

ANIMAL BEHAVIOR

(10/04/2022)

Speciation and
Adaptation



Behavior of the day!

[Click Here](#)



Behavior of the day!

[Click Here](#)





https://github.com/stjohn3/OU_AnimalBehavior_FA2022

Assignments for this week:

After class today/Before Thursday

- Read and Respond to:

Why are there one- and two-horned species of rhinos?

After class Thursday/Before next Tuesday

- Read and Respond to:

Expanding evolutionary neuroscience: insights from comparing variation in behavior

ACTIVITY:

You observe that female *platyfish* prefer males with long tails you are wondering why... Design an experiment to answer this question.





SHARE OUT YOUR IDEAS!

Male *platyfish* do not have tails...



How do we explain the female preference if there is no adaptive value to it?

For today:

4 questions

Object of study

Contemporary: An explanation of the current form of a behavior in terms of present-day	Chronicle: An explanation of the current form of the behavior in terms of a sequence
Mechanism (a.k.a. causation) Causal explanations in terms of what the behavior is and how the behavior is constructed. These explanations can include physical morphology, molecular mechanisms, other underlying biological factors, or external stimuli. Aristotle: material cause	Ontogeny (a.k.a. development) Developmental explanations for sequential changes across the lifespan of an individual. Often these explanations are concerned with the degree to which the behavior can be changed through learning.
Adaptive Value (a.k.a. function) Functional explanations regarding the utility of the current form of the behavior with regard to increasing an organism's lifetime reproductive success. Aristotle: final cause	Phylogeny (a.k.a. evolution) Evolutionary explanations that describe the history of the behavior, such as which ancestor first possessed this trait, what was the antecedent to this behavior, and what selective pressures in the past have shaped this behavior. Aristotle: efficient cause

Why Evolutionary History Matters:



Priapella

Platyfish

Platyfish*

Swordtails

Tails

Preference for
long tails

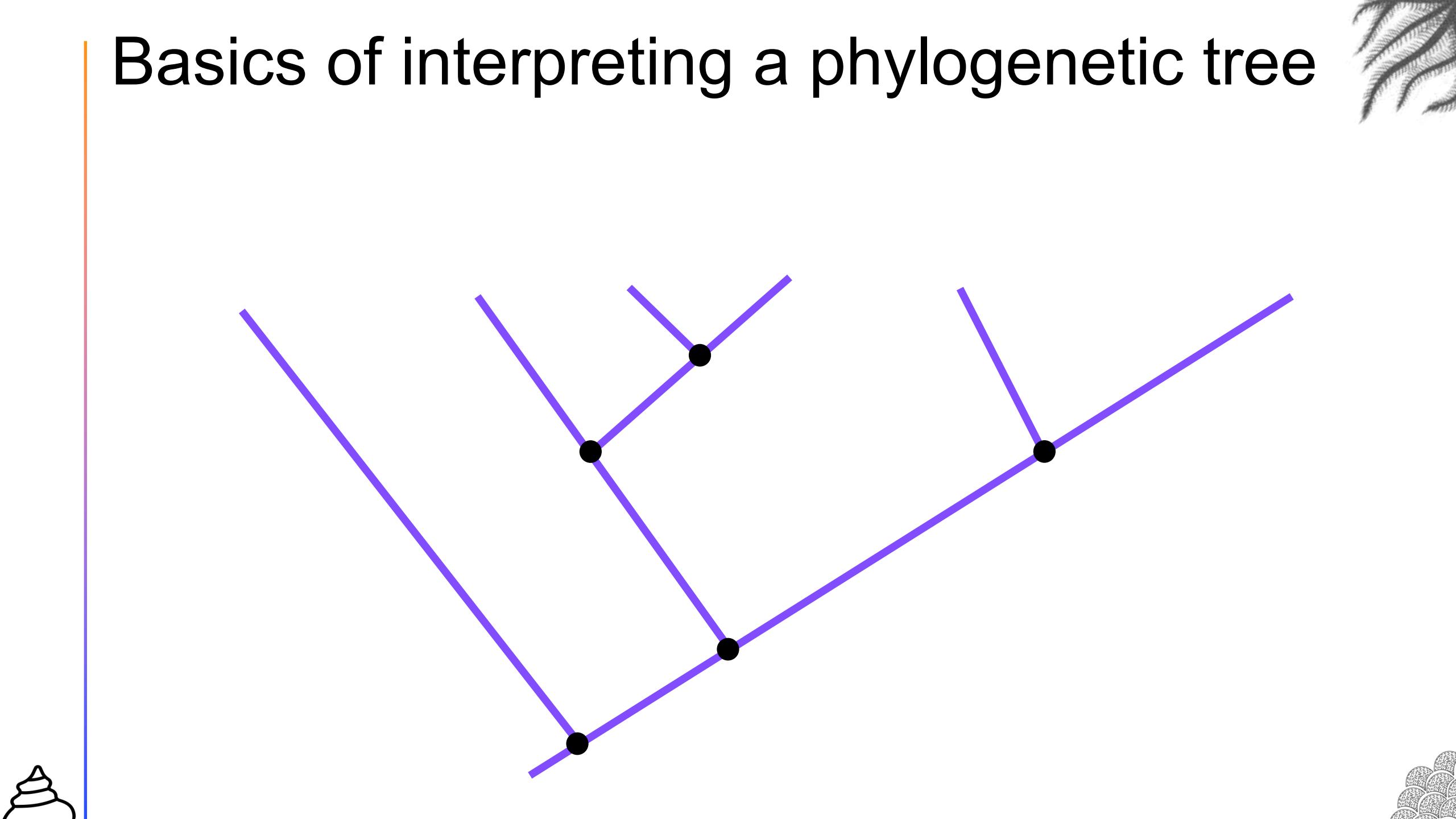
Basolo, A. L. 1990. Female Preference Predates the Evolution of the Sword in Swordtail Fish. *Science* (80-.). 250:808–810.

Agenda

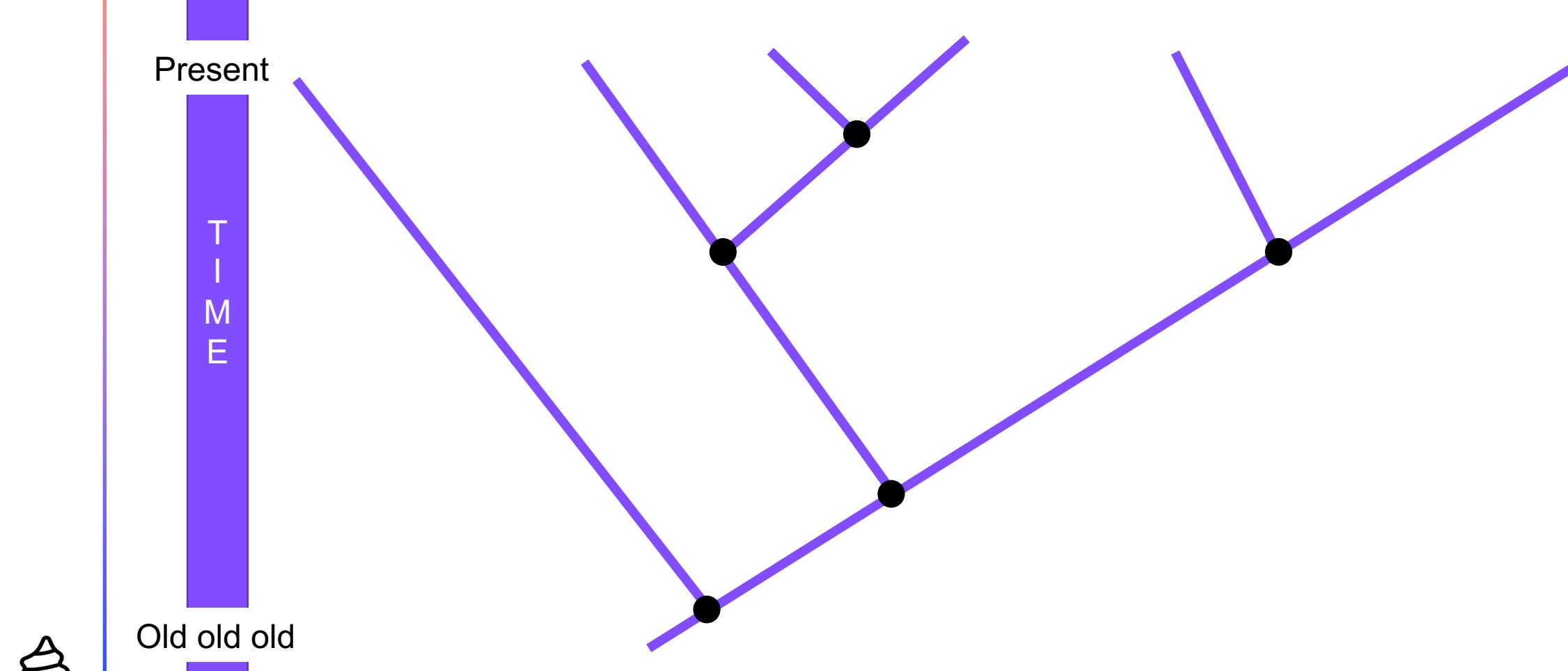
- Basics of interpreting a tree
- What is a species?
- How are species produced?
- Formulating Questions and Making Inferences
- Questions about grad school??



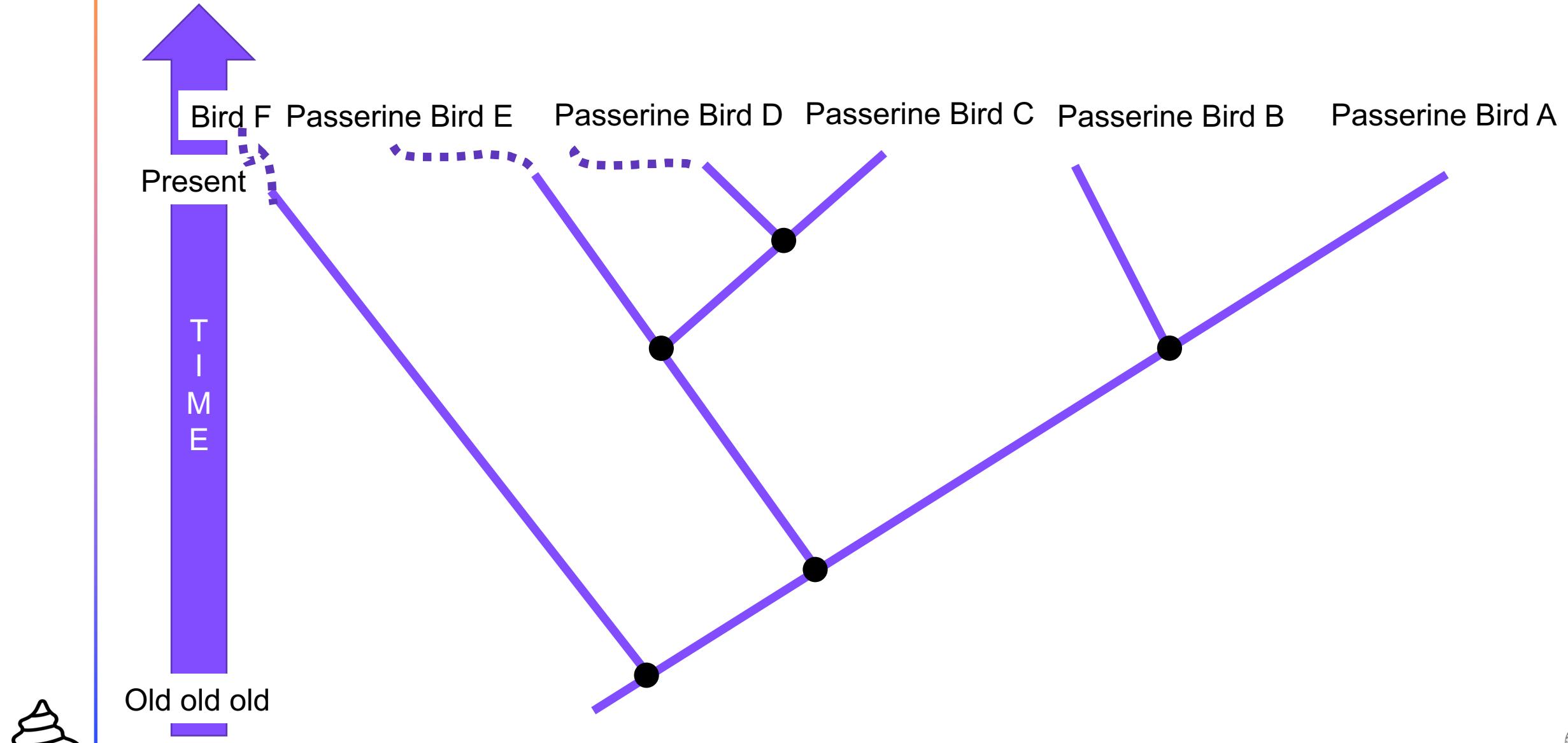
Basics of interpreting a phylogenetic tree



