Numerical Methods
Lab 4 [Newton's Divided Difference Interpolation]

i. Open the Colab file shared in BUX.

ii. Create a copy of that shared file in your drive.

iii. Rename the Colab filename using the format **Name-ID-Lab Section**

Lab Introduction

Part 1: Newton's Divided Difference Interpolation

Newton form of a n degree polynomial:

$$p_n(x) = \sum_{k=0}^{n} a_k n_k(x),$$

where the basis is:

$$n_k(x) = \prod_{j=0}^{k-1} (x - x_j),$$

$$n_0(x) = 1,$$

and the coefficients are:

$$a_k = f[x_0, x_1, \ldots, x_k],$$

where the notation $f[x_0, x_1, \ldots, x_k]$ denotes the divided difference.

By expanding the Newton form, we get:

$$p(x) = f[x_0] + (x - x_0)f[x_0, x_1] + (x - x_0)(x - x_1)f[x_0, x_1, x_2] + \cdots + (x - x_0)(x - x_1)\ldots(x - x_{k-1})f[x_0, x_1, \ldots, x_k]$$

Task 1 – 2+2 marks

1. You have to implement the **calc_div_diff(x,y)** function, which takes input x and y, and calculates all the divided differences. You may use the lambda function difference() inside the calc_div_diff(x,y) function to calculate the divided differences.
2. You have to implement the **__call__()** function, which takes an input x, and calculates y

using all the difference coefficients. x can be a single value or a numpy. In this case, it is a numpy array. You will have to remove the “raise NotImplementedError()” .

Daily Evaluation - 4 marks

Students have learned to represent polynomial interpolation using Newton Divided Difference method. They are now required to apply this understanding through a set of implementation exercises, which will be provided separately.