Worksheet for Lab 6: Error Control Coding

Worksheet 6.1

**Given:** $1\times n$ vector called $\text{data}$, consisting of 0s and 1s. Egs., $\text{data} = [1 \ 0 \ 0 \ 1 \ 0 \ 1 \ 1 \ 1]$ and $n = 8$.

**Output:** $1\times 3n$ vector $\text{repdata}$ based on the values of $\text{data}$, as follows: If $\text{data}(1)$ is 0, the first 3 values of $\text{repdata}$ will be 0s, else, the first 3 values will be 1s. Similarly, if $\text{data}(2)$ is 1, the next 3 values of $\text{repdata}$ will be 1s, and if $\text{data}(3)$ is 0, then $\text{repdata}(7)$ to $\text{repdata}(9)$ will be 0s, and so on. Hence, each element of $\text{data}$ will be repeated 3 times and placed in $\text{repdata}$. This is a repetition code.

Write the MATLAB code (or psuedocode) to do produce $\text{repdata}$, given $\text{data}$ and $n$ ($n$ can be any positive integer, make no other assumptions).

**Note:** This code is identical to Worksheet 5.1.

Worksheet 6.2

**Given:** A $1\times 3n$ vector called $\text{repdata}$.

**Output:** The $1\times n$ vector $\text{data}$, generated as follows: Among the 3 bits $\text{repdata}(1)$, $\text{repdata}(2)$ and $\text{repdata}(3)$, if there are more 1s than 0s, (that is, the patterns 011, 101, 110 or 111), then $\text{data}(1)$ is 1, else it is 0. Similarly, if $\text{repdata}(4:6)$ has a majority of 0s, then $\text{data}(2)$ will be 0, else, it will be 1, and so on. This is a “majority rule” decoder for the repetition code. It takes bits from $\text{repdata}$, 3 at a time, and chooses the most common bit among those 3 as the output bit.

Write the MATLAB code (or psuedocode) to do produce $\text{data}$, given $\text{repdata}$ and $n$.

If we transmit $\text{repdata}$ instead of $\text{data}$, we will be taking three times as long to transmit, when compared to just transmitting $\text{data}$. However, if there is an error in one of the 3 repeated bits in $\text{repdata}$, we can detect this error and correct it, because of majority rule decoding. Any errors in $\text{data}$ cannot be otherwise detected/corrected.

In practice, there is usually a tradeoff between the data rate (how fast we can transmit the bits) and the error probability. Repetition coding is one way to reduce error probability at the expense of greatly reduced data rate. However, there are other more intelligent ways of coding, which incur much lower penalties on the data rate. We will see some some of this in Lab 6.