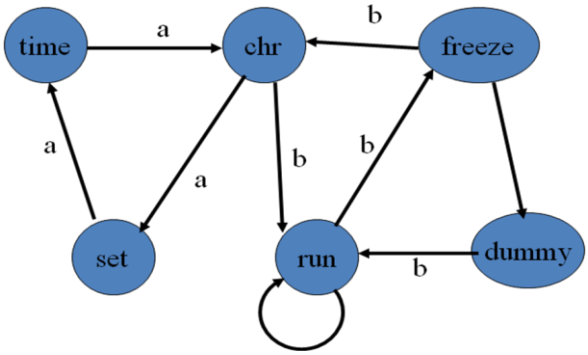
Formal Model and Verification

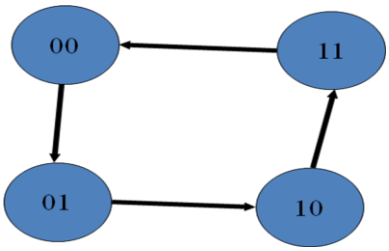
Exercise 10: Models and specifications with temporal logics

1. 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.*

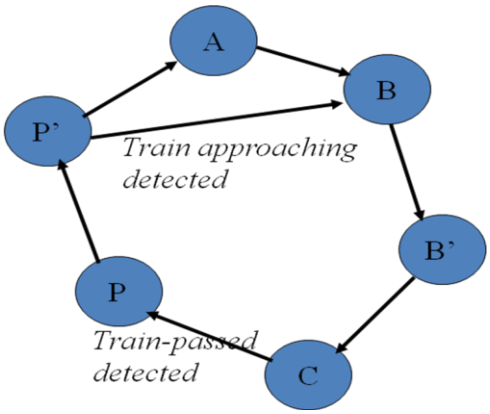


   Please write down an LTL formula that describes the system.

2. Please construct an LTL formula for the following synchronous bit counter with two bit variables a and b.



3. Please construct an LTL for the following asynchronous system.



You may want to consider using a state variable with domain {A,B,B',C,P,P'}. You may also need to consider state variables the two events. Since this is an asynchronous system, you may also need to consider what happens when there is no event occurrences.

4. Please construct a Kripke structure that can tell $\forall\Box\forall\Diamond p$ from $\forall\Box\exists\Diamond p$?

5. Please prove (or argue) why we cannot tell $\forall\Box\forall\Diamond p$ from $\forall\Box\Diamond p$ with any Kripke structure.

6. Please construct a Kripke structure that can tell

$$\forall((\Box \textit{you-have-no-lover}) \rightarrow \Diamond \textit{marry-you})$$

from

$$(\forall \Box \textit{you-have-no-lover}) \rightarrow \forall \Diamond \textit{marry-you}.$$

7. Please construct a Kripke structure that can tell

$$(\forall \Box \textit{you-have-no-lover}) \rightarrow \forall \Diamond \textit{marry-you}$$

from

$$(\forall \Box \textit{you-have-no-lover}) \rightarrow \exists \Diamond \textit{marry-you}$$

8. Please construct a Kripke structure that can tell

$$(\forall \Box \textit{ you-have-no-lover}) \rightarrow \exists \Diamond \textit{ marry-you}$$

from

$$(\exists \Box \textit{ you-have-no-lover}) \rightarrow \forall \Diamond \textit{ marry-you}$$

9. Please construct a Kripke structure that can tell

$$(\exists \Box \textit{ you-have-no-lover}) \rightarrow \forall \Diamond \textit{ marry-you}$$

from

$$\forall((\Box \textit{ you-have-no-lover}) \rightarrow \Diamond \textit{ marry-you})$$