60 POINTS **HOMEWORK 2** **DUE: 1/27/15**

Please save your submission as HW02_[your last name].ipynb (for example, HW02_Smith.ipynb) and email it to the instructor.

1. (20 points) Plot the flow fields for the following source-sink pairs:

   a. Source of strength $\sigma = 2$ at location $(-2,0)$, sink of strength $\sigma = -2$ at location $(2,0)$

   b. Source of strength $\sigma = 2$ at location $(-2,0)$, sink of strength $\sigma = -1$ at location $(2,0)$

   c. Source of strength $\sigma = 2$ at location $(-2,0)$, sink of strength $\sigma = -0.5$ at location $(2,0)$

Describe what happens when the strengths are equal vs. unequal. When the strengths are unequal, the flow seems to be divided into two regions. Describe this phenomenon. In particular, how much of the flow from the source enters each region?

2. (20 points) For the flow field of a single source of strength $\sigma = 1$ located at $(0,0)$, numerically calculate the flow out of the source, i.e. compute the integral $\oint (\mathbf{v} \cdot \mathbf{n}) ds$ on some path around the source. Does your answer match your intuition? How does your numerical answer vary if you choose a path close to the source vs. farther away from it? Explain.

3. (10 points) Place 3 sources and 3 sinks at points of your choosing, with strengths of your choosing, and compute $\oint (\mathbf{v} \cdot \mathbf{n}) ds$ numerically on some path that encloses all of the sources and sinks. Does your answer match your intuition?

4. (10 points) For each of the cases in question 1, plot contours of the velocity potential. How are the contours related to the velocity vectors plotted in question 1?