AI Planning for Autonomy

Problem Set V: Delete Relaxation

1. Discuss in your group the heuristics you used in project 1. Are any of them related to the domain independent heuristics we have covered in class?

- What is the (optimal) delete relaxation heuristic h^+? How would it be interpreted in pacman?
- What is the relationship between h^{max}, h^+, and h^{add}? What about h^*?

2. In a blocks-world problem, the agent's aim is to stack the blocks as in Figure 1.

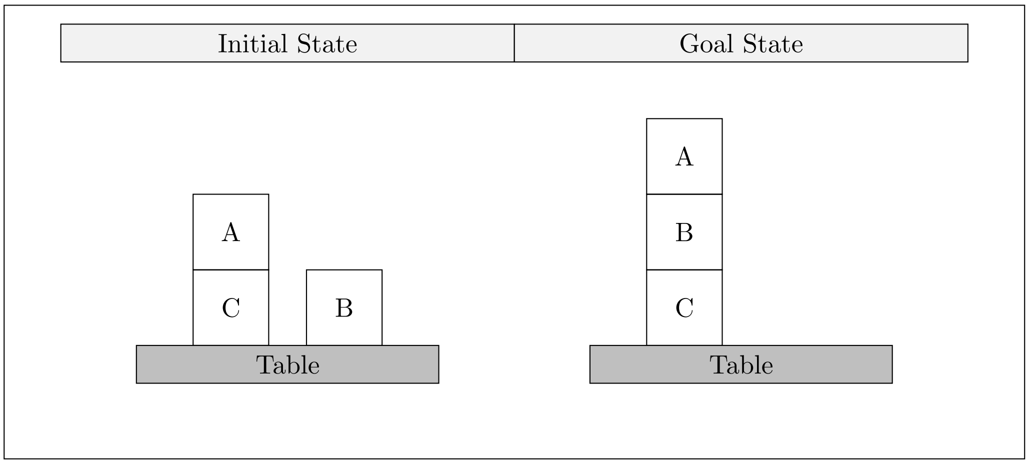


Figure 1: An Initial (Left hand side) and Goal (Right hand side) state of a blocks-world problem.

There are several important classes of domain-independent heuristics. Recall the delete relaxation based heuristics from Lectures:

- Compute $h^{add}(s_0)$ for the 4 operators blocks-world problem.
- Compute $h^{max}(s_0)$ for the 4 operators blocks-world problem.

Delete Relaxation

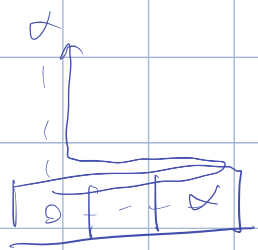
$f = \{at(0,0)\}$

$f = \{at(0,0), at(0,1)\}$

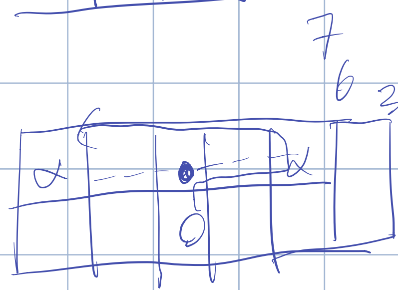
$f = \{at(0,0), at(0,1), at(0,2)\}$

why is this good?

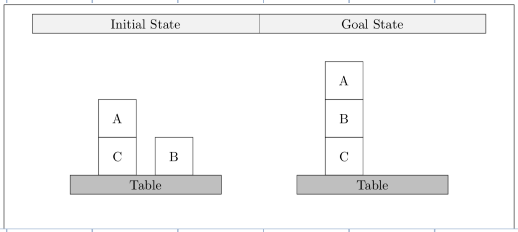
it's more possible to have preconditions in our f, and we can do more actions, have more freedom.



admissible



3+2=5



$G = \{ on(A,B), on(B,C) \}$

$\hookrightarrow stack(A,B) \Rightarrow C(a) = 1$

$\hookrightarrow pre = \{ cl(B), h(A) \}$

$\downarrow$

$unstack(A,C)$

$\downarrow$

$pre = \{ aF, cl(A), on(A,C) \}$

max

$$h^{add}(s,g) = \begin{cases} 0 & g \subseteq s \\ \min\limits_{\substack{a \in A \\ g \in add_a}} c(a) + h^{add}(s, pre_a) & |g| = 1 \\ \sum\limits_{g' \in g} h^{add}(s, g') & |g| > 1 \end{cases}$$

max max max max

g: any state we want it to be true

h^{add} is not admissible, but good

h^{max} is addmissible, but far from h^*

$Init = \{ on(A,C), oT(C), aF, oT(B), cl(A), cl(B) \}$

$G = \{ on(A,B), on(B,C) \}$

h^{add}:

i	cl(A)	cl(B)	cl(C)	oT(A)	oT(B)	oT(C)	on(A,C)	on(A,B)	on(B,C)	h(A)	h(B)	h(C)	aF
0	0	0	∞	∞	0	0	0	∞	∞	∞	∞	∞	0
1	0	0	1	∞	0	0	0	∞	∞	1	1	∞ ?	0
2	0	0	1	2	0	0	0	2	3	1	1	2	0

cl(C)
还是∞