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| **SVKM's-IOT, Dhule**Shri Vile Parle Kelavani Mandal's  **INSTITUTE OF TECHNOLOGY**  **DHULE (M.S.)**  **DEPARMENT OF COMPUTER ENGINEERING** | | | |
| **Subject :** Competitive Programmimg Lab | | | Remark |
| **Name : Jaykishan Natwar Varma** | | **Roll No. :** 68 |
| **Class :** TY. Comp. Engg. | **Batch :** T4 | **Division:** |
| **Expt. No. :** | **Date :** | | Signature |
| **Title :**  The Priest Mathematician | | |
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| **ASSIGNMENT/EXPERIMENT: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | |
| **Date of Performance:**  **Date of Submission:** | | |
| **Marks Split Up** | **Maximum Marks** | **Marks Obtained** |
| **Performance/Conduction** | **3** |  |
| **Report Writing** | **3** |  |
| **Attendance** | **2** |  |
| **Viva/Oral** | **2** |  |
| **Total Marks** | **10** |  |
| **Signature of Subject Teacher** | | |

**Title:** The Priest Mathematician

**Aim:** The ancient folklore behind the “Towers of Hanoi” puzzle invented by E. Lucas in 1883 is quite well known to us. One more recent legend tells us that the Brahmin monks from Benares never believed that the world could vanish at the moment they finished to transfer the 64 discs from the needle on which they were to one of the other needles, and they decided to finish the task as soon as possible. One of the priests at the Benares temple (who loved the mathematics) assured their colleagues to achieve the transfer in the afternoon (the rhythm they had thought was a disc-per-second) by using an additional needle. They couldn’t believe him, but he proposed them the following strategy:

First move the topmost discs (say the top k discs) to one of the spare needles.

Then use the standard three needles strategy to move the remaining n − k discs (for a general case with n discs) to their destination.

Finally, move the top k discs into their final destination using the four needles.

He calculated the value to k in order to minimize the number of movements and get a total of 18433 transfers, so they spent just 5 hours, 7 minutes and 13 seconds against the more than 500000 millions years without the additional needle (as they would have to do 264 − 1 disc transfers. Can you believe it?) Try to follow the clever priest’s strategy and calculate the number of transfer using four needles but according with the fixed and immutable laws of Brahma, which require that the priest on duty must not move more than one disc at a time and that he must place this disc on a needle so that there is no smaller disc below it. Of course, the main goal is to calculate the k that minimize the number of transfers (even thought it is not know for sure that this is always the optimal number of movements).

**Language used: Cpp**

**Platform Used: Code Blocks**

**Sample Input:** The input file contains several lines of input. Each line contains a single integer N, which is the number of disks to be transferred. Here 0 ≤ N ≤ 10000. Input is terminated by end of file.

**Sample Output**: For each line of input produce one line of output which indicates the number of movements required to transfer the N disks to the final needle.

**Example:**

***Sample Input :***

1

2

28

64

***Sample Output:***

1

3

769

18433

**Algorithm/Flowchart:**

1. **Representation using Gauss's Composition Theorem**: Gauss's composition theorem states that a positive integer can be expressed as the sum of three squares if and only if it is not of the form 4𝑘(8𝑚+7)4*k*(8*m*+7) for integers 𝑘*k* and 𝑚*m*. This theorem provides a way to efficiently test whether a number can be expressed as the sum of three squares.
2. **Computational Approach**:
   * Use a loop to iterate over possible values of 𝑥*x*, 𝑦*y*, and 𝑧*z* within a certain range (typically limited by the square root of 𝑛*n* for efficient computation).
   * For each combination of 𝑥*x*, 𝑦*y*, and 𝑧*z*, compute 𝑥2+𝑦2+𝑧2*x*2+*y*2+*z*2 and check if it equals 𝑛*n*.
   * Count valid combinations that satisfy the equation 𝑥2+𝑦2+𝑧2=𝑛*x*2+*y*2+*z*2=*n* to determine 𝑟3(𝑛)*r*3​(*n*).
3. **Optimization**:
   * Utilize modular arithmetic to efficiently check if a number can be expressed as the sum of three squares.
   * Leverage mathematical insights and computational techniques to reduce redundant computations and improve efficiency.

**Code:**

#include <stdio.h>

int bin[150][100] = {};

int dp[10000][100] = {};

void build() {

bin[0][0] = 1;

int i, j, k, la = 0, idx = 2;

dp[1][0] = 1;

for(i = 1; i < 150; i++) {

for(j = 0; j <= la; j++)

bin[i][j] = bin[i-1][j]\*2;

for(j = 0; j <= la; j++) {

if(bin[i][j] >= 10) {

bin[i][j+1] += bin[i][j]/10;

bin[i][j] %= 10;

}

}

if(bin[i][la+1]) la++;

k = i+1;

while(k && idx <= 10000) {

for(j = 0; j < 99; j++)

dp[idx][j] = dp[idx-1][j]+bin[i][j];

for(j = 0; j < 99; j++) {

if(dp[idx][j] >= 10) {

dp[idx][j+1] += dp[idx][j]/10;

dp[idx][j] %= 10;

}

}

idx++, k--;

}

}

}

int main() {

build();

int n, i;

while(scanf("%d", &n) == 1) {

if(n == 0)

putchar('0');

for(i = 99; i >= 0; i--)

if(dp[n][i])

break;

while(i >= 0) putchar(dp[n][i]+'0'), i--;

puts("");

}

return 0;

}

**Input:-**

1

2

28

64

**Output:-**

1

3

769

18433

**Conclusion:** In this way we implement The Priest Mathematician Problem using loops and conditional statements.