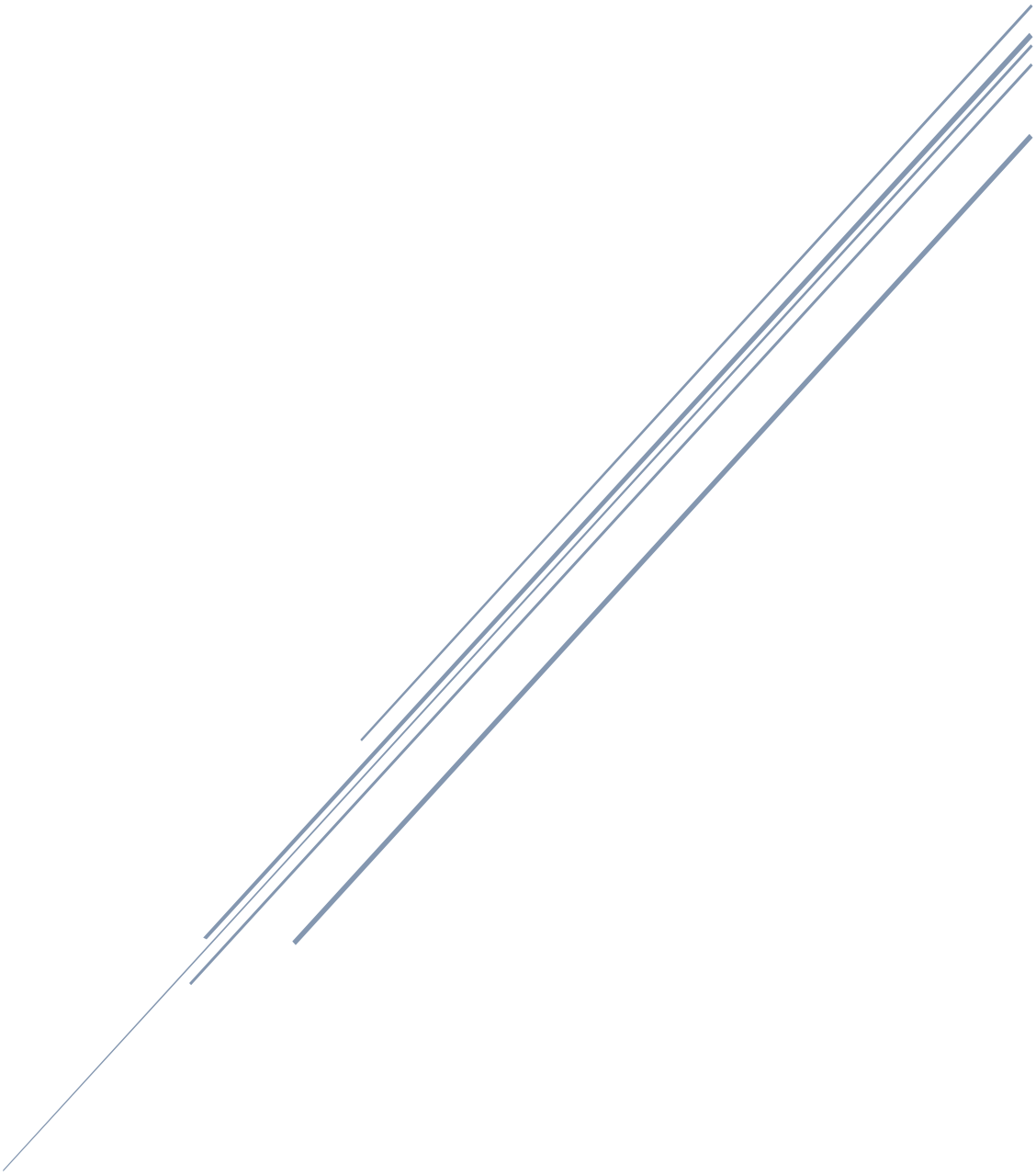
LAB# 4 INTERPOLATION

CST8233 W2021



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LAB OBJECTIVE

The objective of this lab is to get familiar with the following:

1- 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.

STATEMENT OF THE PROBLEM:

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 $x_i,\ i = 1,2,3,\dots,n$. 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 $y_j = f(x_j)$.

Part A:

Given the following data set, find the polynomial to interpolate these data using Lagrange polynomial. Estimate the value when x= 10.

x	5	6	9	11
y	12	13	14	16

Show all the steps to find the estimated value when x=10

Part B:

Lagrange Interpolation Polynomials Pseudocode

Start the program

Input: Read the number of points $(\boldsymbol{n})$

Enter $(\boldsymbol{x_i, y_i})$ of all points $(\boldsymbol{n})$

Read $\boldsymbol{x}$, i.e. $\boldsymbol{x_p}$

Processing:

Calculate the value of the function at $\boldsymbol{x_p}$, i.e. $\boldsymbol{y_p = f(x_p)}$

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 $p = p \times (\frac{x_p - x_j}{x_i - x_j})$

End if

Next j

Calculate $y_p = y_p + p \times y_i$

Next i

Output:

Display the value of y_p

Stop

Write a C\C++ program to implement the Lagrange interpolation for a given set of data points using the previous algorithm. **Test your program using Part A 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: $x_{min} < x_p < x_{max}$.

Note:
This is a sample test data, your program mut be run with different input.

```
Enter number of data: 4

Enter data:

x[1] = 5
y[1] = 12
x[2] = 6
y[2] = 13
x[3] = 9
y[3] = 14
x[4] = 11
y[4] = 16

Enter interpolation point or any character to exit : 10
Valid Point
Interpolated value at 10.000 is     ???????


Enter interpolation point or any character to exit: 2
Invalid Point
Enter interpolation point or any character to exit: !
```