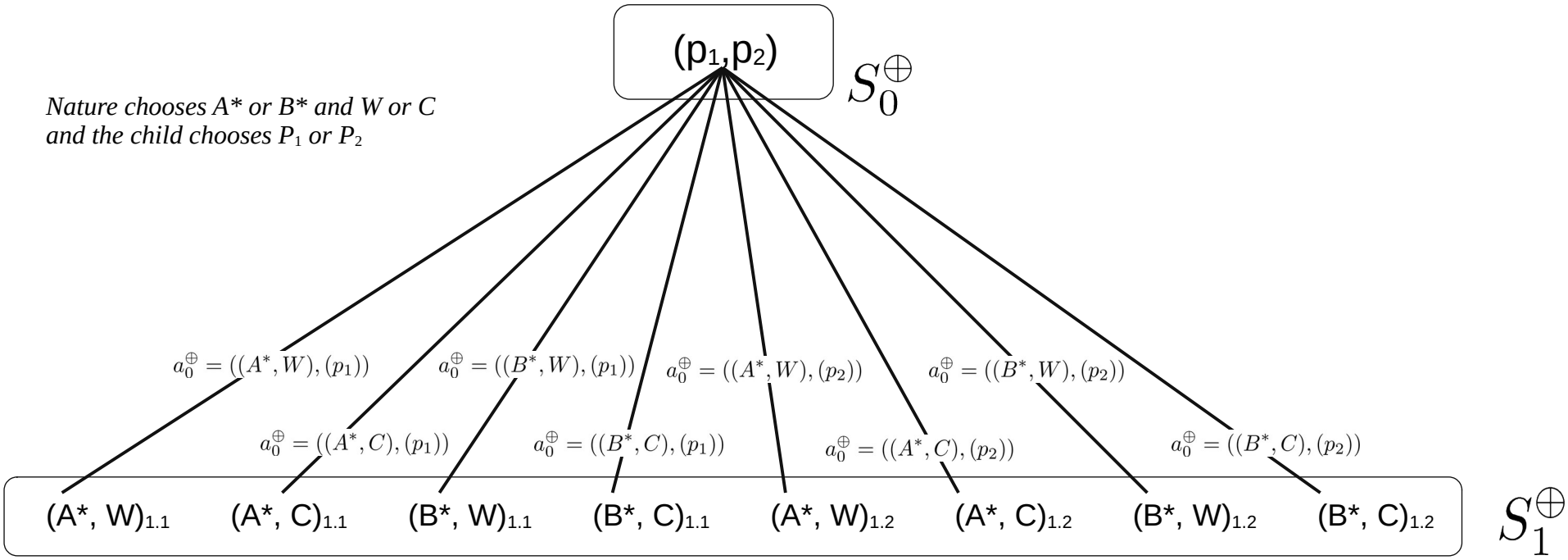
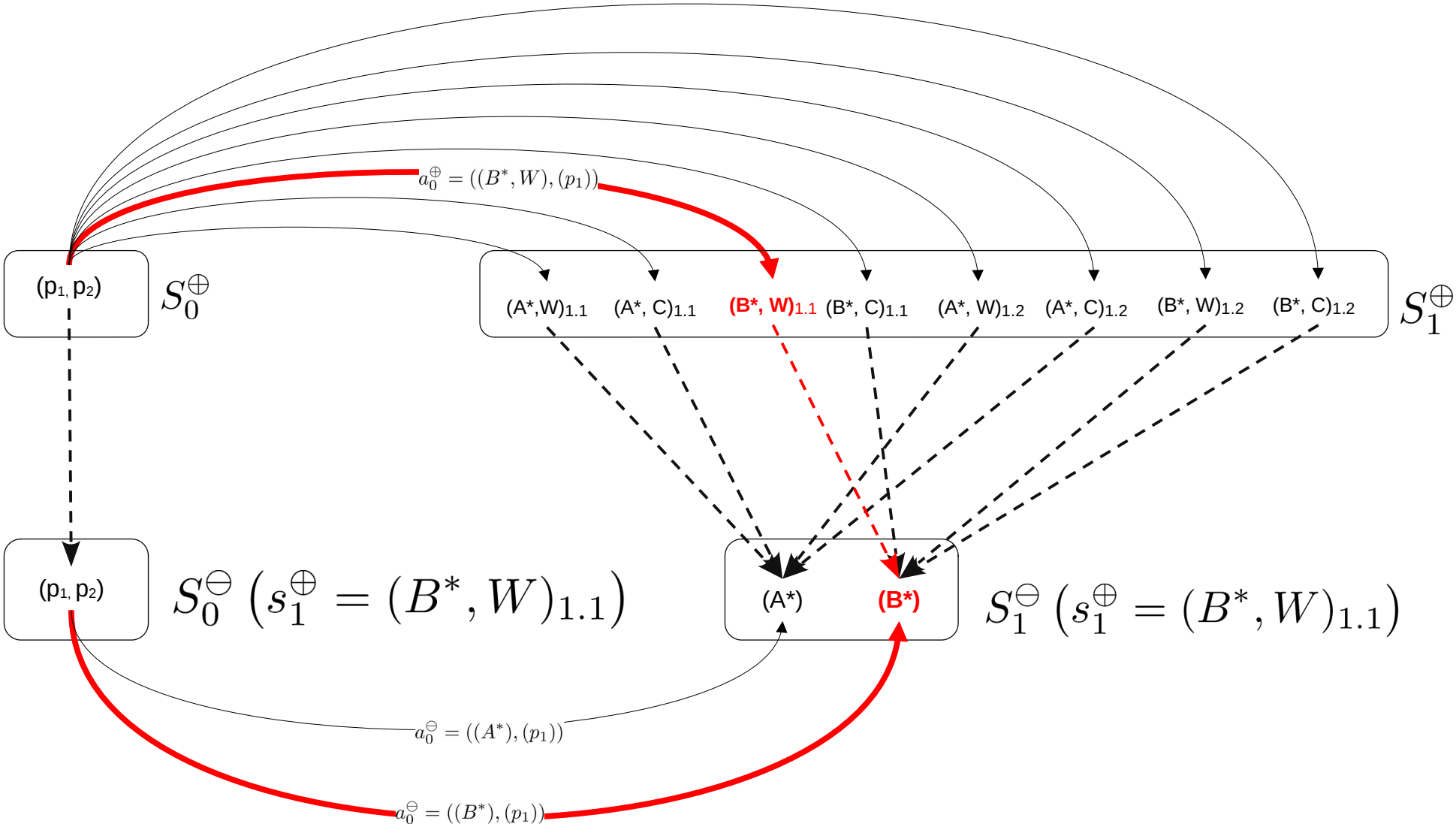
