New Rel (x) $\quad$ Opp, B, Mark

~~mcue~~ (X)

meue abc (x)

walded (x, y)

1) New Rel (Opp)

2) New Rel (B)

3) $\forall x$ New Rel (x) => meue (x)

4) $\forall x$ New Rel (x) => [$\exists y$ meue abc (y) $\land$ walked (y, x)]

5) $\forall x$ [MV(x) => (walked (x, Opp) <=> walded (x, B))]

6) meue abc (Mark)

7) walded (Mark, B)

Th) $\exists x$ MV(x) $\land$ W(x, Op)

$\neg$($\exists x$ MV(x) $\land$ W(x, Op))

$\neg$MV(x) $\lor$ $\neg$W(x, Op) ⑧

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3) $\neg$ New Rel (X) $\lor$ meue (X)

4) $\forall x$ $\exists y$ [New Rel (x) => (meue abc (y) $\land$ walded (y, x)]

$\neg$ New Rel (x) $\lor$ (meue abc (f(x)) $\land$ walked (f(x), x))

$\neg$ New Rel (X) $\lor$ MC (f(x)) ④a

$\neg$ New Rel (x) $\lor$ Walked (f(x), x) ④b

5) [M (x) => [(walked (x, Op) => Walk (x, B)) $\land$ (W(x, B) => W(x, Opp))]]

[$\neg$MV(x) $\lor$ $\neg$W(x, Op) $\lor$ W(x, B)] ⑤a

[$\neg$MV(x) $\lor$ $\neg$W(x, B) $\lor$ W(x, Op)] ⑤b

6 + 8) σ = {x/M} $\quad$ {$\neg$W(M, Op)} ⑨

9 + 5b) σ = {x/M} $\quad$ {$\neg$MV(Mark), $\neg$W(Mark, B)} ⑩

10 e 7) $\quad$ {$\neg$MV(Mark)} ⑪

11 e 6) $\quad$ { }

$S = \langle d_0, d_1, d_2, d_3, d_4, d_5, d_6 \rangle \qquad d_i \in D = \{-1, 0, 1\} \quad i = 0, \dots, 6$

$I = \langle -1, -1, -1, 0, 1, 1, 1 \rangle$

$G = \langle 1, 1, 1, 0, -1, -1, -1 \rangle$

$S^* = \langle d_0^*, d_1^*, d_2^*, d_3^*, d_4^*, d_5^*, d_6^* \rangle$

1) MOVE RIGHT $(\overset{\text{FROM}}{d_i^*}, \overset{\text{TO}}{d_{i+1}^*})$

- PRE: $i < 6$, $d_i^* < 0$, $d_{i+1}^* = 0$
- EFFECT: $d_{i+1}^* \leftarrow d_i^*$
  $d_i^* \leftarrow 0$

2) MOVE LEFT (d_i^*, d_{i-1}^*)

- PRE: $i > 0$, $d_i^* > 0$, $d_{i-1}^* = 0$
- EFFECT: $d_{i-1}^* \leftarrow d_i^*$
  $d_i^* \leftarrow 0$

3) JUMP RIGHT $(\overset{\text{FROM}}{d_i^*}, \overset{\text{OVER}}{d_{i+1}^*}, \overset{\text{TO}}{d_{i+2}^*})$

- PRE: $i < 5$, $d_i^* < 0$, $d_{i+1}^* \neq 0$, $d_{i+2}^* = 0$
- EFFECT: $d_{i+2}^* \leftarrow d_i^*$
  $d_i^* \leftarrow 0$

