In this project, I developed a lossless audio compression application using Rice coding as the primary compression algorithm. To further improve the compression rates, I implemented delta encoding before applying Rice coding. The application was developed in a Jupyter notebook using Python, and the effectiveness of the combined algorithms was analyzed using two sample WAV files, Sound1.wav and Sound2.wav.

Application Analysis: The application I developed takes an uncompressed WAV audio file as input, applies delta encoding followed by Rice coding to compress the file, and saves the compressed data as an .ex2 file. The application can then decode the compressed .ex2 file back into a WAV file. As this is a lossless compression method, the decoded WAV file is identical to the original input file.

The application is divided into several functions, including:

1. Functions to read and write WAV files.
2. Functions to perform delta encoding and decoding.
3. Functions to perform Rice encoding and decoding.
4. A main function that combines the delta and Rice encoding and decoding steps.

Table and Analysis of Results: The application was tested on two sample WAV files, Sound1.wav and Sound2.wav, using Rice coding with two different bit lengths (K = 2 bits and K = 4 bits). The results are shown in the table below:

The compression rates achieved by the combination of delta encoding and Rice coding vary between the two sample files. The difference in compression rates can be attributed to the varying characteristics of the audio data in the two files. Audio files with a higher degree of redundancy or predictability can achieve better compression rates using delta encoding and Rice coding.

Further Development: As part of the further development, I explored ways to improve the compression rates achieved by the application. The implemented delta encoding step predicts the next value based on the current value and encodes the difference between the predicted value and the actual value. This prediction method can improve the compression rate, especially for audio data with a high degree of redundancy.

In the future, I could investigate other prediction methods or lossless data compression algorithms to achieve even better compression rates. Additionally, I could explore optimization techniques to improve the performance and speed of the application.

Conclusion: The application I developed successfully compresses and decompresses WAV audio files using a combination of delta encoding and Rice coding. By analyzing the results, I demonstrated the effectiveness of the combined algorithms in achieving varying compression rates depending on the characteristics of the input audio files. With further development and optimization, the application can potentially achieve even better compression rates and performance.