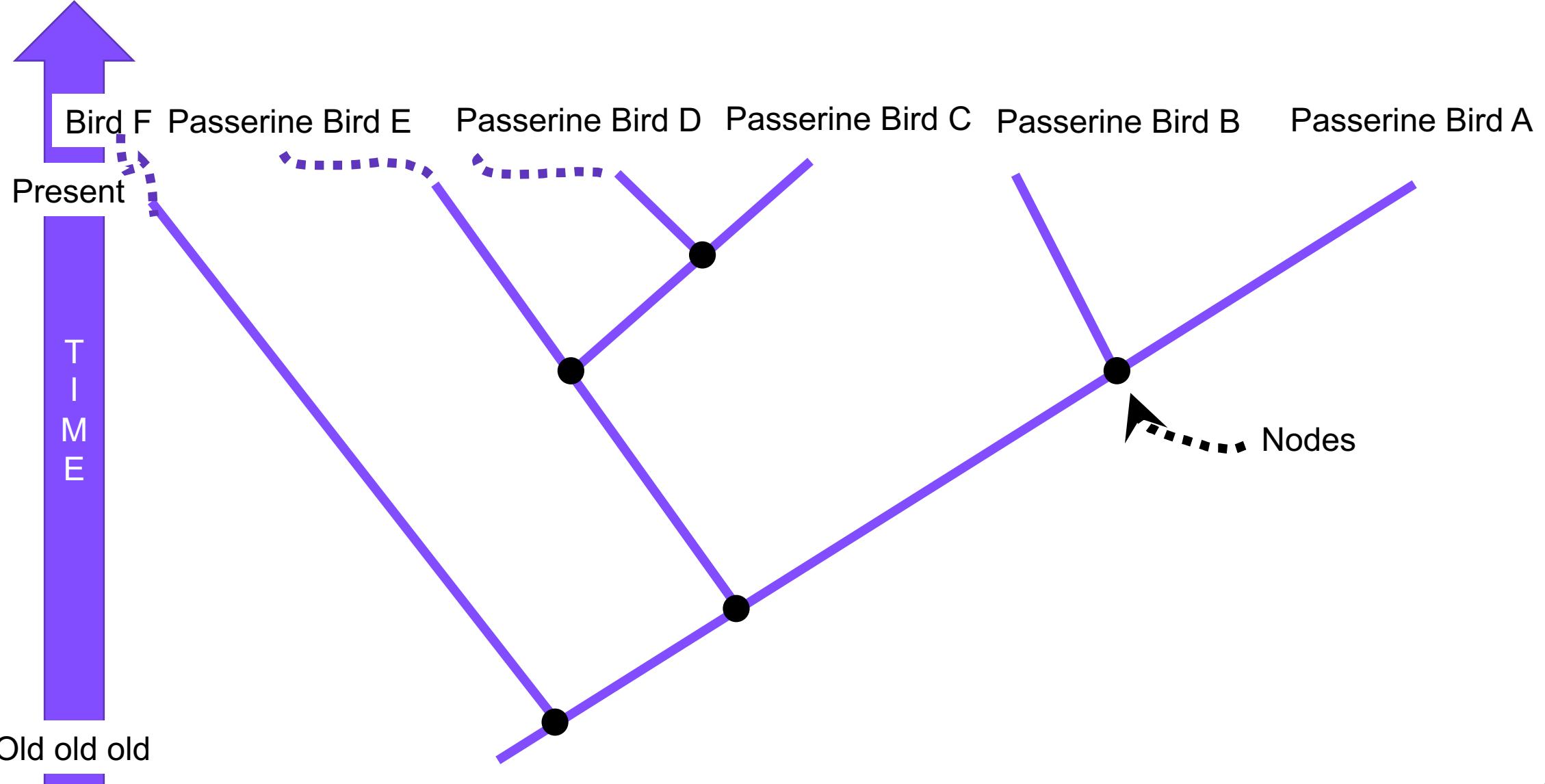
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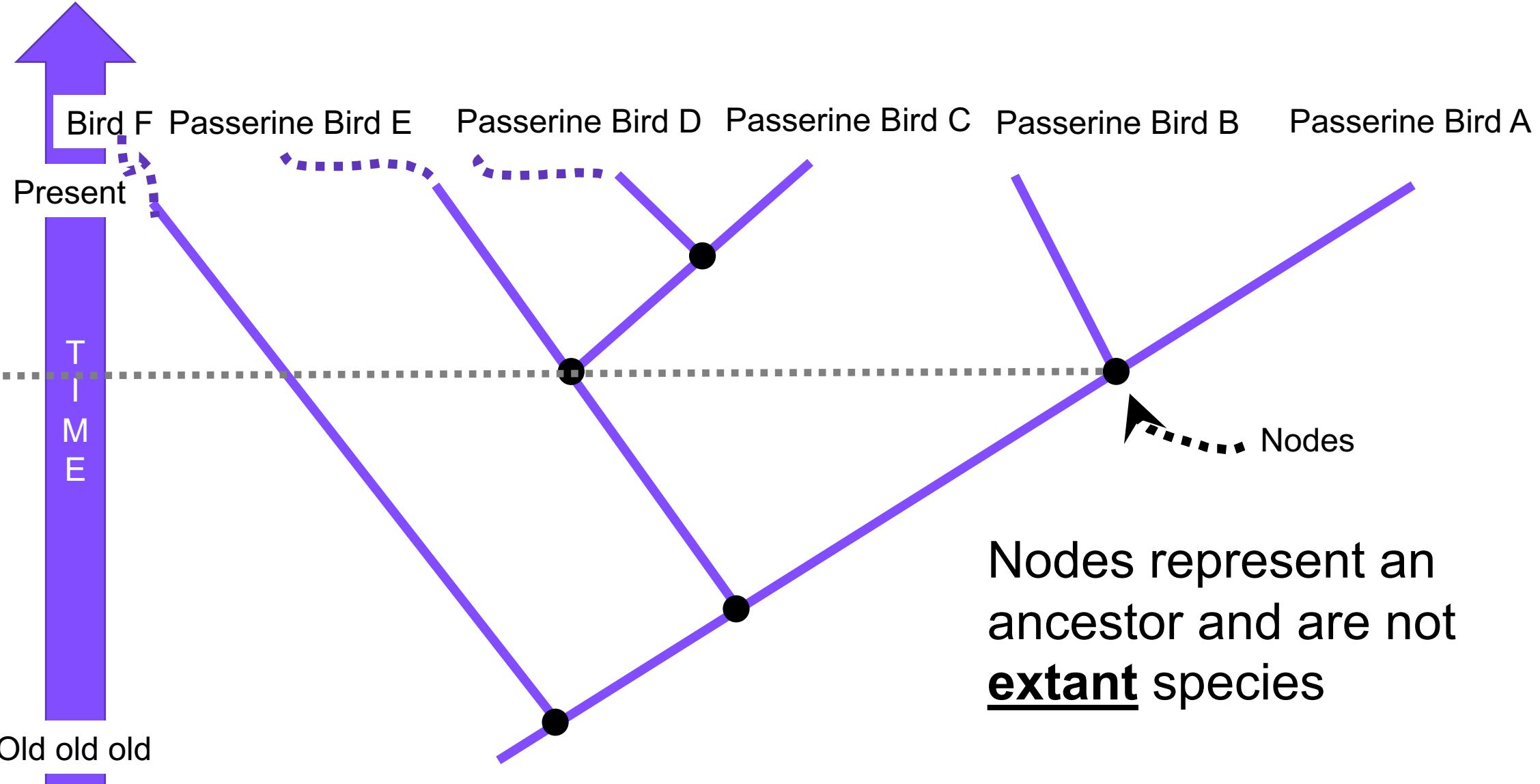
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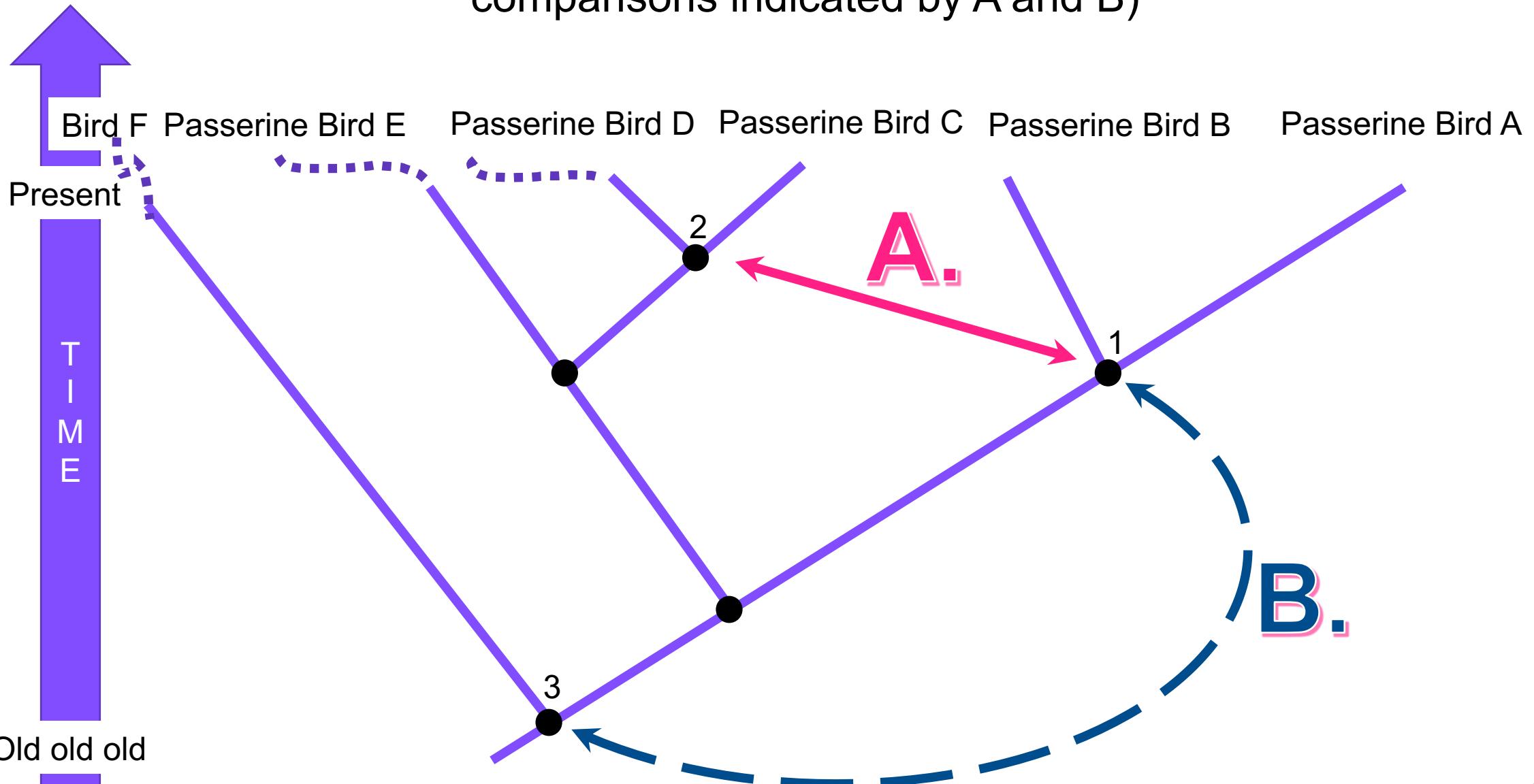
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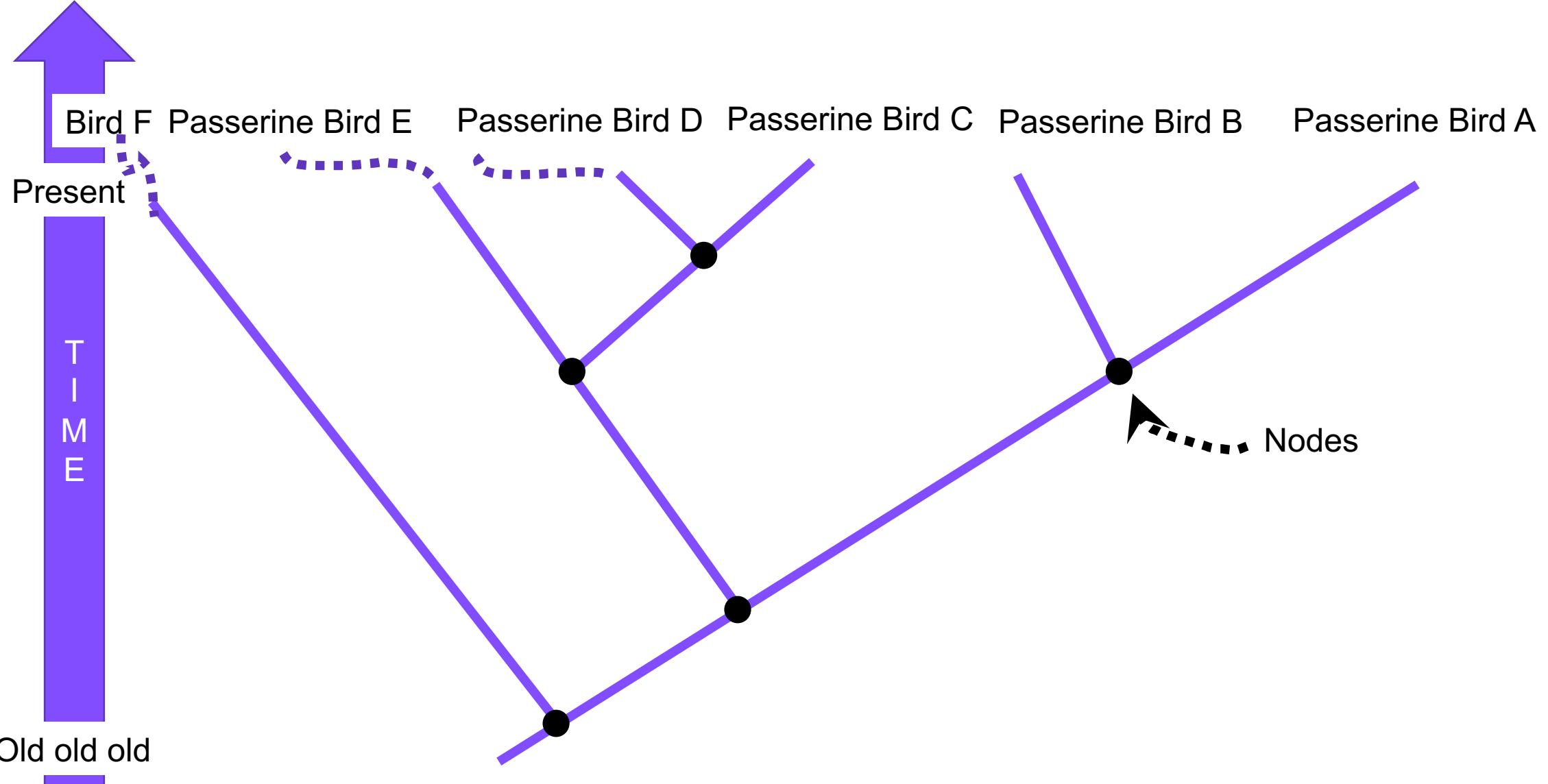
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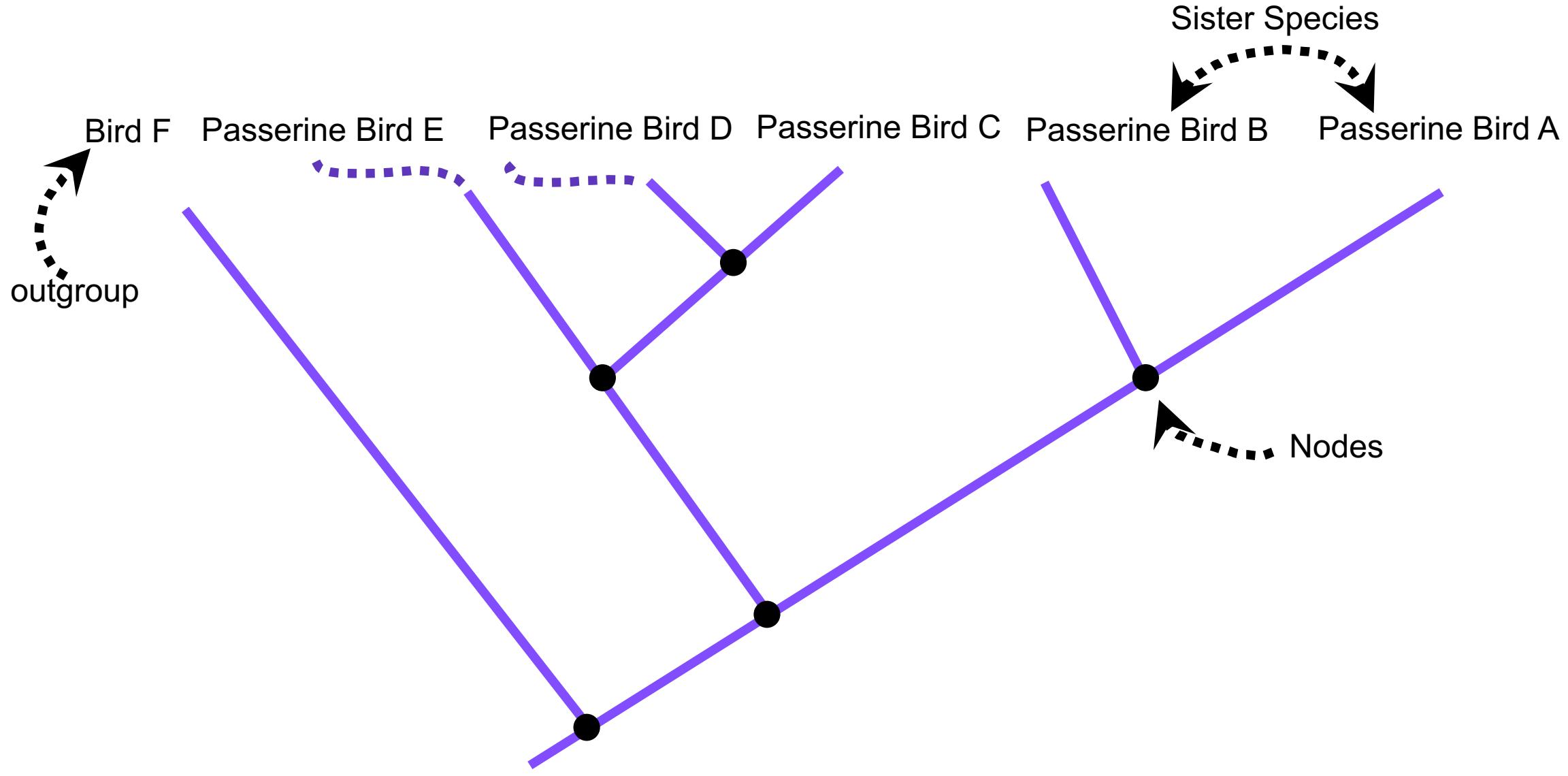
In groups, make observations about nodes 1, 2, and 3. Describe similarities and differences between nodes (Specifically the comparisons indicated by A and B)



Basics of interpreting a phylogenetic tree

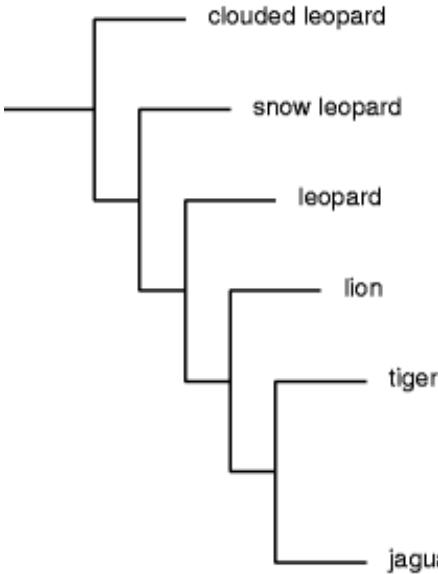


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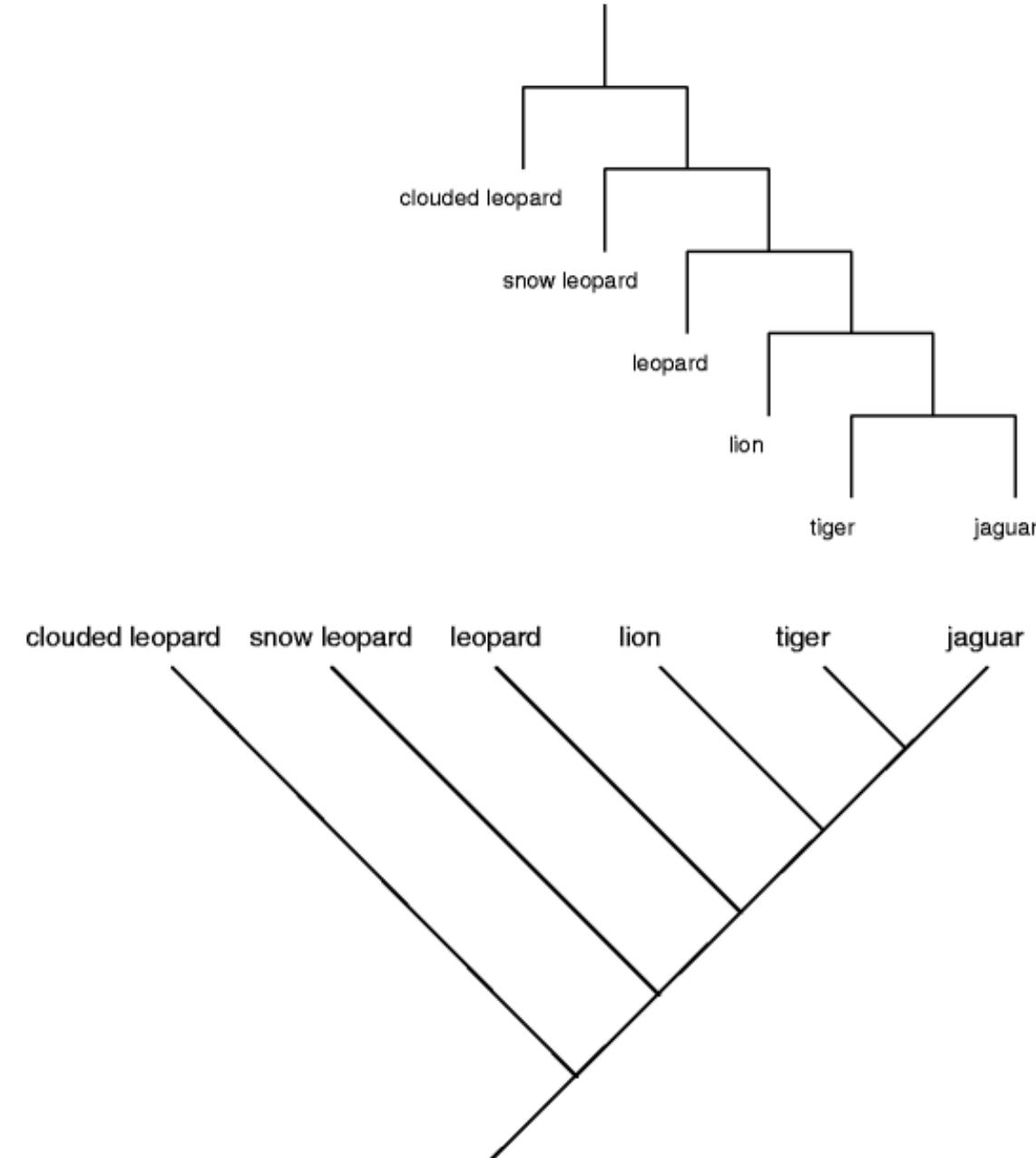


So many ways to draw a family (phylogenetic) tree

(a) usual way family trees are drawn for people (in this case you see a family tree for big cat species)



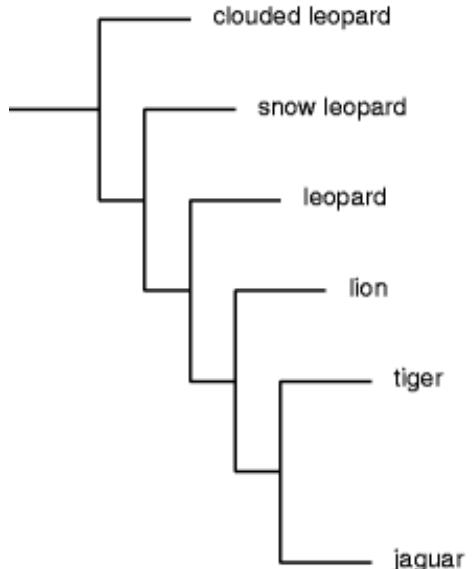
(b) another way to draw the same tree



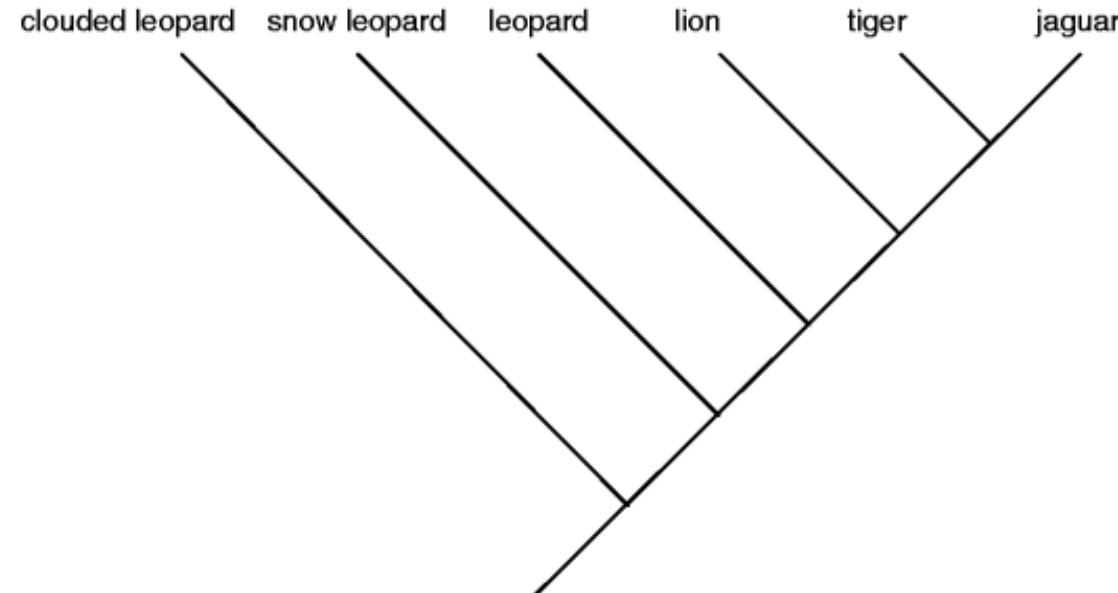
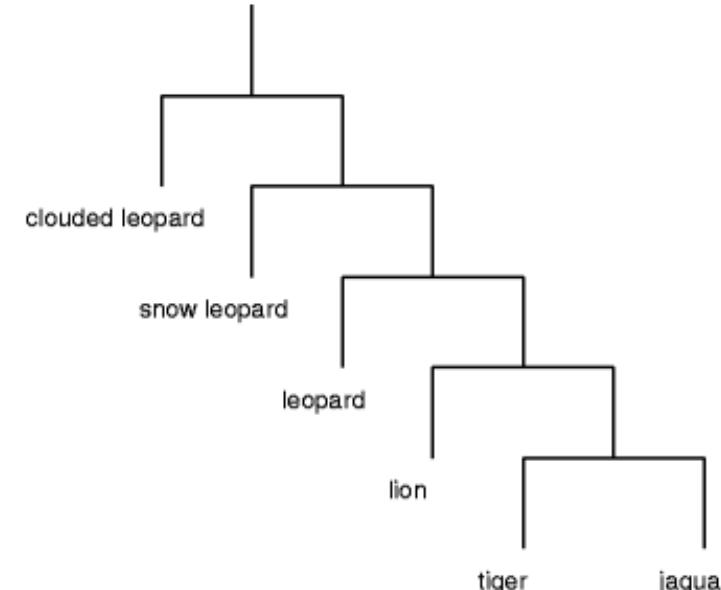
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So many ways to draw a family (phylogenetic) tree

1. Use an arrow to draw time (From old to present) on each of these trees.
2. Draw circles on each node. Put a start on the node that is the oldest.
3. Underline an example of sister species.
4. Fish are an outgroup for tetrapods... add fish as an outgroup on each of these phylogenies



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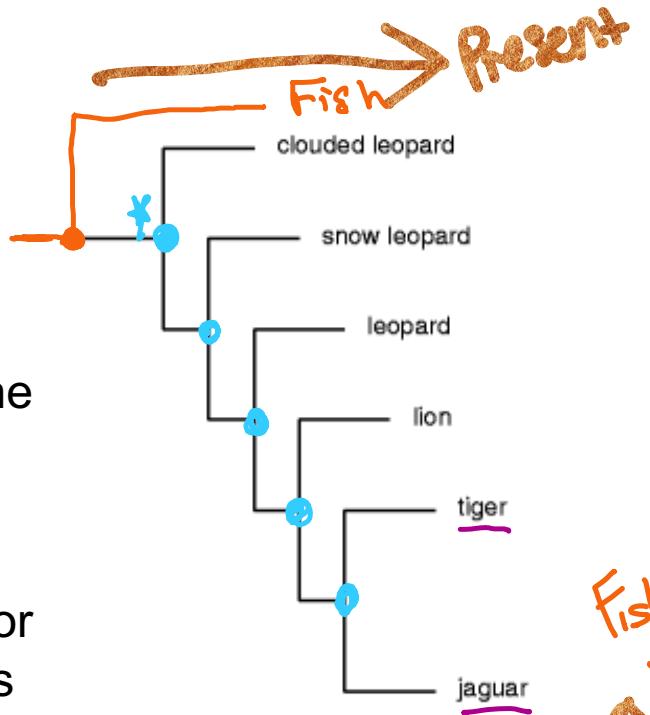


(c) yet another way to draw the same tree

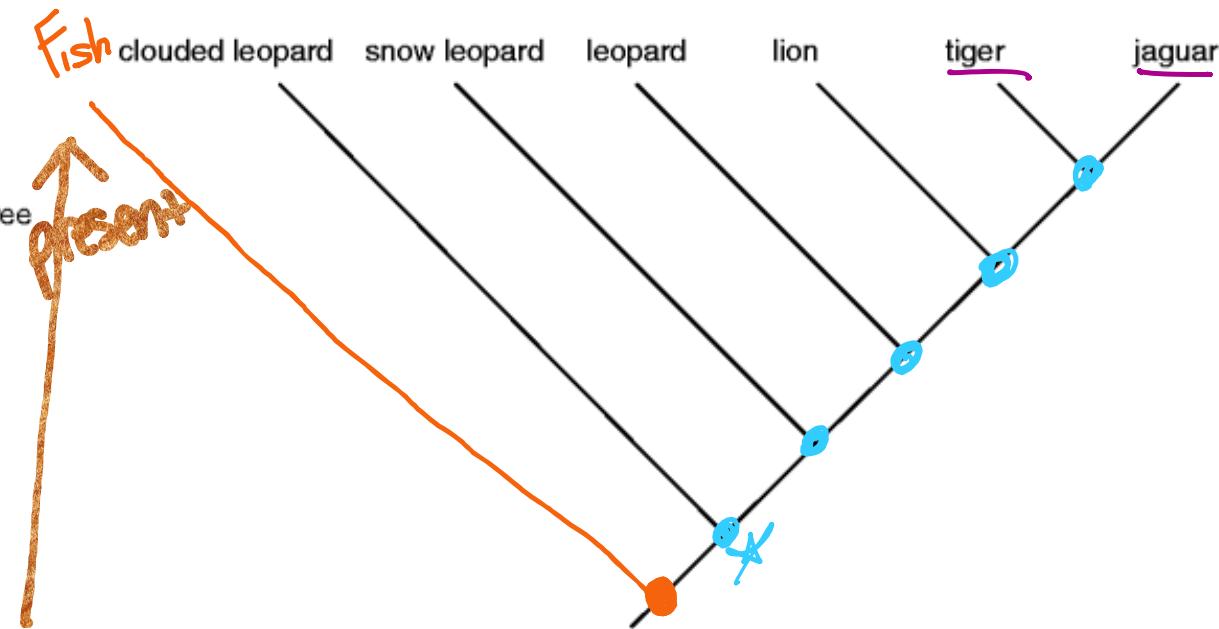
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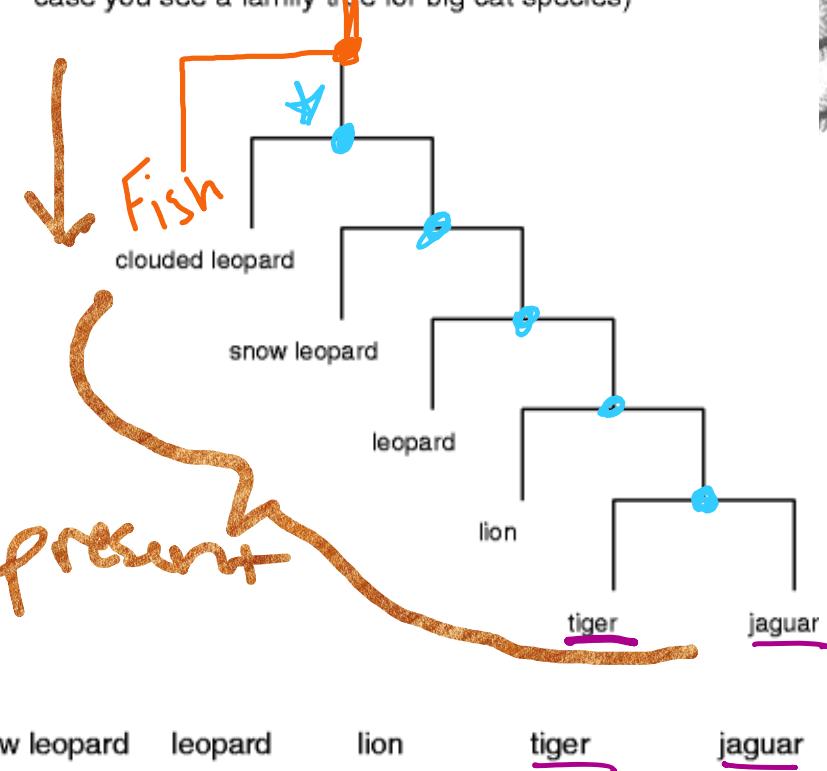


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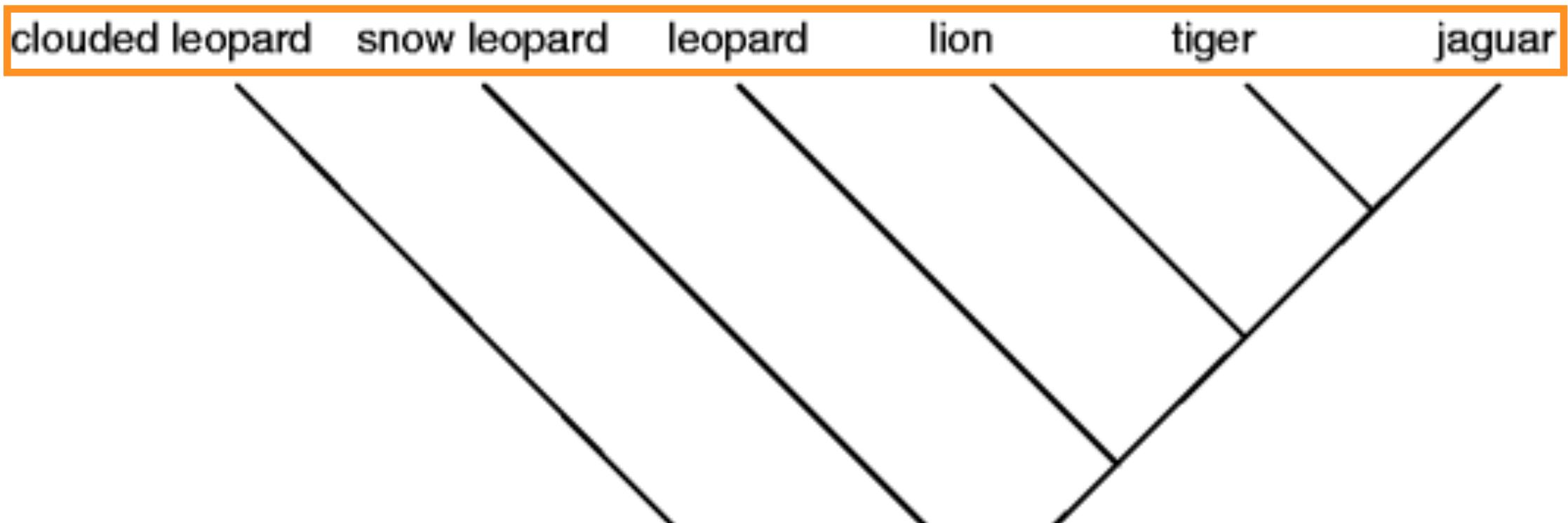
HOW DO WE DECIDE ON THESE RELATIONSHIPS?

