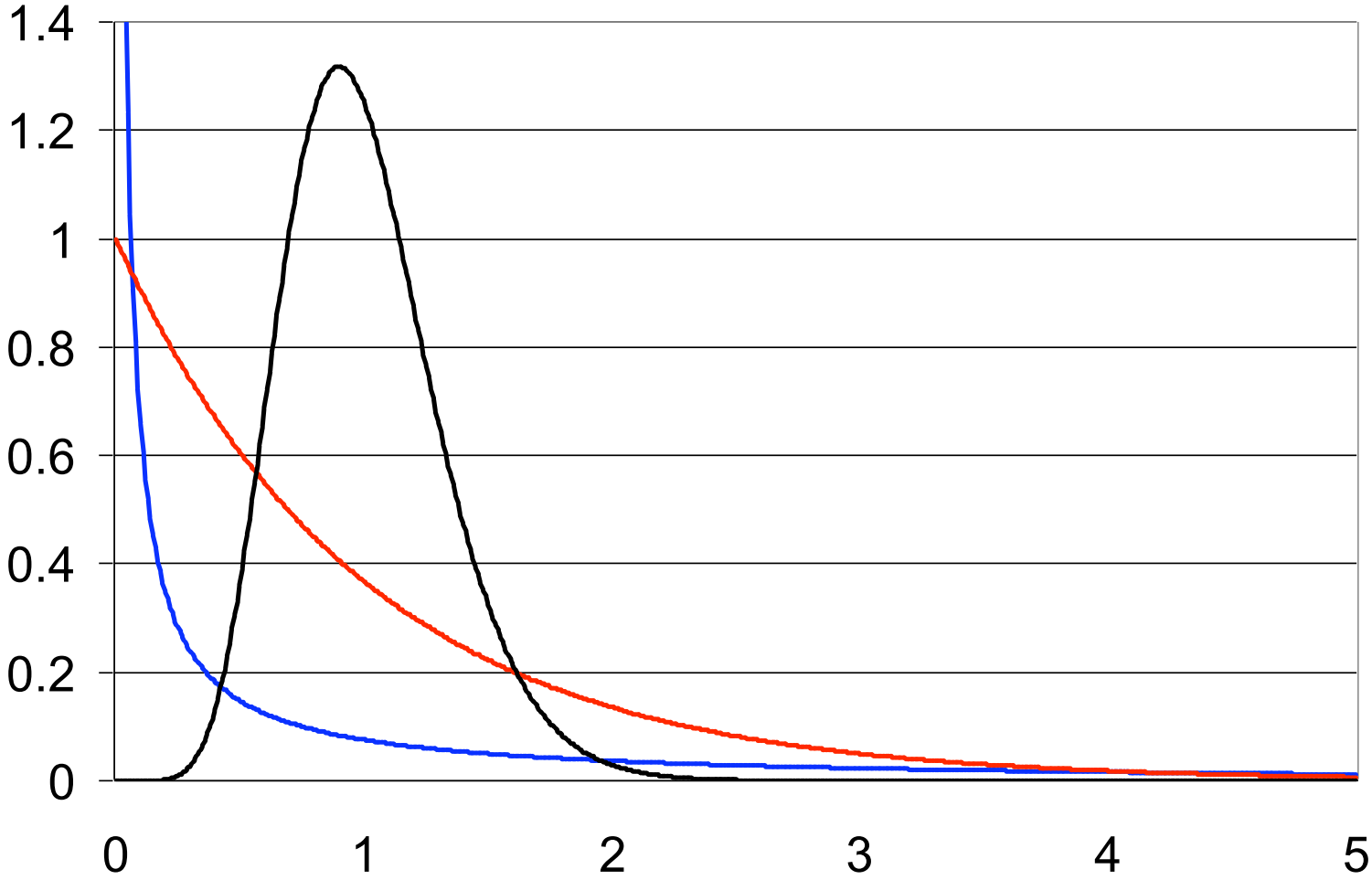
Discrete Gamma (G) model

mixture model formula

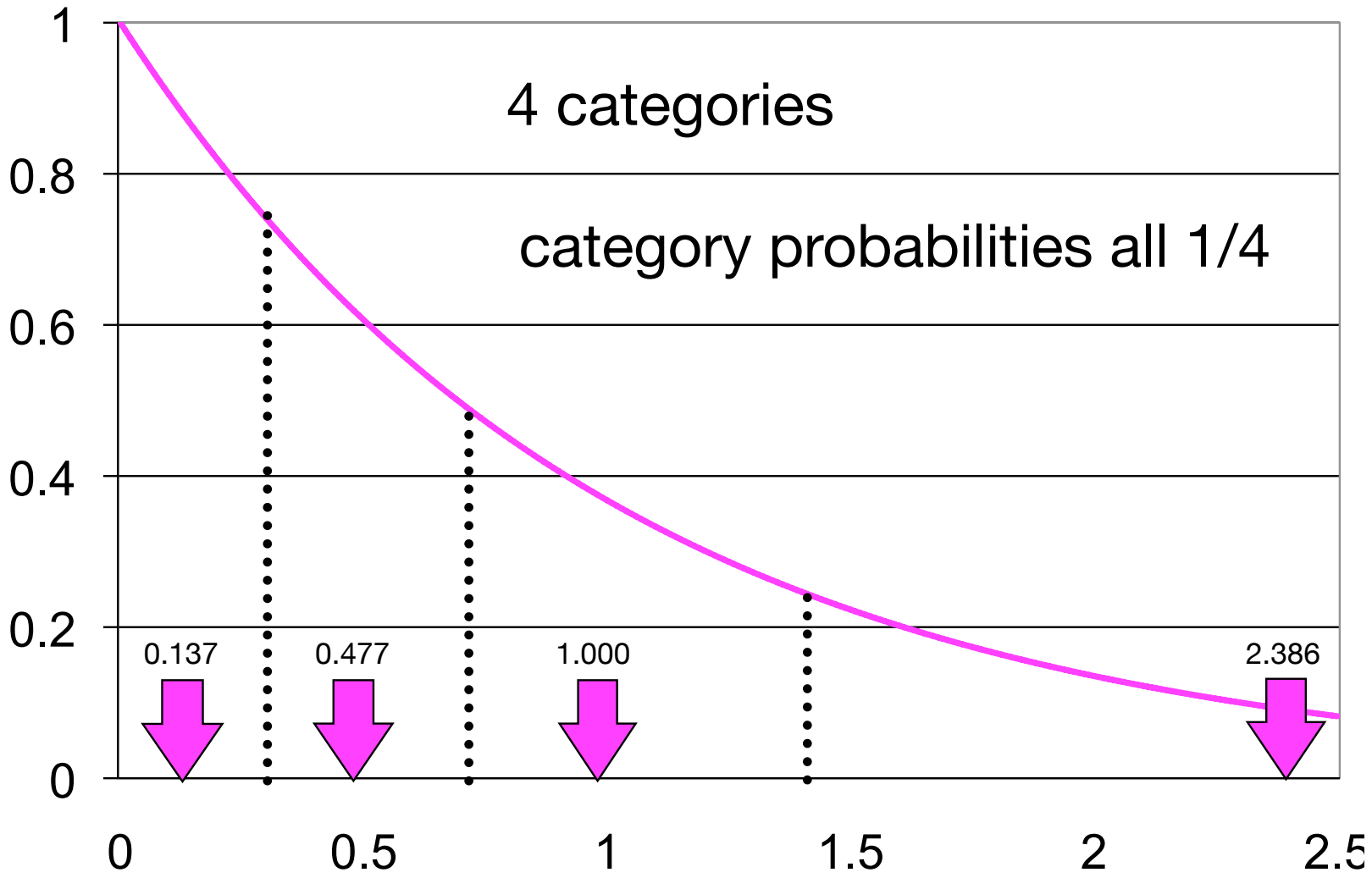
Yang (1993, 1994)

Gamma distributions



mean = 1 axis labels shape = 1/variance

Discrete Gamma (+G)

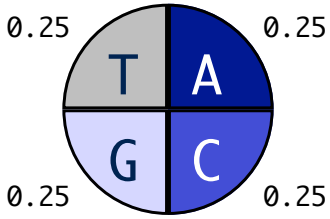


Free rates (+R)

category	relative rates	category probabilities
1	r_1	p_1
2	r_2	p_2
3	r_3	p_3
4	r_4	p_4

$$p_1 + p_2 + p_3 + p_4 = 1$$

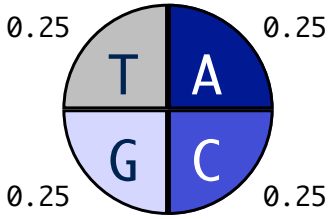
$$p_1 r_1 + p_2 r_2 + p_3 r_3 + p_4 r_4 = 1$$

