Exercise 10

Finite Word Length Effects

1. With the help of the table on page 2 of the lecture notes part IV, add the following numbers using Two's complement, Sign and Magnitude and One's Complement methods:

$$\frac{5}{8} + \frac{1}{8} + \frac{4}{8} - \frac{7}{8}$$

   . What is your observation?(4 points)

2. Generate 100000 samples of a random signal in MATLAB whose mean is 0.8 and variance is 0.5. Pass it through the system $h[n] = [3, 5, 9]$. First calculate (using pen and paper) what the mean and variance of the output should be. Next find out the mean and variance of the output noise using MATLAB. Is there any difference between what you calculated and what MATLAB suggests?(4 points)

3. Prove: (Lecture notes, Page 17)(4 points)

$$\sum_{n=0}^{\infty} h[n] = H(e^{j0})$$

4. Consider the system:
$$y[n] = x[n] + 0.25y[n-1]$$

   Depict the statistical model for fixed-point round-off error of this system. Express the mean and the variance of the output round-off error in terms of the mean and the variance of the input round-off error (denoted by m_e and σ_e^2 respectively). What is the noise gain of this system? Noise gain is defined on page 63 of the lecture notes.(4 points)

5. How many bits are required for SNR $\geq$ 70 dB?(4 points)