

Exercises – Phylogenetics

Universität Bielefeld, SS 2019

Dr. Roland Wittler, M. Sc. Tizian Schulz

<https://gi.cebitec.uni-bielefeld.de/Teaching/2019summer/Phylogenetik>

Exercise Sheet 7 — 23.05.2019

Due: 06.06.2019

Task 1 Neighbor Joining.

(6 points)

Reconstruct a phylogenetic tree from the following matrix. Use

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
<i>A</i> :	0	8	5	8	2
<i>B</i> :		0	8	6	6
<i>C</i> :			0	8	4
<i>D</i> :				0	6
<i>E</i> :					0

(a) Waterman’s algorithm and

(b) *Neighbor Joining*.

Write down all steps.

Hint: When performing Waterman’s algorithm, start with the two taxa *A* and *B*, and try to add all taxa to their edge first. As soon as this is not possible anymore, continue with the path between *A* and *C*. You might get negative edge weights.

Task 2 Fitch-Margoliash.

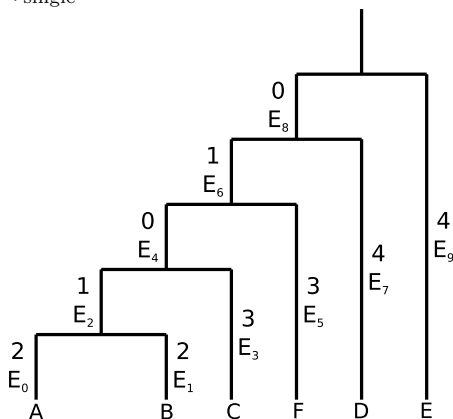
(2 points)

On exercise sheet 6, different agglomerative clustering methods have been used for a tree reconstruction. For the given matrix d^M , the methods *single linkage* and *WPGMA* can result in the trees $\mathcal{T}_{\text{single}}$ and $\mathcal{T}_{\text{WPGMA}}$, respectively.

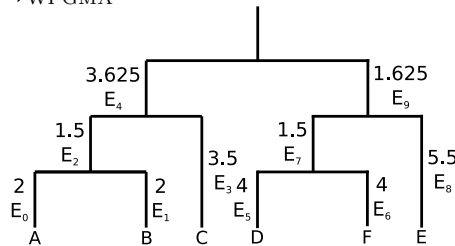
$d^M :=$

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
<i>A</i> :	0	4	8	18	18	6
<i>B</i> :		0	6	12	8	8
<i>C</i> :			0	18	18	12
<i>D</i> :				0	10	8
<i>E</i> :					0	12
<i>F</i> :						0

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



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



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?

Please turn around! Bitte wenden!

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

Write a linear program (LP) that calculates the *minimum evolution tree* (ME tree) for the distance matrix from Task 2 on this exercise sheet and the tree topology resulting for the WPGMA method.

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>.

Send your LP to your T.A.¹

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

Compare your results and the results from Task 2.

¹tischulz[at]cebitec...