

# Phylogenetic Trees

Bret Larget

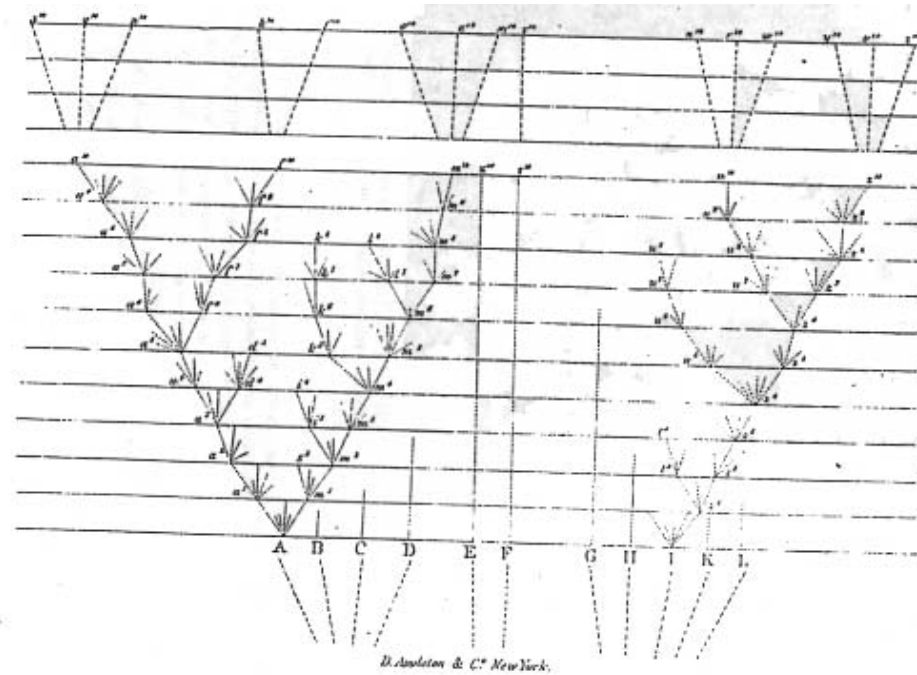
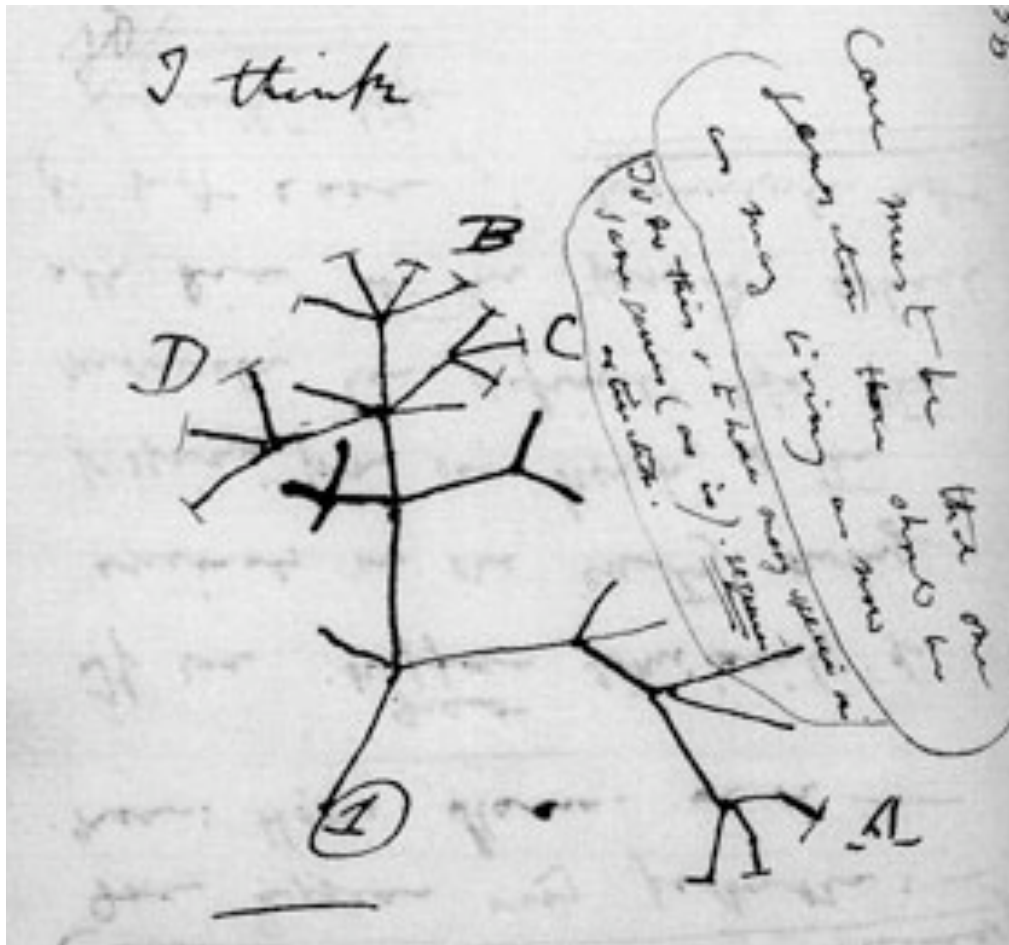
Departments of Botany and of Statistics  
University of Wisconsin—Madison

