

**EBU5303 Multimedia Fundamentals**

# Worksheet 2: Audio & Video, Lossless Compression

## Question 1. Do you remember?

1. What are the sampling and quantisation parameters of CD quality audio?
2. Define frame rate and refresh rate.
3. What image property is used in RLE encoding to achieve compression?
4. What image property is used in Huffman encoding to achieve compression?

## Question 2. Do you understand?

1. Explain what is shown in an audio Spectrogram. Comment the units used on the X and Y axes. Is it 2 dimensional? Justify your answer.
2. How do you recognise a voiced sound in a speech spectrogram?
3. Explain why the effectiveness of lossless compression depends on data properties.
4. Explain why Huffman is said to be close to the entropy.

## Question 3. Can you apply your knowledge?

1. Consider a video with the following properties: frame size is 1280-by-720-pixels; colour depth is 24-bits; frame rate is 30 fps; duration is 1 minute.

How much data rate reduction can be achieved by reducing the width and height of this video to half? Prove your answer by calculating the data rates.

1. The highest frequency of your music signal is 22 KHz. Assuming the Nyquist sampling rate is used and 16 bits per sample, what is the memory in Mbytes required to store a 2-minute passage of digital stereophonic music?
2. Encode the following message using RLE.

Message: ABBBBBCCDDDDDDDBBBBCCAAA

Assuming that each letter in the message represents an 8 bits symbol, how much compression did you achieve?

1. Decode the following binary message using the Huffman encoding table provided below.

Binary message: 1111101111010011011110101101100110111110101011001100100111111

Assuming that each symbol would normally be encoded using 3 bits (which is enough to encode 5 different symbols), how much compression is achieved?

00

01

10

110

111

0.40

0.20

0.20

0.10

0.10

A

B

C

D

E

code

probability

symbol

## Question 4. Can you analyse and/or evaluate?

1. Speech is usually encoded using a smaller bit depth than music. Why?
2. What is missing to MIDI encoding that would make it like listening to a human musical performance?
3. Consider the following statement: “For compression to remain lossless, an image should be encoded/decoded only once”. Is it correct? Justify your answer.
4. Consider the following statement: “Compression is lossless if the decoded image is not perceptually different from the original”. Is it correct? Justify your answer.

## Question 5. Can you create?

1. Write a simple MATLAB program that can read a video file and print its parameters (e.g., file size, duration, frame rate, frame size, colour depth, etc.).
2. Devise a simple pseudo algorithm to segment a speech audio file into individual sounds (phonemes).
3. Write a simple MATLAB program that can read a sequence of values and print the sequence compressed using RLE.
4. Devise a simple pseudo algorithm to perform Huffman coding.