Numerical solutions to general diffusion problems with Dirichlet boundary conditions can be generated using the T–IFISS software package.

- The worked example in the lectures can be computed by running the script file `test_adiff`. After running this script the solution vector is given by `x_gal`. You might find it useful to compare the sparsity structure of the matrices `A` (without Dirichlet boundary conditions imposed) and `A_gal` (the actual Galerkin matrix for this problem). Are either of these matrices singular?

- The next exercise is to reproduce the results in the table of estimated errors on p. 23 of the lecture notes. The estimates $\|u_h\|_E$ in the first row of the table can be generated by running the driver `diff_testproblem` and choosing problem `4` with the grid parameter set to `3` with the approximation method chosen appropriately. Once you have generated a finite element solution, the discrete energy $\|u_h\|_E$ can be computed by simply typing `energy = sqrt(x_gal'*fgal); format long, energy`

  Using linear approximation the estimated energy error η should be equal to `1.3080e-01`. A plot of the computed P_1 solution and associated estimated error can be highlighted by typing `figure(101), shg`. Using quadratic approximation the estimated energy error η should be equal to `3.4800e-02`. A plot of the computed P_2 solution and associated estimated error is then given by typing `figure(102), shg`.

  You might like to generate a table comparing the reference energy errors $\|e_{\rm ref}\|_E$ with the estimated errors η. In the process, you should see that the T–IFISS built-in error estimation gives extremely accurate results!