VEN. 30/10/2020

CCS puro $\longrightarrow$ LTS

K nomi di Processi

$K = P$ $\qquad P \in Processes$

0, nil

$Act = A \cup \bar{A} \cup \{\tau\}$

$\bar{\bar{a}} = a \quad \forall a \in A$

$\alpha \in Act$

$\alpha . P$

$\sum_i P_i$

$P_1 \mid P_2$

$P \setminus L \qquad L \subseteq A$

$P[f] \qquad f : Act \to Act$

$f(\tau) = \tau$

$f(\bar{a}) = \overline{f(a)}$

- RESTRIZIONE $\quad Act = A \cup \bar{A} \cup \{\tau\}$

sia $L \subseteq A$ $\qquad$ CCS $\rightarrow$ LTS

$P \in$ Proc. CCS

- $P \setminus L$ $\quad$ il processo P **non** può interagire con il suo ambiente con azioni $i \in L \cup \bar{L}$ ma le azioni in $L \cup \bar{L}$ sono locali a P.

es $(P_1 \mid P_2) \setminus \{a\}$

$$\frac{P \xrightarrow{\alpha} P'}{P \setminus L \xrightarrow{\alpha} P' \setminus L} \; \alpha, \bar{\alpha} \notin L$$

$L \subseteq A$

- rietichettatura

$f : Act \longrightarrow Act$

$f(\tau) = \tau \;\wedge\; f(\bar{a}) = \overline{f(a)}$

- $P[f]$

$a \longrightarrow b$

$\bar{a} \longrightarrow \bar{b}$

$$\frac{P \xrightarrow{\alpha} P'}{P[f] \xrightarrow{f(\alpha)} P'[f]}$$

$$\frac{P \xrightarrow{\alpha} P'}{K \xrightarrow{\alpha} P'} \; K = P$$

Precedenza degli operatori

$\backslash L \ , \ [f] \ , \ \alpha . P \ , \ | \ , \ +$

$R + a.P \mid b.Q \backslash L = \underline{R + \left((a.P) \mid \left(b.(Q) \backslash L \right) \right)}$

$(R + a.P) \mid (b.Q \backslash L)$ NO

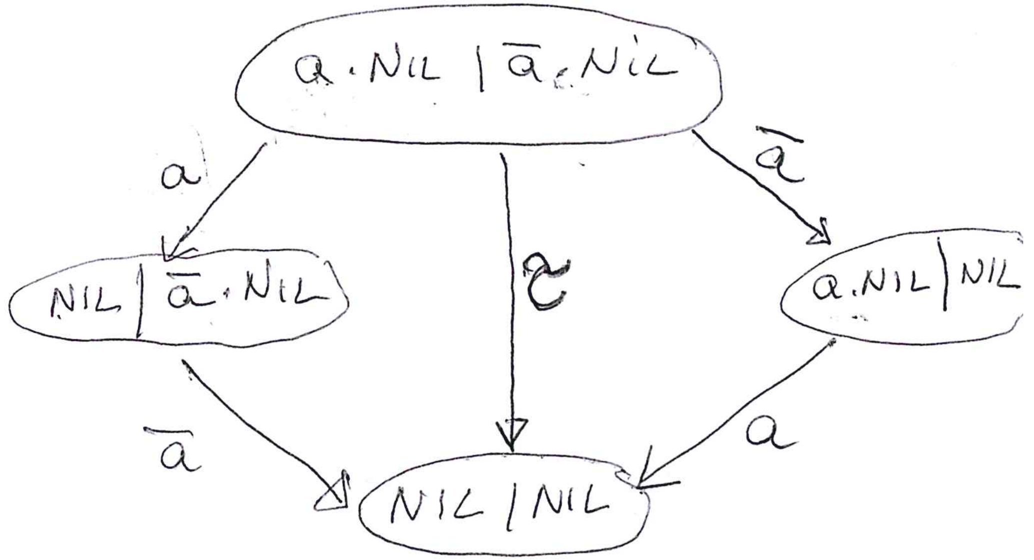
$\underline{(b.Q) \backslash L}$ NO

$a.(P \mid b \dots)$ NO

CCS

$a.NIL \mid \bar{a}.NIL$

LTS



— Reti di Petri

Strutture di eventi

SIMULAZIONE SEQUENZIALE NON DETERMINISTICA

<u>semantica</u>

- "TRUE CONCURRENCY" ⇒ ipotesi che $a, \bar{a}$ .. siano <u>atomiche</u>
- "ordini parziali"