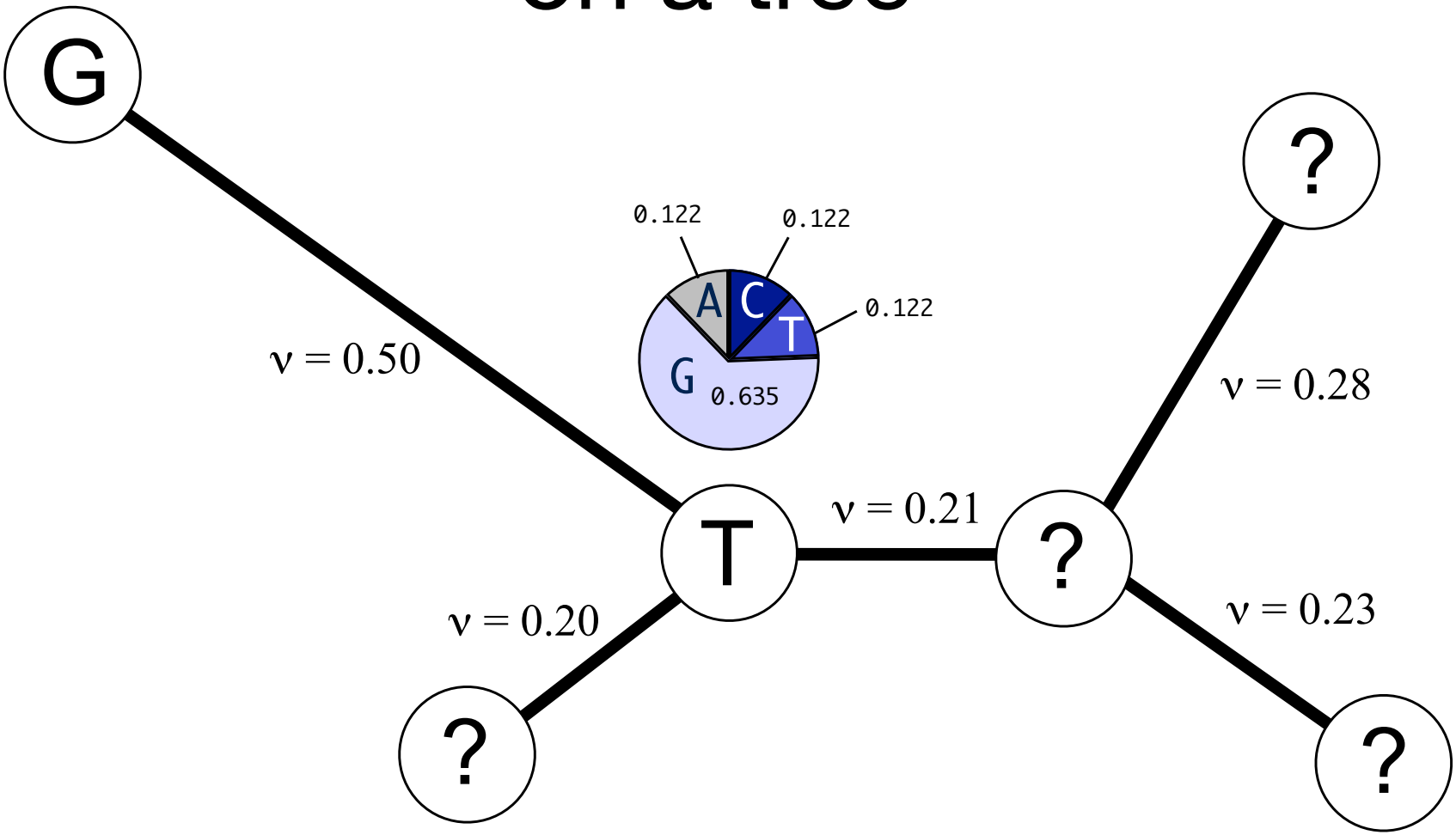


Simulating a site on a tree

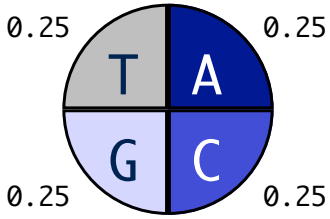
simulate 1 site on tree assuming kappa = 4

