

- (b) Give concrete examples of TS and TS' where at least one of the transition systems is not AP -deterministic, but

$$\text{Traces}(TS) \not\subseteq \text{Traces}(TS') \quad \text{and} \quad \text{Traces}_{fin}(TS) = \text{Traces}_{fin}(TS').$$

EXERCISE 3.5. Consider the set AP of atomic propositions defined by $AP = \{x = 0, x > 1\}$ and consider a nonterminating sequential computer program P that manipulates the variable x . Formulate the following informally stated properties as LT properties:

- (a) false
- (b) initially x is equal to zero
- (c) initially x differs from zero
- (d) initially x is equal to zero, but at some point x exceeds one
- (e) x exceeds one only finitely many times
- (f) x exceeds one infinitely often
- (g) the value of x alternates between zero and two
- (h) true

(This exercise has been adopted from [355].) Determine which of the provided LT properties are safety properties. Justify your answers.

EXERCISE 3.6. Consider the set $AP = \{A, B\}$ of atomic propositions. Formulate the following properties as LT properties and characterize each of them as being either an invariance, safety property, or liveness property, or none of these.

- (a) A should never occur,
- (b) A should occur exactly once,
- (c) A and B alternate infinitely often,
- (d) A should eventually be followed by B .

(This exercise has been inspired by [312].)

EXERCISE 3.7. Consider the following sequential hardware circuit: