

**Problem #3a:**

$\text{In}(x,y) \wedge \text{Dirt}(x,y) \rightarrow \text{Do}(\text{Suck})$

$\text{In}(x,y) \wedge \neg \text{Dirt}(x,y) \wedge \text{WorldSize}(w,h) \wedge y \neq (h-1) \wedge \text{Even}(x) \wedge \text{Facing}(\text{North}) \rightarrow \text{Do}(\text{Forward})$

$\text{In}(x,y) \wedge \neg \text{Dirt}(x,y) \wedge \text{WorldSize}(w,h) \wedge y \neq (h-1) \wedge \text{Even}(x) \wedge \text{Facing}(\text{North}) \rightarrow \text{Do}(\text{Turn})$

$\text{In}(x,y) \wedge \neg \text{Dirt}(x,y) \wedge \text{WorldSize}(w,h) \wedge y \neq (h-1) \wedge x < (w-1) \wedge \text{Even}(x) \wedge \text{Facing}(\text{East}) \rightarrow \text{Do}(\text{Forward})$

$\text{In}(x,y) \wedge \neg \text{Dirt}(x,y) \wedge \text{WorldSize}(w,h) \wedge y \neq (h-1) \wedge \text{Odd}(x) \wedge \text{Facing}(\text{East}) \rightarrow \text{Do}(\text{Turn})$

$\text{In}(x,y) \wedge \neg \text{Dirt}(x,y) \wedge y > 0 \wedge \text{Odd}(x) \wedge \text{Facing}(\text{South}) \rightarrow \text{Do}(\text{Forward})$

$\text{In}(x,y) \wedge \neg \text{Dirt}(x,y) \wedge y = 0 \wedge \text{Odd}(x) \wedge \neg \text{Facing}(\text{East}) \rightarrow \text{Do}(\text{Turn})$

$\text{In}(x,y) \wedge \neg \text{Dirt}(x,y) \wedge y = 0 \wedge \text{WorldSize}(w,h) \wedge x < (w-1) \wedge \text{Odd}(x) \wedge \text{Facing}(\text{East}) \rightarrow \text{Do}(\text{Forward})$

$\text{In}(x,y) \wedge \neg \text{Dirt}(x,y) \wedge y = 0 \wedge \neg \text{Facing}(\text{North}) \rightarrow \text{Do}(\text{Turn})$

**Problem #3b:**

**i)**

*Precondition axiom:*

$$\text{Poss(Forward,s)} \Leftrightarrow \text{In(x,y,s)} \wedge [(\text{Facing(North,s)} \wedge (y < 2)) \vee (\text{Facing(South,s)} \wedge (y > 0)) \vee (\text{Facing(East,s)} \wedge (x < 2)) \vee (\text{Facing(West,s)} \wedge (x > 0))]$$

*Effect axiom:*

$$\begin{aligned} \text{Poss(Forward,s)} \Rightarrow & [[\text{In(x,y,s)} \wedge \text{Facing(North,s)} \Rightarrow \text{In(x,y+1,Do(Forward,s))}] \wedge \\ & [\text{In(x,y,s)} \wedge \text{Facing(South,s)} \Rightarrow \text{In(x,y-1,Do(Forward,s))}] \wedge \\ & [\text{In(x,y,s)} \wedge \text{Facing(East,s)} \Rightarrow \text{In(x+1,y,Do(Forward,s))}] \wedge \\ & [\text{In(x,y,s)} \wedge \text{Facing(West,s)} \Rightarrow \text{In(x-1,y,Do(Forward,s))}]] \end{aligned}$$

**ii)**

$$\begin{aligned} \text{Poss(act,s)} \Rightarrow & [\text{Facing(d,do(act,s))} \Leftrightarrow (\text{Facing(d,s)} \wedge \text{act} \neq \text{Turn}) \vee \\ & (\text{d} = \text{East} \wedge \text{Facing(North,s)} \wedge \text{act} = \text{Turn}) \vee \\ & (\text{d} = \text{South} \wedge \text{Facing(East,s)} \wedge \text{act} = \text{Turn}) \vee \\ & (\text{d} = \text{West} \wedge \text{Facing(South,s)} \wedge \text{act} = \text{Turn}) \vee \\ & (\text{d} = \text{North} \wedge \text{Facing(West,s)} \wedge \text{act} = \text{Turn})] \end{aligned}$$