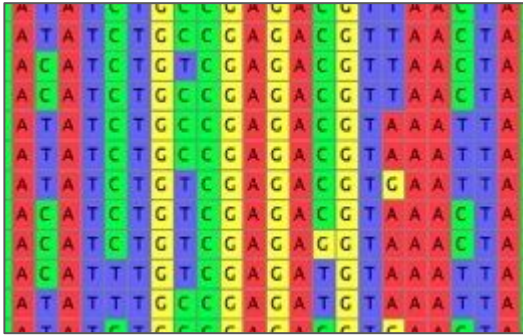


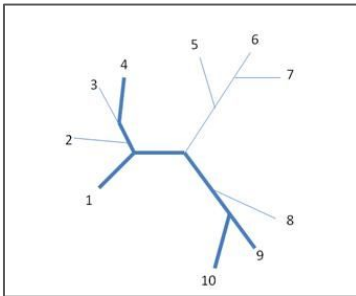
Tree Building and Conflict Analysis

Tree Building

Supermatrix

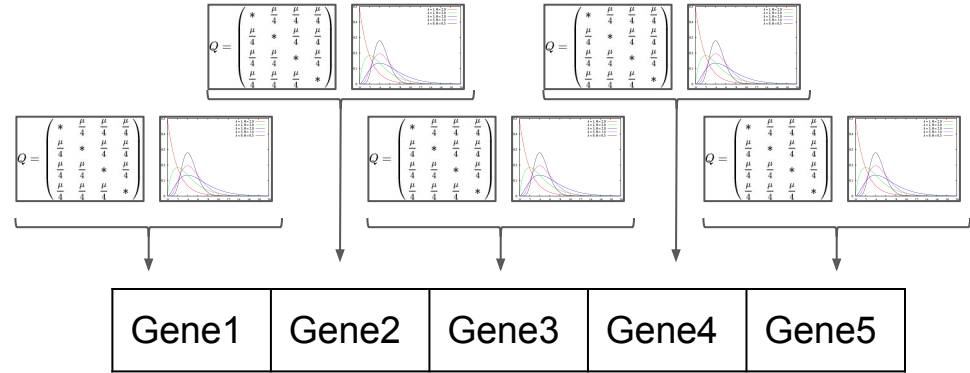
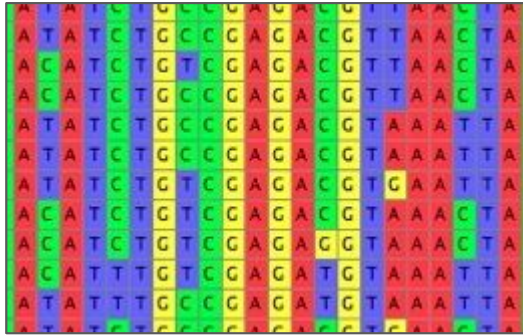


Maximum Quartet Support

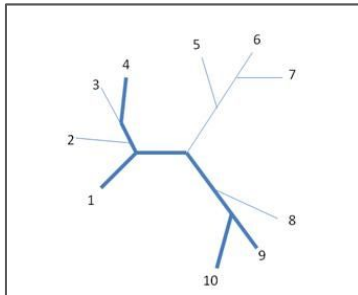


Estimate a model of evolution for each gene

Supermatrix

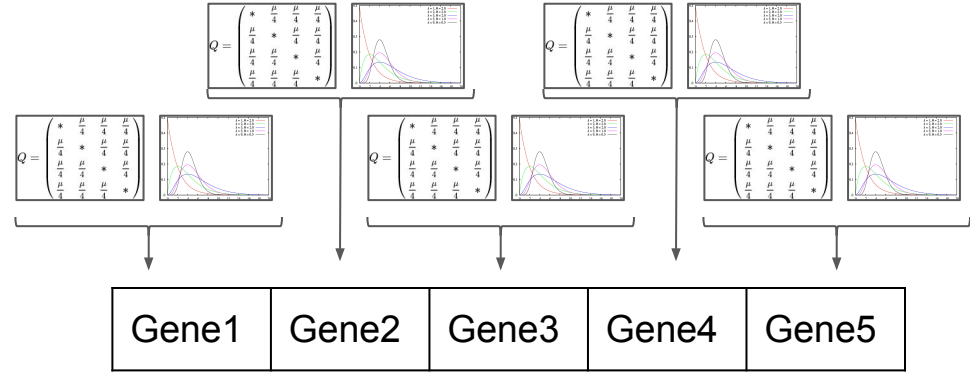
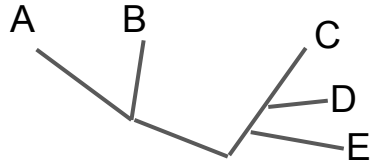


Maximum Quartet Support

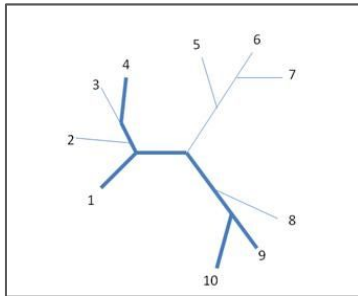


Calculate likelihood on a tree

Supermatrix

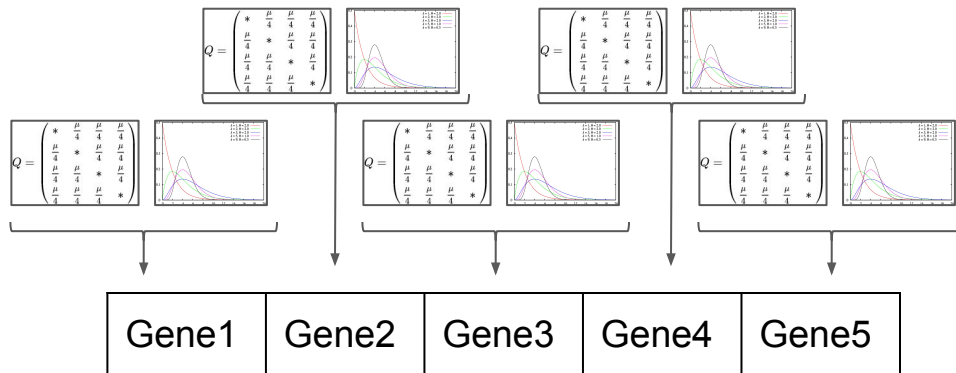
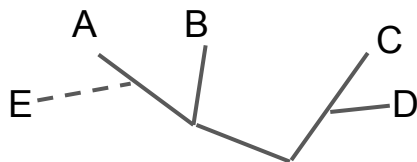


Maximum Quartet Support

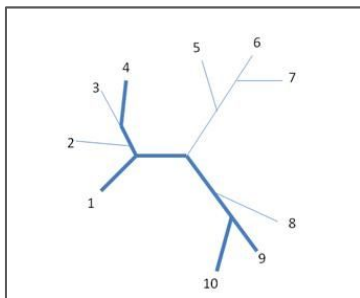


Rearrange the tree and calculate again

Supermatrix

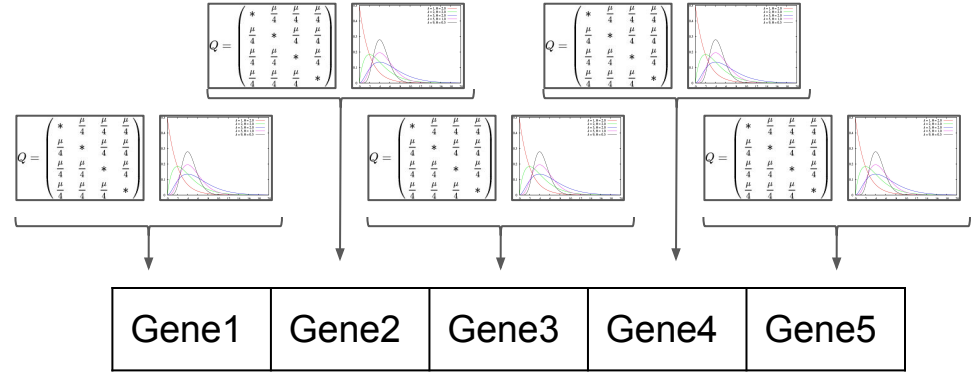
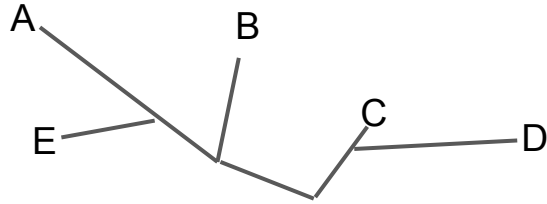


Maximum Quartet Support

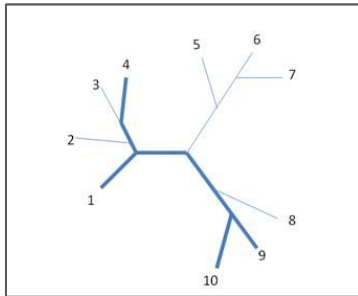


Once the ML is found adjust branch lengths

Supermatrix

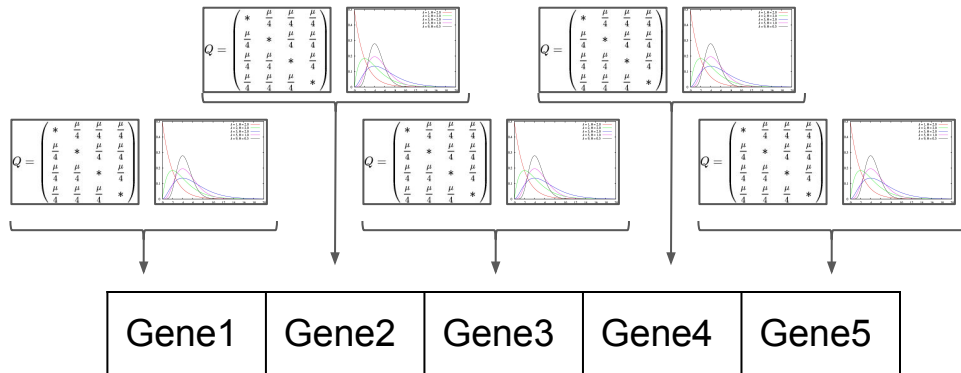
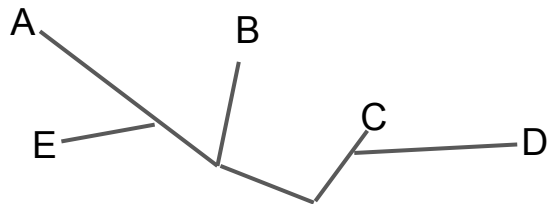


Maximum Quartet Support

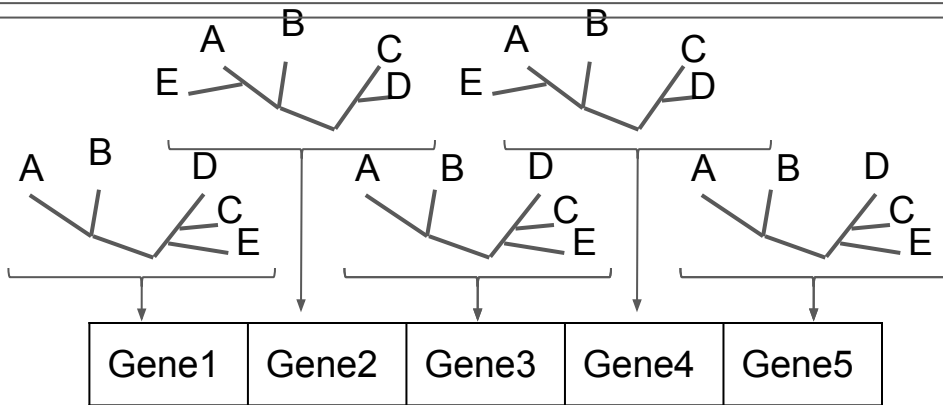
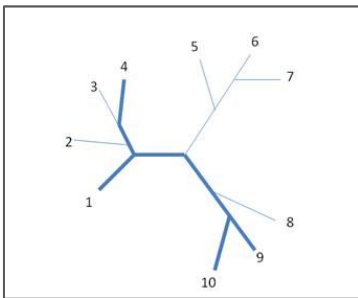


Maximum Quartet Support Species Tree

Supermatrix

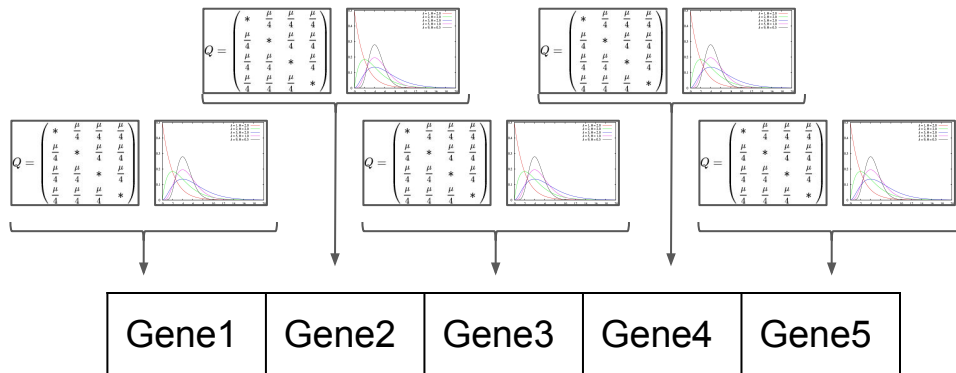
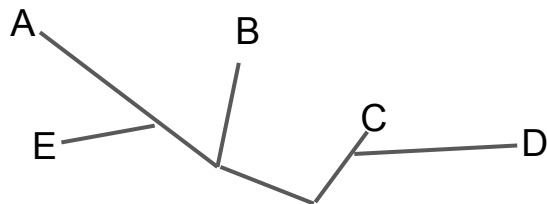


Maximum Quartet Support

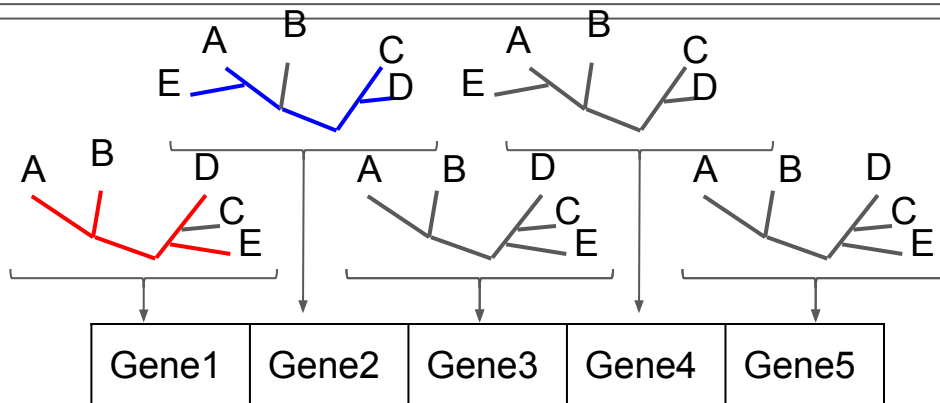
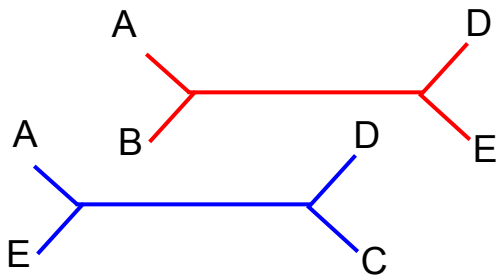