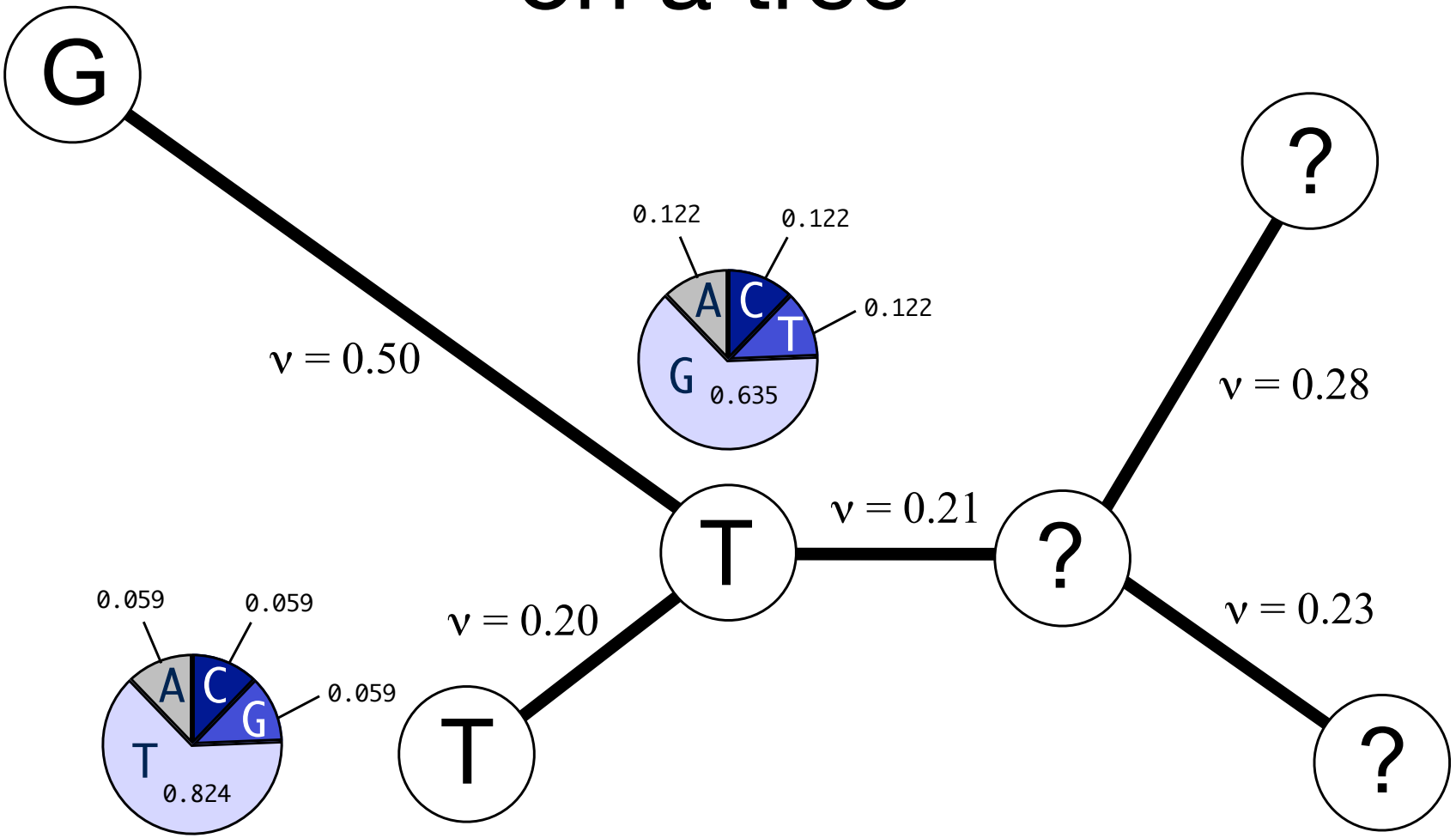
Simulating a site on a tree



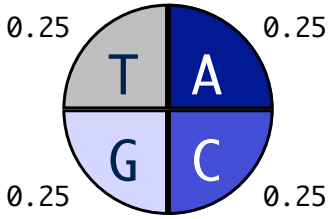


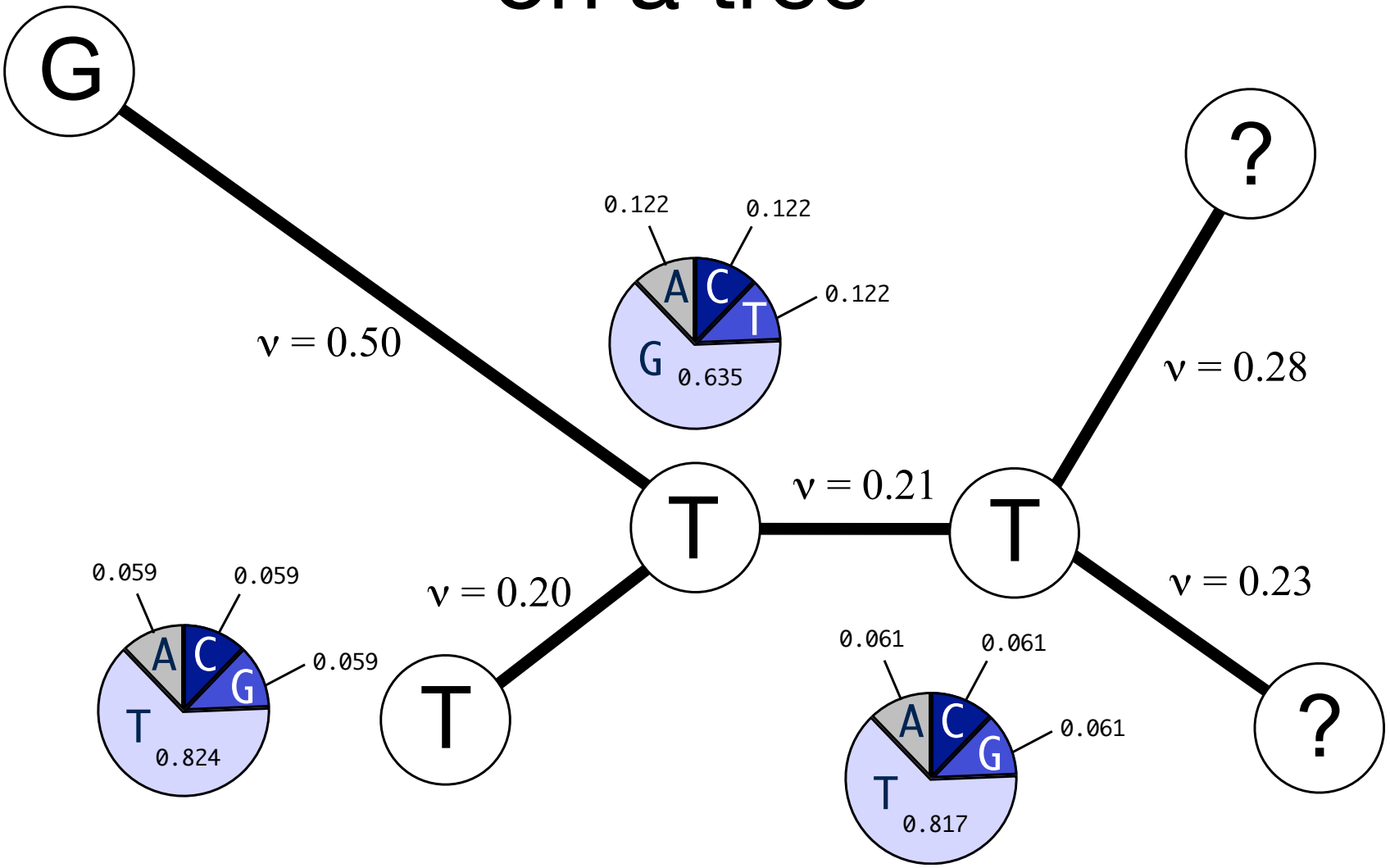
Simulating a site on a tree



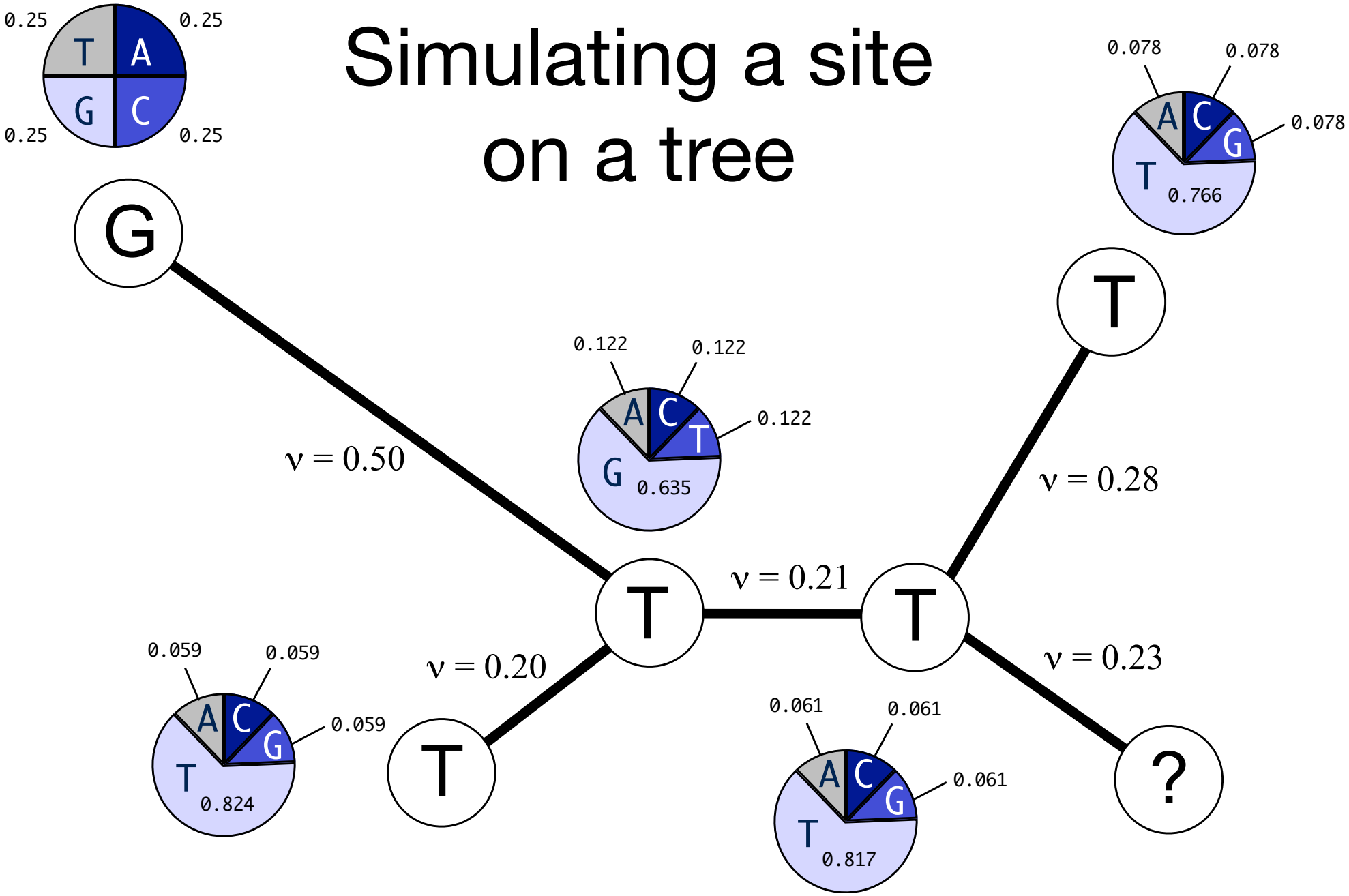


Simulating a site on a tree

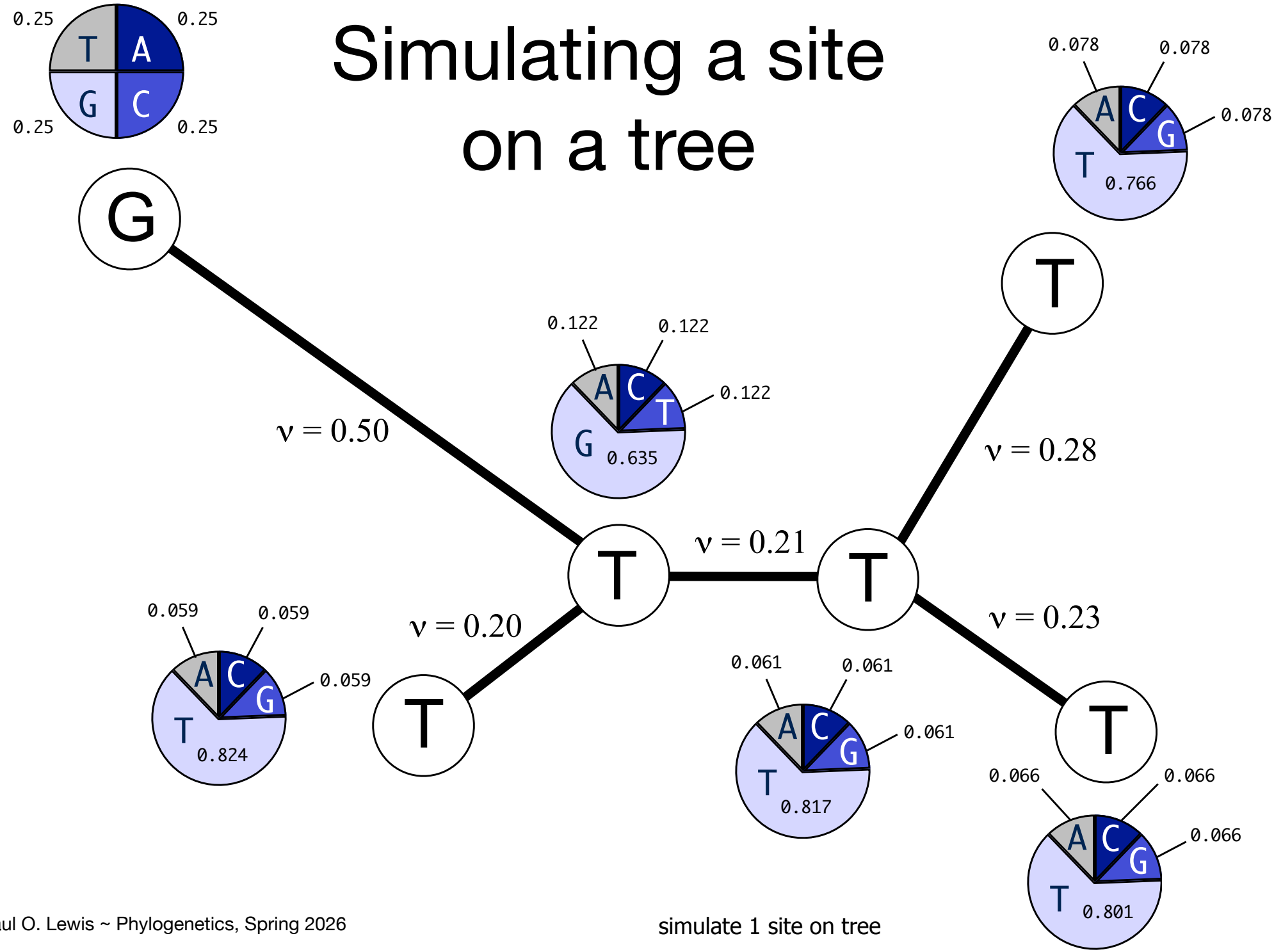




Simulating a site on a tree

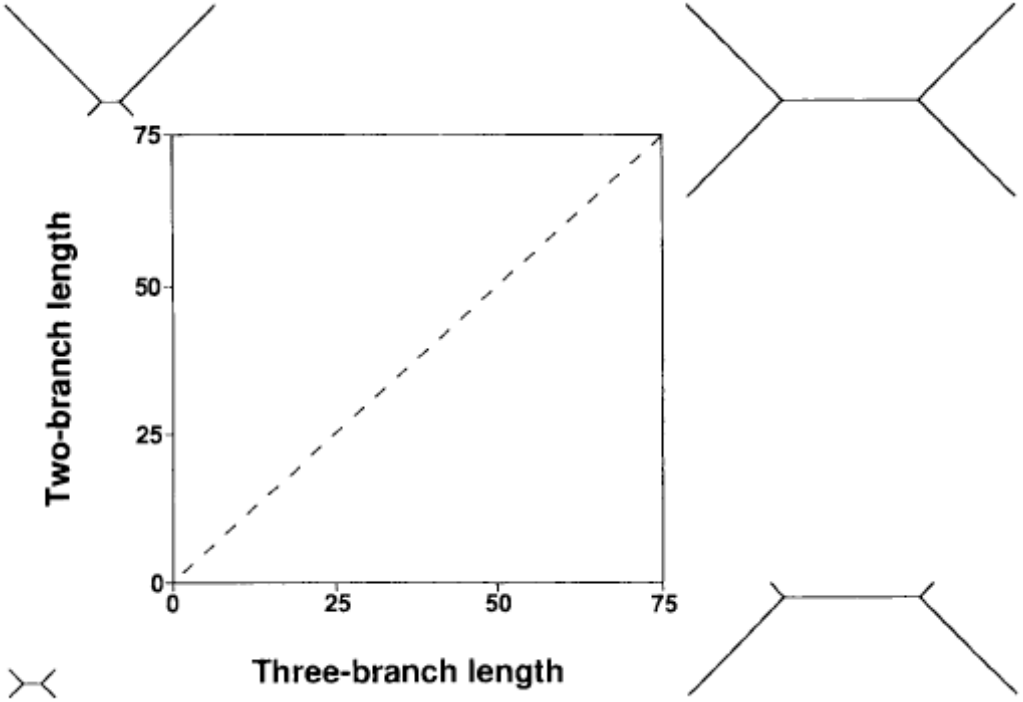