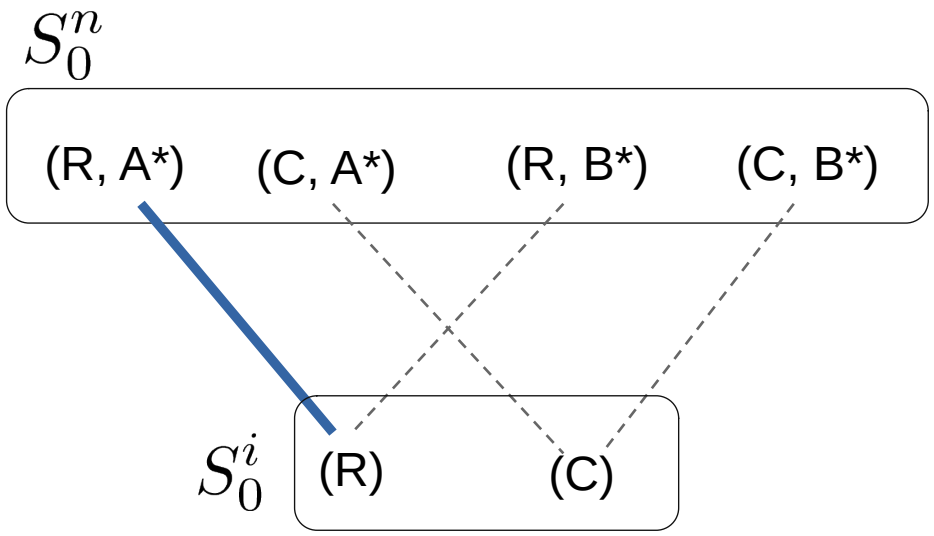
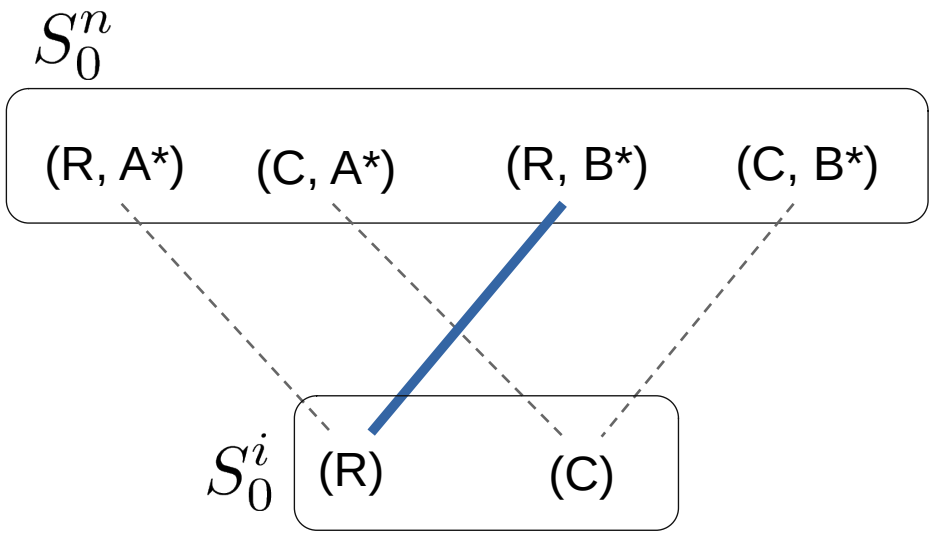

