

Name:

Are you a graduate or undergraduate student? Please circle one.

Bioinformatics Take Home Test #5

Due Date Monday 11/01/2013 before class

(This is an open book exam based on the honors system -- you can use notes, lecture notes, online manuals, and text books.

Teamwork is not allowed on the exams, write down your own answers, do not cut and paste from webpages.

If your answer uses a citation, give the source of the quoted text.)

Notes on Formatting Quizzes: Please make sure each answer is only on one page, by using page breaks. Splitting an answer onto two pages tend to lead to grading errors. Please do not write or type in font smaller than 12 point or write in cursive.

If you submit your quiz via email, please remove the instructions and extras (blank lines, alternative answers for multiple choice questions) from your document, so that only your answers, a minimal amount white space, and optionally the questions, are left.

1. **1pt** True/False Clustalx2 does NOT allow the possibility of treating gaps inserted at the beginning and end of a sequence differently from gaps inserted into the middle of a sequence.
2. **1pt** True/False Clustalx2 does NOT allow for different gap opening and extension penalties.
3. **1pt** True/False There were only 2 humans alive at the time of "Mitochondrial Eve".
4. **1pt** True/False There is only 1 possible tree with three taxa and it is not possible to root a tree with only 3 taxa.
5. **1pt** True/False When downloading an old genome from NCBI, it is best to first re-annotate the genome using RAST, because gene calling has improved significantly in the last 5 years.
6. **1pt** True/False Clustal DOES use a guide tree to align sequences and if the guide tree is the true tree, this will improve the alignment.
7. **1pt** True/False Using a guide tree to calculate an alignment NEVER biases the alignment in favor of the guide tree.
8. **1pt** True/False The term branch in phylogenetics refers to the same thing as the term branch does in botany, i.e. an internal node and all of the twigs that descend from it.

9. **1pt** True/False Spliceosomal introns came before self-splicing introns.
10. **1pt** True/False A phylogeny is a graphical depiction of the evolutionary relatedness of OTUs.
11. **1pt** True/False The introns early hypothesis is that introns arose early in the history of life and were important for combining protein domains to make functional proteins.
12. **1pt** True/False The introns late hypothesis is that introns are parasites that arose late in the formation of life, but still before LUCA and no longer spread to new places in the genome (i.e. most introns are in the ancestral position they have been in since pre-LUCA).
13. **1pt** True/False There are 105 possible rooted and 15 possible unrooted trees with different topology for trees with 5 OTUs.
14. **1pt** True/False There are 34459425 possible rooted and 2027025 possible unrooted trees with different topology for trees with 10 OTUs.
15. **1pt** True/False Phylogenetics is the sister science to bioinformatics and these two disciplines frequently overlap.
16. **1pt** True/False Go plots are conclusive proof of the intron early hypothesis, because an intron was found separating two Go domains, exactly where it was predicted to be.
17. **1pt** True/False If the alignment is improperly calculated and non-homologous positions are aligned, down-stream reconstruction efforts will be able to rectify this problem and will NOT simply regurgitate the same error.
18. **1pt** True/False Muscle calculates a word table for the sequences and then uses the words to align them, without using a guide tree.
19. **1pt** True/False It is easier to look back into the origins of chloroplasts than it is to look into the origins of mitochondria, because the mitochondria originated so much further back in time that the signal has been eroded down to a much greater extent than with chloroplast.

20. **2pt** Which of the following groups represent proper taxonomic groups (i.e., they form a clade in the "traditional" version of tree of life)? More than one correct answer; circle all correct answers.

- A. Bacteria B. Prokaryotes C. Protists D. Green Algae E. Eukaryotes
F. Reptiles G. Mammals H. Birds I. Eukaryotes + Archaea

21. **1pt** Which of the follow terms is a synonym for the branches of a tree?

- a. Interior Node
- b. Split
- c. Bifurcation
- d. All of the above
- e. None of the above

22. **1pt** Which of the following terms is NOT a synonym for the leaves in a phylogenetic tree?

- a. Species
- b. Terminal Node
- c. Taxa
- d. OTU
- e. None of the above

23. **1pt** The place of the root in the tree of life was first determined

- A) finding the group of organisms that had most primitive characters
- B) using an ancient gene duplication
- C) using a random sequence as outgroup
- D) Using parsimony to polarize the tree

24. **1pt** Please draw the all possible unrooted 4 taxa trees with the OTUs A,B, C, and D

25. **1pt** Draw the following tree (((A, Q, C) , (B, E)), H), L)

26. **1pt** A pairwise sequence alignment calculated with the Needleman-Wunch algorithm is the best possible alignment given the parameters (scoring matrix, gap penalty).

- A) The alignment is optimal (as measured by the alignment score), but there might be many equally optimal pathways/traces through the scoring table.
- B) this alignment is always better in aligning homologous structures than a multiple sequence alignment.
- C) The Needleman-Wunch algorithm provides the single best alignment.
- D) None of the above.

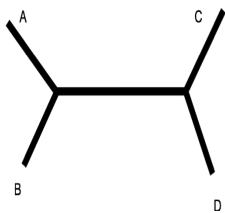
27. **1pt** "Mitochondrial Eve" lived around 200000 years ago. Which genes in modern human trace their ancestry to this person?

- A. $(0.5)^{200000}$ of the genes in the human genome
- B. All of the genes on the X chromosome (she is the mother of our species)
- C. All of them (she is one of the two original humans)
- D. All of the genes on the mitochondrial chromosome
- E. All of the genes responsible for the transition between modern and archaic humans
- F. No genes
- G. None of the above

Extra credit:

28. **1pt** Chloroplasts are maintained in the cell as an organelle with the aid of genes horizontally acquired from Chlamydia, an intracellular parasite. Can you think of any similar mechanism that would allow mitochondria to be retained as organelles?

29. **2.5 pt** There are five different ways to turn this unrooted tree into a rooted tree. Draw all five: (Note: this question is NOT the same as #24)



For Graduate Students: Short essays please.

30. **3pt** Who was Willig Hennig? What contribution did he make to phylogenetics? Why is that contribution so important? And is his system of classification, or is the one that came after him, superior and why?

31. **3pt** Why are gaps important in alignments (what would happen to alignment with no gaps and to an alignment where the insertion of additional gaps accrues no penalty)? What biological phenomena cause gaps in alignments? And how does gap placement relate back to homology in terms of homology at the individual nucleotide level?