Agenda

- Basics of interpreting a tree
- What is a species?
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Phylogenies commonly show the relationship between species. But what is a species? How would we divide up species in order to determine their relationships?



Activity: What is a species?

- Pretend you're in charge of all of biology and you're going to tell everyone what a species is. Your word is law. What criteria will you give for determining what is the same species and what are different species?
- Based on your criteria, are these two organisms the same or different species? If you need more information about them ask me!



There are Many Species Concepts

<u>Biological Species Concept</u> “Species are groups of interbreeding natural populations that are reproductively isolated from other such groups”	<u>Genotypic Cluster Species Concept</u> “A species is a [morphologically or genetically] distinguishable group of individuals that has few or no intermediates when in contact with other such clusters”	<u>Ecological Species Concept</u> “A species is a lineage (or a closely related set of lineages) which occupies an adaptive zone minimally different from that of any other lineage in its range and which evolves separately from all lineages outside its range”
<u>Evolutionary Species Concept</u> “A species is a single lineage of ancestral descendant populations or organisms which maintains its identity from other such lineages and which has its own evolutionary tendencies and historical fate”	<u>Phylogenetic Species Concept</u> “A species is the smallest [exclusive] monophyletic group of common ancestry”	<u>Genealogical Species Concept</u> “A species is a basal, exclusive group of organisms all of whose genes coalesce more recently with each other than with those of any organism outside the group, and that contains no exclusive group within it”

In you groups and answer the following Qs:

- What species concept was your definition of a species closest to?
- Pick one of the previous species concepts
 1. What kind of data would we need to collect on the two fish groups in order to determine if they were the same or different species?
 2. Draw a graph (depicting the data type you decided on) that would support grouping these two fish as:
 - a) Different species
 - b) Same species



**SHARE OUT YOUR
IDEAS!**



Ideas I want you to hold onto:

- All species concepts can be useful.
- One is not more “correct” than the other.
- Which species concept is used depends on the question.

What question are we trying to answer
when we consider phylogeny and
evolutionary history?

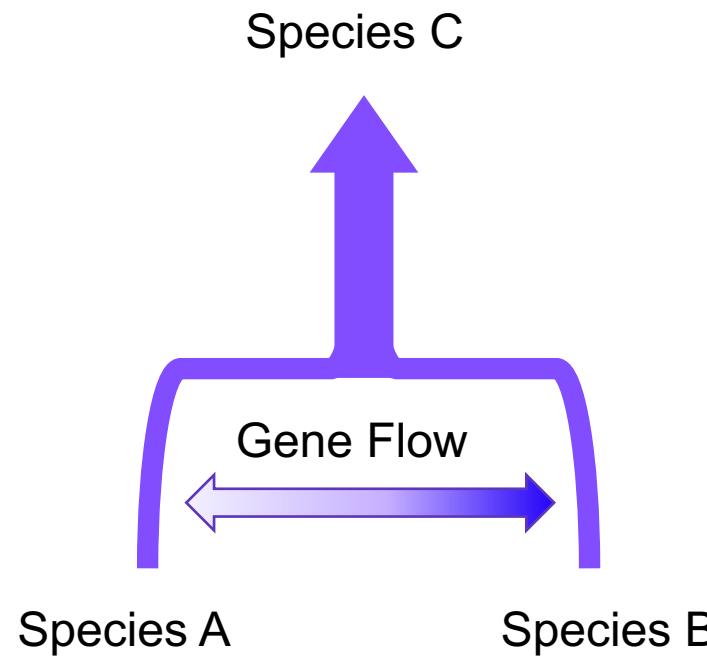
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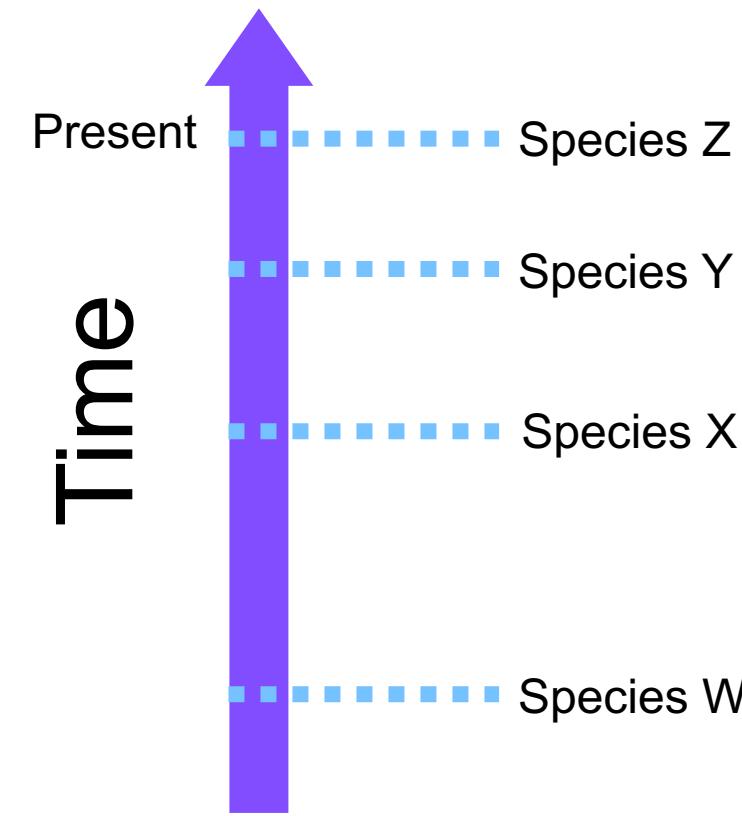


How are species produced?

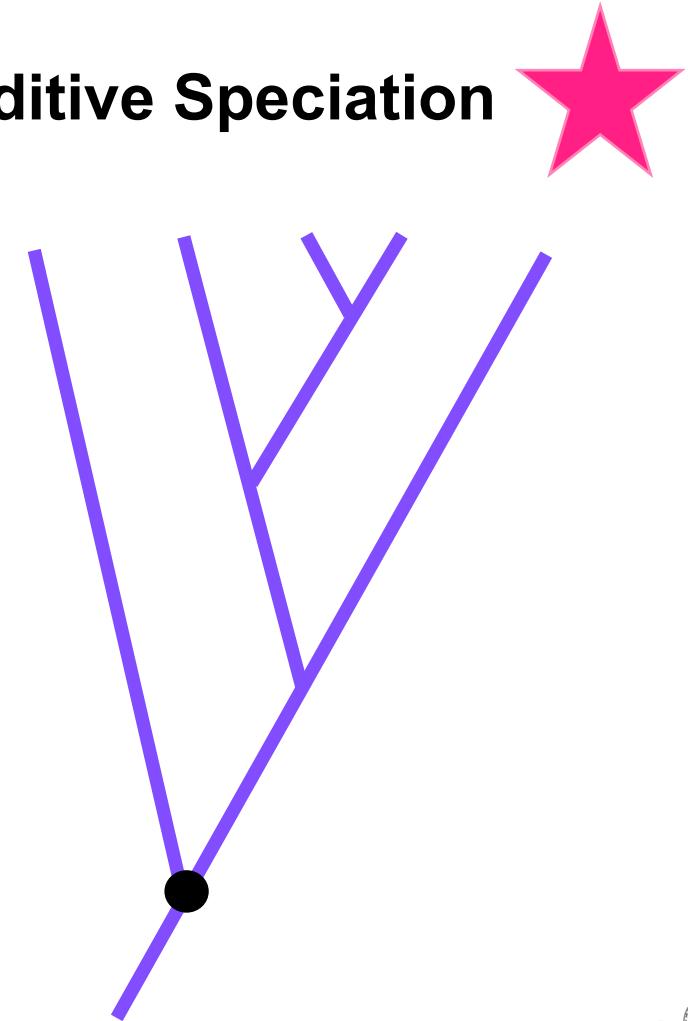
Reductive Speciation



Phyletic speciation



Additive Speciation



★ Additive Speciation

Patterns and Processes of Speciation

The most important thing to remember about speciation is not that it produces species, but
that it produces sister species

Divergence

What Processes can Produce Divergence?

Selection

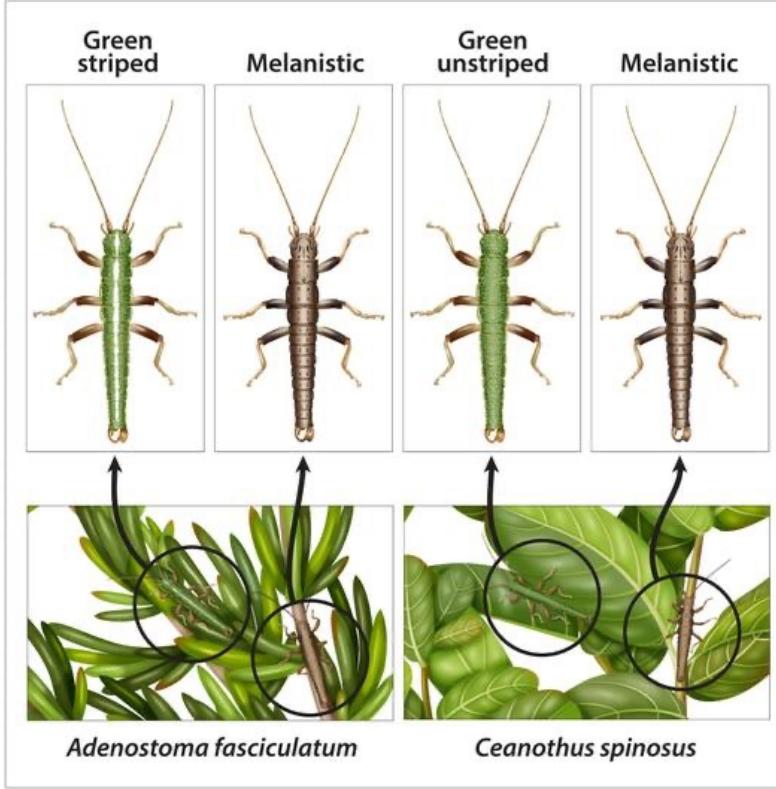
- Allopatric or sympatric
- Adaptation
- Ecological niche
- Environmental pressures

Neutral Processes

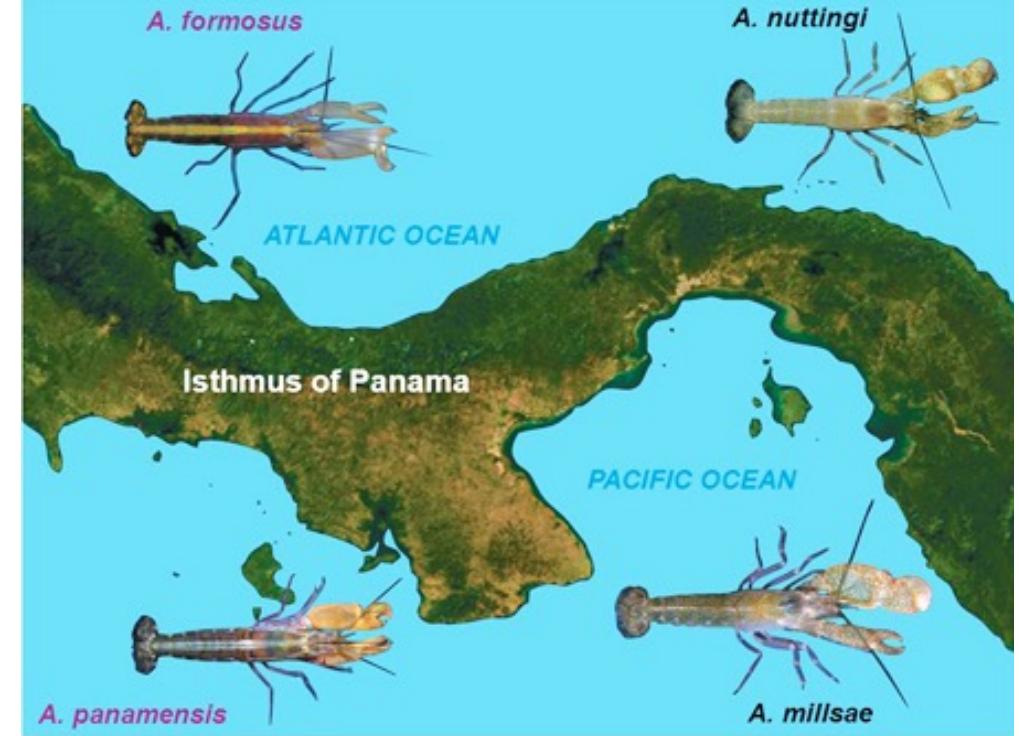
- Allopatric or sympatric
 - Commonly associated with allopatry
- Accumulating changes over time
- Speciation/Divergence is incidental

What Processes can Produce Divergence?

