

**Instructions.** Identify the group of 2 classmates with whom you will complete this assignment. Then, for each of the homework problems below,

1. Please have the group write up one complete solution in L<sup>A</sup>T<sub>E</sub>X.
2. Document the contributions of each member of the group in solving this problem. Be sure to include any references you have used to arrive at this solution, *e.g.* web pages, texts, etc.
3. Include sufficient written discussion to demonstrate your understanding of the problem.

Please submit homework solutions by **February 28** before 11:30 pm.

**Homework Problems.**

1. The Matlab script `poisson.m` solves the Poisson problem on a square  $m \times m$  grid with  $\Delta x = \Delta y = h$ , using the 5-point Laplacian. It is set up to solve a test problem for which the exact solution is  $u(x, y) = \exp(x + y/2)$ , using Dirichlet boundary conditions and the right hand side  $f(x, y) = 1.25 \exp(x + y/2)$ .
  - (a) Test this script by performing a grid refinement study to verify that it is second order accurate. Plot the error versus mesh width and compute an estimate for the convergence rate.
  - (b) Modify the script so that it works on a rectangular domain  $[a_x, b_x] \times [a_y, b_y]$ , but still with  $\Delta x = \Delta y = h$ . Verify that your computed solution agrees with the exact solution.
  - (c) Further modify the code to allow  $\Delta x \neq \Delta y$  and test the modified script. Verify that your computed solution agrees with the exact solution.
  - (d) When  $\Delta x \neq \Delta y$ , how do you expect the error to behave? Give a brief discussion on your reasoning.