Probability Identities

- Random variables in caps (A)
  - values in lowercase: \( A = a \) or just \( a \) for shorthand

- \( P(a \mid b) = \frac{P(a, b)}{P(b)} \)  
  conditional probability

- \( P(a, b) = P(a \mid b) P(b) \)  
  joint probability

- \( P(b \mid a) = \frac{P(a \mid b) P(b)}{P(a)} \)
Probability via Counting

\[ P(\text{circle, red}) = \frac{2}{8} = 0.25 \]
Probability via Counting

\[ P(\text{circle} \mid \text{red}) = \frac{P(\text{circle, red})}{P(\text{red})} \]

\[ \frac{2}{3} \quad \frac{2}{8} \quad \frac{3}{8} \]
Probability via Counting

\[ \frac{2}{3} \cdot \frac{3}{8} = \frac{2}{8} \]
Probability Identities

- Random variables in caps (A)
  - values in lowercase: $A = a$ or just $a$ for shorthand
- $P(a \mid b) = \frac{P(a, b)}{P(b)}$
- $P(a, b) = P(a \mid b) P(b)$
- $P(b \mid a) = \frac{P(a \mid b) P(b)}{P(a)}$
Bayes Rule

- $P(b | a)$
- $P(b | a) = P(a, b) / P(a)$
- $P(b | a) = P(a | b) P(b) / P(a)$