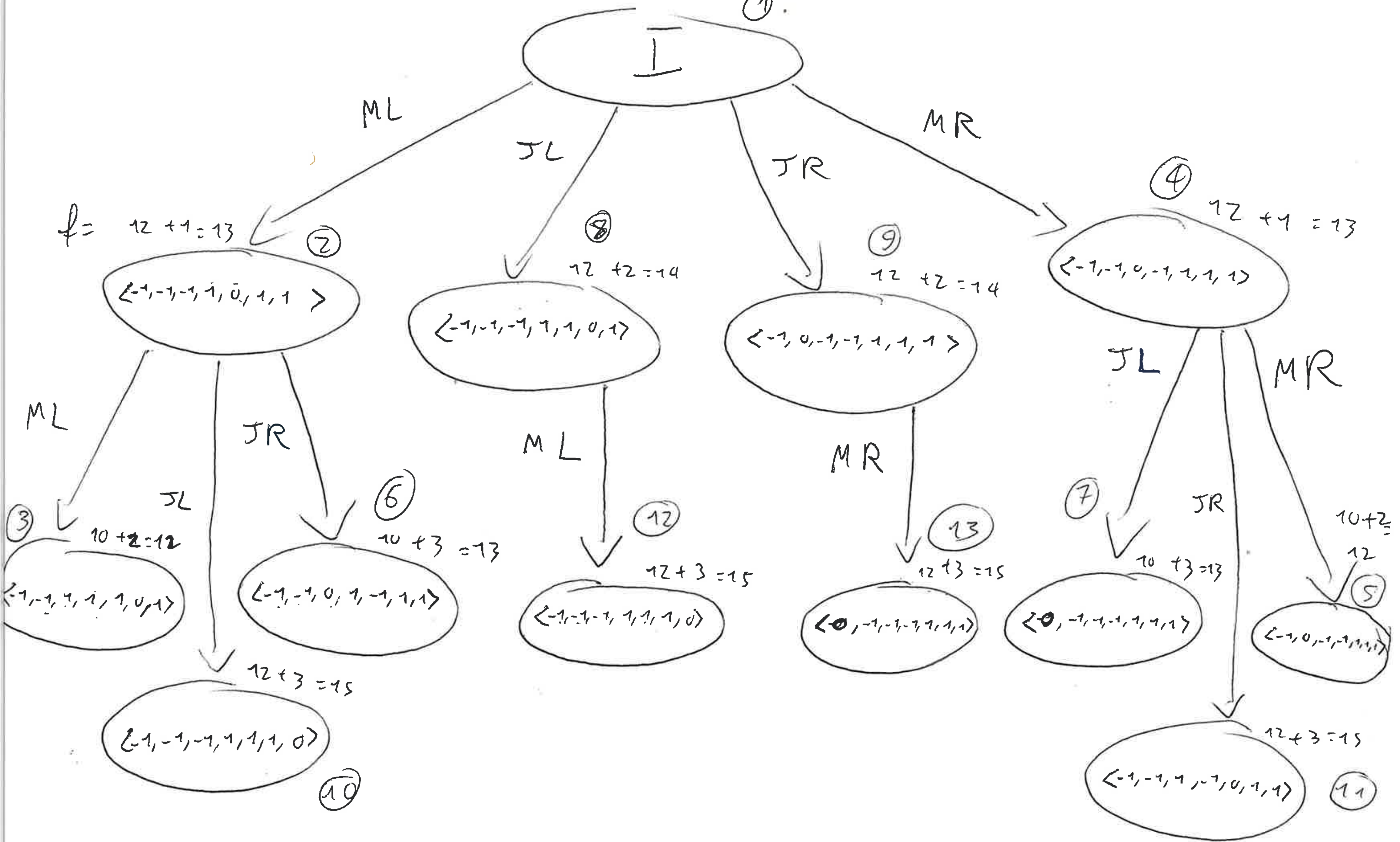
4) JUMPLEFT $(d_i^*, d_{i-1}^*, d_{i-2}^*)$

- PRE: $i > 1$, $d_i^* > 0$, $d_{i-1}^* \neq 0$, $d_{i-2}^* = 0$
- EFFECT: $d_{i-2}^* \leftarrow d_i^*$
  $d_i^* \leftarrow 0$

$$h = |d_0 - 1| + |d_1 - 1| + |d_2 - 1| + |d_4 + 1| + |d_5 + 1| + |d_6 + 1| + |d_3^*|$$

$h(I) = 12$

$h(G) = 0$



1
I
ML
JL
JR
MR
f= 12 +1 = 13
2
<-1,-1,-1,1,0,1,1>
8
12 +2 = 14
<-1,-1,-1,1,1,0,1>
9
12 +2 = 14
<-1,0,-1,-1,1,1,1>
4
12 +1 = 13
<-1,-1,0,-1,1,1,1>
ML
JL
JR
ML
MR
JL
JR
MR
3
10 +2 = 12
<-1,-1,1,1,1,0,1>
6
10 +3 = 13
<-1,-1,0,1,-1,1,1>
12 +3 = 15
<-1,-1,-1,1,1,1,0>
10
12
12 + 3 = 15
<-1,-1,-1,1,1,1,0>
13
12 +3 = 15
<0,-1,-1,-1,1,1,1>
7
10 +3 = 13
<0,-1,-1,-1,1,1,1>
10+2=
12
5
<-1,0,-1,-1,1,1,1>
12 +3 = 15
<-1,-1,1,-1,0,1,1>
11