Take estimated gene trees and make quartets

Supermatrix

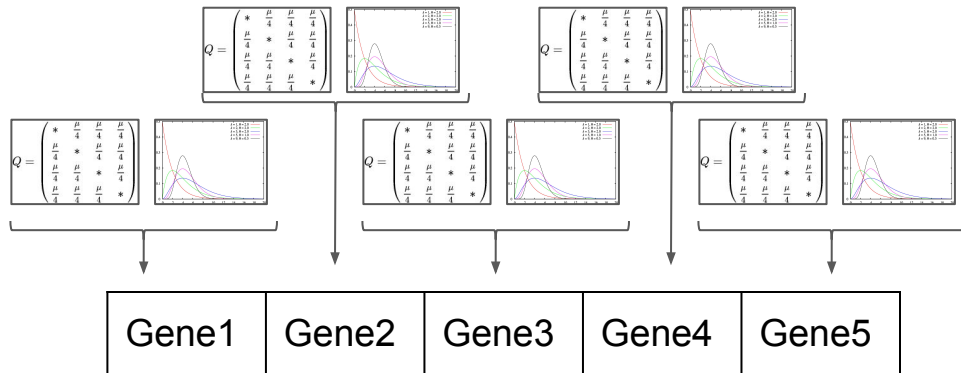
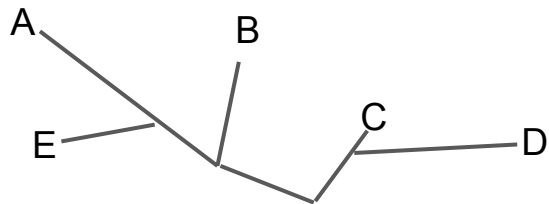


Maximum Quartet Support

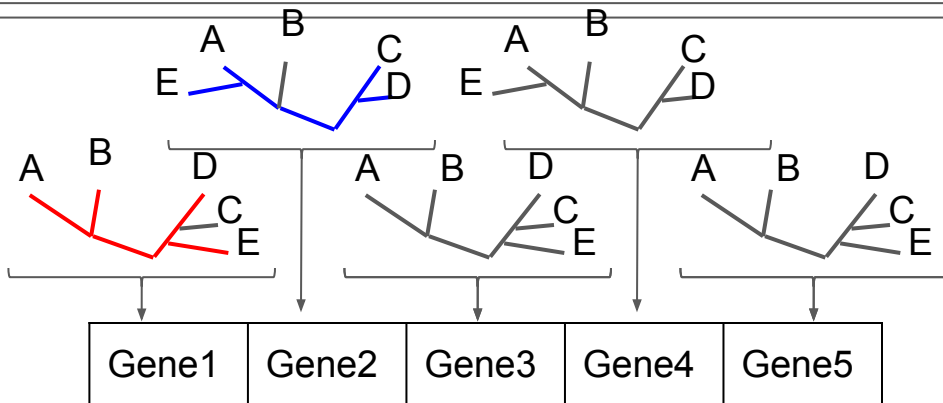
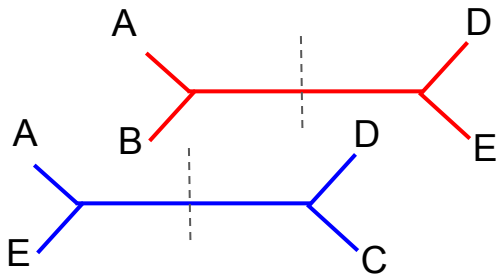


Find relationship supported by most quartets

Supermatrix

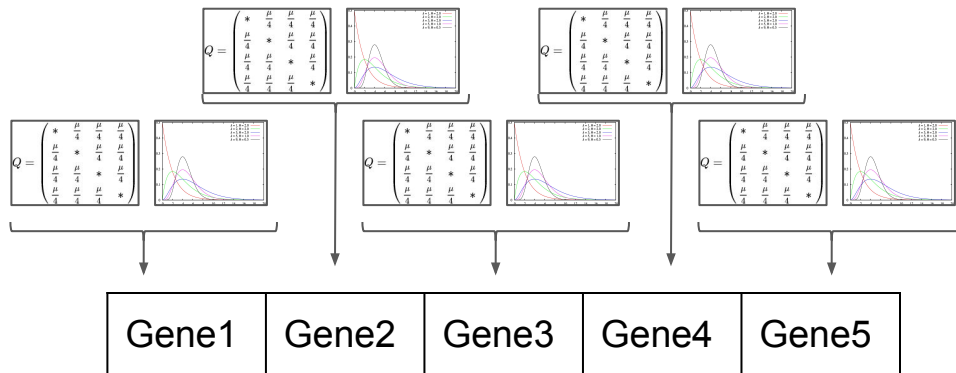
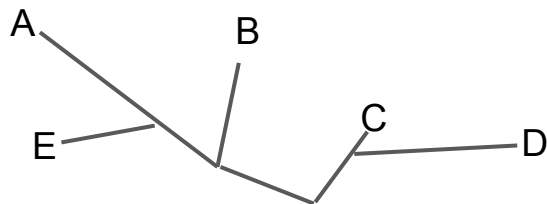


Maximum Quartet Support

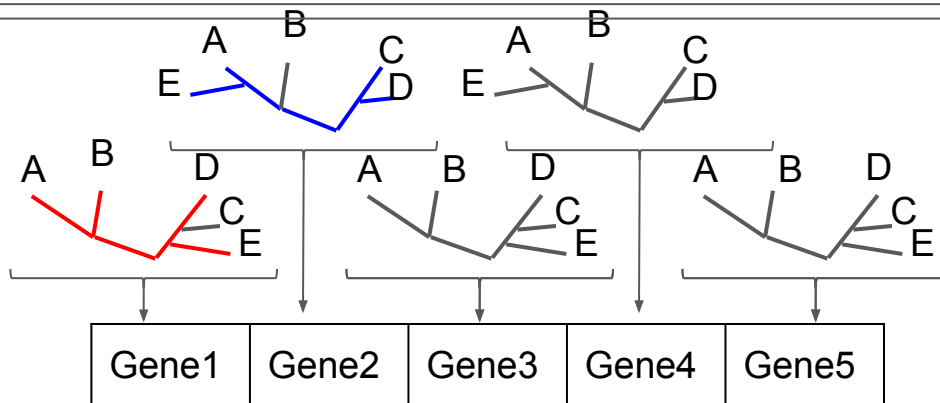
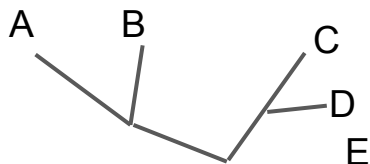


Build tree from that

Supermatrix

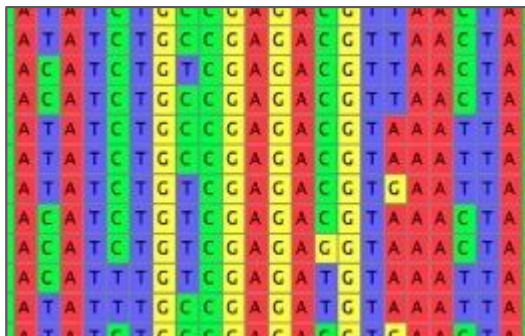


Maximum Quartet Support



Tree Building

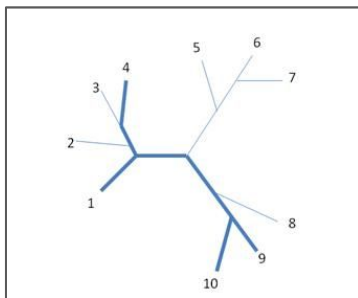
Supermatrix



Assumptions

No conflict among genes
Same rate of molecular evolution among genes
Speciation is bifurcating
A lot more...

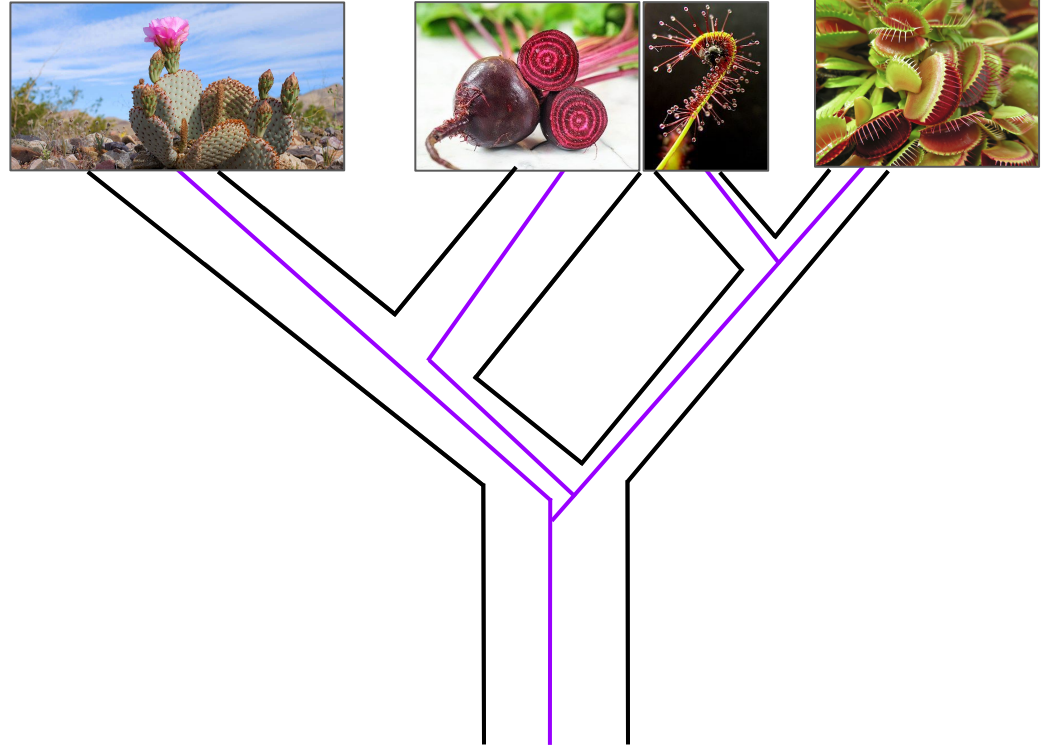
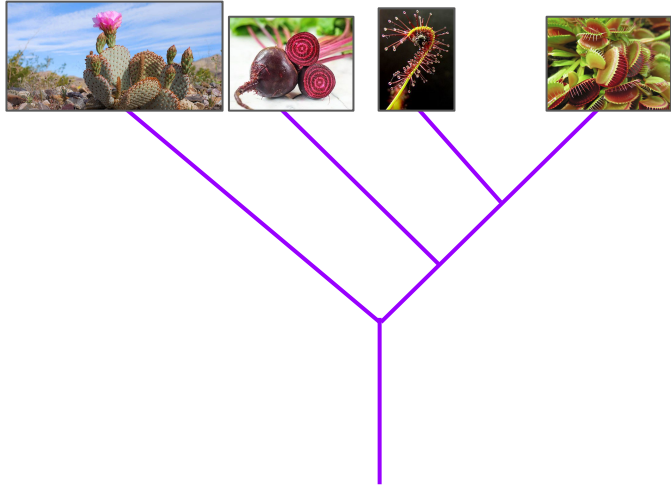
Maximum Quartet Support



Assumptions

Most genes contain enough information resolve the species tree
Conflict from ILS only
Constant population size
A lot more...

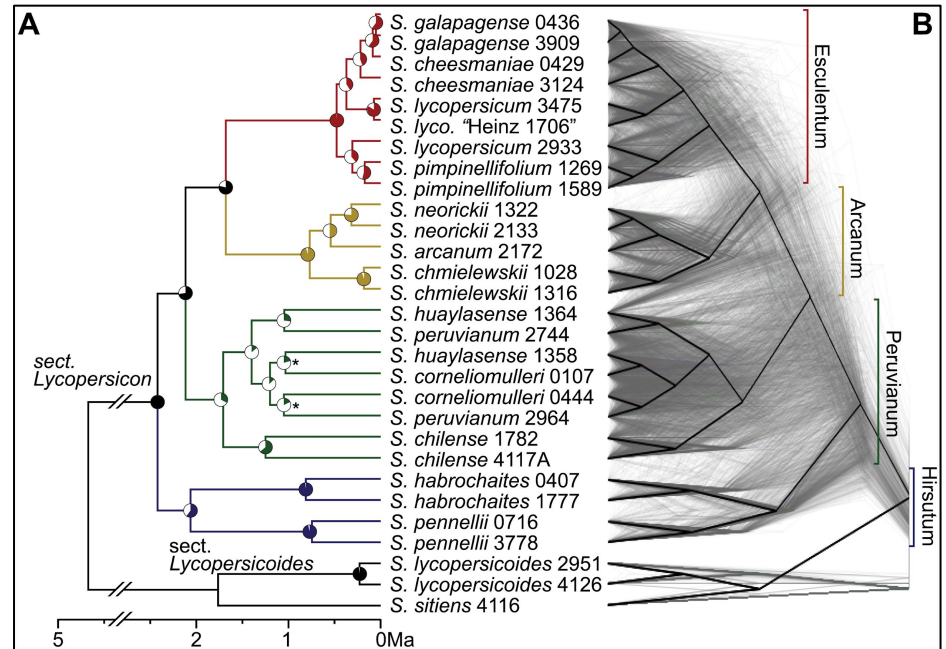
Gene Tree Conflict!



