Stochastic Processes Assignment 1

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2. *A* and *B* are two events. Show that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$.

To start with,

$$A \cup B = (A - B) \cup (A \cap B) \cup (B - A)$$

And by the property regarding probability of events,

$$P(A \cup B) = P(A - B) + P(A \cap B) + P(B - A)$$

While $P(A - B) = P(A) - P(A \cap B)$ and $P(B - A) = P(B) - P(A \cap B)$,

$$\begin{aligned} P(A \cup B) &= P(A) - P(A \cap B) + P(A \cap B) + P(B) - P(A \cap B) \\ &= P(A) + P(B) - P(A \cap B) \end{aligned}$$