Connecting C and Matlab

Matlab has a facility for allowing you to run C programs within matlab, and have them take as input and return as output matlab data types. For one simple example, see mex_speedTest.c. The basic rules are:

- Instead of main, you have a function called mexFunction.
- You use special routines to read and construct matlab data types. These usually have names beginning with mx or mex. For documentation on them, you should examine
  - The secions on C-mx and C-mex functions on this page
  - The section on creating C language mex functions on this page
- It is preferred that you use Matlab's routines for allocating and freeing memory: mxCalloc, mxMalloc and mxFree.
- Include "mex.h" in the file. Don't worry about where it is, and the matlab mex compiler should find it on your system.
- To compile, type mex followed by the filename. For example, I typed mex mex_speedTest.c. This creates mex_speedTest.mexglx (in linux), which is the file that matlab will call when you type mex_speedTest.

I recommend the following examples of mex C code:

- explore.c: code from Mathworks that demonstrates how to process every type of input
- RankMod2.c: code we will use later in the semester for computing the rank of a matrix over GF(2).
- FormDualMod2.c: code we will use later in the semester for computing the dual of a matrix over {0,1}.

Here's an example of compiling and using all three. Before I begin, let me warn you that RankMod2 and FormDualMod2 use the matlab logical type to save space when storing 0/1 data. Early versions of Matlab do not have this data type.

```
mex explore.c
explore
explore(1)


-----------------------------------------------
Name: prhs[0]
Dimensions: 1x1
Class Name: double
-----------------------------------------------
        (1,1) = 1

explore(1,2,3)


-----------------------------------------------
Name: prhs[0]
Dimensions: 1x1
Class Name: double
-----------------------------------------------
        (1,1) = 1


-----------------------------------------------
Name: prhs[1]
Dimensions: 1x1
```

```
Class Name: double
-------------------------------------------------
        (1,1) = 2


-------------------------------------------------
Name: prhs[2]
Dimensions: 1x1
Class Name: double
-------------------------------------------------
        (1,1) = 3

x = rand(3)

x =

      0.53408       0.8385      0.70274
      0.72711      0.56807      0.54657
      0.30929      0.37041      0.44488

y.a = 1; y.b = 'hi there';
z{1} = 1; z{2} = 'hi there';
explore(x,y,z)


-------------------------------------------------
Name: prhs[0]
Dimensions: 3x3
Class Name: double
-------------------------------------------------
        (1,1) = 0.534079
        (2,1) = 0.727113
        (3,1) = 0.30929
        (1,2) = 0.838496
        (2,2) = 0.568072
        (3,2) = 0.370414
        (1,3) = 0.70274
        (2,3) = 0.546571
        (3,3) = 0.44488


-------------------------------------------------
Name: prhs[1]
Dimensions: 1x1
Class Name: struct
-------------------------------------------------


                (1,1).a
-------------------------------------------------
Dimensions: 1x1
Class Name: double
-------------------------------------------------
        (1,1) = 1


                (1,1).b
-------------------------------------------------
Dimensions: 1x8
Class Name: char
-------------------------------------------------
        (1,1) hi there
```

```
------------------------------------------------
Name: prhs[2]
Dimensions: 1x2
Class Name: cell
------------------------------------------------
total num of cells = 2



                Cell Element: (1,1)
------------------------------------------------
Dimensions: 1x1
Class Name: double
------------------------------------------------
        (1,1) = 1



                Cell Element: (1,2)
------------------------------------------------
Dimensions: 1x8
Class Name: char
------------------------------------------------
        (1,1) hi there


mex RankMod2.c
a = round(rand(4,8))

a =

     1     1     0     0     0     0     1     1
     1     1     0     0     1     1     0     1
     1     0     1     1     0     1     0     1
     1     1     1     0     0     0     0     1

RankMod2(a)
??? Usage: input must be a logical matrix

Error in ==> /home/r1/spielman/www/ECC/cc/RankMod2.mexglx
a = rand(4,8) > 1/2

a =

     0     0     1     1     1     0     1     0
     0     1     0     0     1     1     0     1
     1     1     0     1     0     0     1     1
     1     0     0     1     0     1     0     0

RankMod2(a)

ans =

     4

a = rand(4,4) > 1/2

a =

     1     1     0     0
     1     1     0     0
```

```
     0     0     0     1
     0     1     0     0

RankMod2(a)

ans =

     3

a = rand(4,8) > 1/2

a =

     0     0     0     0     0     0     1     1
     1     0     1     0     1     1     1     0
     1     1     1     0     1     0     0     1
     0     0     1     0     1     0     0     1

mex FormDualMod2.c
b = FormDualMod2(a)

b =

     0     0     1     0
     0     0     1     0
     0     1     0     1
     1     0     0     0
     0     1     0     0
     0     0     1     0
     0     0     0     1
     0     0     0     1

explore(b)


-------------------------------------------------
Name: prhs[0]
Dimensions: 8x4
Class Name: logical
-------------------------------------------------
diary off
```