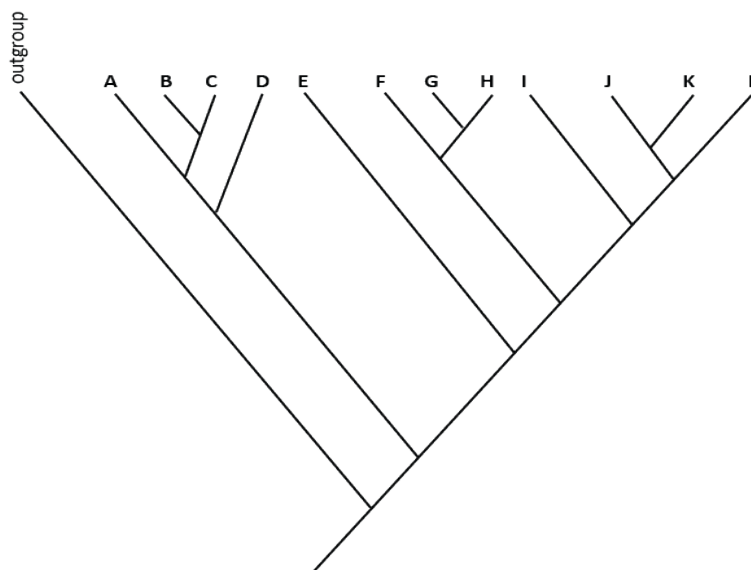


**EEB 2245/2245W Spring 2017: exercises working with phylogenetic trees and characters**

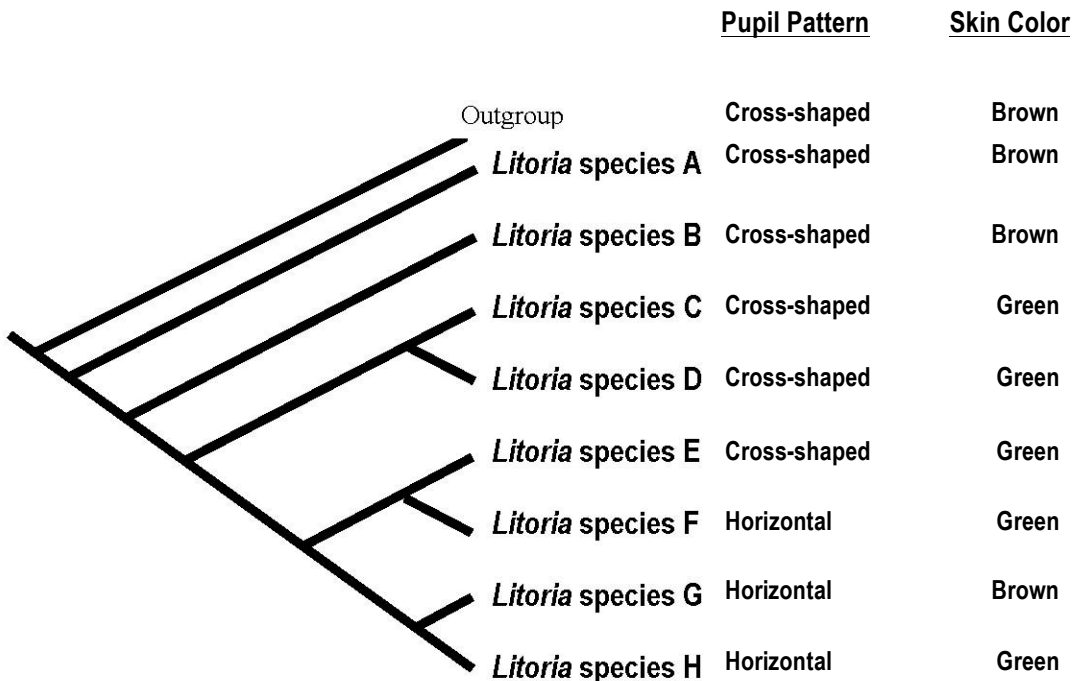
**1. Answer questions a through i below using the tree provided below.**

- a. Identify the taxon (or taxa if there is more than one) that is the sister group of J?
- b. Identify the taxon (or taxa if there is more than one) that is the sister group of E?
- c. Circle the node that represents the most recent common ancestor of A and L.
- d. Circle the node that represents the most recent common ancestor of E and G.
- e. List all taxa that are more closely related to C than they are to D.
- f. List all taxa that are more closely related to K than they are to H.
- g. List four monophyletic groups that include K.
- h. Identify a paraphyletic group that includes F.
- i. Identify a paraphyletic group that includes L.