$f(X, g(Y, a), g(b, Z)) \stackrel{?}{=} f(h(Z), g(a, a), g(b, b))$

$f = f$ ✓

$n = m = 3$ ✓

a) $X \stackrel{?}{=} h(Z)$ b) $g(Y, a) \stackrel{?}{=} g(a, a)$ c) $g(b, Z) \stackrel{?}{=} g(b, b)$

a) $X \stackrel{?}{=} h(Z)$, YES $\sigma = \{X / h(Z)\}$

b) $g(Y, a) \stackrel{?}{=} g(a, a)$

$g = g$ ✓

$n = m = 2$ ✓

d) $Y \stackrel{?}{=} a$ e) $a \stackrel{?}{=} a$

d) $Y \stackrel{?}{=} a$, YES $\sigma = \{Y / a, X / h(Z)\}$

e) $a \stackrel{?}{=} a$ YES

c) $g(b, Z) \stackrel{?}{=} g(b, b)$

$g = g$ ✓

$n = m = 2$ ✓

f) $b \stackrel{?}{=} b$ h) $Z \stackrel{?}{=} b$

f) $b = b$ ✓

h) $Z \stackrel{?}{=} b$ YES

MGU

$$\boxed{\sigma = \{Z / b, Y / a, X / h(b)\}}$$

T^0	i	$p(L_1)$	$p(L_2)$	$p(L_3)$	MF
	0	0	∞	∞	∞

$T_0^1(g)$

$\forall g \subseteq P$

$|g| \le 1$

non tutte le P, solo quelle dell'esercizio

Come è inizializzato?

$$T_0^1(g) = \begin{cases} 0 & \text{if } g \subseteq s \text{ (in initial state)} \\ \infty & \text{o} \sim \end{cases}$$

T^1	i	$p(L_1)$	$p(L_2)$	$p(L_3)$	MF
	1	?			

$$T_1^1(p(L_1)) = Next_0[p(L_1)]$$

$$Next_i(g) = \min\left[Cost_i(g),\ \min_{a \in A,\ regr(g,a) \neq \bot} \left(c(a) + Cost_i(regr(g,a))\right)\right]$$

actions regredibili over g

$$Cost_i(g) = \begin{cases} T_i^{(m)}(g) & |g| \le 1 \\ \max_{g' \subseteq g,\ |g'| = m} T_i^m(g') & |g| > m \end{cases}$$

$$Next_0(p(L_1)) = \min\left[Cost_0(p(L_1)),\ \min_{\dots} \left(c(a) + Cost_0(regr(g,a))\right)\right]$$

$$Cost_0(p(L_1)) = T_0^1(p(L_1)) = 0$$

$\cancel{regr(g,a) = (g \setminus add(a)) \cup pre(a)}$

~~regr(p(L1),~~ (2)

a is regressable over g if: (STRIPS)

- 1) $add_a \cap g \neq \emptyset$
- 2) $del_a \cap g = \emptyset$

$fly(L_2,L_1) \to p(L_1),\ p(L_2)$

$fly(L_3,L_2) \to p(L_2),\ p(L_3)$

$fly(L_1,L_2) \to p(L_2),\ p(L_1)$

$fly(L_2,L_3) \to p(L_3),\ p(L_2)$

$TM \to MF,\ \emptyset$

$a = regr(p(L_1), a)$? $fly(L_1, L_2)$

$c(a) = 1$

$Cost_0(regr(p(L_1), fly(L_2, L_1)))$

~~regr(p(L_1), fly(L_1, L_2))~~

$regr(g, a) = g \setminus add_a \cup pre(a)$

~~regr(g, a)~~ $regr[p(L_1), fly(L_2,L_1)] = \{p(L_1)\} \setminus \{p(L_1)\}$

$\cup\ \{p(L_2)\} = p(L_2)$

$Cost_0(p(L_2)) = \infty$

$Next_0(p(L_1)) = \min[0, 1+\infty] = 0$

$T_1^1(p(L_1)) = 0$

1 ✓ 0 ? ? ?

