University of Basel

Compilability between Generalized Representations for Classical Planning

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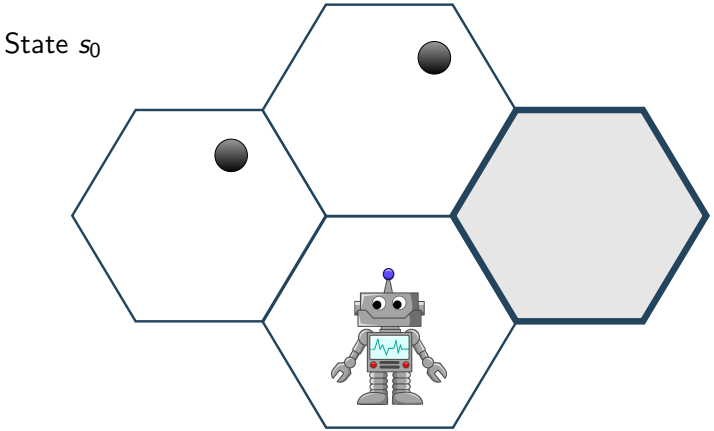
Classical Planning



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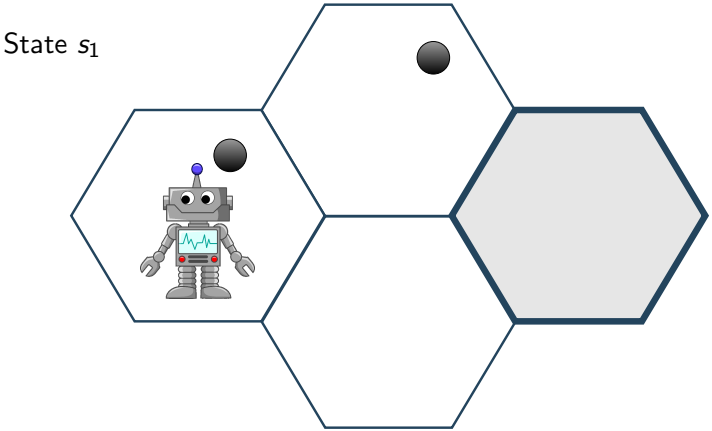
Classical Planning



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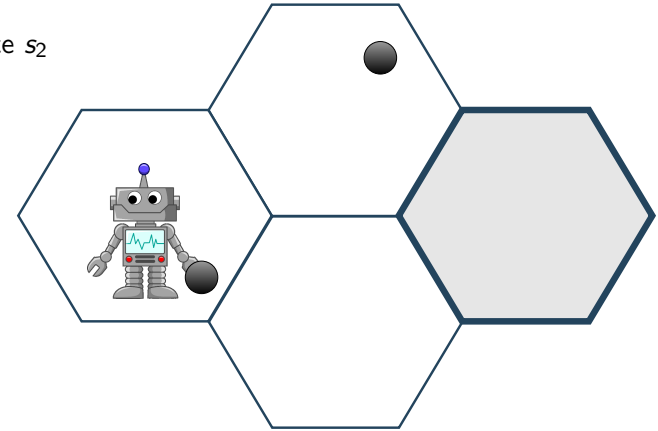
Classical Planning

State s_2



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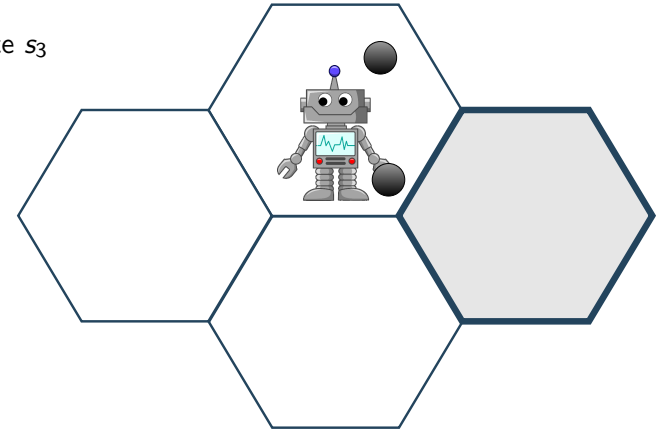
Classical Planning