2. **Hylid frogs (true “tree” frogs) in Australia consist of three genera: *Nyctimystes*, *Cyclorana*, and *Litoria*, and a total of about 70 species (apparently, the skin of one species smells like curry!). The phylogenetic tree showing the relationships among the *Litoria* species from the state of Queensland (denoted A-H) is shown below, along with information about two characters in these frogs: (1) Pupil Pattern and (2) Predominant Skin Color. Using the tree & distribution of character states of each of these characters shown on the tree (which you should assume represents the correct topology) answer the following questions.**

- What is the ancestral state for Pupil Pattern?
- What is the derived state for Skin Color?
- Identify an instance of homoplasy; what type of homoplasy is represented by the example you have chosen?
- Do the *Litoria* species that have horizontal pupils represent a paraphyletic or a monophyletic group? Justify your answer.



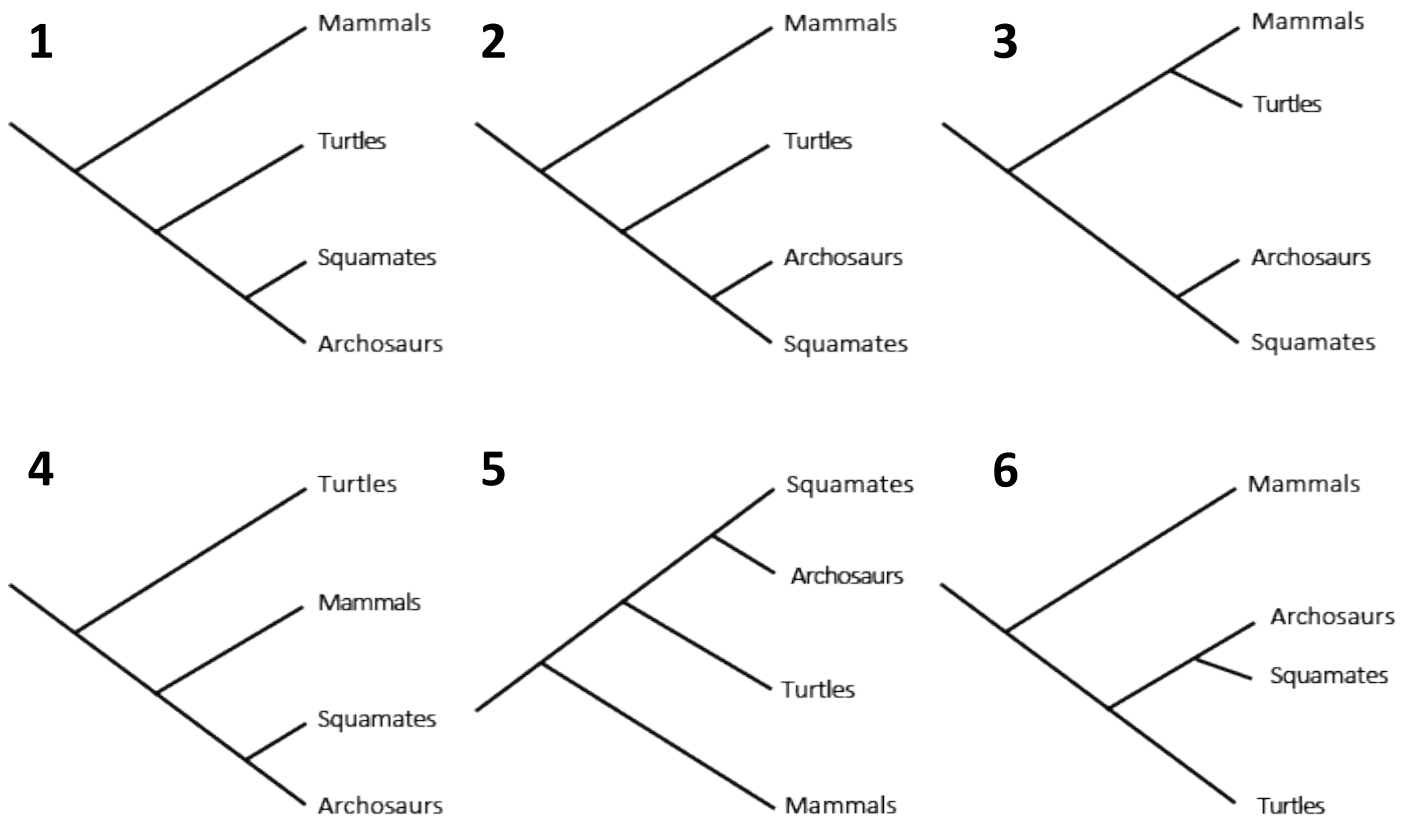
3. Imagine that you have recently found fossils of a lineage of extinct proboscidians (i.e., elephants & their relatives) from fossil beds in the extreme north of Siberia; and further, that these fossils are dated to approximately the early Oligocene. It is determined that the fossils represent 13 distinct species, and that four lineages have *independently acquired* the prominent forward-facing tusks as seen in *Mammuthus* sp., the woolly mammoth.

