

Exercises PV 09/10

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1 LTL

- Express the following requirements in LTL. Make the necessary assumptions if you have to; but be reasonable.

- P and Q cannot not use a resource r simultaneously.

Answer:

$$\Box \neg (use(P, r) \wedge use(Q, r))$$

where $use(P, r)$ is a predicate which is true while and as long as P is using r . Importantly note that it does not represent a program call.

- If P requests access to r , eventually it will get the access.

Answer:

$$\Box (req(P, r) \rightarrow \Diamond use(P, r))$$

where $req(P, r)$ is a predicate which is true while and as long as P is requesting for r .

- If P requests access to r , eventually it will get the access; but only if P persists on maintaining the request.

Answer:

$$\Box ((\Box req(P, r)) \rightarrow (\Diamond use(P, r)))$$

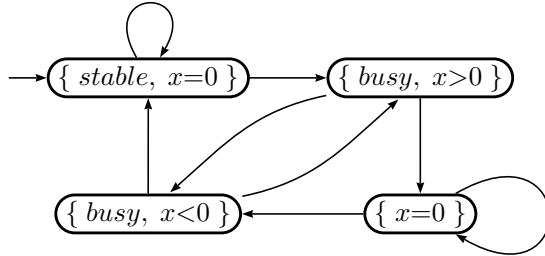
- P cannot access r without first requesting it; and it cannot do so (make a request) without first releasing r (if it was busy using r).

Answer:

$$\Box ((\neg req(P, r) \wedge \neg use(P, r)) \mathbf{W} req(P, r))$$

$$\Box ((use(P, r) \wedge \neg req(P, r)) \mathbf{W} \neg use(P, r))$$

- Below you see a Kripke structure; let's call it M . Give its explicit definition in terms of a tuple etc (see the formal definition in the slides).

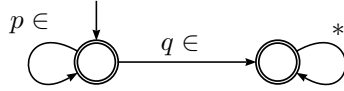


- (a) Why don't we have final states there?
- (b) How is the notion of 'execution' defined for a Kripke structure? And what is an 'abstract execution'?
- (c) Give an execution of M that satisfies the property $\mathbf{X}(\text{busy} \mathbf{U} (x=0))$. Does M satisfy the property?
- (d) So, given a property Kripke structure M , an (abstract) execution Π , and a property ϕ , and an natural number i , what is the difference between:
- $M \models \psi$
 - $\Pi \models \psi$
 - $\Pi, i \models \psi$

3. Construct Buchi automata representing the following LTL formulas:

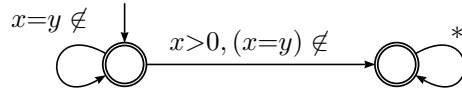
- (a) $p \mathbf{W} q$, where p, q are atomic propositions.

Answer:



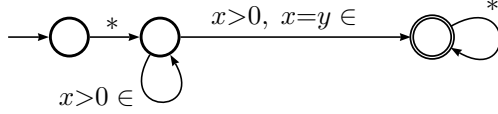
- (b) $\neg(x > 0 \mathbf{U} x = y)$

Answer:



- (c) $(\mathbf{X} x > 0) \mathbf{U} x = y$

Answer:



- (d) $\Diamond \Box (x > 0 \rightarrow x = y)$

Answer:

