Universitetet i Oslo
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Analytical Solutions and Reasoning
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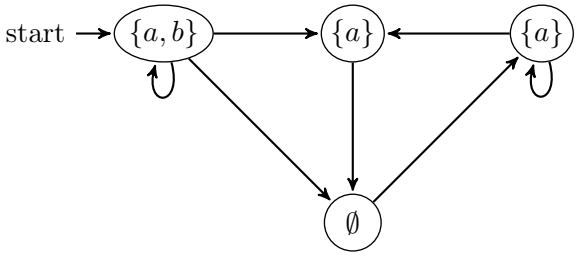
IN 5110/9100: Specification & Verification of Parallel Systems

Autumn 2023 **Series 1** 18.10.2023

Topic: LTL and Büchi automata

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Exercise 1 (Transition System to Büchi) Consider the following transition system (we omitted the labels on the transitions.):

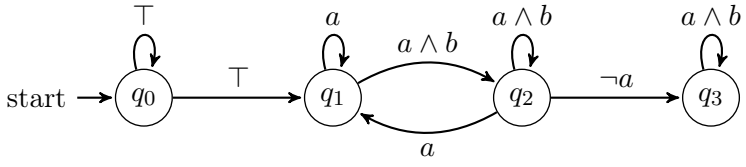


1. Construct a Büchi automaton whose language describes the runs of the TS (as presented in the lecture).

Exercise 2 (LTL to GBA) Let AP = $\{a\}$ and $\varphi = (a \wedge \bigcirc a) U \neg a$ be an LTL formula over AP.

1. Compute all maximal consistent set with respect to φ. (Hint: there are five maximal consistent sets.)
2. Construct the GBA $\mathcal{G}_\varphi$ that describes the same language of infinite words as φ.

Exercise 3 (GBA to BA) Consider the following GBA $\mathcal{G}$ with the alphabet $\Sigma = 2^{\{a,b\}}$ and the set $\mathcal{F} = \{\{q_1, q_3\}, \{q_2\}\}$.



1. Provide an LTL formula that describes the same language as $\mathcal{G}$.
2. Construct the BA $\mathcal{A}$ with $\mathcal{L}(\mathcal{A}) = \mathcal{L}(\mathcal{G})$.

Exercise 4 (deterministic BAs) Which of the following LTL formulas φ_i are representable by a *deterministic* Büchi automaton? Explain your answer.

- $\varphi_1 = \square(a \rightarrow \Diamond b)$
- $\varphi_2 = \neg\varphi_1$