Lehrstuhl für Informatik I
– Algorithmen und Komplexität –
Universität Würzburg

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# Exercise Sheet #6

# Advanced Algorithms (WS 2022/23)

**Exercise 1 – Maximum agreement forest**

For the definition of an agreement forest of two phylogenetic trees $T$ and $T'$, we required that the roots of $T$ and $T'$ are labeled $\rho$. Show why this requirement is necessary for the equality $m(T, T') = d_{SPR}(T, T')$ to always hold.

*Hint:* Show an example with different $d_{SPR}(T, T')$ and $m(T, T')$. **5 Points**

**Exercise 2 – Connectedness of SPR-graph**

Show that the SPR-graph $G$ is connected. **5 Points**

**Exercise 3 – Common subtree reduction**

Let $T$ and $T'$ be two phylogenetic trees on $X = \{1, 2, 3, \ldots, n\}$. Give an efficient algorithm to exhaustively apply the common subtree reduction to $T$ and $T'$. **6 Points**

**Exercise 4 – Nearest neighbor interchange**

The rearrangement operation *nearest neighbor interchange (NNI)* transforms one phylogenetic tree into another one as illustrated in Figure 1. Note that NNI is a restriction of SPR. Determine the size of the neighborhood of a phylogenetic tree $T$ on $n$ leaves under NNI, that is, the number of trees that can be reached from $T$ by applying one NNI operation. **4 Points**

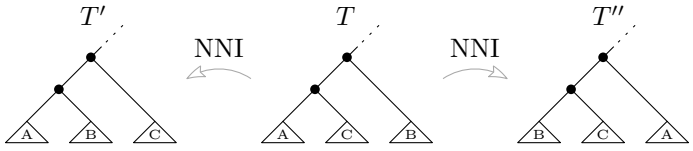


FIGURE 1: How an NNI operation can transform a phylogenetic tree $T$ into a phylogenetic tree $T'$ or $T''$. The triangles labeled $A$, $B$, and $C$ represent different pendant subtrees.

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Please hand in your solutions on Wuecampus until the beginning of the next lecture, that is 14:15 on Wednesday, November 30.