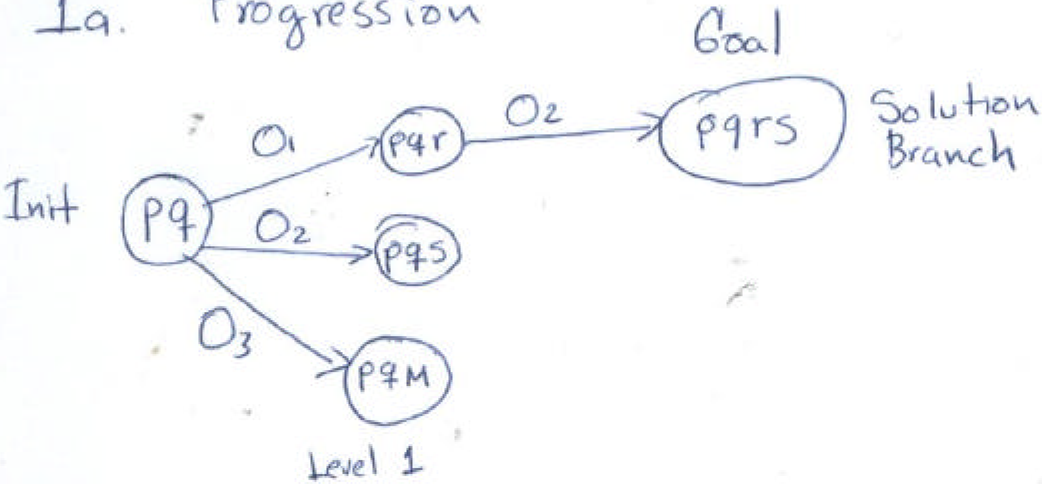
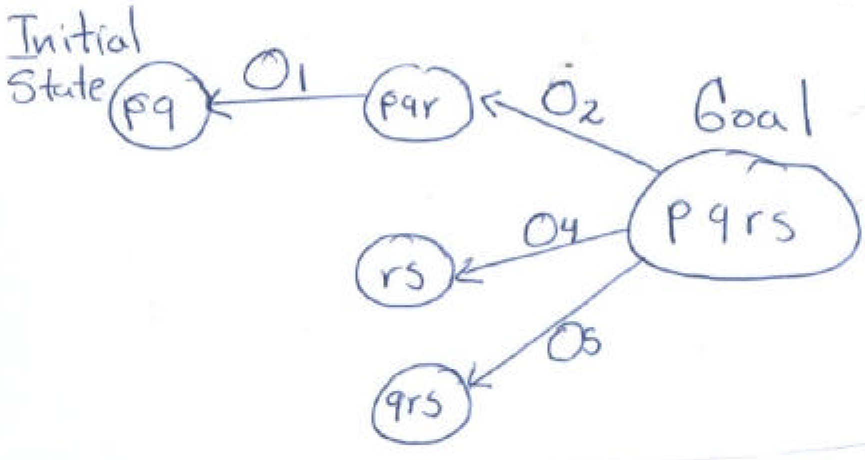
Homework II Solutions

1a. Progression



1b



1c - Set of partial plans to resolve the Flaw "p"

Initial Plan

A_0

P Q

P Q R S

A_∞

O: { $A_0 < A_\infty$ }

OC: { P@A_∞, Q@A_∞, R@A_∞, S@A_∞ }

A: { A_0, A_∞ }

CL: { }

UL = { }

O = Orderings

OC = Open Conditions

A = Actions

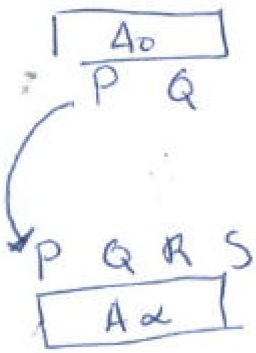
CL = Causal Links

UL = Unsafe Links

1.c (cont).

Set of partial plans resolving "P"

a)



$OC = \{Q@A_\alpha, R@A_\alpha, S@A_\alpha\}$

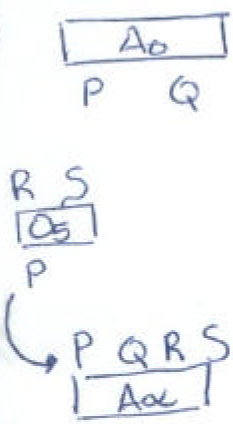
$O = \{A_0 < A_\alpha\}$

$A = \{A_0, A_\alpha\}$

$CL = \{A_0 \xrightarrow{P} A_\alpha\}$

$UL = \{\}$

b)



$OC = \{Q@A_\alpha, R@A_\alpha, S@A_\alpha, R@O_5, S@O_5\}$

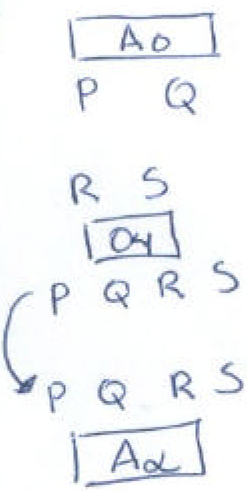
$O = \{O_5 < A_\alpha\}$

$A = \{A_0, O_5, A_\alpha\}$

$CL = \{O_5 \xrightarrow{P} A_\alpha\}$

$UL = \{\}$

c)



$OC = \{Q@A_\alpha, R@A_\alpha, S@A_\alpha, R@O_4, S@O_4\}$

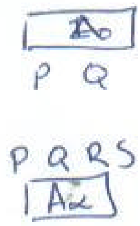
$O = \{O_4 < A_\alpha\}$

$A = \{A_0, O_4, A_\alpha\}$

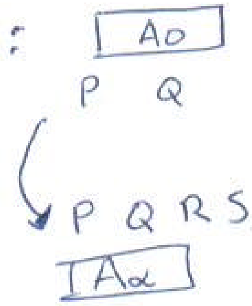
$CL = \{O_4 \xrightarrow{P} A_\alpha\}$

$UL = \{\}$

1c (cont.). Show entire branch.

