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EVENT: Start with the library "mlp" using the compiled version.

```
; prod0_CSXAdd.bm
; . definition of circuits [assumes stringadd.bm] :
;   - if the circuit has only one line: OK without any hint
;   We MAY want to put the TOPO hint, just for the induction, although
; for one line it probably collapses to the same induction (LEN X).
;   - if the circuit has more than one line:
;   - without hints: FAIL
;     - TOP00 is not definable, because of loops in the dependency graph!
;   - with TOPOR: OK
; NOTE: the above comments date back to the hand-generation time, when we
;       were still trying to FIND a way to feed things to BM. They are kept
```

```

;      here for historical purposes only...

;;; DEFINITION OF CIRCUITS:
#|
(setq sysd-prod '(sy-prod (x)
(Yprod S Times x Yprod2)
(Yprod2 R 0 Yprod)
))

(setq sysd-const0 '(sy-const0 (x)
(Yconst0 R 0 Yconst0)
))

(setq prod0_CSXA00 '(
|#

; BM DEFINITIONS and A2 LEMMAS, generated by BMSYSD:
; comb_times.bm: Times combinational element.
; U7-DONE

; no character function def since BM already knows about Times..

; Everything below generated by:      (bmcomb 'times '() '(x y))

DEFINITION:
s-times (x, y)
=  if empty (x) then E
   else a(s-times (p (x), p (y)), l (x) * l (y)) endif

;; A2-Begin-S-TIMES

THEOREM: a2-empty-s-times
empty (s-times (x, y)) = empty (x)

THEOREM: a2-e-s-times
(s-times (x, y) = E) = empty (x)

THEOREM: a2-lp-s-times
len (s-times (x, y)) = len (x)

THEOREM: a2-lpe-s-times
eqlen (s-times (x, y), x)

```

THEOREM: a2-ic-s-times
 $(\text{len}(x) = \text{len}(y))$
 $\rightarrow (\text{s-times}(\text{i}(c_x, x), \text{i}(c_y, y)) = \text{i}(c_x * c_y, \text{s-times}(x, y)))$

THEOREM: a2-lc-s-times
 $(\neg \text{empty}(x)) \rightarrow (\text{l}(\text{s-times}(x, y)) = (\text{l}(x) * \text{l}(y)))$

THEOREM: a2-pc-s-times
 $\text{p}(\text{s-times}(x, y)) = \text{s-times}(\text{p}(x), \text{p}(y))$

THEOREM: a2-hc-s-times
 $((\neg \text{empty}(x)) \wedge (\text{len}(x) = \text{len}(y)))$
 $\rightarrow (\text{h}(\text{s-times}(x, y)) = (\text{h}(x) * \text{h}(y)))$

THEOREM: a2-bc-s-times
 $(\text{len}(x) = \text{len}(y)) \rightarrow (\text{b}(\text{s-times}(x, y)) = \text{s-times}(\text{b}(x), \text{b}(y)))$

THEOREM: a2-bnc-s-times
 $(\text{len}(x) = \text{len}(y)) \rightarrow (\text{bn}(n, \text{s-times}(x, y)) = \text{s-times}(\text{bn}(n, x), \text{bn}(n, y)))$

;; A2-End-S-TIMES

; eof:comb_times.bm

DEFINITION:
topor-sy-prod(ln)
= **if** $ln = \text{'yprod'}$ **then** 1
 elseif $ln = \text{'yprod2'}$ **then** 0
 else 0 **endif**

DEFINITION:
sy-prod(ln, x)
= **if** $ln = \text{'yprod'}$ **then** $\text{s-times}(x, \text{sy-prod}(\text{'yprod2'}, x))$
 elseif $ln = \text{'yprod2'}$
 then if $\text{empty}(x)$ **then** E
 else $\text{i}(0, \text{sy-prod}(\text{'yprod'}, \text{p}(x)))$ **endif**
 else $\text{sfix}(x)$ **endif**

;; A2-Begin-SY-PROD

THEOREM: a2-empty-sy-prod
 $\text{empty}(\text{sy-prod}(ln, x)) = \text{empty}(x)$

THEOREM: a2-e-sy-prod
 $(\text{sy-prod}(ln, x) = E) = \text{empty}(x)$

THEOREM: a2-lp-sy-prod
 $\text{len}(\text{sy-prod}(ln, x)) = \text{len}(x)$

THEOREM: a2-lpe-sy-prod
 $\text{eqlen}(\text{sy-prod}(ln, x), x)$

THEOREM: a2-pc-sy-prod
 $p(\text{sy-prod}(ln, x)) = \text{sy-prod}(ln, p(x))$

;; A2-End-SY-PROD
 ; BM DEFINITIONS and A2 LEMMAS, generated by BMSYSD:

; No TOP0 def for 1 line sysds because it is not needed and confuses BM

DEFINITION:
 $\text{sy-const0}(ln, x)$
 $= \text{if } ln = 'yconst0$
 $\quad \text{then if empty}(x) \text{ then } E$
 $\quad \quad \text{else } i(0, \text{sy-const0}('yconst0, p(x))) \text{ endif}$
 $\quad \text{else sfix}(x) \text{ endif}$

;; A2-Begin-SY-CONST0

THEOREM: a2-empty-sy-const0
 $\text{empty}(\text{sy-const0}(ln, x)) = \text{empty}(x)$

THEOREM: a2-e-sy-const0
 $(\text{sy-const0}(ln, x) = E) = \text{empty}(x)$

THEOREM: a2-lp-sy-const0
 $\text{len}(\text{sy-const0}(ln, x)) = \text{len}(x)$

THEOREM: a2-lpe-sy-const0
 $\text{eqlen}(\text{sy-const0}(ln, x), x)$

THEOREM: a2-pc-sy-const0
 $p(\text{sy-const0}(ln, x)) = \text{sy-const0}(ln, p(x))$

;; A2-End-SY-CONST0

;;; PROOF OF EQUIVALENCE:

; The key fact about SY-Yconst is that it equals the constant 0 function:

THEOREM: sy-const0-is-const

$\text{sy-const0}('y\text{const0}, x) = \text{s-const}(0, x)$

; The key fact (bug) about prod0 is that both lines also equal const-0 sfun
; CRUCIAL NOTE: we only want the 1st equality, but in order for the induction
; proof to succeed, we need the stronger (global) statement.

THEOREM: prod0-is-const

$(\text{sy-prod}('y\text{prod}, x) = \text{s-const}(0, x))$

$\wedge (\text{sy-prod}('y\text{prod2}, x) = \text{s-const}(0, x))$

; now the equality is trivial:

THEOREM: e_prodconst0

$\text{sy-prod}('y\text{prod}, x) = \text{sy-const0}('y\text{const0}, x)$

; eof: prod0_CSXA00.bm

;))

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