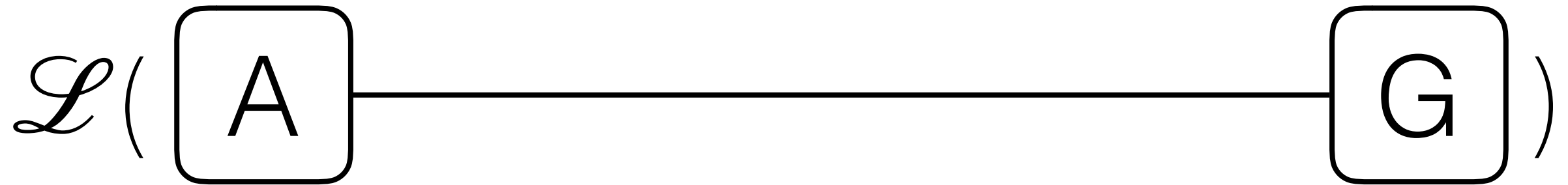


Calculating Likelihoods on Trees

Revisiting a Single Branch



Revisiting a Single Branch

$$\begin{aligned} \mathcal{L}(\text{A} \text{---} \text{G}) &= \\ \mathcal{L}(\text{A} \text{---} \text{A} \text{---} \text{G}) &+ \\ \mathcal{L}(\text{A} \text{---} \text{C} \text{---} \text{G}) &+ \\ \mathcal{L}(\text{A} \text{---} \text{G} \text{---} \text{G}) &+ \\ \mathcal{L}(\text{A} \text{---} \text{T} \text{---} \text{G}) & \end{aligned}$$

Chapman-Kolmogorov Equation

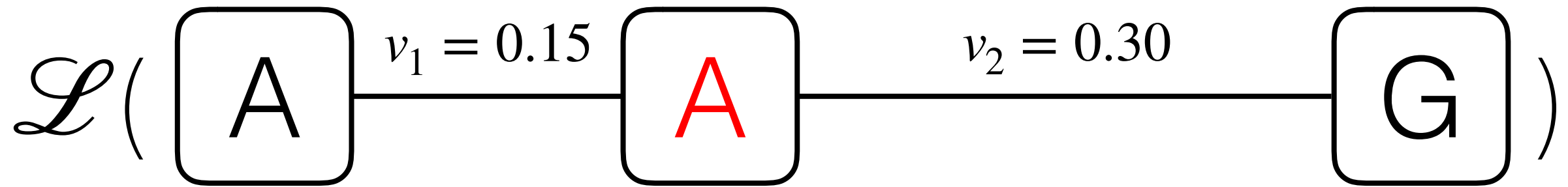
$$\begin{aligned} & \mathcal{L}(\text{A} \text{---} \text{G}) \\ &= \\ & \mathcal{L}(\text{A} \text{---} \text{A} \text{---} \text{G}) + \\ & \mathcal{L}(\text{A} \text{---} \text{C} \text{---} \text{G}) + \\ & \mathcal{L}(\text{A} \text{---} \text{G} \text{---} \text{G}) + \\ & \mathcal{L}(\text{A} \text{---} \text{T} \text{---} \text{G}) \end{aligned}$$

Pulley Principle (Reversibility)

$$\begin{aligned} \mathcal{L}(\text{A} \text{---} \text{G}) &= \\ \mathcal{L}(\text{A} \text{---} \text{A} \text{---} \text{G}) &+ \\ \mathcal{L}(\text{A} \text{---} \text{C} \text{---} \text{G}) &+ \\ \mathcal{L}(\text{A} \text{---} \text{G} \text{---} \text{G}) &+ \\ \mathcal{L}(\text{A} \text{---} \text{T} \text{---} \text{G}) & \end{aligned}$$

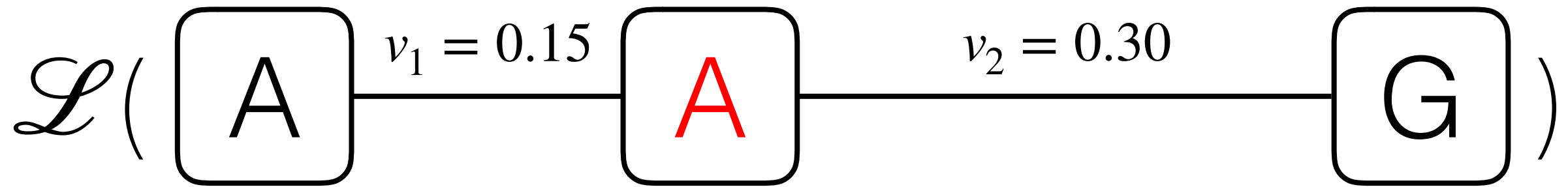
Pulley Principle (Reversibility)

$$\begin{aligned} \mathcal{L}(\text{A} \text{---} \text{G}) &= \\ \mathcal{L}(\text{A} \text{---} \text{A} \text{---} \text{G}) &+ \\ \mathcal{L}(\text{A} \text{---} \text{C} \text{---} \text{G}) &+ \\ \mathcal{L}(\text{A} \text{---} \text{G} \text{---} \text{G}) &+ \\ \mathcal{L}(\text{A} \text{---} \text{T} \text{---} \text{G}) & \end{aligned}$$



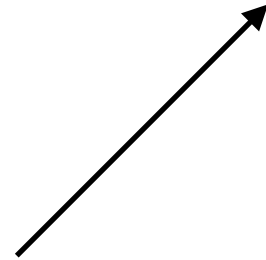
$$P_{AA}(0.15)$$

Probability of starting with an A and ending
with an A on a branch of length 0.15.