Selection

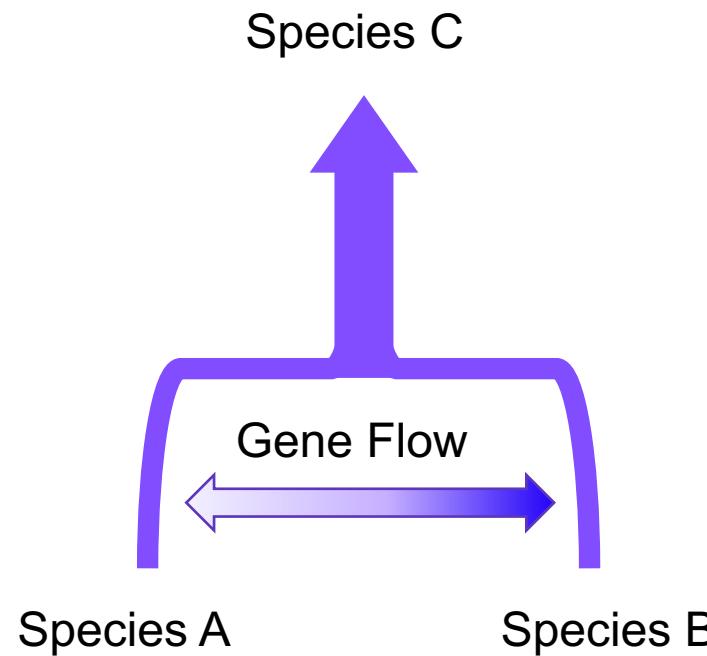


Neutral Processes

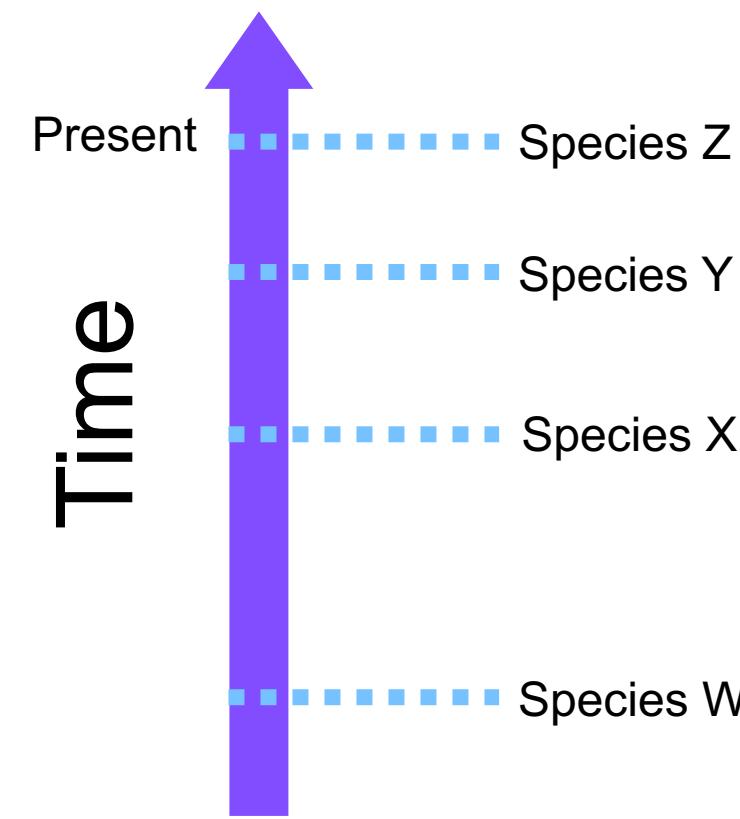


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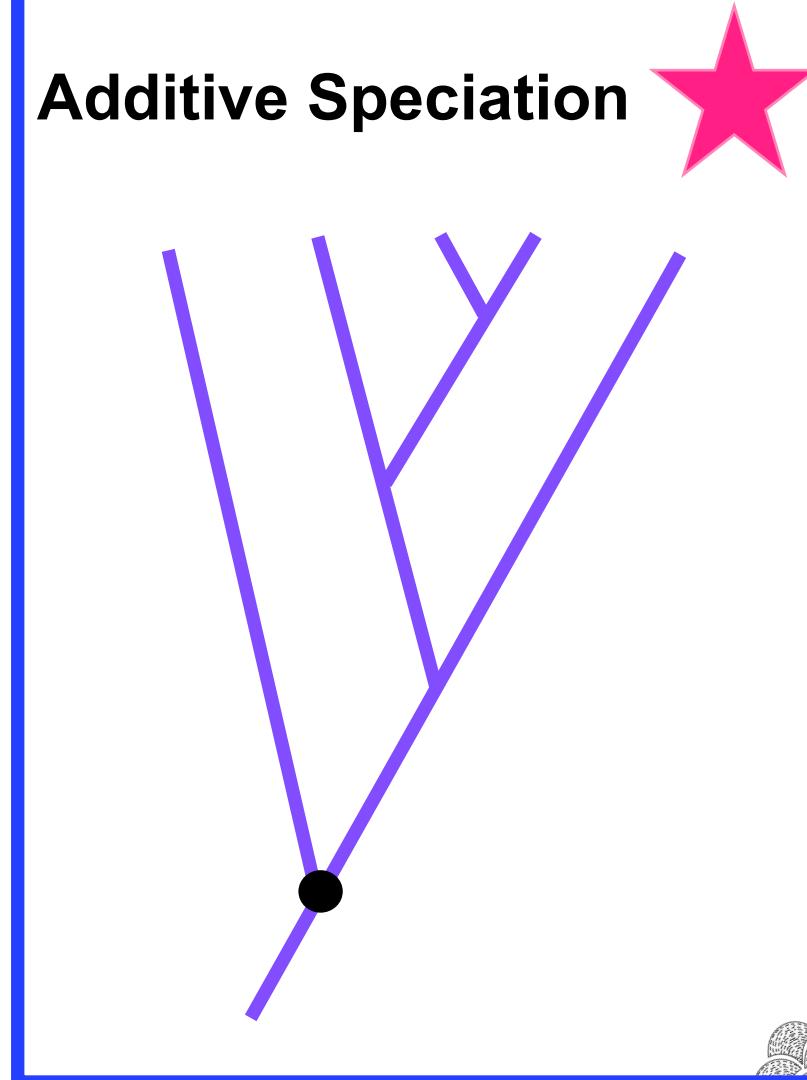
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Additive Speciation



Ideas I want you to hold onto:

- All species concepts can be useful.
- One is not more “correct” than the other.
- Which species concept is used depends on the question.
- Divergence/Speciation does not equal adaptation/selection

**What question are we trying to answer
when we consider phylogeny and
evolutionary history?**

Answer (broadly the def of phylogenetics):

- the study of the evolutionary history and relationships among or within groups of organisms (many studies use species designations as their “groups” of interest)
- A phylogeny is a hypothesis (we don’t know how accurate they are!)
- You can make a phylogeny based on any trait
 - Modern sequencing techniques mean that most phylogenetic analyses are based on genomic data.
 - Using genomic data is powerful for phylogenetic inference because it can help us determine which traits may have been inherited across time vs traits that have changed due to selective pressures.

There are Many Species Concepts

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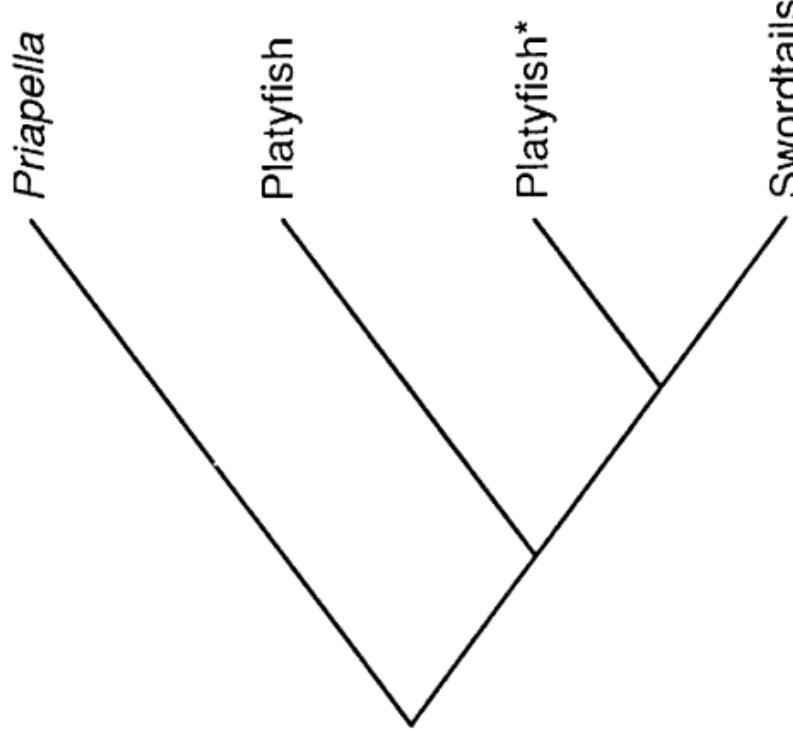
HOW DO WE ASK QUESTIONS THEN?

If every trait that I see today (or even in the fossil record) may be due to the evolutionary history of an organism or processes such as drift... How can I ask cool questions about the evolution of my favorite behavior????

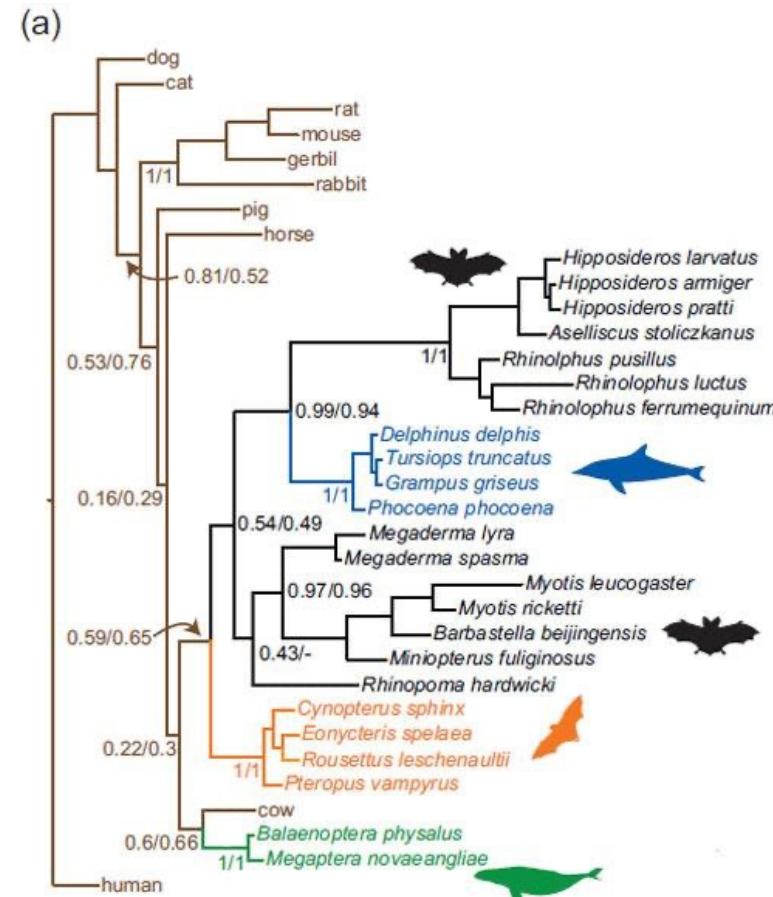


Comparative Framework

One of these things is not like the other

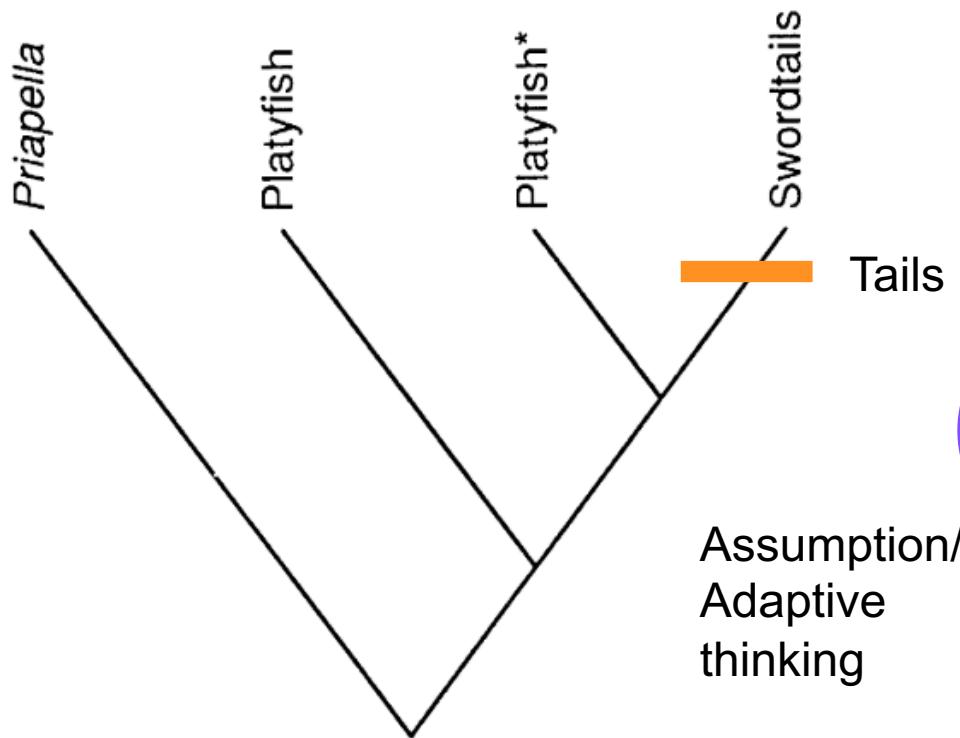


Twinsies (but not related)



