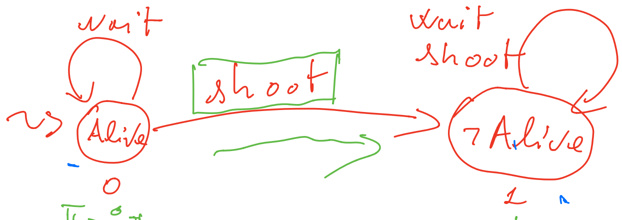


Acts: wait, shoot

Fluents: Alive

Very simple planning domain (deterministic)

CTL

Planning in deterministic domains

$E\,F\,\neg Alive$

$lfp\ Z \equiv \neg Alive \vee EX\,Z$

$[\![Z_0]\!] = \emptyset$

$[\![Z_1]\!] = [\![\neg Alive]\!] \cup Pre_E(Z_0)$

$\{1\} \cup \emptyset = \{1\}$

$[\![Z_2]\!] = [\![\neg Alive]\!] \cup Pre_E(Z_1)$

$= lfp \quad \{1\} \cup \{0,1\} = \{0,1\}$

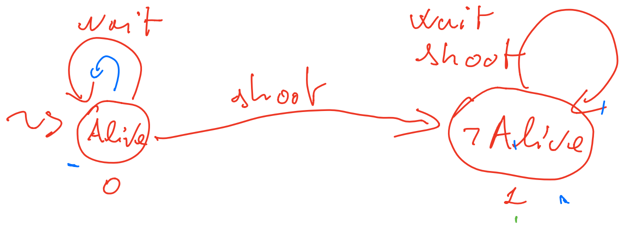
$[\![Z_3]\!] = [\![\neg Alive]\!] \cup Pre_E(Z_2)$

$\{1\} \cup \{0,1\} = \{0,1\}$

$[\![Z_1]\!] = \{1\}$ stage 1

$[\![Z_2]\!] = \{0,1\}$ stage 2

this is our plan!
$\begin{cases} 1: & \text{at goal} \\ 0: & \text{shoot} \end{cases}$



Acts: wait, shoot

Fluents: Alive

Very Simple planning domain

Note this is not planning: we do not have anything (i.e. any plan) to choose.

CTL

$AF \neg Alive$

lfp $Z \equiv \neg Alive \vee AX\, Z$

$[\![Z_0]\!] = \emptyset$

$[\![Z_1]\!] = [\![\neg Alive]\!] \cup Pre_A(Z_0)$

lfp $\{1\} \cup \emptyset = \{1\}$

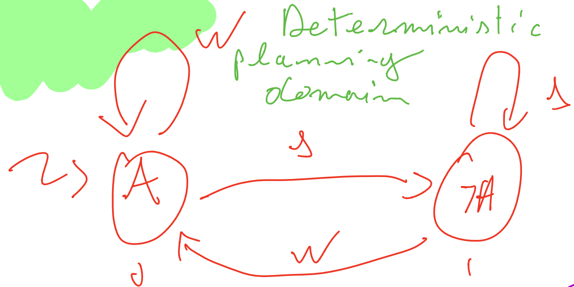
$[\![Z_2]\!] = [\![\neg Alive]\!] \cup Pre_A(Z_1)$

$\{1\} \cup \{1\} = \{1\}$

Note from 0 you cannot make $\boxed{AF \neg Alive}$ true

does not hold in 0 (i.e. the initial state)

Deterministic planning domain



$$\overbrace{E F(\neg Alive \wedge \overbrace{EF\ Alive}^{\alpha})}^{\beta}$$

α : $EF\ Alive$

β : $EF(\neg Alive \wedge \alpha)$

lfp : $Z = Alive \vee EX\ Z$

lfp : $Z = \neg Alive \wedge \alpha \vee EX\ Z$

β : $[\![Z_0]\!] = \emptyset$

$[\![Z_1]\!] = \left(\underbrace{[\![\neg Alive]\!]}_{\{1\}} \cap \underbrace{[\![\alpha]\!]}_{\{0,1\}}\right) \cup Pre_{\exists}(\underbrace{[\![Z_0]\!]}_{\emptyset}) = \{1\}$

$[\![Z_2]\!] = \underbrace{[\![\neg Alive]\!]}_{\{1\}} \cap \underbrace{[\![\alpha]\!]}_{\{0,1\}} \cup \underbrace{Pre_{\exists}([\![Z_1]\!])}_{\{0,1\}} = \{0,1\}$

lfp $\quad \parallel$

$[\![Z_3]\!] = \underbrace{[\![\neg Alive]\!]}_{\{1\}} \cap \underbrace{[\![\alpha]\!]}_{\{0,1\}} \cup \underbrace{Pre_{\exists}([\![Z_2]\!])}_{\{0,1\}} = \{0,1\}$

