Lab Assignment 7

Wednesday, April 28, 2021

According to the Langevin's theory of paramagnetism, the atoms or molecules of a paramagnetic materials can be treated as permanent dipoles with no interactions between them. The total magnetization of such a system can be given by the formula

$$M = N\mu \left[\frac{1}{\tanh(x)} - \frac{1}{x} \right]; \qquad x = \frac{\mu B}{k_B T} \tag{1}$$

where,
μ is the magnetic moment of one atom or molecule,
B is the applied magnetic field along the z direction,
k_B is the Boltzmann constant,
T is the temperature of the material, and
N is the number of moments per unit volume.

Question:

Develop a code to perform the Newton's forward interpolation. Given to you is a file (nfi-input.dat) containing 20 data points that fit the above function in eq.1. Your code should have the following components.

1. A function to calculate $f(x)$ for a given value of 'x' using Newton's forward interpolation. This function should
   - Calculate the forward difference table and print it.
   - Use this table and calculate the interpolated value for a given order.
2. Call this function in `main()` to calculate the value of $f(x)$ at $x = 2.0$.
3. Print the analytical value and a neat table to compare the values obtained with the order of interpolation.

Order of interpolation	Value Obtained	Absolute Error	Relative Error (%)
11			
12			
13			
14			
15			

   - Read the data from a file and write the table to a file.
   - Use equation (1) to determine the analytical value of $f(x = 2.0)$. Take $N = \mu = 1.0$

What do you infer from this exercise?

Note: Please send all the files attached to a folder and upload it. The uploaded folder (**folder-name format: Rollno.-name**) should contain the source code, the output file and the also observations in a seperate file. Please upload only the necessary files and refrain from uploading multiple files.