$$T_1^1(p(L_2)) = Next_0[p(L_2)] = \min\left[\underbrace{Cost_0(p(L_2))}_{+\infty},\ \min_a\left(c(a) + Cost_0(regr(g,a))\right)\right]$$

3

$+\infty$

$regr(p(L_2), a)$? a $\begin{cases} \to fly(L_1, L_2) \\ \to fly(L_3, L_2) \end{cases}$

1) $regr(p(L_2), fly(L_1,L_2)) = p(L_1)$

2) $regr(p(L_2), fly(L_3,L_2)) = p(L_3)$

$$\min\left[(1 + Cost_0(p(L_1))),\ (1 + Cost_0(p(L_3)))\right] = \min(1+0,\ 1+\infty) = 1$$

$$T_1^1\, p(L_2) = Next_0[p(L_2)] = \min(\infty, 1) = 1$$

$\underline{I}$:

1 $\quad\quad$ 0 $\quad\quad$ 1 $\quad\quad$? $\quad\quad$?

$$T_1^1(p(L_3)) = Next_0(p(L_3)) = \min\left[\underbrace{Cost_0(p(L_3))}_{+\infty},\ \min_a\left(c(a) + Cost_0(regr(p(L_3), a))\right)\right]$$

$regr(p(L_3), a)$? $\to a = fly(L_2, L_3)$

$regr(p(L_3), fly(L_2, L_3)) = p(L_2)$

$$T_1^1(p(L_3)) = \min\left[\infty,\ (1 + \infty)\right] = \infty$$

1 $\quad\quad$ 0 $\quad\quad$ 1 $\quad\quad$ $+\infty$ $\quad\quad$?

$$T_1^1(MF) = Next_0(MF) = \min\left[\underbrace{Cost_0(MF)}_{+\infty},\ \min_a\left(c(a) + Cost_0(regr(MF, a))\right)\right]$$ (4)

$regr(MF, a) \rightarrow a = TM$

$regr(MF, TM) = p(L_2) \rightarrow Cost_0(p(L_2)) = +\infty$

$T_1^1(MF) = +\infty$

0	0	∞	∞	∞
1	0	1	∞	∞
2	0	?	?	?

NO NEED TO CHECK AGAIN

$$T_2^1(p(L_2)) = Next_{I_1}(p(L_2)) = \min\left[\underbrace{Cost_1(p(L_2))}_{1},\ \min_a\left(c(a) + Cost_1(regr(p(L_2), a))\right)\right]$$

$a_1 = fly(L_3, L_2) \rightarrow regr(p(L_2), a_1) = p(L_3) \xrightarrow{Cost_1} +\infty$

$a_2 = fly(L_1, L_2) \rightarrow regr(p(L_2), a_2) = p(L_1) \xrightarrow{Cost_1} 0$

$T_2^1(p(L_2)) = \min\left[1, \min(1+\infty, 1+0)\right] = \min[1, 1] = 1$

2	0	1	?	?

$T_2^1(p(L_3)) = Next_1(p(L_3)) = \min\left[Cost_1(p(L_3)), \min_a (c(a), Cost_1(\ldots))\right]$ (5)

$Cost_1(p(L_3)) \downarrow +\infty$

$regre(p(L_3), a)$; $a = fly(L_2, L_3) \Rightarrow regres(p(L_3), fly(L_2, L_3)) = p(L_2)$

(1) $Cost_1(p(L_2)) = 1$

$T_2^1 = \min\left[+\infty, (1+1)\right] = 2$

2 0 1 2 ?

$T_2^1(MF) = Next_1(MF) = \min\left[Cost_1(MF), \min_a (c(a), Cost_1(p(L_2)))\right] =$

$= \min\left[\infty, 1 + 1\right] = 2$

2 0 1 2 2

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3 0 1 ? ?

$T_3^1(p(L_3)) = \min\left[2, (1+1)\right] = 2$

$T_3^1(MF) = \min\left[2, (1+1)\right] = 2$

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i	$p(L_1)$	$p(L_2)$	$p(L_3)$	MF
0	0	∞	∞	∞
1	0	1	∞	∞
2	0	1	2	2
3	0	1	2	2