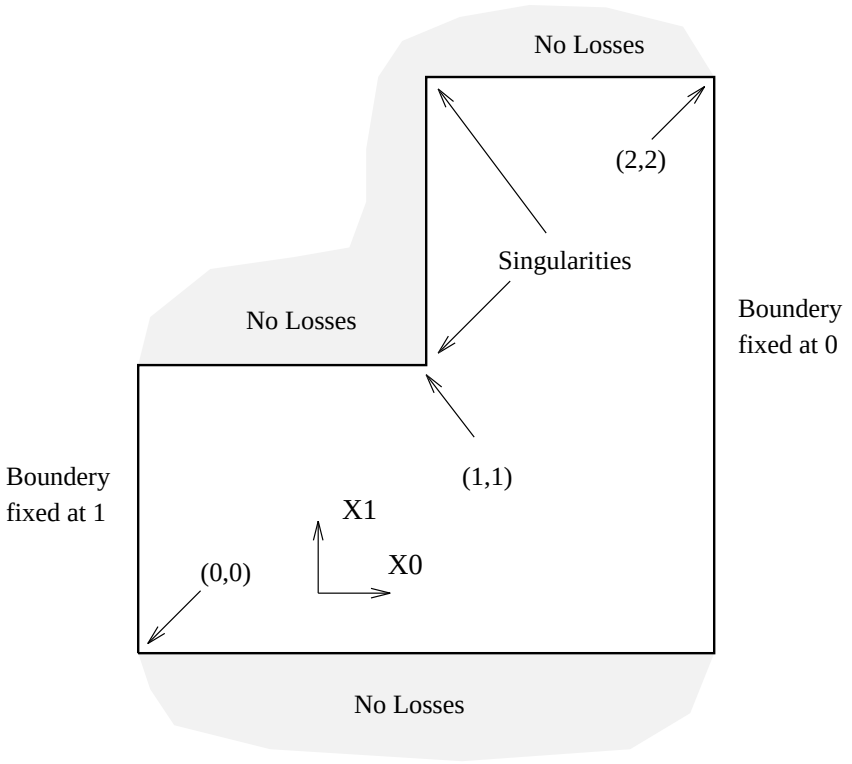
Date: Feb. 11, 1998
Due Date: February 26, 1998

CS 522 Advanced Methods in Scientific Computing

Assignment 4



1. Write a finite element program to solve 2D elliptic problems (i.e. capable of solving physical problems which are governed by 2D Poisson and/or Laplace's equation. The program should use 1st order triangular elements (you can "easily" extend this to quadrilaterals if you like).

2. Refer to the steady state heat problem of Assignment 2.

   - Solve the steady state heat problem using the finite element method.
   - Compare the FE solution to the FD solutions you calculated for the assignment solving Laplaces equation using finite differences.
   - Compare solution times for the two methods (use the same solver).
   - Plot the iso-value (iso-temperature) lines for both the FE and FD solutions.

3. Finite element solution on a nonuniform grid.

   - Given the file delauney.pts on the CS 522 web page (also contained in /pub/CS522/mesh on sci2.cs.utah.edu via anonymous ftp), use the Delauney triangulation program (sweep2d) in the Code directory on the CS 522 web page or from Netlib (voronoi) to create a mesh and then solve problem (1) on this nonuniform mesh.
   - Add points to the original mesh at places where you think the most error is occuring. Re-generate your nonuniform mesh and re-calculate the solution. Continue this process until you think you have reduced the error significantly. You might try and figure out how you could do this process automatically (we will derive a quantitative way to do this in class).