Concurrency: Theory, Languages and Programming

– Proofs in CCS –

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The Scheduler Problem

informal specification

specification as *sequential* process expression

implementation as *concurrent* process expression

comparison between specification and implementaton

- proofs using ABC
- proofs “by hand” (very close to [§ 7.3])

Scheduler, Informally [Mil99, § 3.6]

a set of processes is to be scheduled

starts by sync'ing on with the scheduler

completes by sync'ing on with the scheduler

(1) each *must not* run two tasks at a time

(2) tasks of different *may* run at the same time

are required to occur cyclically (initially, starts)

for each , and must occur cyclically

(3) maximal "progress":

the scheduling must permit
any of the "buttons" to be pressed
at any time provided (1) and (2) are not violated.

Formal Specification [Mil99, § 3.6]

S	scheduler, where is next and every is running
	(* we omit the parameters in the following *)
S	$\left\{\begin{array}{l}\sum \quad \text{S} \\ \sum \quad \text{S} \quad \text{S}\end{array}\right.$
Scheduler	S

- draw the transition graph for
- show that the scheduler is never deadlocked
- what is the difference when dropping the case for ?

Formal "Implementation" [§ 7.3]

Formal "Implementation" (II) [§ 7.3]

Scheduler

Proofs Using ABC

- model the specification for
- model the wrong (!) implementation for
- run the ABC
- analyze the transitions systems (using `step`)
- understand the problem
  w.r.t. the formal & informal specification
- model now the correct implementation for
- run the ABC
- understand the bisimulation relation that ABC has generated
- if time left, try out for . . .

Proofs “by Hand” (I)

means: “guessing” a bisimulation relation !

draw the transition graph of for

generalize for greater . . .

Observe: every reachable state is of the form

where is one of .

Observe that in any state reachable from
only one of the is one of ,
while **all other** are either of .

analyze the “meaning” of the those states

Proofs "by Hand" (II)

analyze the "meaning" of the following states for

Proofs “by Hand” (III)

Let be any partition of .

$\prod \quad \prod$

$\prod \quad \prod$

$\prod \quad \prod$

Note that .

Proofs “by Hand” (IV)

Using the Expansion Law, we show that:

$$\sum$$

$$\sum$$

$$\sum$$

$$\left\{ \begin{array}{ll} & \text{if} \\ & \text{if} \end{array} \right.$$

Proofs “by Hand” (V)

Let be the relation containing the following pairs:

s

s

s

is a weak bisimulation (up to).

contains the pair Scheduler .

Q.E.D.