0: 

(Initial Plan already shown)

1: 

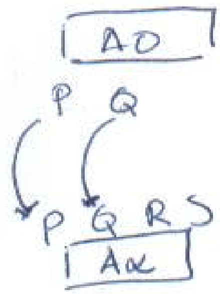
OC = {Q@Aα, R@Aα, S@Aα}

O = {A0 < Aα}

A = {A0, Aα}

CL = {$A0 \xrightarrow{P} A\alpha$}

UL = {}

2: 

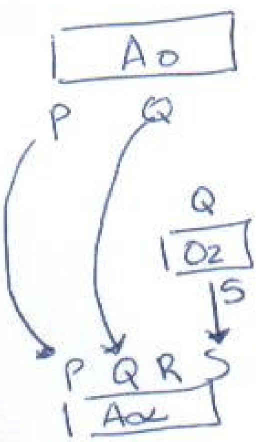
OC = {R@Aα, S@Aα}

O = {A0 < Aα}

A = {A0, Aα}

CL = {$A0 \xrightarrow{P} A\alpha$, $A0 \xrightarrow{Q} A\alpha$}

UL = {}

3: 

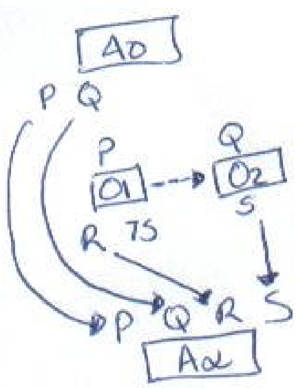
OC = {R@Aα, Q@O2}

O = {A0 < Aα, O2 < Aα}

A = {A0, O2, Aα}

CL = {$A0 \xrightarrow{P} A\alpha$, $A0 \xrightarrow{Q} A\alpha$, $O2 \xrightarrow{S} A\alpha$}

UL = {}

4: 

OC = {P@O1, Q@O2}

O = {A0 < Aα, O2 < Aα, O1 < Aα}

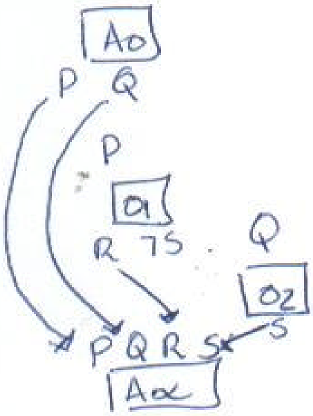
A = {A0, O2, O1, Aα}

CL = {$A0 \xrightarrow{P} A\alpha$, $A0 \xrightarrow{Q} A\alpha$, $O2 \xrightarrow{S} A\alpha$
$O1 \xrightarrow{R} A\alpha$}

UL = {($O2 \xrightarrow{S} A\alpha$; O1}

Next step would be to resolve the threat posting an ordering constraint

5: Solving the unsafe link.



Ordering constraint posted

$OC = \{ P@O_1, Q@O_2 \}$

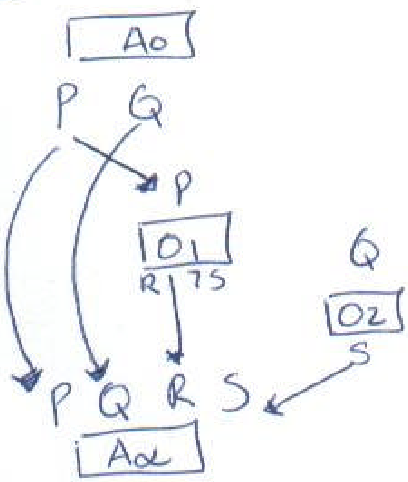
$O = \{ A_0 < A_\alpha, O_2 < A_\alpha, O_1 < O_2 \}$

$A = \{ A_0, O_1, O_2, A_\alpha \}$

$CL = \{ A_0 \xrightarrow{P} A_\alpha, A_0 \xrightarrow{Q} A_\alpha, O_2 \xrightarrow{S} A_\alpha, O_1 \xrightarrow{R} A_\alpha \}$

$UL = \{ \}$

6:



$OC = \{ Q@O_2 \}$

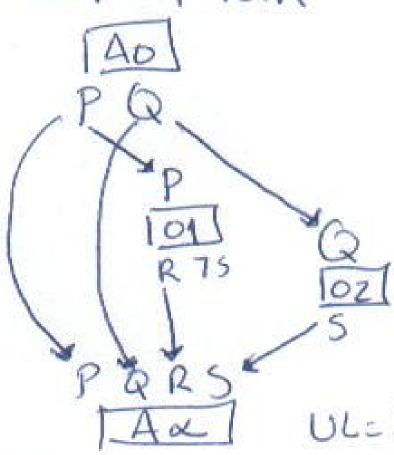
$O = \{ A_0 < A_\alpha, O_2 < A_\alpha, O_1 < O_2, A_0 < O_1 \}$