(p1,p2)
$S_0^{\oplus}$
Nature chooses A or B* and W or C*
and the child chooses P_1 or P_2
$a_0^{\oplus} = ((A^*, W), (p_1))$
$a_0^{\oplus} = ((B^*, W), (p_1))$
$a_0^{\oplus} = ((A^*, W), (p_2))$
$a_0^{\oplus} = ((B^*, W), (p_2))$
$a_0^{\oplus} = ((A^*, C), (p_1))$
$a_0^{\oplus} = ((B^*, C), (p_1))$
$a_0^{\oplus} = ((A^*, C), (p_2))$
$a_0^{\oplus} = ((B^*, C), (p_2))$
(A*, W)1.1
(A*, C)1.1
(B*, W)1.1
(B*, C)1.1
(A*, W)1.2
(A*, C)1.2
(B*, W)1.2
(B*, C)1.2
$S_1^{\oplus}$

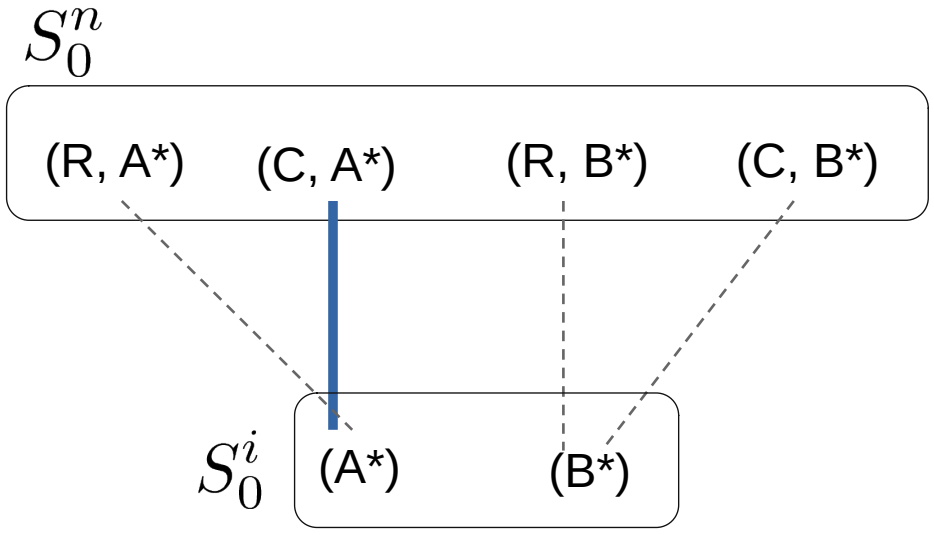

$a_0^{\oplus} = ((B^*, W), (p_1))$
(p1, p2)
$S_0^{\oplus}$
(A*,W)1.1
(A*, C)1.1
(B*, W)1.1
(B*, C)1.1
(A*, W)1.2
(A*, C)1.2
(B*, W)1.2
(B*, C)1.2
$S_1^{\oplus}$
(p1, p2)
$S_0^{\ominus}\left(s_1^{\oplus} = (B^*, W)_{1.1}\right)$
(A*)
(B*)
$S_1^{\ominus}\left(s_1^{\oplus} = (B^*, W)_{1.1}\right)$
$a_0^{\ominus} = ((A^*), (p_1))$
$a_0^{\ominus} = ((B^*), (p_1))$


S_0^n
(R, A*)
(C, A*)
(R, B*)
(C, B*)
S_0^i
(R)
(C)

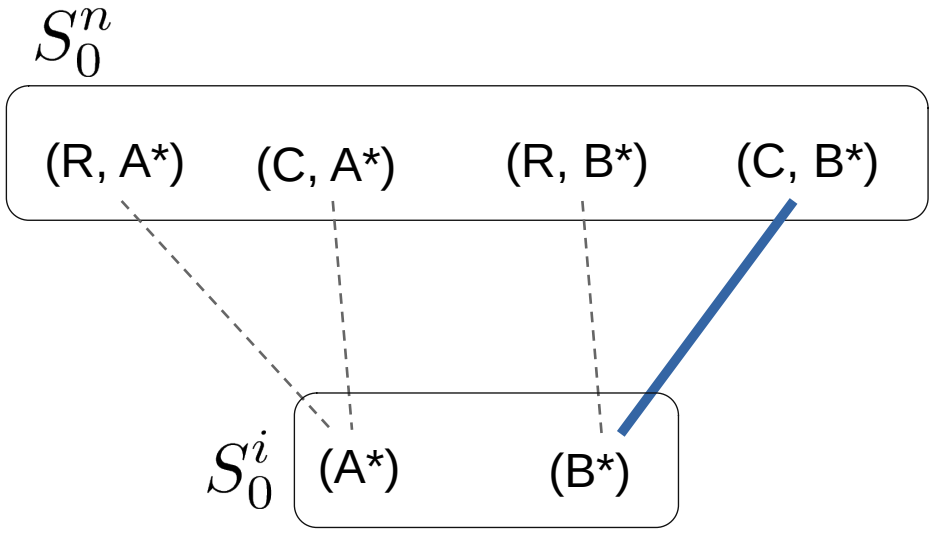
(a)


S_0^n
(R, A*)
(C, A*)
(R, B*)
(C, B*)
S_0^i
(R)
(C)

