**Project 2: Linear system solving**

The temperature T(x) arises due to steady-state heat conduction in a bar 30cm long is governed by the following ordinary differential equation, if uniform temperature is assumed across any cross section:

Where T is the temperature difference from the ambient medium, which is at 200C, x is the axial coordinate distance, and G is a constant that depends on the surface heat transfer rate.

Assuming this equation replaced by a finite difference approximation, using the second central difference given as:

Where i is the ith node, and x=i, Considering 30 subdivisions of the length of the rod, as shown in Figure 1, The temperature differences T0 and T30 are given as 1000C, and the constant G as (0.071)2 cm-2.



**Figure 1 Physical problem considered in question**

**Mathematical Models:**

Build a system equation written as:

AT=b

where T=[T1,T2,…T29] is the temperature difference at each node; b=[b1,b2,…b29]is the constant you derived for equations of all nodes; and A is the coefficient matrix of the system equation.

Tolerance: ξ=10-4

(||Ti(k+1)-Ti(K)||max≤ ξ)

Where i is the node, and k is the number of iteration.

**Problem:**

1. Find the temperature differences at each node:Ti, where i=1,2,…,29. by means of Gauss-Seidel iterative procedure.
2. Modify your program to solve the problem by the successive over-relaxation method.
3. Vary the relaxation factor ω at [1,2] domain (ten steps would be enough), to study the effect of its value on the number of iterations needed for convergence. Find the optimal ωopt.
4. Plot the curve of T along x based on ωopt.
5. Plot a curve to indicate the relationship between ω and the total number of iteration n before convergence (list the data in your report).

Please send a report (including process, results and the algorithm) and the code to the TA.