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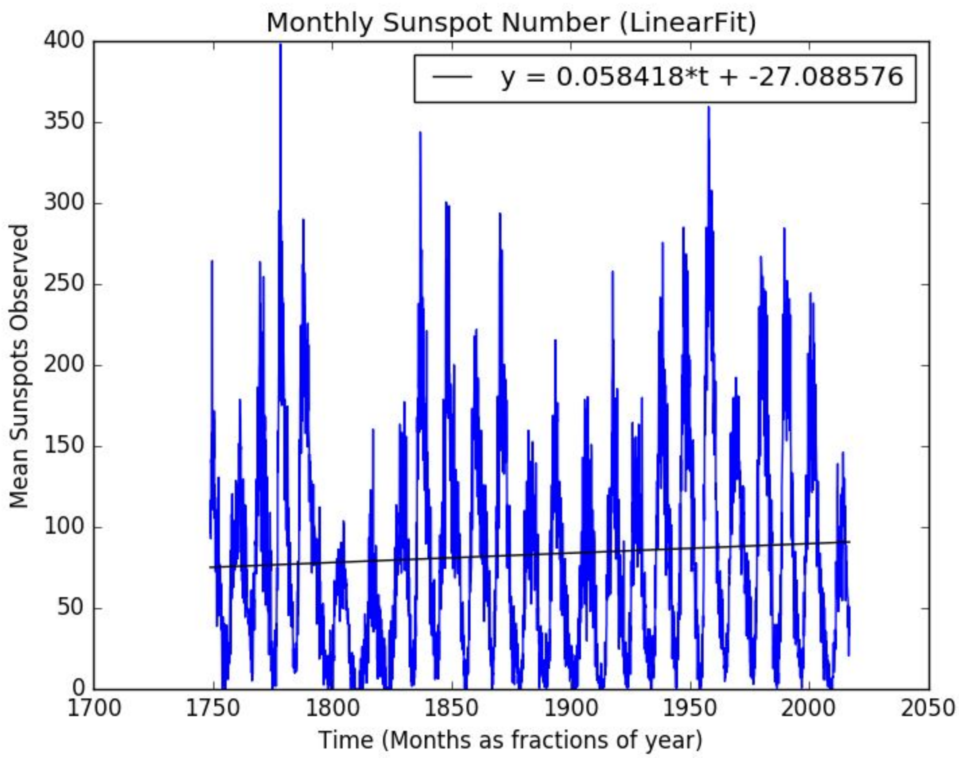
PHYS-256 , Computational Physics
Prof. Adrian Del Maestro
Assignment 6 Report

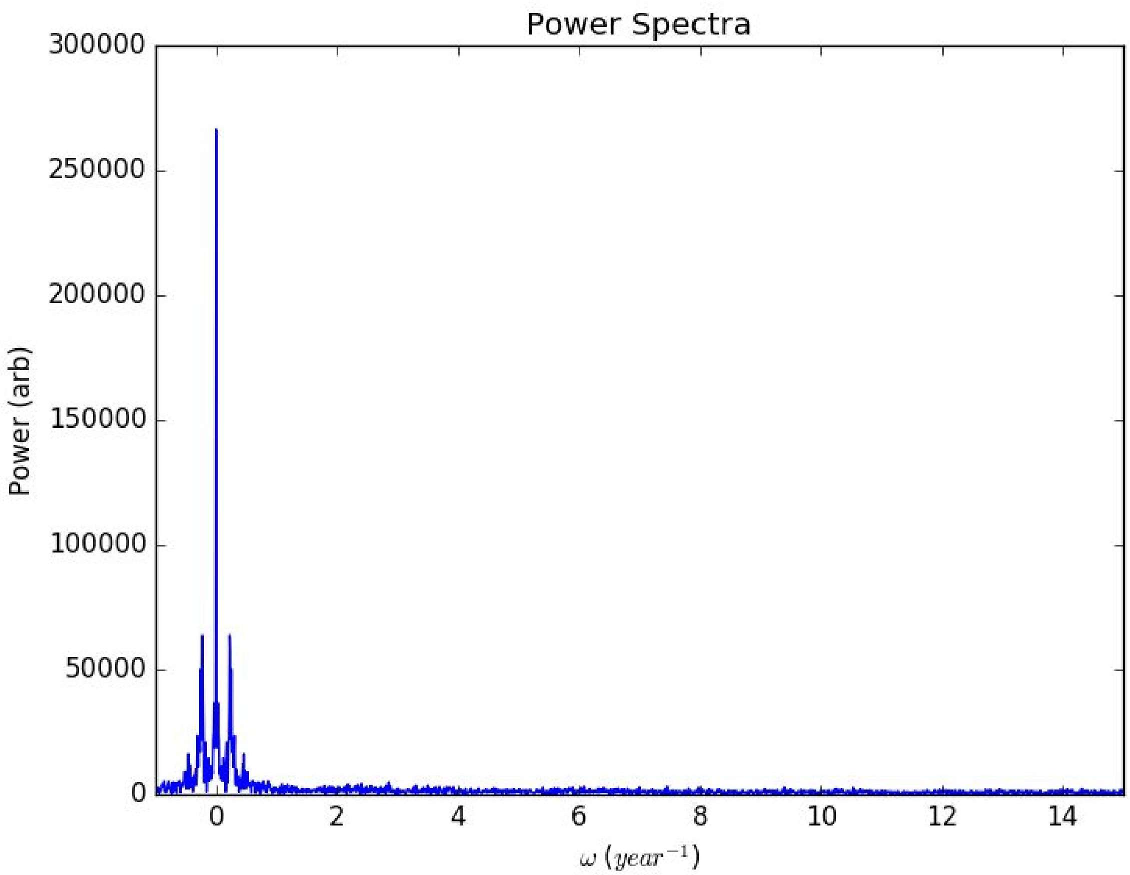
Analysis of Problem #1:

