



Bayes' theorem

$$P(\text{parameters} \mid \text{data, model}) = \frac{\overset{\text{likelihood}}{P(\text{data} \mid \text{parameters, model})} \overset{\text{priors}}{P(\text{parameters} \mid \text{model})}}{P(\text{data} \mid \text{model})}$$

↖ posterior
↗ marginal probability of the data

Putting everything together

posterior

$$P(\text{tree, flower, } \lambda, \mu, \rho, \text{substitution, clock}) \mid \begin{matrix} 0101... \\ 1101... \\ 0100... \end{matrix} =$$

probability of the character
data given everything else*

probability of the timetree
given the tree model

priors on
fossil ages

priors on model parameters

$$\frac{P(\begin{matrix} 0101... \\ 1101... \\ 0100... \end{matrix} \mid \text{tree, flower, } \lambda, \mu, \rho, \text{substitution, clock}) P(\text{tree, flower, } \lambda, \mu, \rho) P(\text{flower}) P(\lambda, \mu, \rho) P(\text{substitution}) P(\text{clock})}{P(\begin{matrix} 0101... \\ 1101... \\ 0100... \end{matrix})}$$

↗ marginal probability of the data

*the tree, the parameters and the tripartite model