$A = \{ A_0, O_1, O_2, A_\alpha \}$

$CL = \{ A_0 \xrightarrow{P} A_\alpha, A_0 \xrightarrow{Q} A_\alpha, O_2 \xrightarrow{S} A_\alpha, O_1 \xrightarrow{R} A_\alpha, A_0 \xrightarrow{P} O_1 \}$

$UL = \{ \}$

7 Final Plan



$OC = \{ \}$

$O = \{ A_0 < A_\alpha, O_2 < A_\alpha, O_1 < O_2, A_0 < O_1, A_0 < O_2 \}$

$A = \{ A_0, O_1, O_2, A_\alpha \}$

$CL = \{ A_0 \xrightarrow{P} A_\alpha, A_0 \xrightarrow{Q} A_\alpha, O_2 \xrightarrow{S} A_\alpha, O_1 \xrightarrow{R} A_\alpha, A_0 \xrightarrow{P} O_1, A_0 \xrightarrow{Q} O_2 \}$

$UL = \{ \}$.

O'0	O0	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:					
O'1	O81	PRE:	~P1(a)	P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:	Q(a)				
O'2	O141	PRE:	P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:	Q(a)				
O'9	O33	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:		W(a)			
O'10	O89	PRE:	~P1(a)	P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:	Q(a)	W(a)			
O'11	O149	PRE:	P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:	Q(a)	W(a)			
O'36	O3	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:				~Q(a)	
O'37	O9	PRE:	~P1(a)	~P2(a)	~R(a)	M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:				~Q(a)	
O'42	O35	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:		W(a)		~Q(a)	
O'43	O41	PRE:	~P1(a)	~P2(a)	R(a)	M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:		W(a)		~Q(a)	
O'60	O1	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	N(b)	EFF:					~Q(b)
O'61	O4	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	M(b)	N(b)	EFF:					~Q(b)
O'62	O80	PRE:	~P1(a)	P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	N(b)	EFF:	Q(a)				~Q(b)
O'63	O82	PRE:	~P1(a)	P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	M(b)	N(b)	EFF:	Q(a)				~Q(b)
O'64	O140	PRE:	P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	N(b)	EFF:	Q(a)				~Q(b)
O'65	O143	PRE:	P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	M(b)	~N(b)	EFF:	Q(a)				~Q(b)
O'66	O32	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	N(b)	EFF:		W(a)			~Q(b)
O'67	O36	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	M(b)	N(b)	EFF:		W(a)			~Q(b)
O'68	O88	PRE:	~P1(a)	P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	N(b)	EFF:	Q(a)	W(a)			~Q(b)
O'69	O90	PRE:	~P1(a)	P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	M(b)	N(b)	EFF:	Q(a)	W(a)			~Q(b)
O'70	O148	PRE:	P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	N(b)	EFF:	Q(a)	W(a)			~Q(b)
O'71	O151	PRE:	P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	M(b)	~N(b)	EFF:	Q(a)	W(a)			~Q(b)
O'84	O2	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	N(b)	EFF:				~Q(a)	~Q(b)
O'85	O6	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	N(a)	~P1(b)	~P2(b)	~R(b)	M(b)	N(b)	EFF:				~Q(a)	~Q(b)
O'86	O8	PRE:	~P1(a)	~P2(a)	~R(a)	M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	N(b)	EFF:				~Q(a)	~Q(b)
O'87	O12	PRE:	~P1(a)	~P2(a)	~R(a)	M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	M(b)	N(b)	EFF:				~Q(a)	~Q(b)
O'88	O34	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	N(b)	EFF:		W(a)		~Q(a)	~Q(b)
O'89	O38	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	N(a)	~P1(b)	~P2(b)	~R(b)	M(b)	N(b)	EFF:		W(a)		~Q(a)	~Q(b)
O'90	O40	PRE:	~P1(a)	~P2(a)	R(a)	M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	N(b)	EFF:		W(a)		~Q(a)	~Q(b)
O'91	O44	PRE:	~P1(a)	~P2(a)	R(a)	M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	M(b)	N(b)	EFF:		W(a)		~Q(a)	~Q(b)
O'18	O17	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:			W(b)		
O'19	O85	PRE:	~P1(a)	P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:	Q(a)		W(b)		
O'20	O145	PRE:	P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:	Q(a)		W(b)		
O'27	O49	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:		W(a)	W(b)		
O'28	O93	PRE:	~P1(a)	P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:	Q(a)	W(a)	W(b)		
O'29	O153	PRE:	P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:	Q(a)	W(a)	W(b)		
O'48	O19	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:			W(b)	~Q(a)	
O'49	O25	PRE:	~P1(a)	~P2(a)	~R(a)	M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:			W(b)	~Q(a)	
O'54	O51	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:		W(a)	W(b)	~Q(a)	
O'55	O57	PRE:	~P1(a)	~P2(a)	R(a)	M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:		W(a)	W(b)	~Q(a)	
O'72	O16	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	N(b)	EFF:			W(b)		~Q(b)
O'73	O20	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	M(b)	N(b)	EFF:			W(b)		~Q(b)
O'74	O84	PRE:	~P1(a)	P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	N(b)	EFF:	Q(a)		W(b)		~Q(b)
O'75	O86	PRE:	~P1(a)	P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	M(b)	N(b)	EFF:	Q(a)		W(b)		~Q(b)
O'76	O144	PRE:	P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	N(b)	EFF:	Q(a)		W(b)		~Q(b)
O'77	O147	PRE:	P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	M(b)	~N(b)	EFF:	Q(a)		W(b)		~Q(b)
O'78	O48	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	N(b)	EFF:		W(a)	W(b)		~Q(b)
O'79	O52	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	M(b)	N(b)	EFF:		W(a)	W(b)		~Q(b)
O'80	O92	PRE:	~P1(a)	P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	N(b)	EFF:	Q(a)	W(a)	W(b)		~Q(b)
O'81	O94	PRE:	~P1(a)	P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	M(b)	N(b)	EFF:	Q(a)	W(a)	W(b)		~Q(b)
O'82	O152	PRE:	P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	N(b)	EFF:	Q(a)	W(a)	W(b)		~Q(b)
O'83	O155	PRE:	P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	M(b)	~N(b)	EFF:	Q(a)	W(a)	W(b)		~Q(b)
O'92	O18	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	N(b)	EFF:			W(b)	~Q(a)	~Q(b)
O'93	O22	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	N(a)	~P1(b)	~P2(b)	R(b)	M(b)	N(b)	EFF:			W(b)	~Q(a)	~Q(b)
O'94	O24	PRE:	~P1(a)	~P2(a)	~R(a)	M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	N(b)	EFF:			W(b)	~Q(a)	~Q(b)
O'95	O28	PRE:	~P1(a)	~P2(a)	~R(a)	M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	M(b)	N(b)	EFF:			W(b)	~Q(a)	~Q(b)
O'96	O50	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	N(b)	EFF:		W(a)	W(b)	~Q(a)	~Q(b)
O'97	O54	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	N(a)	~P1(b)	~P2(b)	R(b)	M(b)	N(b)	EFF:		W(a)	W(b)	~Q(a)	~Q(b)

