# PGE 392K: Numerical Simulation of Reservoirs

## Assignment #6 (SINGLE PHASE PROJECT)
## Due Tuesday, October 18 (5% penalty for each late day)

1. (10 points). Adapt your "PREPROCESSING" function file to determine which grid(s) every well resides based on the x,y,z location (start and end) of the well. Wells (for example horizontal wells) can be perforated in more than one block. You may assume that if a well passes through a block at all then it is perforated in that block. I might recommend a 2-dimensional array where the rows are the well number and the entries are integers that correspond to the blocks of that well that are perforated. For example,

$$well = \begin{pmatrix} 17 & 26 & & \\ 29 & 30 & 31 & 32 \\ 9 & & & \\ 35 & 43 & & \end{pmatrix}$$

   Where well #1 is perforated in blocks 17 and 26, well #2 is perforated in blocks, 29,30,31, and 32, etc.

   For now, you may assume that grids are spaced uniformly but consider adapting your code to allow for non-uniform blocks (e.g. block center x,y,z positions could be provided in a text file).

2. (10 points) Create a function file called "productivity index" that when sent the well #, the block # that is perforated, well, reservoir, fluid, petrophysical, numerical, output properties, it returns the productivity index of the well in that block. Be sure that the function is flexible to allow for wells in any direction and anisotropy.

3. (10 points). Create a function file called "well arrays" that updates the J matrix and Q vectors for all wells based on which blocks they are perforated. Wells can be constant rate or bottomhole pressure. Wells can be perforated on boundary blocks and, theoretically, blocks could have more than one well in them. Therefore, be sure that elements of Q and J are updated and NOT replaced because there may be more than one thing contributing to that element of the array.

4. (10 points). Validate your codes against Examples 5.2,5.3, and 5.4.

5. (60 points). Use your code to solve for pressure versus space and time in the synthetic Thomas oilfield during primary production. Reservoir, fluid, well, petrophysical, and numerical properties are given in the Thomas.yml file. The boundary conditions are no-flow on all boundaries. If the pressure of a constant rate well reaches the bubble point, change the well constraint to a constant BHP well with $P_{wf} = p_b$. Be sure to initialize the reservoir oleic phase pressure as you did in Assignment #2. Once you initialize pressure, you may assume that the Sw= Swr everywhere so flow is single phase and capillary pressure is negligible.

Continue your simulation until 100 days after the last well was converted to a constant BHP well. Make the following plots:

a. Production rate (STB/day) and bottomhole pressure (psia) versus time for all wells.
b. Cumulative oil production (as a % of OOIP) versus time
c. Surface or contour plot of Pressure field (all blocks) in the reservoir at $t = 0$ and at each time a well is converted to a BHP well – and the final pressure.