Plot 1 (Sunspot data with fitting)



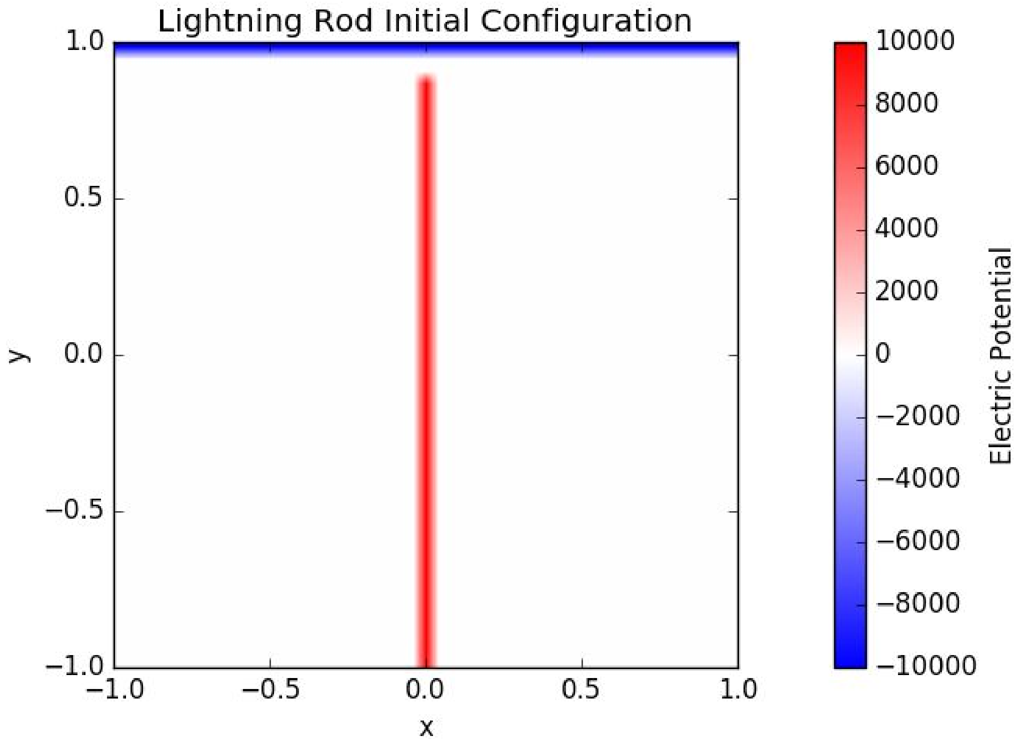
The above plot shows that the number of sunspots observed each month since 1749, is increasing. From the data only, this wasn't so clear, but we can arrive to that conclusion by observing the linear fitting. We can observe that there is some sort of periodicity in the amount of sunspots respect to time.

