ECE178 HW #4

DUE: Friday, October 23, 2009 (by 5PM in the HW box)

Questions 0 to 4 are from the 3^{rd} chapter of Digital Image Processing book by Gonzalez and Woods (3^{rd} Edition).

Q0. Review textbook problems 3.16, 3.19, 3.24, 3.25, 3.28. No need to turn in solutions to these problems.

Q1. problem 3.13

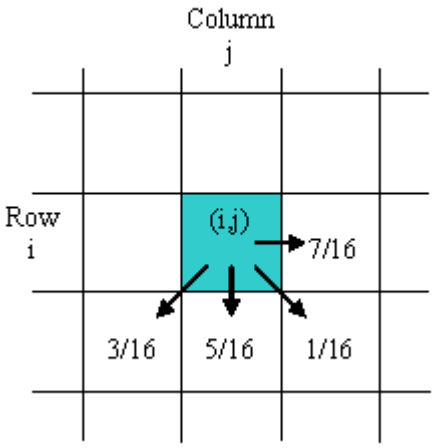
Q2. problem 3.14

Q3. problem 3.17

Q4. problem 3.23

Q4. Write a MATLAB program to reduce the effect of 1-bit quantization using "Floyd-Steinberg Dithering Algorithm". Compare your results with uniform quantization without dithering. Comment on the differences. Use the "lena.gif" (See class website `www.ece.ucsb.edu/~manj/ece178`) to test your program.

In the "Floyd-Steinberg Dithering Algorithm" quantization error introduced at each pixel is spread over the neighboring pixels as follows:



Quantization error observed at pixel (i, j) is diffused to the right, lower left, below and lower right pixels with the following weights $(7/16, 3/16, 5/16, 1/16)$. Here, note that the weights sum up to 1.

Pseudo-code for the algorithm:

```
for i = 1 to height
    for j = 1 to width
        I2(i,j) = Q(I(i,j));
        error = I(x,y) - I2(x,y);
        I(i,j+1) += 7*error/16;
        I(i+1,j-1) += 3*error/16;
        I(i+1,j) += 5*error/16;
        I(i+1,j+1) += error/16;
    end for
end for
```

Here $Q(.)$ represents inform quantization operator. In this homework, assuming that $I(i,j)$ is uniformly distributed over $[0,1]$, $Q(I(i,j))$ can be defined as follows:

$$Q(I(i,j)) = \begin{cases} 1 & I(i,j) \geq 0.5 \\ 0 & else \end{cases}$$

Things to turn in:

(a) M-file

(b) Output of uniform quantization

(c) Output of "Floyd-Steinberg Dithering Algorithm"

(d) Comments on the differences between results.