Zeckendorf's Game

DiPS CodeJam 22

Prompt

In a game of *Zeckendorf*, your task is to find the shortest representation of a given integer as a sum of Fibonacci numbers. For example, the *Zeckendorf* representation of 10 is $10 = 2 + 8$. Numbers **cannot** be repeated.
Pranav and Prithvi are playing a game of Zeckendorf. Can you help them find the answers as fast as possible?

Input Format

The first and only line of input will contain an integer n.

Output Format

The first and only line of your output must contain a space-separated list of the *Zeckendorf* representation of n, sorted in ascending order.

Constraints

$1 \leq n \leq 10^5$

Sample Input/Output

Input	Output
93743	2 5 13 987 17711 75025

Solution

Let's take the sample input (93743) as n. To find the *Zeckendorf* representation, we

- First, find the greatest Fibonacci Number smaller than or equal to n.
- Append the fibonacci number we found to an array.
- Reduce n by f ($n = n - f$).
- Repeat these steps while $n > 0$.
- We now have an array of the *Zeckendorf* representation of n. To obtain the result, we sort the array in ascending order, and then print it.

Sample Program

```
# Helper: Returns the greatest Fibonacci Number smaller than or equal to n.
def nearestSmallerEqFib(n):
     # Edge cases
     if (n == 0 or n == 1):
          return n
     # Finds the greatest Fibonacci mumber smaller than n.
     f1, f2, f3 = 0, 1, 1
     while (f3 <= n):
          f1 = f2;
          f2 = f3;
          f3 = f1 + f2;
     return f2;


n = int(input())
result = []
while (n>0):
     # Find the greatest Fibonacci Number smaller than or equal to n
     f = nearestSmallerEqFib(n);
     # Append the fibonacci number we found
     result.append(f)
     # Reduce n
     n = n-f
result.sort()
print(" ".join(str(e) for e in result))
```