Introduction to Computers and Programming LAB-7 2016/11/16

✧   The output must be in our sample output format.

✧   You can raise your hand to demo once you finish a program.

✧   The bonus question is for this lab only. <u>If you cannot finish question 1 to 4 in time, you are allowed to demo them at next lab hours.</u>

✧   TAs will update lab records every Monday after the lab hours in the link: http://goo.gl/ZVJu2Y

1. The Catalan number

Design a program to calculate the nth Catalan number. The Catalan numbers satisfy the recurrence relation: $C_0 = 1$ and $C_{n+1} = \sum_{i=0}^{n} C_i * C_{n-i}$

Please write your codes only in the *Cn* function.

```c
#include <stdio.h>

int Cn(int n);

int main(void){
    int n, C;
    while(1){
        printf("Enter n:");
        scanf("%d", &n);
        C = Cn(n);
        printf("%dth Catalan number is:%d\n\n", n, C);
    }
    return 0;
}
int Cn(int n){
    //Your Code
}
```

```
Enter n:0
0th Catalan number is:1

Enter n:1
1th Catalan number is:1

Enter n:5
5th Catalan number is:42

Enter n:6
6th Catalan number is:132
```

2. Recognizer of 3

Given a binary number with unknown length, **finish the recursive function *count_zero* to determine if the number of 0's contained in it is a multiple of 3.** Any loop statements in the *count_zero* function are forbidden, and please write your codes only in the *count_zero* function.

```c
#include<stdio.h>
int count_zero(void);

int main(void)
{
    while(1)
    {
        printf ("Enter a binary number: ");
        if(count_zero() % 3 == 0)
        {
            printf("Yeeee!\n\n");
        }
        else
        {
            printf("Boooo!\n\n");
        }
    }
    return 0;
}

int count_zero(void)
{
    // Write your codes here
}
```

```
Enter a binary number: 101010111000
Yeeee!

Enter a binary number: 00111011100
Boooo!

Enter a binary number: 000
Yeeee!

Enter a binary number: 0
Boooo!
```

3. The Tower of Hanoi

The Tower of Hanoi is a mathematical game or puzzle. It consists of three rods, and a number of disks of different sizes which can slide onto any rod. The puzzle starts with the disks in a neat stack in ascending order of size on one rod, the smallest at the top, thus making a conical shape.

The objective of the puzzle is to move the entire stack to another rod, obeying the following rules:

- Only one disk may be moved at a time.
- Each move consists of taking the upper disk from one of the rods and sliding it onto another rod, on top of the other disks that may already be present on that rod.
- No disk may be placed on top of a smaller disk.

Assume the three rods are named A, B and C. Write a program to let the user enter the number of disks, and prints the **Simplest Movements** needed for move all the disks from A to C.

```
Enter the number of disks: 3
Move sheet from A to C
Move sheet from A to B
Move sheet from C to B
Move sheet from A to C
Move sheet from B to A
Move sheet from B to C
Move sheet from A to C
Need at least 7 move.
```

```
Enter the number of disks: 2
Move sheet from A to B
Move sheet from A to C
Move sheet from B to C
Need at least 3 move.
```

Note: You have to use recursion and print the total move count.

4. Numbers in Lexicographical Order

Write a program that first requires user to input a number N and then outputs numbers from 1 to N in lexicographical order. $(1 \le N < 10000)$

```
Please input n: 20
1 10 11 12 13 14 15 16 17 18 19 2 20 3 4 5 6 7 8 9
```

```
Please input n: 50
1 10 11 12 13 14 15 16 17 18 19 2 20 21 22 23 24 25 26 27 28 29 3 30 31
32 33 34 35 36 37 38 39 4 40 41 42 43 44 45 46 47 48 49 5 50 6 7 8 9
```

5. (BONUS) It's more blessed to give than to receive!

Myanmar (Burma) has been named the world's most generous country, pipping the US and Australia to the honor, in Charities Aid Foundation's 2016 World Giving Index.

According to the research, 91 per cent of Myanmar residents gave money to charity in the past year, 62 per cent said they had helped a stranger, and 55 per cent claimed they had volunteered. The ranking of top ten overall generosity is showed as following:

Rank	Country	Overall generosity
1	Myanmar	70%
2	United States	61%
3	Australia	60%
4	New Zealand	59%
5	Sri Lanka	57%
6	Canada	56%
7	Indonesia	56%
8	United Kingdom	54%
9	Ireland	54%
10	United Arab Emirates	53%

Source: goo.gl/bJULT1 、 goo.gl/o8lAh4

Mike is a little boy from Myanmar. He would like to share his cookies to his friends. Can you help him figure out how many ways he can share his cookies? For example, if he has 3 cookies, there are 3 ways to share them: (1) 3 cookies for a friend; (2) 2 cookies for a friend, 1 cookie for another friend; (3) 1 cookie for 3 different friends.

Given the number of cookies Mike has, which is less than 30, **the program shows each way to share these cookies in lines (from largest number to 1)**. Also, **the last line of the output is the number of ways to share cookies**. Your program should be able to let user to input repeatedly.

```
Enter the number of cookies: 5
5
4 1
3 2
3 1 1
2 2 1
2 1 1 1
1 1 1 1 1
There are 7 ways to share cookies.


Enter the number of cookies: 3
3
2 1
1 1 1
There are 3 ways to share cookies.
```