# Lab Assignment – Data Transmission

## Multimedia Networks

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This document is subjected to change, please consult the most recent version at: https://github.com/GillesC/Data-Transmission---Multimedia-Networks.

Adhere to the policies and guidelines of KU Leuven concerning the use of GenAI.

# 1 Introduction

Claude Shannon, an engineer at Bell Telephone Laboratories, and Warren Weaver sought to identify the quickest and most efficient way to get a message from one point to another. As a result of their studies, they developed their model of communication.

In these **three lab sessions** you are going to simulate a **communication model** as presented in Figure 1. This model is a simplified version of the Shannon-Weaver model of communication. The model will be implemented via **Python**. Through this model, the beneficial effects of source and channel coding are studied.

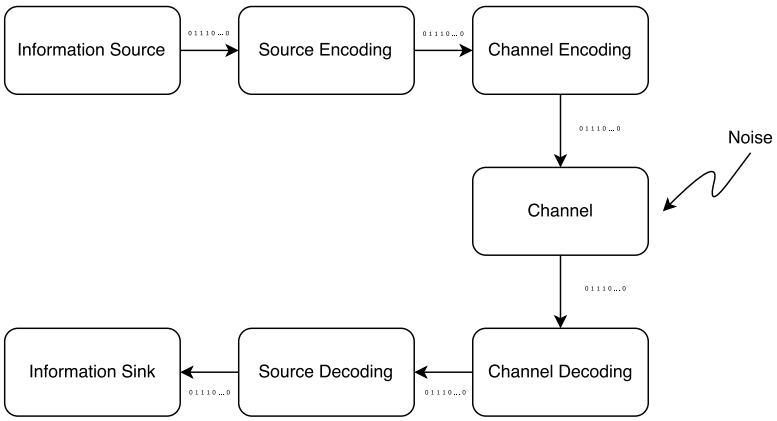


Figure 1: Simplified Model of Communication

# 2 Communication Model

An **image** will serve as the **information source**. To facilitate interoperability between the communication blocks, we suggest using a **bit stream** or a **byte stream** to **exchange** data between these blocks, i.e. every block will receive and send a bit or byte stream to the next one.

A Python template –and additional library functions– can be found in the the following Github repository: `https://github.com/GillesC/Communication-Model-Python`.

## 2.1 Source Encoding and Decoding

Use **Huffman** and **Lempel-Ziv-Welch** as a **source encoding** mechanism. Prior to using the provided template code, study the Huffman and Lempel-Ziv-Welch algorithm.

Question 1

What is the purpose of source encoding? Try to find an example of a real-life scenario where the effect of absence of source encoding would be clearly noticable.

Question 2

Why does the Lempel-Ziv-Welch Algorithm not group the first occurrences of symbols when a combination of the symbols is present in the dictionary?

Question 3

What are the disadvantages of Huffman coding with respect to LZW-coding?

Question 4

What is the correlation between entropy and the number of bits per symbol in the context of compression?

## 2.2 Channel Encoding and Decoding

**Reed-Solomon** (RS) coding will be used for **channel encoding**. In this assignment modulation and channel characteristics can be neglected. After applying Reed-Solomon encoding,

- Simulate storing to disk
- Hence, simulate bit errors (and define an error rate)
- check if Reed-Solomon is able to resolve the introduced errors and compare with the theoretical limit (Singleton bound).
- burst errors
- erasures

**Question 5**

Experiment with the code-word length of an RS message, and conclude.

**Question 6**

Calculate the number of resolved and unrecoverable errors after introducing the bit errors and or erasures.

# 3 Objectives

- Build data transmission blocks via Python.
- Enable and disable blocks to determine their impact on the model.
- Measure the transmitted bit stream size of each block and conclude.
- Measure the operation duration of each block and conclude. For instance, why is Huffman decoding slower than Huffman encoding?

# 4 Evaluation – Quiz and Code

## 4.1 Quiz

The student will be evaluated using an intermediate quiz and source code. To prepare, consult the questions in this assignment and conduct the ´´experiments" and programming yourself. The quiz will assess that the student has **understood** the **communication model**, based on the aforementioned objectives.

## 4.2 Source Code

- All Python **code** must be well **documented**.
- The code has to be send to `gilles.callebaut@kuleuven.be` before the deadline communicated with you during the lab sessions or Toledo.
- Do **not** include your environment folder.
- Use the following file name format: `<firstname>_<lastname>_MMN_code.zip`.

# References