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# Phylogenetics and Darwin

- In 1837, shortly after his famous five-year voyage as naturalist on the *Beagle*, Darwin sketched a tree diagram in one of his notebooks.
- This simple sketch is remarkably similar to modern diagrams of phylogenies.
- In addition, the sole figure in *The Origin of Species* (1859) is a phylogeny.

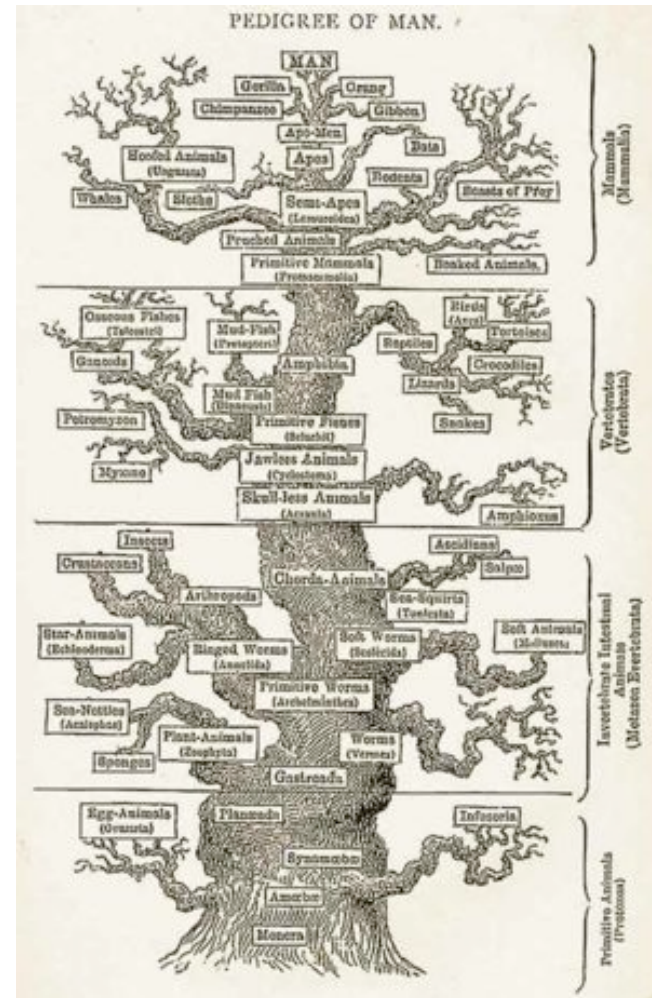
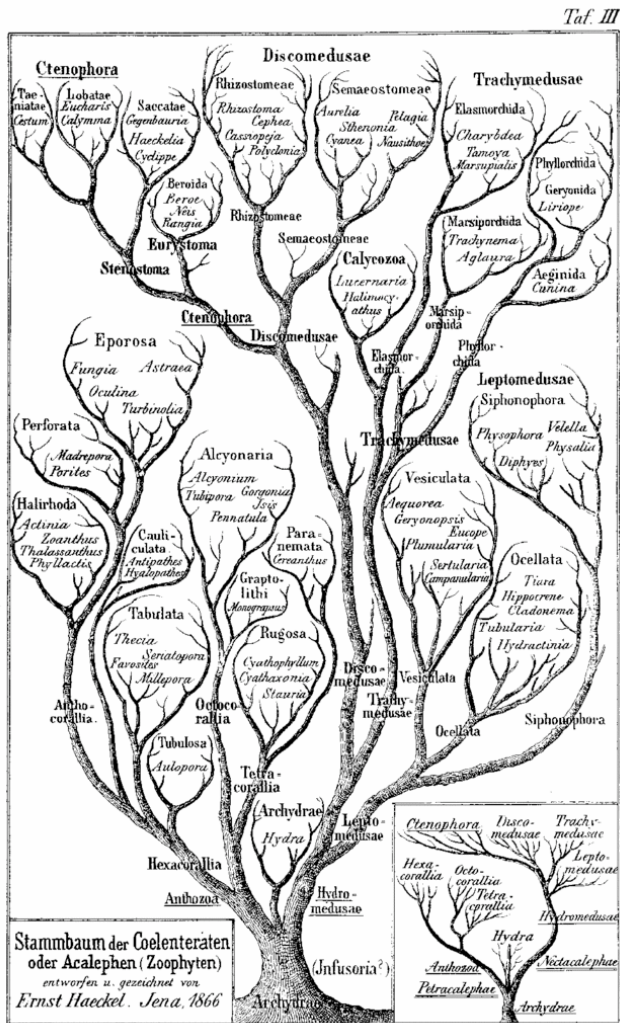
# Darwin's Trees



