CCS and equivalences

José Proença & Renato Neves
pro@isep.ipp.pt & nevrenato@di.uminho.pt

Cyber-Physical Computation 2022/2023
TPC-1

To do

Solve the exercises and produce a PDF with your answers.

How to submit via email

Please send it by email (`pro@isep.ipp.pt`) with the name "`pcf2223-N.pdf`", where "`N`" is your student number. The subject of the email should be "`pcf2223 N TPC-1`".

Valorization questions

Questions marked with **[Hard]** are valorization questions. These have very small marks when compared with the other questions and are meant to be more difficult.

Deadline

7 April 2023 @ 23:59 (Friday)

CCS analysis

Exercise 1. For each of the CCS processes below, **draw** its transition system.

1.1. $A = a.b.0$

1.2. $B = A + a.0$

1.3. $C = (B \mid c.d.A)\backslash\{d\}$

Exercise 2. Recall A and B processes from Ex. 1.

2.1. **Prove** that $A \lesssim B$ or **explain** why not.

2.2. **Prove** that $B \lesssim A$ or **explain** why not.

2.3. **Prove** that $A \sim B$ or **explain** why not.

Exercise 3. [Hard] Prove that, for all CCS processes P and Q:

$$P + Q \quad \sim \quad Q + P$$

CCS modelling

Exercise 4. Consider the 5 components below.

- **T**: A temperature sensor that periodically sends a temperature value;
- **H**: A humidity sensor that periodically sends a humidity value;
- **C**: A clock that sends a timestamp with the current time;
- **O**: An orchestrator that receives a temperature value, followed by a humidity value and by a timestamp, and in the end sends this data package;
- **D**: A display that receives data from the orchestrator and displays the content.

Consider each underlined word above to be an action of our CSS processes.

4.1. Specify each of these 5 components in CCS and **draw** their transition system.

4.2. Specify a new component **S** of this system, which composes the 5 components above in parallel, imposing synchronisation of all actions except display.

4.3. Propose a variation of a similar system **S2** in CCS with no orchestrator. In this variation:

1. the humidity sensor informs the temperature sensor, then
2. the temperature sensor informs the timestamp, then
3. the timestamp sends the whole data to the display; and finally
4. the display prompts the humidity sensor to restart the process.

4.4. [Hard] Experiment with the tool mCRL2 (`https://mcrl2.org`). Use it to **validate** your **S** and **S2** definitions above.