Formal Model and Verification

Exercise 11: Models and specifications with temporal logics

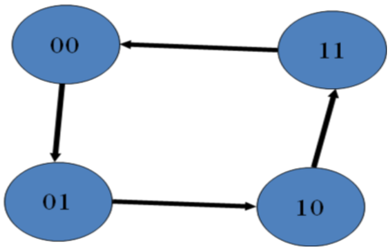
1. Suppose we have the following LTL formula.

$$((p \wedge \neg q) U (q \wedge (q U \Box((\neg q) \wedge r)))) \wedge \Diamond r$$

a) Please construct the closure set of the formula.

b) Please construct a structure in the tableau that satisfies this formula.

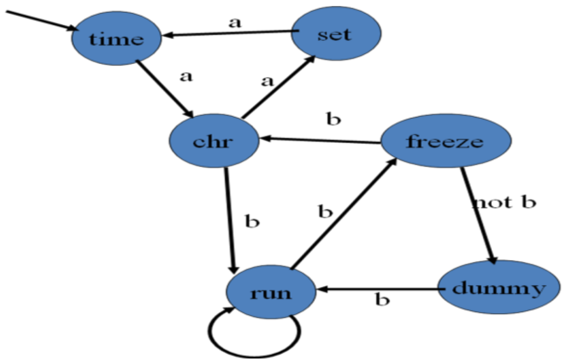
2. We have a synchronous bit counter with two bit variables *a* and *b* in the following.



Please run the labeling algorithm for CTL model-checking for formula

$$(\forall\Diamond(a\wedge\forall\Diamond b))\wedge(\forall\Box\,(b\rightarrow\forall\bigcirc\neg b))$$

3. We have the following state transition diagram for a digital watch.
   The set of AP is {time,chr,freeze,set,run,dummy,a,b}
   Note that *exactly one of time, chr, freeze, set, run, and dummy can be true at any moment.*



   Please construct the propositional formulas that respectively characterize the legal state set, the initial states, and the transition relation.

4. Continued from problem 3, please run the symbolic CTL labeling algorithm to construct a propositional formula that characterizes states that satisfy the following formula.

$$\exists \Diamond \, time$$

5. Continued from problem 4, please run the symbolic CTL labeling algorithm to construct a propositional formula that characterizes states that satisfy the following formula.

$$\neg\exists\Diamond \text{ time}$$

6. Continued from problem 5, please run the symbolic CTL labeling algorithm to construct a propositional formula that characterizes states that satisfy the following formula.

$$\exists\Diamond \neg\exists\Diamond \text{ time}$$

7. Continued from problem 6, please run the symbolic CTL labeling algorithm to construct a propositional formula that characterizes states that satisfy the following formula.

$$\forall\Box\,\exists\Diamond\ time$$