

Exercise Sheet 11

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Exercise 11.1 Boolean Satisfiability

Let $\Sigma = \{\wedge, \vee, \neg, 0, 1, x\}$, $rk(\wedge) = rk(\vee) = 2$, $rk(\neg) = 1$, $rk(0) = rk(1) = rk(x) = 0$.

- (a) Give a deterministic BUTA that recognises the satisfiable Boolean formulas over x .
- (b) Use (a) to establish whether $\neg(x \wedge 0) \vee (\neg x \wedge 1)$ and $(x \vee 0) \wedge (\neg x \wedge 1)$ are satisfiable.

Exercise 11.2 Tree Language Acceptance

Let $\Sigma = \{a, b, c, d\}$ with $rk(a) = rk(b) = 2$, respectively $rk(c) = rk(d) = 0$. Which of the following tree languages are accepted by some BUTA?

- (a) $L_1 := \{t \in \mathcal{T}_\Sigma \mid \text{the path } \epsilon, 0, 01, 010, 0101, \dots \text{ in } t \text{ contains an even number of } a\text{'s}\}$.
- (b) $L_2 := \{t \in \mathcal{T}_\Sigma \mid t \text{ is an unbalanced tree}\}$.
- (c) $L_3 := \{t \in \mathcal{T}_\Sigma \mid \text{there are nodes } u, v \text{ in } t \text{ with } t(u) = c, t(v) = d \text{ and } u \text{ is left of } v\}$.
- (d) $L_4 := \{t \in \mathcal{T}_\Sigma \mid \text{precisely 2014 of } t\text{'s leaves are labelled by } c\}$.

Determine which of the languages above are also accepted by a deterministic TDTA.

Exercise 11.3 NHA for Regular Languages

Similarly to ranked trees, for an unranked tree t we can also define the word obtained by reading the leaves from left to right to be the yield of t . Inductively, $\text{Yield}(a) = a$ and $\text{Yield}(a(t_1 \dots t_n)) = \text{Yield}(t_1) \dots \text{Yield}(t_n)$. Let $L \subseteq \Sigma^*$ be a regular word language.

Construct an NHA accepting the language $\{t \in \mathcal{T}_\Sigma \mid \text{Yield}(t) \in L\}$.

Exercise 11.4 XML Validation

Create an XML document with information about a collection of 3 cars. A car has the following attributes: *brand*, *model*, *year*, *engine*, and (1 or more) *add-ons*. We want to store information about a brand's *owning company(ies)*, *foundation year*, and *headquarters*. Finally, each add-on has a *name* and can be *electronic* or *non-electronic*.

Give a DTD specification for car collections and use it to validate your document.