Logical reasoning and programming, lab session 4

(October 16, 2023)

4.1 Do you know how to efficiently express

$$p_1 + p_2 + \cdots + p_{100} \leq 99?$$

4.2 Is it possible to replace

$$p_1 + \cdots + p_{1024} \leq 1$$

by

$$p_1 + \cdots + p_{512} + x \leq 1 \text{ and } p_{513} + \cdots + p_{1024} + \overline{x} \leq 1?$$

If so, is it equivalent, or equisatisfiable?

4.3 There are various encodings of cardinality constraints, discuss sequential counter and bitwise encodings. You can find further examples in this presentation, this presentation, or in PySAT.

4.4 For an example of a cardinality constraint using if-then-else and BDDs check this presentation.

4.5 Check the API documentation of PySAT. There are various useful things, for example, `IDPool`, `enum_models`, `get_core`.

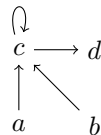**4.6** Check some examples in PySAT.

4.7 Check using implicit hitting set for MaxSAT in this tutorial.

4.8 Formulate the software package upgradability as a MaxSAT problem, see this tutorial.

4.9 Try MaxSAT in PySAT, check WCNF.

4.10 Try CBMC on this example. You can also try this program. For details, see these lecture notes.

4.11 We have a language that contains only one binary predicate symbol $\in$ and we have an interpretation $\mathcal{M} = (D, i)$ such that $D = \{a, b, c, d\}$ and $i(\in)$ is given by the following diagram:

Meaning that $x \in y$ iff there is an arrow from x to y. Decide whether the following formulae are valid in $\mathcal{M}$:

(a) $\exists X \forall Y (\neg (Y \in X))$,

(b) $\exists X \forall Y (Y \in X)$,

(c) $\exists X \forall Y (Y \in X \leftrightarrow Y \in Y)$,

(d) $\exists X \forall Y (Y \in X \leftrightarrow \neg (Y \in Y))$.