

Logical reasoning and programming, lab session 4

(October 10, 2022)

4.1 Do you know how to efficiently express

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

4.2 Is it possible to replace

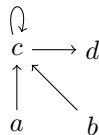
$$p_1 + \dots + p_{1024} \leq 1$$

by

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

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