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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
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.

```
// 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;</pre>
```

Run on IDE

Output:

return 0;

Auxiliary Space : O(1)

```
2619
Time Complexity: O(d)
```

Can we make the solution more efficient?

cout << findCountUpto(d) << endl;</pre>

cout << findCountUpto(d) << endl;</pre>

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^{1} - 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. // 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;</pre> cout << findCountUpto(d) << endl;</pre> cout << findCountUpto(d) << endl;</pre> return 0;

Run on IDE

0

Output:

```
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.



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i don't think time complexity is O(1). since you are using pow() function. if should be O(log(d)).

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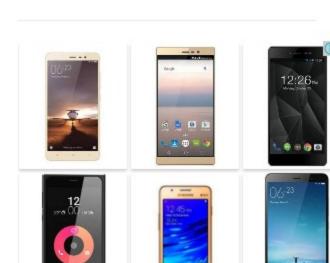
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