State s_3



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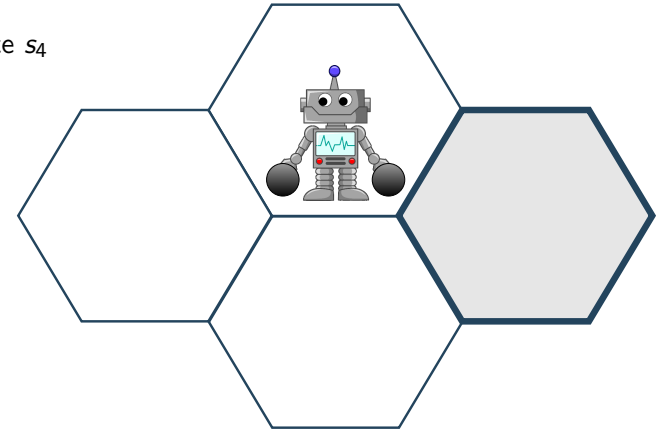
Classical Planning

State s_4



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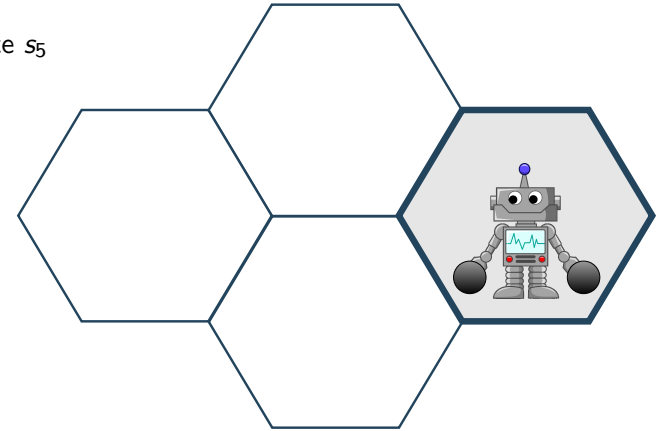
Classical Planning

State s_5



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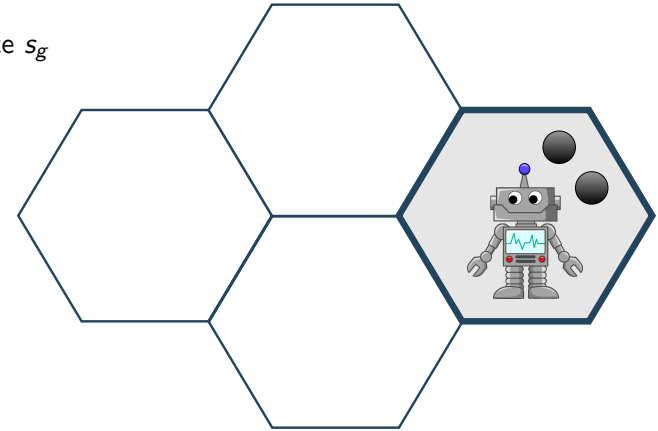
Classical Planning

