

# Term Project

## Algorithm Design

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# Agenda Style

Problem

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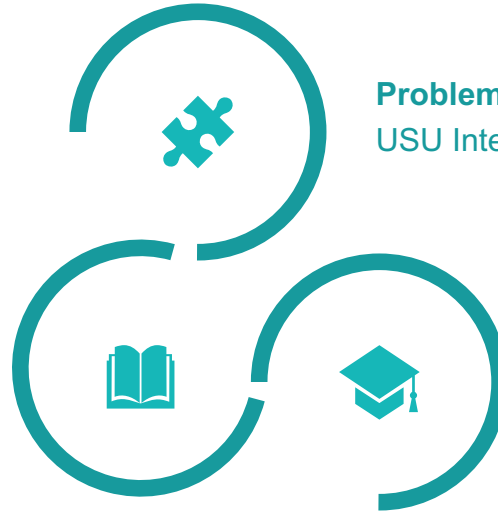
# Problem

Sum of Digits of the Sum of Numbers

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Sum of Digits of the Sum of Numbers

**Problem Author**  
Leonid Volkov



**Problem Source**

USU Internal Contest, March 2002

**Difficulty**

120

# Problem

## Sum of Digits of the Sum of Numbers

### Question:

Let us denote the sum of digits of the number  $N$  by  $S(N)$ . In this problem, we want you to determine, how often the following equality holds:

$$S(A + B) = S(A) + S(B)$$

### Input:

The input contains a single integer  $K$ ,  $2 \leq K \leq 50$ .

### Output:

You should output the number of pairs of  $K$ -digit numbers  $A$  and  $B$  to satisfy the above equality. Counting that number you should be aware of the following:

1. numbers  $A$  and  $B$  should not have leading zeroes;
2. while counting the total number of pairs, the order of numbers  $A$  and  $B$  matters, thus, for instance,  $(12, 26)$  and  $(26, 12)$  are different pairs that satisfy the conditions of the problem.

# Problem

Sum of Digits of the Sum of Numbers

**Sample:**

Input	Output
2	1980

# What is Sum of Digits?

The sum of digit is the end of result of repeatedly computing the sum of the digits until a single digit answer is obtained.

It means the end of result must less than or equal 9.  
Ans it must be a single digit

For Example: Find the sum of digit of number **786**

Step 1: the sum of the digits,  $7 + 8 + 6 = 21$

21 is greater than 9 and it is no a single digit , then continue

Step 2: the sum of the digits from step (1),  $2 + 1 = 3$

3 is less than 9 and it is a single digit. So, **3** is the end of result





**The Way for Solution**



# The Way for Solution

We found that if we pick a pair number that condition is true in the formula, we need to pick the first number and the last number of both. Sum of first number and last number must less than 10

## Example:

Suppose that pair number is 13 and 14, we can think by using the way for solve from above

13 and 14

Sum of first number is  $1 + 1 = 2$   
2 is less than 10

Sum of last number is  $3 + 4 = 7$   
7 is less than 10

So, these two pair is selected

## First version

First, we created function to calculate the sum of digit, then return it. After that we calculate with a simple way by using for-loop to calculate from first pair to last pair.

```
def S(x) :  
    string = []  
    for i in str(x) :  
        string.append(int(i))  
    return sum(string)  
  
result = 0  
first1 = int("1" + ("0" * (x - 1)))  
last1 = int("9" * x)  
  
for i in range(first1, last1) :  
    for j in range(first1, last1) :  
        if (S(i + j) == S(i) + S(j)) :  
            result += 1  
  
print(result)
```

```
2  
1980  
mike@Kasemdets-M:  
3  
108900
```

This code is work, but it use a lot of time to do, so it will not pass, when I submit it to Timus.

## Final version

We found that  $1980 * 55 = 108900$ , that mean from two digit to three digit, there is 55 times. We can count first value that is equal 36 and for second value is equal 55.

From above part (The first for-loop) is instead of first digit and bottom is a last digit.

In the first for-loop, it start from 1 because the question said that zero can't be lead in every pairs.

```
first = 0
✓ for i in range(1, 10) :
✓     for j in range(1, 10) :
✓         if i + j < 10 :
            first += 1

second = 0
✓ for i in range(0, 10) :
✓     for j in range(0, 10) :
✓         if i + j < 10 :
            second += 1
```

## Final version

```
result = first
for i in range(1, x) :
    result *= second
print(result)
```

In two digits, the result is  $36 * 55$ , and three digits is  $36 * 55 * 55$ . That mean the result is equal  $36 * (\text{input value} - 1 \text{ times})$ . When we get this code, it work completely and pass the solution in Timus website

## Approval

9465134	21:19:03 20 Sep 2021	<a href="#">Kasemdet Soommart</a>	<a href="#">1206. Sum of Digits of the Sum of Numbers</a>	Python 3.8 x64	Accepted	0.062	320 KB
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Thank you