O'98	O56	PRE:	~P1(a)	~P2(a)	R(a)	M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	N(b)	EFF:			W(a)	W(b)	~Q(a)	~Q(b)
O'99	O60	PRE:	~P1(a)	~P2(a)	R(a)	M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	M(b)	N(b)	EFF:			W(a)	W(b)	~Q(a)	~Q(b)
O'3	O64	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	~R(b)	~M(b)	~N(b)	EFF:		Q(b)				
O'5	O96	PRE:	~P1(a)	P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	~R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)				
O'7	O156	PRE:	P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	~R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)				
O'12	O72	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	~R(b)	~M(b)	~N(b)	EFF:		Q(b)	W(a)			
O'14	O98	PRE:	~P1(a)	P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	~R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)	W(a)			
O'16	O158	PRE:	P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	~R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)	W(a)			
O'38	O65	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	N(a)	~P1(b)	P2(b)	~R(b)	~M(b)	~N(b)	EFF:		Q(b)			~Q(a)	
O'39	O66	PRE:	~P1(a)	~P2(a)	~R(a)	M(a)	~N(a)	~P1(b)	P2(b)	~R(b)	~M(b)	~N(b)	EFF:		Q(b)			~Q(a)	
O'44	O73	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	N(a)	~P1(b)	P2(b)	~R(b)	~M(b)	~N(b)	EFF:		Q(b)	W(a)		~Q(a)	
O'45	O74	PRE:	~P1(a)	~P2(a)	R(a)	M(a)	~N(a)	~P1(b)	P2(b)	~R(b)	~M(b)	~N(b)	EFF:		Q(b)	W(a)		~Q(a)	
O'21	O68	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	R(b)	~M(b)	~N(b)	EFF:		Q(b)		W(b)		
O'23	O97	PRE:	~P1(a)	P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)		W(b)		
O'25	O157	PRE:	P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)		W(b)		
O'30	O76	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	R(b)	~M(b)	~N(b)	EFF:		Q(b)	W(a)	W(b)		
O'32	O99	PRE:	~P1(a)	P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)	W(a)	W(b)		
O'34	O159	PRE:	P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)	W(a)	W(b)		
O'50	O69	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	N(a)	~P1(b)	P2(b)	R(b)	~M(b)	~N(b)	EFF:		Q(b)		W(b)	~Q(a)	
O'51	O70	PRE:	~P1(a)	~P2(a)	~R(a)	M(a)	~N(a)	~P1(b)	P2(b)	R(b)	~M(b)	~N(b)	EFF:		Q(b)		W(b)	~Q(a)	
O'56	O77	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	N(a)	~P1(b)	P2(b)	R(b)	~M(b)	~N(b)	EFF:		Q(b)	W(a)	W(b)	~Q(a)	
O'57	O78	PRE:	~P1(a)	~P2(a)	R(a)	M(a)	~N(a)	~P1(b)	P2(b)	R(b)	~M(b)	~N(b)	EFF:		Q(b)	W(a)	W(b)	~Q(a)	
O'4	O100	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:		Q(b)				
O'6	O132	PRE:	~P1(a)	P2(a)	~R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)				
O'8	O180	PRE:	P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)				
O'13	O108	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:		Q(b)	W(a)			
O'15	O134	PRE:	~P1(a)	P2(a)	R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)	W(a)			
O'17	O182	PRE:	P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)	W(a)			
O'40	O101	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	N(a)	P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:		Q(b)			~Q(a)	
O'41	O103	PRE:	~P1(a)	~P2(a)	~R(a)	M(a)	N(a)	P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:		Q(b)			~Q(a)	
O'46	O109	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	N(a)	P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:		Q(b)	W(a)		~Q(a)	
O'47	O111	PRE:	~P1(a)	~P2(a)	R(a)	M(a)	N(a)	P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)	EFF:		Q(b)	W(a)		~Q(a)	
O'22	O104	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:		Q(b)		W(b)		
O'24	O133	PRE:	~P1(a)	P2(a)	~R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)		W(b)		
O'26	O181	PRE:	P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)		W(b)		
O'31	O112	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:		Q(b)	W(a)	W(b)		
O'33	O135	PRE:	~P1(a)	P2(a)	R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)	W(a)	W(b)		
O'35	O183	PRE:	P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:	Q(a)	Q(b)	W(a)	W(b)		
O'52	O105	PRE:	~P1(a)	~P2(a)	~R(a)	~M(a)	N(a)	P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:		Q(b)		W(b)	~Q(a)	
O'53	O107	PRE:	~P1(a)	~P2(a)	~R(a)	M(a)	N(a)	P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:		Q(b)		W(b)	~Q(a)	
O'58	O113	PRE:	~P1(a)	~P2(a)	R(a)	~M(a)	N(a)	P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:		Q(b)	W(a)	W(b)	~Q(a)	
O'59	O115	PRE:	~P1(a)	~P2(a)	R(a)	M(a)	N(a)	P1(b)	~P2(b)	R(b)	~M(b)	~N(b)	EFF:		Q(b)	W(a)	W(b)	~Q(a)	

