Lab 6

Math 9830 Timo Heister, heister@clemson.edu

Note: Unless specifically asked to submit a solution, just work on the exercises and keep track of your progress in your journal.

1. Make yourself familiar with step-5 (I added a copy of step-5 to the class github repository). The step-5 documentation is at `https://www.dealii.org/current/doxygen/deal.II/step_5.html`. Go read it.

2. As always, run step-5 in 2d and 3d and visualize the result in ParaView.

3. Use the method of manufactured solutions with a=0.1 and

$$u_{ref} = \sin(2\pi x)\cos(4\pi y)$$

   and implement this function as a `class Solution : public Function<dim>`.

4. Change the domain to a unit square and use the correct right-hand side and boundary conditions. Visually check that your u_h is correct.

5. deal.II allows you to compute the error $\|u - u_{ref}\|_0$ between a given reference and the computed solution:

```
Vector<float> difference_per_cell (triangulation.n_active_cells());
VectorTools::integrate_difference (dof_handler,
                                   solution,
                                   Solution<dim>(),
                                   difference_per_cell,
                                   QGauss<dim>(fe.degree+2),
                                   VectorTools::L2_norm);

double L2_error = VectorTools::compute_global_error(triangulation,
                                    difference_per_cell,
                                    VectorTools::L2_norm);
```

   Implement this and check the convergence rate for Q1 and Q2 elements.
   Put the convergence tables into your journal for me to check.

6. Bonus: Figure out how to compute the H1 seminorm as well. What rates do you get?