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|#

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

; pplinc3.bm is our 1st PIPELINE proof.

;;; (Sugared) Circuits:

#|

(setq A '(SY-A (x)

(Y1 S Inc x)

(Y2 S Inc Y1)

(Y3 S Inc Y2)

; and the cork:

(Yc2 R 2 Y3)

(Yc1 R 1 Yc2)

```
(Yout R 0 Yc1)
))
```

```
(setq B '(SY-B (x)
(Z1 S Inc x)
(Z2 R 0 Z1)
(Z3 S Inc Z2)
(Z4 R 0 Z3)
(Z5 S Inc Z4)
(Zout R 0 Z5)
))
```

```
(setq pplinc3 '( |#
; BM DEFINITIONS and A2 LEMMAS, generated by BMSYSD:
; comb_inc.bm: INCrement combinational element
; U7-DONE
```

DEFINITION: $\text{inc}(u) = (1 + u)$

; Everything below generated by: (bmcomb 'inc '() '(x))

```
DEFINITION:
s-inc(x)
=  if empty(x) then E
   else a(s-inc(p(x)), inc(l(x))) endif

;; A2-Begin-S-INC
```

THEOREM: a2-empty-s-inc
 $\text{empty}(\text{s-inc}(x)) = \text{empty}(x)$

THEOREM: a2-e-s-inc
 $(\text{s-inc}(x) = E) = \text{empty}(x)$

THEOREM: a2-lp-s-inc
 $\text{len}(\text{s-inc}(x)) = \text{len}(x)$

THEOREM: a2-lpe-s-inc
 $\text{eqlen}(\text{s-inc}(x), x)$

THEOREM: a2-ic-s-inc
 $\text{s-inc}(i(c_x, x)) = i(\text{inc}(c_x), \text{s-inc}(x))$

THEOREM: a2-lc-s-inc
 $(\neg \text{empty}(x)) \rightarrow (l(\text{s-inc}(x)) = \text{inc}(l(x)))$

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

THEOREM: a2-hc-s-inc
 $(\neg \text{empty}(x)) \rightarrow (h(\text{s-inc}(x)) = \text{inc}(h(x)))$

THEOREM: a2-bc-s-inc
 $b(\text{s-inc}(x)) = \text{s-inc}(b(x))$

THEOREM: a2-bnc-s-inc
 $\text{bn}(n, \text{s-inc}(x)) = \text{s-inc}(\text{bn}(n, x))$

;; A2-End-S-INC

; eof:comb_inc.bm

DEFINITION:
topor-sy-a(ln)
= if $ln = 'y1$ then 1
 elseif $ln = 'y2$ then 2
 elseif $ln = 'y3$ then 3
 elseif $ln = 'yc2$ then 0
 elseif $ln = 'yc1$ then 0
 elseif $ln = 'yout$ then 0
 else 0 endif

DEFINITION:
sy-a(ln, x)
= if $ln = 'y1$ then s-inc(x)
 elseif $ln = 'y2$ then s-inc(sy-a($'y1, x$))
 elseif $ln = 'y3$ then s-inc(sy-a($'y2, x$))
 elseif $ln = 'yc2$
 then if empty(x) then E
 else i(2, sy-a($'y3, p(x)$)) endif
 elseif $ln = 'yc1$
 then if empty(x) then E
 else i(1, sy-a($'yc2, p(x)$)) endif
 elseif $ln = 'yout$
 then if empty(x) then E
 else i(0, sy-a($'yc1, p(x)$)) endif
 else sfix(x) endif

:: A2-Begin-SY-A

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

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

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

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

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

:: A2-End-SY-A

DEFINITION:

$\text{topor-sy-b}(ln)$
= **if** $ln = 'z1$ **then** 1
 elseif $ln = 'z2$ **then** 0
 elseif $ln = 'z3$ **then** 1
 elseif $ln = 'z4$ **then** 0
 elseif $ln = 'z5$ **then** 1
 elseif $ln = 'zout$ **then** 0
 else 0 **endif**

DEFINITION:

$\text{sy-b}(ln, x)$
= **if** $ln = 'z1$ **then** $\text{s-inc}(x)$
 elseif $ln = 'z2$
 then if $\text{empty}(x)$ **then** E
 else $i(0, \text{sy-b}('z1, p(x)))$ **endif**
 elseif $ln = 'z3$ **then** $\text{s-inc}(\text{sy-b}('z2, x))$
 elseif $ln = 'z4$
 then if $\text{empty}(x)$ **then** E
 else $i(0, \text{sy-b}('z3, p(x)))$ **endif**
 elseif $ln = 'z5$ **then** $\text{s-inc}(\text{sy-b}('z4, x))$
 elseif $ln = 'zout$
 then if $\text{empty}(x)$ **then** E
 else $i(0, \text{sy-b}('z5, p(x)))$ **endif**
 else $\text{sfix}(x)$ **endif**

```
;; A2-Begin-SY-B
```

```
THEOREM: a2-empty-sy-b  
empty (sy-b (ln, x)) = empty (x)
```

```
THEOREM: a2-e-sy-b  
(sy-b (ln, x) = E) = empty (x)
```

```
THEOREM: a2-lp-sy-b  
len (sy-b (ln, x)) = len (x)
```

```
THEOREM: a2-lpe-sy-b  
eqlen (sy-b (ln, x), x)
```

```
THEOREM: a2-pc-sy-b  
p (sy-b (ln, x)) = sy-b (ln, p (x))
```

```
;; A2-End-SY-B
```

```
;;; CORRECTNESS PROOF (hand generated, dreamer!):
```

```
; EQ-A-B: just like in CorrSL, since there are no loops, straight unfolding  
; should work, as long as Brain's normalization is strong enough...  
; Note about the hint:  
;   - STR-add1-len-P2 (and hence LEN) came from CorrSL.  
;   - at first we disabled S-INC thinking that it was irrelevant, but it  
;     IS necessary, since it affects the value of the cork.
```

```
THEOREM: eq-a-b  
sy-b ('zout, x) = sy-a ('yout, x)
```

```
; eof: pplinc3.bm  
;))
```

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