

Minitest 2

Important notes:

- This exam is CLOSED book.
- The use of phones is not permitted. Please leave your phone by the examiner if you must go to the bathroom during the exam.
- Please clearly write your name and fill in your student ID by shading the appropriate entries on the grid above.
- Please write your answers on the white space below the question.
- Please show as much of your work as possible; this includes explaining the reasoning behind your calculations, we really like to give partial credit.
- All problems can be solved without lengthy computations. We advise you to look for a simple solution if you can.
- This exam has **2 problems** (100 points total) on **XX pages**, including this one.

Good luck!

Problem 1: *Data compression* (50 points total)

- (a) (5 points) Is the code $C = \{0, 01, 011, 0111\}$ instantaneous? Indicate why or why not.

- (b) (10 points) Find whether or not the code $C = \{01, 100, 1101, 10111, 01011\}$ is uniquely decodable via the algorithm of Sardinas-Patterson.

- (c) (5 points) Can the code $C = \{0, 10, 110, 1110\}$ be a Huffman code? Indicate why or why not.

- (d) (10 points) Can a uniquely decodable binary code with lengths $\{1, 2, 3, 3, 3\}$ exist? Indicate why or why not.

- (e) (10 points) Construct the Huffman code of an ensemble with symbols $\{a, b, c, d\}$ that occur with probabilities $\{0.35, 0.3, 0.25, 0.1\}$.

- (f) (5 points) What is the average length of the Huffman code in the previous exercise? If you were not able to find it, assume that the codewords for the symbols $\{a, b, c, d\}$ are respectively $\{0, 10, 110, 111\}$.

- (g) (5 points) Let X be an ensemble with alphabet $\{a, b, c\}$ and probabilities $\{0.8, 0.1, 0.1\}$. Construct the extended ensemble X^2 . That is: 1) specify the alphabet of X^2 and 2) give the probabilities of each symbol in the alphabet of X^2 .