a. What type of homoplasy is characterized by the occurrence of these similar morphologies across the 13 species? How do you know this? Justify your answer.

b. Is this case of homoplasy an example of the same type of homoplasy as was illustrated in the placental, monotreme, and marsupial anteater species example given in lecture? Explain your answer.

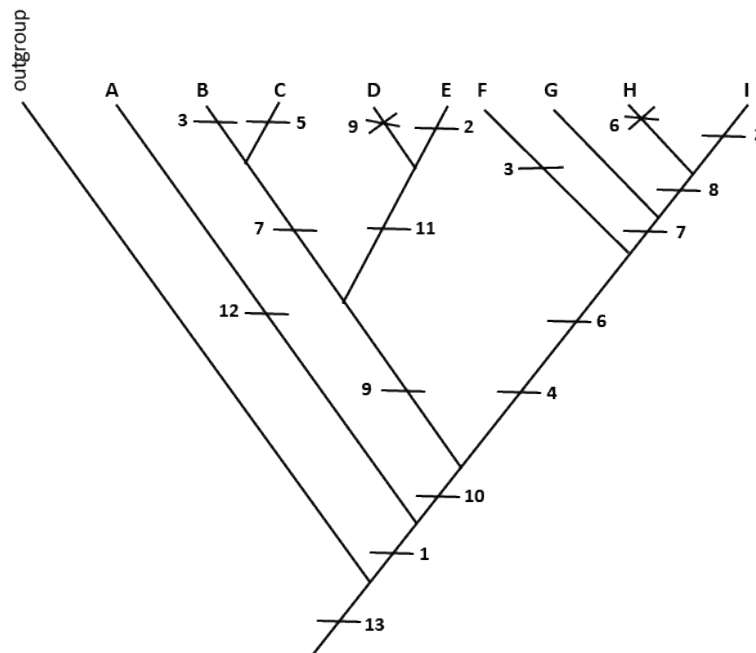
4. a. Which of the 6 trees shown below illustrate the same set of phylogenetic relationships (i.e., the same topology) as tree 1?

b. Which of the tree topologies shown below is most parsimonious?

