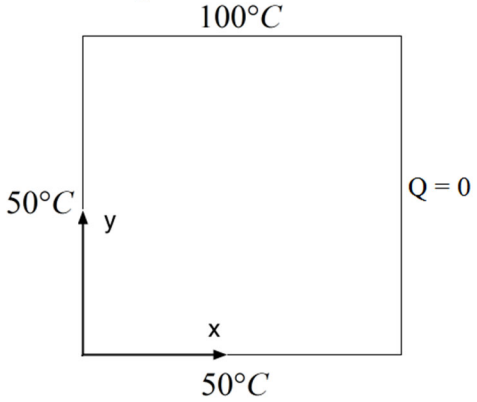
MEEN 644 – Numerical Heat Transfer and Fluid Flow
Spring 2019
HOMEWORK SET #3

Instructor: N. K. Anand

Due Date: February 26, 2019 Maximum points: 60

Consider a thin copper square plate of dimensions 0.5m by 0.5m. The thermal conductivity of the material is 386 W/m/K. The temperature of west and south edges are maintained at 50℃ and north edge is maintained at 100℃. The east edge is insulated.



Using finite volume method, write program to predict the steady state temperature solution. Use **15** uniform control volumes (CVs) in both X-direction and Y-direction. Use the line -by-line procedure with over relaxation factor α_t from 1.00 to 1.40 in steps of 0.05 to identify $\alpha_{optimum}$ (alpha optimum). **(20 points)**

Declare convergence when, $R_t = \sum_{CV} \left| a_p T_p - \sum_{nb} a_{nb} T_{nb} - b_p \right| \le 10^{-5}$

a) Plot number of iterations required for convergence for each α_t. **(15 points)**
b) Solve the same problem using 21 x 21, 25 x 25, 31 x 31, 41 x41 CVs, respectively. Plot the temperature at the center of plate (0.25m, 0.25m) vs. CVs. **(15 points)**
c) Plot the steady state temperature contour in the 2D domain with 41 x 41 CVs solution **(10 points)**

Note: Please mention your sweeping arrangement for a single iteration for example: [one sweep (South to North) followed by one sweep from (West to East)] per iteration. The TDMA function developed in Homework 2 can be readily used.