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$$P(\emptyset) = 0:$$

$$\underbrace{P(\Omega)}_{=1} = P(\Omega \cup \emptyset) = \underbrace{P(\Omega)}_{=1} + P(\emptyset)$$

$$\Rightarrow 1 = 1 + P(\emptyset) \Rightarrow P(\emptyset) = 0$$

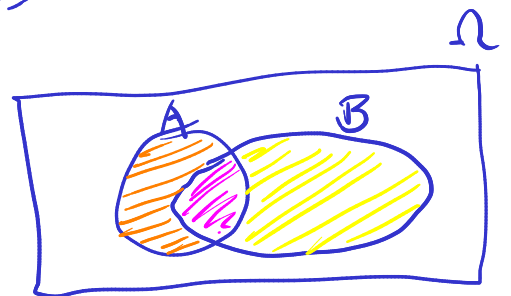
$$P(\bar{A}) = 1 - P(A):$$

$$P(A) + P(\bar{A}) = P(A \cup \bar{A}) = P(\Omega) = 1$$

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

$$P(A) = P(\underbrace{A \cap B}_{\text{pink}}) \cup \underbrace{A \cap \bar{B}}_{\text{orange}}$$

$$P(B) = P(A \cap B) \cup \underbrace{\bar{A} \cap B}_{\text{yellow}}$$



$$\Rightarrow P(A) + P(B) = P(A \cap B) + P(A \cap \bar{B}) + P(A \cap B) + P(\bar{A} \cap B)$$

$$\Rightarrow P(A) + P(B) - P(A \cap B) = \underbrace{P(A \cap \bar{B})}_{\text{orange}} + \underbrace{P(A \cap B)}_{\text{pink}} + \underbrace{P(\bar{A} \cap B)}_{\text{yellow}} = P(A \cup B)$$