

Communication and Concurrency

Lecture 3

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Transition rules (including axioms)

$$\text{R}(\cdot) \quad a.E \xrightarrow{a} E$$

$$\text{R}(\text{in}) \quad a(x).E \xrightarrow{a(v)} E\{v/x\} \quad \text{if } v \in D$$

$$\text{R}(\text{out}) \quad \bar{a}(e).E \xrightarrow{\bar{a}(v)} E \quad \text{if } \text{Val}(e) = v$$

$$\text{R}(\stackrel{\text{def}}{=}) \quad \frac{P \xrightarrow{a} F}{E \xrightarrow{a} F} \quad P \stackrel{\text{def}}{=} E$$

$$\text{R}(+) \quad \frac{E_1 + E_2 \xrightarrow{a} F}{E_1 \xrightarrow{a} F} \quad \frac{E_1 + E_2 \xrightarrow{a} F}{E_2 \xrightarrow{a} F}$$

$$\text{R}(| \text{com}) \quad \frac{E | F \xrightarrow{\tau} E' | F'}{E \xrightarrow{a} E' \quad F \xrightarrow{\bar{a}} F'}$$

$$\text{R}(|) \quad \frac{E | F \xrightarrow{a} E' | F}{E \xrightarrow{a} E'} \quad \frac{E | F \xrightarrow{a} E | F'}{F \xrightarrow{a} F'}$$

$$\frac{E \setminus J \xrightarrow{a} F \setminus J}{E \xrightarrow{a} F} \quad a \notin J \cup \bar{J}$$

Example: protocol that may lose messages

$$\begin{aligned} \text{Sender} & \stackrel{\text{def}}{=} \text{in}(x).\overline{\text{sm}}(x).\text{Send1}(x) \\ \text{Send1}(x) & \stackrel{\text{def}}{=} \text{ms}.\overline{\text{sm}}(x).\text{Send1}(x) + \text{ok}.\text{Sender} \\ \text{Medium} & \stackrel{\text{def}}{=} \text{sm}(y).\text{Med1}(y) \\ \text{Med1}(y) & \stackrel{\text{def}}{=} \overline{\text{mr}}(y).\text{Medium} + \tau.\overline{\text{ms}}.\text{Medium} \\ \text{Receiver} & \stackrel{\text{def}}{=} \text{mr}(x).\overline{\text{out}}(x).\overline{\text{ok}}.\text{Receiver} \\ \\ \text{Protocol} & \equiv (\text{Sender} \mid \text{Medium} \mid \text{Receiver}) \setminus \{\text{sm}, \text{ms}, \text{mr}, \text{ok}\} \end{aligned}$$

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access to `Resource` is triggered by ok by E
- ▶ Observation of $ok =$ release of `Resource`
- ▶ τ cannot be observed in this way

Observable transitions

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

U $\stackrel{\text{def}}{=} \text{write}(x).\overline{\text{in}}(x).\text{ok}.U$

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What is difference between?

$$(C \mid U) \setminus \{\text{in}, \text{ok}\}$$

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$E \xRightarrow{\varepsilon} F$ or $E \xRightarrow{a} F$ where $a \neq \tau$

$$R(\xRightarrow{\varepsilon}) \quad E \xRightarrow{\varepsilon} E \quad \frac{E \xRightarrow{\varepsilon} F}{E \xrightarrow{\tau} E' \quad E' \xRightarrow{\varepsilon} F}$$

$$R(\xRightarrow{a}) \quad \frac{E \xRightarrow{a} F}{E \xRightarrow{\varepsilon} E' \quad E' \xrightarrow{a} F' \quad F' \xRightarrow{\varepsilon} F}$$

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4. Draw the observable graph for Peterson