α : $[\![Z_0]\!] = \emptyset$

$[\![Z_1]\!] = \underbrace{[\![Alive]\!]}_{\{0\}} \cup Pre_{\exists}(\underbrace{[\![Z_0]\!]}_{\emptyset}) = \{0\}$

$[\![Z_2]\!] = \underbrace{[\![Alive]\!]}_{\{0\}} \cup \underbrace{Pre_{\exists}([\![Z_1]\!])}_{\{0,1\}} = \{0,1\}$

lfp $\quad \parallel$

$[\![Z_3]\!] = \underbrace{[\![Alive]\!]}_{\{0\}} \cup \underbrace{Pre_{\exists}([\![Z_2]\!])}_{\{0,1\}} = \{0,1\}$

<u>0, β</u> : <u>shoot</u>

1, β : at α ∧ ¬Alive

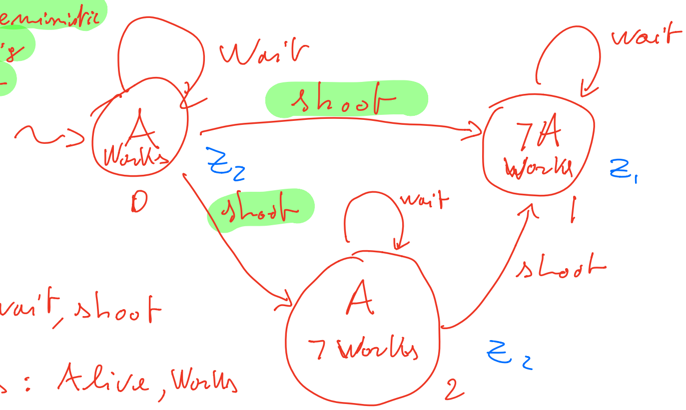
<u>0, α</u> : at the goal (Alive)

1, α : w

0, $\boxed{\beta}$: shoot	plan
1, $\boxed{\beta}$: 1, α : w	requires
0, $\boxed{\alpha}$: at goal	mem!

because we depend on the history not only the last state!

Nondeterministic planning domain



acts: wait, shoot

Fluents: Alive, Works

Goal CTL

EF ¬Alive

Will this goal work for finding a plan to kill the turkey?

lfp

$Z \equiv \neg Alive \vee EX\, Z$

$[\![Z_0]\!] = \emptyset$

$[\![Z_1]\!] = [\![\neg Alive]\!] \cup Pre_E([\![Z_0]\!]) = \{1\} \cup \emptyset = \{1\}$

lfp $[\![Z_2]\!] = [\![\neg Alive]\!] \cup Pre_E([\![Z_1]\!]) = \{1\} \cup \{0,1,2\} = \{0,1,2\}$

$\parallel$

$[\![Z_3]\!] = [\![\neg Alive]\!] \cup Pre_E([\![Z_2]\!]) = \{1\} \cup \{0,1,2\} = \{0,1,2\}$

plan

0: shoot
2: shoot
1: at the goal

"Is this plan any good?"

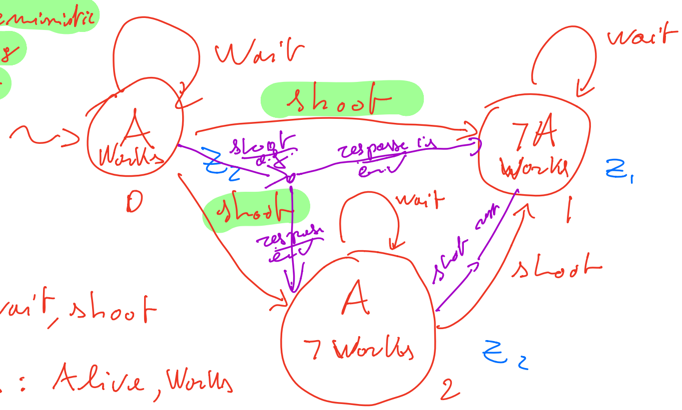
NO!

We do not control the nondeterminism!

(hence we do not control the transitions)

CTL works well for deterministic domain only!

Nondeterministic planning domain



acts: wait, shoot

Fluents: Alive, Works

Goal CTL

EF $\neg Alive$

Will this goal work for finding a plan to kill the turkey?

lfp

$Z \equiv \neg Alive \vee EX\, Z$

$[\![Z_0]\!] = \emptyset$

$[\![Z_1]\!] = [\![\neg Alive]\!] \cup Pre_R([\![Z_0]\!]) = \{1\} \cup \emptyset = \{1\}$

lfp $[\![Z_2]\!] = [\![\neg Alive]\!] \cup Pre_R([\![Z_1]\!]) = \{1\} \cup \{0,1,2\} = \{0,1,2\}$

$\quad\;\; ||$

$[\![Z_3]\!] = [\![\neg Alive]\!] \cup Pre_R([\![Z_2]\!]) = \{1\} \cup \{0,1,2\} = \{0,1,2\}$

plan
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