Advanced problem 1

Generate a coarse 3-dimensional grid with the geometry shown [here (Links to an external site.)](https://content.byui.edu/file/91e63036-a45c-4349-87a8-0d7a4f000517/1/team_cases/advProb1/geom.pdf) (Links to an external site.). Use a single block. Keep the total number of cells to 40,000 or less. Demonstrate that the grid is of good quality. Run with an inlet Reynolds number of 1000 and a uniform inlet velocity. Dimensions in the figure are in centimeters. (Hint: your grid will likely end up quite non-orthogonal. In *fvSolution*, use 2 nonorthogonal correctors.)

Once the coarse grid has run, generate 2 or 3 plots showing where the grid requires refinement. Then refine the grid and rerun. (Multigrading will likely be beneficial.)

Create plots that show areas of interest. How uniform is the outflow? Demonstrate the difference in solution between a 1st order accurate solution and a 2nd order accurate solution and between the coarse and fine grids.

Submit an a short report. Discuss the solution -- what you observe and learn from it. Also include a short description of how your team produced the grid and why you believe it to have good mesh quality.

# Advanced problem 2

Starting with the [laminar cylinder case (Links to an external site.)](https://content.byui.edu/file/91e63036-a45c-4349-87a8-0d7a4f000517/1/CFD_Fund/cylinder-template.tgz), at a Reynolds numbers of 200, run the case laminar using 2nd order accuracy in time and space. Determine the drag coefficient. How does it compare to textbook values?

Add turbulence and run the case at Reynolds numbers of 10,000 and 600,000 for both the k-omega SST and k-epsilon models. Make sure the yplus values at the cylinder wall is appropriate. Modify the grid if necessary. Determine the drag coefficients. How do they compare to textbook values?

Compare flow patterns between the three cases.

Submit an a short report. Discuss the solution -- what you observe and learn from it. Also include a short description of how your team set up the turbulence and why you feel it is correct and accurate.