CST8233: Lab #6

Lagrange Interpolation

Objective

The objective of this lab is to familiarize the student with the theory topics covered in Week 5. Mainly, this lab focuses on Lagrange Interpolation.

Earning

To earn your mark for this lab, each student should finish the lab's requirements within the lab session and demonstrate the working code to the instructor.

Discussion

Lagrange interpolation is usually used to find an unknown value of a function at a random value of the independent variable. For example, if a function is defined as $y = f(x)$, where y is the dependent variable and x is the independent variable, and we are given a set of points of this function at $x_i,\ i = 1,2,3,\ldots,n$. and we need to find the value of $f(x_j)$, where x_j is not one of the values x_i, then we can use Lagrange Interpolation to find $y_j = f(x_j)$.

Lagrange Interpolation Polynomials Pseudocode

Start the program
- Read the number of points $(\boldsymbol{n})$
- Enter $(\boldsymbol{x_i}, \boldsymbol{y_i})$ of all points $(\boldsymbol{n})$
- Read $\boldsymbol{x}$, i.e. $\boldsymbol{x_p}$
- Calculate the value of the function at $\boldsymbol{x_p}$, i.e. $\boldsymbol{y_p} = \boldsymbol{f}(\boldsymbol{x_p})$
  - Using Lagrange interpolation to find $\boldsymbol{y_p}$:
  - Initialize $\boldsymbol{y_p} = 0$
  - For $i = 1$ to n
    - Set $p = 1$
    - For $j = 1$ to n
      - If $i \neq j$, then
        - Calculate $p = p \times \left(\frac{x_p - x_j}{x_i - x_j}\right)$
      - End if
    - Next j
    - Calculate $y_p = y_p + p \times y_i$
  - Next i
- Display the value of y_p

Stop

Laboratory Problem Description

Write a C program to implement the Lagrange interpolation for a given set of data points using the previous algorithm. Test your program using the following data. It is important to check that the value where you will perform the interpolation at, i.e. x_p, falls in the range between the smallest and largest values of the independent variable: $x_{min} < x_p < x_{max}$.

Enter number of data: 5

Enter data:

x[1] = 5
y[1] = 150
x[2] = 7
y[2] = 392
x[3] = 11
y[3] = 1452
x[4] = 13
y[4] = 2366
x[5] = 17
y[5] = 5202

Enter interpolation point: 9
Interpolated value at 9.000 is 810.000