Name: _____

Date: _____

Collaborators: _____

(Collaborators submit their individually written assignments together)

Question:	1	2	3	Total
Points:	45	20	10	75
Score:				

Instructor/grader comments:

Steepest descent method

1. Use the code that we develop in class and conduct numerical experiments to determine the properties of the Steepest Descent method.

   (a) (15 points) Verify whether or not the convergence rate of the method significantly depends on the right hand side of the equation $Ax = b$ where `A = laplacian2d(8)`. Conduct your calculations for the following vectors b_i:

   1. `b1 = rand(n, 1);`
   2. `b2 = randn(n, 1);`
   3. `b3 = ones(n, 1);`

   where n is the dimension of the matrix A.

   On the same graph plot the convergence parameter vs the iteration number for all calculations. Clearly describe your conclusions in your project's readme file. Place the code you wrote for this part of the homework in the matlab file **hw04p1a.m**

   (b) (15 points) Verify whether or not the convergence rate of the method significantly depends on the initial approximation for the solution x of the equation $Ax = b$ where `A = laplacian2d(8)`. Conduct your calculations for the following vectors x_0:

   1. `x01 = rand(n, 1);`
   2. `x02 = randn(n, 1);`
   3. `x03 = ones(n, 1);`

   where n is the dimension of the matrix A.

   On the same graph plot the convergence parameter vs the iteration number for all calculations. Clearly describe your conclusions in your project's readme file. Place the code you wrote for this part of the homework in the matlab file **hw04p1b.m**

   (c) (15 points) Verify whether or not the convergence rate of the method depends on the matrix in the equation $Ax = b$, where `b3 = ones(n, 1);`. Conduct your calculations for the following matrices A_i:

   1. `A1 = A;`
   2. `A2 = A + 5*speye(n);`
   3. `A3 = A + 9*speye(n);`

where `A = laplacian2d(8)` and n is the dimension of the matrix A.

On the same graph plot the convergence parameter vs the iteration number for all calculations. Clearly describe your conclusions in your project's readme file. Place the code you wrote for this part of the homework in the matlab file **hw04p1c.m**

Comparing iterative algorithms for solving linear systems of equations

2. (20 points) Compare the performance of Jacobi, Gauss-Seidel, SOR, and Steepest Descent methods.

   Try several values of ω and present your results for the best performing value.

   On the same graph plot the convergence parameter vs the iteration for the four methods, using `A = laplace2d(n)` and `b = ones(n^2, 1)` for `n = 16`. Clearly describe your conclusions in your project's readme file. Place the code you wrote for this part of the homework in the matlab file **hw04p2.m**

   Clearly describe your observations and conclusions in your project's readme file.

Gitlab

3. (10 points) Create a gitlab project called **hw04** (name it exactly as shown). Upload **all** required matlab code and create your readme file. Share the project with the instructor.