

Gene state
given the data

$$P\left(\begin{array}{c} \text{fun A} \\ \text{fun B} \end{array} \begin{array}{|c|} \hline \text{[Diagram: 2x2 grid with red and blue squares]} \\ \hline \end{array} \mid \begin{array}{c} \text{[Diagram: 4 dogs]} \\ \text{[Diagram: 4 cats]} \end{array}, \begin{array}{c} \text{[Diagram: 4 birds]} \\ \text{[Diagram: 4 fish]} \end{array}\right)$$

It's parent state
given the data

$$P\left(\begin{array}{c} \text{fun A} \\ \text{fun B} \end{array} \begin{array}{|c|} \hline \text{[Diagram: 2x2 grid with red and blue squares]} \\ \hline \end{array} \mid \begin{array}{c} \text{[Diagram: 4 dogs]} \\ \text{[Diagram: 4 cats]} \end{array}, \begin{array}{c} \text{[Diagram: 4 birds]} \\ \text{[Diagram: 4 fish]} \end{array}\right)$$

$$\mathbb{P}\left(\mathbf{x}^p = \mathbf{x} \mid \tilde{D}\right) = \underbrace{\left\{ \prod_{m \in \mathbf{O}(p)} \mathbb{P}\left(\tilde{D}_m \mid x_m\right) \right\}}_{\text{Everything below } x^p} \underbrace{\sum_{x_p} \mathbb{P}\left(x_p \mid \tilde{D}\right) \frac{\mathbb{P}\left(\mathbf{x}^p = \mathbf{x} \mid x_p\right)}{\mathbb{P}\left(\tilde{D}_p \mid x_p\right)}}_{\text{Everything above } x^p}$$