One of the major powers of transcriptomes is identifying gene tree conflict

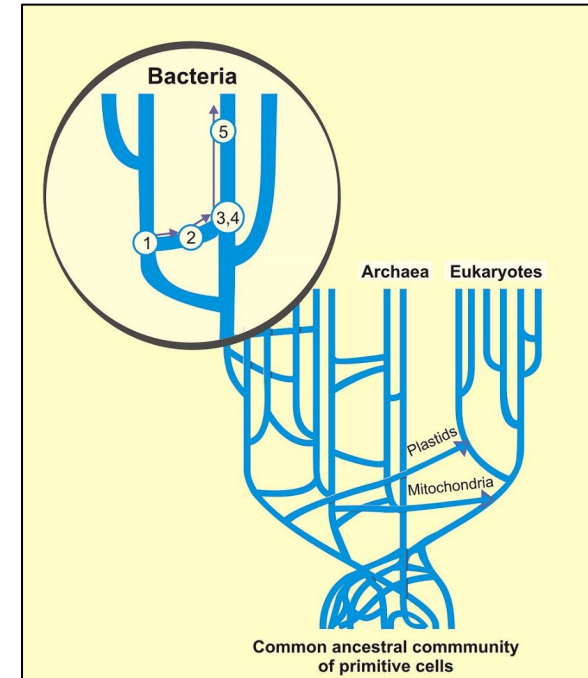
In this workshop we will consider conflict to be when a gene tree topology is different than a species tree

Conflict may seem like an inconvenience, but it is a biological reality providing us with insight into evolution



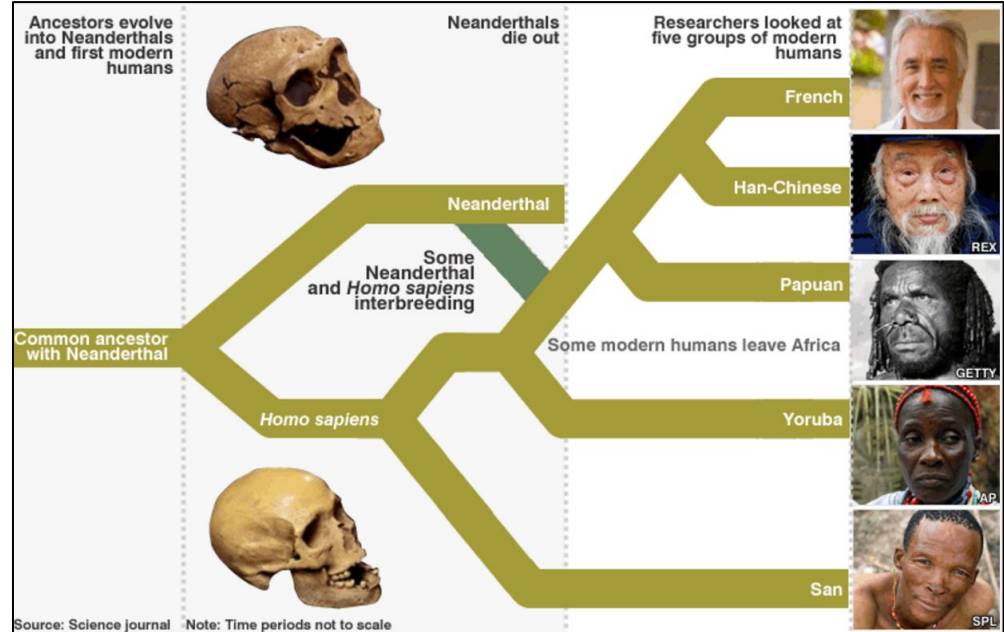
Biological reasons for conflict

➤ Horizontal gene transfer



Biological reasons for conflict

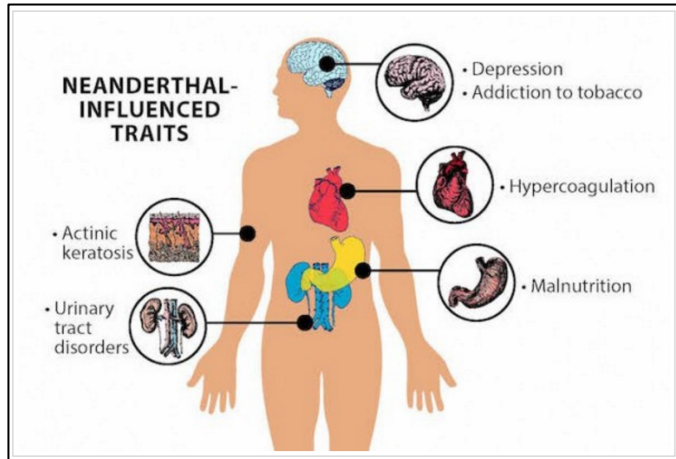
- Horizontal gene transfer
- Introgression



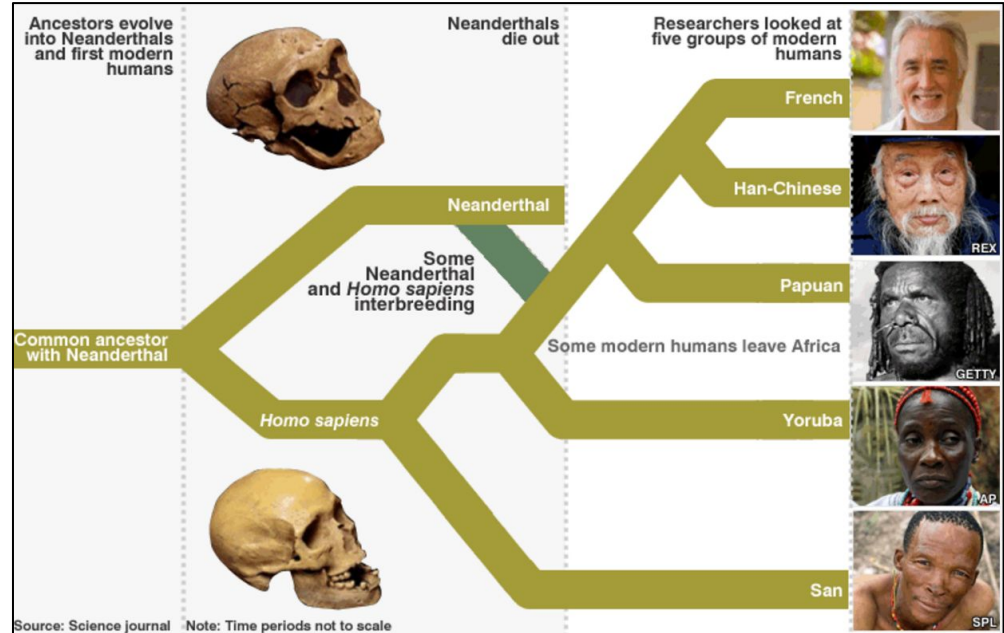
http://news.bbc.co.uk/1/hi/shared/spl/hi/sci_nat/10/neanderthal/img/neanderthals_786.gif

Biological reasons for conflict

- Horizontal gene transfer
- Introgression



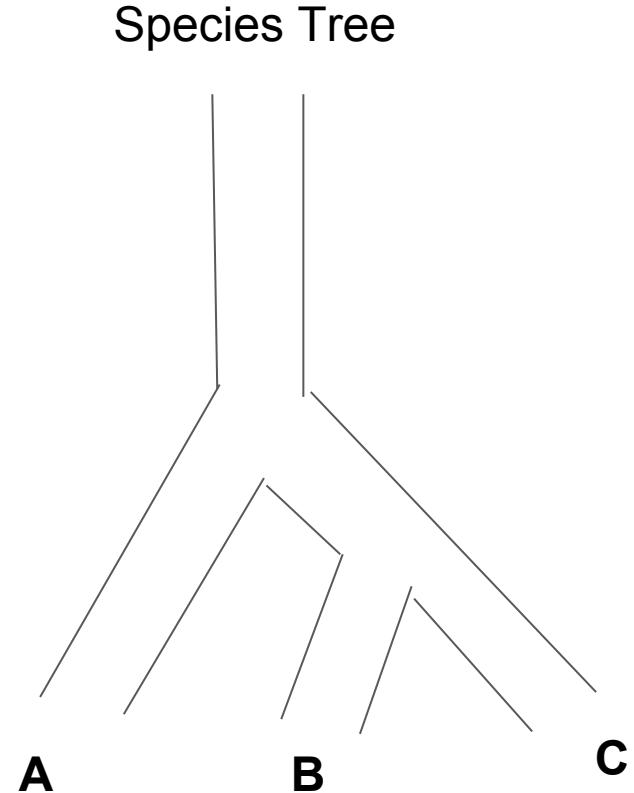
<http://news.vanderbilt.edu/2016/02/neanderthal-dna-has-subtle-but-significant-impact-on-human-traits/>



http://news.bbc.co.uk/1/hi/shared/spl/hi/sci_nat/10/neanderthal/img/neanderthals_786.gif

Biological reasons for conflict

- Horizontal gene transfer
- Introgression
- Incomplete Lineage Sorting (ILS)



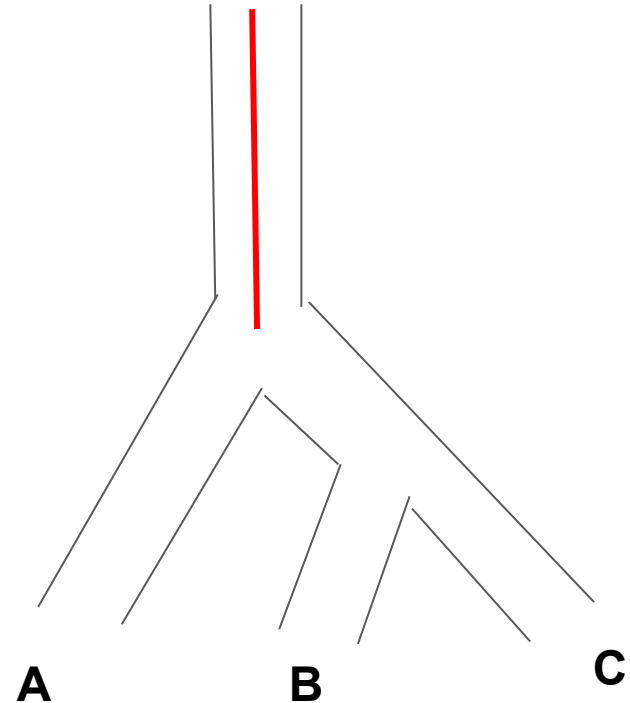
Biological reasons for conflict

- Horizontal gene transfer
- Introgression
- Incomplete Lineage Sorting (ILS)

Concordant Gene



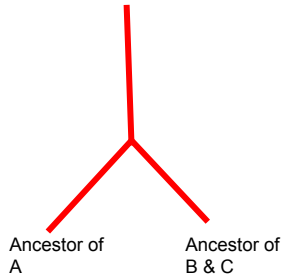
Species Tree



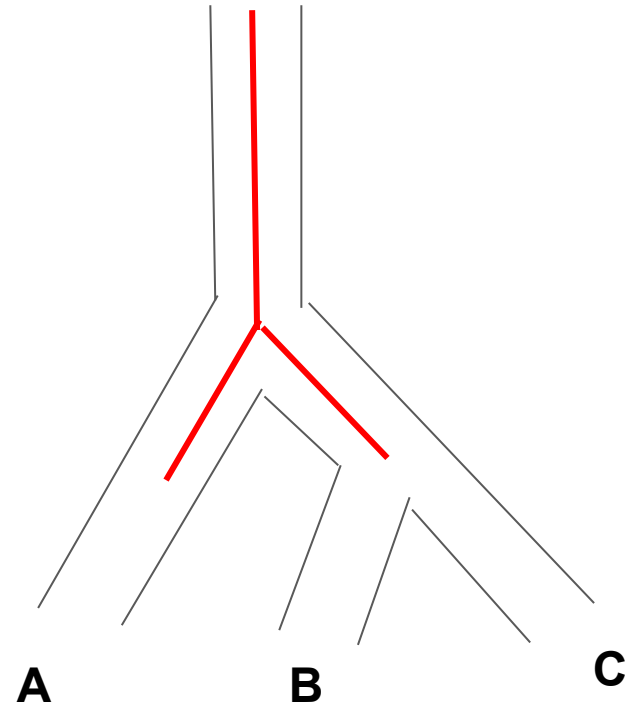
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Concordant Gene



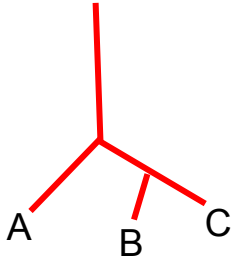
Species Tree



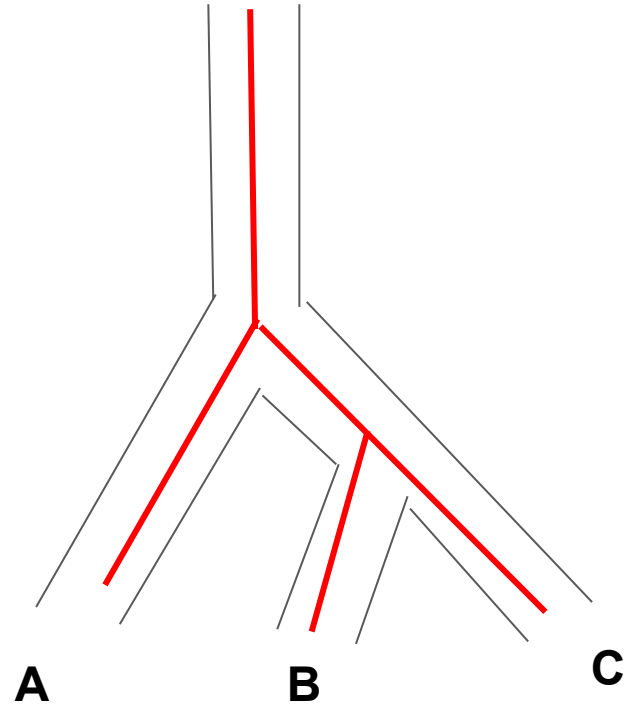
Biological reasons for conflict

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Concordant Gene



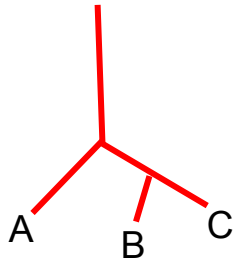
Species Tree



Biological reasons for conflict

- Horizontal gene transfer
- Introgression
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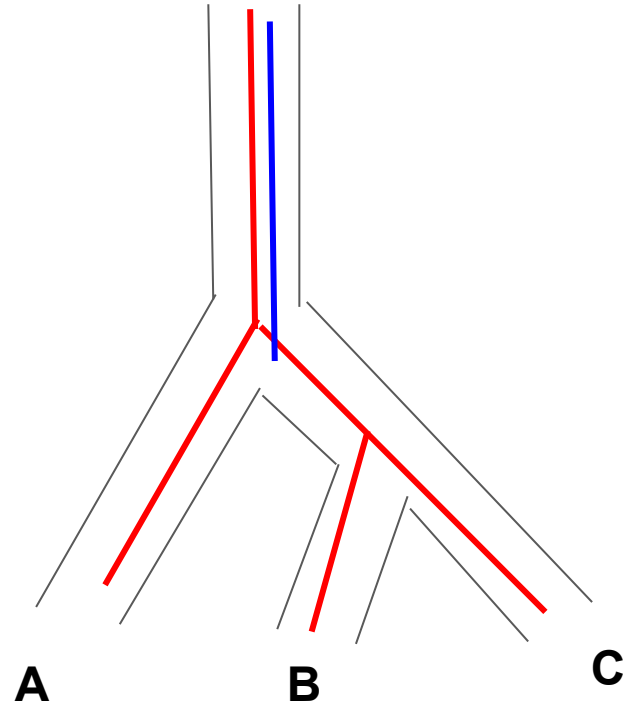
Concordant Gene



Conflicting Gene



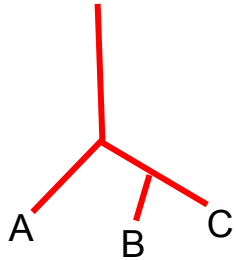
Species Tree



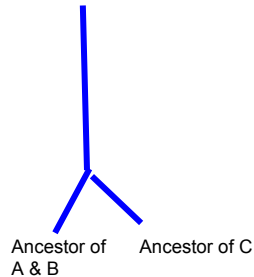
Biological reasons for conflict

- Horizontal gene transfer
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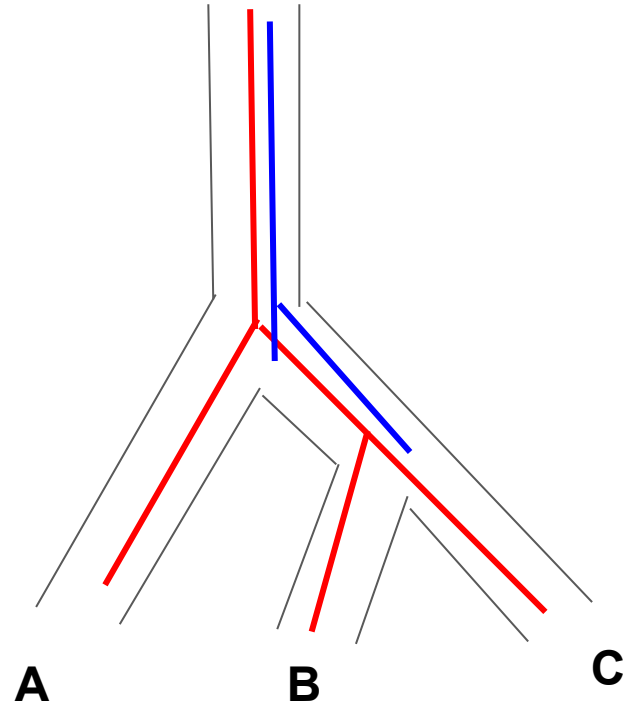
Concordant Gene



