

Exercises – Phylogenetics

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<http://wiki.techfak.uni-bielefeld.de/gi/Teaching/2015winter/Phylogenetik>

Exercise List 8 — 08.12.2015

Due to: 15.12.2015

Exercise 1 Relations.

(3 Points)

Create at least six pairs from the following terms/graphics and explain the relation between them in a sentence.

(a) additive

(b) agglomerative clustering

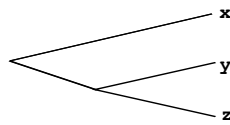
(c) Waterman

(d) UPGMA

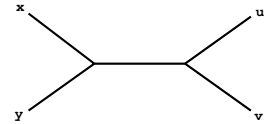
(e) ultrametric

(f) four-point-condition

(g)



(h)



(i) molecular clock

Exercise 2 Reconstruction of additive trees.

(4 Points)

The distance matrix on the right is *additive*.

Use the algorithm of Waterman (lecture notes, section 7.3.1) to reconstruct the corresponding tree.

Proceed lexicographically, i.e. start with the edge $\{A, B\}$ and add the taxa C, D and E in that order. Pick the pair $\{A, B\}$ to add a new taxon first. Sometimes you have to choose another pair.

Write down all steps.

	A	B	C	D	E
A :	0	11	7	9	10
B :		0	8	8	9
C :			0	6	7
D :				0	3
E :					0

Turn around!

Exercise 3 Fitch-Margoliash.

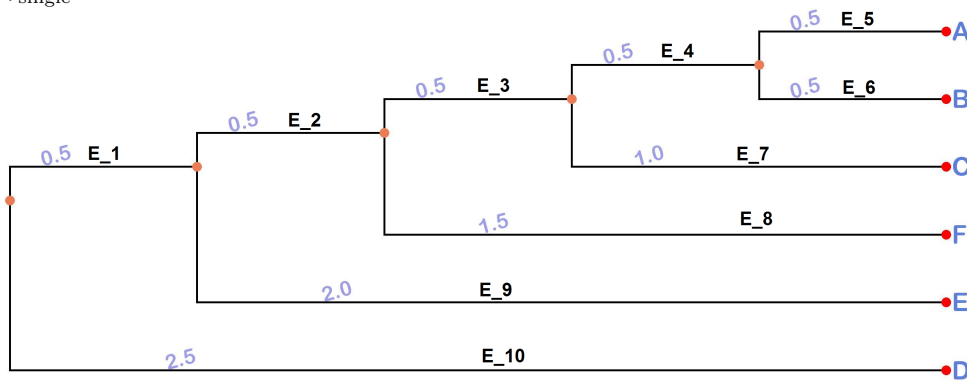
(4 Points)

On the exercise list 7 the clustering methods *Single linkage* and *WPGMA* were used to reconstruct a tree. For each method is a possible tree given below.

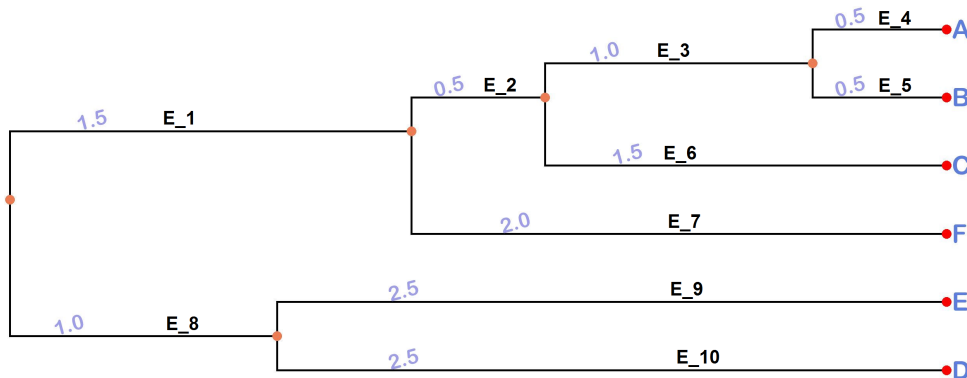
$$d^M :=$$

	A	B	C	D	E	F
A:	0	1	4	9	9	6
B:		0	2	9	9	4
C:			0	9	9	3
D:				0	5	6
E:					0	4
F:						0

$\mathcal{T}_{\text{single}} =$



$\mathcal{T}_{\text{WPGMA}} =$



Calculate the *Least Squares* error $E := \|\vec{d}^{\mathcal{T}} - \vec{d}^M\|^2$ (Fitch and Margoliash) for these trees. Write d^M as a vector. Proceed as follows:

- Write down $M^{\mathcal{T}}$ and \vec{w} w.r.t \mathcal{T} . (You can skip this step for $\mathcal{T}_{\text{WPGMA}}$.)
Hint: Merge the two edges that are incident to the root.
- Calculate $\vec{d}^{\mathcal{T}}$. (Get the values for $\mathcal{T}_{\text{WPGMA}}$ from the tree.)
- In the end calculate $E := \|\vec{d}^{\mathcal{T}} - \vec{d}^M\|^2$.

Which of the trees is the “better” one?