# Early History

- Shortly after the 1859 publication of *The Origin of Species*, many biologists came to accept the truth of a universal *Tree of Life*.
- Ernst Haeckel and many others created highly stylized trees that were based on expert opinion.
- A century passed before development of *formal scientific methods* for estimating phylogenies began.

# Haeckel's Trees



# What is the Origin of Whales?

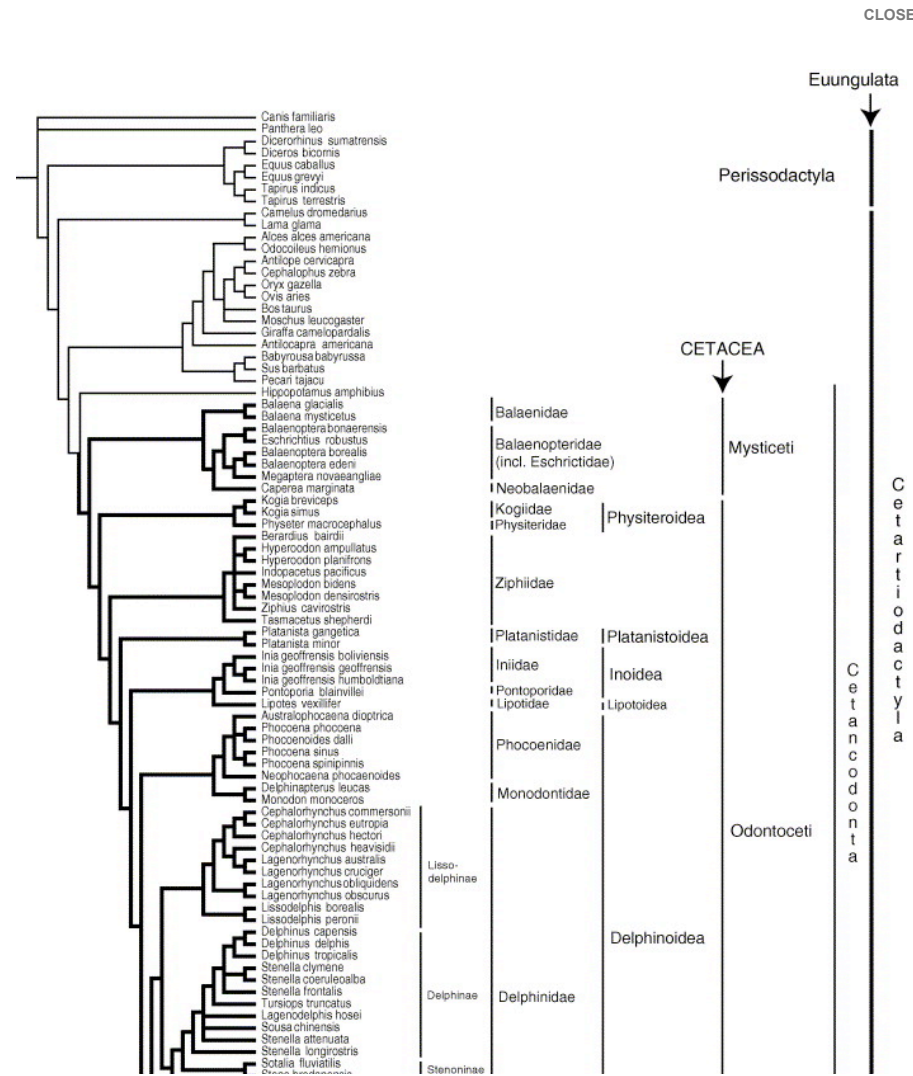
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giant sperm whale	ATGACCAACATCCGAAAATCACACCCATTAATAAAAATCATT
bowhead whale	ATGACCAACATCCGAAAAACACACCCACTAATAAAAATTATT
right whale	ATGACCAACATCCGAAAAACACACCCAGTAATAAAAATTATT
minke whale	ATGACCAACATCCGAAAAACACACCCACTAATAAAAATTATC
fin whale	ATGACCAACATCCGAAAAACACACCCACTAATAAAAATCGTC
blue whale	ATGACCAACATCCGAAAAACACACCCACTAATAAAAATCATC
humpback whale	ATGACCAACATCCGAAAAACACACCCACTAATAAAAATTATC
...	
hippopotamus	ATGACAAACATCCGAAAATCTCACCCCTTAATAAAAATTATC
camel	ATGACAAACATCCGAAAATCACACCCACTTCTAAAATTATA
pig	ATGACCAACATCCGAAAATCACACCCACTAATAAAAATTATC
cow	ATGACTAACATTTCGAAAGTCCCACCCACTAATAAAAATTGTA
sheep	ATGATCAACATCCGAAAAACCCACCCACTAATAAAAATTGTA
goat	ATGACCAACATCCGAAAGACCCACCCATTAATAAAAATTGTA



# An Estimated Whale Phylogeny

ScienceDirect - Full Size Image

09/04/2007 09:10 AM



[http://www.sciencedirect.com/science?\\_ob=MiamiCaptionURL&\\_method...urlVersion=0&\\_userid=443835&md5=df655f7ee732c807488f9262b841bcf](http://www.sciencedirect.com/science?_ob=MiamiCaptionURL&_method...urlVersion=0&_userid=443835&md5=df655f7ee732c807488f9262b841bcf) Page 1 of 2



# Why is Phylogenetics Important?

- It is an exaggeration to say phylogenetics are everywhere, but phylogenetic trees are used in many areas of biology beyond the obvious area of systematics.
- Other areas include forensics and developmental biology.
- From a statistical point of view, the evolutionary history of organisms means that species *should not be treated as independent samples*.
- Even if evolutionary relationships are not of primary interest, a good statistical analysis might need to account for the phylogeny to explain some part of the dependence among observations from different species.



