Count positive integers with 0 as a digit and maximum ‘d’ digits

Given a number d, representing the number of digits of a number. Find the total count of positive integers which have at-least one zero in them and consist d or less digits.

```
Examples:
Input : d = 1
Output : 0
There's no natural number of 1 digit that contains a zero.

Input : d = 2
Output : 9

Input : d = 3
Output : 180
For d = 3, we've to count numbers from 1 to 999, that have
atleast one zero in them.
Similarly for d=4, we'd check every number from 1 to 9999.
```

We strongly recommend that you click here and practice it, before moving on to the solution.

This is mainly an extension of below post.

Count ‘d’ digit positive integers with 0 as a digit.

If we observe carefully the problem is very similar to the one which we had discussed in our first set. For a given d, we can get the required answer if we find numbers that have 0s and consist of digits 1, 2, 3….., d. Finally we can add them to get the output.

Below is a C++ program for the same.

```cpp
// C++ program to find the count of positive integer of a
// given number of digits that contain atleast one zero
#include<bits/stdc++.h>
using namespace std;

// Returns count of 'd' digit integers have 0 as a digit
int findCount(int d)
{
    return 9*(pow(10,d-1) - pow(9,d-1));
}

// utility function to count the required answer
int findCountUpto(int d)
{
    // Count of numbers with digits smaller than
    // or equal to d.
    int totalCount = 0;
    for (int i=1; i<=d; i++)
        totalCount += findCount(i);

    return totalCount;
}

// Driver Code
int main()
{
    int d = 1;
    cout << findCountUpto(d) << endl;

    d = 2;
    cout << findCountUpto(d) << endl;

    d = 4;
    cout << findCountUpto(d) << endl;
    return 0;
}
```

Run on IDE

Output :

```
0
9
2619
```

Time Complexity : O(d)
Auxiliary Space : O(1)

Can we make the solution more efficient ?
Yes, if we see closely, the required answer is obtained using the sum of following two Geometric Progressions:

```
i'th term of G.P. 1 = 9*10^i - 1  where 1 <= i <= d
i'th term of G.P. 2 = 9*9^i - 1 where 1 <= i <= d
The final answer is nothing but,
```

$$Answer = \sum_{k=1}^{d} |G.P1| - \sum_{k=1}^{d} |G.P2|$$

```
Sum of G.P 1 = 9*(10^d - 1)/(10-1)
             = 9*(10^d - 1)/9
Similarly,
Sum of G.P 2 = 9*(9^d - 1)/(9-1)
             = 9*(9^d - 1)/8
Using the above facts, we can optimize the solution to run in O(1)
```

Below is an efficient program for the same.

```cpp
// C++ program to find the count of natural numbers upto a
// given number of digits that contain atleast one zero
#include<bits/stdc++.h>
using namespace std;

// Utility function to calculate the count of natural numbers
// upto a given number of digits that contain atleast one zero
int findCountUpto(int d)
{
    // Sum of two GP series
    int GP1_Sum = 9*((pow(10,d)-1)/9);
    int GP2_Sum = 9*((pow(9,d)-1)/8);

    return GP1_Sum - GP2_Sum;
}

// Driver Code
int main()
{
    int d = 1;
    cout << findCountUpto(d) << endl;

    d = 2;
    cout << findCountUpto(d) << endl;

    d = 4;
    cout << findCountUpto(d) << endl;
    return 0;
}
```

Run on IDE

Output :

```
0
9
2619
```

Time Complexity : O(1)
Auxiliary Space : O(1)

In the next set we’d see another problem of increased difficulty that can be solved using very similar technique.

This article is contributed by Ashutosh Kumar. Please write comments if you find anything incorrect, or you want to share more information about the topic discussed above.

Company Wise Coding Practice   Topic Wise Coding Practice

2 Comments Category: Mathematical

Related Posts:

- Find Last Digit Of a^b for Large Numbers
- Reverse and Add Function
- Number of elements with odd factors in given range
- Stein’s Algorithm for finding GCD
- GCD of two numbers when one of them can be very large
- Sub-string Divisibility by 11 Queries
- Sub-string Divisibility by 3 Queries
- Converting Decimal Number lying between 1 to 3999 to Roman Numerals

Previous post in category   Next post in category

Logged in as Ruturaj Mohanty 1 (Logout)
2.3 Average Difficulty : 2.3/5.0
Based on 9 vote(s)
Basic Easy Medium Hard Expert
Add to TODO List
Mark as DONE

Writing code in comment? Please use code.geeksforgeeks.org, generate link and share the link here.

2 Comments GeeksforGeeks 1 Login
Recommend Share Sort by Newest
Join the discussion…

Fattepur Mahesh • 6 months ago
http://code.geeksforgeeks.org/...
Reply • Share ›

kumar • 6 months ago
i don't think time complexity is O(1).
since you are using pow() function.
if should be O(log(d)).
1 • Reply • Share ›

Subscribe Add Disqus to your site Privacy DISQUS

Start Coding Today

Popular Posts
- Top 10 Algorithms and Data Structures for Competitive Programming
- Top 10 algorithms in Interview Questions
- How to begin with Competitive Programming?
- Reflection in Java
- Memory Layout of C Programs
- Push Relabel Algorithm
- Heavy Light Decomposition
- Sorted Linked List to Balanced BST
- Generics in Java
- Aho-Corasick Algorithm for Pattern Searching
- Binary Search , QuickSort , MergeSort , HeapSort

- Common Interview Puzzles
- Interview Experiences
- Advanced Data Structures
- Design Patterns
- Dynamic Programming
- Greedy Algorithms
- Backtracking
- Pattern Searching
- Divide & Conquer
- Geometric Algorithms
- Searching
- Sorting
- Hashing
- Analysis of Algorithms
- Mathematical Algorithms
- Randomized Algorithms
- Recursion

Tags
Accolite Adobe Advance Data Structures Advanced Data Structures Amazon array Bit Magic C++ CN c puzzle D-E-Shaw Directi Divide and Conquer Dynamic Programming Flipkart GATE GATE-CS-DS-&-Algo GATE-CS-Older GFacts Goldman Sachs Google Graph Greedy Algorithm Hashing Interview Experience Java MakeMyTrip MAQ Software MathematicalAlgo Matrix Microsoft Morgan Stanley Operating systems Oracle Pattern Searching puzzle Python Recursion Samsung SAP Labs SnapDeal stack Stack-Queue STL Zoho

Subscribe and Never Miss an Article
Email Address Subscribe

Like us on Facebook

Follow us on Twitter

Recent Comments

Gaurav Singh I too got confused first. Then my friend...
Microsoft Interview experience | Set 98 (On Campus for IDC) · 19 minutes ago

abcd bro can u tell me how to design test cases
Recursively remove all adjacent duplicates · 29 minutes ago

yamaha Cool buddy. As he said "After this round I did...
Amazon Interview Experience | Set 311 (On Campus for Internship and FTE) · 32 minutes ago

cool_dude this question was asked in amazon written test.
Maximize number of 0s by flipping a subarray · 58 minutes ago

suzuki bro he was not selected..dont irriate him by...
Amazon Interview Experience | Set 311 (On Campus for Internship and FTE) · 1 hour ago

adit vira Simple Java Solution using Iterative level...
Get Level of a node in a Binary Tree · 1 hour ago

All Categories
Select Category

- GeeksQuiz
- GeeksforGeeksIDE
- GeeksforGeeks Practice
- Data Structures
- Algorithms
- C Programming
- C++ Programming
- Java Programming
- Books
- Interview Experiences
- GATE CS
- GATE CS Forum
- Android App