Conflicting Gene



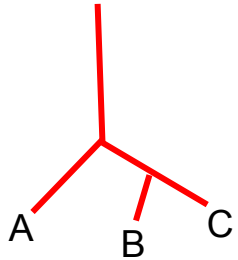
Species Tree



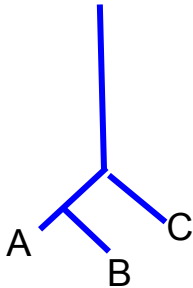
Biological reasons for conflict

- Horizontal gene transfer
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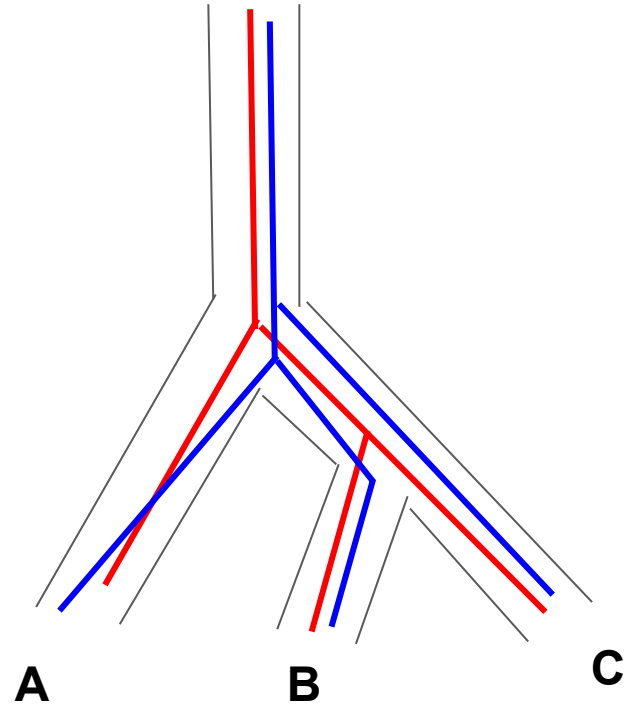
Concordant Gene



Conflicting Gene

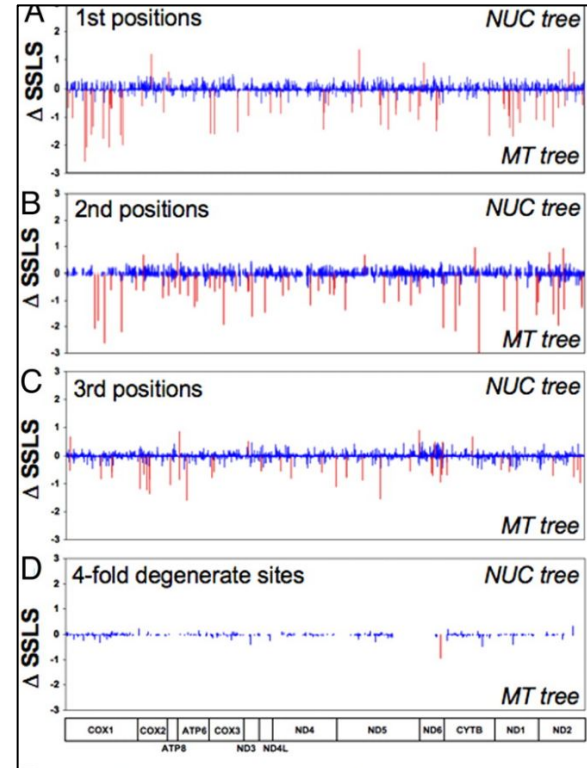


Species Tree



Biological reasons for conflict

- Horizontal gene transfer
- Introgression
- Incomplete Lineage Sorting (ILS)
- Convergence



Biological reasons for conflict

- Horizontal gene transfer
- Introgression
- Incomplete Lineage Sorting (ILS)
- Convergence

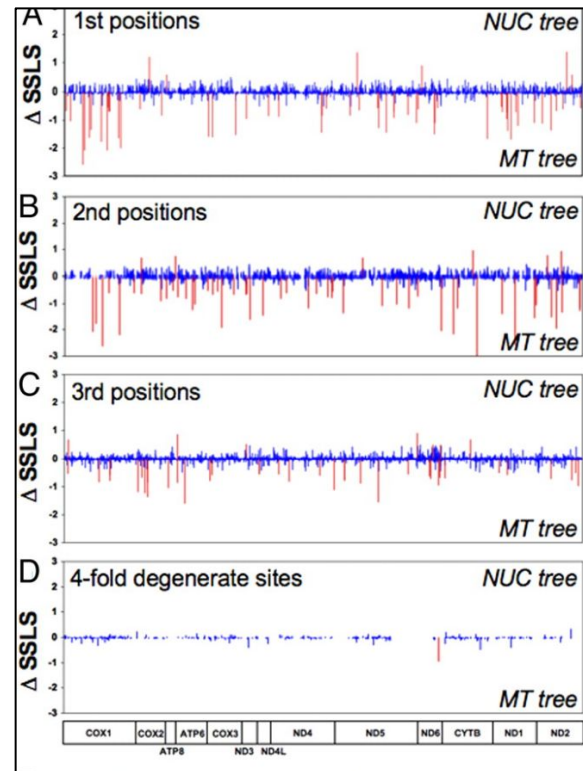
Prestin gene



<https://en.wikipedia.org/wiki/Bat#/media/File:Big-eared-townsend-fledermaus.jpg>

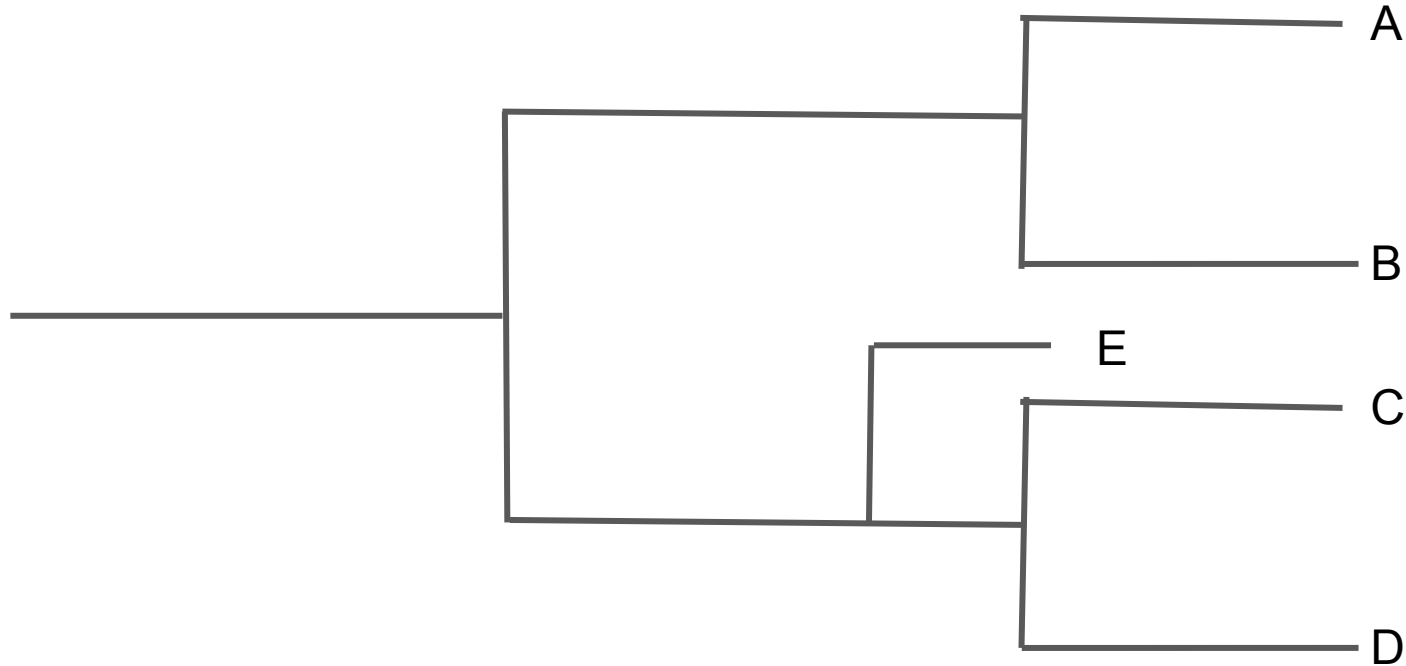


animal-dream.com

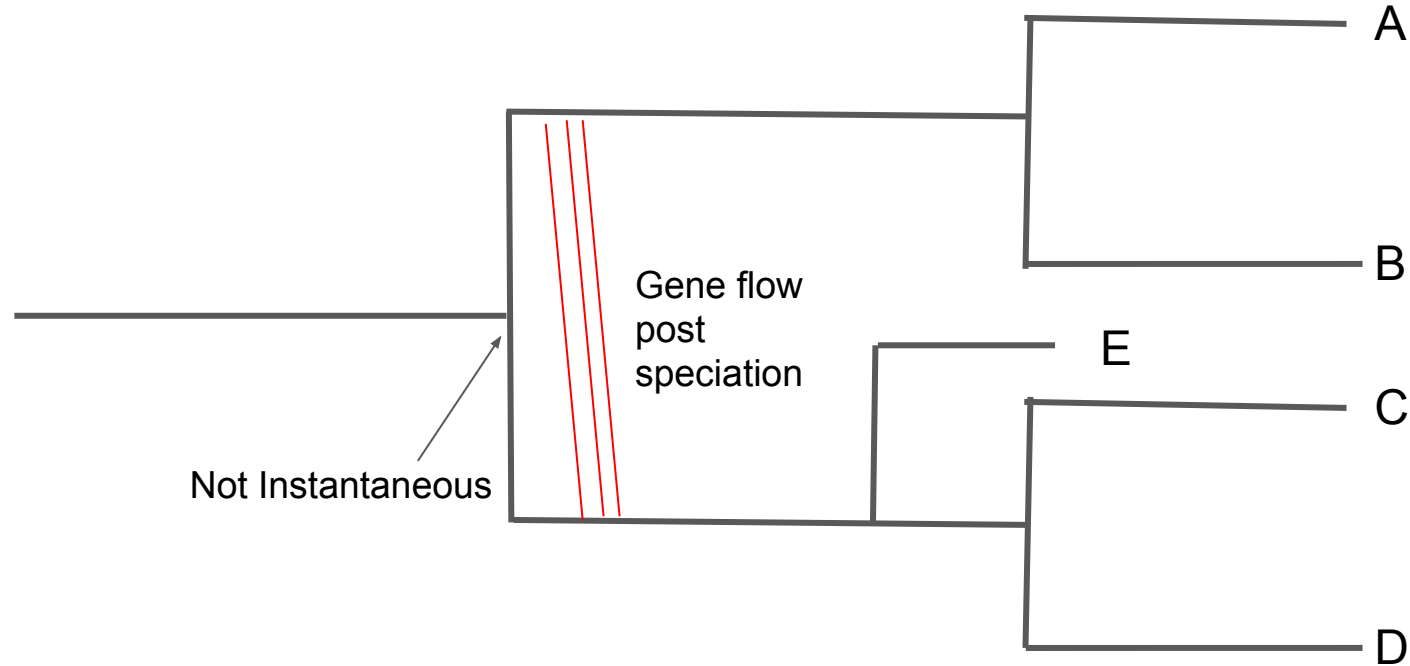


Castoe 2009

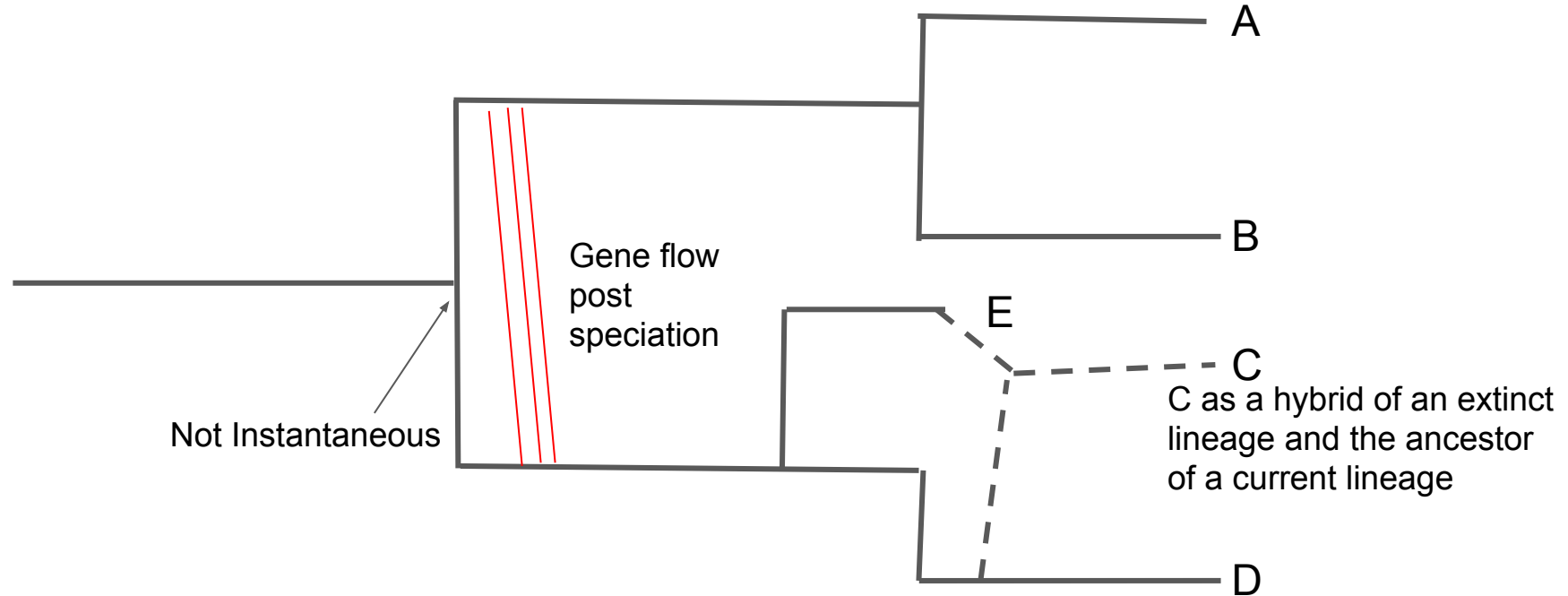
Phylogenetic conflict is insightful to how evolution proceeds



Phylogenetic conflict is insightful to how evolution proceeds

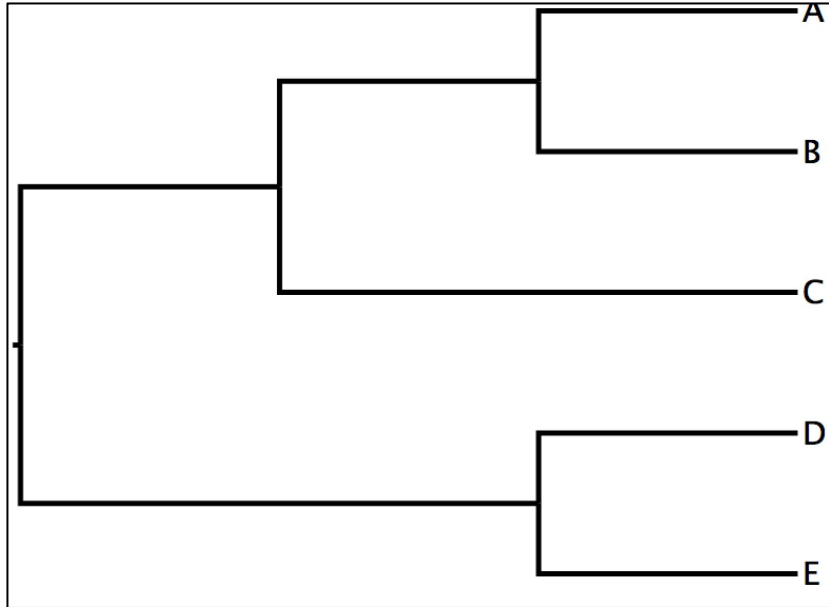


Phylogenetic conflict is insightful to how evolution proceeds



So how do we analyze conflict?

