Computational Fluid Dynamics (ME EN 6720)
Project 1, Spring 2016
Due Tuesday April, 7th

Project #1

   This project will consist of developing your own solver code for the 2D incompressible Navier-Stokes equations. Consider the lid driven cavity flow depicted below in the figure. The top of the lid moves with a constant velocity U in the x direction and the cavity is square and each side of the cavity has a length w. The fluid in the cavity has kinematic viscosity ν. Using a primitive variables formulation and the projection method, follow the algorithm on page 170 of Ferziger and Perić (2002) to solve for the 2D flow field in the cavity.
Deliverables:

- A description of your methodology including: the general method (i.e. pressure projection), your discretization schemes and grid layout, your chosen Poisson pressure equation methodology, and your time advancement method.

- Run at least two Reynolds numbers $Re = Uw/\nu$ chosen to demonstrate 'high' and 'low' Re behavior (hint Re=1000 should be 'high'). For each Re submit plots of the following during the initial flow development phase **and** at steady-state.

    - The velocity vectors in the cavity as a function of x and y
    - The stream function in the cavity as a function of x and y
    - The vorticity in the cavity as a function of x and y

    Note it is acceptable to combine more than one (but not all three) of these plots together. For example, velocity vectors over vorticity. You should also include a short description of the differences in the dynamics of the two different simulations at their early development stage and steady-state stage.

- Evidence of grid convergence for the high-Re case. Include a discussion justifying your criteria and the outcome of your tests.

- Your code