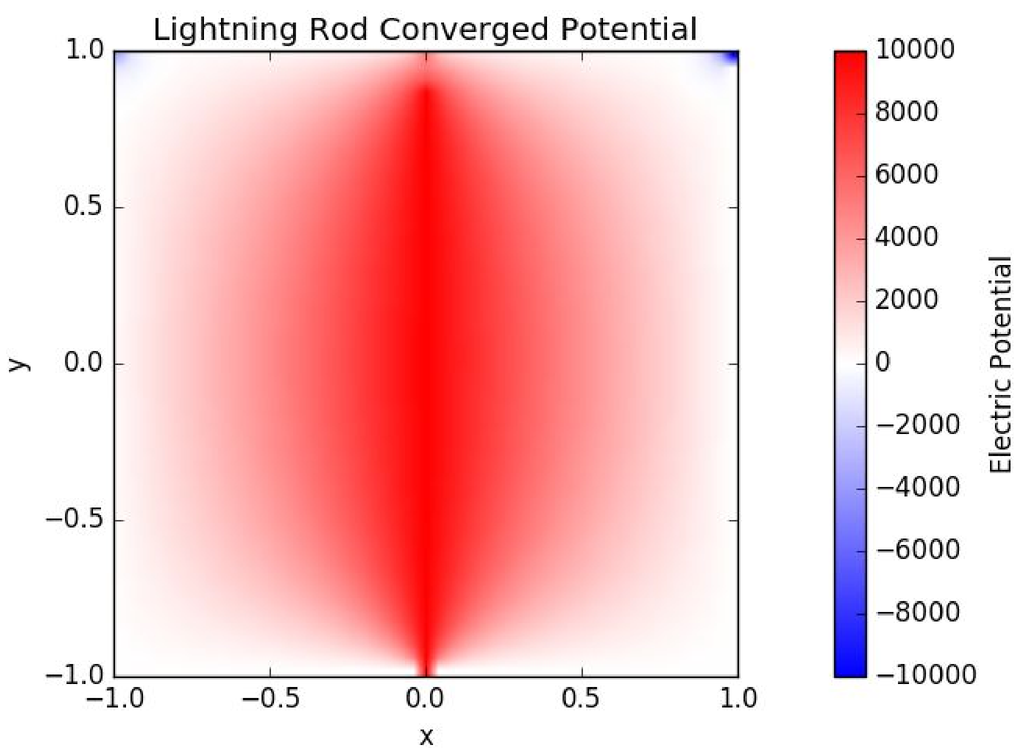
Plot 2 (Power Spectra of Sunspot Data)



The above plot, represents the power spectra of the data in **Plot 1**. This spectra was obtained by doing a Fast Fourier Transform on the data and taking its modulus ($\hat{y}^2$). What this plot basically tells us is at what frequencies there is more variation in the data.

