# Minitest 1

**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:** *Measuring information* (50 points total)
Let us imagine that you want to transmit a word from the foreign language Icish to a friend. In this language words have always only two letters, first a consonant then a vowel. The consonants in the language are $\mathcal{C} = \{b, c, d, f\}$ and they occur respectively with probabilities $\{1/2, 1/4, 1/4, 0\}$. The vowels in the language are $\mathcal{V} = \{a, e, i, o, u\}$. The probability of having a vowel in a word depends on the consonant as follows:

| | $a$ | $e$ | $i$ | $o$ | $u$ |
|---|---|---|---|---|---|
| $b$ | 1/2 | 1/4 | 1/4 | | |
| $c$ | | 1/2 | 1/4 | 1/4 | |
| $d$ | 1/4 | | 1/2 | 1/4 | |
| $f$ | 1/4 | 1/4 | | 1/2 | |

(a) What is the entropy of $C$? (5 points)

Answer 1a

(b) What is the entropy of $V$? (5 points)

Answer 1b

(c) What is the entropy of a vowel given that the consonant was $b$? (5 points)

Answer 1c

(d) What is the entropy of a word? (15 points)

Answer 1d

(e) Construct a Huffman code to transmit words (20 points)

Answer 1e

**Problem 2:** (50 points total)