



## Lab 9 Recursion

### 1 Lab Objectives

- Learning about Recursion.
- More practice on loops and Arrays.
- Verify your solutions on hackerrank <https://www.hackerrank.com/programming-lab-9-f2018>.

### 2 Problem 1 - Fibonacci (Revisited)

Write a recursive program that calculates the  $n^{th}$  term of Fibonacci series. Compare it with the iterative version.

Which one is faster? Why is that?

### 3 Problem 2 - Print Sequence

Given an integer  $n$ , write recursive function that prints 1 through  $n$ .

### 4 Problem 3 - Sum of Digits

Write a recursive function to calculate and return the sum of digits of a given number.

### 5 Problem 4 - Asterisks Pattern

Write a recursive function to produce a pattern of  $n$  lines of asterisks. First line has 1 asterisk, second has 2 asterisks, up to the  $n^{th}$  line that has  $n$  asterisks. Then, line  $n+1$  has  $n-1$ , next lines has  $n-2$ , and so on until line  $2n-1$ , which has 1 asterisk. For example, for  $n = 4$ , the output should be:

```
*
**
***
****
***
**
*
```



## 6 Problem 5 - Pain In The Head

Given an array of length  $N$ , and you want to convert that array to have all the numbers power of 2. You can do any of the following operations as many times as you want:

- Erase an integer  $Z$  from the array and insert two new integers  $X, Y$  such that  $X + Y = Z$ .
- Erase 2 integers  $X, Y$  and insert new integer  $Z$  such that  $Z = X + Y$ .

what is the smallest array in size such that all its elements are powers of two and at the same time new array will still have the same sum as the old array?

You must use functions to solve this problem.

Use long long to avoid overflow.

Think of a good algorithm to solve this problem!

### Input Format:

The first line of input contains an integer  $T$ , number of test cases.

Each test case contains two lines, the first line will contain a single integer  $N$ .

The second line will contain  $N$  space separated integers.

### Constraints:

$$1 \leq T \leq 10$$

$$1 \leq N \leq 100000$$

$$1 \leq a[i] \leq 1000000000$$

### Output Format:

For each test case print a single integer, the length of the smallest array in size and all of its elements are powers of two.

### Sample Input:

```
5
1
16
2
1 3
3
2 2 2
4
11 11 11 11
5
1 2 3 4 5
```



### Sample Output:

1  
1  
2  
3  
4

### Explanation:

Just think in binary  
For the fifth test case  
5  
1 2 3 4 5

The equivalent array shall be of 4 places only all power of 2, and has the sum of 15.

## 7 [BONUS] Problem 6 - Convert to Base n

Write a program that uses a recursive method to convert an integer from base 10 to another base. Your program should read the integer and the base as inputs. The recursive function should **print** the number in the new base. So, if the inputs were:  
number = 13, base = 2, then the output should be: 1101

**Note:** Supporting up to base 10 will get you half the bonus grade. Supporting higher bases will get you the full mark of the bonus.

## 8 Notes

- Read the lab **carefully** and stick exactly to what's required!
- You should not use any loop, global variable, or static variable in this lab.
- You are required to bring your C programs for all problems to the lab on a CD / Flash memory / Laptop.
- Cheating will be severely penalized (for both parties). So, it is better to deliver nothing than deliver a copy!
- You are encouraged to ask any questions on Piazza, or in person.

Good Luck isA :)