1 4F-1 Bookkeeping

- **0 pts** Correct

Exercise 4F-2

I modeled my VC rule for `let` after the implementation of `let` as a few sequential assignments with a temporary variable. I couldn't figure out how to make it work without the fresh variable t, but here's the rule:

$$\mathrm{VC}(\texttt{let}\ x = e\ \texttt{in}\ c, B) = [x/t][e/x]\mathrm{VC}(c, [t/x]B) \quad (t \text{ is fresh})$$

2 4F-2 VCGen for Let

- **0 pts** Correct

Exercise 4F-3

We know that the VC rule for `let` defined in the problem statement of 4F-2 is unsound. To demonstrate this, consider:

$$\begin{aligned} c &:= \texttt{let}\ x = 0\ \texttt{in}\ \texttt{skip} \\ B &:= (x = 0) \\ \sigma &:= \{x := 1\} \end{aligned}$$

Based on our known VC rules, we know:

$$\begin{aligned} \mathrm{VC}(c, B) &= \mathrm{VC}(\texttt{let}\ x = 0\ \texttt{in}\ \texttt{skip}, x = 0) \\ &= [0/x]\mathrm{VC}(\texttt{skip}, x = 0) \\ &= [0/x](x = 0) \\ &= (0 = 0) \\ &= \textbf{true} \end{aligned}$$

So, trivially, $\sigma \models \mathrm{VC}(c, B)$. However, $\langle c, \sigma \rangle \Downarrow \sigma$, since the command c will have no effect after setting x to 0, skipping, and setting x back to its original value. And $\sigma \not\models B$. So the rule is unsound.

3 4F-3 VCGen Mistakes

- **0 pts** Correct

Exercise 4F-4

Frankly, `do` c `while` b is the same as c; `while` b `do` c. This inspired my Hoare rule for `do` c `while` b:

$$\frac{\vdash \{A\}\ c\ \{B\} \quad \vdash \{B \wedge b\}\ c\ \{B\}}{\vdash \{A\}\ \texttt{do}\ c\ \texttt{while}\ b\ \{B \wedge \neg b\}}$$

4 4F-4 Axiomatic Do-While

- **0 pts** Correct