1 5F-1 Bookkeeping

- **0 pts** Correct

5F-2

I pick the first option.

$$\text{do}_{Inv}\ c\ \text{while}\ b$$

which is equivalent to $c; \text{while}_{Inv}\ b\ \text{do}\ C$

$VC(\text{do}_{Inv}\ c\ \text{while}\ b, B)$

$= VC(c; \text{while}_{Inv}\ b\ \text{do}\ c, B)$

$= VC(c, VC(\text{while}_{Inv}\ b\ \text{do}\ c, B))$

$= VC(c, Inv) \wedge (\forall x_1 .. x_n\ Inv \Rightarrow (b \Rightarrow VC(c, Inv)) \wedge \neg b \Rightarrow B))$

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2 5F-2 VCGen Do-While

- 0 pts Correct

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5F-3.

$$\frac{\vdash \{X \wedge b\}\ c\ \{X\}}{\vdash \{X\}\ \text{while } b \text{ do } c\ \{X\}}\ \text{stark.}$$

1. stark
2. A: $n<2$
3. B: $n\le 0$
4. σ. $\sigma(n)=1$
5. σ': $\sigma'(n)=0$
6. c: while $n>0$ do $n:=n-1$
7. $\langle c,\sigma\rangle \Downarrow \sigma'$: $n=0$ after $n:=n-1$ then jump out of while loop
8. $\sigma \models A$: $\sigma \models n<2$
9. $\sigma' \models B$: $\sigma' \models n\le 0$
10. It's not possible to prove $\{n<2\}$ while $n>0$ do $n:=n-1$ $\{n\le 0\}$ using stark rule.

According to stark rule: $\vdash \{X\}$ while b do c $\{X\}$

but there is no X satisfies the $\{A\}\ c\ \{B\}$ above

$n<2 \Rightarrow X \wedge X \Rightarrow n\le 0$ is unsatisfiable.

$$\frac{\vdash \{X\}\ c\ \{X\}}{\vdash \{X\}\ \text{while } b \text{ do } c\ \{X \wedge \neg b\}}\ \text{targaryen}$$

1. targaryen
2. A: $n\ge 0$
3. B: $n=0$
4. $\sigma(n)=1$
5. $\sigma'(n)=0$
6. c: while $n>0$ do $n:=n-1$
7. $\langle c,\sigma\rangle \Downarrow \sigma'$ $n=0$ after $n:=n-1$ then jump out of while loop
8. $\sigma \models n\ge 0$
9. $\sigma' \models n=0$
10. It is not possible to prove $\vdash \{n\ge 0\}$ while $n>0$ do $n:=n-1$ $\{n=0\}$

X should satisfy: $\{X\}\ n:=n-1\ \{X\}$ ①

$n\ge 0 \Rightarrow X$ ②

$X \wedge \neg(n>0) \Rightarrow n=0$ ③

from ③, we get a constrain: $X \Rightarrow n\ge 0$ $\left(\begin{array}{l} X\wedge n\le 0 \Rightarrow n=0 \\ \equiv \neg X \vee n>0 \vee n=0 \\ \equiv X \Rightarrow n\ge 0 \end{array}\right)$

Combined with ②, X must be $n\ge 0$

$\{n\ge 0\}\ n:=n-1\ \{n\ge 0\}$ is wrong.

So, there is no X with this rule can prove $\{A\}\ c\ \{B\}$.

3 5F-3 VCGen Mistakes

- 0 pts Correct