Esercizio x LUN. 2/11

costruire il LTS associato a

$$\left(\left(a.P_1' + \bar{b}\,P_1''\right) \mid \left(\bar{a}.P_2' + b.P_2''\right)\right) \setminus \{a\}$$

$$S = \overline{lez}.S$$

$$Uni = (M \mid LP) \setminus \{coin, caffè\}$$

$$M = coin.\overline{caffè}.M$$

$$LP = \overline{lez}.\overline{coin}.caffè.LP$$

$$A \cup \bar{A} = \{coin, \overline{coin}, \overline{lez}, caffe, \overline{caffe}\}$$

CCS

gli operatori

$. \,,\, \mid \,,\, +$

$S = \overline{lez}.S$

$S \xrightarrow{\overline{lez}} S$

$S \overset{?}{-}$ uni

implementazione $\overset{?}{\models}$ Specifica

$uni = (M \mid LP) \setminus \{coin, coffe\} =$

$$(coin.\overline{coffe}.M \mid \overline{lez}.\overline{coin}.coffe.LP) \setminus \{coin, coffe\}$$

$$\downarrow \overline{lez}$$

$$(coin.\overline{coffe}.M \mid \overline{coin}.coffe.LP) \setminus \{coin, coffe\}$$

$$\downarrow \tau$$

$$(\overline{coffe}.M \mid coffe.LP) \setminus \{coin, coffe\}$$

$$\downarrow \tau$$

$$\frac{a.p \xrightarrow{a} p \quad \wedge \quad \overline{a}.q \xrightarrow{\overline{a}} q}{a.p \mid \overline{a}.q \xrightarrow{\tau} p \mid q}$$

implementazione F specifica

Rel. R di equivalenza tra Processi CCS

$R \subseteq P_{CCS} \times P_{CCS}$

- rifl.
- simm.
- transitive

- astrarre dagli stati
  considerare Act
- astrarre dalle sincronizzazioni
  interne (τ)
- astrarre rispetto al non-determinismo

R deve essere una CONGRUENZA
rispetto agli operatori del CCS.

R rel. di equivalenza è una CONGRUENZA

<u>sse</u> $\forall\, p, q \in$ Proc. ccs

$\forall\, C[\cdot]$ <u>contesto</u> <u>ccs</u>

se $p\ R\ q$ allora $C[p]\ R\ C[q]$

es. $Uni = (M \mid LP) \setminus \{coffe, coin\}$

$(\cdot \mid LP) \setminus \{coffe, coin\}$

se $M_1\ R\ M_2$ allora $(M_1 \mid LP) \setminus \{coffe, coin\}$

$$R$$

$(M_2 \mid LP) \setminus \{caffè, coin\}$

CCS $\quad P_1 \qquad P_2$

LTS $\quad \nabla_1 \quad \underline{\text{iso}} \quad \nabla_2$

troppo forte

<u>Eq. rispetto alle Tracce</u> $\quad$ (~~iso~~ <u>CONGRUENZA</u>)

$P \in$ Processi CCS $\qquad \text{Tracce}(P) = \{ w \in Act^* \mid \exists p' \in \text{Processi} \;\; p \xrightarrow{w} p' \}$

