CCS with data communication

- value passing CCS
- translation to standard CCS
- CCS is Turing-powerful

Value Passing CCS

Main Idea

Handshake synchronization is extended with the possibility to exchange integer values.

$$\overline{pay(6)}.Nil \mid pay(x).\overline{save(x/2)}.Nil \mid Bank(100)$$
$$\downarrow \tau$$
$$Nil \mid \overline{save(3)}.Nil \mid Bank(100)$$
$$\downarrow \tau$$
$$Nil \mid Nil \mid Bank(103)$$

Parametrized Process Constants

For example: $Bank(total) \stackrel{\text{def}}{=} save(x).Bank(total + x)$.

Translation of Value Passing CCS to Standard CCS

Value Passing CCS

$$C \stackrel{\text{def}}{=} in(x).C'(x)$$

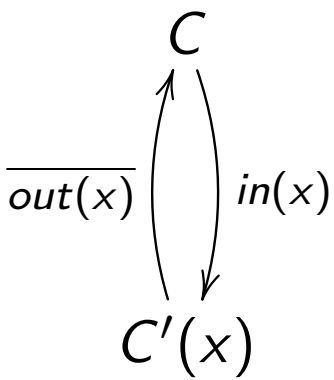
$$C'(x) \stackrel{\text{def}}{=} \overline{out(x)}.C$$

$\longrightarrow$

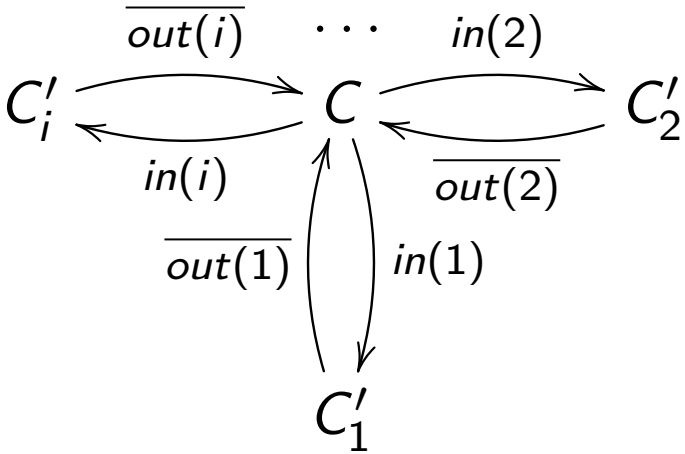
Standard CCS

$$C \stackrel{\text{def}}{=} \sum_{i \in \mathbb{N}} in(i).C'_i$$

$$C'_i \stackrel{\text{def}}{=} \overline{out(i)}.C$$



symbolic LTS



infinite LTS

CCS Has Full Turing Power

Fact

CCS can simulate a computation of any Turing machine.

Remark

Hence CCS is as expressive as any other programming language but its use is to rather describe the behaviour of reactive systems than to perform specific calculations.