State s_g



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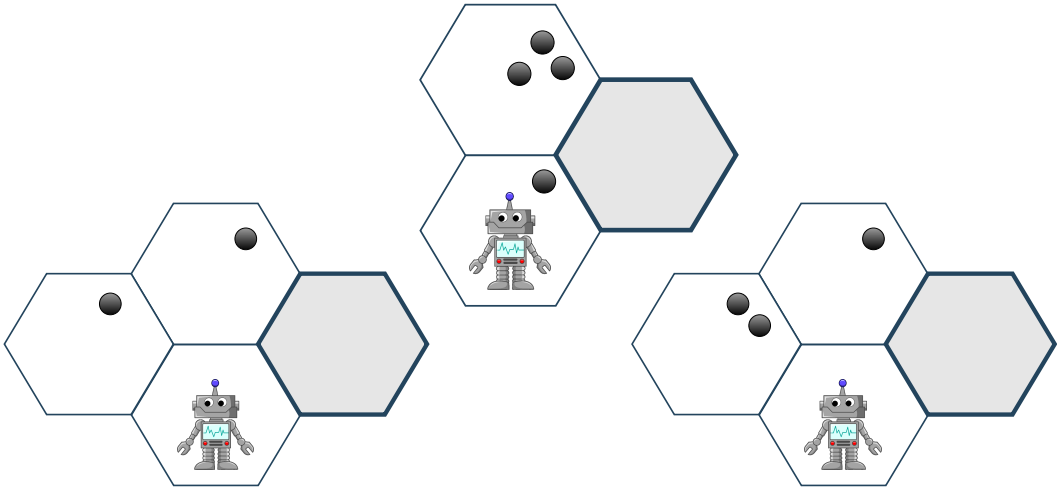
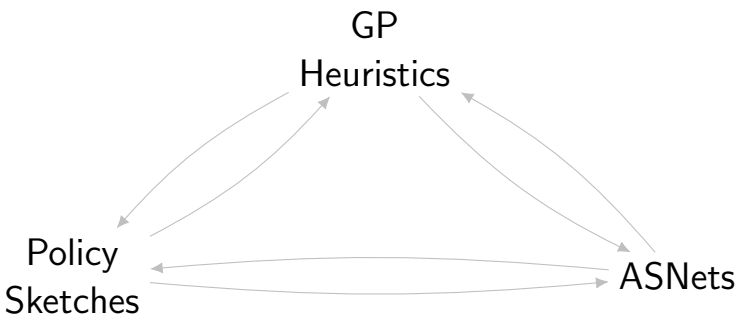
Generalized Planning



Overview



Generalized Potential Heuristics

Features
$f_i : S \to \mathbb{Z}$

Weights
$w_i : \mathcal{F} \to \mathbb{R}$

f_1 number of balls in target room
f_2 number of carried balls

$w_1 = -10$
$w_2 = -1$

Generalized Potential Heuristics

Features $f_i : S \to \mathbb{Z}$

Weights $w_i : \mathcal{F} \to \mathbb{R}$

GP Heuristic

$h^{GP}(s) = \sum_i w_i \cdot f_i(s)$

f_1 number of balls in target room

f_2 number of carried balls

$w_1 = -10$

$w_2 = -1$

$h^{GP}(s) = -10 \cdot f_1(s) - f_2(s)$

Policy Sketches

Features	Conditions	Effects
$n : S \to \mathbb{N}$	$n = 0, n > 0$	$n\downarrow, n\uparrow, n?$
$p : S \to \{\bot, \top\}$	$p, \neg p$	$p, \neg p, p?$

n number of balls in target room

p robot carries a ball?

Policy Sketches

Features	Conditions	Effects
$n : S \to \mathbb{N}$	$n = 0, n > 0$	$n\downarrow, n\uparrow, n?$
$p : S \to \{\bot, \top\}$	$p, \neg p$	$p, \neg p, p?$

Sketch Rules

$r_i = \{conditions\} \to \{effects\}$

Policy Sketch

$R = \{r_1, r_2, ...\}$

n number of balls in target room

p robot carries a ball?

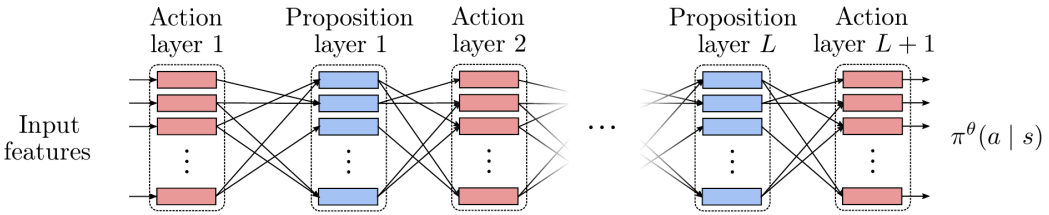
$r_1 = \{\neg p\} \to \{p\}$

$r_2 = \{p\} \to \{p?, n\uparrow\}$

Policy Sketch

$R = \{r_1, r_2\}$

Action Schema Networks



Sam Toyer, Sylvie Thiébaux, Felipe Trevizan, and Lexing Xie. Asnets: Deep learning for generalised planning. Journal of Artificial Intelligence Research, 68:1–68, 2020.