$p \xrightarrow{w} p'$ $\qquad$ se $w = \varepsilon \quad p = p'$

$\qquad\qquad\qquad$ se $w = a x \quad p \xrightarrow{a} p'' \xrightarrow{x} p'$

P_1 è equivalente rispetto alle tracce a P_2

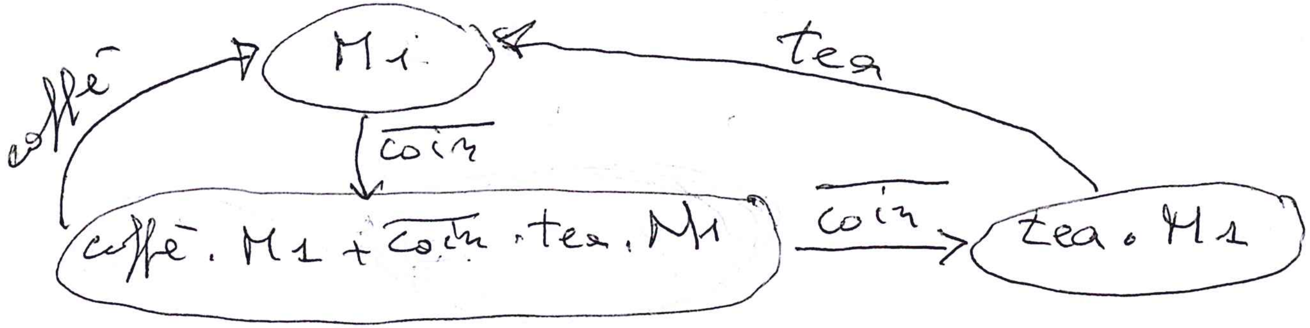
$P_1 \sim^{T} P_2$ <u>sse</u> $\text{Tracce}(P_1) = \text{Tracce}(P_2)$

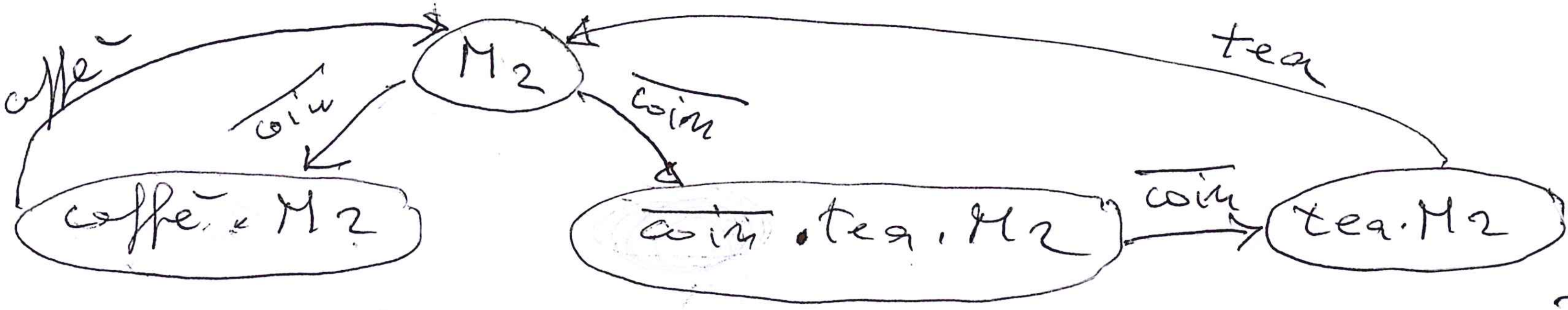
$(LP \mid M_i) \setminus \{coin, caffè\}$

$$M_1 = \overline{coin}.(caffè.M_1 + \overline{coin}.tea.M_1)$$

$$M_2 = \overline{coin}.caffè.M_2 + \overline{coin}.\overline{coin}.tea.M_2$$

$$\text{Tracce}(M_1) \overset{?}{=} \text{Tracce}(M_2) \equiv M_1 \overset{?T}{\sim} M_2$$





$$\text{Tracce}(M_1) \overset{?}{=} \text{Tracce}(M_2) \qquad M_1 \overset{T}{\sim} M_2$$

sì

$LP = \overline{lez} . coin . \overline{coffe} . LP$

$(LP \mid M_1) \setminus \{coin, caffè\}$

$(LP \mid M_2) \setminus \{coin, caffè\}$

$\Rightarrow$ può andare in <u>deadlock</u>

↳ Bisimulazione

$M_1 \sim^{T} M_2$

$M_1 \not\sim^{Bis} M_2$