

12-703/24-703
Numerical Methods in Engineering

Homework 1

1. 80%

Using either C++ or FORTRAN develop a program that generates a rectangular mesh. This program should take as input the width (L_x) and height (L_y) of the domain and the number of elements in the x and y directions (n_x, n_y). Consider the center of the domain to be located at the origin (0,0).

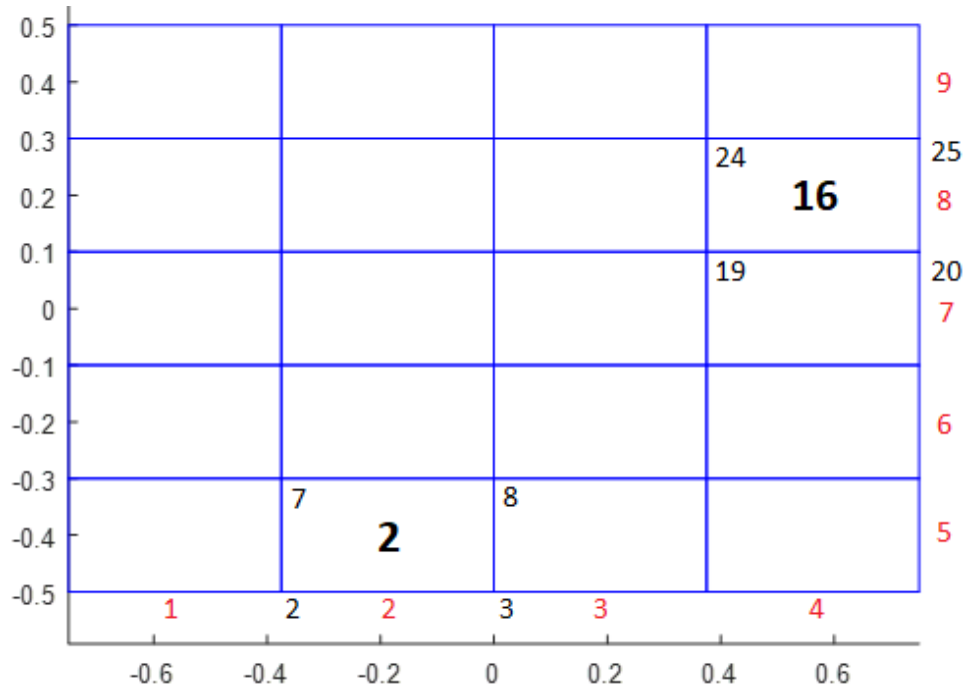


Figure 1: Example for $L_x = 1.5$, $L_y = 1$, $n_x = 4$ and $n_y = 5$, elements 2 and 16 have their nodes labeled, the first 9 boundary elements are numbered in red.

Your program should output three text files, a Node File, "cords.txt", an Element File, "conec.txt" and a Boundary File, "bound.txt". The first file should contain the coordinates of each point, the second should have the indexes of the nodes that make up each element, in counter-clockwise fashion and the third should have the indices of the boundary elements and the name of the global boundary. The lower boundary of the domain is to be labeled "1", the right boundary "2" and so on.

To clarify, in the example shown in Figure 1, the 16-th row of "conec.txt" should read

$$conec_{16} = [19 \ 20 \ 25 \ 24]$$

The 2-nd and 8-th rows of "bound.txt" should read

$$\begin{aligned} bound_2 &= [2 \ 3 \ 1] \\ bound_8 &= [20 \ 25 \ 2] \end{aligned}$$

2. 20%

Modify your program so it can generate a general quadrilateral mesh. Instead of L_x and L_y the input would now be the coordinates of the four corners and, as before, the number of elements in each directions.

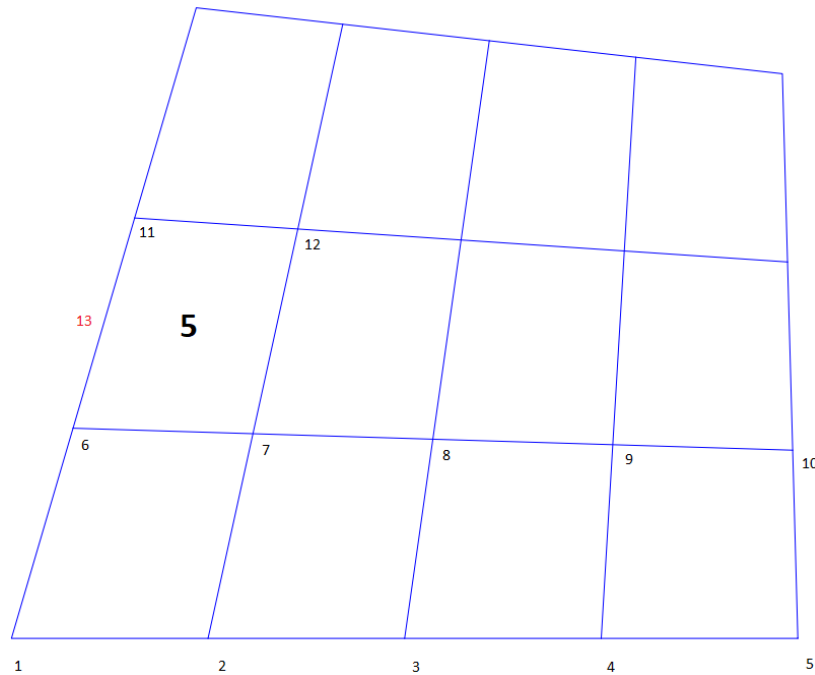


Figure 2: General quadrilateral with $n_x = 4$ and $n_y = 3$, element 5 has its nodes numbered and boundary element 13 is shown.

You can see an example of what is expected in Figure 2. Following the previous example, the 5-th row of “conec.txt” should read

$$conec_5 = [6 \ 7 \ 12 \ 11]$$

And, the 13-th row of “bounds.txt” should be

$$bound_{13} = [11 \ 6 \ 4]$$

Note: Your code should be well documented.