CMPT-439 Numerical Computation
Project 8

1. (**40 points**). Design a function in any language utilizing three rules of numerical differentiation (see **slide 29** of **Lecture 9** class notes):
   - **a)** The 2-points *forward* difference formula
   - **b)** The 3 points *forward* difference formula
   - **c)** The 3 points *centered* difference formula

   This function shall have five arguments – a vector of values of x, a vector of values of $f(x)$, a value of h (step), a flag determining a method (a, b, c) of numerical differentiation, and a parameter determining a type of interpolation to be used (quadratic or cubic). The length of vectors x and $f(x)$ should be found inside a function or transferred there as an additional argument.
   This function shall evaluate whether it is necessary to apply quadratic or cubic interpolation to find missing values of f, and apply it if necessary.
   A function should return a derivative value.
2. (**40 points**) Find a value of $f'(0.26)$ with $h = 0.01$ if the function f is given by the following table

x	$f(x)$
0.15	0.1761
0.21	0.3222
0.23	0.3617
0.27	0.4314
0.32	0.5051
0.35	0.5441

   Use the Lagrange interpolation (you have utilized it in Project 7) to find the missing values of the function (but only the missing values) and employ all three rules a), b), and c) to evaluate a derivative.
   You may need to write a calling function to call a function designed in Task 1 three times for each of the rules a), b), and c).

3. (**15 points**) Ask a generative AI tool (ChatGPT or any other) to create a function utilizing 2-point forward formula, 3-point forward formula, and 4-point centered formula for numerical differentiation using the same programming language, which you used. Give the AI tool an assignment to evaluate a derivative, which you needed to evaluate in # 2, using all three formulas. **Is AI-generated code correct? Was it able to evaluate a derivative using all 3 formulas?**

   (see below):

4. (**15 extra credit points**)
   Find a value of $f'(0.26)$ with $h = 0.01$ if the function f is given by the following table (employ all three rules a), b), and c) to evaluate a derivative). **Use the Lagrange interpolation** (you have utilized it in Project 7) to find the missing values of the function (but only the missing values).

x	$f(x)$
0.15	0.1761
0.23	0.3617
0.32	0.5051
0.35	0.5441

5. (**5 points**) Write a brief report presenting your solution and demonstrating your understanding of this solution.