Subgoals

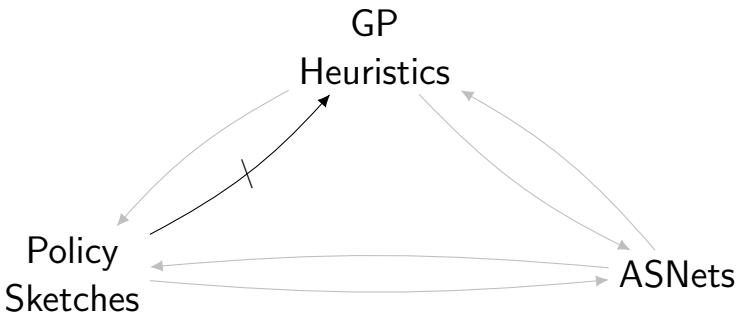
Given a state s

Generalized Potential Heuristics:
All states s' with $h^{GP}(s) > h^{GP}(s')$ are subgoals of s

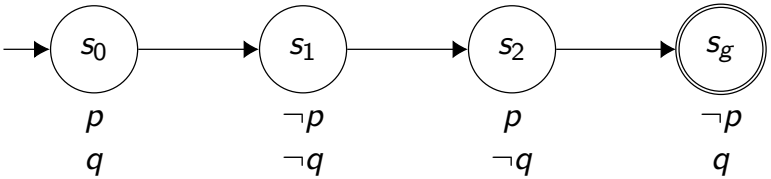
Policy Sketches:
For all sketch rules r_i applicable to s,
all s' satisfying the effects of the r_i are subgoals of s

Action Schema Networks:
All successors s' chosen by π are subgoals of s

Overview



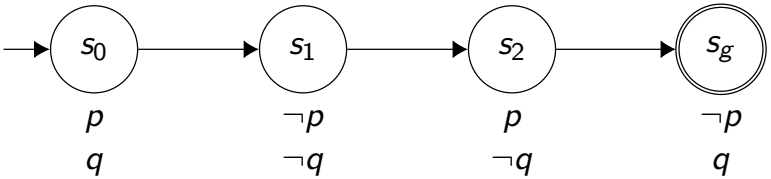
Policy Sketches into GP Heuristics



Features

p, q

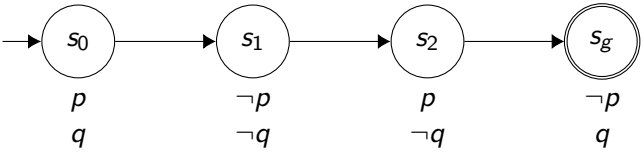
Policy Sketches into GP Heuristics



Features	Sketch Rules	Sketch
p, q	$r_1 = \{p, q\} \rightarrow \{\neg p, \neg q\}$	$R = \{r_1, r_2\}$
	$r_2 = \{\neg p, \neg q\} \rightarrow \{p\}$	

Policy Sketches into GP Heuristics

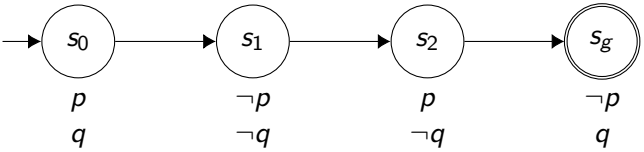
s_1 is subgoal of s_0,
s_2 is subgoal of s_1



Features	Weights	GP Heuristic
$f_i = ?$	$w_i = ?$	$h^{GP}(s) = ?$

Policy Sketches into GP Heuristics

s_1 is subgoal of s_0,
s_2 is subgoal of s_1



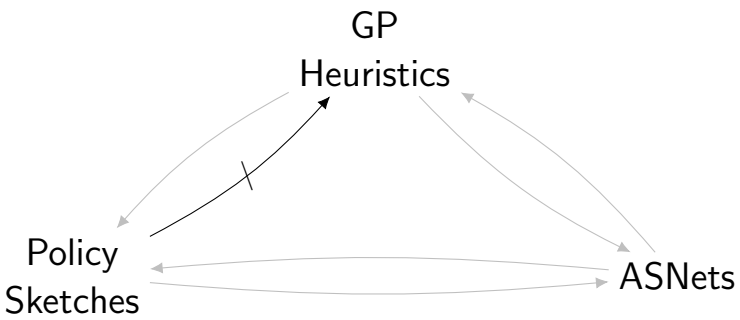
$h^{GP}(s_0) > h^{GP}(s_1)$
$h^{GP}(s_1) > h^{GP}(s_2)$

