

# Homework 1 – Math 206D, Fall 2006

Due on Thursday, October 19th, 2006

Implement the Galerkin Finite Element method for the problem:

$$\begin{aligned} -(au')' &= f \text{ in } (0,1) \\ u(0) = u(1) &= 0 \end{aligned} \tag{1}$$

for  $a(x) = e^x$  and  $f(x) = e^x(2x + 1)$ . Use a uniform mesh, and piecewise linear functions. Your code should have the following procedures:

- (a) Read input mesh size  $h$ .
- (b) Calculate the element stiffness matrices and element load vectors.
- (c) Assemble the stiffness matrix and load vector.
- (d) Solve the linear system of equations (you can use any solver from Netlib, or, in Matlab,  $A \setminus b$ ).
- (e) Find the actual solution to the equation by hand (by direct integration) and find the error of your approximate solution.

With your code, do the following:

- 1.- Solve the system of equations for several values of  $h$ , compute the error (in some appropriate norm), and determine the order of accuracy of your method.
- 2.- Plot your solution, the real solution, and the error (using Matlab, gnuplot, or any other appropriate program).