Species Tree

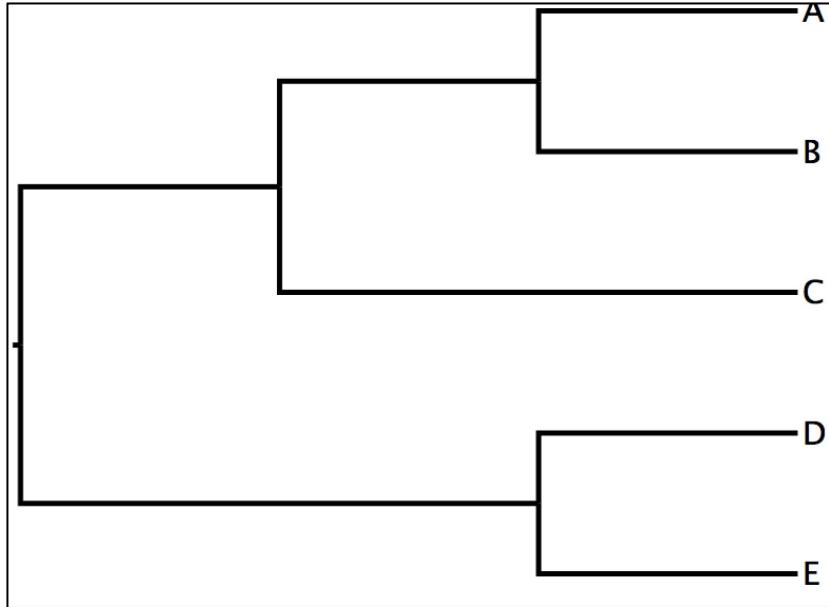


Newick

`((A,B),C),(D,E));`

So how do we analyze conflict?

Species Tree



Newick

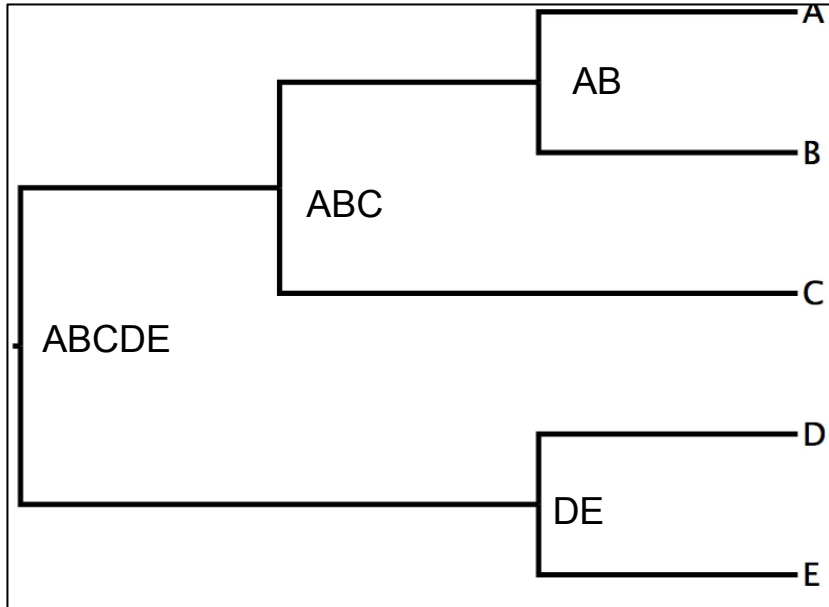
`((A,B),C),(D,E);`

Bipartitions

AB
ABC
DE
ABCDE

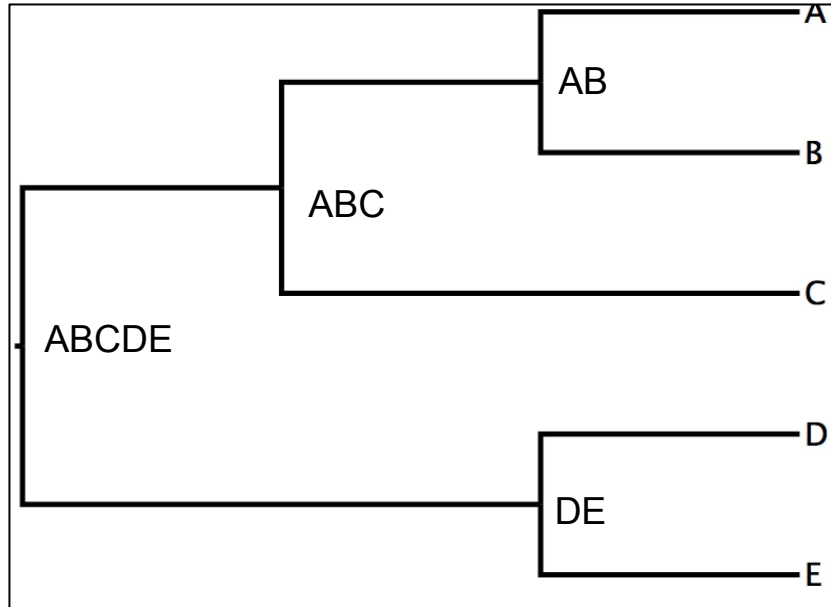
So how do we analyze conflict?

Species Tree

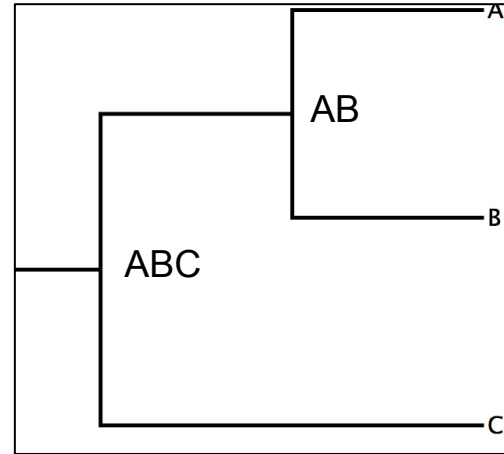


So how do we analyze conflict?

Species Tree

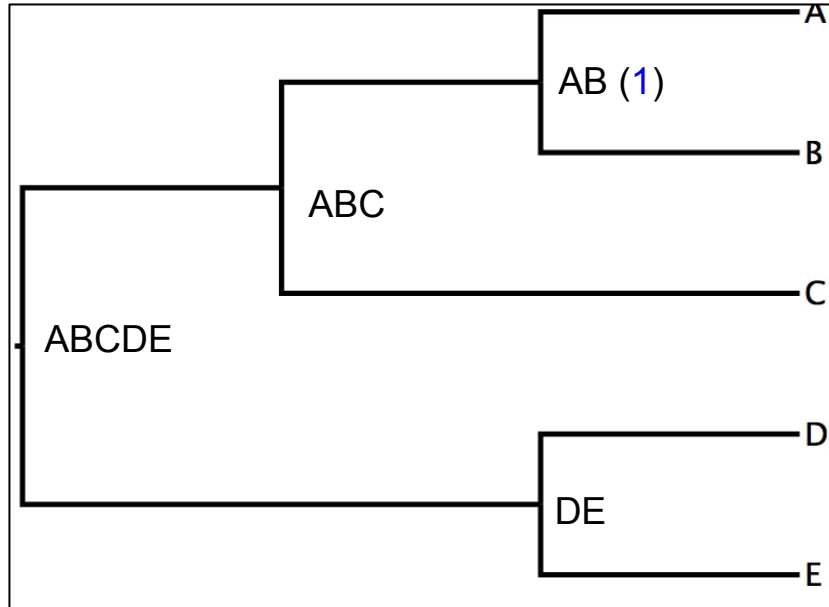


Gene Tree

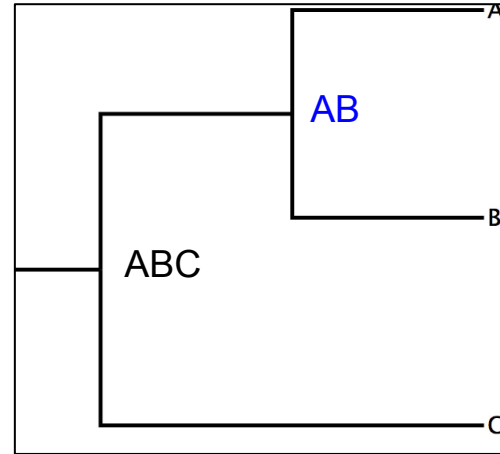


So how do we analyze conflict?

Species Tree

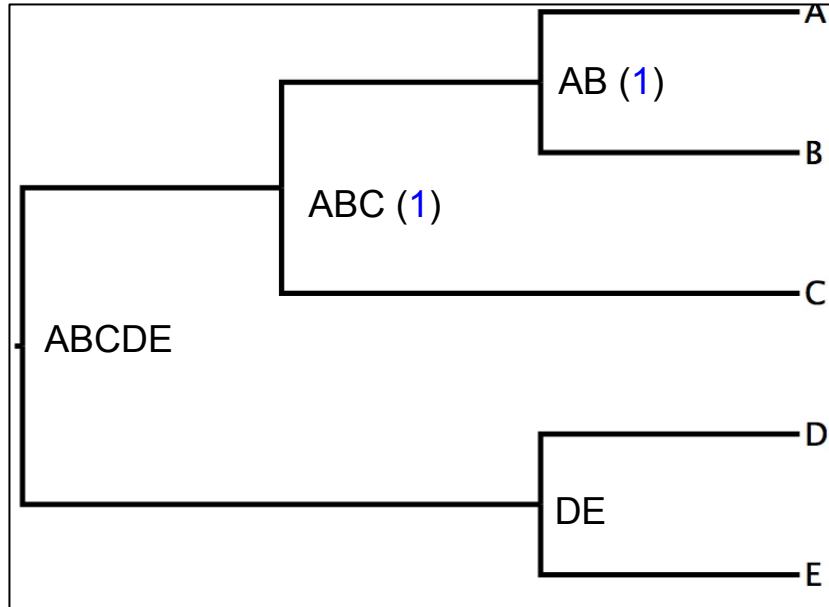


Gene Tree

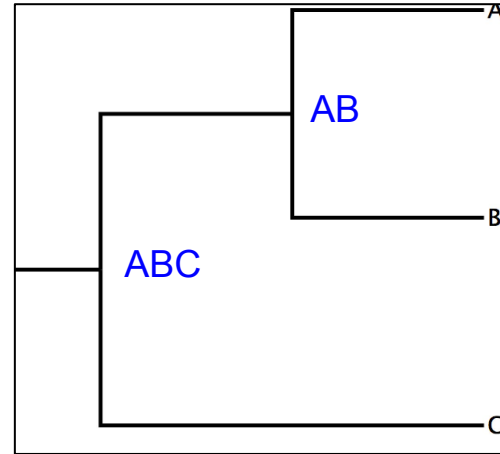


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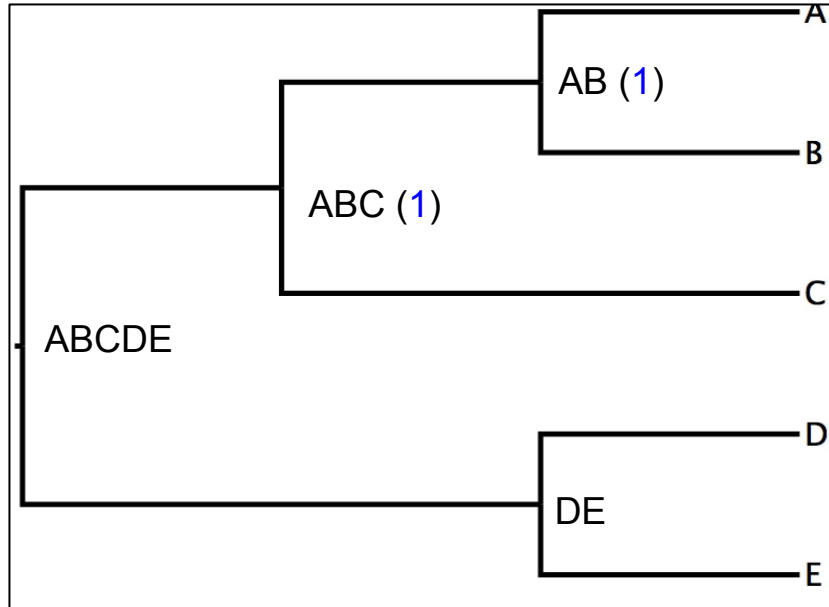


