Exercises – Phylogenetics

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https://gi.cebitec.uni-bielefeld.de/Teaching/2016winter/Phylogenetik

Exercise Sheet 4 — 22.11.2016

Due: 29.11.2016

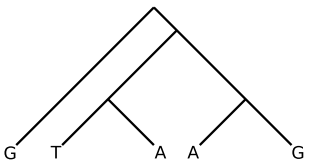
Task 1 Perfect Phylogeny: Construction. **(3 points)**

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

Task 2 Small Parsimony – Fitch-Algorithm. **(3 points)**

(a) Apply the Fitch-Algorithm (as presented in the lecture / lecture notes) on the tree on the right. Write down all solutions and their parsimony cost that can be found with the algorithm. Specify the set S for each internal node (see figure on page 28).



(b) Now, we have a look at the original work of Walter M. Fitch: "Towards Defining the Course of Evolution: Minimum Change for a Specific Tree Topology", published in the journal "Systematic Zoology". You can find this article online: http://www.jstor.org/stable/2412116. In this article, Fitch introduces an extra step after the bottom-up phase such that the top-down phase will find *all* optimal labelings.
Use this algorithm to enrich the set S for the tree above. Are there new solutions that were not found in task (a)? Indicate such a solution and its parsimony cost.

Task 3 Small Parsimony – Sankoff-Algorithm. **(3 points)**

Apply the Sankoff-Algorithm (**with unit costs**) on the tree from Task 2 in order to determine a most parsimonious labeling for the internal nodes. Specify the values for $C(u, a)$ for each internal node (like in the figure on page 30).

Write down all solutions, that were not found in Task 2(a).

1 Bonus Point: Repeat the exercise with the following cost function:

cost	A	C	G	T
A	0	2	1	2
C	2	0	2	1
G	1	2	0	2
T	2	1	2	0