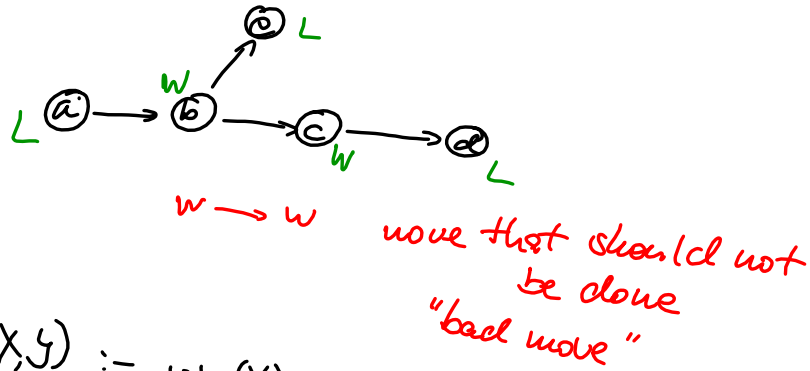


Consider small example



badmove (X, Y) :- win(X), move(X, Y), win(Y).
 2.6/5 lose(X) :- pas(X), not win(X).

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Back to the big wh-move game: WFS

$$I_0 = \emptyset$$

P: P+ms for badmove^(as)
underestimate of true atoms lose(X)

$$I_1 = T_{I_0}^{\omega}(\emptyset)$$

$$P_{I_0} = \{ \dots \}$$

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$P_g = \{ \quad \} \quad \therefore \quad \text{win}(x) := \neg \text{move}(x, y), \text{ not win}(y).$
grand always only when move(x,y) is true

$\text{win}(a) := \neg \text{move}(a, b), \neg \text{win}(b).$	$\text{badmove}(a, b) := \neg \text{win}(a), \text{win}(b).$
$\text{win}(b) := \neg \text{move}(b, c), \neg \text{win}(c).$	\vdots
$\text{win}(c) := \neg \text{move}(c, d), \neg \text{win}(d).$	$\text{lose}(a) := \text{pos}(a), \neg \text{win}(a).$
$\text{win}(d) := \neg \text{move}(d, e), \neg \text{win}(e).$	$\text{lose}(b) := \neg \text{win}(b).$
$\text{win}(e) := \neg \text{move}(e, a), \neg \text{win}(a).$	$\text{lose}(c) := \neg \text{win}(c).$
$\text{win}(f) := \neg \text{move}(f, g), \neg \text{win}(g).$	$\text{lose}(d) := \neg \text{win}(d).$
$\text{win}(g) := \neg \text{move}(g, h), \neg \text{win}(h).$	$\text{lose}(e) := \neg \text{win}(e).$
$\text{win}(h) := \neg \text{move}(h, i), \neg \text{win}(i).$	$\text{lose}(f) := \neg \text{win}(f).$
$\text{win}(i) := \neg \text{move}(i, j), \neg \text{win}(j).$	$\text{lose}(g) := \neg \text{win}(g).$
$\text{win}(j) := \neg \text{move}(j, k), \neg \text{win}(k).$	$\text{lose}(h) := \neg \text{win}(h).$
$\text{win}(k) := \neg \text{move}(k, l), \neg \text{win}(l).$	$\text{lose}(i) := \neg \text{win}(i).$
$\text{win}(l) := \neg \text{move}(l, m), \neg \text{win}(m).$	$\text{lose}(j) := \neg \text{win}(j).$
$\text{win}(m) := \neg \text{move}(m, n), \neg \text{win}(n).$	$\text{lose}(k) := \neg \text{win}(k).$
	$\text{lose}(l) := \neg \text{win}(l).$
	$\text{lose}(m) := \neg \text{win}(m).$
	$\text{lose}(n) := \neg \text{win}(n).$

