AI1103 - Assignment 2

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Download latex-tikz codes from

https://github.com/rajasekhar156/assignment−2−AI1103\\ \\

QUESTION:
If P and Q are two random events, then the following is TRUE:

(A) Independence of P and Q implies that $\Pr(P \cap Q) = 0$

(B) $\Pr(P \cup Q) \geq \Pr(P) + \Pr(Q)$

(C) If P and Q are mutually exclusive, then they must be independent.

(D) $\Pr(P \cap Q) \leq \Pr(P)$

ANSWER:
(A) Independence of P and Q means if P happens, then outcome of Q won't be affected by that.
so

$$\Pr(P/Q) = \Pr(P) \tag{0.0.1}$$

$$\frac{\Pr(P \cap Q)}{\Pr(Q)} = \Pr(P) \tag{0.0.2}$$

$$\implies \Pr(P \cap Q) = \Pr(P).\Pr(Q) \tag{0.0.3}$$

This is what we can say hence (A) is wrong

(B)As

$$\Pr(P \cup Q) = \Pr(P) + \Pr(Q) - \Pr(P \cap Q) \tag{0.0.4}$$

$$\Pr(P \cup Q) + \Pr(P \cap Q) = \Pr(P) + \Pr(Q) \tag{0.0.5}$$

$$\Pr(P \cap Q) \geq 0 \tag{0.0.6}$$

$$\implies \Pr(P) + \Pr(Q) \geq \Pr(P \cup Q) \tag{0.0.7}$$

Hence (B) is also wrong

(C) When P and Q are mutually exclusive, then either P occurs or Q occurs but not both simultaneously. So if P happens, chance of Q happening gets ruled out and vice-versa. Hence, mutually exclusive events are dependent.
Hence (C) is also wrong

(D)As

$$\Pr(Q/P) = \frac{\Pr(P \cap Q)}{\Pr(P)} \tag{0.0.8}$$

And

$$\Pr(Q/P) \leq 1 \tag{0.0.9}$$

$$\frac{\Pr(P \cap Q)}{\Pr(P)} \leq 1 \tag{0.0.10}$$

$$\Pr(P \cap Q) \leq \Pr(P) \tag{0.0.11}$$

Hence (D) is correct.