1. Computational
   a) Write a program in python that can calculate the potential in a 3-dimensional space using the method of relaxation.
      - To do this you will need an expression for V(x,y,z) that is the average of the points around it.
        - Recall this is a method of averaging. This is very simply done in 1-d to obtain a line between two points by repeatedly finding the average values of all the points in between the points defining the boundary.
        - This could also be done in 2-D as we showed in WS07. The values of V(x,y) was the average value of the points around it,

          $$V(x,y)=\frac{1}{4}\left(V(x+\delta,y)+V(x-\delta,y)+V(x,y+\delta)+V(x,y-\delta)\right).$$

        - **Determine a similar expression for a 3 dimensional case.**
      - I strongly suggest working some of this out by hand before coding. The process for 1,2 and 3 dimensions is more or less the same. Create code that first accomplishes the 1-d case. You will need the 2-d case for your experimental project so make sure you can do that as well.
   b) Use your 3-d program to determine the potential around two finite similar conductive spheres with potentials 1V and -1V.

- Before writing your code you **must** do some work on paper.
  - This should include necessary diagrams relating the necessary quantities.
  - Create a basic outline of what your program needs to do and how it is going to do it.
    - Doing this will tremendously reduce the time required.
    - **If you are not a comfy coder this is the only way you will get help.** Computational programs that compute solutions to problems like this are effectively sums. We saw how to go from a sum to an integral, we are going the other way now.
    - If you have properly planned out the necessary flow to your program then you can more easily be assisted with writing the code to match.
    - **There are no exceptions to the points above.**
  - **You can consult with others and seek advice in relation to the development of your code structure** but be careful when consulting others in regards to code. It is tempting to copy the code from others. **Your code needs to be your own work.**
- **Your code must be written in python and must be appropriately commented.**

What needs to be submitted:
Everyone must make an individual, standalone, written report about your computation. The report should use whole sentences, proper grammar, and should be written so that you are explaining it to someone who has NONE of the background material. That is, **you must explain how you arrived at your solution using enough words so that someone could duplicate your work based on your verbal (written) description.** You would be wrong to assume that your instructor wants to see your entire code or huge tables of numbers used in your calculations in the report.

The report should include the following sections:

- An introduction (a standalone description of what you were asked to calculate and a statement of whom you worked with, no more than 2 people per group),

- a description of how the method of relaxation works.
- Any necessary physical diagrams to help visualize.
- a standalone conclusion statement of the project (e.g. What is the key aspect of what you are demonstrating?)

Grading:

Clarity, presentation, grammar:	40%
How you attempted this calculation:	30%
The analysis and interpretation of the results:	30%

Your code can be tested for accuracy using well known configurations. We have a pretty good idea as to what the potential lines around two point charges looks like. Setup a 2-d version of the 1V and -1V spheres and produce a contour plot. Once you are satisfied move to the 3-D solution. This solution is more difficult to plot, however, you can compare various locations to hand calculated solutions at the same location.