Simulating a site on a tree



simulate 1 site on tree

Uses of simulation in phylogenetics



Felsenstein (1978), Huelsenbeck & Hillis (1993)

Systematic Biology
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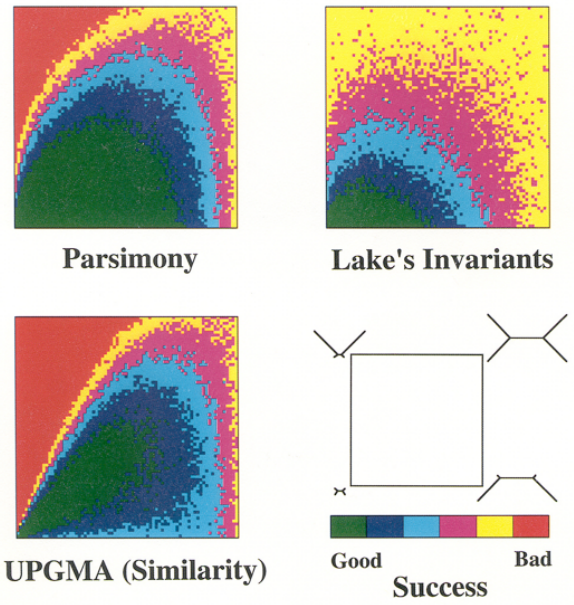

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Success of Maximum Likelihood Phylogeny Inference in the Four-Taxon Case

Brandon S. Gaut and Paul O. Lewis
Program in Statistical Genetics, Department of Statistics, North Carolina State University

Gaut & Lewis (1995)

Uses of simulation in phylogenetics

https://imgur.com/gallery/eH0aCzk

megabat

https://www.milkwood.net/2015/09/21/how-to-build-a-microbat-box/

microbat

one or two origins of bats?

