TAM 470 / CSE 450

Homework 11

Problem 1 (20 points)

No coding required:

Follow these steps to solve **by hand** the FEA problem described in Chapter 6, problem 25 of the Moin textbook:

(a) (4 pts) Write down the LM array for the 2D triangular mesh of Moin Figure 6.26(b). Use a local node-numbering scheme that starts at the bottom left node of each triangular element and numbers the nodes in a counterclockwise sense.

(b) (6 pts) Compute the stiffness matrix and force vector for each element, taking care to follow the local node-numbering scheme described in part (a).

(c) (6 pts) Use the LM array from Part (a) and your calculated arrays from Part (b) to assemble the equations into a global form. Show your assembly calculations by hand, i.e. do not use a computer code/routine to facilitate the assembly process.

(d) (4 pts) Modify the system of equations to impose the Dirichlet boundary conditions and solve for the unknown nodal solution values U_1, U_2, and U_3. You can use Python or another tool solve the system of equations.

Problem 2 (20 points)

Part 1 (14 pts, PL) Go to PrairieLearn and follow the instructions to complete a 2D FEA code to solve the steady-state heat transfer problem shown in Figure 1, with constant body heating Q throughout the domain:

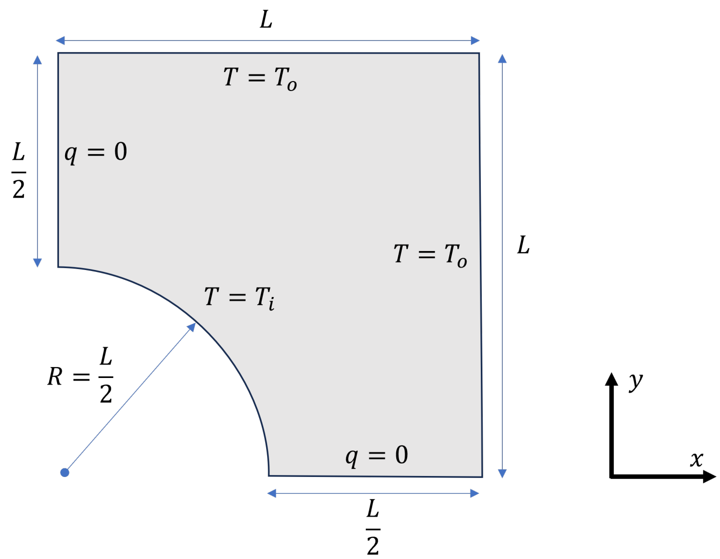

Figure 1: Domain and boundary conditions for the FEA problem.

Part 2 (6 pts) After completing the programming problem on PrairieLearn, run the code to submit a plot of your solution for the 2 provided mesh files, using $T_o = 10$, $T_i = 20$, $k = 1$, and $Q = 200$. This is 2 total plots.

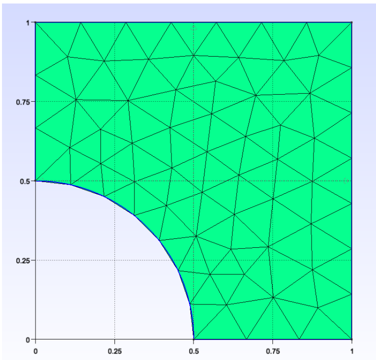

Figure 2: Coarse FEA mesh.

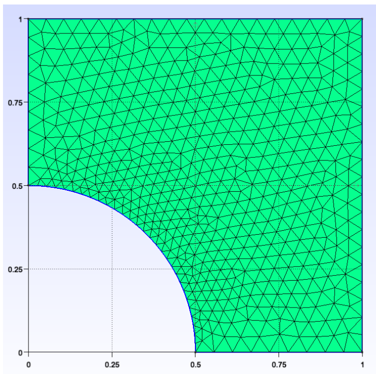

Figure 3: Fine FEA mesh.