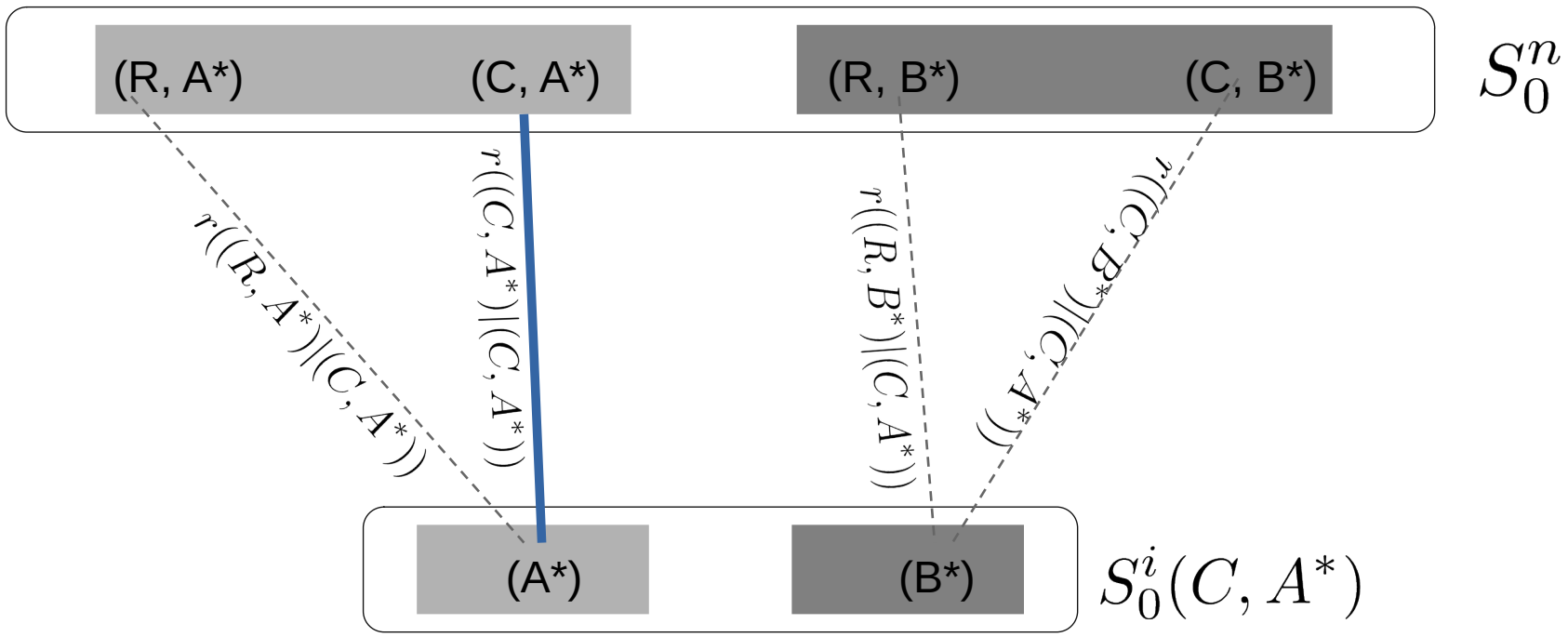
(b)

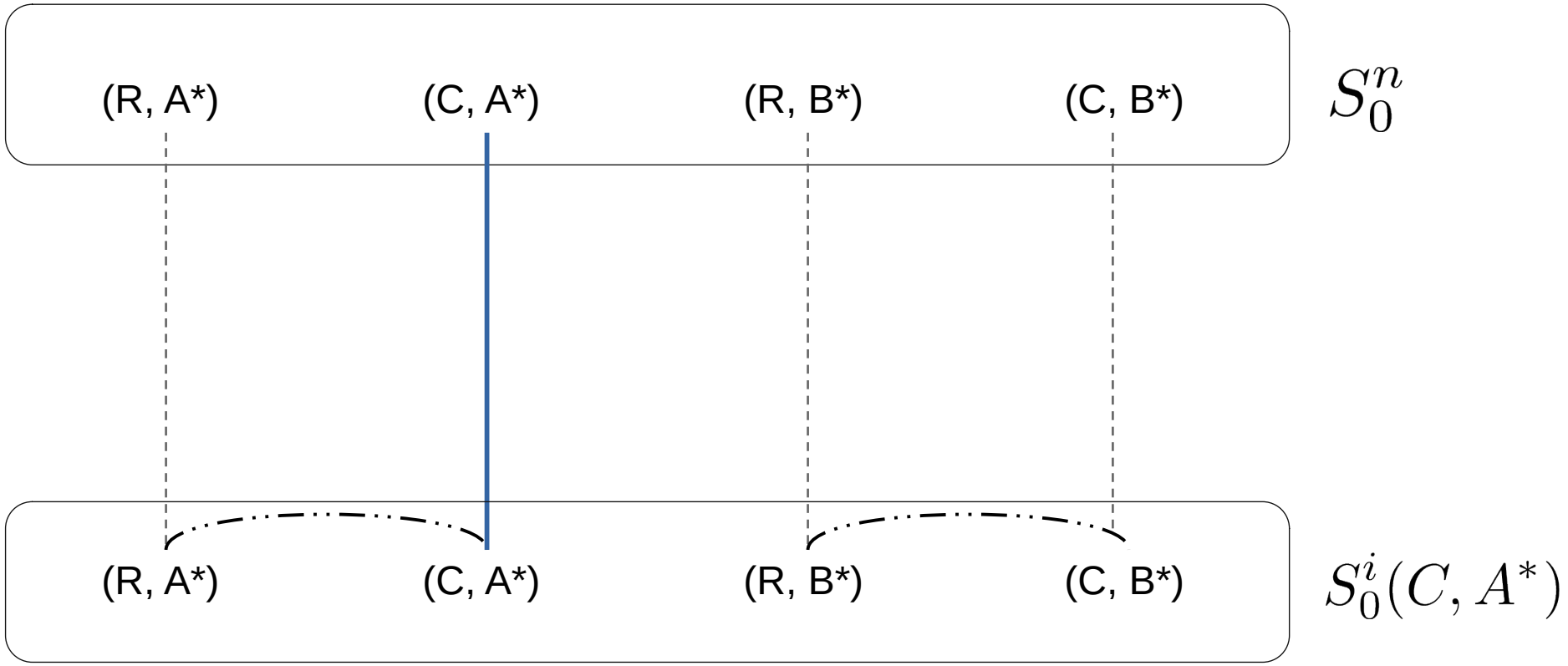

S_0^n
(R, A*)
(C, A*)
(R, B*)
(C, B*)
S_0^i
(A*)
(B*)