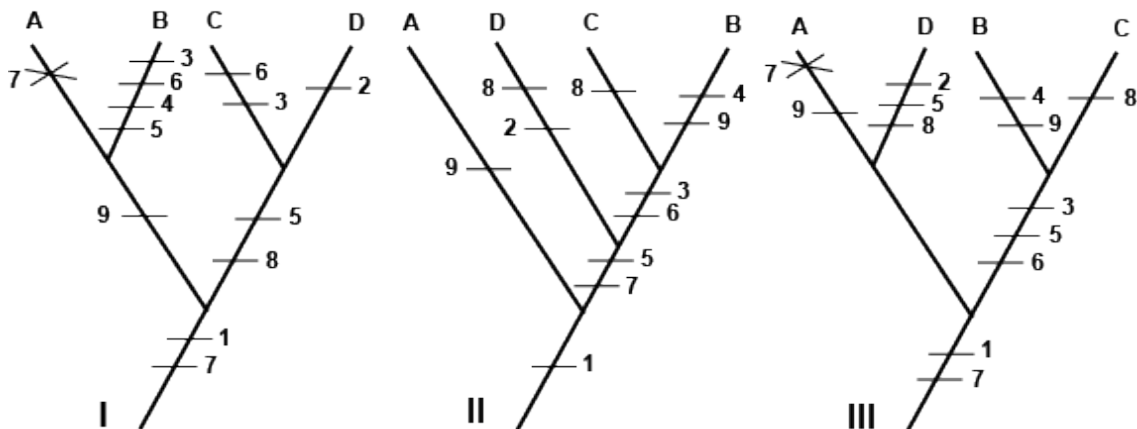


5. Use the tree of the relationships among 9 species (A through I) in the bird family Xiidae to answer the following questions.

- Identify a homoplasious character.
- Identify a reversal.
- Identify a convergent character.
- Identify a parallelism.



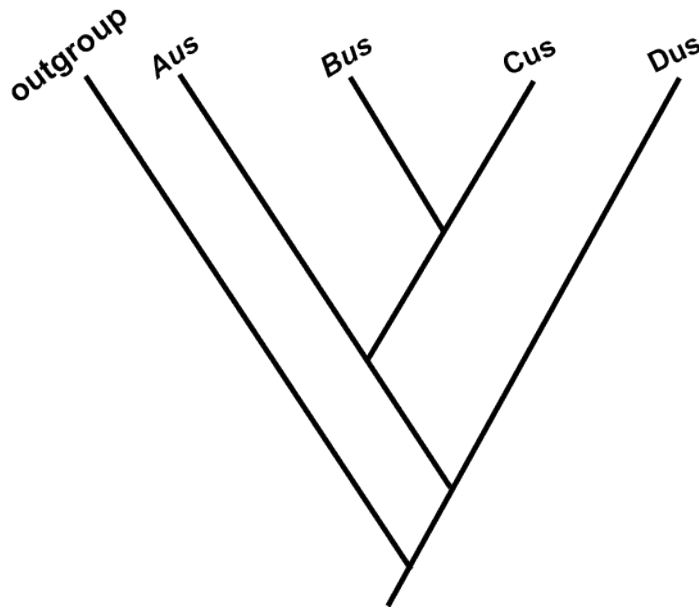
6. Which of the following phylogenetic trees is the MOST parsimonious?



7. Use the data matrix of molecular characters and the corresponding tree provided below to answer the following questions.

**Taxon**                      **base position**

	1	2	3	4	5	6
<i>Aus</i>	A	T	T	A	A	C
<i>Bus</i>	G	C	T	T	T	C
<i>Cus</i>	G	C	T	T	G	C
<i>Dus</i>	T	T	G	A	C	C
<i>Eus</i> (outgroup)	T	C	A	A	C	G



- Map the characters in the above data matrix onto the above tree topology in the most parsimonious way possible. (i.e., avoid postulating homoplasy unless that is the only option).
- Identify a synapomorphy for the group *Bus* + *Cus*.
- Identify a character that is homoplasious on the tree topology provided.
- Identify a binary character in this matrix.
- Identify a synapomorphy for the ingroup taxa.

**AND NOW TO REALLY TEST YOUR UNDERSTANDING OF GENERATING PHYLOGENETIC TREES...**

8. Based on the tapeworm data matrix provided below: (a) Draw the most parsimonious tree topology for the relationships among these tapeworms; (b) illustrate the most parsimonious mapping of the character states in the matrix on the most parsimonious tree; (c) What is the length of the most parsimonious tree?

<b>Taxon</b>	<b>Character</b>						
	<b>Scolex hooks</b>	<b>Uterus condition</b>	<b>Cirrus armature</b>	<b>Testes number</b>	<b>Ovary shape</b>	<b>Larval type</b>	<b>Vitelline form</b>
<i>Toanium orbita</i>	present	lobate	spined	2	tetralobed	cysticercus	follicular
<i>Toanium itera</i>	absent	lobate	naked	2	tetralobed	cysticercus	compact
<i>Toanium arctos</i>	present	branched	naked	10	bilobed	cysticercus	compact
<i>Toanium littum</i>	present	branched	spined	10	bilobed	cysticercus	follicular
<i>Endopium equus</i> (outgroup)	present	lobate	naked	10	tetralobed	hydatid cyst	follicular