Quiz 1
(15 min. Total: 15)

13.5

Computer communications networks (ELL785)

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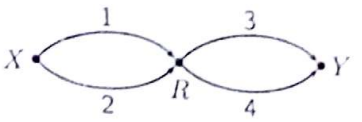
1. [9] Consider the following table of events and their probabilities

event	A	B	C	D
probability	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{8}$	$\frac{1}{4}$

   (a) [3] Suppose A and B are mutually exclusive. Find $\Pr[A \cup B]$.
   (b) [3] Suppose A and B are independent. Find $\Pr[A + B]$.
   (c) [3] Is it possible that the events A, B, C and D are mutually exclusive? Justify your answer.

2. [6] A communication network consisting of three nodes and four links is shown below.



Symbol	Event
F	No path from X to Y exists
A_i	Link i fails

   (a) [3] Write an expression for F in terms of A_1, A_2, A_3 and A_4
   (b) [3] Let $\Pr[A_i] = p_i$ and write an expression for $\Pr[F]$ in terms of p_i's. Assume that links fail independent of each other.

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(1) (a) $Pr(A \cup B) = Pr(A) + Pr(B) - Pr(A \cap B)$ → 0 (mutually ex.)

$= 1/4 + 1/2 = 3/4$ ✓

(b) $Pr(A \cup B) = Pr(A) + Pr(B) - Pr(A \cap B)$

$= Pr(A) + Pr(B) - Pr(A) \cdot Pr(B)$ (∵ ind.)

$= 1/4 + 1/2 - 1/8$

$= \frac{3}{4} - \frac{1}{8} = 5/8$ ✓

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(c) No, they cannot because $Pr[A] + Pr[B] + Pr[C] + Pr[D] > 1$, and hence there should be some non-zero quantity among $Pr[A \cap B]$ or $Pr[B \cap C]$ or $Pr[C \cap D]$ or $Pr[A \cap D]$ or $Pr[A \cap B \cap C]$ or $Pr[B \cap C \cap D]$ or $Pr[A \cap C \cap D]$

Q2

(a) $F = A_1A_2 + A_3A_4$ ✓ (3)

(b) $Pr[F] = p_1p_2 + p_3p_4$ (1.5)