Nils Hagner 4346038 Felix Karg 4342014
Michael Fleig 4340085 Anush Davtyan 4368689

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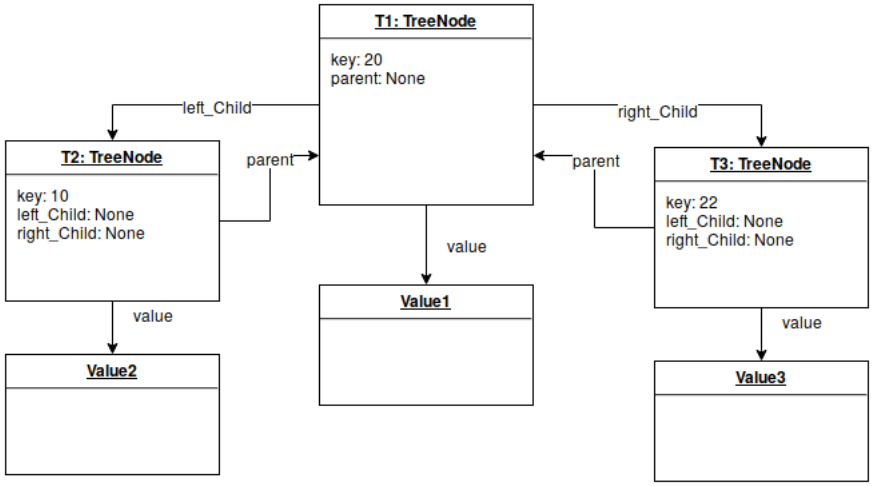
Solutions for Excercise sheet 2

Exercise 1 – OCL

i $\mathcal{S} = (\{Int\}, TreeNode, Object, \{key : Int, left\_Child : TreeNode, right_Child : TreeNode, parent : TreeNode, value : Object\}, \{TreeNode \mapsto \{key, left\_Child, right\_Child, paren$
$\{\}\}, \{\}, \{TreeNode \mapsto \emptyset, Object \mapsto \{\}\})\mathcal{D}(Int) = Z, \mathcal{D}(TreeNode) = \{T1, T2, T3, ...\}, \mathcal{D}(Object) = \{O1, O2, O3, ...\}$

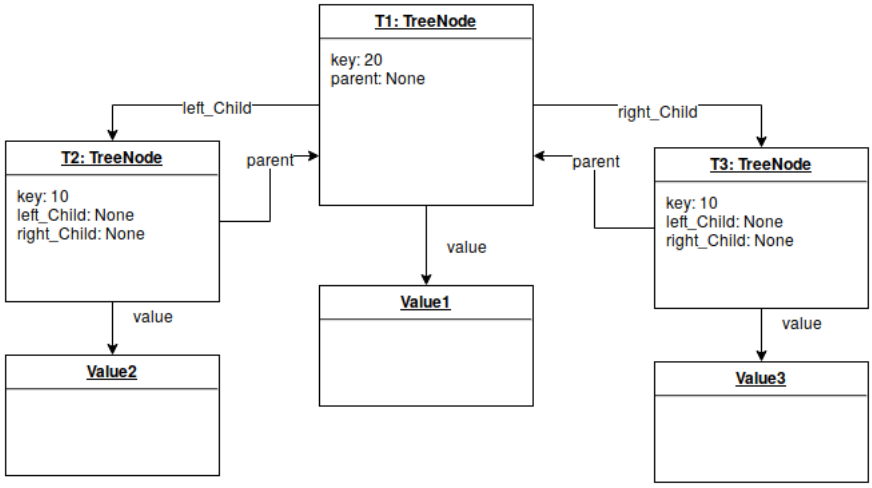
a)

$\sigma_1 = \{T_1 \mapsto \{key \mapsto 20, left\_Child \mapsto \{T2\}, right\_Child \mapsto \{T3\}, parent \mapsto \emptyset, value \mapsto O_1\}$
$T_2 \mapsto \{key \mapsto 10, left\_Child \mapsto \emptyset, right\_Child \mapsto \emptyset, parent \mapsto \{T1\}, value \mapsto O_2\}$
$T_3 \mapsto \{key \mapsto 20, left\_Child \mapsto \emptyset, right\_Child \mapsto \emptyset, parent \mapsto \{T1\}, value \mapsto O_3\}$
$O_1 \mapsto \{\}$
$O_2 \mapsto \{\}$
$O_3 \mapsto \{\}$
$\}$



The system state σ_1 evaluates to true because $key(left\_Child(T_1)) \leq key(T_1) \leq key(right\_Child(T_1))$

$$\sigma_2 = \{T_1 \mapsto \{key \mapsto 20, left\_Child \mapsto \{T2\}, right\_Child \mapsto \{T3\}, parent \mapsto \emptyset, value \mapsto O_1\}$$
$$T_2 \mapsto \{key \mapsto 10, left\_Child \mapsto \emptyset, right\_Child \mapsto \emptyset, parent \mapsto \{T1\}, value \mapsto O_2\}$$
$$T_3 \mapsto \{key \mapsto 10, left\_Child \mapsto \emptyset, right\_Child \mapsto \emptyset, parent \mapsto \{T1\}, value \mapsto O_3\}$$
$$O_1 \mapsto \{\}$$
$$O_2 \mapsto \{\}$$
$$O_3 \mapsto \{\}$$
$$\}$$



The system state σ_2 evaluates to false because
$key(left\_Child(T_1)) < key(right\_Child(T_1)) = key(T_1)$

$$\sigma_3 = \{\}$$

The system state σ_3 evaluates to $\perp$ because there are no Instances of TreeNode and the formula can not be evaluated to true or false.