

Syntax and Semantics:

Exercise Session 9

Exercise 1.

Evaluate the following expressions and describe their derivation trees –use the big-step semantics of $\mathbb{A}\text{exp}$.

- (i) $(\bar{3} + \bar{12}) * (\bar{4} * (\bar{5} * \bar{8}))$
- (ii) $(\bar{3} + (\bar{12} * \bar{4})) * (\bar{5} * \bar{8})$
- (iii) $(\bar{3} + (\bar{12})) * ((\bar{4}) * (\bar{5} * \bar{8}))$

Exercise 2.

Suggest a new small-step semantics for $\mathbb{A}\text{exp}$, which is deterministic. (Hint: Use rules to ensure that the evaluation is done from left to right.)

Exercise 3.

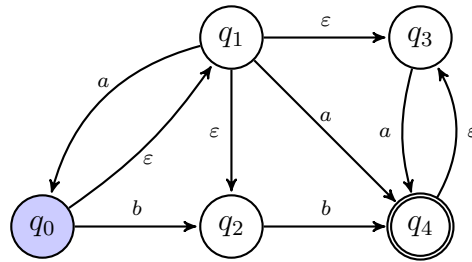
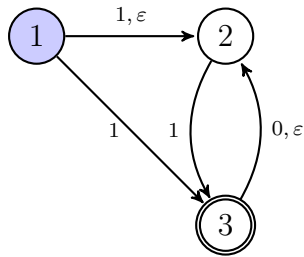
Give a big-step and a small-step semantics for $\mathbb{B}\text{exp}$ for the case

$$b ::= a_1 = a_2 \mid a_1 < a_2 \mid \neg b_1 \mid b_1 \wedge b_2$$

assuming that we already have a big-step and a small-step semantics for $\mathbb{A}\text{exp}$ defined by \rightarrow_A and \Rightarrow_A respectively.

Exercise 4.

Convert the following non-deterministic automata to deterministic ones.



Exercise 5.

Consider the regular expression $(bc \cup aaa)^*$. Provide an NFA that recognizes the same language as the regular expression.

Exercise 6.

Consider the language $L = \{a^k b^{2k} \mid k \geq 0\}$.

- (i) Prove that L is not regular.
- (ii) Prove that L is context-free.