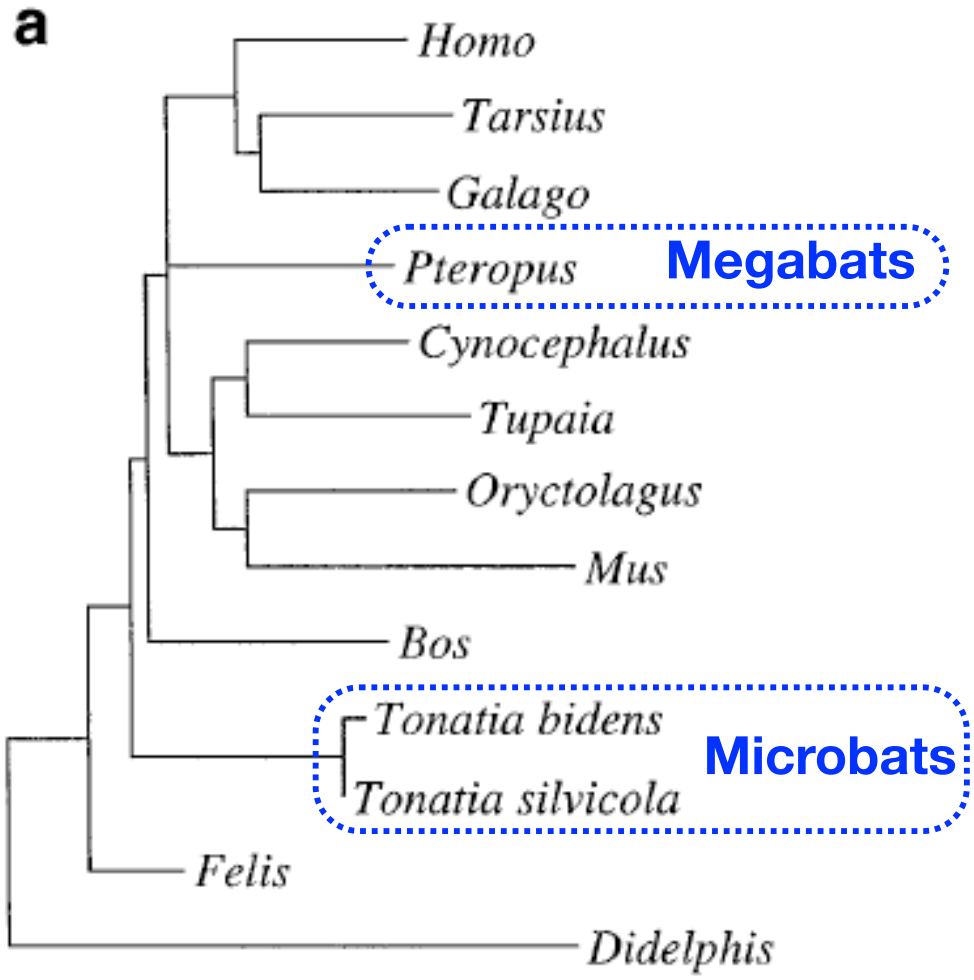
Bat monophyly test: background

- Most phylogenetic studies concluded bats monophyletic (microbats and megabats together)
- Pettigrew argued megabats related instead to primates (megabats were “flying primates”)
- Pettigrew: apparent monophyly is an artifact: high AT composition of all bats leads to “base compositional attraction”
- Test by simulating data under null (flying primate) hypothesis (assuming strong AT bias in bat lineages) and see how often bat monophyly occurs in phylogenetic analyses

Pettigrew (1991)

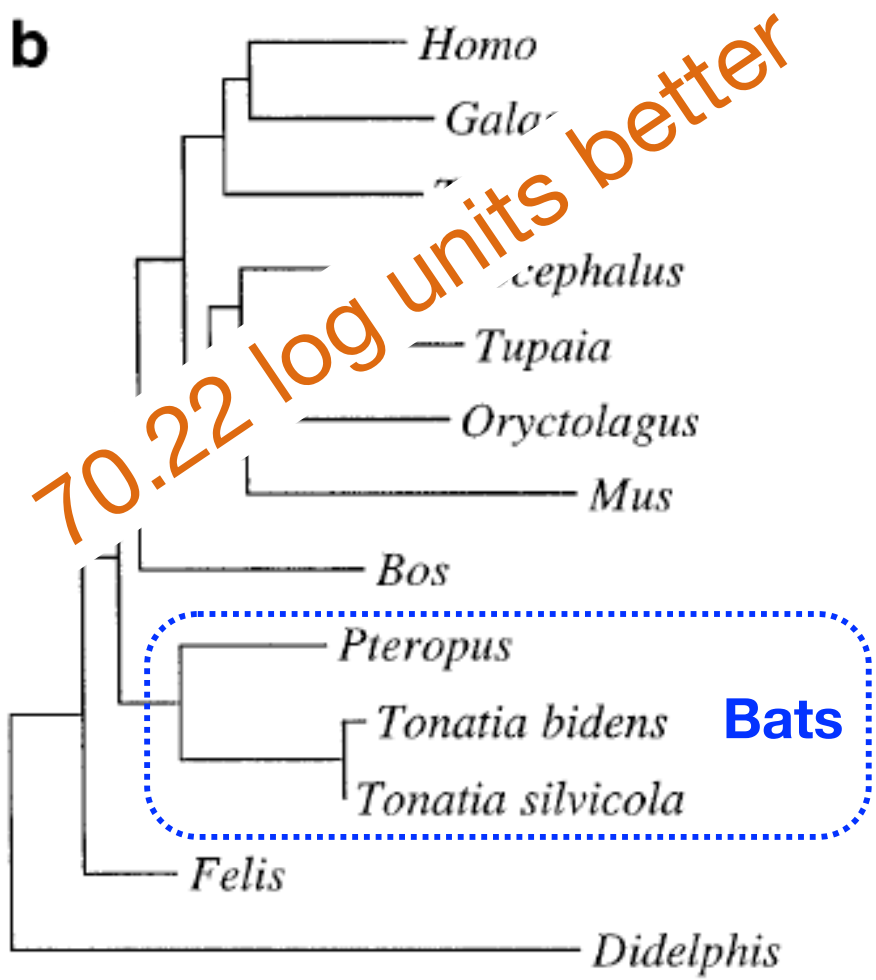
Bat monophyly example

Null hypothesis



Constrained (log L = –6316.83)

Alternative hypothesis (ML tree)

