

EE 703: Digital Message Transmission

Instructor: Saravanan Vijayakumaran

Indian Institute of Technology Bombay

Autumn 2013

Assignment 2

Due Date: September 4, 2013

The Python program located at <https://gist.github.com/avras/b187068a995a27fc8569> implements the following decision rule for the 3-repetition code.

$$\begin{aligned}\Gamma_0 &= \left\{ \mathbf{y} \in \Gamma \mid d(\mathbf{y}, 000) \leq d(\mathbf{y}, 111) \right\} \\ \Gamma_1 &= \left\{ \mathbf{y} \in \Gamma \mid d(\mathbf{y}, 000) > d(\mathbf{y}, 111) \right\}\end{aligned}$$

It can be run using the command `python rep.py` on a system with Python installed. The lists `ZeroPartition` and `OnePartition` correspond to Γ_0 and Γ_1 respectively.

1. Change the program to implement the following decision rule.

$$\begin{aligned}\Gamma_0 &= \left\{ \mathbf{y} \in \Gamma \mid d(\mathbf{y}, 000) < d(\mathbf{y}, 111) \right\} \\ \Gamma_1 &= \left\{ \mathbf{y} \in \Gamma \mid d(\mathbf{y}, 000) \geq d(\mathbf{y}, 111) \right\}\end{aligned}$$

Do the partitions change? Why or why not?

2. Repeat the previous exercise for $N = 4$ i.e. the 4-repetition code. Do the partitions change? Why or why not?
3. Change the program to implement the optimal decision rule given by the following partition.

$$\begin{aligned}\Gamma_0 &= \left\{ \mathbf{y} \in \Gamma \mid \pi_1 P(\mathbf{Y} = \mathbf{y} \mid X = 1) \leq \pi_0 P(\mathbf{Y} = \mathbf{y} \mid X = 0) \right\} \\ \Gamma_1 &= \left\{ \mathbf{y} \in \Gamma \mid \pi_1 P(\mathbf{Y} = \mathbf{y} \mid X = 1) > \pi_0 P(\mathbf{Y} = \mathbf{y} \mid X = 0) \right\}\end{aligned}$$

The probabilities π_0 and π_1 are represented by the variables `probZero` and `probOne` respectively. Verify that the optimal decision rule is the same as the minimum distance decoder when $\pi_0 = \frac{1}{2}$.

4. For $N = 3$, find a value of π_0 such that $\Gamma_1 = \{111\}$.

There is no hard copy submission for this assignment. You will be required to upload the program files in Moodle.