TD2 MVFA: Linear-Time properties
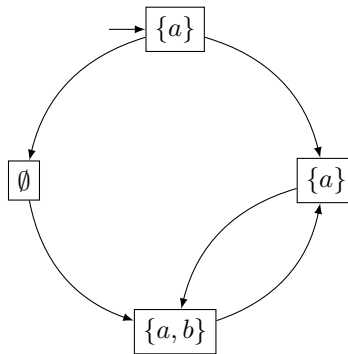
Exercise 1

Give the traces on the set of atomic propositions $\{a, b\}$ of the following transition system:

Exercise 2

You have seen a way to transform a transition system TS with terminal states into an "equivalent" transition system TS^* without terminal states.

1. Give a formal definition of this transformation.

2. Prove that the transformation preserves trace-equivalence, *i.e.* show that if TS_1 and TS_2 are such that $Traces(T_1) = Traces(T_2)$, then $Traces(T_1^*) = Traces(T_2^*)$.

Exercise 3

Consider the set AP of atomic propositions defined by $AP = \{x = 0, x > 0\}$ and consider a non-terminating sequential computer program P that manipulates the variable x.

  Formulate the following informally stated properties as LT properties:

1. false;

2. initially x is equal to zero;

3. initially x differs from zero;

4. initially x is equal to zero, but at some point x exceeds zero;

5. x exceeds zero only finitely many times;

6. x exceeds zero infinitely often;

7. the value of x alternates between zero and not zero;

8. true.

Determine which of the provided LT properties are safety properties and which are liveness properties.

Exercise 4

Let P and P' be two LT properties. Prove or disprove: $Pref(P) = Pref(P')$ if and only if $Cl(P) = Cl(P')$.

Exercise 5

Let P and P' be liveness properties over AP. Prove or disprove the following claims:

1. $P \cup P'$ is a liveness property;

2. $P \cap P'$ is a liveness property.

Answer the same questions for P and P' being safety properties.