CS/CNS 257c: Simulation
Due Thursday, May 27, 11:59pm, *electronic submission*

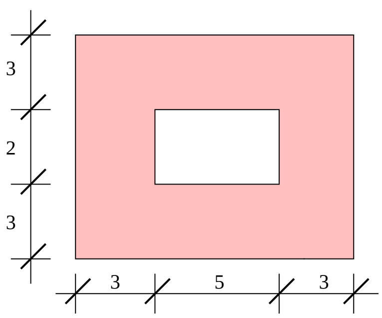
Homework 6

1. **Mesh refinement**
For mesh refinement, we will use the constrained Delaunay triangulation utility *Triangle*, written by Jonathan Shewchuck. *Triangle* is a C program which produces a finite element mesh from a set of points and domain boundaries. A MATLAB interface is provided which returns a triangle mesh for a set of points and boundary edges. Both the program and the MATLAB interface may be downloaded from the class web page, along with a handout detailing their use.

   In this assignment you are required to refine an existing mesh. This is accomplished by adding new points within the boundaries and retriangulating the domain. A good discretization of the domain is obtained by carefully selecting elements to refine.

2. **Refinement indicators for the heat equation**
Implement the residual-based refinement indicator for your finite element code from the previous assignment. For simplicity, consider only the jump terms at element boundaries when computing the refinement indicator. Further set the interpolation constant to $C = 1/8$ (see "Computational differential equations" page 381). Mark for refinement some portion of the elements ($20\% - 40\%$) for which the error is observed to be large.

3. **Adaptive mesh refinement**
The mesh generator and the refinement indicator provide us with the machinery for adaptive mesh refinement for arbitrary two-dimensional problems. As discussed in class, compute an optimal mesh by refining the marked elements. Demonstrate the functionality of your program with the following example of a heat chamber:



The temperature inside the chamber is prescribed with 0 and outside with 100. For simplicity, set the diagonal terms of the heat conductivity matrix to 1. Compute and visualize the temperature distribution inside the chamber walls. Compare the results for coarse and adaptively refined meshes.