ELEC 4700 Laplace Equation by Iteration PA Assignment

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Feb. 3rd, 2022. Due Feb. 5th @ midnight.

Goal In this PA you should familiarize with yourself with Finite Difference modeling of the Laplace equation in 2D and it's solution by iteration.

$$\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} = 0 \tag{1}$$

Tasks

1. Basic formulation
   - First write out the finite difference form of Laplace's equation
   - Write the equation in a form that can be solved by iteration.
   - How will you handle boundary conditions?
   - Show this work to one of the TA's (If you are working offline you don't have to do this.)
2. Coding:
   (a) You are to formulate a 2D Laplace solver using iteration. Initially set the BC's to be 1 on the left side and 0 on the right and with $\frac{\partial V}{\partial y} = 0$ (insulating BC) on the top and bottom.
      i. Create a matrix V as the solution variable (nx, ny) in size.
      ii. Set a maximum number of iterations
      iii. Loop through the iterations getting a new solution and resetting the BC's
      iv. Movie!
      v. Play with the number of iterations and see what we get. What is the expected solution?
      vi. Now reset the BC's to be 1 on left/right and 0 on top and bottom. What do you get.
      vii. Calculate the electric field. Plot E_x and E_y using *surf()* and use *quiver()* to plot a vector field.
      viii. Now do the simulation using the image processing function *imboxfilt(V,3)*. Look it up!

Checkout When you are Ready:

1. Create a new repo on your github account called LAPA
2. Clone the repo to your machine
3. Add your code to the repo, commit, and push it back to github
4. Check that it worked, if it did, you're all set
5. Email the appropriate TA