Gene Tree

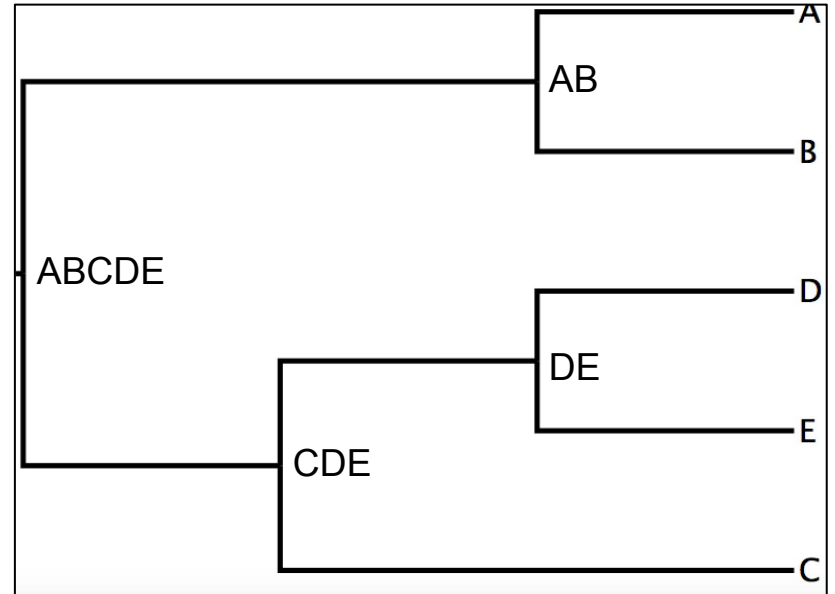


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Species Tree

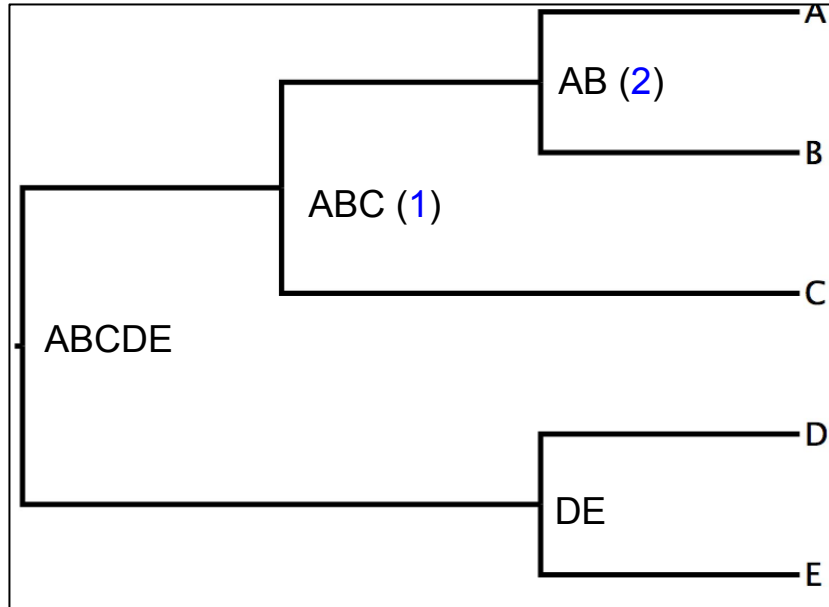


Gene Tree

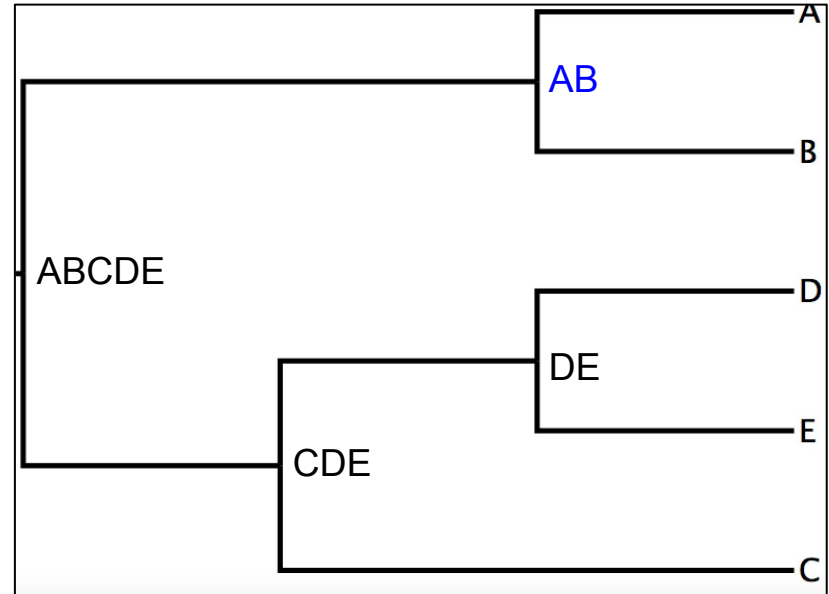


So how do we analyze conflict?

Species Tree

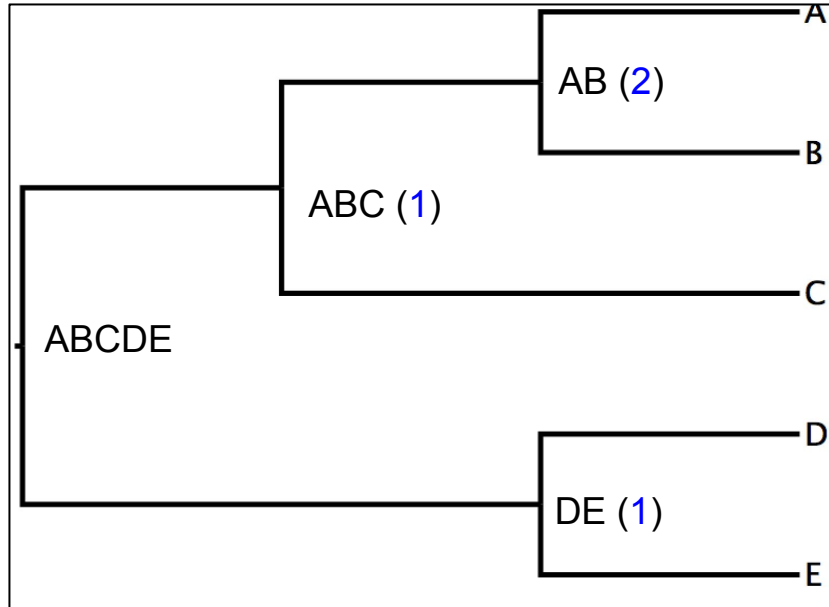


Gene Tree

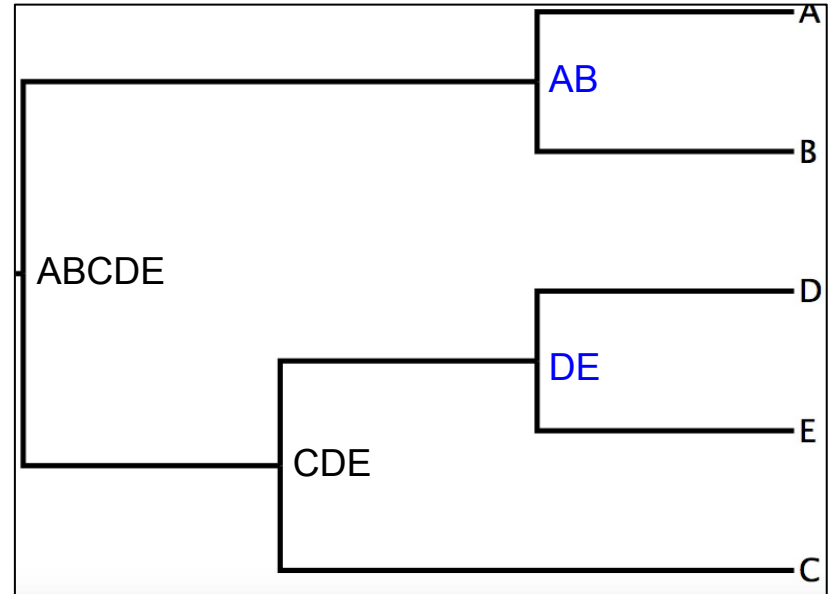


So how do we analyze conflict?

Species Tree

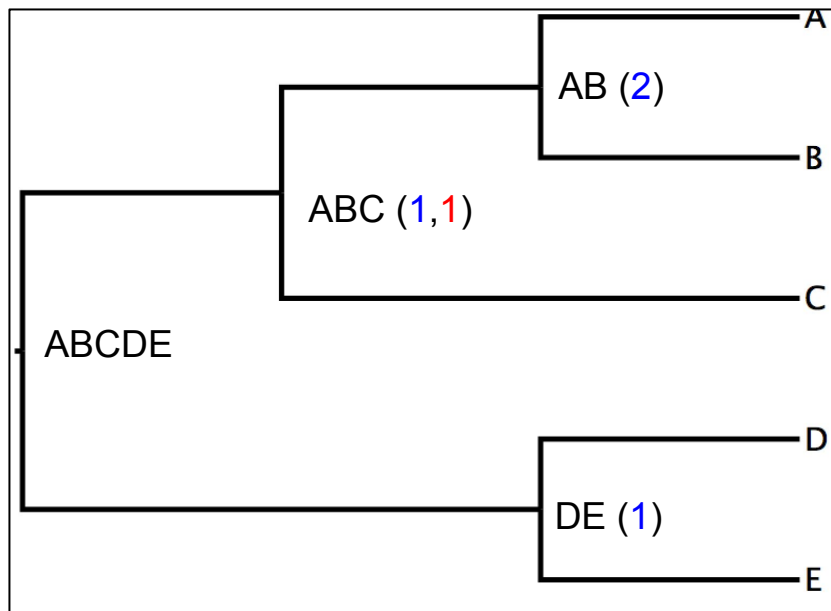


Gene Tree

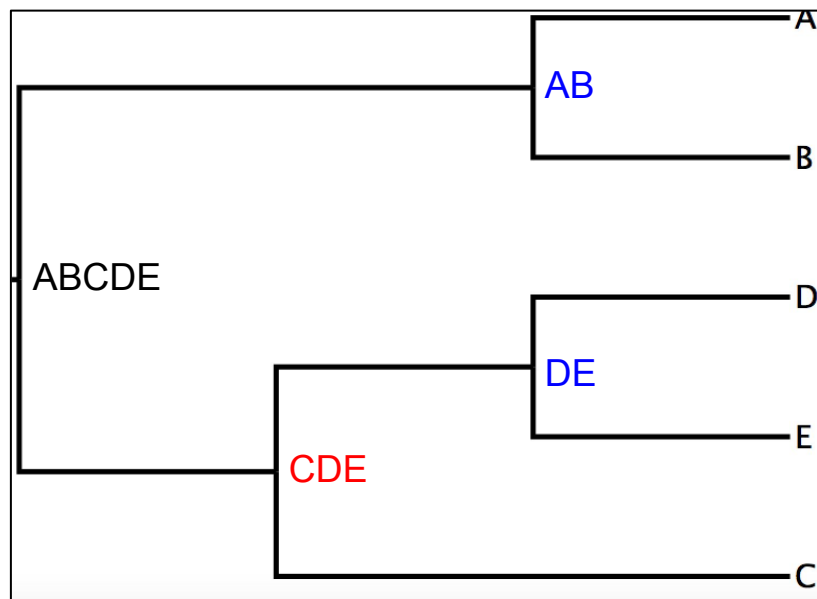


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Species Tree

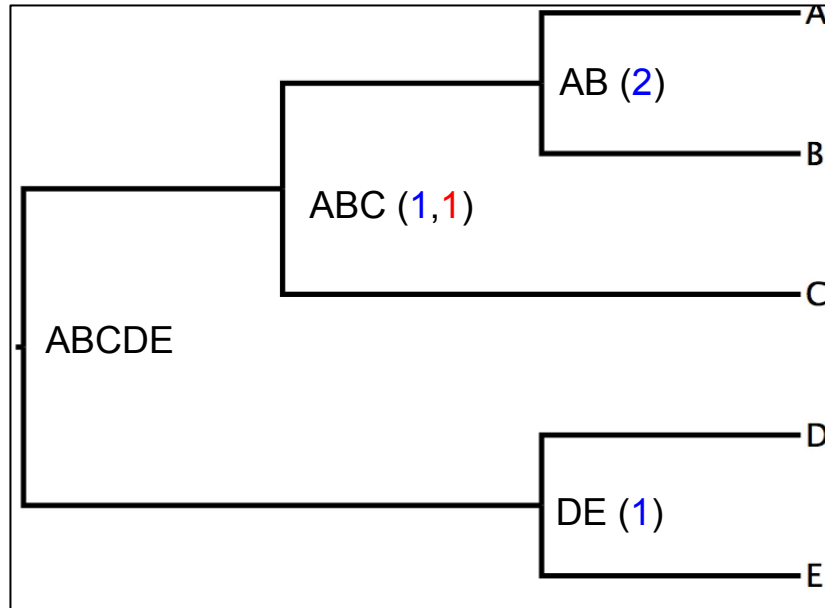


Gene Tree

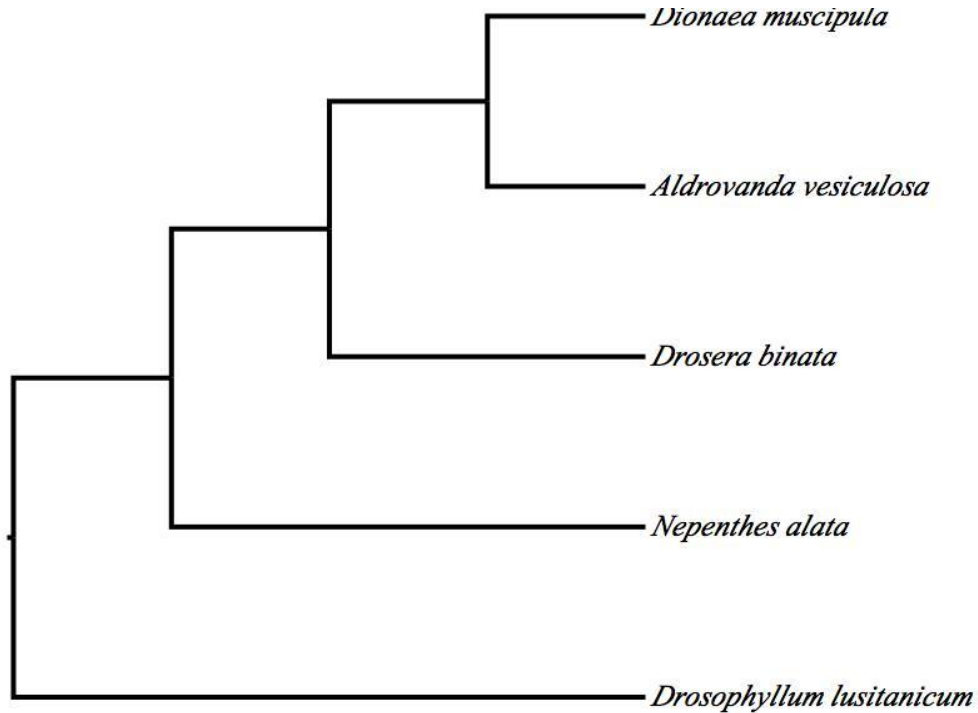


So how do we analyze conflict?

