660. Remove 9

Dec. 10, 2017 | 4.5K views

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Start from integer 1, remove any integer that contains 9 such as 9, 19, 29...

So now, you will have a new integer sequence: 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, ...

Given a positive integer `n`, you need to return the n-th integer after removing. Note that 1 will be the first integer.

Example 1:

```
Input: 9
Output: 10
```

Hint: n will not exceed `9 x 10^8`.

Approach #1: Mathematical

Intuition

Let's write the first numbers and try to notice a pattern. Those numbers are:

```
1, 2, 3, 4, 5, 6, 7, 8,
10, 11, 12, 13, 14, 15, 16, 17, 18,
20, 21, 22, 23, 24, 25, 26, 27, 28,
...
80, 81, 82, 83, 84, 85, 86, 87, 88,
100, 101, 102, ...
```

These numbers look exactly like all base-9 numbers!

Indeed, every base-9 number is a number in this sequence, and every number in this sequence is a base-9 number. Both this sequence and the sequence of all base-9 numbers are in increasing order. The answer is therefore just the n-th base-9 number.

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```python
class Solution(object):
    def newInteger(self, n):
        ans = ''
        while n:
            ans = str(n%9) + ans
            n /= 9
        return int(ans)
```

Complexity Analysis

- Time Complexity: $O(1)$, since N has at most 9 digits.
- Space Complexity: $O(1)$.

Analysis written by: @awice.

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Hai_dee ★ 934 July 6, 2019 2:28 PM

There are questions ranked as "easy" that are more difficult than this. Surely this question should be an "easy" or maybe a "medium" rather than a "hard". It's fairly straightforward to recognise that if we remove a digit that we're going into base 9, and thus it's just a base 10 to 9 conversion algorithm, which is fairly straightforward (and especially if one just thinks about how they'd convert from base 10 to base 2 and then apply the same idea, something most programmers have done before).

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Merciless ★ 487 June 9, 2019 8:42 PM

just a reminder that in Python 3 "n /= 9" should be "n //= 9"

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ZhassanB ★ 221 February 13, 2019 4:46 AM

To my opinion, it is very unlikely that one comes up with base-9 solution as you pointed out here.

Here is my more straightforward but O(log10(n)) solution which is fast enough and more intuitive However I also spent a lot of time to figure out the pattern.

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dubey_k ★ 0 December 17, 2017 5:01 AM

public class Base9 {

```
public static int convertToBase9(int x)
{
    if(x%10 == 9)
```

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be-humble ★ 697 December 1, 2019 12:50 PM

Approach #2 (log(n))
We can use binary search

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