BU CS320 Assignment 6: Context Free Grammars

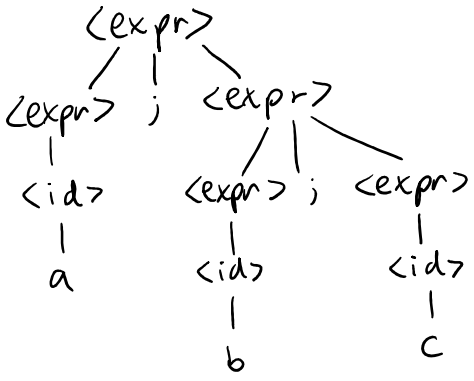
November 6, 2023

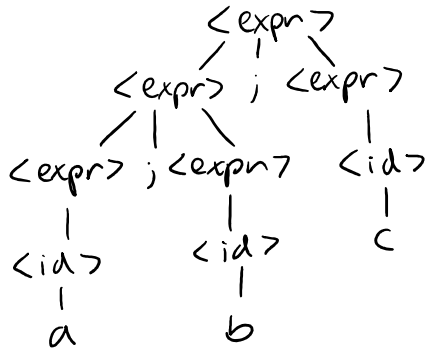
1. Given the following grammar where $\langle expr \rangle$ is the starting symbol:

$$
\begin{array}{lll}
\langle id \rangle & ::= & \text{a} \mid \text{b} \mid \text{c} \mid \ldots \mid \text{z} \\
\langle dig \rangle & ::= & 0 \mid 1 \mid 2 \mid \ldots \mid 9 \\
\langle expr \rangle & ::= & () \mid \langle dig \rangle \mid \langle id \rangle \\
 & \mid & \text{let } \langle id \rangle = \langle expr \rangle \text{ in } \langle expr \rangle \\
 & \mid & \langle expr \rangle \text{ ; } \langle expr \rangle \\
 & \mid & \text{begin } \langle expr \rangle \text{ end}
\end{array}
$$

Demonstrate the grammar above is ambiguous.

a ; b ; c





2 different parse trees for same expression,

so grammar is ambiguous.

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

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

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

$\langle expr \rangle$ ::= () | $\langle dig \rangle$ | $\langle id \rangle$
| let $\langle id \rangle$ = $\langle expr \rangle$ in $\langle expr \rangle$
| $\langle expr \rangle$; $\langle expr \rangle$
| begin $\langle expr \rangle$ end

```
<id> ::= a | b | c | … | z

<dig> ::= 0 | 1 | 2 | … | 9

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

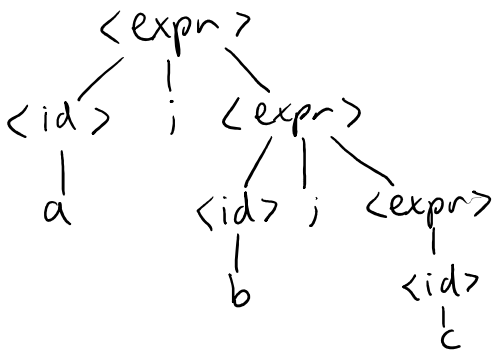
3. Demonstrate your modified grammar fixes the previously shown ambiguity.

```
<id> ::= a | b | c | … | z

<dig> ::= 0 | 1 | 2 | … | 9

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

a ; b ; c



only 1 possible parse tree for a ; b ; c, so unambiguous. ✓