Homework 2

1. Chapter 3 #3

We have the following BNF:

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

2. Chapter 3 #6(b)

Leftmost derivation:

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

Parse tree:

3. Chapter 3 #7(a)

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

Parse tree:

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 $c > 8$.