In the 196 ground actions there are many duplicates, which can be eliminated.

There will be a total 99 ground actions left after removing all duplicates.

In fact there will be a total of 196 actions before and 100 actions after removing duplicates respectively if we include the action with only negative preconditions and no effects

The argument for including it is that the action sequence consisting only of the lifted action in the all-false state is a valid plan;

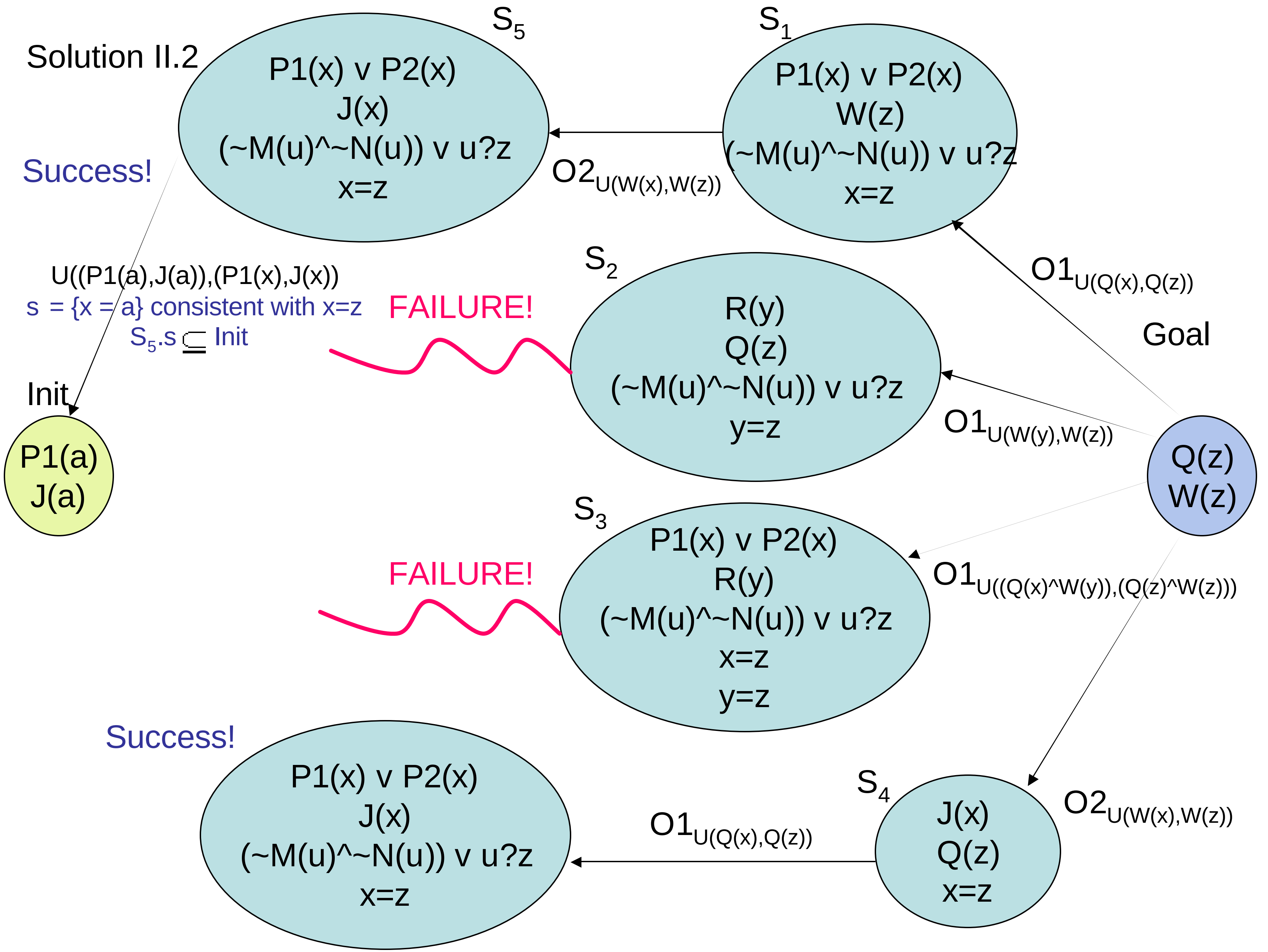
if we eliminate that grounding, then there is no valid ground plan corresponding to it.