Plot 3 a) Initial Potential of Lightning Rod and Conductor b) Final Potential

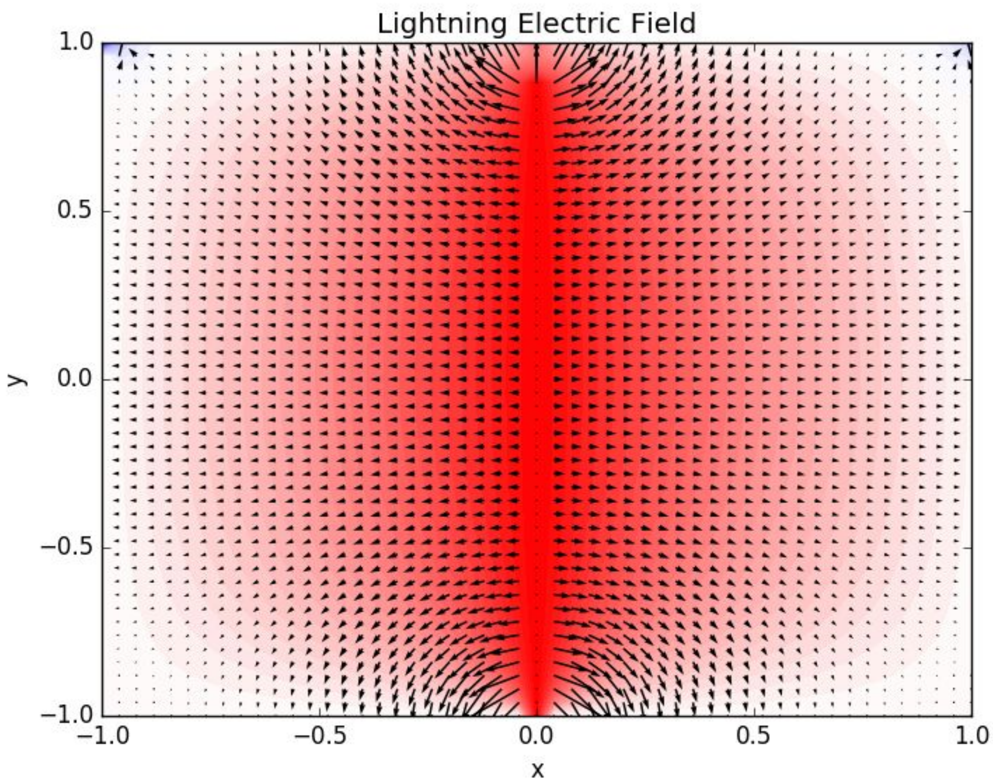




Plot 3 (a) shows the initial potential of the system. I chose the potential of the lightning rod to be positive and the potential of an infinite conducting plane above it, as negative. This situation can be compared to that of a positively charged lightning rod and the negatively charged clouds.

Plote 3 (b) shows that the region on top of the lightning rod, is no longer negatively charged. This is in fact how lightning rods work. The positive charges on the rod, ionize atoms by attracting their electrons and repelling the positively charged nuclei toward the clouds. The negative charges in the clouds are then neutralized by this ions, creating a 'neutrally charged' area in the clouds on top of the rod.

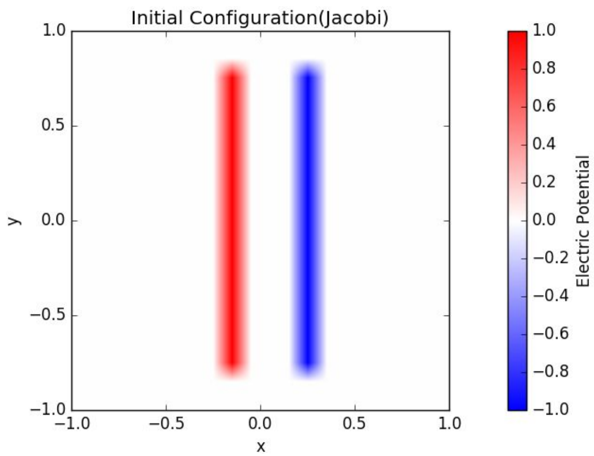
Plot 4 Final Electric Field

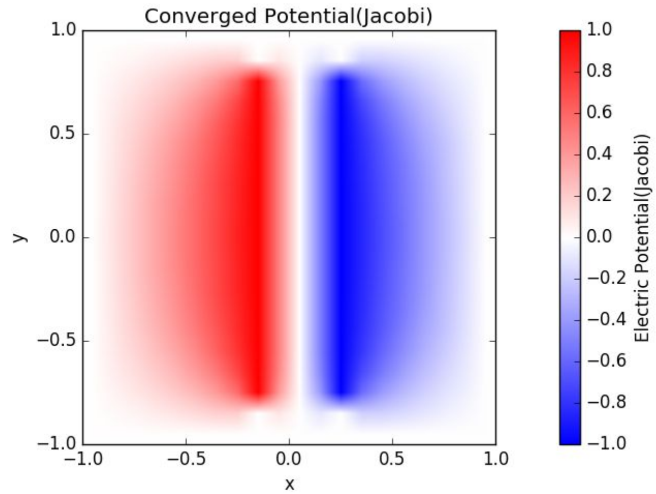


Let's focus on the tip of the lightning rod. Here, the electric field is coming out of the rod on converging towards the negative conducting plane (clouds). This electric field will then provide a pathway for electrons to move towards the rod (electrons move opposite to direction of E-field). Thus, even though lightning rods prevent lightning to strike, if it happens to strike, it will do so at the lightning rod.

