

# Lab 6

Math 9830

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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](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?