CSE/EE 485
Matlab Assignment One
Due 20 September 2005

This assignment is designed to get you acquainted with the MATLAB environment and some of the tools in the image processing toolbox. Your resulting program should be short!

Write an M-function (a MATLAB .m file with a function) with the following specifications.

function H=imcircle(r,m,n)
% function H=imcircle(r,m,n)
% imcircle generates a circle inside a rectangle.
% H=imcircle(r,m,n) generates a circle of radius \( r \) centered
% a rectangle of height \( m \) and width \( n \). \( H \) is a binary image with
% ones of the circle and zeros elsewhere. \( r \) must be an integer \( \geq 1 \)

These should also be the first few lines of your function. When you type
\( \gg \) help imcircle
these first few comment lines will appear on the screen, telling you what the function does and how to call it.

You will need the following MATLAB intrinsic functions to produce this function: \textit{meshgrid}, \textit{round}, and \textit{error}. Run the help command on each of these functions to make certain that you know what they do. You are not allowed to use any \textit{for} or \textit{while} loops or similar programming structures!! This can and should be done with array processing.

Some additional hints. The command
\[
x = 0:m-1; y = 0:n-1;
\]
\[
[X,Y] = \text{meshgrid}(x,y);
\]
will give you the grid that you need. The commands
\[
x0 = \text{round}(m/2); y0 = \text{round}(m/2);
\]
will give the positions in the grid of the center of the circle. Before you construct the circle you need to verify that \( r \) is a valid input. For that you must verify: (1) that \( r \) is a positive integer (the \textit{round} function will help); (2) that a circle of radius \( r \) will fit in an \( m \times n \) rectangle. Use the MATLAB intrinsic function \textit{error} to print out appropriate error messages if these are violated and if they are then the function should not assign a value to \( H \).
The statement
A=fun(X,Y)
will assign make A an M x N grid of where A(I,J) is fun at X=I and Y=J (remember to use the dot appropriately, that may require you to ask me or the TA some questions). Thus, if r is a valid input, you will need to create H, an \( m \times n \) matrix of zeros and ones, from the appropriate A.

From the grid values X and Y, H can be produced in one or two lines using the relational operators \( \geq, \leq, >, <, == \) (equal), \( \neq \) (not equal) and the logical operators \& (AND), \( \mid \) (OR), and \( \sim \) (NOT). For instance, the two commands
A= abs(X-x0)+abs(Y-y0);
H= A==r;
yields the border of the region that is the \( D_4 \) distance of \( r \) from the pixel \( (x0,y0) \). Note that the Euclidean distances will not yield integer values, so you will need to use round to get the correct value.

Please run your function on the following inputs.

1. \( m = n = 50, r = 30 \). This should yield an appropriate error message.
   To get output, do
   \[
   \gg \text{diary}
   \gg \text{m=50}
   \gg \text{n=50}
   \gg \text{r=30}
   \gg \text{H=imcircle(r,m,n)}
   \gg \text{diary off}
   \]

2. \( m = n = 10, r = 0 \). Use a sequence similar to that above. This should give a different error message.

3. \( m = n = 10, r = 3 \) Again use a sequence similar to that above. This should give you an \( H \) of zeros and ones.

Running these three examples will yield a file called “diary” in your working directory. When you exit from Martland, just print this file using the command

\[
\% \text{lpr diary}
\]
The diary records everything that appears on the screen during a MATLAB session and it is cumulative. Thus before the MATLAB session that you want to turn in, you should type

```
% rm diary
```

to remove the old diary file.

4. \(m = n = 512, r = 150\). Do not bother with the diary file on this. Instead do

```
>> m=512;
>> n=512;
>> r=150;
>> H=imcircle(r,m,n);
>> imshow(H)
>> title('Circle of radius 150 on a 512 x 512 grid')
```

This should produce a figure window which will show a white circle on a black background with the appropriate title. To print this, click on File, then Print, then OK.

Please turn in your code and all of your outputs