



Multimedia Systems

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Exercise 2.1: FEC

1. Choose a arbitrary bit string (4 bit) \rightarrow 1101
 - a) Code the bit string with the given (7,4) Hamming code.

$$\vec{y} = \vec{x} \circ G = (1 \ 1 \ 0 \ 1) \circ \begin{pmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 0 & 1 \end{pmatrix} = (1 \ 1 \ 0 \ 1 \ 0 \ 0 \ 0)$$

- b) Suppose there is no error during the transmission. Decode the coded bit string.

$$\vec{s} = \vec{r} \circ H^T = (1 \ 1 \ 0 \ 1 \ 0 \ 0 \ 0) \circ \begin{pmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} = (0 \ 0 \ 0) \Rightarrow \vec{e} = (0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0)$$

Exercise 2.1: FEC

- c) During the transmission, one bit (of your choice) is inverted. Decode the received bit string.

- received bit string: (1 1 0 0 0 0 0)

$$\vec{s} = (1 \ 1 \ 0 \ 0 \ 0 \ 0 \ 0) \circ \begin{pmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} = (1 \ 0 \ 1) \Rightarrow \vec{e} = (0 \ 0 \ 0 \ 1 \ 0 \ 0 \ 0)$$

- d) Decode the received bit string after inverting one more bit.

- received bit string: (1 0 0 0 0 0 0)

$$\begin{aligned} \vec{s} = (1 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0) \circ H^T &= (1 \ 1 \ 0) \Rightarrow \vec{e} = (1 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0) \\ &\Rightarrow \vec{y}' = (0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0) \neq \vec{y} \end{aligned}$$

Exercise 2.2

- Discuss the relationship between error rate, overhead and complexity of decoding.

