

PDE'S FINITE ELEMENT METHOD HOMEWORK 2

1. Implement Galerkin's piece-wise linear Finite Element Method for the problem:

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

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

- (a) Read input mesh size h .
 - (b) Calculate element matrices and element load vectors.
 - (c) Assemble element matrices and element load vectors.
 - (d) Solve the linear system of equations.
 - (e) A posteriori error bound.
 - (f) Write out the FEM approximation and error bound.
- (i) Use your code to compute the approximation for $h = 0.05$. Plot the FEM approximation $u_h(x)$ (use a plotting software e.g matlab, gnuplot, techplot, etc.)
- (ii) Verify with your code the accuracy and convergence of the FEM.