Exercises

Week 43

DM536 Introduction to Programming
DM562 Scientific Programming
DM857 Introduction to Programming
DS830 Introduction to Programming

1 Programming with loops

1. Define a function `print_up_triangle(n)` that prints an upside "right triangle" with base and height `n` and made of asterisks like the one below.

```
>>> print_up_triangle(5)
*
**
***
****
*****
```

2. Define a function `print_down_triangle(n)` that prints a downside "right triangle" with base and height `n` and made of asterisks like the one below.

```
>>> print_down_triangle(5)
*****
****
***
**
*
```

3. Write a function `print_iso_triangle(n)` that prints an upside isosceles triangle made of asterisks like the one below.

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

4. Define a function `factorial(n)` that returns $n!$, the factorial of n ($n! = 1 \cdot 2 \cdot \ldots \cdot n$) computed using iteration.

5. Define a function `double_factorial(n)` that returns $n!!$ ($n!! = 1 \cdot 3 \cdot 5 \cdot \ldots \cdot n$ if n is odd and $n!! = 2 \cdot 4 \cdot 6 \cdot \ldots \cdot n$ if n is even).

6. Define a function `sum_up_to(n)` that returns the sum of all integer numbers greater than 0 and smaller than `n`.

7. Define a function `sum_between(m,n)` that returns the sum of all integer numbers greater than `m` and smaller than `n`.

8. Define a function `sum_even_between(m,n)` that returns the sum of all integer even numbers greater than `m` and smaller than `n`.

9. Define a function `sum_odds_between(m,n)` that returns the sum of all integer odd numbers greater than `m` and smaller than `n`.

10. Define a function `print_divisors(n)` that given a positive integer `n` prints all integers that divide `n`.

11. Define a function `divisors(n)` that given a positive integer `n` returns the list of all integers that divide `n`.

12. Define a function `is_prime(n)` that given a positive integer `n` returns `True` if `n` is prime and `False` otherwise.

13. Suppose that f is a continuous and positive function over an interval $[a, b]$. The area between axis and the graph of f in the interval $[a, b]$ (also called the integral of f in $[a, b]$) can be computed as precisely as required by the following method: we divide the interval $[a, b]$ in n subintervals of equal width, and approximate the integral of f in each subinterval by the area of the rectangle whose height is given by the value of f value in the midpoint of the interval. Define a function `integrate(f,a,b,n)` that given a function `f(x : float) -> float`, floats `a` and `b`, and a positive integer `n`, returns the approximate value of the integral of `f` over [`a`, `b`] using the algorithm above.

14. Define a function `gcd(m,n)` that returns the greatest common divisor of `m` and `n` computed using Euclides' algorithm and iteration:

$$gcd(m, n) = \begin{cases} m & \text{if } m = n \\ gcd(m, n - m) & \text{if } m < n \\ gcd(m - n, n) & \text{if } m > n \end{cases}$$