Exercises – Phylogenetics

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https://gi.cebitec.uni-bielefeld.de/Teaching/2018summer/Phylogenetik

Exercise Sheet 3 — 26.04.2018

Due: 03.05.2018

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	β	z	a
B	β	y	b
C	α	x	a
D	α	z	c

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 Identification of Characters. **(2 points)**

Consider the four species rat, bee, raven and human.
Find at least three characters and their corresponding states with respect to each species in a way that:

(a) a perfect phylogeny does exist.

(b) no perfect phylogeny exists.

Hint: The characters and their states should be chosen in the same way as for the vehicles on page 17 in the lecture notes.

Task 3 Perfect Phylogeny. **(3 points)**

(a) Decide whether there exists a perfect phylogeny for the matrix on the right. Use the theorem of Gusfield on page 21 (bottom) in the lecture notes.

(b) Running time *Gusfield*: Discuss the run-time complexity $O(nm^2)$ of the approach above. Keep in mind that set operations are no constant-time operations as they have to be performed on a per-element basis.

(c) Running time *Pointer Trick*: Recall step 1 of the PP-construcitn algorithm on page 22. How can the columns of a binary $n \times m$ matrix be sorted in $O(nm)$ time?

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