BU CS320 Assignment 6: Context Free Grammars

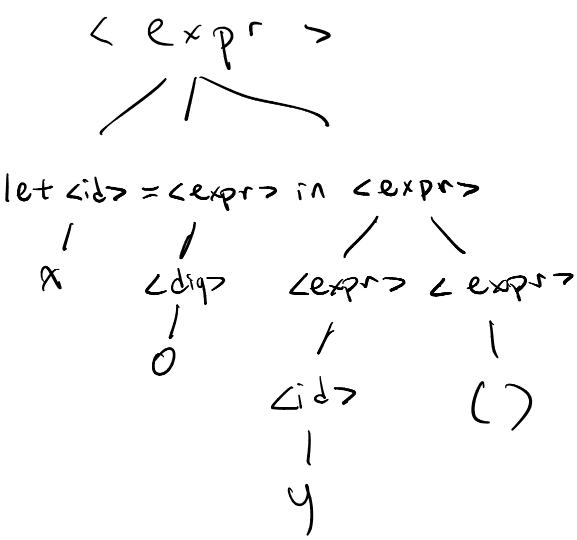
November 6, 2023

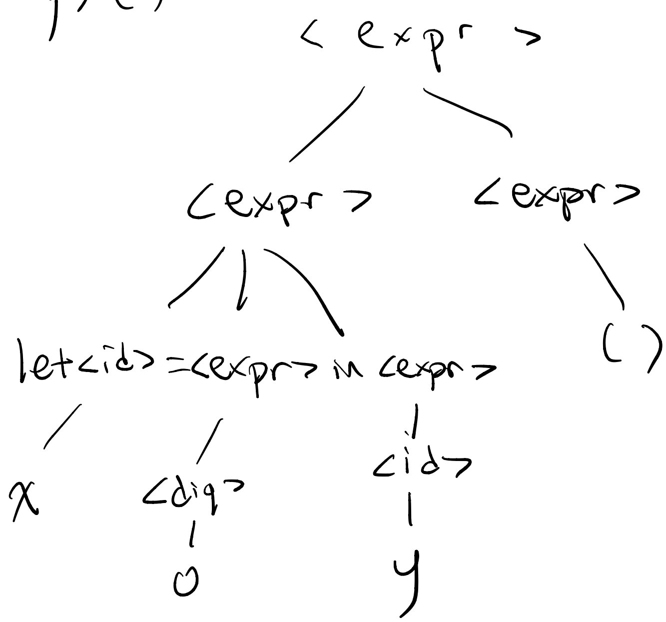
1. Given the following grammar where $\langle expr \rangle$ is the starting symbol:

$$
\begin{array}{lcl}
\langle id \rangle & ::= & \text{a} \mid \text{b} \mid \text{c} \mid \text{...} \mid \text{z} \\[6pt]
\langle dig \rangle & ::= & 0 \mid 1 \mid 2 \mid \text{...} \mid 9 \\[6pt]
\langle expr \rangle & ::= & () \mid \langle dig \rangle \mid \langle id \rangle \\
 & \mid & \text{let } \langle id \rangle = \langle expr \rangle \text{ in } \langle expr \rangle \\
 & \mid & \langle expr \rangle \ ; \langle expr \rangle \\
 & \mid & \text{begin } \langle expr \rangle \text{ end}
\end{array}
$$

Demonstrate the grammar above is ambiguous.

let x = 0 in y;()





2 parse trees to evaluate expression:

let x = 0 in y;()

2. Modify the grammar (reproduced below) to be unambiguous. Hint: There is not just one way.

$$
\begin{aligned}
\langle id \rangle \quad &::= \ \mathrm{a} \mid \mathrm{b} \mid \mathrm{c} \mid ... \mid \mathrm{z} \\
\langle dig \rangle \quad &::= \ 0 \mid 1 \mid 2 \mid ... \mid 9 \\
\langle expr \rangle \quad &::= \ () \mid \langle dig \rangle \mid \langle id \rangle \\
&\quad \mid \ \mathrm{let}\ \langle id \rangle = \langle expr \rangle \ \mathrm{in}\ \langle expr \rangle \\
&\quad \mid \ \langle expr \rangle \ ; \langle expr \rangle \\
&\quad \mid \ \mathrm{begin}\ \langle expr \rangle \ \mathrm{end}
\end{aligned}
$$

<id> ::= a | b | c | ... | z

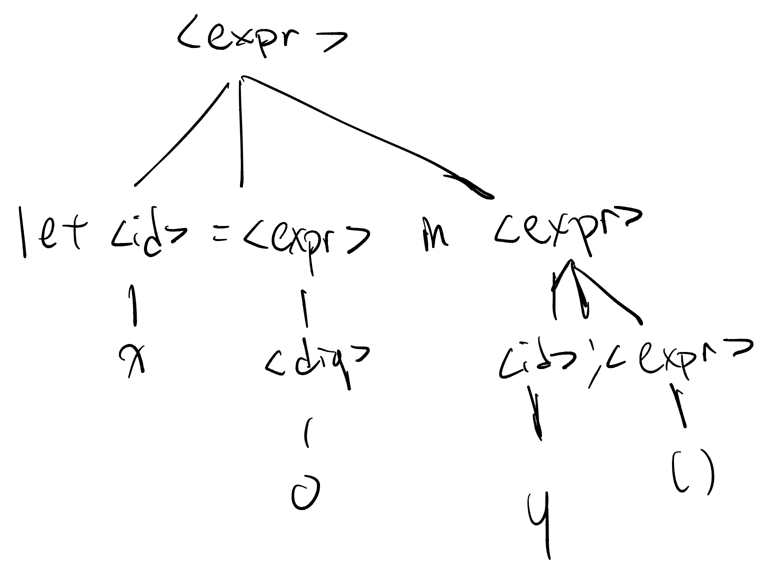
<dig> ::= 0 | 1 | 2 | ... | 9

<expr> ::= ( ) | <dig> | <id>
| let <id> = <expr> in <expr>
| begin <expr> end
| ( ) ; <expr>
| <dig> ; <expr>
| <id> ; <expr>
| begin <expr> end ; <expr>

making the grammar left recursive

3. Demonstrate your modified grammar fixes the previously shown ambiguity.

let x = 0 in y ; ()



Only 1 way to construct the expression

let x = 0 in y ; ()

No more ambiguity.