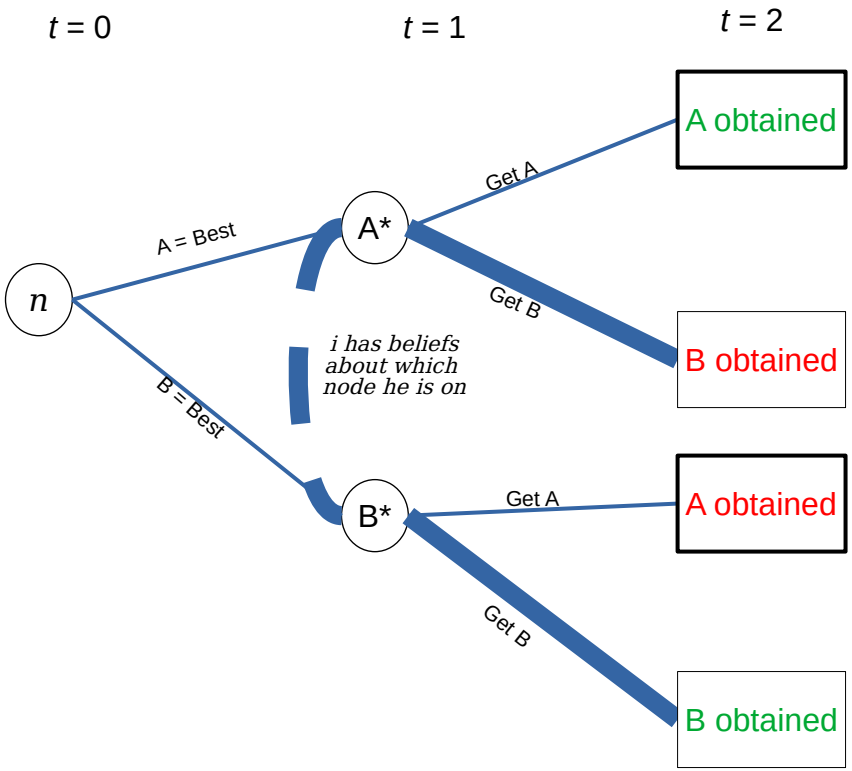
(c)

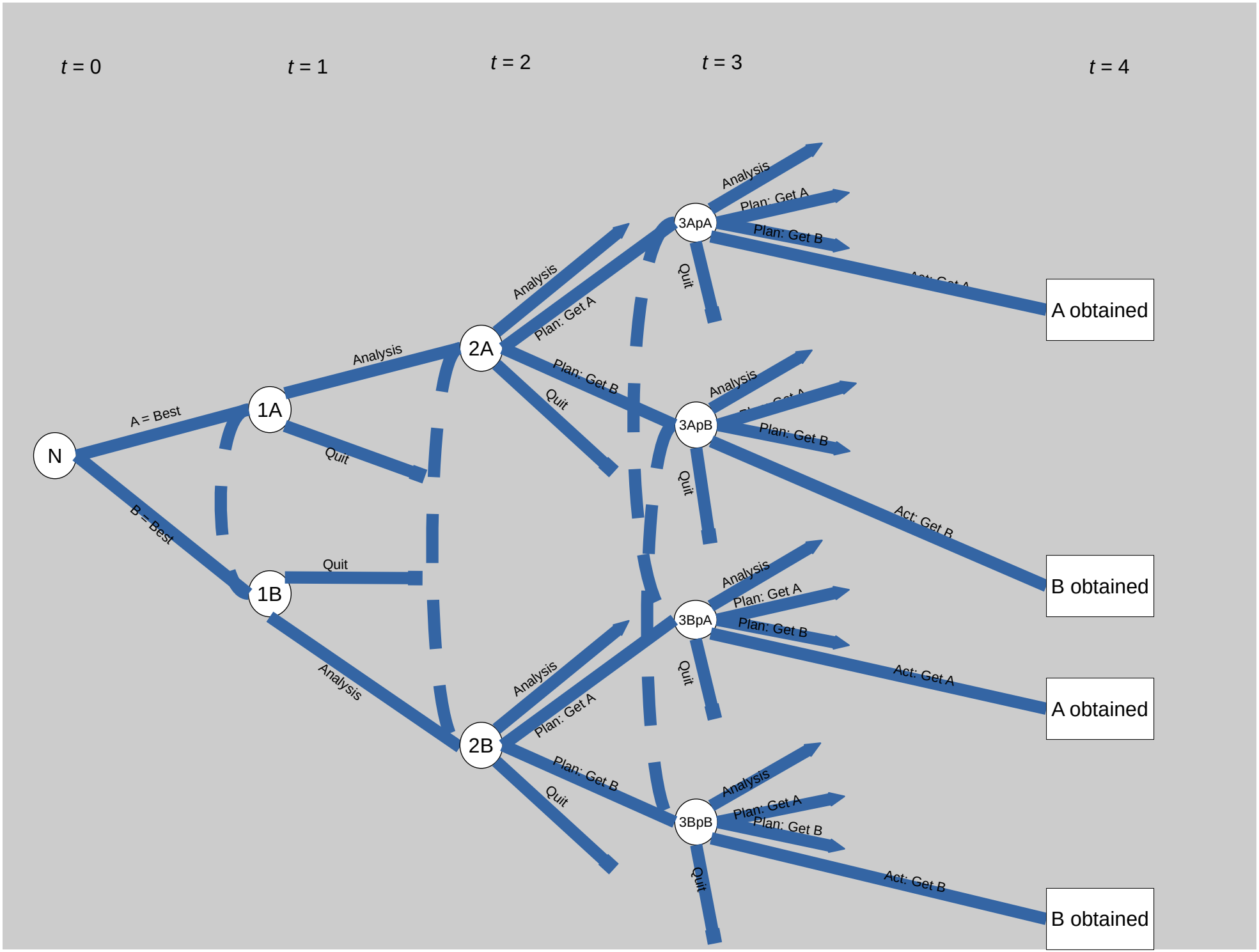

S_0^n
(R, A*)
(C, A*)
(R, B*)
(C, B*)
S_0^i
(A*)
(B*)

