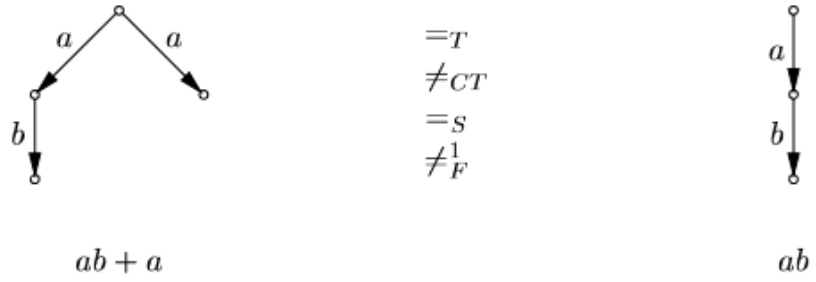
Question 1

> In the paper available at https://www.cse.unsw.edu.au/~rvg/pub/spec1.pdf there are a number of pictures, called Counterexample 1, 2, 3, etc. For each of counterexamples 2 to 6, provide a HML formula (if needed with infinite conjunctions) that holds for the left process, but not for the right one.

Part a) Counterexample 2

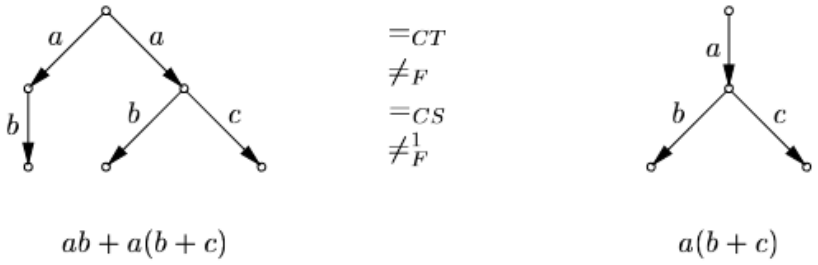


Counterexample 2: Trace and simulation equivalent, but not completed trace equivalent

There exists an a transition from which there is no valid b transition:

$$ab + a \vDash \langle a \rangle [b] \bot$$

Part b) Counterexample 3

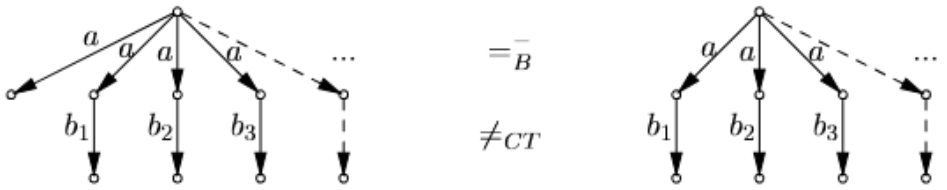


Counterexample 3: Completed trace and completed simulation equivalent, but not failures equivalent or even singleton-failures equivalent

There exists an a transition from which there is no valid c transition:

$$ab + a(b + c) \vDash \langle a \rangle [c] \bot$$

Part c) Counterexample 4

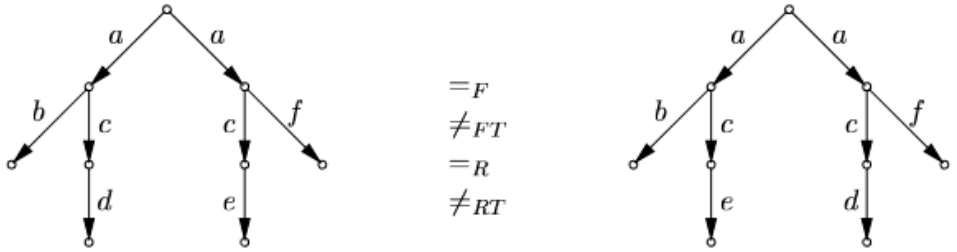


Counterexample 4: HML- and finite-failures equivalent, but not completed trace equivalent

There exists an a transition from which there are no valid transitions:

$$Left \vDash \langle a \rangle \left(\bigwedge_{i \in [0,\infty)} [b_i] \bot \right)$$

Part d) Counterexample 5



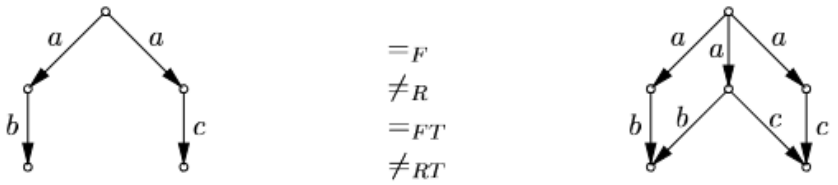
$a(b + cd) + a(f + ce)$ $\qquad$ $a(b + ce) + a(f + cd)$

Counterexample 5: Failures and ready equivalent, but not failure trace or ready trace equivalent

There exists an a from which the process may do an f and may also do a c followed by an e:

$$a(b + cd) + a(f + ce) \vDash \langle a \rangle \Big(\langle f \rangle \top \wedge \langle c \rangle \langle e \rangle \top \Big)$$

Part e) Counterexample 6



$ab + ac$ $\qquad$ $ab + a(b + c) + ac$

Counterexample 6: Failures and failure trace equivalent, but not ready or ready trace equivalent

For all a the process may do a b but not a c, or a c but not a b

$$ab + ac \vDash [a] \Big(\big(\langle b \rangle \top \wedge \langle c \rangle \bot \big) \vee \big(\langle b \rangle \bot \wedge \langle c \rangle \top \big) \Big)$$

Question 2

> Give an example of a process that satisfies the HML formulas $[a]\langle b\rangle\top$ and $\langle a\rangle([b]\langle c\rangle\top)$ but does not satisfy $[a]\langle b\rangle\langle c\rangle\top$.

The process $a\,.\,b\,.\,\mathbf{0} + a\,.\,b\,.\,c\,.\,\mathbf{0}$ meets these requirements:

1. $[a]\langle b\rangle\top$: For all a transitions there is at least one b transition
   - Both possible a transitions are followed by a b
2. $\langle a\rangle([b]\langle c\rangle\top)$: There exists an a transition such that all b transitions can be followed by a c
   - The second a transition has only one b, which can be followed by c
3. $[a]\langle b\rangle\langle c\rangle\top$: For all a transitions there is at least one b followed by at least one c
   - The first a transition has a b which cannot do a c, and so it does not fulfil this formula