PROGRAMMATION 1 - HAX816X - 2021/2022 - EVALUATION 4 - TEMPLATES

les fichiers à rendre à l'issue de cette évaluation sont indiqués en rouge*. merci de respecter la dénomination demandée. Merci de ne déposer sur l'ENT qu'un seul fichier (dossier compressé) contenant l'ensemble de vos unités de compilation.*

Exercice 1. Polynomial Interpolation

Given a set of $n+1$ values $\{y_i\}_{i=1}^{n+1}$ of a function f at $n+1$ distinct points $\{x_i\}_{i=1}^{n+1}$, where n is a positive integer, we focus in this exercice on polynomial interpolation, in which a polynomial $p_n(x)$ of degree n is constructed to approximate $f(x)$, that satisfies the conditions $y_i = p_n(x_i)$, $i = 0, 1, \ldots, n$.

The approximating polynomial $p_n(x)$ can be written in the Lagrange form as follows:

$$p_n(x) = \sum_{i=0}^{n} y_i L_i^n(x),$$

where each L_i^n is a polynomial of degree n and depends only on the $\{x_i\}$ as follows:

$$L_i^n(x) = \prod_{\substack{j=0 \\ j\neq i}}^{n} \frac{x - x_i}{x_j - x_i}.$$

In the following we want to implement this polynomial as a **template** function. Indeed, some applications require more accuracy than others, so with a template function, a user may conveniently choose single, double, long double, or other precisions.

(1) define, in a file named lagrange.hpp, a template function with the following prototype:

```
template<typename T> T lagrange(T* vx, T* vy, T x_in, const int n)
```

in which the arrays vx and vy store, respectively, the given $\{x_i\}_{i=1}^{n+1}$ and $\{y_i\}_{i=1}^{n+1}$ coordinates of the interpolation points and n stands for the polynomial degree of p_n. The function template computes and return the polynomial p_n value at point x_in. In practice, the template parameter T may be either **float**, **double**, or any other required precision,

(2) test your function in a main_lagrange.cpp program, by considering the interpolation problem given by $x_i = 1 + i/4.0$, $y_i = \exp(x_i)$, pour $i = 0, 1, 2, 3$ and use your function template to find an approximate function value at $x = 1.4$.

Fin du sujet.