

ECE 6605  
Information Theory

HW #6: Assigned October 27 2003, due November 5,2003.

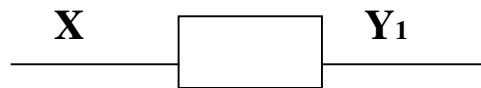
1) **A channel with two independent looks at Y.**

Let  $Y_1$  and  $Y_2$  be conditionally independent and conditionally identically distributed given  $X$ .

- (a) Show  $I(X; Y_1, Y_2) = 2I(X; Y_1) - I(Y_1; Y_2)$ :
- (b) Conclude that the capacity of the channel



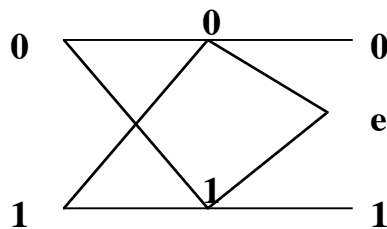
is less than twice the capacity of the channel



2) **Can signal alternatives lower capacity?**

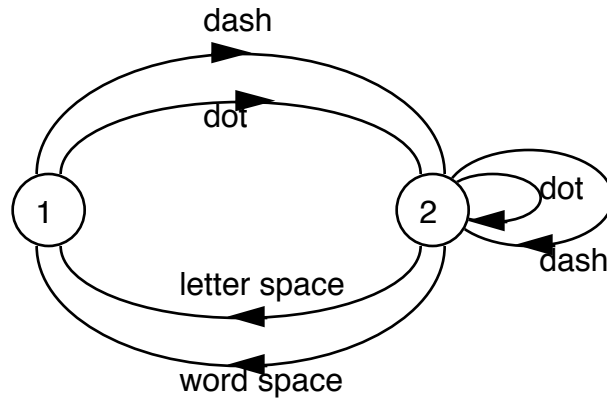
Show that adding a row to a channel transition matrix does not decrease capacity.

3) **Find the capacity of the following cascaded channel.** Suppose a BSC with capacity  $C_1$  is followed by a binary erasure channel with capacity  $C_2$ . What is the capacity of the resulting cascaded channel?



5) Consider the following Morse code system. Assuming the dots, dashes and spaces are transmitted across a noiseless channel, what is the largest information transmission rate (in information-bits/channel-use) possible subject to the dot/dash/space constraints?

Design a simple code that converts information bits to dot/dash/spaces satisfying the constraints and compute its rate.



6) In compact disc (CD) and digital versatile disc (DVD) the channel is constrained. The inputs must satisfy the  $(d,k)$  runlength limiting constraint with  $d=2$ ,  $k=10$ . In the next generation after DVD, the so-called Blu-ray standard uses a  $(1,7)$  constraint. Compute the capacity of the  $(1,7)$  noiseless constrained channel.