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Computation Structures 1: Digital Circuits

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Tutorial : Huffman Encoding

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Huffman Encoding

6/6 points (ungraded)

Note: For this problem, your answers will be marked as wrong unless the encodings for all cases are correct.

The Registrar's office would like to encode the letter grades (A, B, C, D, F) from a large course with 1000 students. They plan to encode each grade separately using a variable-length code. An analysis of previous terms has produced the following table of grade probabilities. In case it's useful, a thoughtful former 6.004 student has augmented the table by computing $p * log_2 (1/p)$ for each grade.

Grade	p	$plog_2 (1/p)$
A	0.24	0.49
B	0.35	0.53
C	0.21	0.47
D	0.13	0.38
F	0.07	0.27
Totals	1.00	2.14

A) Use Huffman's algorithm to construct an optimal variable-length encoding.

Encoding for A: 0b [10] ✔

Encoding for B: 0b [11] ✔

Encoding for C: 0b [01] ✔

Encoding for D: 0b [001] ✔

Encoding for F: 0b [000] ✔

B) Two 6.004 students have proposed competing variable-length codes. Alice says that encoding 1000 grades using her code will, on the average, produce messages of 2200 bits. Bob says that encoding 1000 grades using his code will, on the average, produce messages of 1950 bits. Which of the following is your best response when the Registrar asks your opinion?

○ Choose Bob's: it has the shorter average length

○ Choose Alice's: more bits means more information is transmitted

○ Choose Bob's: Bob's average message length is less than the information entropy

◉ Choose Alice's: Bob's average message length is less than the information entropy

○ Choose neither: a fixed-length code will have lower average message size

✔

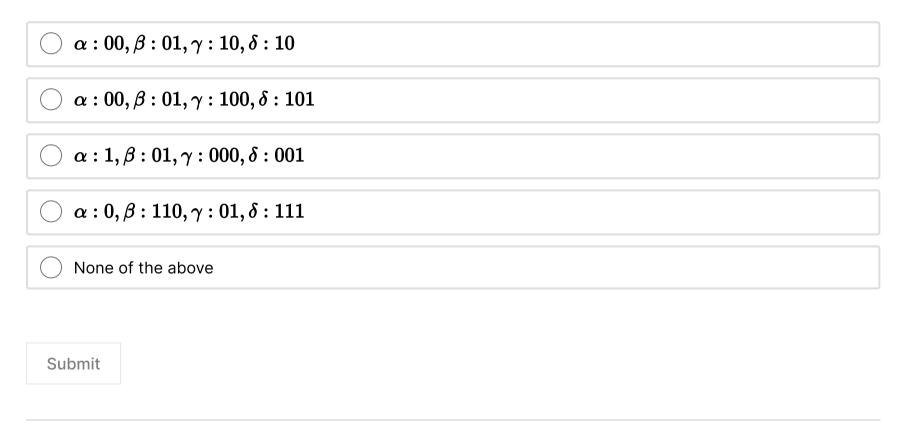[Submit]

Calculator

✔   Correct (6/6 points)

Huffman Encoding

1 point possible (ungraded)

We wish to transmit messages comprised of the four symbols shown below with their associated probabilities and 5-bit fixed-length encoding.

Symbol	$P(symbol)$
α	.5
β	.125
γ	.25
δ	.125

Huffman's algorithm is used to construct a variable-length code for the four symbols for transmitting a single symbol at a time. The resulting encoding could be:

○ $\alpha : 00, \beta : 01, \gamma : 10, \delta : 10$

○ $\alpha : 00, \beta : 01, \gamma : 100, \delta : 101$

○ $\alpha : 1, \beta : 01, \gamma : 000, \delta : 001$

○ $\alpha : 0, \beta : 110, \gamma : 01, \delta : 111$

○   None of the above

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?	**Fixed but variable?** In the second question, it says we want to transmit with a fixed length encoding, but then you have us construct a variable Huffma…	2
💬	**Grammatical error** It should say "comprising" or "composed of". "comprised of" is a common grammatical mistake.	1
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