Homework 2

1. Chapter 3 #3

We have the following BNF:

$\langle assign \rangle \rightarrow \langle id \rangle = \langle expr \rangle$
$\langle id \rangle \rightarrow$ A | B | C
$\langle expr \rangle \rightarrow \langle expr \rangle * \langle term \rangle \mid \langle term \rangle$
$\langle term \rangle \rightarrow \langle factor \rangle + \langle term \rangle \mid \langle factor \rangle$
$\langle factor \rangle \rightarrow (\langle expr \rangle) \mid \langle id \rangle$

2. Chapter 3 #6(b)

Leftmost derivation:

$\langle assign \rangle \implies \langle id \rangle = \langle expr \rangle$
$\implies$ B = $\langle expr \rangle$
$\implies$ B = $\langle id \rangle$ * $\langle expr \rangle$
$\implies$ B = C * $\langle expr \rangle$
$\implies$ B = C * ($\langle expr \rangle$)
$\implies$ B = C * ($\langle id \rangle$ * $\langle expr \rangle$)
$\implies$ B = C * (A * $\langle expr \rangle$)
$\implies$ B = C * (A * $\langle id \rangle$ + $\langle expr \rangle$)
$\implies$ B = C * (A * C + $\langle id \rangle$)
$\implies$ B = C * (A * C + B)

Parse tree (see figure 1):

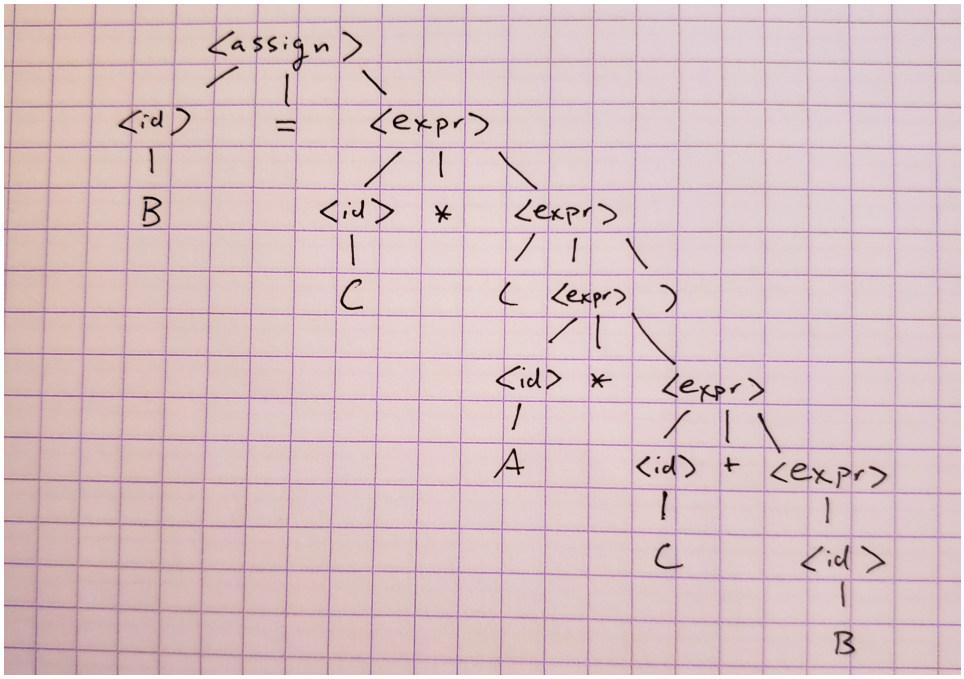

Figure 1: Parse tree for question 2

3. Chapter 3 #7(a)

$\langle assign \rangle \implies \langle id \rangle = \langle expr \rangle$
$\implies$ A = $\langle term \rangle$ * $\langle factor \rangle$
$\implies$ A = $\langle term \rangle$ * $\langle id \rangle$
$\implies$ A = $\langle term \rangle$ * C
$\implies$ A = $\langle factor \rangle$ * C
$\implies$ A = ($\langle expr \rangle$) * C
$\implies$ A = ($\langle expr \rangle$ + $\langle term \rangle$) * C
$\implies$ A = ($\langle expr \rangle$ + $\langle factor \rangle$) * C
$\implies$ A = ($\langle expr \rangle$ + $\langle id \rangle$) * C
$\implies$ A = ($\langle expr \rangle$ + B) * C
$\implies$ A = ($\langle term \rangle$ + B) * C
$\implies$ A = ($\langle factor \rangle$ + B) * C
$\implies$ A = (A + B) * C

Parse tree:

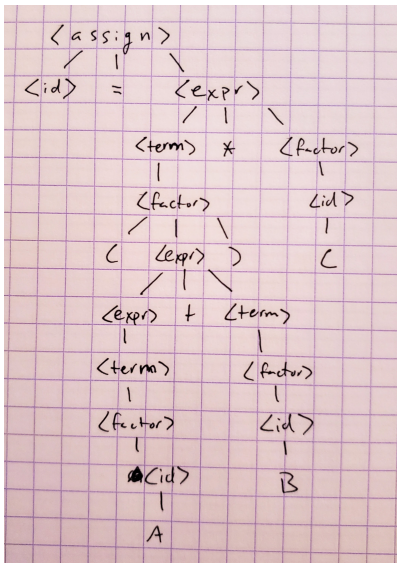

Figure 2: Parse tree for question 3

4. Chapter 3 #11

The strings `baab` and `bbaab` are valid, but `bbbab` and `bbaaaaa` are not.

5. Chapter 3 #15

We have the following EBNF grammar:

⟨*program*⟩ → `begin` ⟨*stmt_list*⟩ `end`
⟨*stmt_list*⟩ → ⟨*stmt*⟩ {; ⟨*stmt_list*⟩}
⟨*stmt*⟩ → ⟨*var* = ¡*expression*⟩
⟨*var*⟩ → A | B | C
⟨*expression*⟩ → ⟨*var*⟩ {(+ | -) ⟨*var*⟩ }

6. Chapter 3 #17

We have the following BNF grammar:

$$\begin{aligned} S &\rightarrow SbA \mid A \\ A &\rightarrow aA \mid abA \end{aligned}$$

7. 23(a and b)

(a)

$$\begin{aligned} &2 * (b-1) - 1 > 0 \\ &2 * (b-1) > 1 \\ &(b-1) > \frac{1}{2} \\ &b > \frac{3}{2} \end{aligned}$$

So the weakest precondition is $b > \frac{3}{2}$

(b)

$$\begin{aligned} &\frac{c+10}{3} > 6 \\ &c + 10 > 18 \\ &c > 8 \end{aligned}$$

So the weakest precondition is $c > 8$.