

**Math 128B, Spring 2021.**  
**Homework 10 / final project.**

For each problem, turn in your code and MATLAB diaries if necessary. One of the goals of this assignment is to write elegant MATLAB code. Please do not submit code that merely reproduces Algorithm 11.2, 11.4, 12.1, 12.3, or 12.4. Instead, study the theoretical description of each algorithm and implement it using available matrix functions in MATLAB. Your code for each problem below should be only a few lines long.

**Prob 1.** Create a MATLAB function for the nonlinear shooting algorithm and run it with step sizes  $h = 0.1$ ,  $h = 0.05$ , and  $h = 0.01$  to approximate the solution to the boundary value problem

$$y'' = -(y')^2 - y + \ln x, \quad 1 \leq x \leq 2, \quad y(1) = 0, \quad y(2) = \ln 2.$$

Plot your results against the exact solution  $y = \ln x$ . Discuss.

**Prob 2.** Same as in Problem 1 for the finite difference method.

**Prob 3.** Implement the Poisson equation finite-difference method in MATLAB and use your code to solve any of the subproblems to problem 3 on p. 742.

**Prob 4.** Implement the Crank-Nicholson method in MATLAB; use your code to solve problem 2 on p. 754.

**Prob 5.** Implement the Wave equation finite-difference method in MATLAB; use your code to solve problem 2 on p. 763.