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$P_{I_0} = \{ \quad \} \quad \therefore \quad \text{win}(x) := \neg \text{move}(x, y), \text{ not win}(y).$
grand always only when move(x,y) is true

$\text{win}(a) := \neg \text{move}(a, b), \neg \text{win}(b).$	$\text{badmove}(a, b) := \neg \text{win}(a), \text{win}(b).$
$\text{win}(b) := \neg \text{move}(b, c), \neg \text{win}(c).$	\vdots
$\text{win}(c) := \neg \text{move}(c, d), \neg \text{win}(d).$	$\text{lose}(a) := \text{pos}(a), \neg \text{win}(a).$
$\text{win}(d) := \neg \text{move}(d, e), \neg \text{win}(e).$	$\text{lose}(b) := \neg \text{win}(b).$
$\text{win}(e) := \neg \text{move}(e, a), \neg \text{win}(a).$	$\text{lose}(c) := \neg \text{win}(c).$
$\text{win}(f) := \neg \text{move}(f, g), \neg \text{win}(g).$	$\text{lose}(d) := \neg \text{win}(d).$
$\text{win}(g) := \neg \text{move}(g, h), \neg \text{win}(h).$	$\text{lose}(e) := \neg \text{win}(e).$
$\text{win}(h) := \neg \text{move}(h, i), \neg \text{win}(i).$	$\text{lose}(f) := \neg \text{win}(f).$
$\text{win}(i) := \neg \text{move}(i, j), \neg \text{win}(j).$	$\text{lose}(g) := \neg \text{win}(g).$
$\text{win}(j) := \neg \text{move}(j, k), \neg \text{win}(k).$	$\text{lose}(h) := \neg \text{win}(h).$
$\text{win}(k) := \neg \text{move}(k, l), \neg \text{win}(l).$	$\text{lose}(i) := \neg \text{win}(i).$
$\text{win}(l) := \neg \text{move}(l, m), \neg \text{win}(m).$	$\text{lose}(j) := \neg \text{win}(j).$
$\text{win}(m) := \neg \text{move}(m, n), \neg \text{win}(n).$	$\text{lose}(k) := \neg \text{win}(k).$
	$\text{lose}(l) := \neg \text{win}(l).$
	$\text{lose}(m) := \neg \text{win}(m).$
	$\text{lose}(n) := \neg \text{win}(n).$

$T_{P_0}^1(\emptyset) = \{ \text{win}(a), \text{win}(b), \text{win}(c), \text{win}(d), \text{win}(e), \text{win}(f), \text{win}(g), \text{win}(h), \text{win}(i), \text{win}(j), \text{win}(k), \text{win}(l), \text{win}(m), \text{win}(n) \}$
note: not win(f), win(j), win(k), win(n) !
bad move rule: always nothing

$T_{P_0}^2(\emptyset) = T_{P_0}^1(\downarrow) = \{ \text{lose}(a), \text{lose}(b), \dots, \text{lose}(n) \}$ *all positions*

$T_{P_0}^3(\emptyset) = T_{P_0}^2(\downarrow) = \{ \text{lose}(a), \text{lose}(b), \dots, \text{lose}(n) \}$ *all positions*
no change $\Rightarrow = T_{P_0}^2(\emptyset)$

\Rightarrow overestimate of the atoms
 $f, j, k, n \notin \text{win}$
 $= I_1$

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$P_I = \{ \dots \}$ \therefore win(x) :- move(x,y), not win(y).
 grand tactics only when move(x,y) is true

