Feedback — Problem Set XI

You submitted this homework on **Mon 1 Apr 2013 9:21 AM CDT -0500**. You got a score of **0.00** out of **12.00**. You can attempt again, if you'd like.

In this problem set, you will be given a total of ten attempts. We will accept late submission until the fifth day after the due date, and late submission will receive half credit. Explanations and answers to the problem set will be available after the due date. Since the homework problems will become gradually more challenging as the course proceeds, we highly recommend you to start the habit of printing out the problems and working on them with paper and pencil. Also, please be sure to read the problem statements carefully and double check your expressions before you submit.

A Link text version of this problem set is available for you to print. Note: all mathematical expressions have to be exact, even when involving constants. Such an expression is required when a function and/or a variable is required in the answer. For example, if the answer is $\sqrt{3}x$, you must type `sqrt(3)*x`, not `1.732*x` for the answer to be graded as being correct.

Question 1

Source Compression

Consider the following 5-letter source

Letter	Probability
a	0.5
b	0.25
c	0.125
d	0.0625
e	0.0625

Find this source's entropy.

$H(A) = ?$ bits

You entered:

Your Answer		Score	Explanation
	✘	0.00	
Total		0.00 / 1.00	

Question 2

How many bits are required ro represent this five-letter source with a simple code?

You entered:

Your Answer		Score	Explanation
	✘	0.00	
Total		0.00 / 1.00	

Question 3

Find an variable-length code for this sequence that satisfies the Source Coding Theorem. Does your code achieve the entropy limit?

Your Answer	Score	Explanation

- Yes, the code reaches the entropy limit
- No, the code does not reach the entropy limit

Total	0.00 / 1.00

Question 4

How much more efficient is this code than the simple binary code?

On average, the Huffman code saves _____ bits/letter

You entered:

Your Answer		Score	Explanation
	✘	0.00	
Total		0.00 / 1.00	

Question 5

Speech Compression

When we sample a signal, such as speech, we quantize the signal's amplitude to a set of integers. For a B-bit converter, signal amplitudes are represented by 2^B integers. Although these integers could be represented by a binary code for digital transmission, we should consider whether a Huffman coding would be more efficient.

Load into MATLAB the segment of speech contained in `y.mat`. Its sampled values lie in the interval $(-1, 1)$. To simulate a 3-bit converter, we use MATLAB's `round` function to create quantized amplitudes corresponding to the integers $[0\ 1\ 2\ 3\ 4\ 5\ 6\ 7]$.

```
y_quant = round(3.5*y + 3.5);
```

Note that this one line quantizes the entire dataset!

Find the relative frequency of occurrence of quantized amplitude values. The following MATLAB program computes the number of times each quantized value occurs.

```
clear count; for n=0:7; count(n+1) = sum(y_quant == n); end;
```

Find the entropy of the source. $H(A) = ?$ bits

You entered:

Your Answer		Score	Explanation
	✘	0.00	
Total		0.00 / 1.00	

Question 6

Find the Huffman code for this source. What is the average bit length for your code?

$\bar{B}(A) = ?$ bits

You entered:

Your Answer	Score	Explanation
✘	0.00	
Total	0.00 / 1.00	

Question 7

How many fewer bits would be used in transmitting the entire speech segment found in the variable `y` with your Huffman code in comparison to simple binary coding?

You entered:

Your Answer	Score	Explanation
✘	0.00	
Total	0.00 / 1.00	

Question 8

Error correcting codes

An error-correcting code maps pairs of information bits into codewords of length 5 as follows.

Data	Codeword
00	00000
01	01101
10	10111

11	11010

What is this code's efficiency? $E = ?$

You entered:

Preview Help

Your Answer	Score	Explanation
✘	0.00	Could not parse student submission
Total	0.00 / 1.00	

Question 9

Find the generator matrix G for this code.

$G = ?$

NOTE: To enter the values for a matrix, type the rows in sequence. For example, to type the matrix

$$\begin{bmatrix} 1 & 1 & 2 \\ 3 & 5 & 8 \end{bmatrix}$$

your would enter `1 1 2 3 5 8`

You entered:

Your Answer	Score	Explanation
✘	0.00	

Total	0.00 / 1.00

Question 10

Find the parity-check matrix H for this code.

$H = ?$

NOTE: For example, to enter the values for the matrix

$$\begin{bmatrix} 1 & 1 & 2 \\ 3 & 5 & 8 \end{bmatrix}$$

type `1 1 2 3 5 8`

You entered:

Your Answer		Score	Explanation
	✘	0.00	
Total		0.00 / 1.00	

Question 11

What is the block error probability (the probability of one or more errors occurring in the decoded codeword)? Express your answer in terms of p_e. To enter p_e, type `pe` .

$\Pr[B] = ?$

You entered:

Preview Help

Your Answer		Score	Explanation
	✘	0.00	Could not parse student submission
Total		0.00 / 1.00	

Question 12

A clever (?) engineer proposes the following $(6, 3)$ code to correct errors incurred in transmission through a digital channel. With d_1, d_2, d_3 representing the data bits and $c_1, c_2, c_3, c_4, c_5, c_6$ representing the bits in each codeword,

$$c_1 = d_1 \quad c_4 = d_1 \oplus d_2 \oplus d_3$$

$$c_2 = d_2 \quad c_5 = d_2 \oplus d_3$$

$$c_3 = d_3 \quad c_6 = d_1$$

What is the error correcting capability of this code? Type in the number of single-bit errors and the number of double-bit errors this code can correct. For example, if the answer is 4 single-bit errors and 2 double bit errors, you would enter `4 2`.

You entered:

Your Answer	Score	Explanation

	✘	0.00
Total		0.00 / 1.00