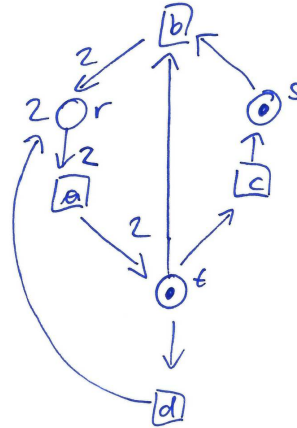


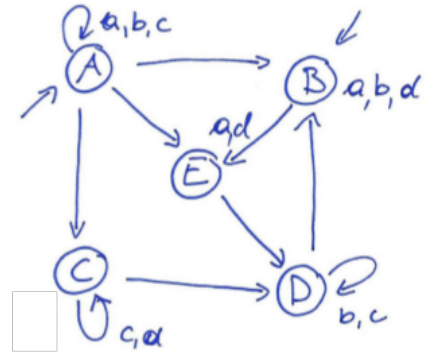
Exercises

1.) Show the LTS for the following PTN. How many markings are possible in theory?



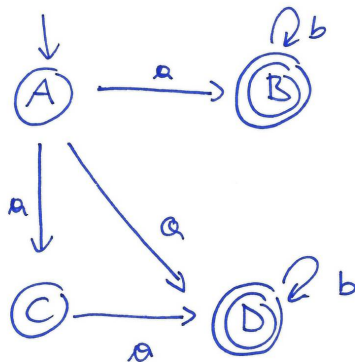
2.) Consider the Kripke structure on the right. Which entailments hold?

1. $A \models A(cUa)$
2. $A \models EGd$
3. $B \models EFAG(b \wedge c)$
4. $C^\omega \models (cUd)$
5. $C^\omega \models (cUa)$
6. $(B, E, D)^\omega \models G(a \rightarrow Xb)$

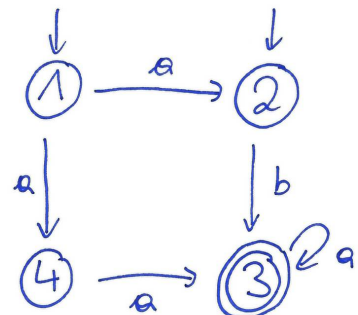


3.) Given automata A_1 and A_2 below. (1) Show the power automaton of A_1 . (2) Show the product automaton of A_2 and the power automaton of A_1 .

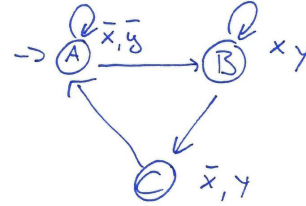
A_1



A_2



4.) Given the Kripke structure on the right. Formulate a SAT encoding asking if $G(x \vee \bar{y})$ is violated after two steps.



5.) Given the (buggy) transition function $x' \leftrightarrow y, y' \leftrightarrow z, z' \leftrightarrow 1$. Formulate a SAT encoding asking if $F(\neg x \wedge \neg y \wedge \neg z)$ is violated after three steps starting from initial state $(\neg x \wedge \neg y \wedge z)$.

6.) Argue if ACTL formulas $AX(\neg p \vee A[pUq])$ and $AXp \vee AX\neg q$ have an equivalent LTL formula.

7.) Do the following HML/CTL formulas hold w.r.t. A_1 from 3.) (ignore the final states)?

1. $A \models AG([a]\langle b \rangle 1)$
2. $A \models EX([a][b][a]1 \vee \langle a \rangle 1)$
3. $B \models A(aUb)$

8.) Interpret A_1 from above as LTS. Transform A_1 to a Kripke structure.

9.) Make A_1 from above deterministic by using the the Oracle construction (both versions).

10.) What are the truth values of the following QBFs. Justify your answer.

- $\forall a \exists b \forall c \exists d. ((c \vee \neg b) \wedge (b \vee d \vee c) \wedge (\neg b \vee \neg c \vee \neg a) \wedge (\neg d \vee \neg b \vee a))$
- $\forall a \exists b \forall c \exists d. ((c \vee \neg b) \wedge (b \vee d \vee c) \wedge (\neg b \vee \neg c \vee \neg a) \wedge (\neg d \vee \neg b \vee a) \wedge (b \vee a))$