MTH 655/659, Final asssignment

Show all your work, attach code and plots, if relevant.

Choose one of the following:

1) *Time-dependent problem:* Implement (you can use the code from HW1) finite element solution to $u_t - u_{xx} = f$ on $(0, 1)$ where f and boundary and initial conditions are such that $u(x, t) = sin(\pi x)x^2e^{-t}$ is the exact solution. Choose at least two different schemes for discretization in time. For each scheme confirm the expected order of convergence and discuss stability of the scheme.

Alternatively, you can solve a similar problem in 2D with the ACF code.

2) *A-posteriori error estimator:* Consider the problem from HW1/#8. Solve it on uniform grid for a few values of $h = .2, .1, .05$: compute the error in H^1 norm. Compute the error estimator on the uniform grid. Then suggest a way to adapt the grid keeping number of nodes fixed so that the error is more or less evenly distributed over elements. Then show the actual error and the error estimate on the new grid.

Assume you want to keep the H_1 error under a certain tolerance ϵ (set it equal to tenth of the error you found for $h = .1$). Find h so that the energy error (and estimate) are below ϵ, with a uniform grid. Then find a nice non-uniform grid for which the same is satisfied. Compare the number of elements/computational time you have to use and comment.

3) *Open ended:* What was the most/least interesting part of the class. How are you going to apply what you have learned to your research ?