Features
$f_i = ?$

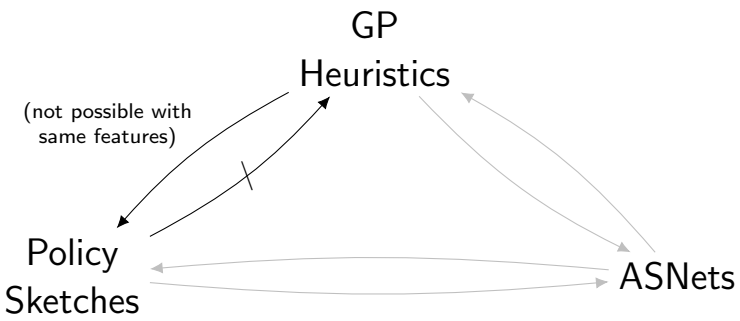
Weights
$w_i = ?$

GP Heuristic
$h^{GP}(s) = ?$

Overview



Overview


GP
Heuristics
(not possible with
same features)
Policy
Sketches
ASNets

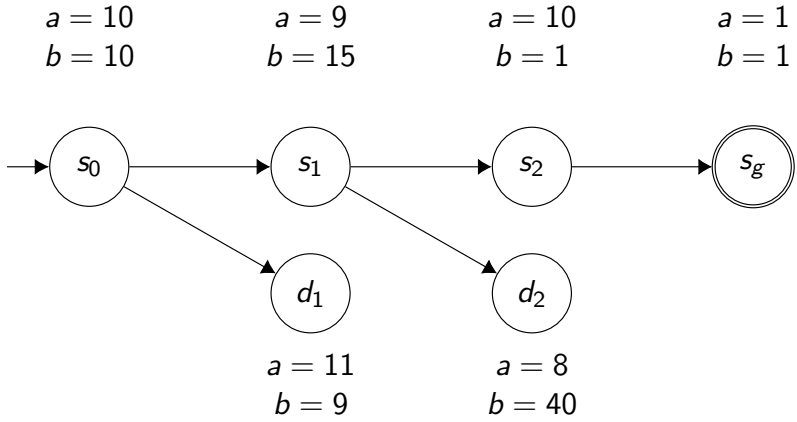
GP Heuristics into Policy Sketches

Generalized Potential Heuristic h^{GP}

Sketch Feature h^{GP}

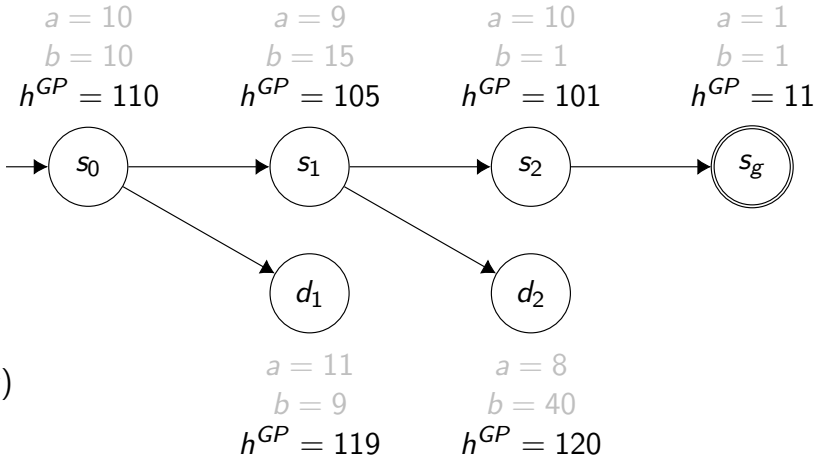
Policy Sketch $R = \{\{\} \rightarrow \{h^{GP}\downarrow\}\}$

