Homework - 4
Group 26

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1.

a. For state σ = {x = α, y = β}, after a single iteration of the loop,
do x ≠ 0 ➞ x := x-1; y := y+1 ☐ x ≠ 0 ➞ x := x-1; y := y+2 od
M(DO,{x = α, y = β}) = {{x = α-1,y = β+1}, {x = α-1,y = β+2}}

b. For the first two iterations,

$\rightarrow^2\langle DO, \sigma'[x \mapsto \alpha-1][i \mapsto \beta+1], \sigma''[x \mapsto \alpha-1][i \mapsto \beta+2]\rangle$

$\rightarrow^3\langle DO, \sigma'[x \mapsto \alpha-2][i \mapsto \beta+2], \sigma''[x \mapsto \alpha-2][i \mapsto \beta+4]\rangle$

Thus, the 4 final states are {x = α-1,y = β+1}, {x = α-1,y = β+2}, {x = α-2,y = β+2}, {x = α-2,y = β+4}.

c. For k iterations where 1<k≤ α will follow the similar pattern to the first two iterations we did.
Thus, Σ′ such that $\langle DO, \sigma \rangle \rightarrow^{*}_{\kappa} \langle DO, \tau \rangle$ iff τ ∈ Σ′ will be
$\rightarrow^{*}_{\kappa}\langle DO, \sigma'[x \mapsto \alpha-k][i \mapsto \beta+k], \sigma''[x \mapsto \alpha-k][i \mapsto \beta+2k]\rangle$
There will be 2 states, one for each condition of the non-deterministic loop which are,
τ={{x = α-k,y = β+k}, {x = α-k,y = β+2k}}

2. If σ ⊨ {p} S {q} and σ ⊭ p, then ⊥ ∈ M(S, σ) **<u>may or may not</u>** occur.
3. If σ ⊨ {p} S {q} and σ ⊭ p, then M(S, σ) - {⊥} ⊨ q **<u>may or may not</u>** occur.
4. If σ ⊨ {p} S {q} and σ ⊨ p, then ⊥ ∈ M(S, σ) **<u>may or may not</u>** occur.
5. If σ ⊨ {p} S {q} and σ ⊨ p, then M(S, σ) - {⊥} ⊨ q **<u>may or may not</u>** occur.
6. If ⊨tot {p} S {q} then ⊨tot {p} S {T} **<u>must</u>** occur.
7. If ⊨tot {p} S {T} then ⊨tot {p} S {q} **<u>may or may not</u>** occur.
8. If σ ⊭ {p} S {q} and S is deterministic, then σ ⊨ p and ⊥ ∉ M(S, σ) and M(S, σ) ⊨ ¬q **<u>must</u>** occur.
9. If ⊥ ∉ M(S, σ), M(S, σ) ⊭ q, and S is deterministic, then M(S, σ) ⊨ ¬q **<u>must</u>** occur.

10. If $\perp \notin M(S, \sigma)$, $M(S, \sigma) \nvDash q$, and S is nondeterministic, then $M(S, \sigma) \vDash \neg q$ **may or may** not occur.
11. If $M(S, \sigma) \nvDash q$, $\tau \in M(S, \sigma)$, and S is nondeterministic, then $\tau \vDash q$ **may or may not** occur.
12. If $\sigma \vDash \{p\}\ S\ \{q\}$, then $\sigma \vDash \{p\}\ S\ \{\neg q\}$ **may or may not** occur.
13. If $\sigma \nvDash_{tot} \{p\}\ S\ \{q\}$ and S is deterministic, then $\sigma \vDash \{p\}\ S\ \{\neg q\}$ **must** occur.
14. If $\sigma \nvDash_{tot} \{p\}\ S\ \{q\}$ and S is nondeterministic, then $\sigma \vDash \{p\}\ S\ \{\neg q\}$ **may or may not** occur.
15. If $\sigma \nvDash \{p\}\ S\ \{q\}$ and S is deterministic, then $\sigma \vDash_{tot} \{p\}\ S\ \{\neg q\}$ **must** occur.
16. If $\sigma \nvDash \{p\}\ S\ \{q\}$ and S is non-deterministic, then $\sigma \vDash_{tot} \{p\}\ S\ \{\neg q\}$ **may or may not** occur.