# Forensic Phylogenetic Tree

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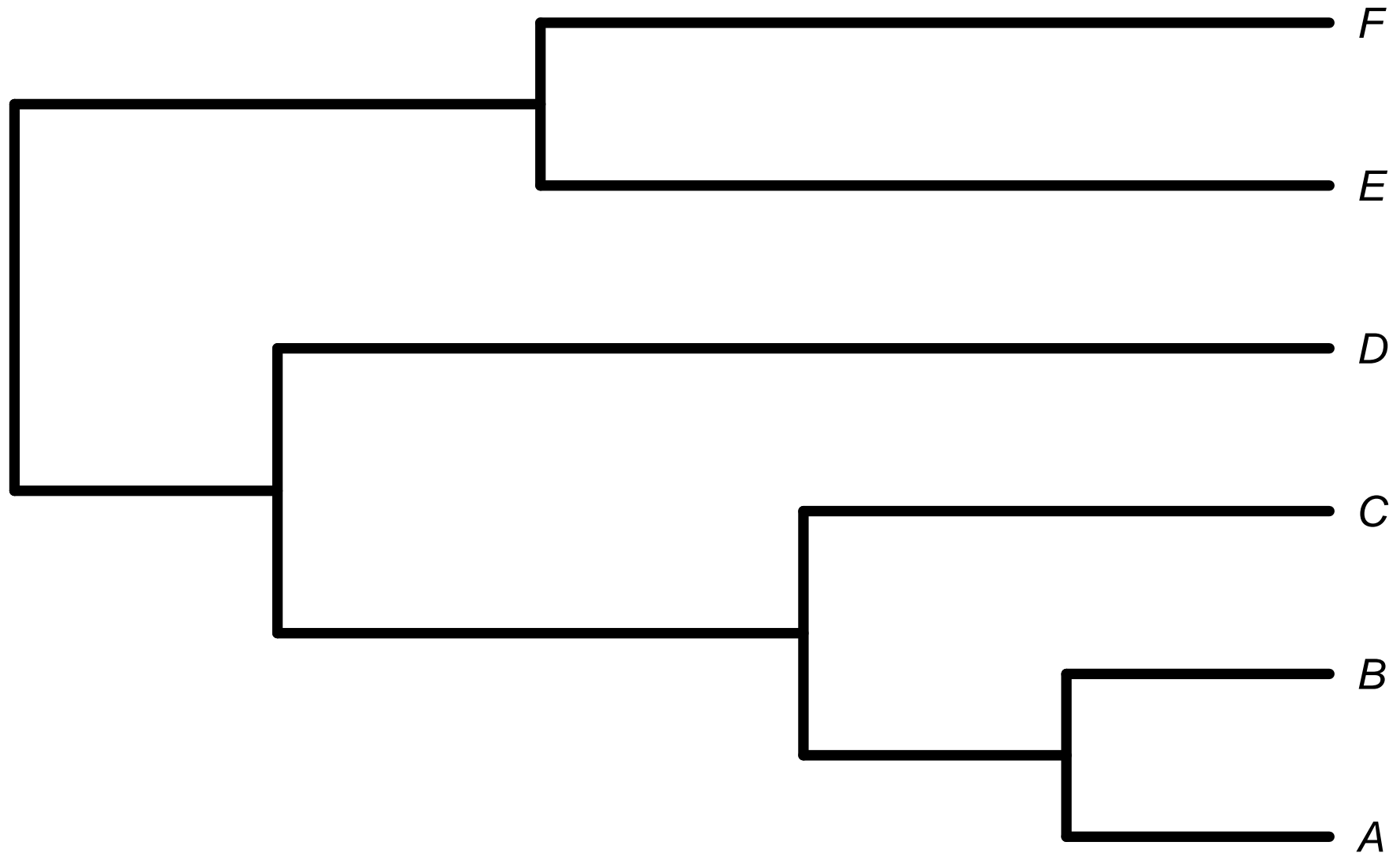
HIV Forensics