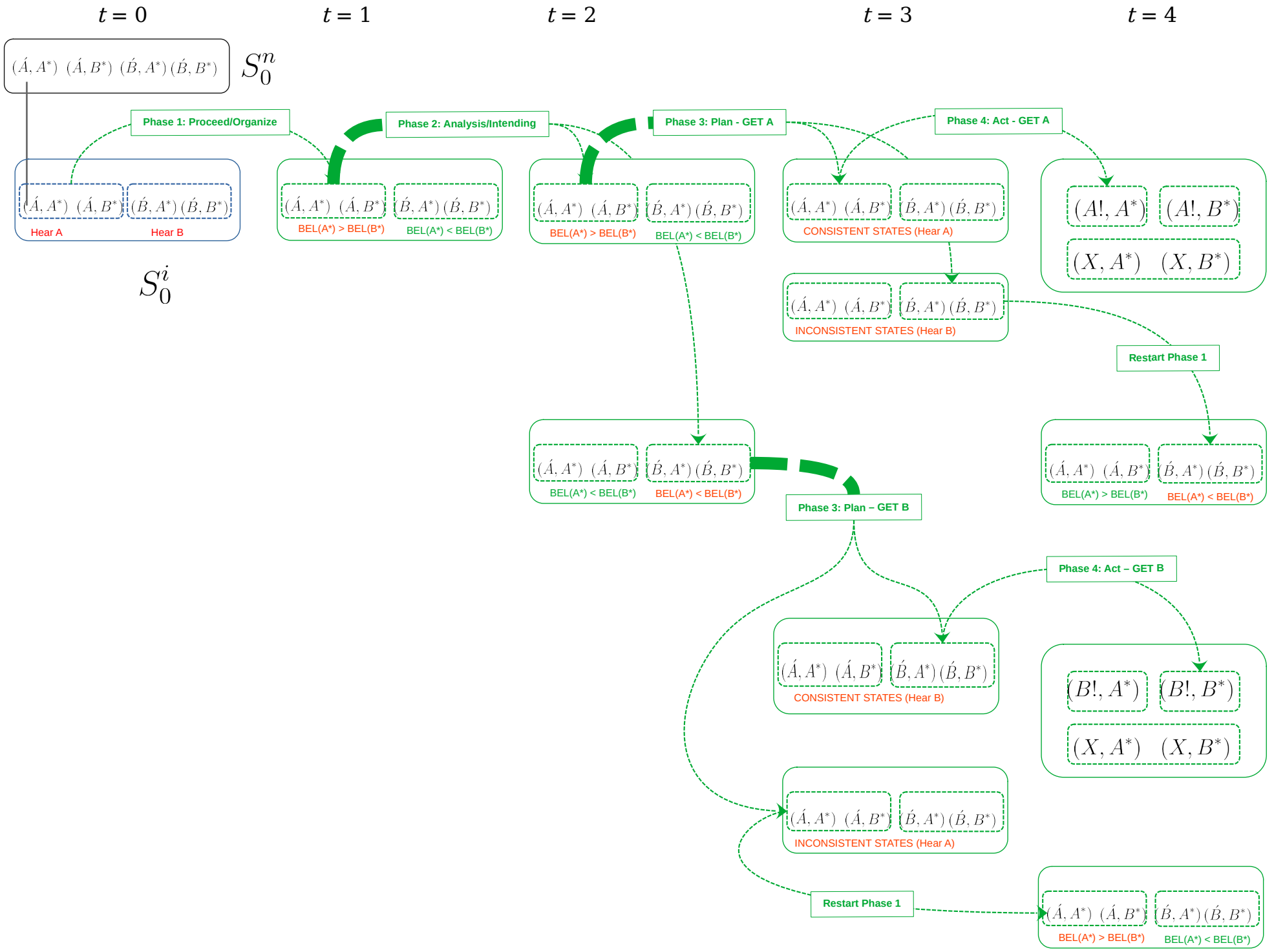
(d)

