Term Project
Algorithm Design
1073. Square Country
Difficulty : 157

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1073. Square Country

Time limit: 1.0 second

Memory limit: 64 MB

There live square people in a square country. Everything in this country is square also. Thus, the Square Parliament has passed a law about a land. According to the law each citizen of the country has a right to buy land. A land is sold in squares, surely. Moreover, a length of a square side must be a positive integer amount of meters. Buying a square of land with a side a one pays a^2 quadrics (a local currency) and gets a square certificate of a landowner.

One citizen of the country has decided to invest all of his N quadrics into the land. He can, surely, do it, buying square pieces 1×1 meters. At the same time the citizen has requested to minimize an amount of pieces he buys: "It will be easier for me to pay taxes," — he has said. He has bought the land successfully.

Your task is to find out a number of certificates he has gotten.

Input

The only line contains a positive integer $N \leq 60\,000$, that is a number of quadrics that the citizen has invested.

Output

The only line contains a number of certificates that he has gotten.

Sample

input	output
344	3

Dynamic Programming

```java
import java.util.Scanner;
import java.util.Arrays;

public class s1073 {
    public static void main (String [] args) throws Exception {
        Scanner read = new Scanner(System.in);
        int n = read.nextInt();
        int up = (int)Math.ceil(Math.sqrt(n));
        int dp[] = new int[n+1];
        Arrays.fill(dp, 9999999);
        dp[0] = 0;
        for(int i=1;i<=up;i++){
            for(int j=i*i;j<=n;j++){
                dp[j] = Math.min(dp[j], dp[j-i*i]+1);
            }
        }
        System.out.println(dp[n]);
        read.close();
    }
}
```

Language	Judgement result	Test #	Execution time	Memory used
Java 1.8	Accepted		0.14	2 276 KB

Lagrange’s Four Square Theorem

```
int t1, t2, t;
for (int i = (int) Math.sqrt(n / 4); i * i <= n; i++) {
     t1 = n - i * i;
     for (int j = (int) Math.sqrt(t1 / 3); j <= i && j * j <= t1; j++) {
          t2 = t1 - j * j;
          for (int k = (int) Math.sqrt(t2 / 2); k <= j && k * k <= t2; k++) {
               t = (int) Math.sqrt(t2 - k * k);
               if (t <= k && t * t == t2 - k * k) {
                    System.out.println("(" + i + "^2) + (" + j + "^2) + ("+ k + "^2) + ("+ t +"^2)");
               }
          }
     }
}
```

Lagrange's optimization

```java
import java.util.Scanner;

public class b1073 {
    public static void main(String[] args) throws Exception {
        Scanner read = new Scanner(System.in);
        int n = read.nextInt();
        int ans = numSquares(n);
        System.out.println(ans);
        read.close();
    }

    public static int numSquares(int n) {
        while (n % 4 == 0)
            n /= 4;
        if (n % 8 == 7)
            return 4;
        for (int a = 0; a * a <= n; ++a) {
            int b = (int) Math.sqrt(n - a * a);
            if (a * a + b * b == n) {
                return (a != 0 && b != 0) ? 2 : 1;
            }
        }
        return 3;
    }
}
```

Language	Judgement result	Test #	Execution time	Memory used
Java 1.8	Accepted		0.124	2 124 KB

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Problem Author: Stanislav Vasilyev
Problem Source: Ural State Univerisity Personal Contest Online February'2001 Students Session
Tags: dynamic programming (hide tags for unsolved problems)

Difficulty: 157 Printable version Submit solution Discussion (52)
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Reference

- Weisstein, Eric W. "Lagrange's Four-Square Theorem." From *MathWorld*--A Wolfram Web Resource. http://mathworld.wolfram.com/LagrangesFour-SquareTheorem.html