CS/CNS 257c: Simulation
Due Monday, May 17, 11:59pm, *electronic submission*

Homework 5

1. **Three noded finite element for heat conduction**
   Implement the element stiffness matrix and the element load vector for a finite element in two dimensions. Use the isoparametric concept and numerical quadrature for your implementation. In order to have a general program, you should read the necessary constitutive and load parameters from a input file. Verify your implementation with the results given for Problem 15.28 in "Computational Differential Equations".

2. **Finite element program for heat conduction in 2D**
   Assemble the element matrices and vectors to a global stiffness matrix and load vector based on the connectivity information of the elements. Further eliminate the degrees of freedom associated with the Dirichlet boundary conditions from the linear equation system. Read the connectivity data and the Dirichlet nodes from the files connectivity.dat and dirichlet.dat.

3. **Heat conduction on the unit square**
   At the boundaries of the unit square the prescribed temperature is zero. The temperature at the center is prescribed with 1. The connectivity matrix for a discretization with three noded elements can be obtained from the class homepage. Compute the temperature distribution on the unit square with your finite element program.

   Visualize the computed temperature distribution as a color plot or as a surface with the height θ over the unit square.

4. **Extra credit**
   Implement the four noded finite element for heat conduction. Generate a mesh with four noded elements for the unit square. Compare the results of your computations with four and three noded elements.