**Summary**

Project Title: Autoencoder-Based Channel Coding and Decoding for Wireless Communications

Channel Coding and Decoding for Wireless Communications

Project Description:

This project aims to explore the application of autoencoders in improving the reliability of data transmission over noisy wireless channels. I will design and implement an end-to-end communication system that uses autoencoders for both channel coding and decoding, thereby enhancing the error correction capabilities of the wireless communication system.

Implement a realistic wireless communication channel model in MATLAB. Consider factors like fading, noise, and interference. can use standard channel models like Rayleigh or AWGN channels.

Create a dataset of random binary data sequences for training and testing. This dataset will be used to train and evaluate the autoencoder-based channel coding system.

Design and implement an autoencoder architecture for channel coding. I can start with a simple architecture and experiment with more complex ones as the project progresses.

Define the encoder and decoder networks.

Train the autoencoder using the training dataset. Monitor and record the loss during training.

Simulate the wireless transmission process by passing the encoded data through the channel model.

Add noise and simulate various channel conditions to evaluate the performance of the autoencoder-based coding system.

Implement the decoding process using the trained autoencoder.

Evaluate the bit error rate (BER) and packet error rate (PER) for different SNR values and compare the performance with conventional error correction techniques like Hamming codes or Turbo codes.

Plot BER and PER curves to visualize the performance gain achieved by using the autoencoder-based coding system.

Compare the performance of the autoencoder-based system with traditional error correction methods.

Experiment with hyperparameter tuning and different autoencoder architectures to improve performance.

Explore techniques like deep autoencoders, convolutional autoencoders, or recurrent autoencoders to enhance coding efficiency.

Document project in a comprehensive report, including the problem statement, methodology, results, and conclusions.

Deliverables:

MATLAB code for the complete project, including the channel model, autoencoder design, and evaluation scripts.

A well-documented report with detailed explanations, figures, and tables.

A presentation summarizing the key aspects and outcomes of the project.

This project will provide with a comprehensive understanding of how autoencoders can be employed to improve channel coding and decoding in wireless communications, which is a critical aspect of modern wireless communication systems.