Universität Greifswald
Institute für Mathematik and Informatik
Lecturer: Marc Hellmuth Tutor: Nikolai Nøjgaard

12. Exercise "Bioinformatics", SS 17

Aufgabe 1: (4 Credits)
Let $(T = (V, E); t, \sigma)$ be a gene tree, $S = (W, F)$ a species tree and $\mu\colon V \to W \cup F$ a map that satisfies (M1) and (M3) as given in the definition "reconciliation maps". Show that for all $x \in V$:

$$\mu(x) \succeq_S \mathrm{lca}_S(\sigma(L_T(x)))$$

Aufgabe 2: (6+6=12 Credits)
Let $(T = (V, E); t, \sigma)$ be a binary gene tree, $S = (W, F)$ a species tree and $\mu\colon V \to W \cup F$ a reconciliation map for $(T = (V, E); t, \sigma)$ and S.

(a) For all $v, w \in V$ we have $\mu(\mathrm{lca}_T(v, w)) \succeq_S \mathrm{lca}_S(\mu(v), \mu(w))$.

(b) If $x \in V$ is a speciation vertex with children v, w in T, then $\mu(u)$ and $\mu(v)$ are incomparable in S, that is, neither $\mu(u) \preceq_S \mu(v)$ nor $\mu(v) \preceq_S \mu(u)$ is satisfied.

Aufgabe 3: (4 Credits)
Consider the two gene trees T_1 and T_2 that one can obtain from (symmetric) genetic distance scores for genes in the gene families G^1 and G^2 as given in the exercise sheet 11 (last exercise). Use the species triples that one can obtain from T_1 and T_2 to determine a species tree S for T_1 and T_2. Draw the species tree S and the reconciliation map μ between the gene trees and the species tree (by drawing the gene trees within S).

Deadline: Tuesday - July 4, 2017