**Problem 1** (5 points) discuss the significance of the spectral radius for the iterative solution of

A~x =~b, including how it is used to determine convergence and how it is related to the rate of convergence.

The spectral radius determines the speed of convergence and if it is smaller than 1 it converges very slowly. So the large the spectral radius the faster the convergence.

**Problem 2** Print the solution vector from each method converged to an absolute tolerance of 10􀀀6.

Jacobi:

Gauss Seidel:

SOR:

**Problem 3**

**Part A (10 points)**

**Iterations:**

Jacobi:

Gauss Seidel:

SOR:

**Compare:** Iterations for 10E-6 for convergence versus relative error

Jacobi:

Gauss Seidel:

SOR:

Which method required the least amount of iterations?

What do you observe about reaching a tighter convergence tolerance?

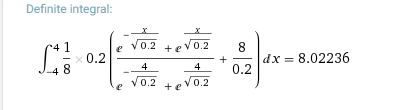
**Part B** (10 points) Perform an experiment to determine !opt for SOR. Explain your procedure and include the results.

I choose to use the brute force method by continuously looping until the difference in my perceived optimal values for *w* is less than the tolerance I set, in this case 1E-6.

I define my optimal *w* by creating two lists that append values as I move throughout all the possible values of *w* (0 to 2). The first list is comprised by the amount of iterations while the second is a list of the current *w;* these list of course end up being the same size. By finding the min of the iteration list and using that index for the *w* list I can determine the perceived optimal value. However to keep the loop going for better precision I reset my bounds of possible *w* by using the two indexed values around my “best” *w* as the new range. To break out of the loop I compare the relative difference of the “best” *w* and the previous “best” *w*

*Wopt* = 1.17331963004

**Problem 4** Attached as an analytic solution



**Problem 5**

Plot:

Max Error for h = 0.1 is: 14.1509454215

Compare answer to solution for Analytic solution in prb 4 using max error

**Problem 6**

Repeat 5 for h= 1, .5, .1, .05, .01

Max Error for h = 1 is: 333.996611559

Max Error for h = 0.5 is: 110.827037012

Max Error for h = 0.1 is: 14.1509454215

Max Error for h = 0.05 is: 10.687944599

Max Error for h = 0.01 is: 14.6884176906

What can you conclude about the relationship between the maximum error and the total number of meshes?

What is the order convergence?