Spring 2009
EE 4601: Assignment 3

- Date Assigned: February 3, 2009.
- Date Due: February 12, 2009.

1. Text problem 4.1
2. Text problem 4.2
3. Text problem 4.3
4. Assume that

$$s(t) = \begin{cases} \frac{A}{T}t, & 0 \le t \le T \\ 0, & \text{elsewhere} \end{cases}$$

is a known signal in the presence of additive white Gaussian noise.

a) Design a matched filter for $s(t)$. Sketch the waveform at the output of the matched filter.

b) Now assume that a correlation detector is used instead. Sketch the waveform at the output of the correlation detector.

5. Consider binary signaling on an additive white Gaussian noise channel. The conditional probability density functions of the matched filter or correlator outputs are

$$\begin{aligned} f_{y|1}(y|1) &= \frac{1}{\sqrt{2\pi}\sigma_w} \exp\{\frac{-(y-E)^2}{2\sigma_w^2}\}, \quad \sigma_w^2 = \frac{N_o E}{2} \\ f_{y|0}(y|0) &= \frac{1}{\sqrt{2\pi}\sigma_w} \exp\{\frac{-(y+E)^2}{2\sigma_w^2}\}, \quad \sigma_w^2 = \frac{N_o E}{2} \end{aligned}$$

Decisions are made such that we choose "1" if $y > \lambda$ and we choose "0" if $y < \lambda$. In Lecture 9, we have seen that the optimum decision threshold (minimizes the bit error probability) is $\lambda = 0$ if $P('1') = P('0') = 1/2$. What is the optimum decision threshold if $P('1') \neq P('0')$? *Hint: Use the theorem of total probability to write down the probability of bit error, P_b, then take the derivative of P_b with respect to λ.*