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Pries: 460 Information and Coding Theory:
Quiz 1, February 10, 2014.

Name: _____

This quiz has 4 pages. Each page is worth 10 points. Show all your work. Explain all your answers to receive full credit.

1. How many strings are there in $(\mathbb{Z}/7)^5$ containing exactly two zeros?

2. How many encoding functions are there from the set of source symbols $\{a, b, c, d, e, f, g, h\}$ to the set of codewords in $(\mathbb{Z}/2)^3$?

3. Construct an instantaneous binary code containing the codewords 0, 10, one codeword of length 3 and 2 codewords of length 4.

4. Show that there is no instantaneous binary code containing one codeword of length 1, one codeword of length 2 and 5 codewords of length 4.

5. Consider the following set of vectors in $(\mathbb{Z}/11)^{10}$:

$$\begin{aligned}w_1 &= 1 - 000 - 00000 - 1 \\w_2 &= 0 - 600 - 00000 - 1 \\w_3 &= 0 - 040 - 00000 - 1 \\w_4 &= 0 - 003 - 00000 - 1 \\w_5 &= 0 - 000 - 90000 - 1 \\w_6 &= 0 - 000 - 02000 - 1 \\w_7 &= 0 - 000 - 00800 - 1 \\w_8 &= 0 - 000 - 00070 - 1 \\w_9 &= 0 - 000 - 00005 - 1\end{aligned}$$

(a) The vectors w_1, \dots, w_9 are all in the ISBN code. Show that this is true for w_9 (skip the others).

(b) Write the vector $v = 0 - 101 - 00000 - 6$ as a linear combination of w_1, \dots, w_9 .

(c) The vectors w_1, \dots, w_9 are a basis for the ISBN code. Circle TRUE/FALSE and briefly explain why.

6. Your source has 32 symbols and a uniform probability distribution.

(a) What is the average length of the block code of length 5?

(b) What is the average length of the comma code $\{0, 10, 110, \dots\}$?

Please copy the honor pledge and sign your name: "I have not given, received, or used any unauthorized assistance."