fix all negated literals

win(a) :- move(a,b), not win(b).	badmove(a,b) :- move(a,b), win(b).
win(b) :- move(b,c), not win(c).	lose(a) :- pose(a), not win(a).
win(c) :- move(c,d), not win(d).	lose(b) :- not win(b).
win(d) :- move(d,e), not win(e).	lose(c) :- not win(c).
win(e) :- move(e,f), not win(f).	lose(d) :- not win(d).
win(f) :- move(f,g), not win(g).	lose(e) :- not win(e).
win(g) :- move(g,h), not win(h).	lose(f) :- not win(f).
win(h) :- move(h,i), not win(i).	lose(g) :- not win(g).
win(i) :- move(i,j), not win(j).	lose(h) :- not win(h).
win(j) :- move(j,k), not win(k).	lose(i) :- not win(i).
win(k) :- move(k,l), not win(l).	lose(j) :- not win(j).
win(l) :- move(l,m), not win(m).	lose(k) :- not win(k).
win(m) :- move(m,n), not win(n).	lose(l) :- not win(l).
	lose(m) :- not win(m).
	lose(n) :- not win(n).

$T_{P_I}^1(\emptyset) = \{ \text{win(a), win(b), win(i), lose(f), lose(k), lose(n)} \}$
 \therefore bad move does not (yet) deny anything

$T_{P_I}^2(\emptyset) = T_{P_I}^1(\emptyset) = \{ \text{win(a), win(b), win(i), badmove(a,b), lose(f), lose(k), lose(n)} \}$

$= T_{P_I}^3(\emptyset) = I_2$ *next underestimate*

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I_2 : a,b,i win; (f,k,n lost)

$P_I = \{ \dots \}$ \therefore win(x) :- move(x,y), not win(y).
 grand tactics only when move(x,y) is true

win(a) :- move(a,b), not win(b).	badmove(a,b) :- move(a,b), win(b).
win(b) :- move(b,c), not win(c).	lose(a) :- pose(a), not win(a).
win(c) :- move(c,d), not win(d).	lose(b) :- not win(b).
win(d) :- move(d,e), not win(e).	lose(c) :- not win(c).
win(e) :- move(e,f), not win(f).	lose(d) :- not win(d).
win(f) :- move(f,g), not win(g).	lose(e) :- not win(e).
win(g) :- move(g,h), not win(h).	lose(f) :- not win(f).
win(h) :- move(h,i), not win(i).	lose(g) :- not win(g).
win(i) :- move(i,j), not win(j).	lose(h) :- not win(h).
win(j) :- move(j,k), not win(k).	lose(i) :- not win(i).
win(k) :- move(k,l), not win(l).	lose(j) :- not win(j).
win(l) :- move(l,m), not win(m).	lose(k) :- not win(k).
win(m) :- move(m,n), not win(n).	lose(l) :- not win(l).
	lose(m) :- not win(m).
	lose(n) :- not win(n).

$T_{P_I}^1(\emptyset) = \{ \text{win(a), win(b), win(c), win(d), win(e), win(f), win(g), win(h), win(i), win(j), win(k), win(l), win(m), win(n)} \}$
 \therefore bad move: not win

$T_{P_I}^2(\emptyset) = \{ \text{" } \} \cup \{ \text{badmove(a,b)} \}$
 $= T_{P_I}^3(\emptyset) = I_3 = \{ \text{badmove(a,b), (c,d), (f,g), ... } \}$

not in win: (f,k,n)

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win a, b, d, g, h, i, m

$P_{\mathcal{I}_5} = \{ \quad \quad \quad \text{win}(x) :- \text{move}(x,y), \text{not win}(y). \quad \quad \quad \text{ground atoms only when move}(x,y) \text{ is true}$

win(a) :- move(a,b), \negwin(b). win(b) :- move(b,c), \negwin(c). win(c) :- move(c,d), \negwin(d). win(d) :- move(d,e), \negwin(e). win(e) :- move(e,a), \negwin(a). win(f) :- move(f,g), \negwin(g). win(g) :- move(g,h), \negwin(h). win(h) :- move(h,m), \negwin(m). win(i) :- move(i,j), \negwin(j). win(l) :- move(l,d), \negwin(d). win(m) :- move(m,h), \negwin(h).	lose(a) :- post(a), \negwin(a). lose(b) :- \negwin(b). lose(c) :- \negwin(c). lose(d) :- \negwin(d). lose(e) :- \negwin(e). lose(f) :- \negwin(f). lose(g) :- \negwin(g). lose(h) :- \negwin(h). lose(i) :- \negwin(i). lose(l) :- \negwin(l). lose(m) :- \negwin(m). lose(n) :- \negwin(n).
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$\mathcal{I}_6 = \{ \text{win: } a, b, d, g, i \quad \text{lose: } e, f, h, k, m \quad \text{badmove: } \dots \}$

