Brown/Paris Numerical Analysis: Problem set 2

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1 Finite difference method for the Poisson problem with Dirichlet boundary conditions

We will solve the equation

$$u_i'' = f_i$$

with dirichlet boundary conditions

 $u_0 = u_N = 0$

and forcing term

$$f_i = \sin(\pi x_i)$$

on the interval [0, 1]. To do this we will use the centered finite difference method described in class.

- Generate the matrix corresponding to the discretized Poisson problem with Dirichlet BCs. Save this as a subroutine, as we will be using this matrix as a test problem for future assignments.
- Solve the problem using $u_h = inv(\mathbf{A})b$ and generate a plot demonstrating the rate of convergence for the method.
- Use the *tic* and *toc* functions to demonstrate how the total CPU time scales with the number of unknowns in the system
- Repeat using:
 - MATLAB's matrix solve operator
 - Converting to sparse matrix format, generating inverse, and solving again
 - Converting to sparse matrix format and solving with MATLAB's matrix solve operator
- If you have extra time, try repeating but using the higher order finite difference formulas