This would be important in conformat planning -- Will

Choices for A					Choices for B				
~P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)
~P1(a)	P2(a)	~R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	~R(b)	~M(b)	~N(b)
P1(a)	~P2(a)	~R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	~R(b)	~M(b)	~N(b)
~P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	~P2(b)	R(b)	~M(b)	~N(b)
~P1(a)	P2(a)	R(a)	~M(a)	~N(a)	~P1(b)	P2(b)	R(b)	~M(b)	~N(b)
P1(a)	~P2(a)	R(a)	~M(a)	~N(a)	P1(b)	~P2(b)	R(b)	~M(b)	~N(b)

~P1(a)	~P2(a)	~R(a)	~M(a)	N(a)		~P1(b)	~P2(b)	~R(b)	~M(b)	N(b)
~P1(a)	~P2(a)	~R(a)	M(a)	~N(a)		~P1(b)	~P2(b)	~R(b)	M(b)	~N(b)
~P1(a)	~P2(a)	R(a)	~M(a)	N(a)		~P1(b)	~P2(b)	R(b)	~M(b)	N(b)
~P1(a)	~P2(a)	R(a)	M(a)	~N(a)		~P1(b)	~P2(b)	R(b)	M(b)	~N(b)

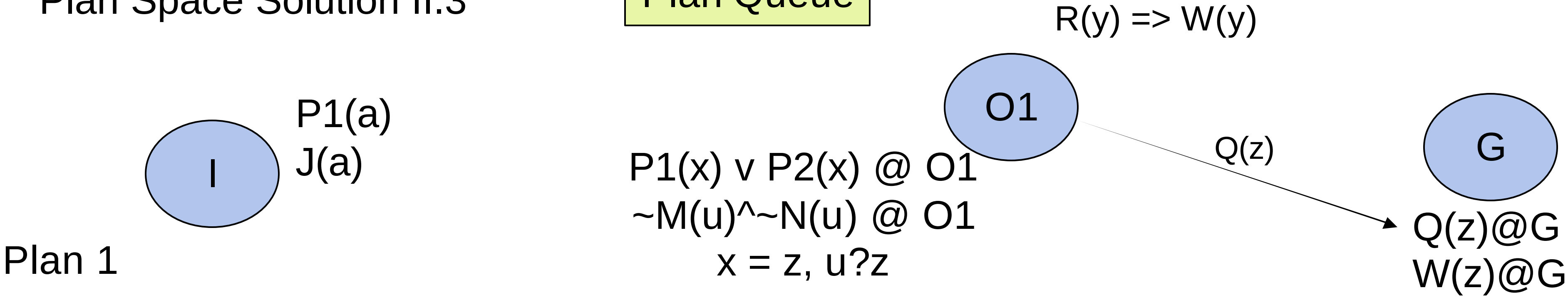
Choices are independent of each other; 100 choices

