MA322 Scientific Computing lab: 03

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- To execute my .py file
  Run **$python3 180123029_NamanGoyal.py** on the terminal. The snapshot is given below questions wise:

Ques.1

```
~/Desktop/sci lab/lab03  python3 180123029_NamanGoyal.py                          ✔
------------------Q1------------------

Part I --->
Approx Value of f(0.43) using degree 1 Interpolating polynomials is 2.4188032000
Approx Value of f(0.43) using degree 2 Interpolating polynomials is 2.3488631200
Approx Value of f(0.43) using degree 3 Interpolating polynomials is 2.3606047341

Part II --->
Approx Value of f(0.18) using degree 1 Interpolating polynomials is -0.5066478440
Approx Value of f(0.18) using degree 2 Interpolating polynomials is -0.5080498520
Approx Value of f(0.18) using degree 3 Interpolating polynomials is -0.5081430744
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```

- The approximate value of f(x) given above is calculated using **Newton's forward-difference** formula.

Ques.2

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------------------Q2------------------

Part I --->
Approx Value of f(-1/3) using degree 1 Interpolating polynomials is 0.2150464625
Approx Value of f(-1/3) using degree 2 Interpolating polynomials is 0.1803110461
Approx Value of f(-1/3) using degree 3 Interpolating polynomials is 0.1745240786

Part II --->
Approx Value of f(0.25) using degree 1 Interpolating polynomials is -0.1386928650
Approx Value of f(0.25) using degree 2 Interpolating polynomials is -0.1329522063
Approx Value of f(0.25) using degree 3 Interpolating polynomials is -0.1327747744
------------------------------------------------------
```

- The approximate value of f(x) given above is calculated using **Newton's backward-difference** formula.

Ques.3

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------------------Q3-------------------

The Value of Del2P(10) is 1140.0000000000
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```

- Since P(x) is a 4-degree polynomial, hence **Del4(P(x)) is constant for all x**. Hence the value of Del4(P(10)) can be calculated using **Newton's forward-difference** formula and the answer is provided in the snapshot above.

Ques.4

```
------------------Q4------------------

The Actual Value of g(0.25) is 3.9584633481
Approx Value of g(0.25) using Forward Interpolating of g(x) is 3.9115984375
Approx Value of g(0.25) using Forward Interpolating of x*g(x) is 3.9584781250
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```

- Approximation using **Newton's forward-difference** formula on g(x) and x*g(x). The **approximation is better in the case of x*g(x)** from observation. The possible reason may be because as x -> 0 function sin(x)/x*x explodes while sin(x)/x which is x*g(x) goes to 1. The error will be more in g(x) as compared to x*g(x), hence making a little diversion from the actual value.

Ques.5

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------------------Q5------------------

Both Polynomials P && Q successfully interpolated all the data correctly
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```

- We can check for values of P(x) and Q(x) for the x given, and we can observe all the values are correctly satisfied with the value answer array.
- This doesn't violate the uniqueness property of the interpolating polynomials because both the polynomials simplified would result in the same simplified formula. Hence putting the values in the same functions but different representations would be the same. Hence, P && Q both interpolate the data.

Ques.6

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-------------------Q6--------------------

The coefficient of x3 in P(x) is -11/12
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```

- From the given data, we can conclude that P(x) is a 4-degree polynomial because all fourth-order forward differences for P(x) are 1.
- As we know that (coeffofan)*factorial(n) = Del(n)(P(x)). Put n = 4 to get coefficient of x4 in P(x) to be 1/24. Let's generate a cubic polynomial using P(x) - 1/24*x4.
- Now calculating the 3rd-forward difference, we can obtain the leading coefficient of the generated cubic polynomial which will be the same as P(x)'s x3 coefficient.

Ques.7

```
-------------------Q7-------------------

The Value of f(0.75) is 6.0000000000
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~/Desktop/sci lab/lab03
```

- Since P(x) is a cubic polynomial thus the generated interpolating polynomial would require at least 4 data points which in this case is x0, x1, x2, x3. Hence P(x3) should be equal to f(x3 = 0.75). Hence, calculate the value putting x = 0.75 in the given polynomial P(x).
