MAE 250H, Spring 2019
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Midterm Project, Due Tuesday, May 14

The final project requires the solution for the viscous flow inside of a lid-driven cavity, as shown in Figure **??**. All four walls of the cavity are rigid, and all but the top wall are stationary. The top wall moves steadily in the $+x$ direction at speed 1 (i.e. the problem is non-dimensionalized by this wall speed). The problem has a steady-state solution.

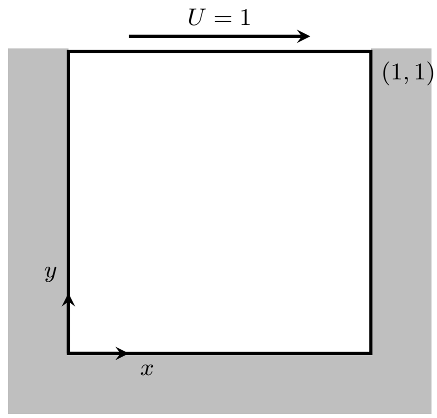

Figure 1: Lid-driven cavity geometry.

1. Develop a 2-d incompressible Navier–Stokes solver in velocity–pressure form or vorticity–streamfunction form, using 2nd-order Adams–Bashforth for the convective term, the trapezoidal method for the viscous term, and 2nd-order central differencing for spatial derivatives. The implicit treatment of the viscous term should be carried out with factorization using he ADI method, as in Homework 5.

2. Carry out the solution of the cavity problem for at least three different Reynolds numbers, with the largest at least 5000. Perform a convergence analysis to demonstrate that your results are insensitive to the grid spacing for each of these choices.

3. A high-accurate solution at a wide range of Reynolds numbers is available from Ghia et al. (1982), which is posted online with the project. Use this as a reference for validating your results. You can use either an overlaid comparison of streamlines or a comparison of the velocity profile at some cross-section.

4. Write a report that details your results, including your convergence analysis and your comparison with the results of previous work. Comment on the physics of the problem, including the behaviors as Reynolds number increases.

5. Finally, have fun with your code and some interesting variation of the problem. Report your results.