Species Tree



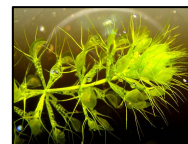
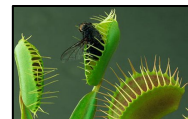
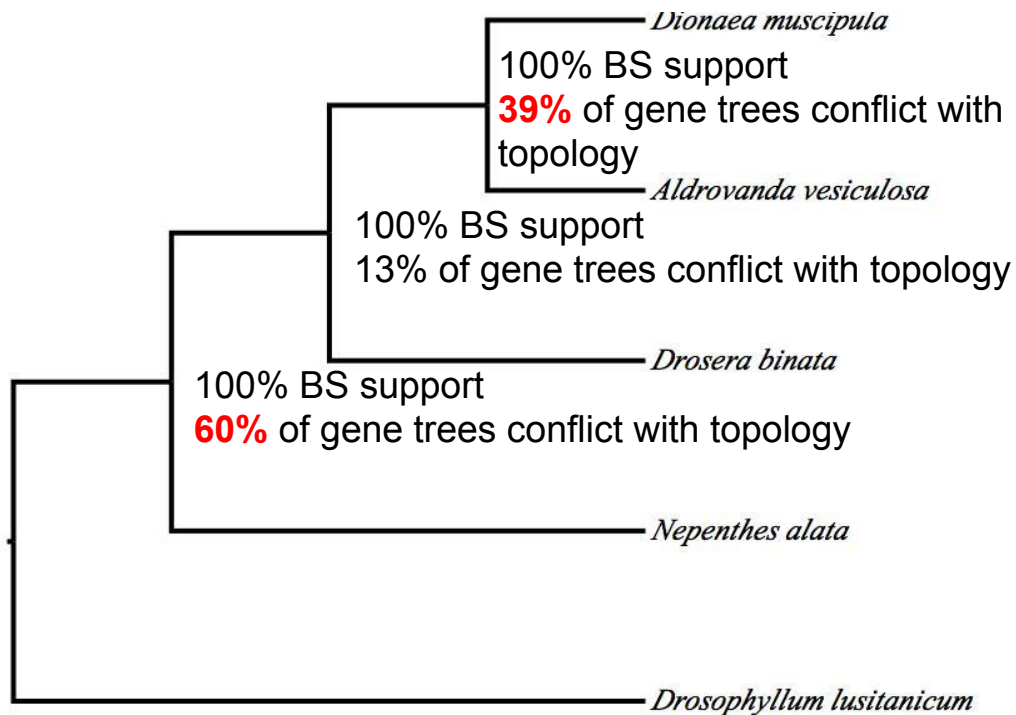
Real world examples of this



0.5



Real world examples of this



To the exercise!

Back to slides!

Why not the bootstrap?

Calculating Bootstrap Probabilities of Phylogeny Using Multilocus Sequence Data

Tae-Kun Seo [Author Notes](#)

Molecular Biology and Evolution, Volume 25, Issue 5, 1 May 2008, Pages
960–971, <https://doi.org/10.1093/molbev/msn043>

Published: 14 February 2008 **Article history** ▼

Alternatives

Novel Information Theory-Based Measures for Quantifying Incongruence among Phylogenetic Trees FREE

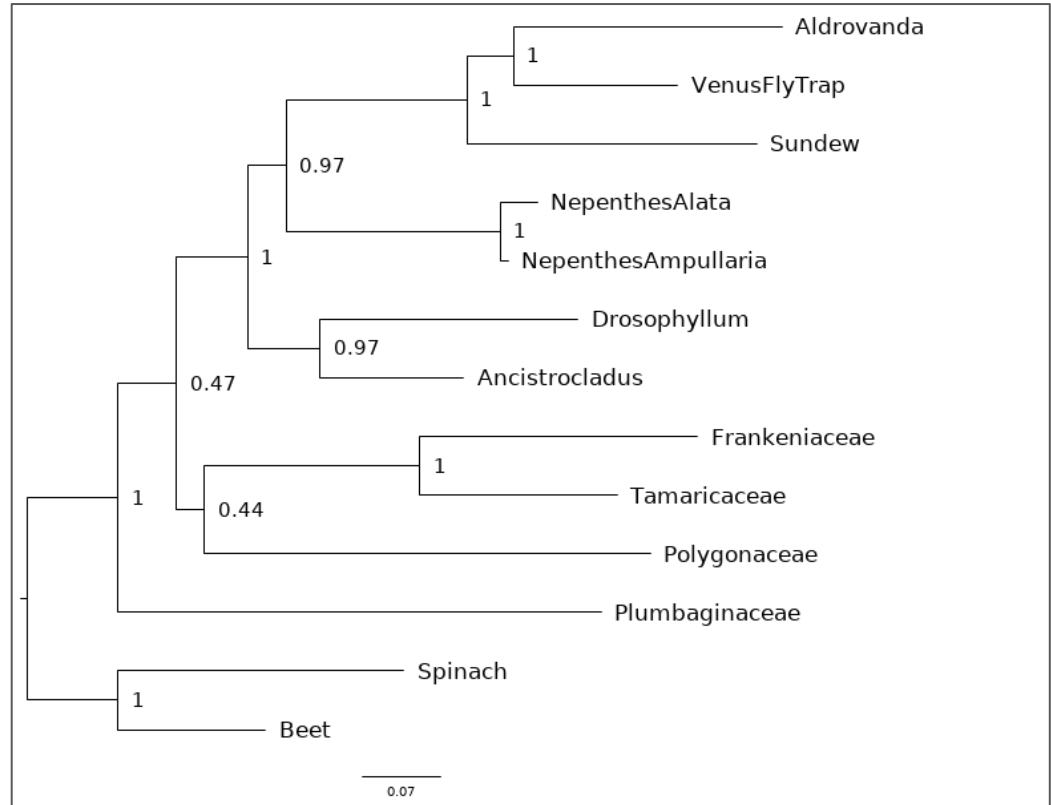
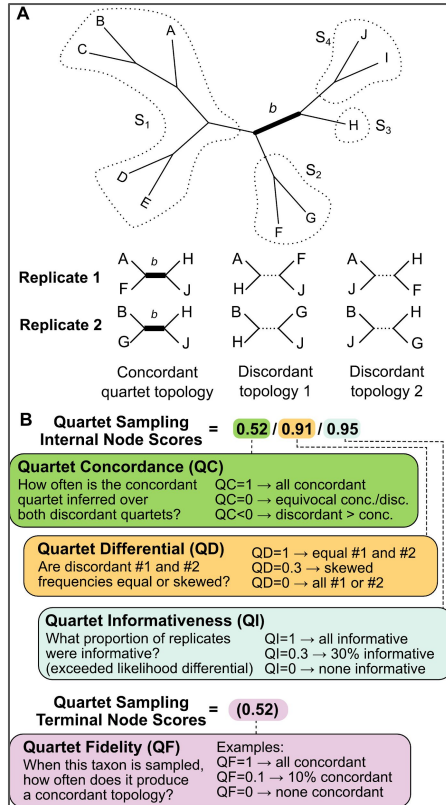
[Leonidas Salichos](#), [Alexandros Stamatakis](#), [Antonis Rokas](#) ✉ [Author Notes](#)

Quartet Sampling distinguishes lack of support from conflicting support in the green plant tree of life

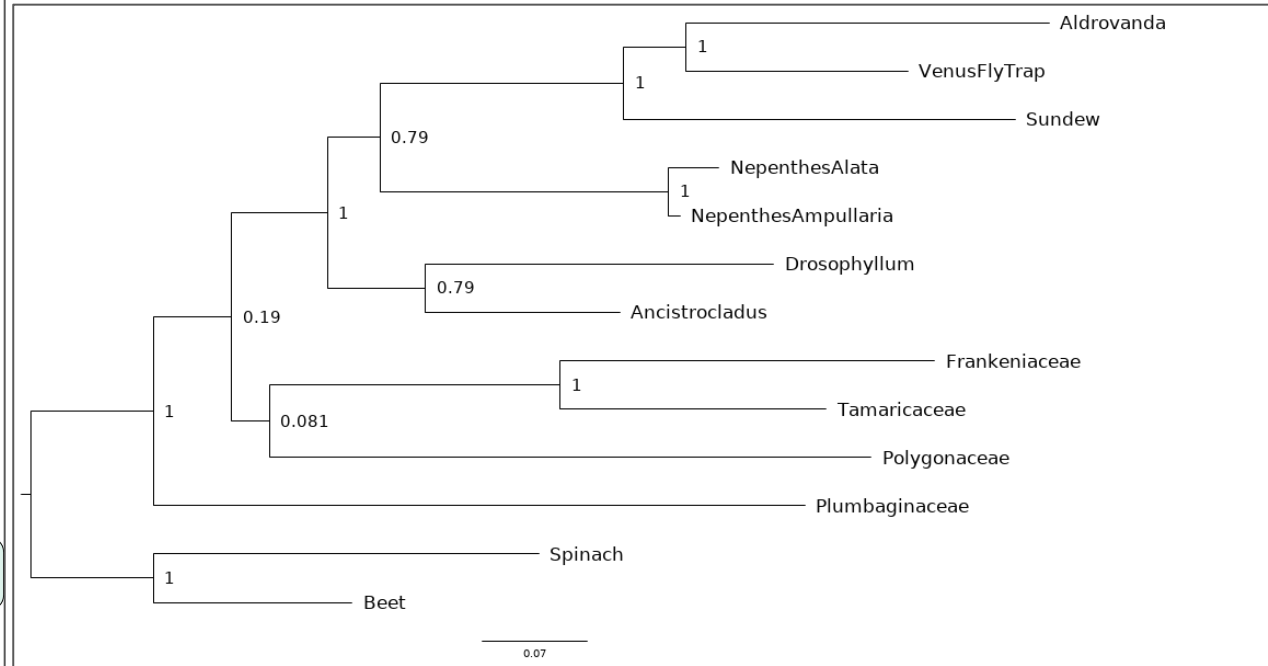
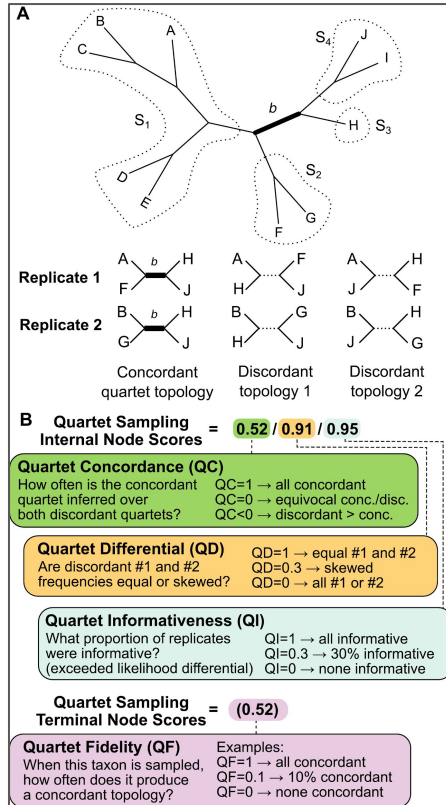
[James B. Pease](#) ✉, [Joseph W. Brown](#), [Joseph F. Walker](#), [Cody E. Hinchliff](#), [Stephen A. Smith](#) ✉

Quartet-based computations of internode certainty provide accurate and robust measures of phylogenetic incongruence

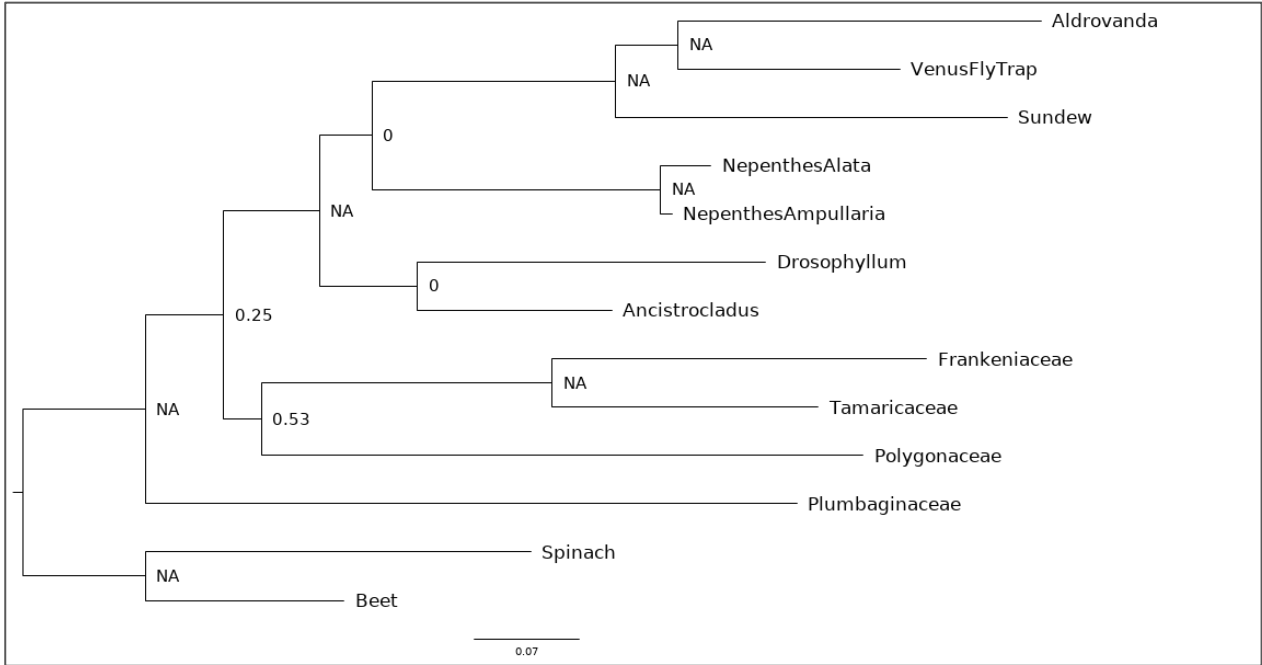
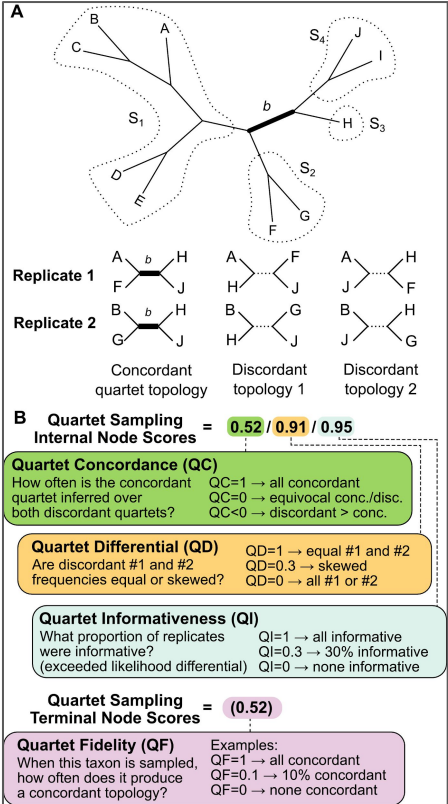
What is quartet sampling (Freq)



