

Part I – 50 minutes

1. Build a *SHIQ* TBox, representing the statements below. You can only use the concept names shown in grotesque font, and the role names `hasChild` and `hasFriend`.

A Person is Lucky if she or he has a Happy grandparent and has at least two Clever children. We know that a Lucky Person either has no friends or all her/his parents are not Happy. We also know that no one can be both Clever and Lucky.

2. Consider the *SH* TBox $\mathcal{T} = \{O \sqsubseteq \exists hC^-.O, \exists hF.O \sqsubseteq B, hC^- \sqsubseteq hF\}$ and the reasoning task of deciding the satisfiability of concept **B** wrt. \mathcal{T} .

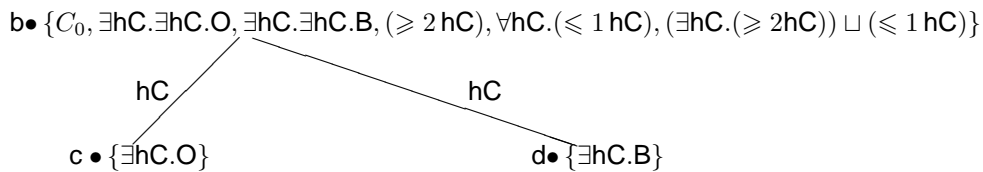
Write down the concept C' and the TBox \mathcal{T}' obtained by the internalisation of this reasoning task, i.e. reduce this task to deciding the satisfiability of concept C' wrt. TBox \mathcal{T}' , where \mathcal{T}' contains role axioms only.

3. Transform the following concept C_0 into an equivalent concept C_1 in NNF:

$$C_0 = \neg((\geq 1R) \sqcap \forall R.(\neg B \sqcup \exists R.\neg B) \sqcap \exists R.(\leq 5R) \sqcap (\geq 2R.B)).$$

Part II – 30 minutes

5. Consider the following tableau state \mathbf{T} , which was obtained in the process of deciding the satisfiability of the concept $C_0 = \exists hC.\exists hC.O \sqcap \exists hC.\exists hC.B \sqcap (\geq 2 hC) \sqcap \forall hC.(\leq 1 hC) \sqcap ((\exists hC.(\geq 2 hC)) \sqcup (\leq 1 hC))$:



Which transformation rules of the *ALCN* tableau algorithm for empty TBoxes are applicable in tableau \mathbf{T} ? For each applicable rule

- give the node(s) and the concept it applies to;
- construct its output, the set of tableau states $S_{\mathbf{T}}$;
- check if any of the new states contains a clash.

(Note that you only have to deal with tableau states reachable from \mathbf{T} by a **single** rule application.)

When drawing tableau states, you don't have to copy the unchanged node and edge labels. You can refer to a list of concepts in a node label of \mathbf{T} by \dots , i.e. when a rule extends a node label by a concept D you can use the node label $\{\dots, D\}$.