Comparative Framework

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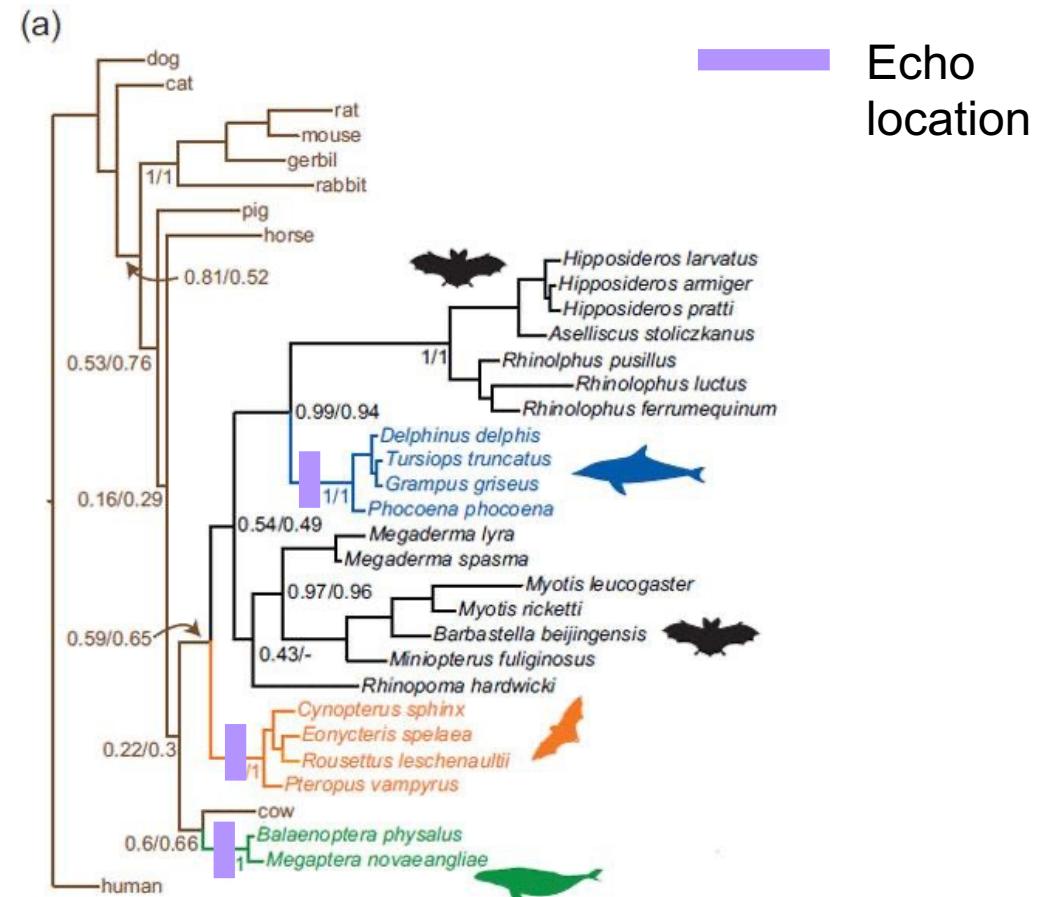


1. I know that the evolutionary history does not include long tails
2. Therefore, I think the change for tails occurred here
3. Because it is **different** I am hypothesizing it is adaptive for XYZ
4. If it is adaptive for XYZ then my species of interest should be better at XYZ than the other species
 - Here you test adaptive trait of interest across all groups
5. Then we can start asking about what may have changed in the environment that made the trait of interest adaptive

Comparative Framework

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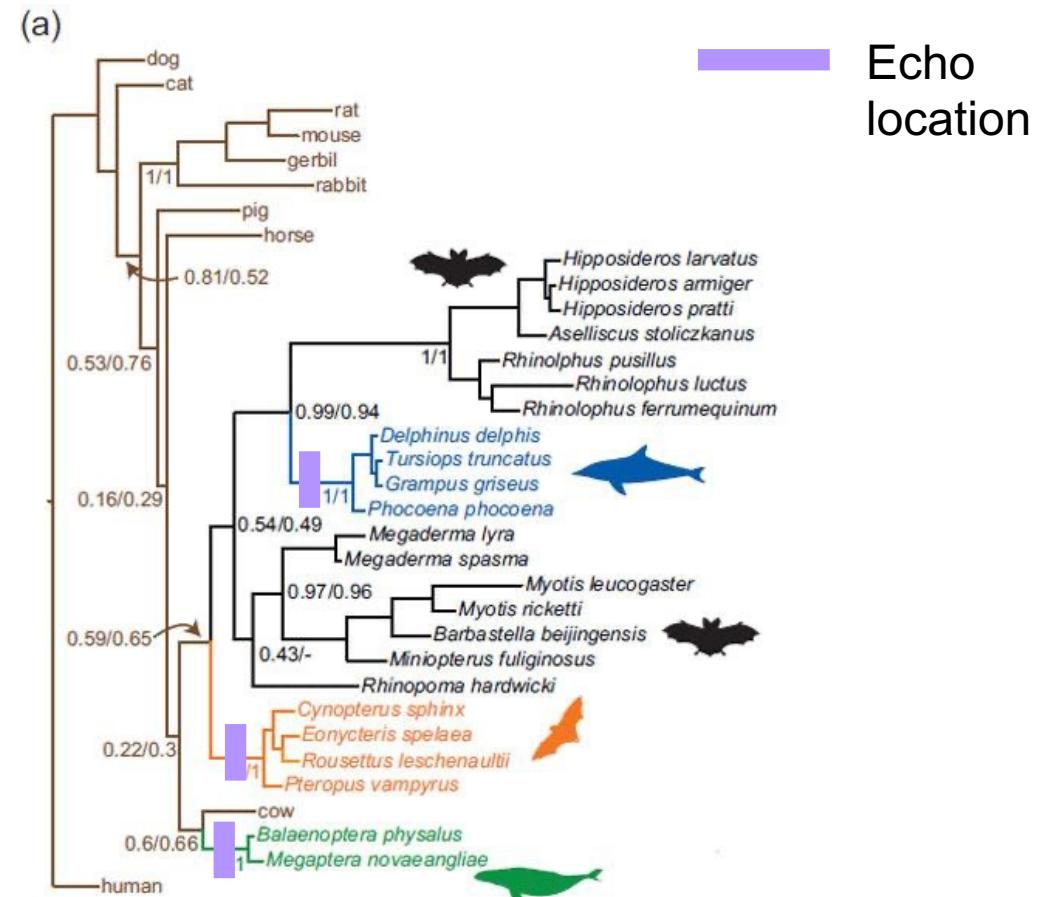
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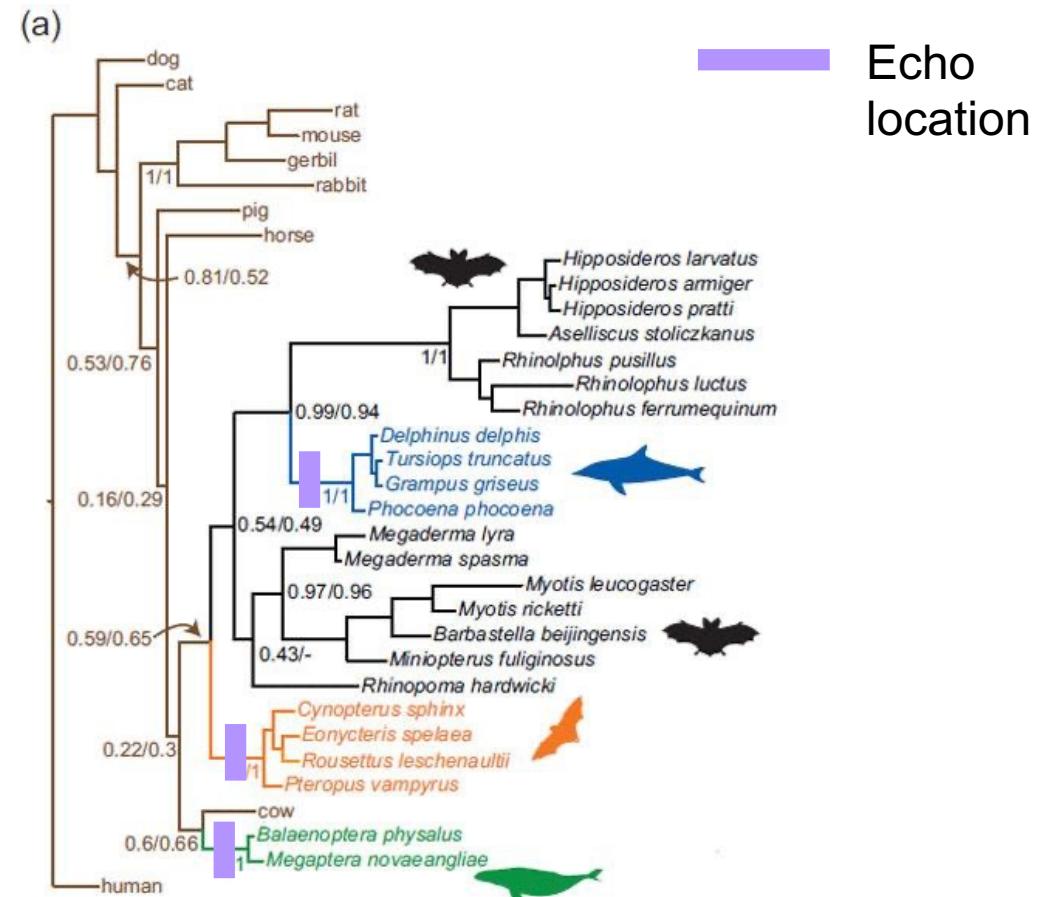
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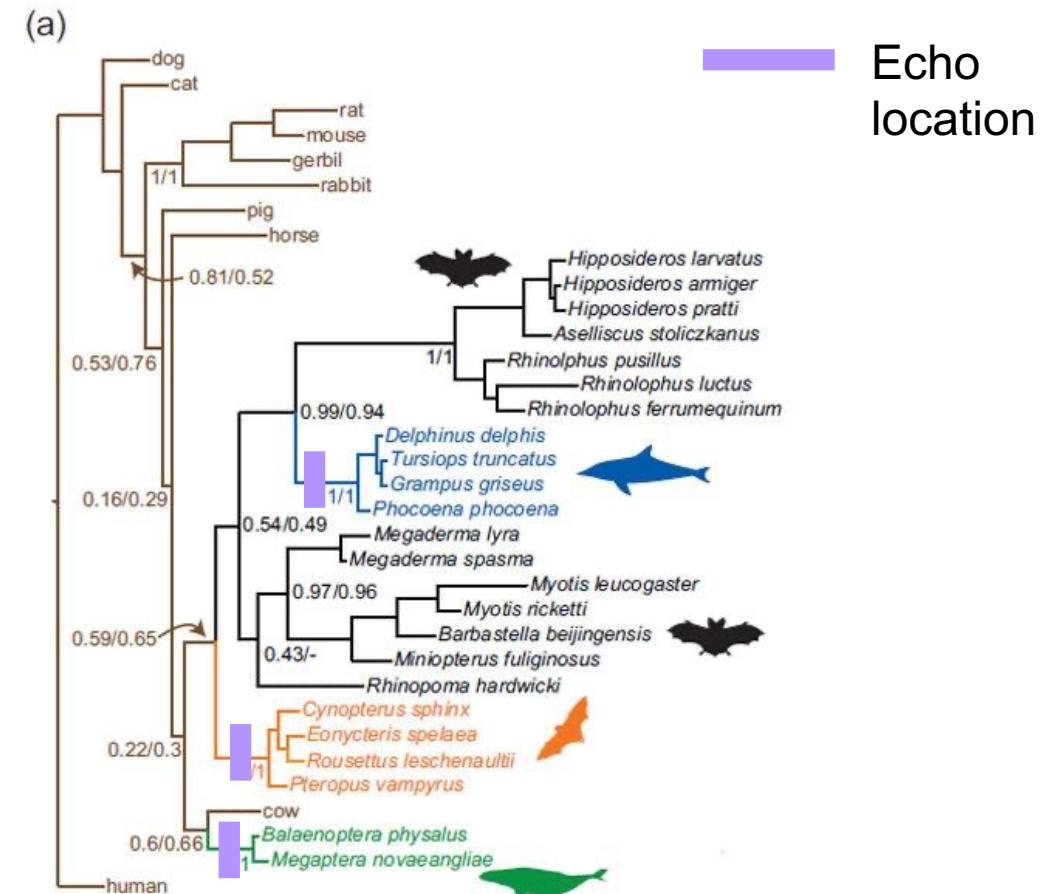
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 - Design a study to investigate whether I am right about that selective pressure by comparing the convergent groups

