

Exercises – Phylogenetics

Universität Bielefeld, SS 2019

Dr. Roland Wittler, M. Sc. Tizian Schulz

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

Exercise Sheet 3 — 25.04.2019

Due: 02.05.2019

Task 1 Characters and States.

(2 points)

The four taxa A , B , C and D have the common characters 1, 2 and 3 with states as specified in the following character state matrix:

	1	2	3
A	z	α	c
B	z	β	a
C	x	α	a
D	y	β	b

Draw all possible binary, unrooted trees that contain the given taxa as leaves. Decide for each character and for each tree whether the character is compatible with regard to the tree.

Is one of the trees a *perfect phylogeny*?

Task 2 Perfect Phylogeny.

(2 points)

- Running time *Gusfield*: Discuss the run-time complexity $O(nm^2)$ of the algorithm that solves the *perfect phylogeny problem* according to Gusfield's theorem. Keep in mind that set operations are no constant-time operations as they have to be performed on a per-element basis.
- Running time *Pointer Trick*: Recall step 1 of the PP-construction algorithm on page 22. How can the columns of a binary $n \times m$ matrix be sorted in $O(nm)$ time?

Task 3 Perfect Phylogeny: Construction.

(3 points)

Use the $\mathcal{O}(mn)$ algorithm (lecture notes, pages 22–23) to create a perfect phylogeny for the given matrix. Indicate all intermediate results after steps 1 and 2.

	1	2	3	4	5
A	0	0	0	1	0
B	0	1	1	0	1
C	1	0	0	0	1
D	0	0	1	0	1
E	1	0	0	0	1