

**Northwestern University**  
Department of Electrical and Computer Engineering

ECE 428: Information Theory

Spring 2004

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**Problem Set 1**

**Date issued: March 30, 2004**

**Date Due: April 6, 2004**

Reading Assignment: Chapter 1, Chapter 2, Sections 2.1-2.6

Do the following problems:

1. Let  $A$  and  $B$  be independent binary-valued random variable, and let  $C = A \oplus B$ , where  $\oplus$  denotes mod-2 addition. Either prove or provide a counterexample for each of the following equalities:
  - a.  $H(A,B) = H(C)$
  - b.  $H(C|A) = H(B|C \oplus B)$
  - c.  $H(A|C) = H(B)$
2. When calculating entropy, by convention it is assumed that  $0 \log(1/0) = 0$ . Show that this must be assumed if we want  $H(X)$  to be a continuous function of a probability vector  $\mathbf{p} = (p_1, \dots, p_N)$ . (i.e.,  $\mathbf{p}$  is the p.m.f. of  $X$ ).
3. Problem 2.5 in C&T.
4. Problem 2.9 in C&T.
5. Problem 2.10 in C&T.
6. Problem 2.24 in C&T.