# Computer Science and Programming Lab Class 4

## Task 1 Function - Parameter passing (10 minutes)

Implement the task of "find all prime numbers in the range [2,1000]" by using two functions: The first function judges if a given number is a prime number and the second function, given a range of numbers, return a list of all prime numbers in the range.

## Task 2 Function – Recursion (5 minutes)

Please implement a function recsum(N) which computes the sum of all numbers from 1 to N recursively.

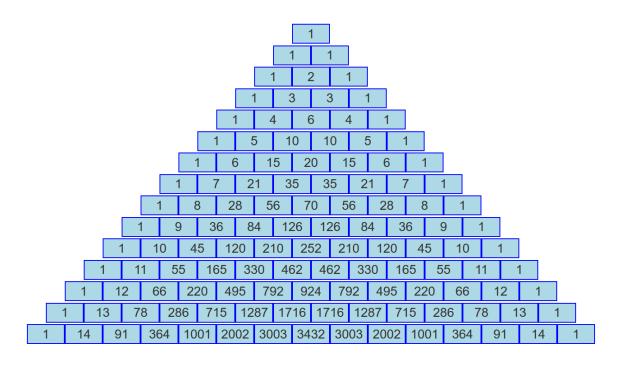
### Task 3 Function – Recursion (15 minutes)

Please implement a function called fibonacci() which reads in an integer  $\mathbf{n}$  and returns the  $\mathbf{n}$ th number in Fibonacci sequence.

**Hint:** The Fibonacci sequence is characterized by the fact that every number after the first two is the sum of the two preceding ones. That is  $F_n = F_{n-1} + F_{n-2}$ . We define that F(0) = 0 and F(1) = 1. Please solve this problem using recursion, by breaking down a larger problem into smaller subproblems.

#### Task 4 Recursion – Pascal's Triangle (15 minutes)

Write a function which implements the Pascal's triangle. The first rows of the triangle are shown on the next page:



Task 5 Recursion - Full permutation (15 minutes)

Write a function which recieves a list and print all permutation of the elements, i.e., all possible orders of elements.

```
# sample input:
permutation([1,2,3])
# sample output:
[1, 3, 2]
[1, 2, 3]
[3, 1, 2]
[3, 2, 1]
[2, 1, 3]
[2, 3, 1]
```

## Task 6 Loop - Goldbach conjecture (15 minutes)

Goldbach's conjecture is one of the oldest and best-known unsolved problems in number theory and all of mathematics. It states: Every even integer greater than 2 can be expressed as the sum of two primes.

Please verify Goldbach conjecture for integers smaller than 1000. For any even number n in that interval which obeys the conjecture, please print the two prime numbers summing up to n.

**Hint:** Find all prime numbers smaller than 1000 at first and store them in a list. Afterwards, iterate all numbers from 1 to 999, and try to express them as a sum of any two elements of the prime number list. You can generate all pairs of prime numbers by using a nested loop. However, note that a function without nested loops would be more efficient.

## Task 7 Function – Recursion (20 minutes)

Write a recursive function find\_index(), which returns the index of a number in the Fibonacci sequence, if the number is an element of this sequence and returns -1 if the number is not contained in it, i.e., we have: fibonacci(find\_index(n)) == n