

# COMP 10280 Programming I (Conversion)

## Practical Sheet 11 Déardaoin, 7 Deireadh Fómhair 2021

For each of the following questions, write an algorithm in pseudocode first before writing a Python program. Submit your algorithms in pseudocode as well as your Python programs.

1. Taking the program to calculate the factorial of a number presented in class, investigate how it would be possible to have just two cases, one where the number is less than 0 and one where it isn't. Rewrite the program to do this.

Save this program as p11p1.py.

2. Write a program that prompts the user for an integer and uses a while loop to calculate that number of terms of the Fibonacci Series. Try to make the program as small and efficient as possible.

Save this program as p11p2.py.

3. Write a program that prompts the user for a series of integers and, for each of the numbers entered, uses a for loop to calculate that number of terms of the Fibonacci Series. The program should stop when a negative number is entered.

Save this program as p11p3.py.

4. The *Catalan Numbers* form a sequence of natural numbers. They are defined as follows:

$$C_n = \frac{1}{n+1} \binom{2n}{n} = \frac{(2n)!}{(n+1)!n!} = \prod_{k=2}^n \frac{n+k}{k} \text{ for } n \geq 0$$

An alternative expression for  $C_n$  is:

$$C_n = \binom{2n}{n} - \binom{2n}{n+1} = \frac{1}{n+1} \binom{2n}{n} = \frac{1}{n} \binom{2n}{n+1} \text{ for } n \geq 0$$

The Catalan numbers satisfy the recurrence relations

$$C_0 = 1 \text{ and } C_{n+1} = \sum_{i=0}^n C_i C_{n-i}, n \geq 0$$

and

$$C_0 = 1 \text{ and } C_{n+1} = \frac{2(2n+1)}{n+2} C_n, n \geq 0$$

The first few Catalan Numbers are:

$C_0 = 1, C_1 = 1, C_2 = 2, C_3 = 5, C_4 = 14, C_5 = 42, C_6 = 132, C_7 = 429, C_8 = 1430.$

(See, for example, [https://en.wikipedia.org/wiki/Catalan\\_number](https://en.wikipedia.org/wiki/Catalan_number).)

Write a program that prompts the user for an integer and calculates that number of Catalan Numbers using one or more of the above techniques.

Save this program as p11p4.py.

**Please upload your work to  
the Brightspace site before Sunday  
evening.**

**You should keep a copy of your programs  
for your portfolio.**