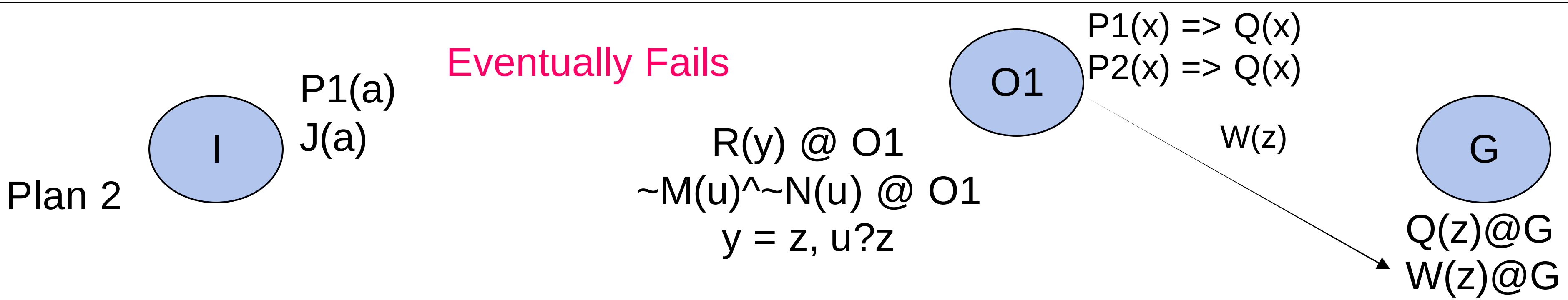


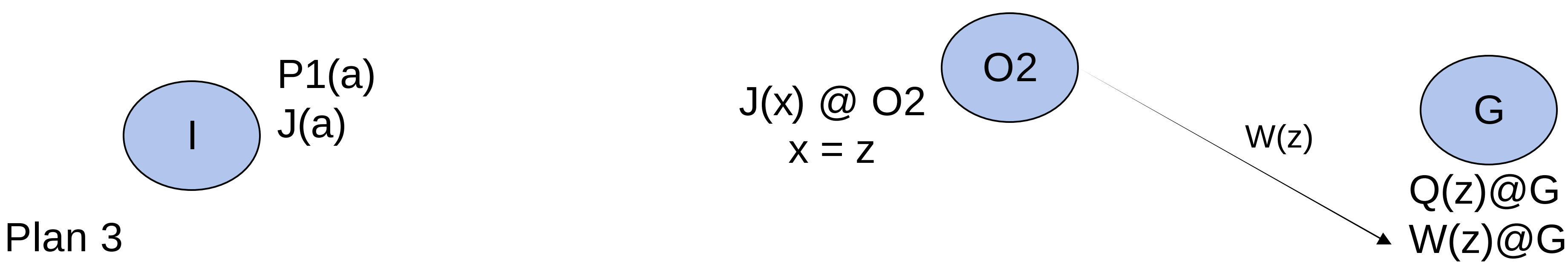
Solution II.2
S5
P1(x) v P2(x)
J(x)
(~M(u)^~N(u)) v u?z
x=z
S1
P1(x) v P2(x)
W(z)
(~M(u)^~N(u)) v u?z
x=z
O2U(W(x),W(z))
Success!
U((P1(a),J(a)),(P1(x),J(x))
s = {x = a} consistent with x=z
S5.s ⊆ Init
FAILURE!
S2
R(y)
Q(z)
(~M(u)^~N(u)) v u?z
y=z
O1U(Q(x),Q(z))
Goal
Init
P1(a)
J(a)
O1U(W(y),W(z))
Q(z)
W(z)
S3
P1(x) v P2(x)
R(y)
(~M(u)^~N(u)) v u?z
x=z
y=z
FAILURE!
O1U((Q(x)^W(y)),(Q(z)^W(z)))
Success!
P1(x) v P2(x)
J(x)
(~M(u)^~N(u)) v u?z
x=z
S4
J(x)
Q(z)
x=z
O2U(W(x),W(z))
O1U(Q(x),Q(z))

