

Exercises – Phylogenetics

Universität Bielefeld, SS 2018
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<https://gi.cebitec.uni-bielefeld.de/Teaching/2018summer/Phylogenetik>

Exercise Sheet 7 — 07.06.2018

Due: 14.06.2018

Task 1 Agglomerative Clustering.

(3 points)

Use WPGMA to reconstruct phylogenetic trees from the matrix below. State the corresponding matrix in every intermediate step and write down the final tree. If there are several possibilities, follow only one.

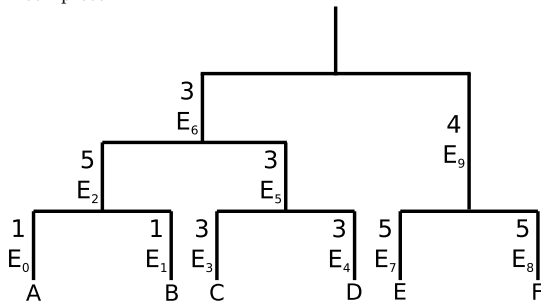
	A	B	C	D	E	F
A :	0	2	8	12	18	18
B :		0	4	8	18	18
C :			0	6	18	18
D :				0	8	12
E :					0	10
F :						0

Task 2 Fitch-Margoliash.

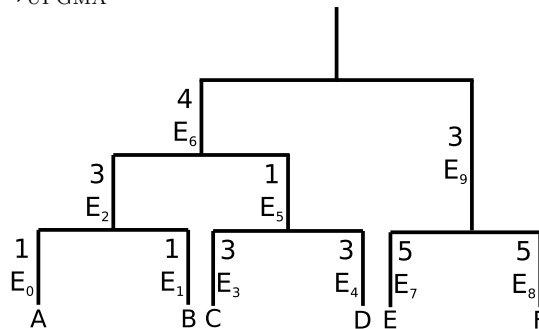
(3 points)

Besides WPGMA, other agglomerative clustering variants can be used to reconstruct a tree from the matrix in Task 1. The methods *complete linkage* and *UPGMA* can result in the trees $\mathcal{T}_{\text{complete}}$ and $\mathcal{T}_{\text{UPGMA}}$, respectively.

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



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



Calculate the *least squares error* $E := \|\vec{d}^T - \vec{d}^M\|^2$ (according to Fitch and Margoliash) for both trees. You do not need to write down matrix M^T and vector \vec{w} explicitly.

Which tree is the “better” one?

Task 3 Reconstruction of Additive Trees.

(3 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. Try pair $\{A, B\}$ to add a new taxon first. Sometimes you might 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

Please turn over! Bitte wenden!

Task 4 Minimum Evolution.**(3 points)**

Write a linear program (LP) that calculates the *minimum evolution tree* (ME tree) for the distance matrix from Task 1 and the tree topology $\mathcal{T}_{\text{UPGMA}}$ from Task 2.

Use an online solver to get a solution for it, for instance:

- <http://www.zweigmedia.com/RealWorld/simplex.html> or
- <http://www.phpsimplex.com/simplex/simplex.htm?l=en>.

You can either include your LP in your solution sheet or send it to Roland.

What are the minimum total edge length and the individual edge lengths?