University of Msila **2025/2026**
Department of Mathematics Level.
1st year Mathematics
Module : ASD2

Exercise series N° 1 (User-Defined Types)

I . Enumerations:

Exercise 1 (TD) :

The Boolean set is:

$$\mathbb{B} = \{\text{True,False}\}$$

1. Define an enumeration `Boolean` with values FALSE and TRUE.
2. Write a function `isPositive(int n)` that returns TRUE if $n \geq 0$, and FALSE otherwise.
3. Write a main program that reads an integer and displays whether it is positive.

Exercise 2 (TP) :

For any two real numbers x and y, exactly one of the relations holds:

$$x < y, x = y, x > y$$

1. Define an enumeration `Comparison` with values LESS, EQUAL, GREATER.
2. Write a function that compares two real numbers and returns the corresponding enumeration value.
3. Display the result using a switch statement

Exercise 3 (TD) :

Let:

$$P(x) = ax^2 + bx + c$$

1. Define an enumeration `Sign` with values NEGATIVE, ZERO, POSITIVE.
2. Write a function that computes the value of $P(x)$.
3. Write a second function that returns the sign of $P(x)$.
4. Write a complete program that reads a, b, c, x and displays the sign of $P(x)$.

Exercise 4 (TP) :

The direction of a vector in the plane can be classified using quadrants.

1. Define an enumeration `Quadrant` with values ORIGIN, AXIS, Q1, Q2, Q3, Q4.
2. Write a function that determines the quadrant of a vector (x, y).
3. Write a complete program to test the function.

Exercise 5 (TD) :

An integer can be classified as:

- negative, zero, or positive
- even or odd

1. Define two enumerations: `Sign` and `Parity`.
2. Write functions to compute both properties.

3. Write a program that displays both classifications for a given integer.

Exercise 6 (TP) :

For the equation:

$$ax^2 + bx + c = 0$$

the discriminant is:

$$\Delta = b^2 - 4ac$$

1. Define an enumeration `SolutionType` with values NO_REAL_ROOT, ONE_REAL_ROOT, TWO_REAL_ROOTS.
2. Write a function that computes the discriminant.
3. Write a function that returns the type of solution using the enumeration.
4. Write a program that displays the result.

II. Records:

Exercise 1 (TD) :

Suppose that we have P a point in the Plane defined by:

$$P = (x, y) \in \mathbb{R}^2$$

1. Define a structure `Point`.
2. Write a program that reads a point and displays its coordinates.
3. Write a function that computes the distance to the origin.

Exercise 2 (TP)

We adopt that the set of rational numbers is given by :

$$\mathbb{Q} = \left\{ \frac{p}{q} \mid q \neq 0 \right\}$$

5. Define a structure `Rational`.
6. Write a function that prints a rational number in the form p/q.
7. Test your function with several values.

Exercise 3 (TD) :

Given the set of vectors in $\mathbb{R}^2$,

4. Define a structure Vector.
5. Write functions for vector addition and scalar multiplication.
6. Write a program that demonstrates both operations.

Exercise 4 (TP) :

We define a complex number z by : z=a+bi

7. Define a structure Complex.
8. Write functions for addition and modulus.
9. Write a complete program to test these functions.

Exercise 5 (TD) :

We define the derivative P' of the polynomial P of degree n by:

$$P'(x) = \sum_{i=1}^{n} i\, a_i x^{i-1}$$

10. Define a structure for a polynomial.
11. Write a function that computes the derivative polynomial.
12. Write a program that displays the derivative.

Exercise 6 (TP) :

1. Define a structure `Rectangle` with width and height as integer members.
2. Write a function scale_rectangle that takes a Rectangle by value, multiplies both its width and height by factor, and returns the new Rectangle by value.
3. Write a program that tests this function.