HW #4

DUE: Wednesday, November 5, 2008 (by 5PM in the HW box)

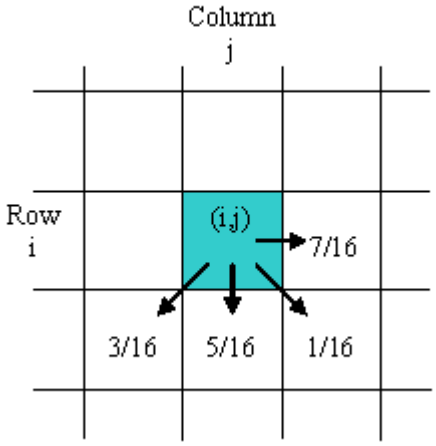
Q1. Problem 3.14

Q2. Problem 3.16

Q3. Problem 3.29

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.