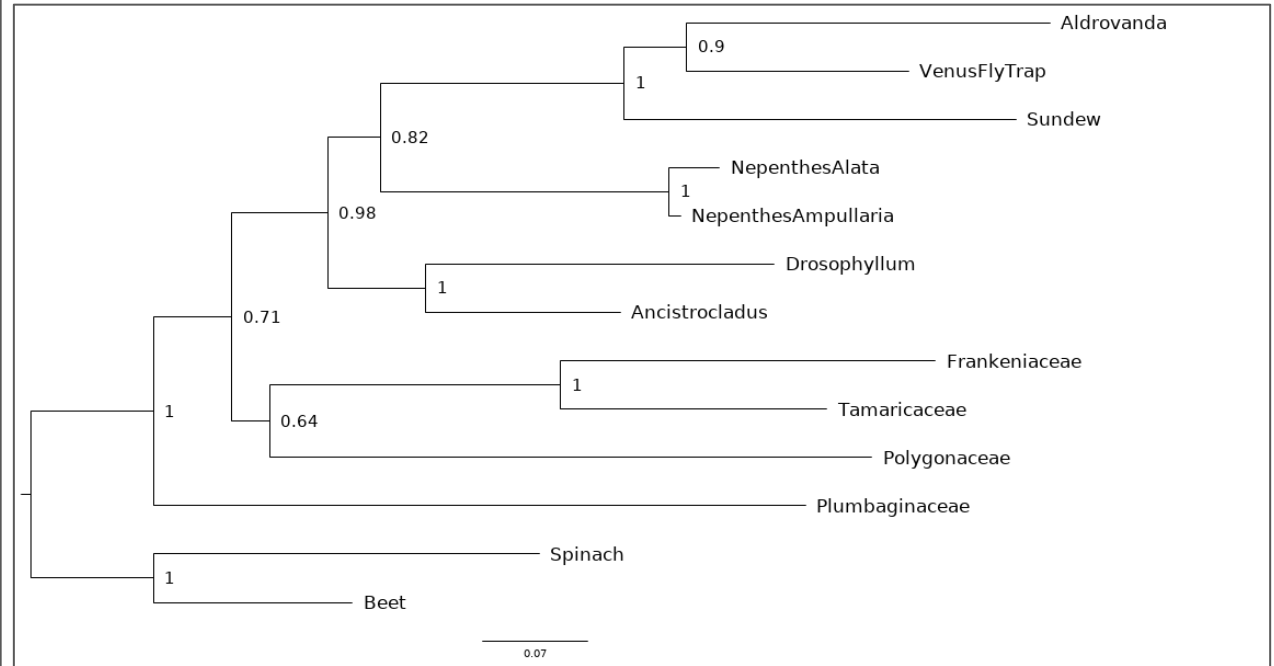
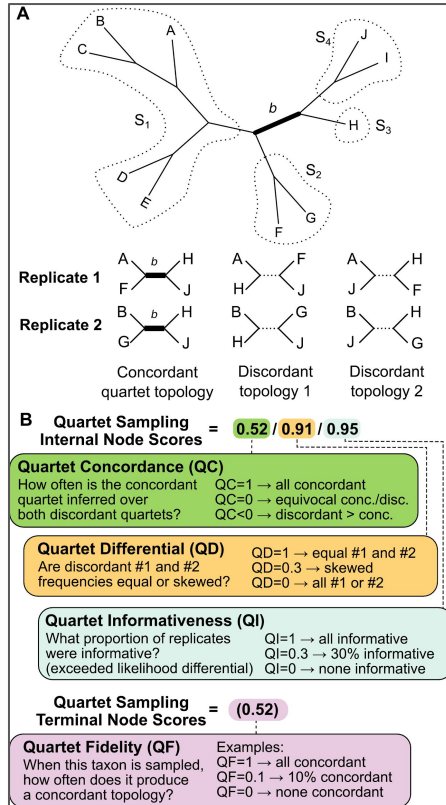
What is quartet sampling (QC)



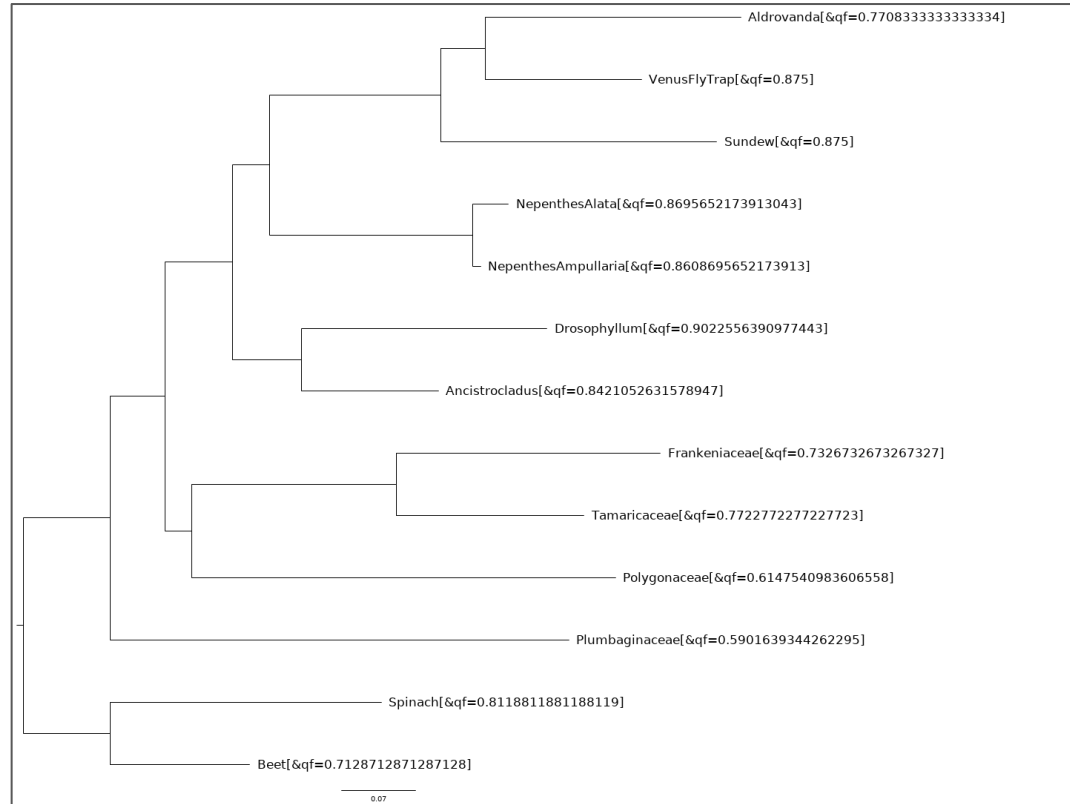
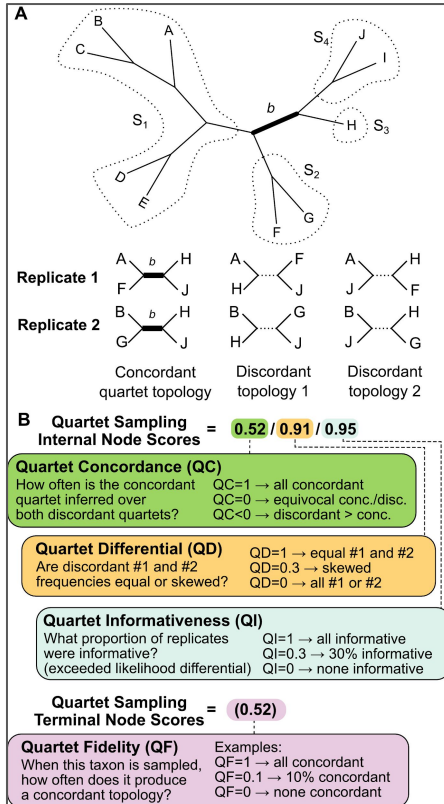
What is quartet sampling (QD)



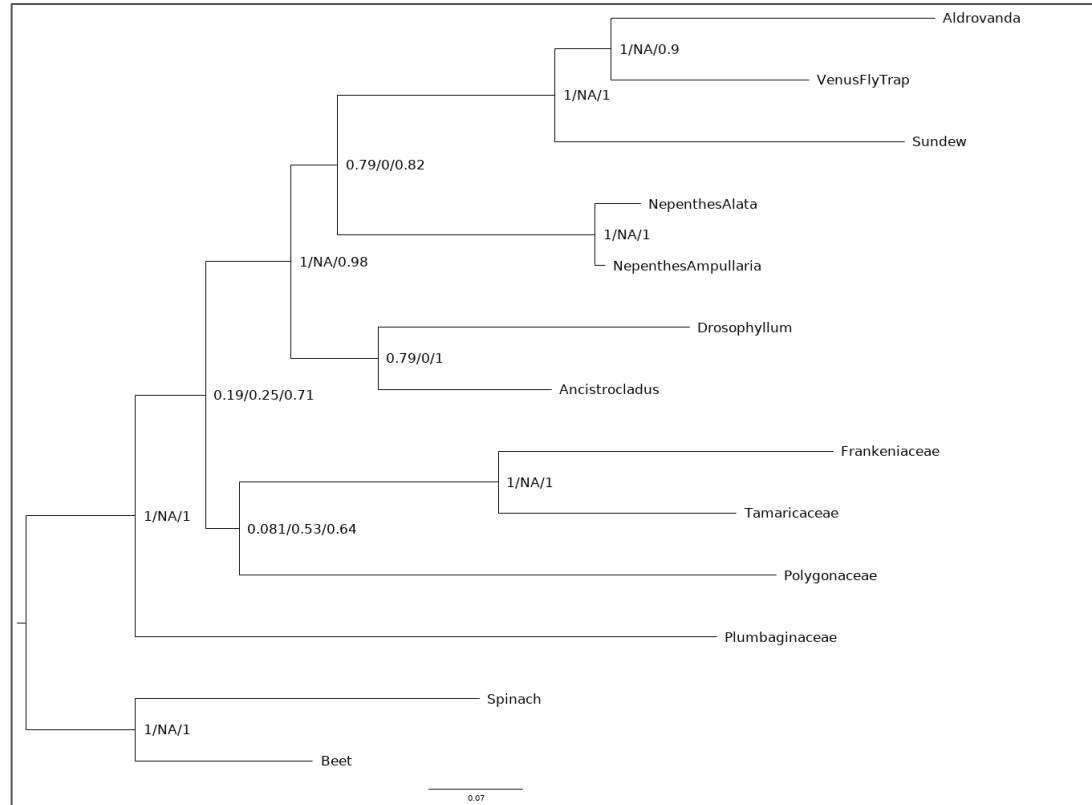
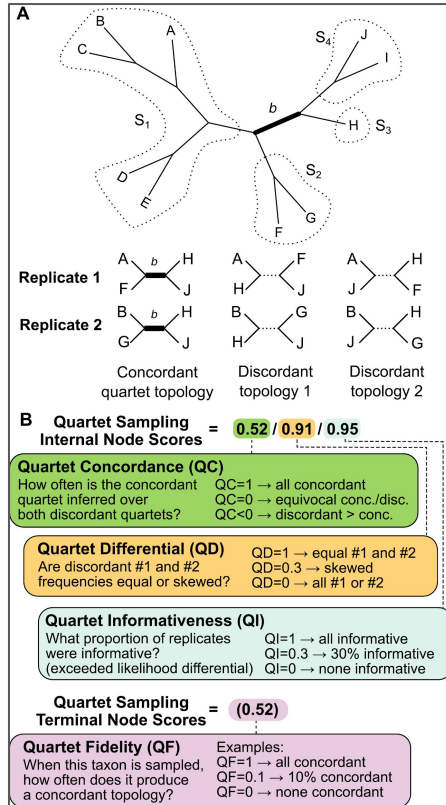
What is quartet sampling (QI)



What is quartet sampling (QF)



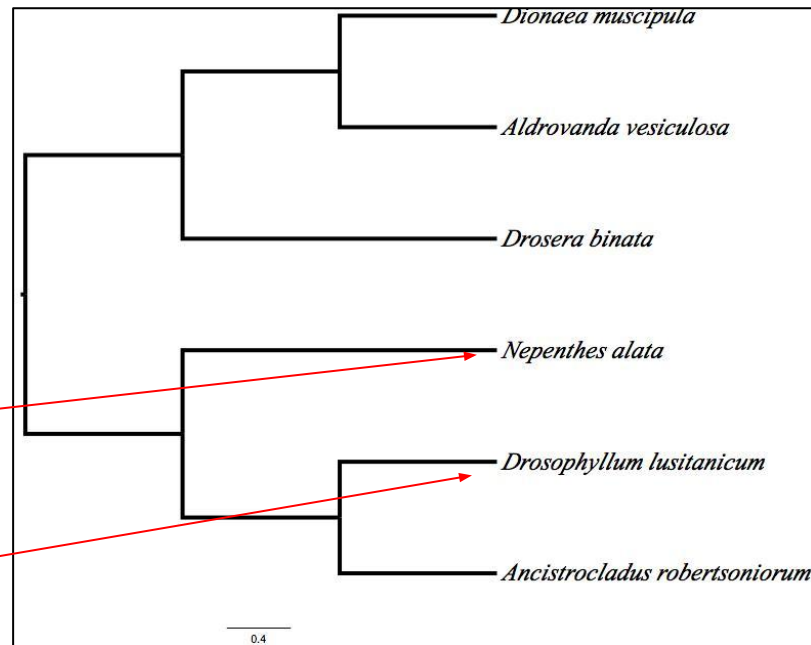
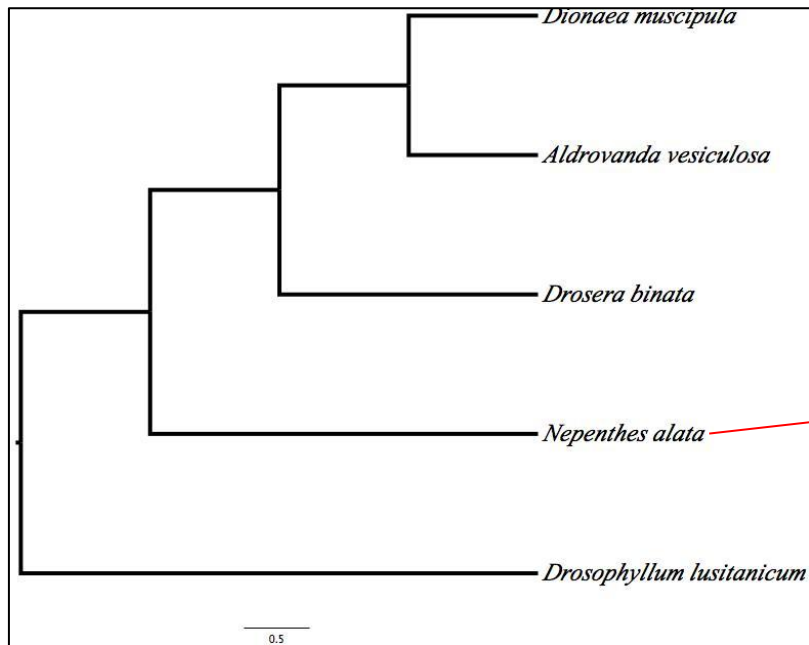
What is quartet sampling (What this means)



Questions?

Increased sampling alters conflicting relationship

All nodes have 100% BS support in both cases



Analyzing this conflict

METHODOLOGY ARTICLE

OPEN ACCESS

Analysis of phylogenomic datasets reveals conflict, concordance, and gene duplications with examples from animals and plants

Stephen A Smith  , Michael J Moore, Joseph W Brown and Ya Yang

BMC Evolutionary Biology 2015 15:150 | DOI: 10.1186/s12862-015-0423-0 | © Smith et al. 2015

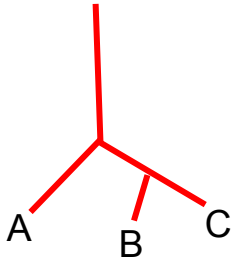
Received: 23 March 2015 | Accepted: 25 June 2015 | Published: 5 August 2015

Biological reasons for conflict

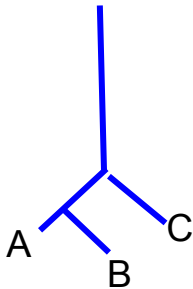
- Horizontal gene transfer
- Introgression
- Incomplete Lineage Sorting (ILS)

Very Important to keep this in mind with Plastid DNA!

Concordant Gene



Conflicting Gene



Species Tree

