Scientific Computing :Final Project

Due by 18:00 19.June Late submission is not accepted.

- Consider the LotkaVolterra predatorprey model system.

$$\frac{dy_1}{dt} = Ay_1(t)(1 - By_2(t)), y_1(0) = y_{1,0},$$
$$\frac{dy_2}{dt} = Cy_2(t)(Dy_1(t) - 1), y_2(0) = y_{2,0}$$

  with positive constants A,B,C,D. The variable t denotes time, $y_1(t)$ the number of prey (e.g., rabbits) at t, and $y_2(t)$ the number of predators (e.g., foxes). If there is only a single type of predator and a single type of prey, then this model is often a reasonable approximation of reality.
  Solve the Lotka-Volterra predator-prey model with the parameters A=4, B=12, C=3, D=13, and solve approximately this model for $0 \leq t \leq 5$ by Explicit Euler, Implcit Euler, Improved Euler, RT2, RK4, LeapFrog, Use stepsizes h= 0.001,0.0005,0.00025. Use the initial values $y_1(0) = 3, y_2(0) = 5$. Plot y_1 and y_2 as functions of t, and plot y_1 versus y_2. Compare and Comment on your results.

- Solve the Matrix system with matrix A(mtx format matrix would be given) and randomly generated b by direct method(Pivoted LU and QR-using Givens rotations) and iterative method(Jacobi, Gauss-Seidel, and SOR). Explanation for matrix A is given in `https://www.cise.ufl.edu/research/sparse/matrices/HB/494_bus.html`. Compare computing time for each method (you can show it in the table or graphs) and discuss about your results (e.g., relaxation parameter for SOR method, stopping criteria , number of iterations for iterative method in case the exact solution does not exist).

Matrix(494bus.mtx) will be uploded. You might need to search about internal randon number generator function, what mtx matrix format is and how to read in those files in your code, how to visualize y_1 versus y_2 phase plane and so on. Try to figure out by searching google and this is the way you learn something NEW in your study. Brief pseudocodes you implemented in your code should be appeared in your final term paper.