

ECE 6005  
Information Theory

HW#2

- 1) Problem 20, Chapter 2 in C&T, all parts.  
Part a is the hardest part, you have to show  $H(X_2 | X_1) = H(X_1 | X_2)$ . Hint: use the fact the  $X_1$  and  $X_2$  are identically distributed, i.e.  $p(X_1 = a) = p(X_2 = a)$  for all events  $a$ .
- 2) Problem 21, Chapt. 2 C&T
- 3) a) Prove  $H(X_1, \dots, X_n, Y_1, \dots, Y_n) = H(X_1, \dots, X_n) + H(Y_1, \dots, Y_n)$   
b) What is the weakest condition for which equality is achieved?
- 4) Problem 3, Chapter 3 in C&T, part a) and b) only
- 5) If  $X \rightarrow Y \rightarrow Z$  is a Markov chain in that order, prove  $H(X|Y) = H(X|Z)$ .
- 6) Prove  $H(X, Y, Z) - H(X, Y) = H(X, Z) - H(X)$
- 7) Alternate statement of the Data Processing Theorem (proves that the Markov chain is "reversible").  
If  $X \rightarrow Y \rightarrow Z$  is a Markov chain in that order, prove  $I(Y; Z) \leq I(X; Z)$  and show that this means  $H(Z|X) \geq H(Z|Y)$

**to prove this start with  $I(Z; XY)$  and do the same thing as in the proof of the DPT**