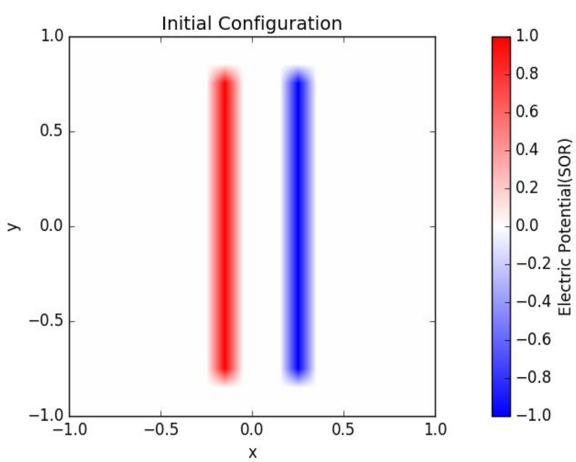
Plot 5 Initial and Final Potential of Capacitors (Results from Jacobi and SOR Methods)

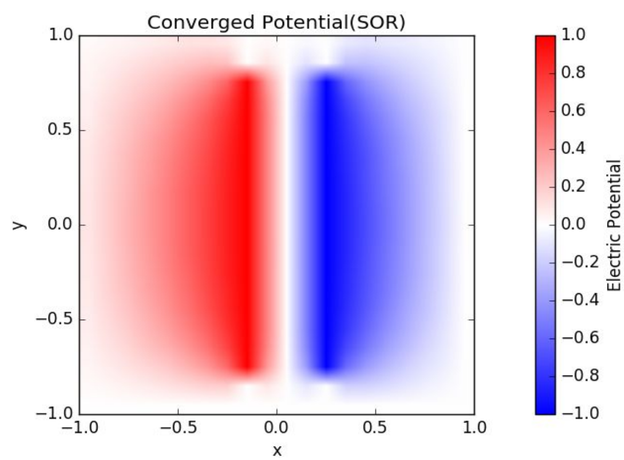
JACOBI





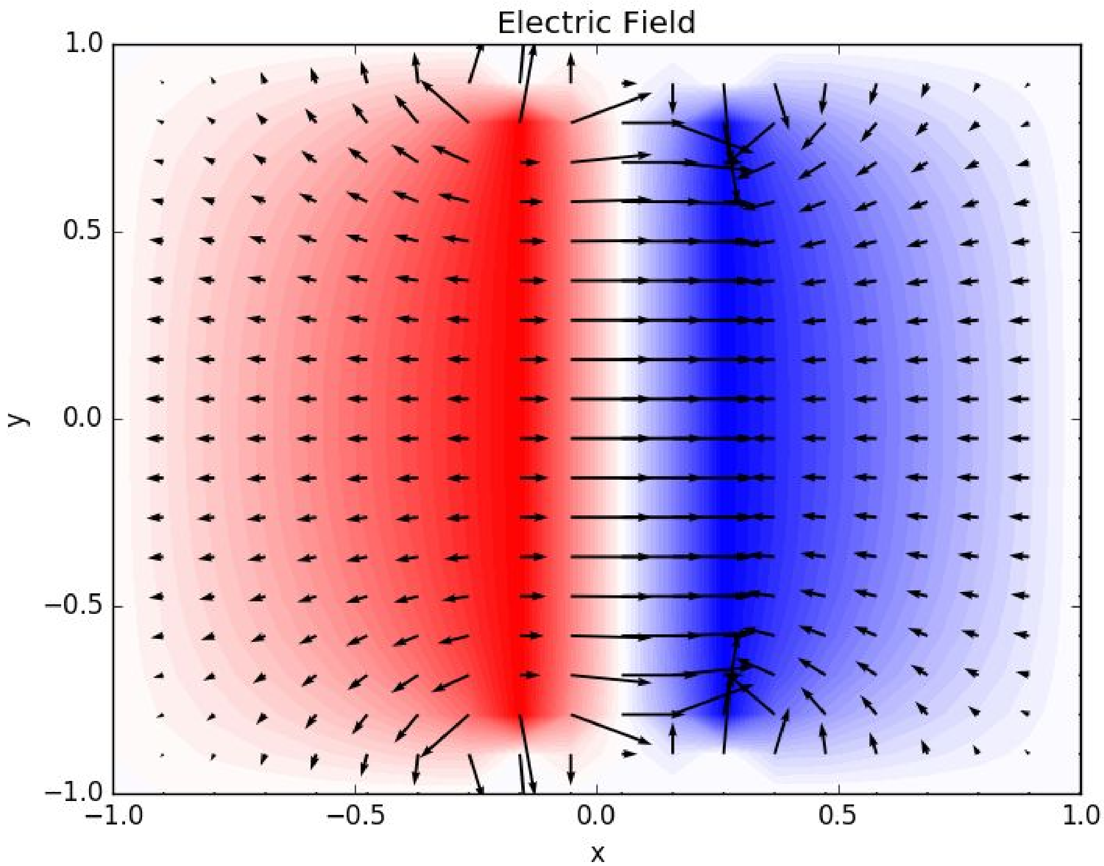
SOR





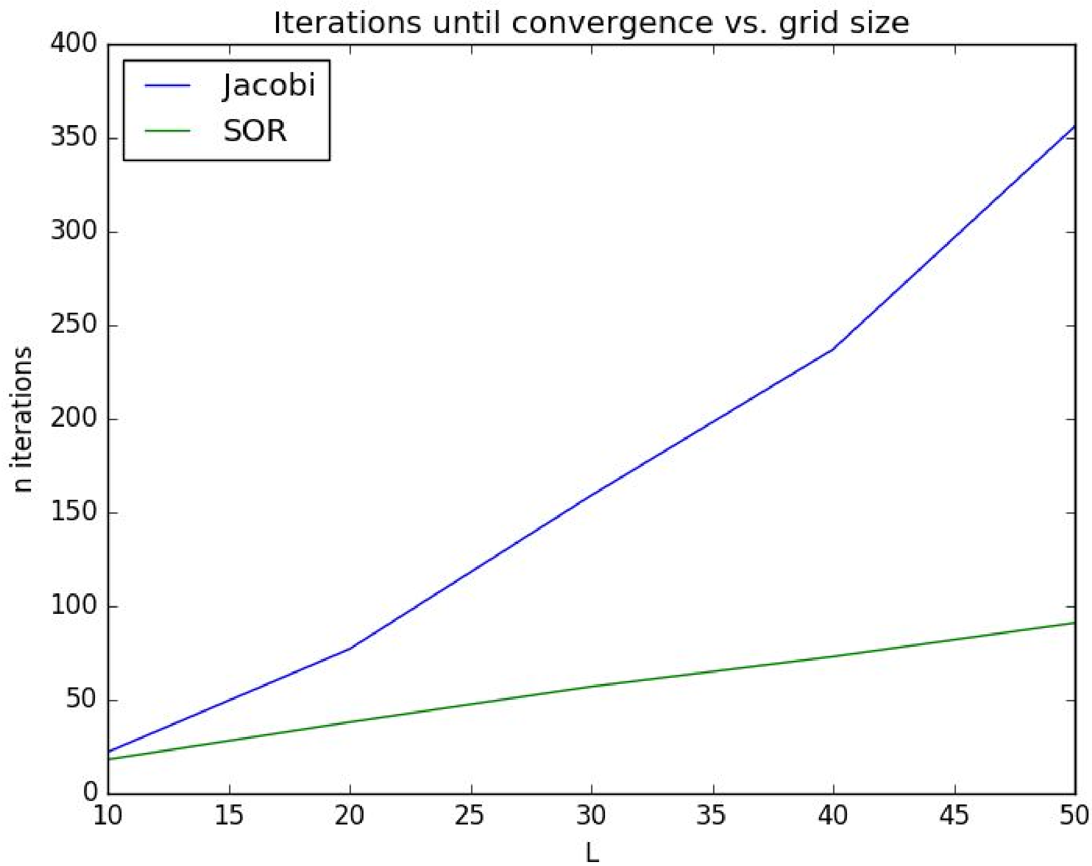
Not surprisingly, the results are the same for both methods. What is interesting is checking out what method converged to the final potential faster.

Plot 7 Electric Field between the capacitors



Electric field diverging from positive plate and converging to negative plate. We can see that that the electric field is very strong in between the plates.

Plot 6 Scaling Comparison between Jacobi Method and SOR Method



As we can see, as we in increase the grid size L, the number of iterations that it takes for the Jacobi method to converge, increase as L^2 . In the other hand, for the SOR methods, the number of iterations increases linearly.