Figure 2

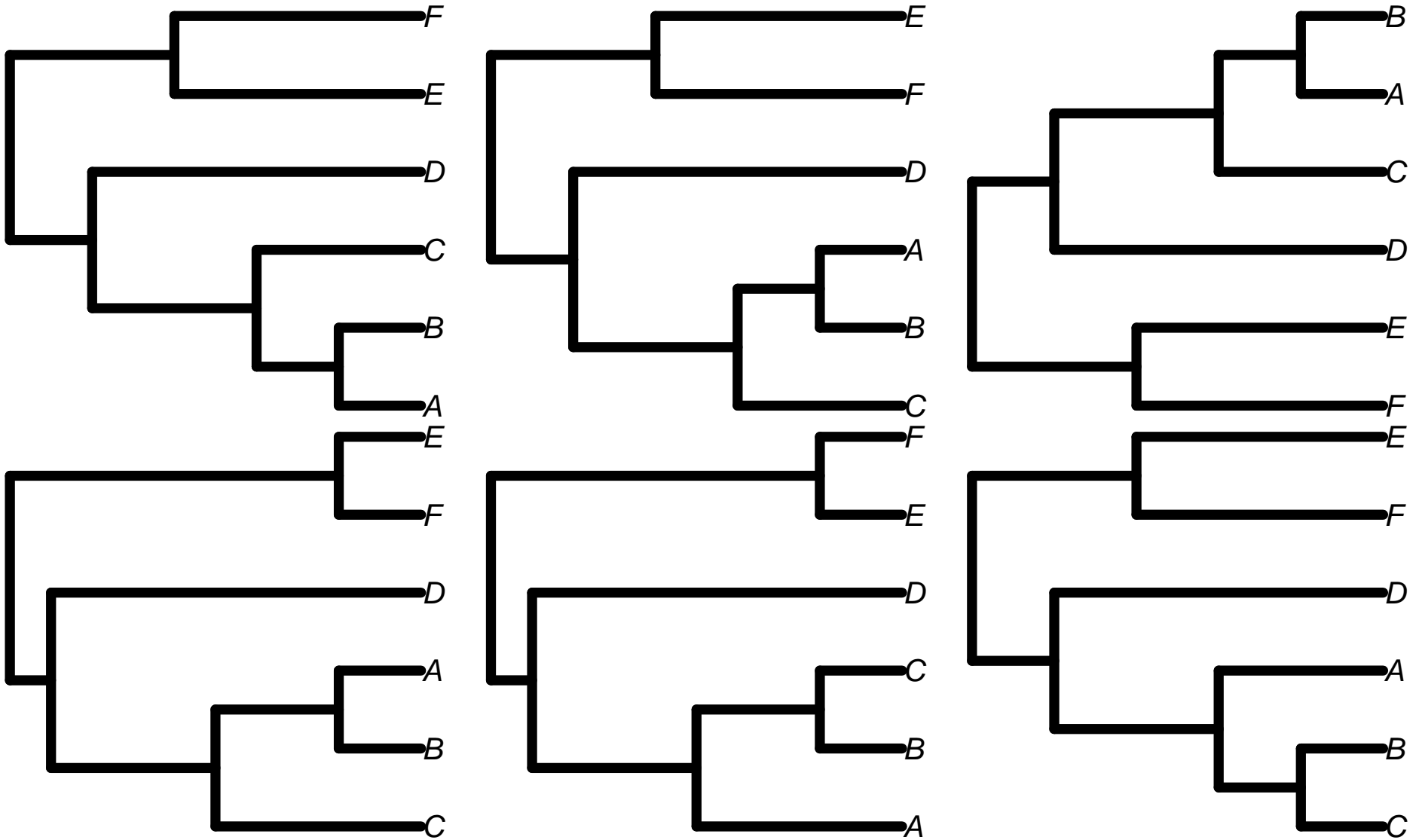


Figure 2. Neighbor-joining phylogram representing the reconstruction of the phylogenetic relationships between the *env* (C2-V5) sequences obtained from the index case (A31-44), the alleged recipient (B22-29), three local controls (LC45 and LC48; LC46 and LC47; and LC49 and LC50) and 48 sequences chosen from GenBank. Ten iterations of random sequence addition were used. Scale bar represents 10% genetic distance. Bootstrap values are shown at nodes with greater than 70% support.

