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$$\begin{aligned} \mathbf{P}((A \cup B) \cap C) &= \text{Distributive property} \mathbf{P}((A \cap C) \cup (B \cap C)) \\ &= \text{Inclusion-exclusion} \mathbf{P}(A \cap C) + \mathbf{P}(B \cap C) - \mathbf{P}((A \cap C) \cap (B \cap C)) \\ &= \mathbf{P}(A \cap C) + \mathbf{P}(B \cap C) - \mathbf{P}(A \cap B \cap C) \\ &= \text{Independence} \mathbf{P}(A) \mathbf{P}(C) + \mathbf{P}(B) \mathbf{P}(C) - \mathbf{P}(A) \mathbf{P}(B) \mathbf{P}(C) \\ &= \text{Factorisation} (\mathbf{P}(A) + \mathbf{P}(B) - \mathbf{P}(A) \mathbf{P}(B)) \mathbf{P}(C) \\ &= \text{Independence} (\mathbf{P}(A) + \mathbf{P}(B) - \mathbf{P}(A \cap B)) \mathbf{P}(C) \\ &= \text{Inclusion-exclusion} \mathbf{P}(A \cup B) \mathbf{P}(C) \end{aligned}$$

$A \cup B$  and  $C$  are independent.



## Slogan

Events determined by disjoint subsets of independent events are also independent.