MA-221(Numerical Analysis)
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Lab Assignment-8
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Instructions

- Solve each problem using Python, C++, and MATLAB.

Question 1: Fuel Efficiency Prediction

Background

A researcher studies fuel efficiency dependency on speed, but a data point is missing.

Data Table

Speed (mph)	Fuel Efficiency (MPG)
10	12.34000000
20	18.78000000
30	25.56000000
40	30.23000000
50	??? (Find this!)
60	34.56000000
70	33.78000000
80	29.45000000
90	22.78000000
100	15.23000000

Tasks

1. Use Newton's divided difference interpolation to estimate the missing value.
2. Predict fuel efficiency at 65 mph.
3. Discuss overfitting with higher-degree polynomials.

Question 2: Stock Price Prediction

Background:

A financial analyst predicts stock prices using interpolation.

Data Table

Day	Stock Price (Rs)
1	150.56000000
2	152.78000000
3	155.23000000
4	158.67000000
5	162.78000000
6	167.23000000
7	172.67000000
8	179.78000000
9	188.23000000
10	198.67000000

Tasks

1. Use Lagrange's Interpolation and find the Polynomial.
2. Predict stock price on Day 11.
3. Compute absolute error given actual price is 210.56000000.
4. Predict stock price on Day 15 and discuss extrapolation.

3. Satellite Signal Delay Problem

Background:

A team of engineers is studying the **signal delay** (in milliseconds) between a **satellite** and a ground station at different distances. However, one data point was **corrupted** due to transmission errors, and the missing value needs to be estimated using **Lagrange Interpolation** before further analysis.

Data Table

Distance (d) (km)	Signal Delay $T(d)$ (ms)
100	1.12
200	1.45
300	1.89
400	**???** *(Find this!)*
500	2.78
600	3.12
700	3.45
800	3.89
900	4.56
1000	5.12

Tasks

1. **Estimate the missing value at** $d = 400$ **km** using **Lagrange's Interpolation Formula**.
2. Fit a **cubic polynomial model** $P_3(d)$ to the data after estimating the missing value.
3. Predict the **signal delay at** $d = 750$ **km**.

4. Water Flow – But What if the Pipe Breaks?

Background:

An engineer is analyzing how **water flow rate (L/s)** depends on **pipe diameter (cm)**, but they suspect that at a **certain diameter, the pipe might collapse** and disrupt the trend.

Data Table

Diameter D (cm)	**Flow Rate $F(D)$ (L/s)**
2.00000000	1.23456789
3.00000000	3.67891234
4.00000000	6.78912345
5.00000000	11.23456789
6.00000000	17.78912345
7.00000000	26.23456789
8.00000000	**Unexpectedly low value!** ← (Find out why)
9.00000000	49.78912345
10.00000000	65.23456789

Tasks

1. Fit a **Newton's interpolation** to smooth the flow rate data.
2. Determine if $D = 8$ **cm is an outlier**.
3. Predict the flow rate at $D = 8.5$ **cm**.