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.

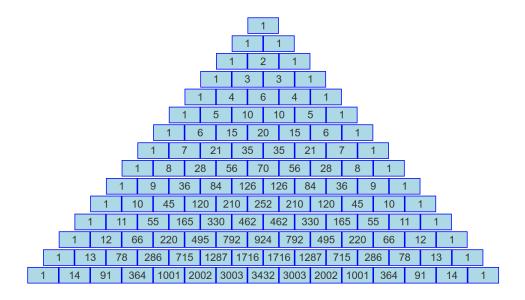
Task 3. Function – Recursion (15 minutes)

Please implement a function called fibonacci() which reads in an integer ${\bf n}$ and returns the ${\bf n}$ 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 (10 minutes)

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



Task 5. Dictionary – Basic (5 minutes)

Build a dictionary in Python to store basic information of Alice. Alice's name is 'Alice'. Alice has an age of 16. Alice's hobby is reading. The books she likes to read are 'Alice's Adventures in Wonderland', 'The Little Prince' and 'Harry Potter'. Name the dictionary with Alice, and find the second book she likes to read.

Task 6. Dictionary – Basic (10 minutes)

Build a dictionary in Python which stores for each number in the interval [1,1000], whether it is a prime number. If the number (=key) is a prime number, then the value of the dictionary element should be 'yes'. Otherwise, the value should be 'no'

Task 7. 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 8. Function – Recursion (10 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: $fib(find_index(n)) == n$