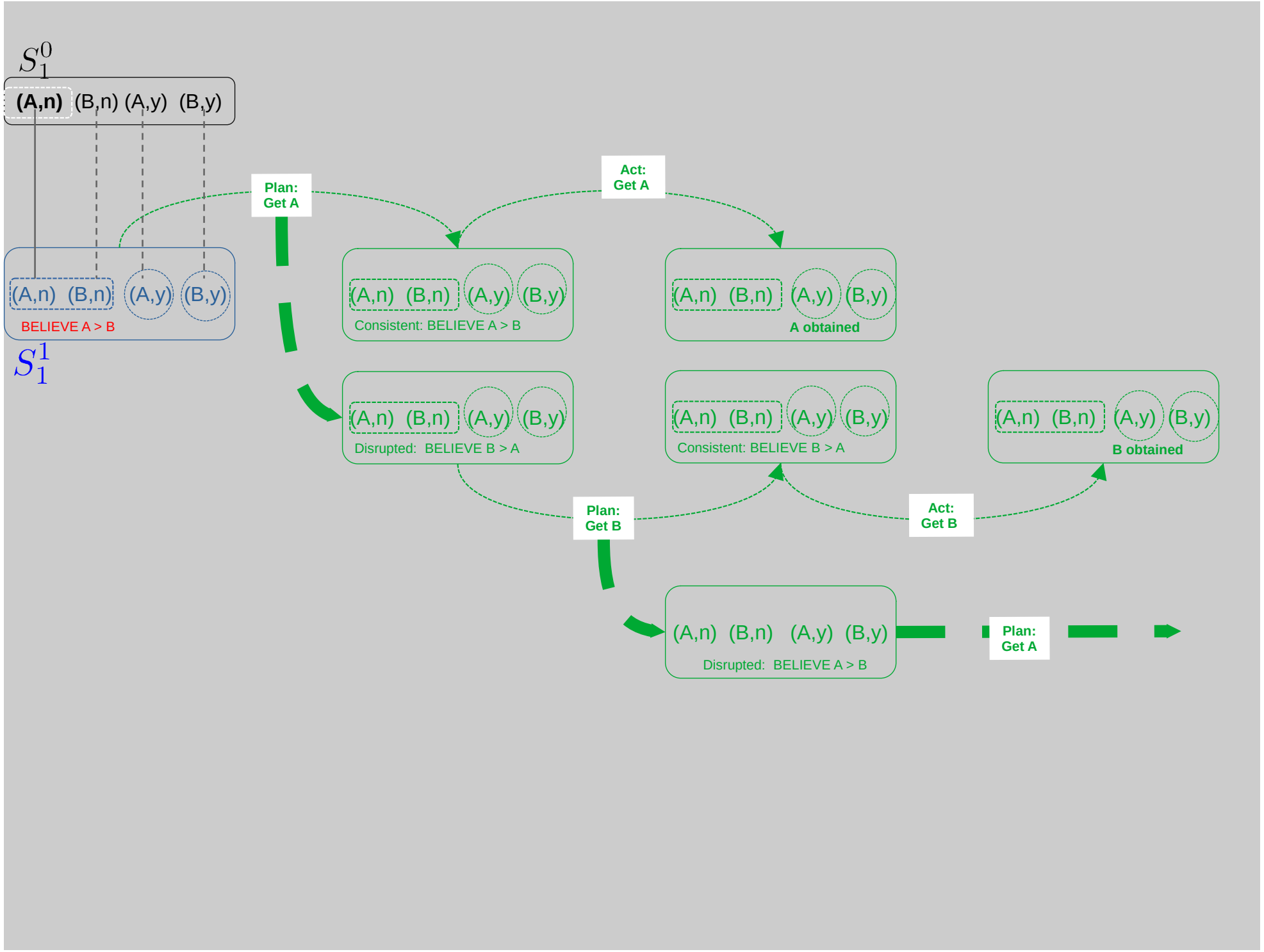

(R, A*)
(C, A*)
(R, B*)
(C, B*)
S_0^n
$r((R, A^*)|(C, A^*))$
$r((C, A^*)|(C, A^*))$
$r((R, B^*)|(C, A^*))$
$r((C, B^*)|(C, A^*))$
(A*)
(B*)
$S_0^i(C, A^*)$

