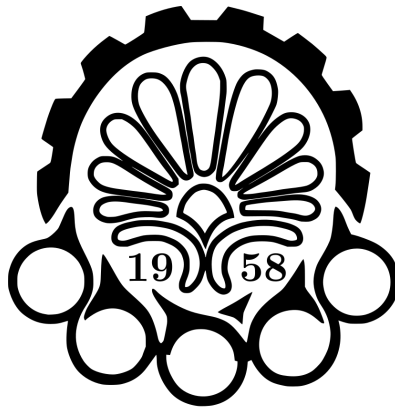


Embedded Systems

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Homework 9

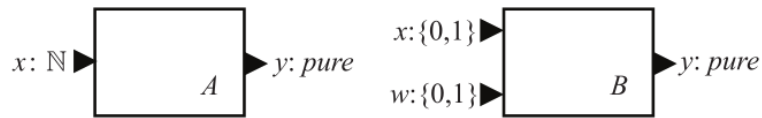
Chapter 14 - Equivalence and Refinement

June 1, 2024

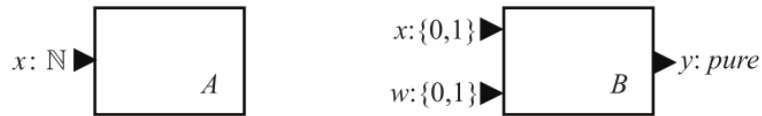
Question 1

In Figure 14.6 are four pairs of actors. For each pair, determine whether

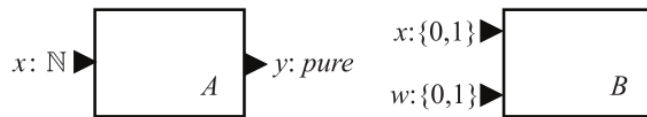
- A and B are type equivalent,
- A is a type refinement of B ,
- B is a type refinement of A , or
- none of the above.



(a)



(b)



(c)

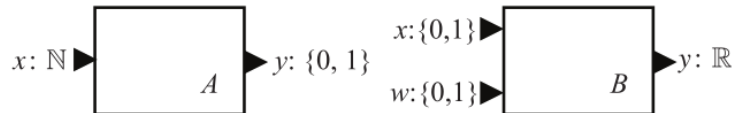


Figure 1: Four pairs of actors whose type refinement relationships are explored in Exercise 1

Soloution

- (a) B is a type refinement of A
- (b) B is a type refinement of A
- (c) None
- (d) B is a type refinement of A

Question 3

The state machine in Figure 14.7 has the property that it outputs at least one 1 between any two 0's. Construct a two-state nondeterministic state machine that simulates this one and preserves that property. Give the simulation relation. Are the machines bisimilar?

Solution

The simulation relation for the machine created in the figure below can be written as follows:

$$\{(0, a), (1, b), (2, b), (3, b)\}$$

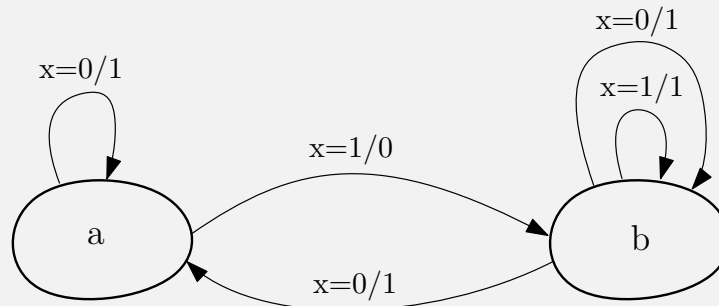


Figure 2: Solution of Q3

The created machine has non-deterministic states that cannot be generated by machine 14.7. Therefore, the bisimilar relation does not hold.

Question 5

Consider the state machine in Figure 14.10. Find a bisimilar state machine with only two states, and give the bisimulation relation.

input: x : pure
output: y : $\{0, 1\}$

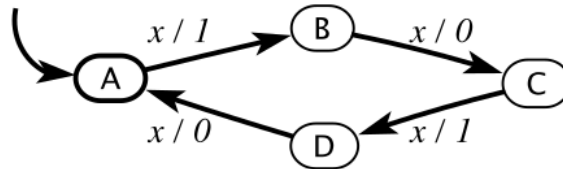


Figure 3: A machine that has more states than it needs

Solution

We can write simulation relation as bellow:

$$S_{a,b} = \{(A, AB), (B, CD), (C, AB), (D, CD)\}$$

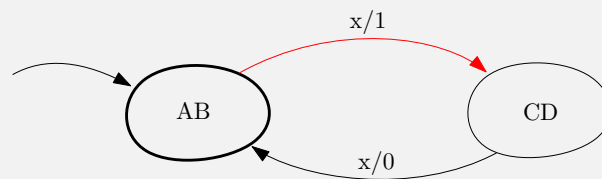


Figure 4: Solution of Q5

End of Homework 9

All of this figures, draw with `ipe`. You can download this software here:

ipe.otfried.org