Accurately calculating the volume of a reservoir is one of the challenges of Civil Engineers. To solve this, one may need careful measurements, labor and specific equipment. *CE305 Ltd*. is a company, whose expertise area is the calculation of reservoir volumes. The company is currently working on *Lake Newton* project.

Since the volume of a reservoir mainly depends on the depth and the area of the reservoir, depth measurements play a significant role in volume calculations. Therefore, the board of *CE305 Ltd.* wants to consult you for interpolating the depth of the Lake Newton along A-A (Fig.1), where the vertical profile changes dramatically.

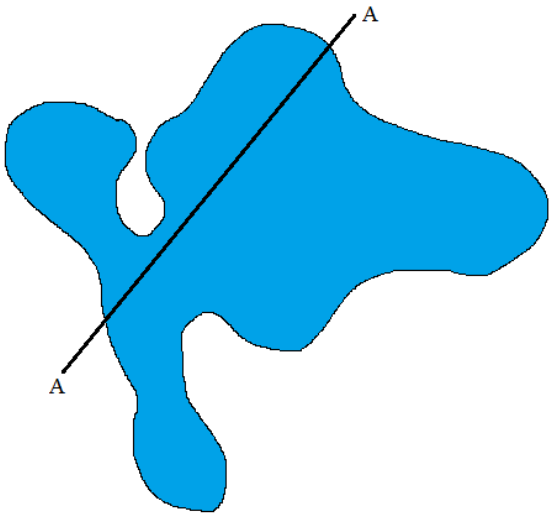

Figure 1: Lake Newton

It is planned that the depth of the reservoir needs to be measured in every 5 meters in x direction along A-A (Fig 2). However, since the equipment of the company is too old, some measurements could not be finished. You can have access to available measurements as two text files (‘x.txt’ and ‘y.txt’, one for x and the other for depth measurement, respectively).

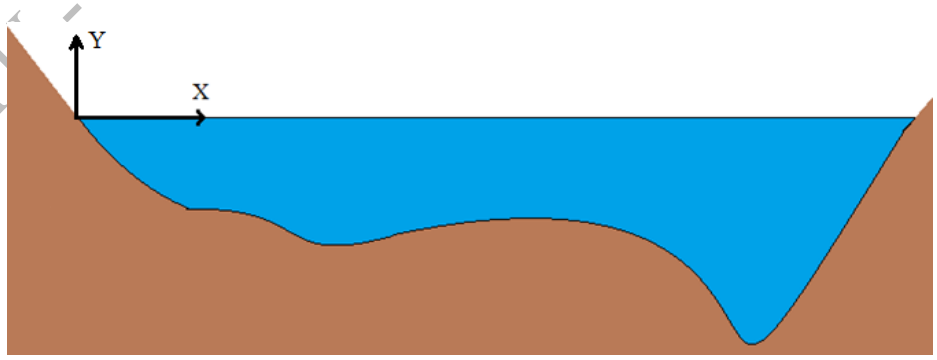

Figure 2: Profile of Lake Newton along A-A

Part A.

To analyze the data you should download 'lab6_data.zip' from our website, unzip it and copy all of the files to the working directory of MATLAB (which is usually the folder named MATLAB under MY DOCUMENTS). To create the vectors and analyze the given data in MATLAB, use 'load' command.

```
XCoor=load('x.txt');
Depth=load('y.txt');
```

Part B.

The data for x=90, x=95, x=135, and x=160 are missing. Interpolate the depth of the reservoir at these points by using cubic splines. For this purpose you can use `CubicSp` function which returns the coefficients of the cubic interpolation functions. For N data points there are N-1 interpolation functions. These functions can be expressed in matrix form as follows:

$$\begin{bmatrix} f_1 \\ f_2 \\ \vdots \\ f_{N-1} \end{bmatrix} = \begin{bmatrix} a_1 & b_1 & c_1 & d_1 \\ a_2 & b_2 & c_2 & d_2 \\ \vdots & \vdots & \vdots & \vdots \\ a_{N-1} & b_{N-1} & c_{N-1} & d_{N-1} \end{bmatrix} \cdot \begin{bmatrix} x^3 \\ x^2 \\ x \\ 1 \end{bmatrix}$$

`CubicSp` function takes the known x and y values as input arguments and returns the coefficient matrix for the interpolation functions. `CubicSp` function is used as follows:

```
CoefficientMat=CubicSp(Xcoor,Depth);
```

By using the coefficient matrix and adequate interpolation functions, you are expected to interpolate the depth of the reservoir for the missing data.

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Part C.

There is also `CubicSpIp` function which takes an additional input for the points that will be interpolated. This function calculates the coefficient matrix of the interpolation functions first, and then determines the positions of the points that will be interpolated. `CubicSpIp` function is used as follows:

```
[CoefficientMat Ip]=CubicSpIP(Xcoor,Depth,[Data1;Data2]);
```

In addition to the coefficient matrix, the interpolation values of 'Data1' and 'Data2' are returned as 'Ip' vector. By using `CubicSpIp` function, interpolate the missing data in ***Part B*** and compare your results.

Part D.

The *CE305 Ltd.* needs depth values of *Lake Newton* along A-A for every 1 meter. Calculate your interpolated values accordingly. Plot the interpolation values and available depth measurements on the same graph.

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