IOI & EGOI Team Selection Test

2025

Zeckendorf Representation

Time limit: 3 seconds **Memory limit: 512 MB**

Description

Lea just started her journey in competitive programming. After learning about Fibonacci numbers and how to compute them efficiently, she heard another interesting fact. Each positive number can be uniquely represented as the sum of non-consecutive Fibonacci numbers. This is the Zeckendorf representation of a positive integer.

Formally, given a (shifted) Fibonacci sequence defined as $F_1 = 1, \quad F_2 = 2, \quad F_n = F_{n-1}+F_{n-2} \quad \forall n > 2$ .the Zeckendorf Representation of a positive integer N is the unique sequence of m binary digits $d_i \in \{0, 1\}$, written as $d_m d_{m-1} \dots d_2 d_1$. such that $N = \sum_{i=1}^{m} d_i F_i$ and $d_m = 1$

Task

Write a program to help Lea find the Zeckendorf representation of the Q numbers $N_1, ..., N_Q$.

Constraints

-1 $\leq Q \leq 10^4$
-1 $\leq N_i \leq 10^{16}$

Input Data

A single line containing Q. The following Q lines contain the numbers $N_1, ..., N_Q$, one per line.

Output Data

For each number $N_1, ..., N_Q$ output the Zeckendorf reprensentation of that number, one per line.

Execution example

Input

```
4
5
7
4
1
```

Output

```
1000
1010
101
1
```

The first 4 Fibonacci numbers are $F_1 = 1, F_2 = 2, F_3 = 3, F_4 = 5$ and we can write $5 = 1 \cdot F_4 + 0F_3 + 0F_2 + 0F_1$, hence its representation is 1000. Moreover, we can write $7 = 1F_4 + 0F_3 + 1F_2 + 0F_1$, hence its representation is 1010.

Note: 110 is not a valid representation for 5 even though $F_2 + F_3 = 5$, as it contains two consecutive 1 digits.

Subtasks

description	Score	constraints
1	10	$N_i \leq 10$
2	15	$Q = 1, N_i \leq 10^5$
3	25	$N_i \leq 10^6$
4	50	No additional constraints