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|#

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

```
;(setq theta '(
```

```
; theta.bm
; This is a 2nd order circuit constructor, derived from all the "Accumulator"
; examples, as well as the simple counter example. Basically, it arises in
; a case where the SPEC is easily expressible: as the iteration of "last-char"
; function which can be expressed only using the input string (x). So in other
; words, we have a string to char function "last-char" which defines the
; circuit, for example: the sum of all inputs, the length of input, etc...
; and we just build the corresponding string function in a "standard" fashion.
; This standard fashion is the THETA operator.
```

```

; This file just attempts to abstract the construction, and the correctness
; proof that goes with it, to facilitate future instantiations.
;
; Clearly, there is no sugar involved.
;
; Standard hints necessary for a PROVE-LEMMA have been removed in the
; corresponding ADD-AXIOM.

```

```

;;; DEFINITION OF CIRCUIT:

```

EVENT: Introduce the function symbol *sysd-theta* of 2 arguments.

```

;sysd-stringp is normally deduced by BM.

```

```

AXIOM: sysd-stringp
stringp(sysd-theta(line, x))

```

```

;;; SPEC definition:

```

EVENT: Introduce the function symbol *spec-theta-lastchar* of one argument.

```

; this is the standard extension from last-char-fun to MLP-string-fun.

```

```

DEFINITION:
spec-theta(x)
= if empty(x) then E
  else a(spec-theta(p(x)), spec-theta-lastchar(x)) endif

```

```

;;; PROOF of equivalence with spec:

```

```

;;; 2nd order instantiations for circuits:
;; theta-begin

```

```

AXIOM: a2-empty-theta
empty(sysd-theta(line, x)) = empty(x)

```

```

AXIOM: a2-e-theta
(sysd-theta(line, x) = E) = empty(x)

```

```

AXIOM: a2-lp-theta
len(sysd-theta(line, x)) = len(x)

```

```

AXIOM: a2-lpe-theta
eqlen(sysd-theta(line, x), x)

```

```

AXIOM: a2-pc-theta
  ( $\neg$  empty( $x$ ))  $\rightarrow$  (p(sysd-theta( $line$ ,  $x$ )) = sysd-theta( $line$ , p( $x$ )))

;; theta-end

;;; Circuit CORRECTNESS:

; Theta-correct-ax is a "predicative correctness statement", i.e. what we would
; do if we didn't have functional equality as a specification method, but
; instead used a purely axiomatic approach. It matches the intuitive view
; of just looking at the last char.

AXIOM: theta-correct-ax
  ( $\neg$  empty( $x$ ))  $\rightarrow$  (l(sysd-theta('ytheta,  $x$ )) = spec-theta-lastchar( $x$ ))

; To go to a functional equality once we have the "last" (ax) statement is
; a trivial induction, if we start out with an P-L split which is unnatural
; for BM, so we force it w/ a USE hint of A-p-l-split

THEOREM: a-p-l-split
  ( $\neg$  empty( $x$ ))
   $\rightarrow$  (sysd-theta('ytheta,  $x$ )
      = a(p(sysd-theta('ytheta,  $x$ )), l(sysd-theta('ytheta,  $x$ ))))

; Interestingly: A-P-L needs to be disabled for theta-correct to go through.
; yet in more specific cases such as macc, or funacc, it is not needed, and
; in fact just makes a very minor time improvement.

THEOREM: theta-correct
  sysd-theta('ytheta,  $x$ ) = spec-theta( $x$ )

; eof: theta.bm
;))

```

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