

<u>Help</u>





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Tutorial: Quantifying Information

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⊞ Calculator

Quantifying Information

1/1 point (ungraded)

I make up a random 4-bit two's complement number by flipping a fair coin to determine each bit. You're trying to guess the number. If I tell you that the number is positive (> 0), how many bits of information have I given you? Provide the answer in the form log2(X/Y).

Information in my message: $\log_2(16/7)$ bits $\log_2\left(\frac{16}{7}\right)$

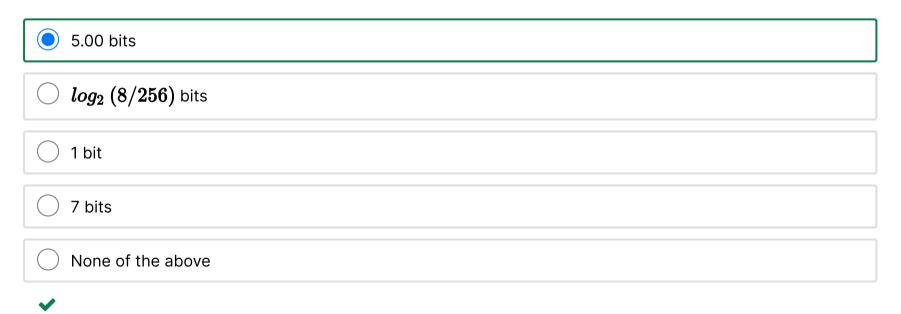
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✓ Correct (1/1 point)

Quantifying Information

1/1 point (ungraded)

X is an unknown 8-bit binary number. You are given another 8-bit binary number, Y, and told that the Hamming distance between X and Y is 7. How many bits of information about X have you been given?



Explanation

There are 8 numbers with Hamming distance of 7 from Y. Information is given by: $log_2\left(\frac{1}{P(E)}\right)$ where P(E) is the probability of the event. There are 2^8 total 8-bit numbers so $P\left(E\right)=\frac{8}{256}$ and therefore info = $log_2\left(\frac{256}{8}\right)$ = 5.00 bits.

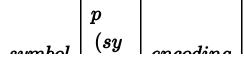
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Answers are displayed within the problem

Quantifying Information and Error Correction

2/3 points (ungraded)

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



⊞ Calculator

รฐานบบเ	$mbo \ l)$	сисошну
А	0.25	00000
В	0.5	11100
С	0.125	11011
D	0.125	10111

An unknown letter is received and you are told it's not D. How much information have you received?

 $log_2 \left(1-0.125
ight)$ bits

 $log_2 \ (0.125)$ bits

 $-log_2\left(1-0.125
ight)$ bits

 $-log_2 \ (0.125)$ bits

None of the above

×

Explanation

The information received is given by the log base 2 of 1 over the probability of the message: $log_2(\frac{1}{P_{message}})$. The probability of the message in this case is 1 - p(D) = 1 - 0.125. So the answer is $log_2\left(rac{1}{1-0.125}
ight) = -log_2\left(1-0.125
ight)$

When transmitting a message comprised of these four symbols with the probabilities as given above, the expected amount of information received when learning of a symbol is

1.75 bits

1.25 bits

2 bits

1.5 bits

None of the above



Explanation

The expected amount of information received is given by the probability-weighted sum of the information received from learning each symbol: $\sum p_i * log_2(\frac{1}{p_i})$. The expected information in this case is then $0.25*log_{2}\left(4.0
ight)+0.5*log_{2}\left(2.0
ight)+0.125*log_{2}\left(8.0
ight)+0.125*log_{2}\left(8.0
ight)=1.75$ bits.

If we transmit messages using the 5-bit fixed-length encoding shown above, will it be possible to perform singlebit error detection and correction at the receiver?



yes

not enough information to tell



■ Calculator

Explanation

Comparing each of the encodings to all others, we find that the minimum number of bits that change from one encoding to another is 2 bits. This means that the Hamming distance for this encoding is 2. In order to detect a single-bit (E = 1) error, one needs a Hamming distance greater than or equal to E + 1 = 2. To correct a single-bit (E = 1) error, one needs a Hamming distance greater than or equal to E + 1 = 3, so single-bit errors can be detected but not corrected using this encoding.

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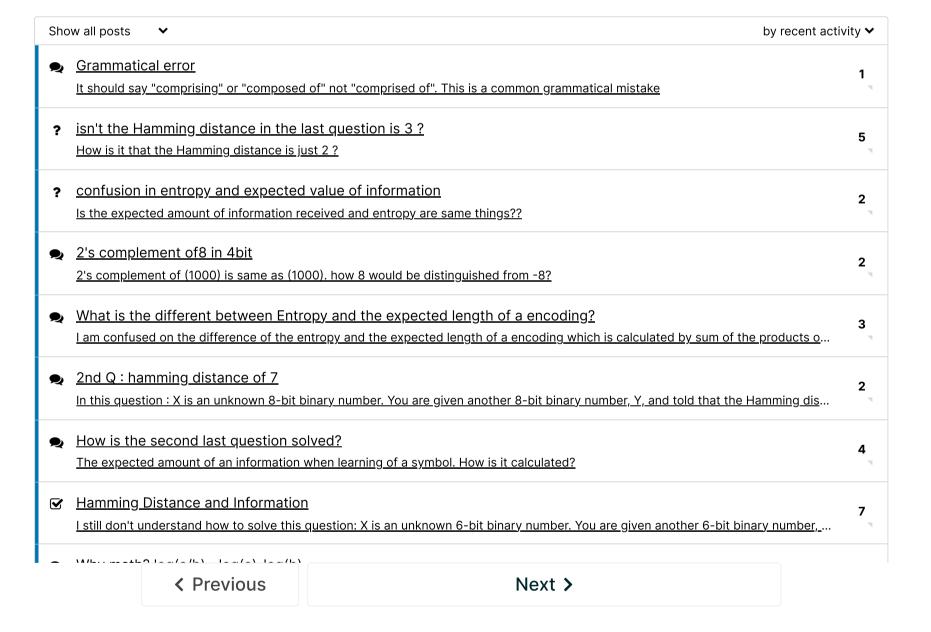
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