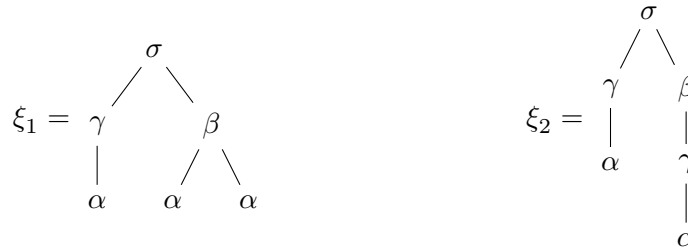


# Formale Übersetzungsmodelle

## Task 1 (ranked alphabets and trees)

Consider the following trees:



- Give  $\text{height}(\xi_i)$ ,  $\text{size}(\xi_i)$ ,  $\text{pos}(\xi_i)$ ,  $\text{sub}(\xi_i)$  for  $i \in \{1, 2\}$ .
- Extend the intersection, union, and subset relation to ranked alphabets.
- Define minimal ranked alphabets  $\Delta_1$  and  $\Delta_2$  such that  $\xi_1 \in \mathbf{T}_{\Delta_1}$  and  $\xi_2 \in \mathbf{T}_{\Delta_2}$ .
- Prove or refute: There is a ranked alphabet  $\Gamma$  such that  $\xi_1, \xi_2 \in \mathbf{T}_{\Gamma}$ .

## Task 2 (definition by structural induction)

Let  $\Sigma$  be a ranked alphabet,  $A$  a set,  $\xi \in \mathbf{T}_{\Sigma}(A)$ ,  $w \in \text{pos}(\xi)$ ,  $\zeta \in \mathbf{T}_{\Sigma}(X_k)$ , and  $\zeta'_1, \dots, \zeta'_k \in \mathbf{T}_{\Sigma}(A)$ . Define the following characteristics of  $\xi$  and  $\zeta$  by structural induction:

- $\text{height}(\xi)$ , number of nodes on the longest path in  $\xi$ ,
- $\text{size}(\xi)$ , number of nodes in  $\xi$ ,
- $\text{pos}(\xi)$ , set of positions in  $\xi$ ,
- $\text{sub}(\xi)$ , set of subtrees of  $\xi$ ,
- $\xi(w)$ , the label of  $\xi$  at position  $w$ ,
- $\xi|_w$ , the subtree of  $\xi$  at position  $w$ ,
- $\xi[\zeta]_w$ , the tree obtained by substituting the subtree of  $\xi$  at position  $w$  with  $\zeta$ ,
- $\text{yield}(\xi)$ , the sequence of leaves of  $\xi$  from left to right, and
- $\zeta[\zeta'_1, \dots, \zeta'_k]$ , the tree obtained from  $\zeta$  by substituting  $x_i$  by  $\zeta'_i$  for every  $i \in \{1, \dots, k\}$ .

**Note** The tutorial's time might not suffice to present all solutions. Please prepare to ask for the solutions you are most interested in.