Concurrency Theory

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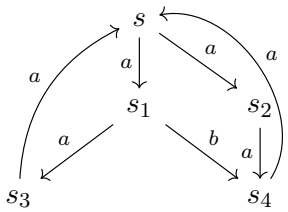
Sheet 5

Due: Monday, 2025-12-01

Exercise 5.1

Consider the LTS below:



a) Decide whether state s satisfies the following HML formulae:

1) $s \models \langle a \rangle tt$
2) $s \models \langle b \rangle tt$
3) $s \models [a] ff$
4) $s \models [b] ff$
5) $s \models [a]\langle b \rangle tt$
6) $s \models \langle a \rangle\langle b \rangle tt$
7) $s \models [a]\langle a \rangle[a][b] ff$
8) $s \models \langle a \rangle(\langle a \rangle tt \wedge \langle b \rangle tt)$
9) $s \models [a](\langle a \rangle tt \wedge \langle b \rangle tt)$
10) $s \models \langle a \rangle([b][a] ff \wedge \langle b \rangle tt)$
11) $s \models \langle a \rangle([a](\langle a \rangle tt \wedge [b] ff) \wedge \langle b \rangle ff)$

b) Evaluate the following expressions according to the HML semantics:

1) $[\![[a][b] ff]\!]$
2) $[\![\langle a \rangle(\langle a \rangle tt \wedge \langle b \rangle tt)]\!]$
3) $[\![[a][a][b] ff]\!]$
4) $[\![[a](\langle a \rangle tt \vee \langle b \rangle tt)]\!]$

If you have questions, please post a message in the dedicated chat.

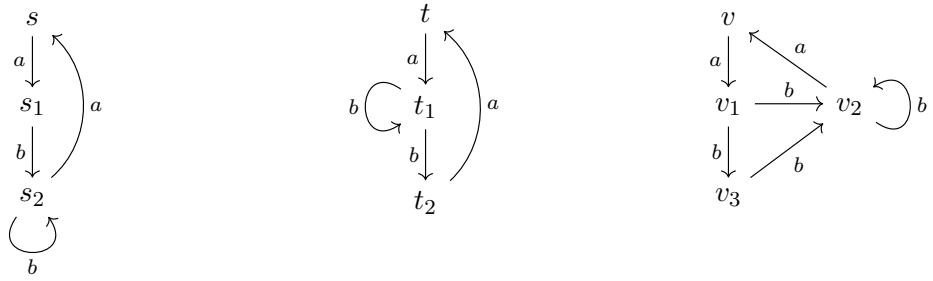
Exercise 5.2

Find a single LTS (i.e. not three different LTS) with an initial state s such that the following statements are true:

- $s \models \langle a \rangle (\langle b \rangle \langle c \rangle tt \wedge \langle c \rangle tt)$
- $s \models \langle a \rangle \langle b \rangle ([a]\, ff \wedge [b]\, ff \wedge [c]\, ff)$
- $s \models [a] \langle b \rangle ([c]\, ff \wedge \langle a \rangle tt)$

Exercise 5.3

Consider the three finitely branching LTS below:



Prove the following statements:

a) $s \not\sim t$

b) $s \not\sim v$

c) $t \not\sim v$

By providing distinguishing HML formulae.

Exercise 5.4

Decide whether the following CCS statements are true or not. Provide distinguishing HML formulae for the expressions that are not strongly bisimilar.

a) $b.a.nil + b.nil \sim b.(a.nil + b.nil)$

b) $a.(b.c.nil + b.d.nil) \sim a.b.c.nil + a.b.d.nil$

c) $a.nil \parallel b.nil \sim a.b.nil + b.a.nil$

d) $(a.nil \parallel b.nil) + c.a.nil \sim a.nil \parallel (b.nil + c.nil)$