

Problem3: V-Circle for Multi-grid; Iteration times: N=200

Multi-Grid and 2-Grid use 10 for relaxation iteration.

Gauss-seidel iterates 20*200 times.

	Residue	Residue Ratio	Error
$l=3$ $N=2^3+1$ $H=\frac{1}{2^3+1}$			
$l=6$ $N=2^6+1$ $H=\frac{1}{2^6+1}$			
$l=9$ $N=2^9+1$ $H=\frac{1}{2^9+1}$			

We use the same algorithm of Gauss-Seidel Method from HW5 and compare with the result we have in HW6. In 1D, the relative reduction is of 2-Grid Method is very small, so we cannot describe it clearly since the change is not significant according to N. The ratios at first iteration are both small for the Gauss-Seidel Method and the V-Circle Multi-grid Method. But the Multi-grid Method converges much quicker at N=1, making it a quicker solver.

Also, for the Gauss-Seidel Method and the Multi-grid Method, the “asymptotic” convergence seems to be related to number of nodes. It looks like with the growth of l (numbers of nodes is $N(l)=2^l+1$), the ratios of the Multi-Grid Method and the Gauss-Seidel Method both converges to 1. The speed of convergence is much slower for V-Circle Multi-Grid Method, making it converge faster than the Gauss-Seidel Method.