Plan Space Solution II.3

Plan Queue

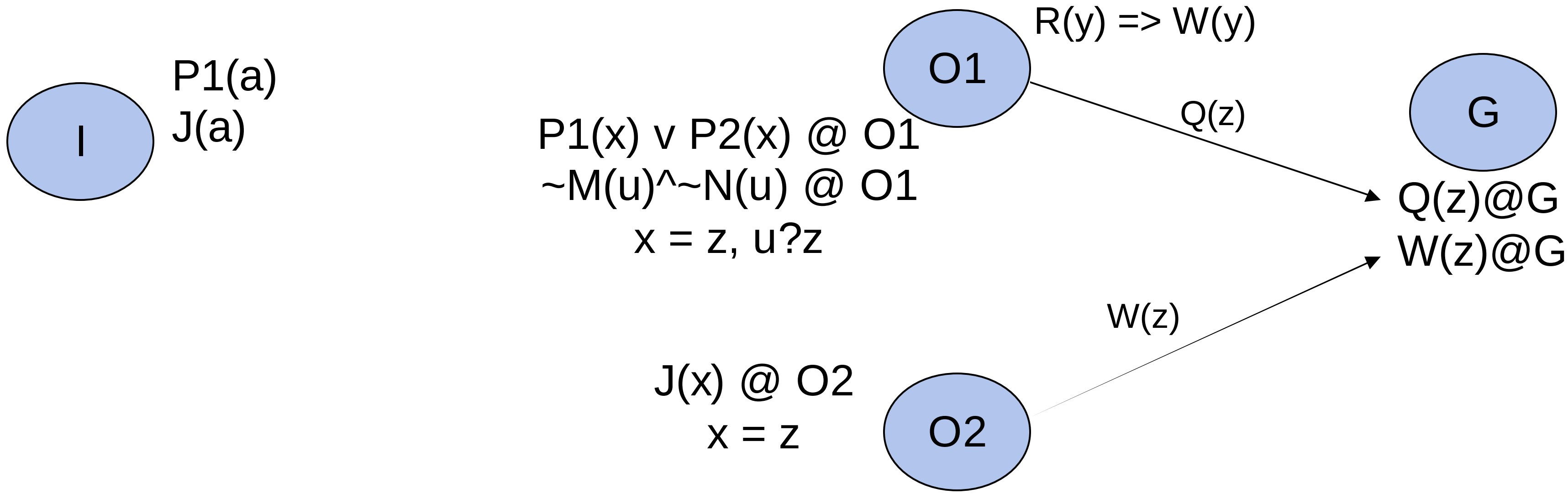




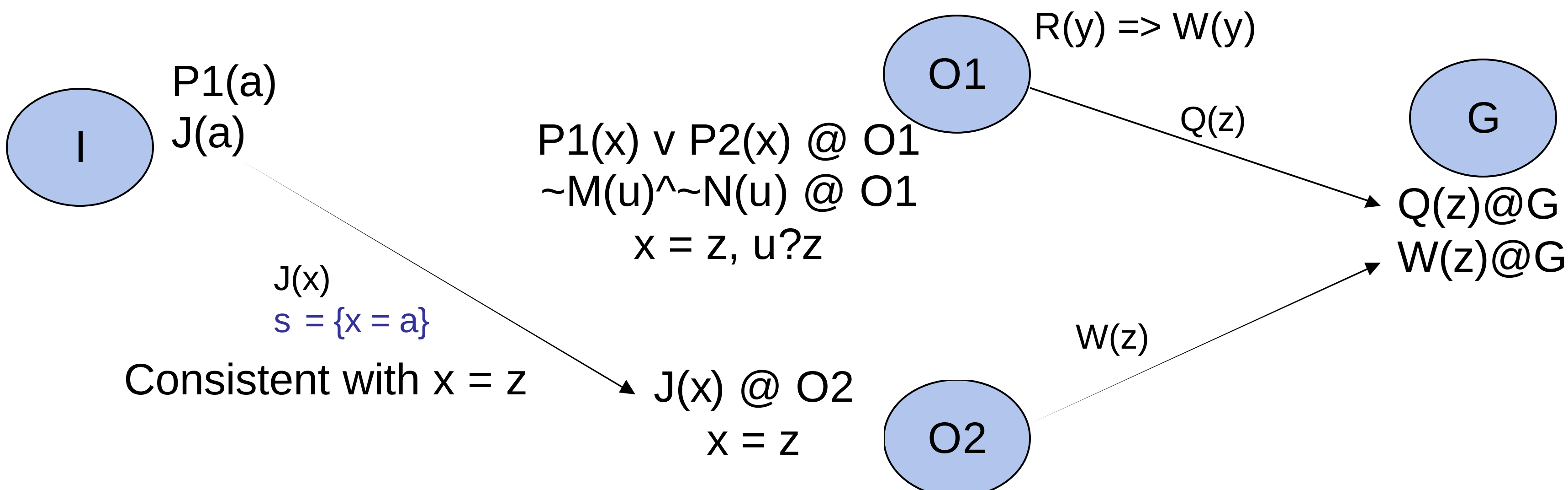


Plan Space Solution II.3 Cont…

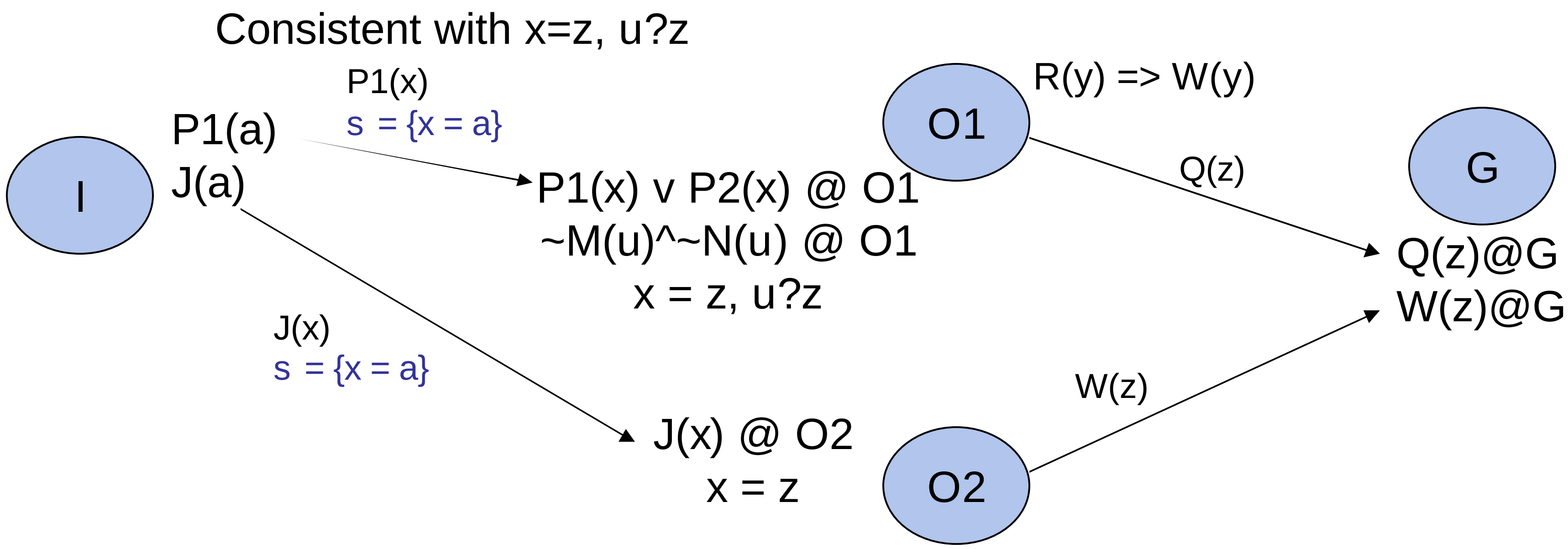
- Selecting only one trace (Plan 1). Resolving open condition W(z)@G with O2



- Resolving now open condition J(x) by inserting a causal link to I



- Resolving now open condition P1(x) v P2(x) by inserting a causal link to I



Algorithm stops, we do not have more open conditions to satisfy. Conjunct ~M(u)^~N(u) gets satisfied by CWA from I. Constraints are also consistent, and we do not have any unsafe links.