CSM-322: Information and Coding Theory
Lab - 4

(Odd Semester 2024-25)

September 19, 2024

Q1. Hamming Distance

Given an array of integers. Write a program to calculate the sum of Hamming distances of all pairs of integers in the array in their binary representation (32 bit).

```
Example: arr = {1, 3, 5}
Output: 8
Explanation: H(5, 1) + H(5, 3) + H(5, 5) + H(3, 1)
+ H(3, 3) + H(3, 5) + H(1, 1) + H(1, 3) + H(1, 5) = 8,
where H is Hamming distance.
```

Q2. Maximum Likelihood Decoding

Suppose that codewords from the code "S" are being sent over a BSC with crossover probability "p". Suppose that the word "c" is received. Write a program to find the most likely codeword using maximum likelihood decoding rule.

```
Example: S = {000, 111}, c = 110
if p = 0.05 output is 111
if p = 0.95 output is 000
```

Q3. Nearest Neighbour/Minimum Distance Decoding

Suppose that codewords from the code "S" are being sent through a noisy channel. Suppose that the word "c" is received. Write a program to find the most likely codeword using nearest neighbour decoding.

```
Example: S = {000, 111}, c = 110
Output: 111
Explanation: Hamming_distance(110, 111) < Hamming_distance(110, 000)
```