NAME:

ECE697NA- Homework I
Introduction to Scientific Computing

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1 1D problem: `hw1.f90`

1.1 Eigenvalue Solver- Lapack

Complete the code (add lapack DSYEV function), run the code to fill-up the following table and answer the questions (report results using only 2 decimal digits).

	N=50	N=100	N=500	N=2500
Time (s)				
$|E_1 - Ea_1|/|Ea_1|$				
$|E_2 - Ea_2|/|Ea_2|$				
$|E_9 - Ea_9|/|Ea_9|$				
$|E_{10} - Ea_{10}|/|Ea_{10}|$				
max Residual (among 1 to 10)				

1. What is happening to the relative error when N increases and why?

2. In a separate document, plot the eigenvalues (E_i in function of i – use file 'E.out') obtained using the analytical and numerical calculations for $N = 100$. Why do you think the error keeps increasing with large eigenvalues?

3. What is happening to the residual and why?

4. Comment on the execution time in function of N?

2 2D problem: `hw1_2d.f90`

1- **Complete the missing code sections**
2- Compile, run the code and answer questions
3- **Include a printing of your modified `hw1_2d.f90` code with the Homework**

2.1 Direct solver- Lapack

Run the code to fill-up the following table and answer the questions (report results using only 2 decimal digits).

Nx=Ny	N=Nx*Ny	Residual	Relative error	Exec. Time (s)
10	100			
20	400			
40	1600			
80	6400			

1. You will provide a couple of (3D) plots on a separate document. One showing the numerical results obtained for Nx=Ny=40 (N=1600), and another one showing the resulting relative error obtained at each grid point.

2. Comment on the execution time in function of N ?

2.2 Iterative solver - Gauss-Seidel

Run the code to fill-up the following table and answer the questions (report results using only 2 digits).
    Using **Nx=Ny=80** (N=6400) for all.

#iterations	Residual	Relative error	Exec. Time (s)
100			
1000			
5000			
10000			

1. Comment on the efficiency of the iterative solver when the number of iterations increases vs the results obtained for the 1D problem.

2. Comment on the execution time in function of the number of iterations ?

3. Comment on the efficiency of the iterative solver vs the direct solver; How can one explain such differences in execution time ?