Twinsies (but not related)



Similarities in the framework:

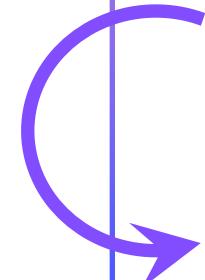


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Assumption/ Adaptive thinking

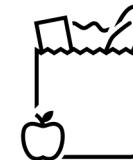
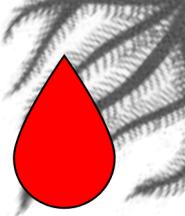
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Eptesicus fuscus



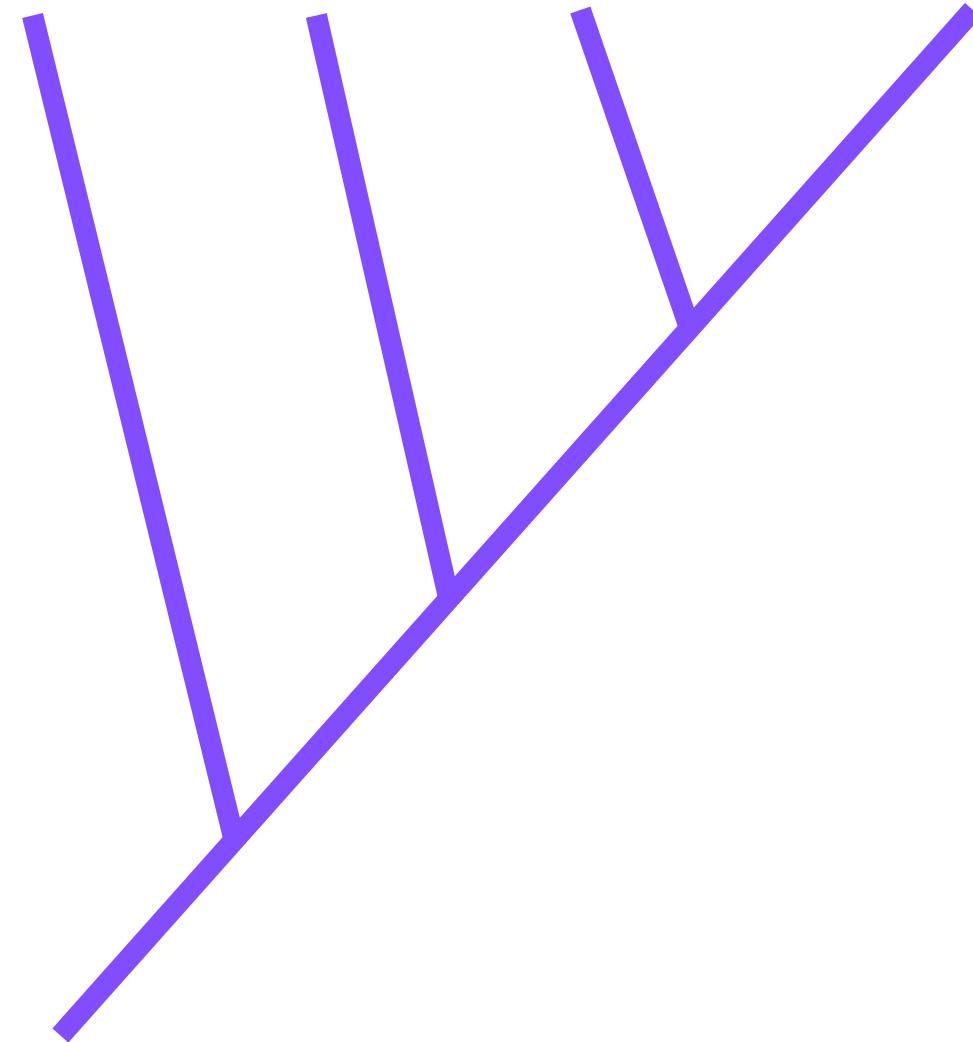
A. jamaicensis



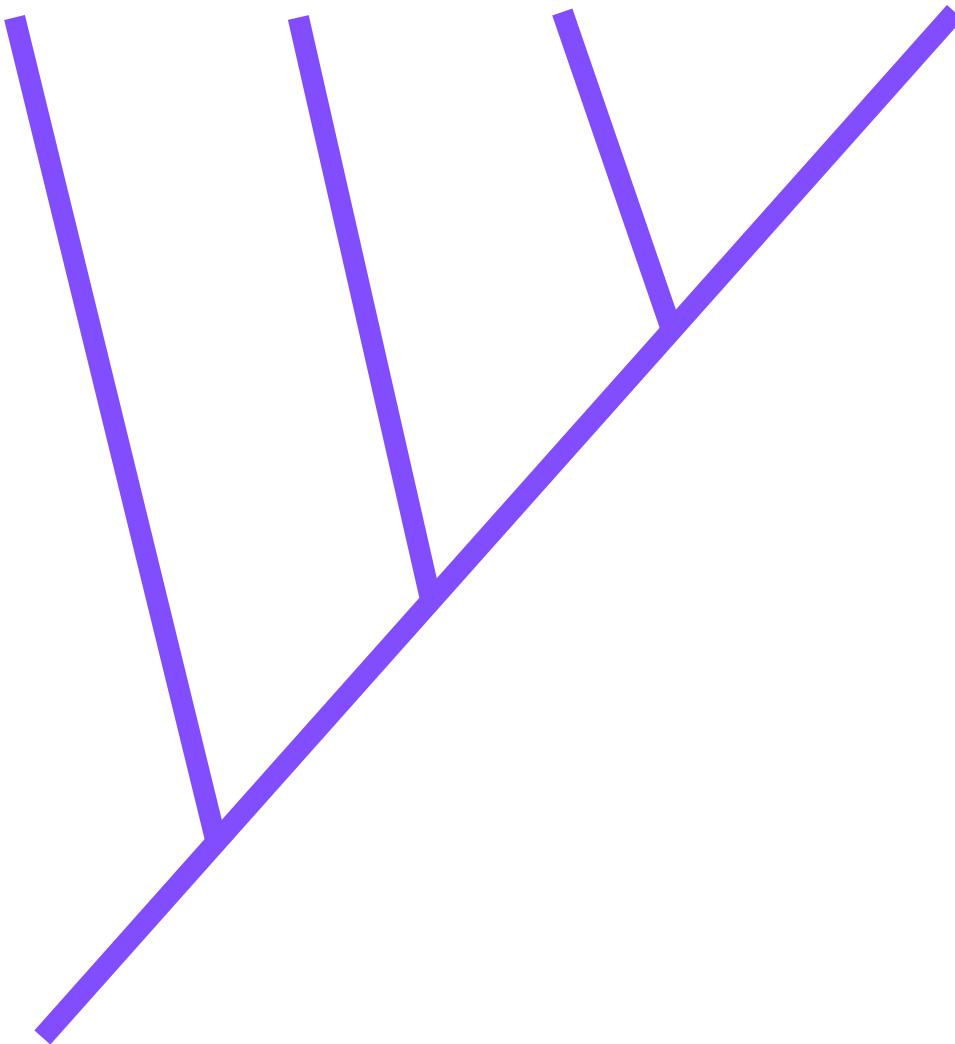
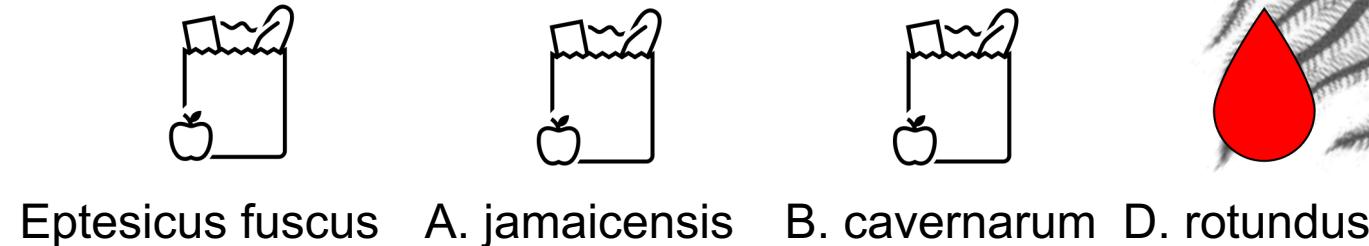
B. cavernarum D. rotundus

Activity: Vampire bats

Taste aversion learning is adaptive for not eating things that will make you sick. But this has never been investigated in bats or in generalists vs specialists. You do an experiment where you determine whether specific species of bats can acquire taste aversions. Surprisingly, you find that *D. rotundus* did not learn to associate novel tastes with aversive gastrointestinal events, but all other species in your study did. Now you want to know **WHY**. Using the phylogeny to the right (and a phylogenetic framework) answer the following questions:



1. Who is the outgroup? Is it a generalist or a specialist?
2. Is this an example of “one of these things is not like the other” or “twinsies”?
3. Mark on the phylogeny where taste aversion learning evolved.
4. Given what we know about
 - 1) the evolutionary history of the group and 2) their dietary description (gen vs spec.) give two processes that may have produced this pattern
 1. Why can we not differentiate between these two processes at this point in time?



Agenda

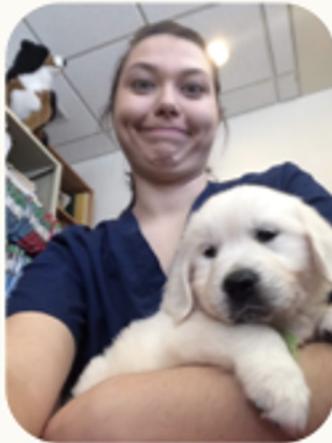
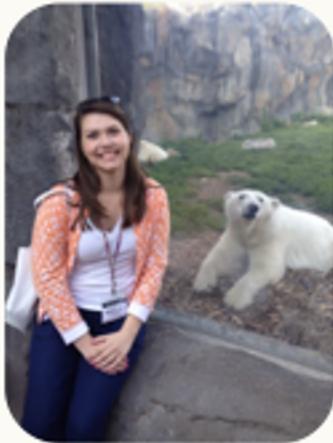
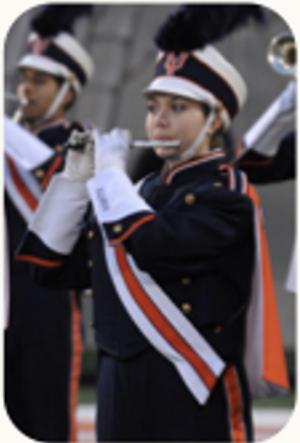
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QUESTIONS FOR ME





Undergraduate
Degree

Brookfield
Zoo

Veterinary
Clinic

Masters
Degree

PhD