Most of the class was taken up with MATLAB programming examples. Here are a few things I pointed out:

1. **Sparse Matrix Commands**
   - The matrices $L_h$ that come up in finite difference methods are huge, but mostly full of zeros. Sparse matrices are stored as triples $(i, j, a_{ij})$, and only the nonzero entries are stored.
   - MATLAB can handle sparse matrices. Type "help sparfun" to get started. You need to take care to create matrices as sparse, after that MATLAB will take care of the rest.

2. **Resizing Matrices**
   - Matrices in MATLAB are stored column by column.
   - $A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \end{pmatrix}$ stored as $\begin{pmatrix} a_{11} \\ a_{21} \\ a_{12} \\ a_{22} \\ a_{13} \\ a_{23} \end{pmatrix}$
   - The "resize" command leaves the vector of values alone, and just interprets it differently:
     - $B = \text{resize}(A, 3, 2) \Rightarrow B = \begin{pmatrix} a_{11} & a_{22} \\ a_{21} & a_{13} \\ a_{12} & a_{23} \end{pmatrix}$

When solving a 2D elliptical problem, you can use this to go back and forth between thinking of $u(x, y)$ as a vector (for solving the equation) and a 2D grid of values (for plotting).
3. **Plotting Surfaces**

The standard 1-D "plot" command is `plot(x,y)`, which plots the points \((x_i, y_i)\) and connects them with straight lines. It is basically a discrete version of the parametric representation \((x(t), y(t))\) of a curve in the plane.

The 2-D plot command is `surf(x,y,z)` or `surface(x,y,z)`. I have not been able to figure out what the difference is between the two.

These commands have 2 options:

(a) \(x, y\) are matrices. In that case, it plots the points \((x_{ij}, y_{ij}, z_{ij})\) and draws lines in the \(i\) and \(j\) directions. This is a discrete version of the parametric form of a surface in 3D \((X(r,s), Y(r,s), Z(r,s))\).

(b) \(x, y\) are vectors, \(z\) is a matrix.

In that case, \((x_{ij}, y_{ij}) = (x_i, y_i)\) (rectangular grid).

This is a discrete version of \(z = f(x, y)\).

This version is easier (as long as the region \(S\) is a rectangle).