



MACHAKOS UNIVERSITY

University Examinations for 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

SCO 405: COMPRESSION TECHNIQUES

DATE: 30/4/2019

TIME: 11.00-1.00 PM

INSTRUCTIONS

Answer **question ONE** and any other **TWO** questions.

QUESTION ONE (COMPULSORY)

- a) Outline the key difference between I-Frames, P-Frames and B-Frames (6 marks)
- b) Many of the compression algorithms, especially MPEG, use the concept of slices when encoding a video frame. (8 marks)
 - i. Describe what the reason is to use slices in encoded frames.
 - ii. Describe one advantage and one disadvantage when using one slice per frame versus using many slices per frame.
- c) Calculate the average entropy for the message: **HELLO WORLD!** (6 marks)
- d) Encode the message **AAAABBBBAABBBBBCCCCCCCCDABCBAABBBBCCD** using
 - i. Pattern Substitution (3 marks)
 - ii. Run Length Encoding (fixed and variable) (4 marks)
 - iii. Shano-Fannon Encoding (3 marks)

QUESTION TWO (20 MARKS)

- a) A networking company uses a compression technique to encode the message before transmitting over the network. Suppose the message contains the following characters with their frequency:

Character	Frequency
a	5
b	9
c	12
d	13
e	16
f	45

Note that each character in input message takes 1 byte. If the compression technique used is Huffman Coding, calculate the number of bits that will be saved in the message (12 marks)

- b) Explain three kinds of motion prediction techniques in video compression (6 marks)
- c) State the basic concept used in defining an Information Theoretic approach to data compression (2 marks)

QUESTION THREE (20 MARKS)

- a) State 3 examples each of a lossless and a lossy compression technique (3 marks)
- b) Draw the flow chart of arithmetic coding (3 marks)
- c) Using the table and input sequence below, encode the message below using arithmetic coding

Symbols	Probability
0	0.63
2	0.11
14	0.1
136	0.1
222	0.06

Input symbol 2 0 0 136 0 (6 marks)

- d) What is data compression and why data compression is important? What is the difference between lossless and lossy data compression. (8 marks)

QUESTION FOUR (20 MARKS)

- a) Define DPCM and outline its fundamental steps (6 marks)
- b) A multimedia presentation must be delivered over a network at a rate of 1.5 Mbits per second. The presentation consists of digitized audio and video. The audio has an average bit rate of 300 Kbits per second. The digitised video is in PAL format is to be compressed using the MPEG-1 standard. Assuming a frame sequence of: IBBPBBPBBPBBI..... and average compression ratios of 10:1 and 20:1 for the I-frame and P-frame. what is the compression ratio required for the B-frame to ensure the desired delivery rate? You may assume that for PAL the luminance Signal is sampled at the spatial resolution of 352x288 and that the two chrominance signals are sampled at half this resolution. The refresh rate for PAL is 25Hz. You should also allow 15% overheads for the multiplexing and packetisation of the MPEG-1 video. (7 marks)
- c) Describe LZW coding algorithm (3 marks)
- d) Given that Alphabet: $X = \{A, B, C\}$ and Message: ABABCBABAB, encode the message using the LZW algorithm (4 marks)

QUESTION FIVE (20 MARKS)

- a) Briefly outline the basic principles of Inter-Frame Coding in Video Compression. (8 marks)
- b) Discuss MPEG-4 structured audio standard. (8 marks)
- c) A source image file with 65,536 bytes is compressed into a file with 16,384 bytes. Calculate
 - i. Compression ratio (2 marks)
 - ii. Compression factor (2 marks)