understate

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win : a, b, c, d, i

$P_{\mathcal{I}_6} = \{ \quad \quad \quad \text{win}(x) :- \text{move}(x,y), \text{not win}(y). \quad \quad \quad \text{ground atoms only when move}(x,y) \text{ is true}$

win(a) :- move(a,b), \negwin(b). win(b) :- move(b,c), \negwin(c). win(c) :- move(c,d), \negwin(d). win(d) :- move(d,e), \negwin(e). win(e) :- move(e,a), \negwin(a). win(f) :- move(f,g), \negwin(g). win(g) :- move(g,h), \negwin(h). win(h) :- move(h,m), \negwin(m). win(i) :- move(i,j), \negwin(j). win(l) :- move(l,d), \negwin(d). win(m) :- move(m,h), \negwin(h).	lose(a) :- post(a), \negwin(a). lose(b) :- \negwin(b). lose(c) :- \negwin(c). lose(d) :- \negwin(d). lose(e) :- \negwin(e). lose(f) :- \negwin(f). lose(g) :- \negwin(g). lose(h) :- \negwin(h). lose(i) :- \negwin(i). lose(l) :- \negwin(l). lose(m) :- \negwin(m). lose(n) :- \negwin(n).
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$\mathcal{I}_7 = \{ \text{win: } a, b, c, d, g, h, i, m \quad \text{lose: } e, f, g, j, l, m, k, n, \quad \text{badmove: } \dots \}$

both win and lose : g, h, m

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win: a, b, c, d, g, h, i, m

$I_7 = \{ \dots \}$ / win(x) :- move(x,y), not win(y).
 good ideas only when move(x,y) is true

~~win(a) :- move(a,b), not win(b).~~
~~win(b) :- move(b,c), not win(c).~~
~~win(c) :- move(c,d), not win(d).~~
~~win(d) :- move(d,e), not win(e).~~
~~win(e) :- move(e,a), not win(a).~~
~~win(f) :- move(f,g), not win(g).~~
~~win(g) :- move(g,h), not win(h).~~
~~win(h) :- move(h,i), not win(i).~~
~~win(i) :- move(i,j), not win(j).~~
~~win(j) :- move(j,k), not win(k).~~
~~win(k) :- move(k,l), not win(l).~~
~~win(l) :- move(l,m), not win(m).~~
~~win(m) :- move(m,n), not win(n).~~

bad move(a,d) :- ^{win(a)} move(a,b), win(b)

~~lose(a) :- pass(a), win(a).~~
~~lose(b) :- win(b).~~
~~lose(c) :- not win(c).~~
~~lose(d) :- not win(d).~~
~~lose(e) :- not win(e).~~
~~lose(f) :- not win(f).~~
~~lose(g) :- not win(g).~~
~~lose(h) :- not win(h).~~
~~lose(i) :- not win(i).~~
~~lose(j) :- not win(j).~~
~~lose(k) :- not win(k).~~
~~lose(l) :- not win(l).~~
~~lose(m) :- not win(m).~~
~~lose(n) :- not win(n).~~

$I_8 = \{ \dots \}$ win: a, b, c, d, ~~g, h, i~~, i = win I_6
 lose: e, f, k, l, n = lose I_6
 bad use: ... } = I_6

whether win or lose: g, h, m $\Rightarrow I_8 = I_7$

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