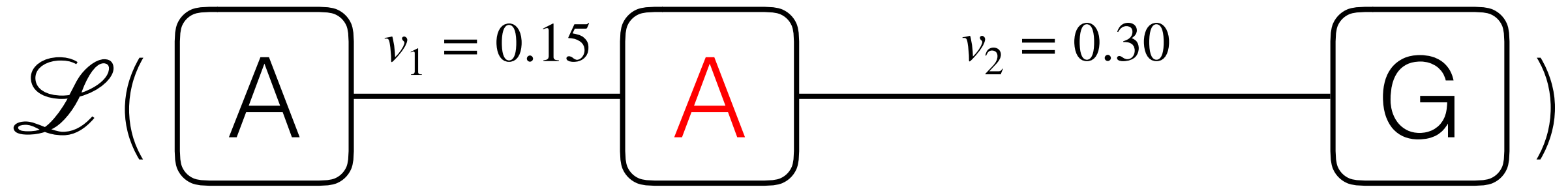


$P_{AA}(0.15)$

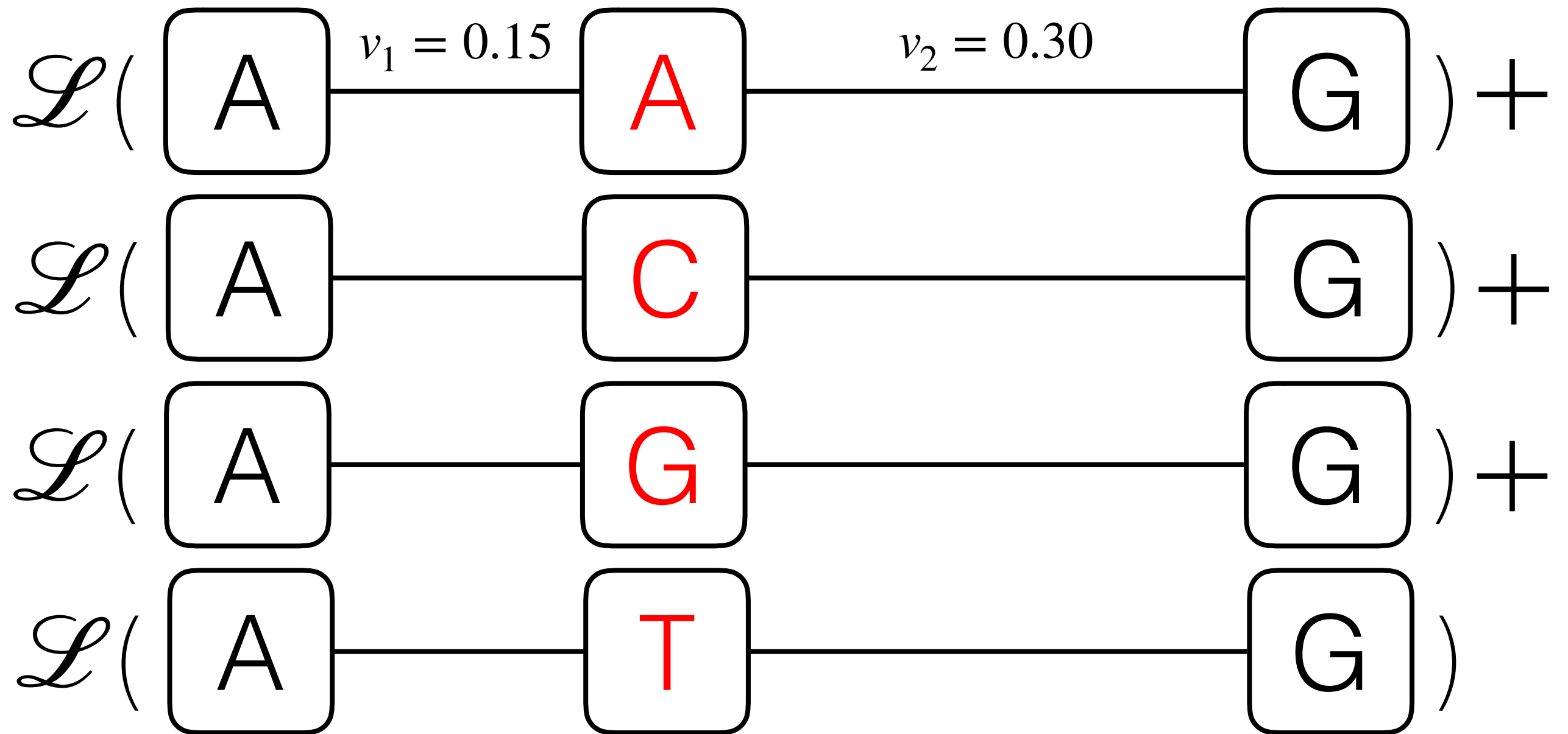
$P_{AG}(0.30)$



Probability of starting with an A and ending
with a G on a branch of length 0.30.

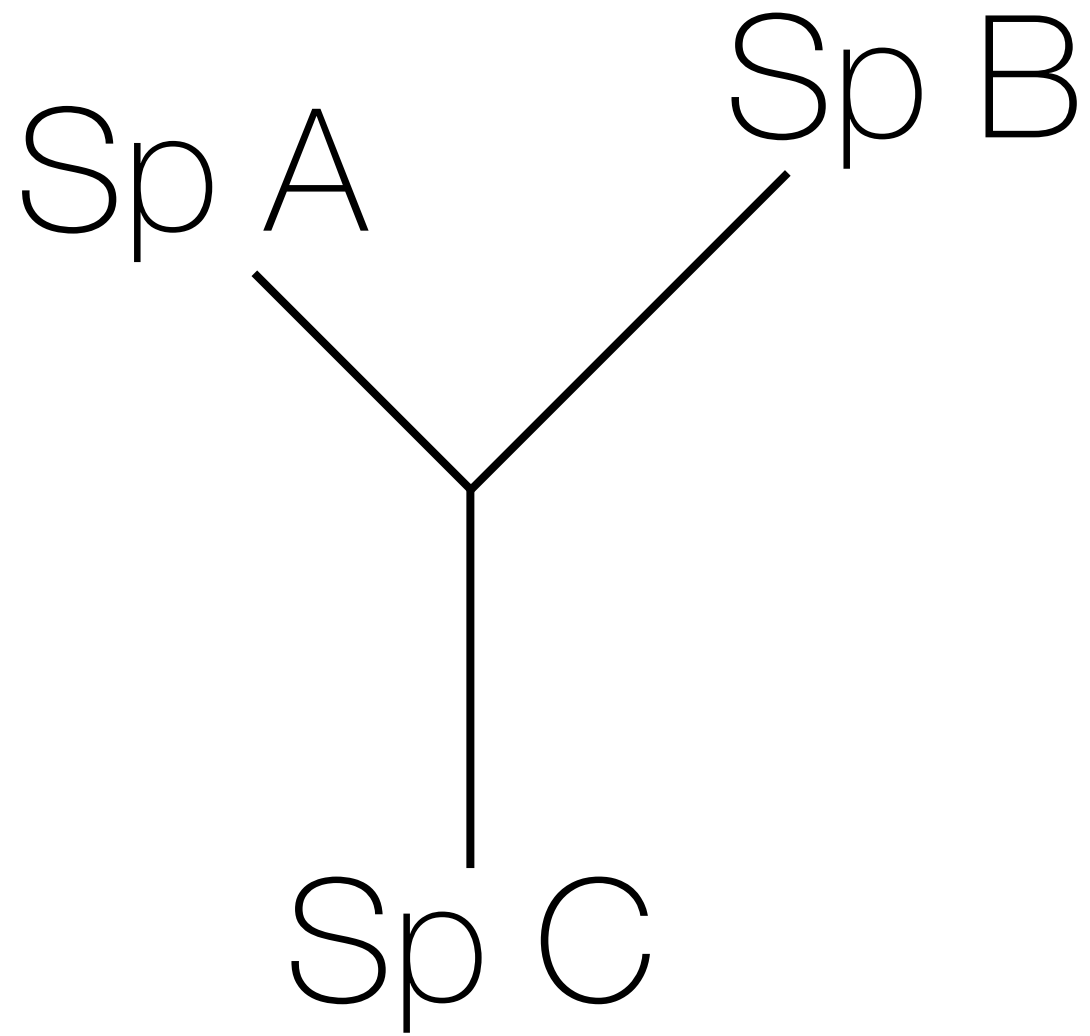


$$P_{AA}(0.15) * P_{AG}(0.30)$$



$$\begin{aligned}
 & \left(P_{AA}(0.15) \right) * P_{AG}(0.30) + \\
 & \left(P_{AC}(0.15) \right) * P_{CG}(0.30) + \\
 & \left(P_{AG}(0.15) \right) * P_{GG}(0.30) + \\
 & \left(P_{AT}(0.15) \right) * P_{TG}(0.30)
 \end{aligned}$$

Three-Taxon Unrooted Tree



Three-Taxon Unrooted Tree