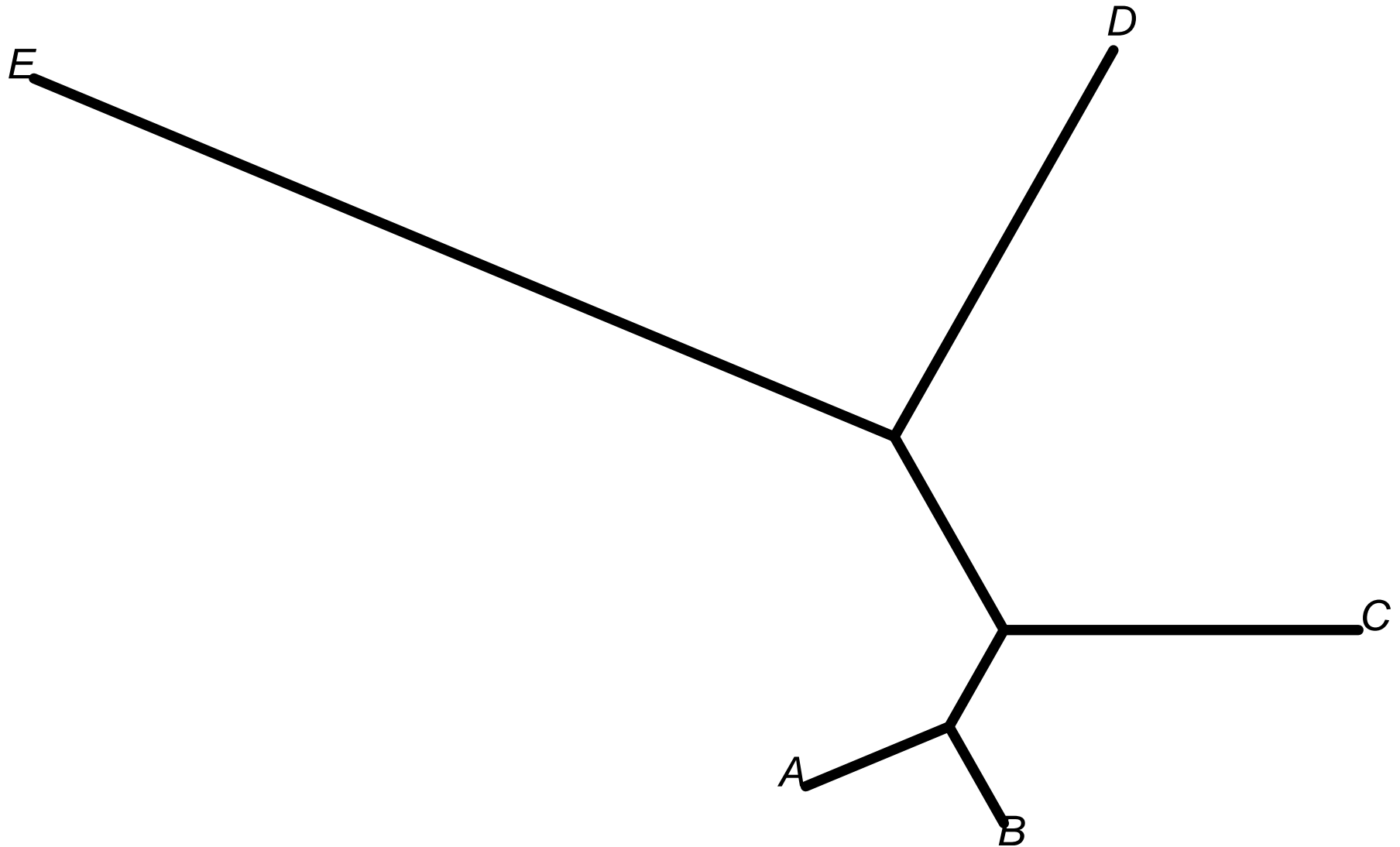
# Activity 1: Example Tree



# Activity 2: Compare Trees



# Activity 3: Unrooted Tree



# Activity 4: Labeled Histories