GP Heuristics into Policy Sketches (Same Features)



Features a, b

GP Heuristics into Policy Sketches (Same Features)



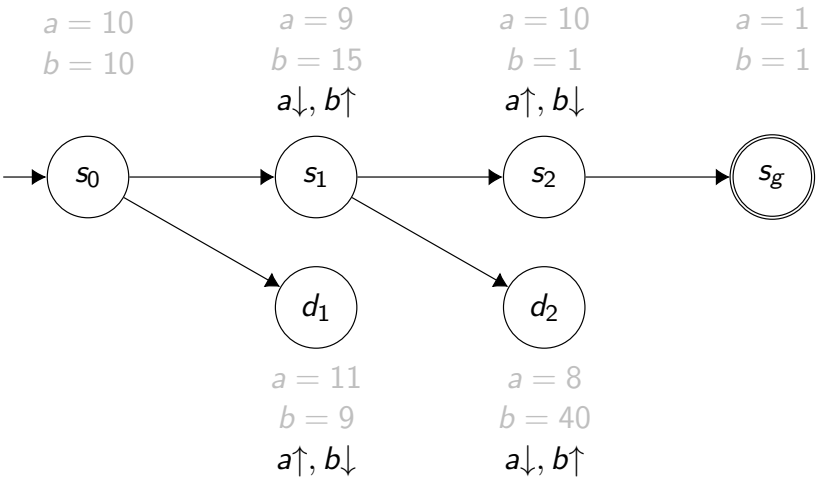
Features a, b

$h^{GP}(s) =$
$10 \cdot a(s) + 1 \cdot b(s)$

GP Heuristics into Policy Sketches (Same Features)

s_{i+1} subgoal of s_i,
d_{i+1} **not** subgoal of s_i

Features a, b



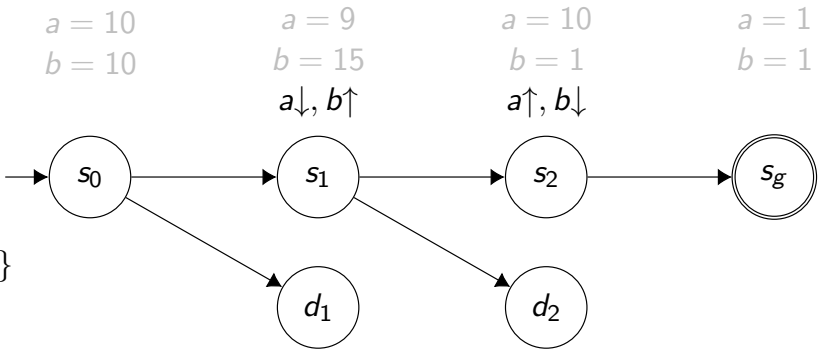
GP Heuristics into Policy Sketches (Same Features)

