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

EVENT: For efficiency, compile those definitions not yet compiled.

DEFINITION:

$bc(n, m)$
= **if** $m \simeq 0$ **then** 1
 elseif $n < m$ **then** 0
 else $bc(n - 1, m) + bc(n - 1, m - 1)$ **endif**

EVENT: Disable eval\$.

THEOREM: for-append-sum

for (x ,
 append(a , b),

```

    test,
    'sum,
    body,
    alist)
= (for (x,
      a,
      test,
      'sum,
      body,
      alist)
  + for (x,
        b,
        test,
        'sum,
        body,
        alist))

```

THEOREM: bc-x-x1

$\text{bc}(x, 1 + x) = 0$

THEOREM: bc-x-x

$\text{bc}(x, x) = 1$

THEOREM: from-to-opens-at-btm

$\text{from-to}(0, b) = \text{cons}(0, \text{from-to}(1, b))$

THEOREM: member-from-to

$(i \in \text{from-to}(a, b)) = ((i \in \mathbf{N}) \wedge (i \not\leq a) \wedge (b \not\leq i))$

THEOREM: for-sum-plus

```

for (i,
    range,
    test,
    'sum,
    list('plus, a, b),
    alist)
= (for (i,
      range,
      test,
      'sum,
      a,
      alist)
  + for (i,
        range,
        test,

```

'sum,
b,
alist))

THEOREM: times-plus-distributivity-again
 $((a + b) * c) = ((a * c) + (b * c))$

THEOREM: difference-sub1-2
 $((i \neq 0) \wedge (x \neq i)) \rightarrow ((x - (i - 1)) = (1 + (x - i)))$

THEOREM: out-with-the-factors
 $((one \simeq \mathbf{nil}) \wedge (one \neq var))$
 $\rightarrow$ (for (var,
 range,
 condition,
 'sum,
 list('times, one, two),
 alist)
 = (eval\$(TRUE, one, alist)
 * for (var,
 range,
 condition,
 'sum,
 two,
 alist)))

THEOREM: lessp-1
 $(i < 1) = (i \simeq 0)$

THEOREM: lessp-crock1
 $(i \neq 0) \rightarrow ((x < (i - 1)) = ((x < i) \wedge (\text{fix}(x) \neq (i - 1))))$

THEOREM: zero-sum
 for (i,
 l,
 cond,
 'sum,
 '0,
 alist)
 = 0

THEOREM: shift-indicial-up-crock
 $(n \neq 0)$
 $\rightarrow$ (for i in from-to(1, n)
 sum exp(a, i) * (bc(x, i - 1) * exp(b, x - i)) endfor

$$\begin{aligned}
&= \text{for } i \text{ in from-to}(0, n-1) \\
&\quad \text{sum exp}(a, 1+i) \\
&\quad \quad * \text{ (bc}(x, i) * \text{exp}(b, x - (1+i))) \text{ endfor}
\end{aligned}$$

THEOREM: goal1

$$\begin{aligned}
&((x \in \mathbf{N}) \wedge (x \neq 0) \wedge (1 \neq x) \wedge ((x-1) \neq 0)) \\
\rightarrow &((a * \text{for } i \text{ in from-to}(1, x-1) \\
&\quad \text{sum bc}(x, i) * (\text{exp}(a, i) * \text{exp}(b, x-i)) \text{ endfor}) \\
&= (a * (b * \text{for } i \text{ in from-to}(1, x-1) \\
&\quad \text{sum bc}(x, i) \\
&\quad \quad * (\text{exp}(a, i) \\
&\quad \quad \quad * \text{exp}(b, (x-1)-i)) \text{ endfor})))
\end{aligned}$$

THEOREM: newton

$$\begin{aligned}
&\text{exp}(a+b, n) \\
&= \text{for } i \text{ in from-to}(0, n) \\
&\quad \text{sum bc}(n, i) * \text{exp}(a, i) * \text{exp}(b, n-i) \text{ endfor}
\end{aligned}$$

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