Guidelines to PS # 4.0

Duedate postponed to Monday, Feb 26th

In regards to the maximum likelihood binary detector in AWGN:

1. For the case where $\mu_1 = -1$ and $\mu_2 = 1$, the input symbols $i[n]$ can be generated using the built-in function `rand.m` that generates a uniform random variable $X \sim U([0,1])$ via

$$i[k] \;=\; \begin{cases} 1 & x[k] \geq 0.5 \\ -1 & x[k] < 0.5 \end{cases}$$

2. For the case where $\mu_1 = 0$ and $\mu_2 = 1$, the input symbols $i[n]$ can be generated using the built-in function `rand.m` that generates a uniform random variable $X \sim U([0,1])$ via

$$i[k] \;=\; \begin{cases} 1 & x[k] \geq 0.5 \\ 0 & x[k] < 0.5 \end{cases}$$

3. To implement the two operations described above make use of the `find.m` command that will enable you to search for the array indices where a particular property is true. For example to determine the indices where the values are greater than 0.5 we would use

```
ind1 = find(x >= 0.5); ind2 =find(x < 0.5);
```

4. To generate AWGN of a specified mean and variance use the built-in standard gaussian random variable generator `randn.m` and scale and shift this variable, i.e.,

$$X \sim N(0,1), \quad Y = \sigma X + \mu \;\; \Rightarrow \;\; Y \sim N(\mu, \sigma^2).$$

5. Generate the corrupted symbols $s[k]$ by simply adding the noise generated in step 3 to the sequence from either step 1 or 2 via:

$$s[k] \;=\; i[k] + y[k].$$

6. The decision rule for the detector for the case where $\mu_1 = -1$ and $\mu_2 = 1$ can be implemented via:

$$\hat{i}[k] \;=\; \begin{cases} 1 & s[k] \geq 0 \\ -1 & s[k] < 0 \end{cases}$$

7. A decision error occurs in the eventuality where $\hat{i}[k] \neq i[k]$. The probability of decision error can then be approximated via:

```
p_err = length(find(i~=i_hat))/length(i);
```

8. To obtain curves for $\Pr(\epsilon)$ versus σ run the function `bindet.m` by running it in a loop for different σ.