
138
```

Sample Output

```
0 []
1 [0]
2 [0,0]
3 [1]
4 [0,1]
5 [0,0,1]
6 [1,1]
7 [2]
8 [0,2]
9 [0,0,2]
10 [1,2]
11 [0,1,2]
12 [0,0,1,2]
13 [1,1,2]
14 [2,2]
15 [3]
16 [0,3]
100663270 [0,0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,25]
512 [0,8]
513 [0,0,8]
62086533 [1,3,6,7,9,10,11,13,15,16,19,20,22,23,24]
1000000 [2,5,8,13,15,16,17,18]
2 [0,0]
455 [1,2,5,6,7]
27374 [1,1,3,4,5,6,8,10,12,13]
138 [0,1,2,6]
```