

Exercises – Phylogenetics

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

Exercise List 9 — 17.12.2015

Due to: 12.01.2016

Exercise 1 Neighbor Joining.

(6 Points)

Use *Neighbor Joining* to reconstruct a phylogenetic tree from the following matrix. Write down all steps.

	A	B	C	D	E
A :	0	4	2	2	4
B :		0	7	6	4
C :			0	2	6
D :				0	6
E :					0

Exercise 2 Minimum Evolution.

(6 Points)

Write a LP (linear program) that calculates the *minimum evolution tree* (ME tree).

We want to calculate the ME tree for a given graph \mathcal{G} . This is very similar to the Steiner tree setup: For a given graph \mathcal{G} find a tree that covers all vertices and minimizes the weight of the edges. In a more formal way, we want to find a tree T that minimizes L , where

$$L := \sum_{i=1}^{2i-3} \omega_i$$

where ω_i is the length of the edge i .

There are also two constraints that have to be considered:

- (a) $\omega_i \geq 0, \forall i$
All branch lengths are non-negative.

- (b) $d_{i,j}^T \geq d_{i,j}^M, \forall i, j$

The tree distance of any pair (i, j) is not allowed to be smaller than the measured distance. This becomes clear if you think about evolution. The alignment distance might underestimate the real number of changes during evolution (e.g. a mutation from A to C back to A). However, the alignment distance will never overestimate this number of changes. Our given data is the measured distance, therefore the “real” distance in the tree might be greater.

Use an online solver to get a solution for your LP.

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

Use your LP with the data from Task 1. Compare the result from the LP with your tree from the Neighbor Joining algorithm.

Send your LP to your T.A.¹

If you have trouble with linear programming here are some links that might help:

https://en.wikipedia.org/wiki/Linear_programming and <http://www.purplemath.com/modules/linprog.htm>

Purplemath has also a nice example to visualize the idea and need of LP:

<http://www.purplemath.com/modules/linprog3.htm>

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