

1. $\langle id \rangle ::= a | b | c | \dots | z$

$\langle dig \rangle ::= 0 | 1 | 2 | \dots | 9$

$\langle expr \rangle ::= () | \langle dig \rangle | \langle id \rangle$

1 $\text{let } \langle id \rangle = \langle expr \rangle \text{ in } \langle expr \rangle$

1 $\langle expr \rangle ; \langle expr \rangle$

1 $\text{begin } \langle expr \rangle \text{ end}$

use example: $\text{let } x = 5 \text{ in begin } x ; x \text{ end}$

There are two different derivations

$\langle expr \rangle$

1 $\text{let } \langle id \rangle = \langle expr \rangle \text{ in } \langle expr \rangle$

1 $\text{let } x = \langle expr \rangle \text{ in } \langle expr \rangle$

1 $\text{let } x = \langle dig \rangle \text{ in } \langle expr \rangle$

1 $\text{let } x = 5 \text{ in } \langle expr \rangle$

1 $\text{let } x = 5 \text{ in begin } \langle expr \rangle \text{ end}$

1 $\text{let } x = 5 \text{ in begin } x ; \langle expr \rangle \text{ end}$

1 $\text{let } x = 5 \text{ in begin } x ; x \text{ end}$

$\langle expr \rangle$

1 $\text{let } \langle id \rangle = \langle expr \rangle \text{ in } \langle expr \rangle$

1 $\text{let } x = \langle expr \rangle \text{ in } \langle expr \rangle$

1 $\text{let } x = \langle dig \rangle \text{ in } \langle expr \rangle$

1 $\text{let } x = 5 \text{ in } \langle expr \rangle$

1 $\text{let } x = 5 \text{ in } \langle dig \rangle$

1 $\text{let } x = 5 \text{ in } x$

There are two different ways to derive the same strings, displaying ambiguity.

2. $\langle id \rangle ::= a | b | c | \dots | z$

$\langle dig \rangle ::= 0 | 1 | 2 | \dots | 9$

$\langle expr \rangle ::= \langle term \rangle | \langle let \rangle$

$\langle term \rangle ::= () | \langle dig \rangle | \langle id \rangle | \langle semi \rangle | \langle begin \rangle$

$\langle let \rangle ::= \text{let } \langle id \rangle = \langle expr \rangle \text{ in } \langle term \rangle$

$\langle semi \rangle ::= \langle term \rangle ; \langle term \rangle$

$\langle begin \rangle ::= \text{begin } \langle expr \rangle \text{ end}$

3. $\langle \text{exp}_1 \rangle$

$\langle \text{let} \rangle$

$\text{let } \langle \text{id} \rangle = \langle \text{exp} \rangle \text{ in } \langle \text{term} \rangle$

\downarrow

a

\downarrow

b

\downarrow

$\langle \text{term} \rangle$

\downarrow

$\langle \text{term} \rangle ; \langle \text{term} \rangle$

\downarrow

$\langle \text{id} \rangle$

\downarrow

a

\downarrow

$\langle \text{id} \rangle$

\downarrow

c