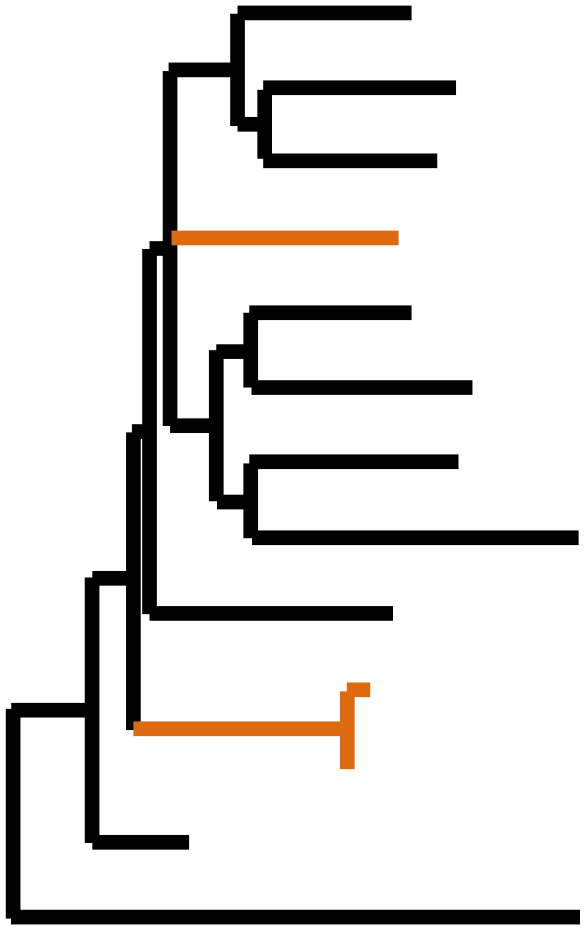


70.22 log units better

Unconstrained (log L = –6246.61)

Van Den Bussche et al. (1998)

Simulating base-compositional attraction attraction



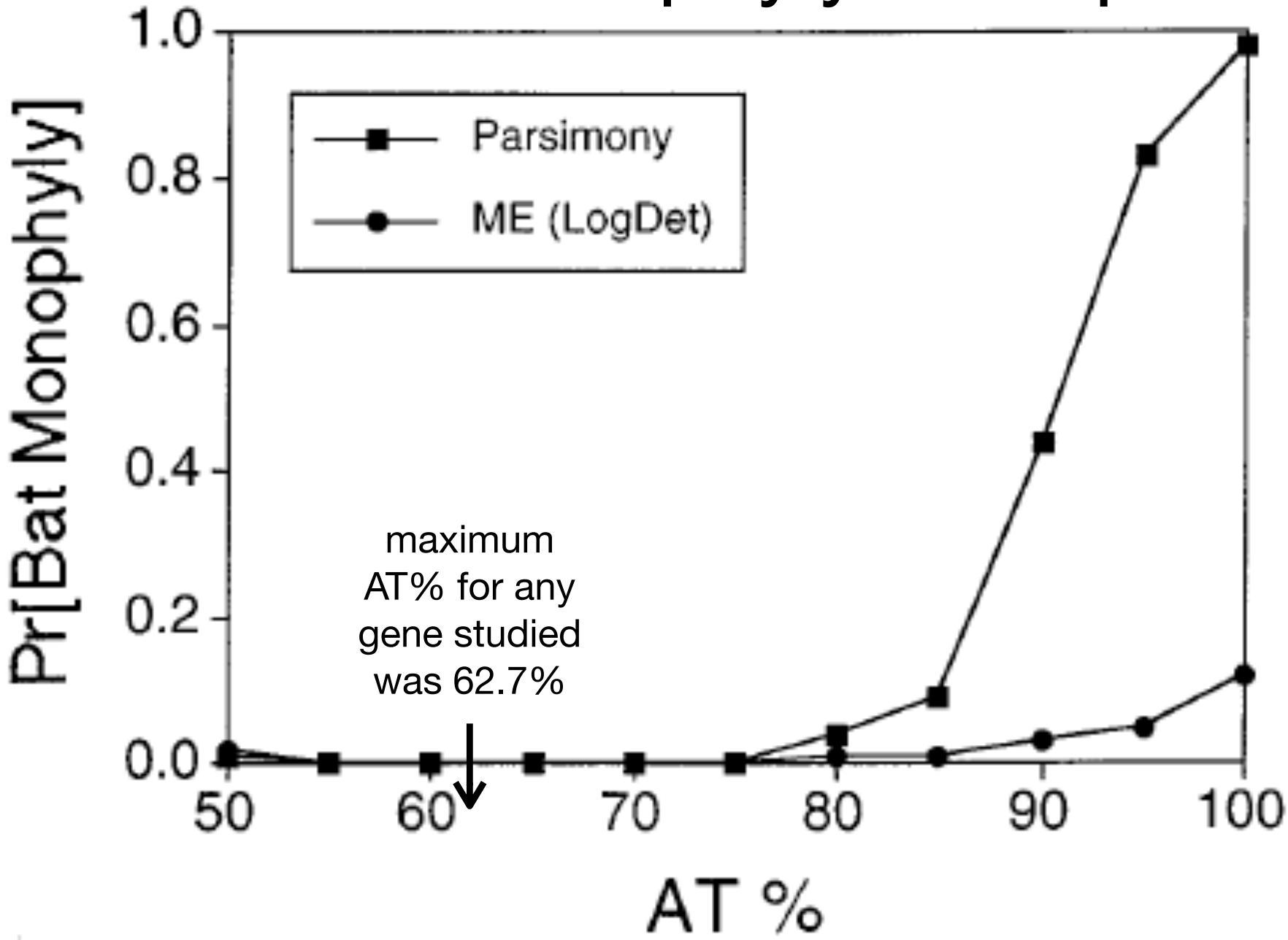
JC69 model applies to **black** lineages only

F81 model applies to **orange** lineages only

$$\pi_A = \pi_T = 0.4$$

$$\pi_C = \pi_G = 0.1$$

Bat monophyly example



Van Den Bussche et al. (1998)