

# Lab 3

Math 9830

Timo Heister, [heister@clemson.edu](mailto:heister@clemson.edu)

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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.

Note: You will need the deal.II Documentation available at <https://www.dealii.org/current/doxygen/deal.II/index.html>.

1. Make yourself familiar with step-2 (I added a copy of step-2 to the class github repository) and looking up help about deal.II. The step-2 documentation is at [https://www.dealii.org/current/doxygen/deal.II/step\\_2.html](https://www.dealii.org/current/doxygen/deal.II/step_2.html). Go read it. There are also video lectures linked that are created by a colleague of mine.
2. How does the pattern change if you use a globally refined (say 3 times) unit square?
3. How does the pattern change if you increase the polynomial degree from 1 to 2 or to 3? Does that make sense?
4. How many entries per row do you expect for a Q1 element (assuming four cells are around each vertex)? Check that this is true for the mesh in the question above (look for `row_length(i)` and output them for each row). How does that change with a different mesh? Can you construct a mesh (without hanging nodes) that has a row with more entries?
5. Print all entries for row 42 for the original sparsity pattern from the c++ code (figure out how to access sparsity pattern entries).
6. Are these patterns symmetric? Why/why not?
7. Compute and output statistics like the the number of unknowns, bandwidth of the sparsity pattern, average number of entries per row, and fill ratio.