s_{i+1} subgoal of s_i,
d_{i+1} **not** subgoal of s_i

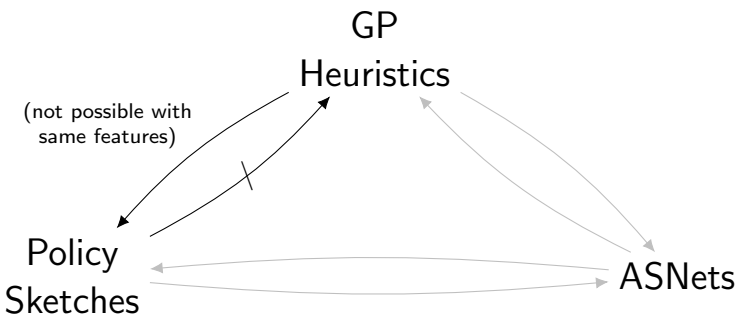
Features a, b

$r_1 = \{\} \rightarrow \{a\downarrow, b\uparrow\}$
$r_2 = ?$

Policy Sketch
$R = \{r_1, r_2, ...\}$



Summary


GP
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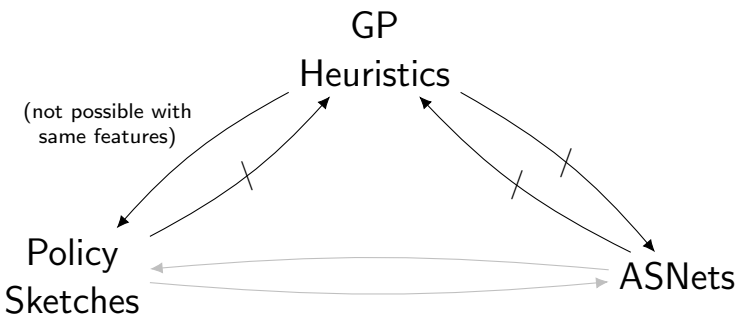
ASNets

Summary


GP
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(not possible with
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ASNets

Questions?

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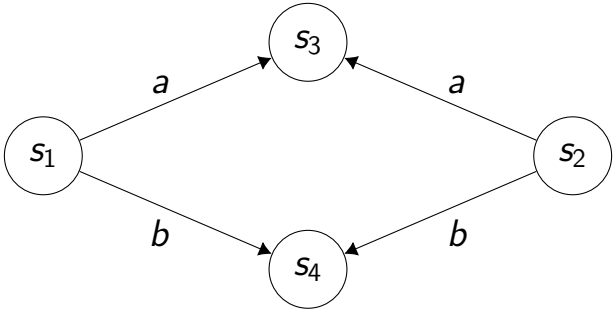
ASNets into GP Heuristics



GP Heuristics into ASNets

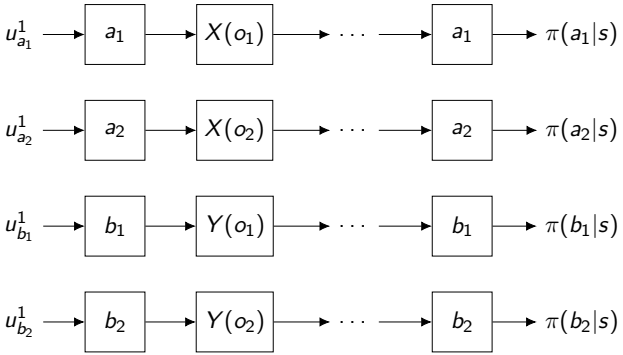
Task P

Propositions:
$X(o_1), X(o_2), Y(o_1), Y(o_2)$

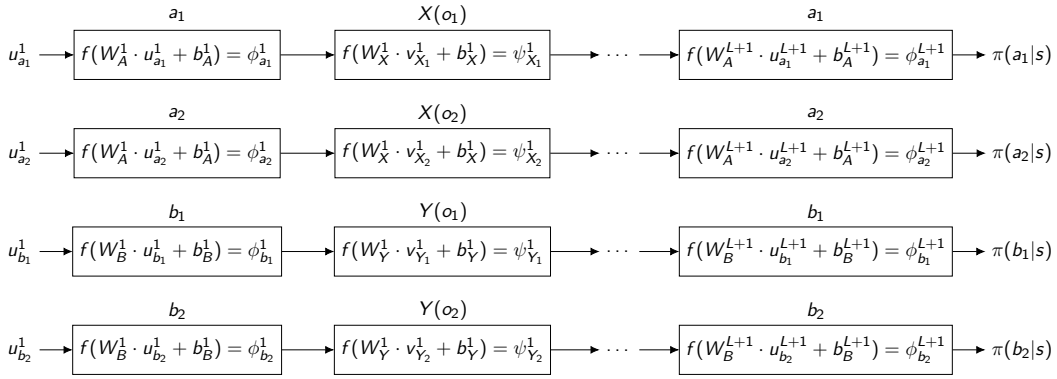
Goal: make all propositions true

Actions: a_1, a_2, b_1, b_2
Each action makes one proposition true

General structure of an ASNet initialized for task P



ASNets into GP Heuristics (Complete ASNet Structure)



General structure of an ASNet initialized for task P with independent subproblems