# PGE 392K: Numerical Simulation of Reservoirs

## Assignment #4
## Due Tuesday, Sept 27 (5% penalty for each late day)

1. (50 points). Develop a reservoir simulator to solve for flow in a 1D, homogeneous reservoir using a finite difference method that is second order accurate in space. The program should allow the user to define properties in an input '.yml' file, similar to assignment #2. The program should also be flexible enough to allow for different boundary conditions and numerical methods (explicit, implicit, Crank-Nicholson). Use the provided pseudocode as a guide but make sure you understand all the lines of code in it. You may vectorize the loops to create the arrays, but do be mindful that later codes will be multidimensional and heterogeneous, so that transmissibility will vary spatially and need to be called from a function. You should have the following files:
   a. Main/script file that calls the preprocessing, grid arrays, and postprocessing functions and performs the computational loop in time
   b. Preprocessing function: identical or similar to the one created in assignment #2
   c. Grid arrays function that computes T, A, Q, etc.
   d. Postprocessing function that computes plots
   e. Analytical solution function: identical or similar to assignment #3

2. (15 points). Edit your .yml file to match the inputs provided in Example 3.4. Then validate your simulator by comparison to the explicit, implicit, and C-N method in Examples 3.4 and 3.5. In particular compare all your arrays (T, A, Q, ct, etc.) to the example (be careful with units) before performing the loop in time. Then show the numerical grid pressures match the values in the examples in space and time.

3. (15 points). Increase the number of grid blocks to $N$ = 25 and choose a time step is stable for all three methods. Plot dimensionless pressure (points) versus dimensionless distance at $t_D$ = 0.25 for all three methods on the same plot and compare to the analytical solution (continuous lines).

4. (10 points). Repeat problem #3, but use a timestep that is 5% larger than the value required for stability of the explicit method.

5. (10 points). Repeat problem #3, but change the boundary conditions to Dirichlet-Neumann and Dirichlet-Dirichlet where the Dirichlet boundary condition on the right equals to the initial condition.