



Prof. M. Gastpar

Quiz 1 (Homeworks 1, 2 & 3)













Due on Moodle

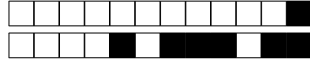
on Monday, March 10, 2025, at 23:59.

Quiz 1

SCIPER: 111111

- This quiz is to be solved individually.
- Try not to use any of the course materials other than the formula collection on a first attempt.
- Once you are done, enter your answers into Moodle. Moodle will give you feedback. You can update your answers as many times as you want before the deadline.
- For each question there is **exactly one** correct answer. We assign **negative points** to the **wrong answers** in such a way that a person who chooses a wrong answer loses **25 %** of the points given for that question.

Respectez les consignes suivantes Observe this guidelines Beachten Sie bitte die unten stehenden Richtlinien		
choisir une réponse select an answer Antwort auswählen	ne PAS choisir une réponse NOT select an answer NICHT Antwort auswählen	Corriger une réponse Correct an answer Antwort korrigieren
  		 
ce qu'il ne faut PAS faire what should NOT be done was man NICHT tun sollte		
     		

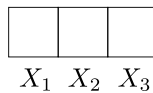
**Question 1**

[2 Points] In a binary Huffman code, symbols with equal probability always have codewords of equal length.

☐ VRAI ☐ FAUX

Question 2 [5 points] *Note: This is an **open** question. In the real exam, we will grade your arguments. Here for the quiz, we do not have the capacity to do this. Therefore, you will merely enter your final answer into a multiple choice grid on Moodle. However, do make sure to carefully look at the solution and compare to your answer. How many points would you have given yourself?*

Consider the following three boxes.



We fill the three boxes with bits with the following procedure:

- (a) We select one box uniformly at random and we fill it with 1;
- (b) For each of the remaining two boxes, we fill it with either 0 or 1 independently and uniformly at random.

We denote the value in the i -th box with the random variable X_i , as in the figure. What is $H(X_1, X_2, X_3)$?

Question 3:

[6 Points] About a binary source code for a source whose alphabet has 5 letters, we only know the codeword lengths: $\ell_1 = 1, \ell_2 = 2, \ell_3 = 4, \ell_4 = 5, \ell_5 = 6$.

Answer the following true/false questions.

This source code could be a Huffman code.

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It is possible that this source code is uniquely decodable.

☐ VRAI ☐ FAUX

The average codeword length of this source code could be equal to the entropy of the source.

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Question 4 [3 points] Let E and F be two events. Suppose that they satisfy $p(E|F) = p(E) > 0$.

Then we must have $p(F|E) = p(F)$.



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Question 5 [2+3 points] Let S be a random variable taking values in $\{a, b, c, d, e\}$ with the following probabilities.

	a	b	c	d	e
$p_S(\cdot)$	1/3	1/3	1/9	1/9	1/9

Let Γ_D be the D -ary Huffman code for S . Let $L(S, \Gamma_D)$ be the average codeword-length of Γ_D , and let $H_D(S)$ be the D -ary entropy of S . Answer the following true/false questions.

(a) If $D = 3$, then $L(S, \Gamma_D) = H_D(S)$.

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(b) $L(S, \Gamma_D) > H_D(S)$ for every $D > 3$.

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