Aula 10: Hennessy-Milner Logic with recursion (cont.)

Interaction & Concurrency Course Unit: Reactive Systems Module

May 12, 2023

Recommended reading

Chapter 6 Aceto et al. 2007.

Concepts introduced and discussed:

- mutually recursive processes,
- image finite LTS,
- bisimulation equivalence class,
- largest fixed points and invariant properties,
- characteristic formula for a process.

Some relevant definitions, examples, theorems (from Aceto et al. 2007):

- Definition 5.3 - (Image finite processes),
- Theorem 5.1 (Henessy-Milner theorem),
- Theorem 6.2 (Invariants as largest fixed points),
- mutually recursive equational system (pp. 135),
- semantics of an equational system over a set of variables, interpreted over n-dimensional vectors of sets of processes (pp. 136, 137),
- Example 6.9,
- Example 6.10,
- Theorem 6.4 (characteristic property for a process).

Exercises suggested (from Aceto et al. 2007):

- Exercise 6.8.3,
- Exercise 6.9,

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- ~~Exercise 6.12,~~
- ~~Exercise 6.13.~~

References

Aceto, Luca et al. (2007). *Reactive Systems - Modelling, Specification and Verification*. Cambridge University Press.

3. *Compute the least and largest solutions of the system of equations*

$$X = [a]Y$$
$$Y = \langle a \rangle X$$

over the transition system associated with the CCS term

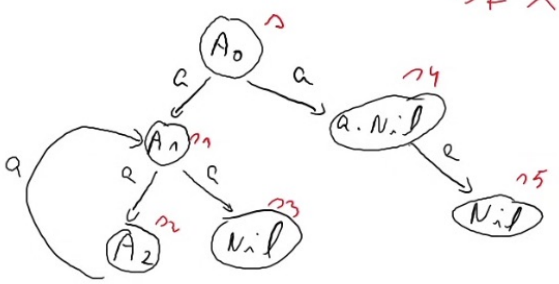
$$\begin{aligned} A_0 &= a.A_1 + a.a.0 \\ A_1 &= a.A_2 + a.0 \\ A_2 &= a.A_1 \ . \end{aligned}$$

CCS $A_0 = a.A_1 + a.a.Nil$

$A_1 = a.A_2 + a.Nil$

$A_2 = a.A_1$

$n \models X$



$X \overset{max}{=} \underbrace{[a]Y}_{F_X}$

$Y \overset{max}{=} \underbrace{\langle a \rangle X}_{F_Y}$

$Proc = \{n, n_1, n_2, n_3, n_4, n_5\}$

$[\![X]\!] = Proc$

$[\![Y]\!] = Proc$

$([\![X]\!], [\![Y]\!]) = ([\![F_X]\!], [\![F_Y]\!])$

$(Proc, Proc) = ([.a.]\, Proc, \langle .a. \rangle\, Proc)$

$= (\{n, n_1, n_2, n_3, n_4, n_5\}, \{n, n_1, n_2, n_4\})$

$(Proc, \{n, n_1, n_2, n_4\}) = ([.a.]\{n, n_1, n_2, n_4\}, \langle .a. \rangle \{n, n_1, n_2, n_4\})$

$= (\{n, n_2, n_3, n_5\}, \{n, n_1, n_2\})$

Maior ponto fixo

→ fazer o mesmo para o menor ponto fixo.