ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

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Discussion: Jan 21–Jan 25
Some room(s)

Tutorials for Verification
Exercise sheet 10

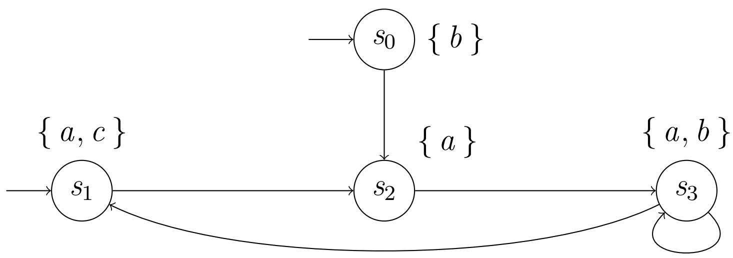
Exercise 1: Generalized Büchi automata

(a) Construct a GNBA for the LTL-formula $\neg\bigcirc(a \wedge b)$. Provide an accepting run for the word $\{a\}^\omega$ and explain why there is no accepting run for the word $\emptyset\{a, b\}\{a\}\{b\}^\omega$.

(b) Construct a GNBA for the LTL-formula $\varphi = a \, \mathsf{U} \, (\neg a \wedge b)$.

Exercise 2: CTL

Consider the following transition system over the set of atomic propostions $\{ a, b, c \}$:



Give for each of the following CTL-formulae the set of states for which the formula is satisfied.

(a) $a \wedge \exists \bigcirc b$	(b) $\exists \bigcirc c$	(c) $\forall \bigcirc \exists \bigcirc c$
(d) $\forall(a \, \mathsf{U} \, b)$	(e) $\forall(b \, \mathsf{U} \, a)$	(f) $\forall(b \, \mathsf{U} \, \forall \Box a)$
(g) $\forall(a \, \mathsf{U} \, \exists \Box b)$	(h) $\neg\exists(a \, \mathsf{U} \, \exists \Box b)$	(i) $\forall((\exists \Diamond c) \, \mathsf{U} \, (\forall \Box a))$
(j) $\forall \Diamond \forall \Box a$	(k) $\forall \Box \forall \Diamond b$	(l) $\forall \Box \exists \Diamond c$

Exercise 3: Existential Normal Form
Convert the following CTL formulas into existential normal form:

(a) $\forall \bigcirc a$

(b) $\forall \Box \forall \Diamond a$

(c) $\forall (a \mathsf{W} b)$

(d) $\exists (a \mathsf{W} b)$

(e) $\forall (a \mathsf{U} b)$