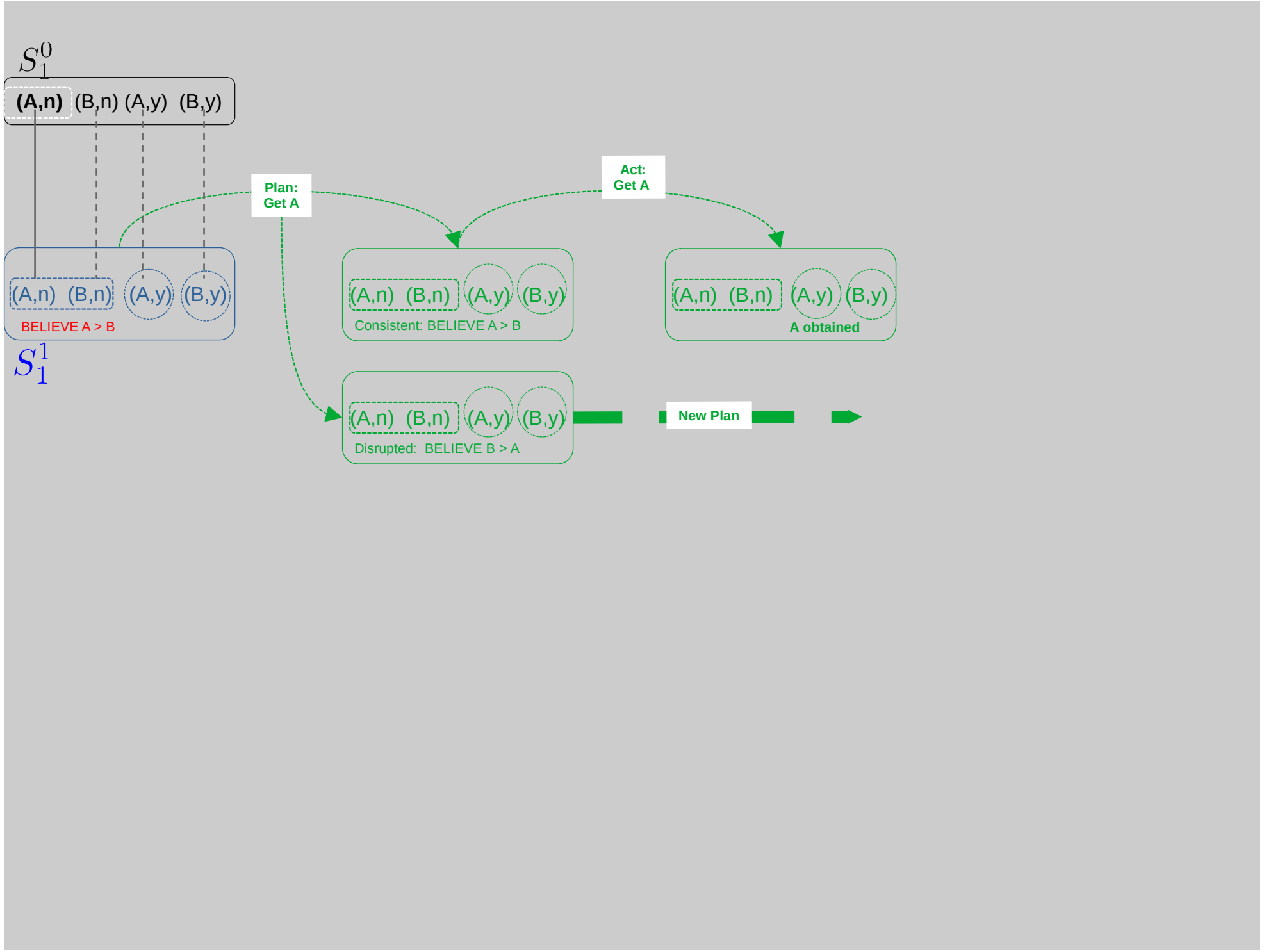

(R, A*)
(C, A*)
(R, B*)
(C, B*)
S_0^n
(R, A*)
(C, A*)
(R, B*)
(C, B*)
$S_0^i(C, A^*)$

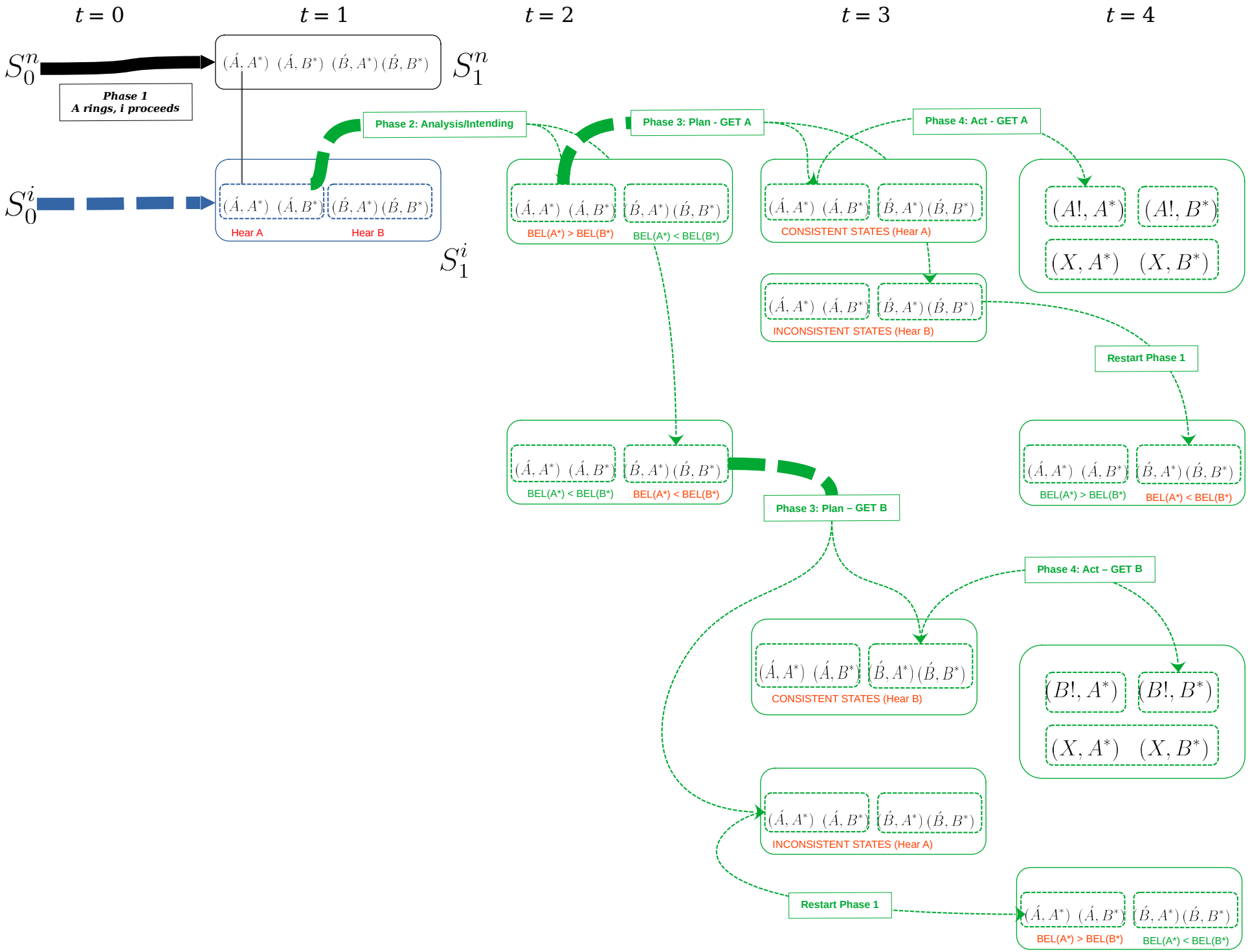

t = 0
t = 1
t = 2
n
A = Best
B = Best
A*
B*
Get A
Get B
Get A
Get B
A obtained
B obtained
A obtained
B obtained
i has beliefs about which node he is on

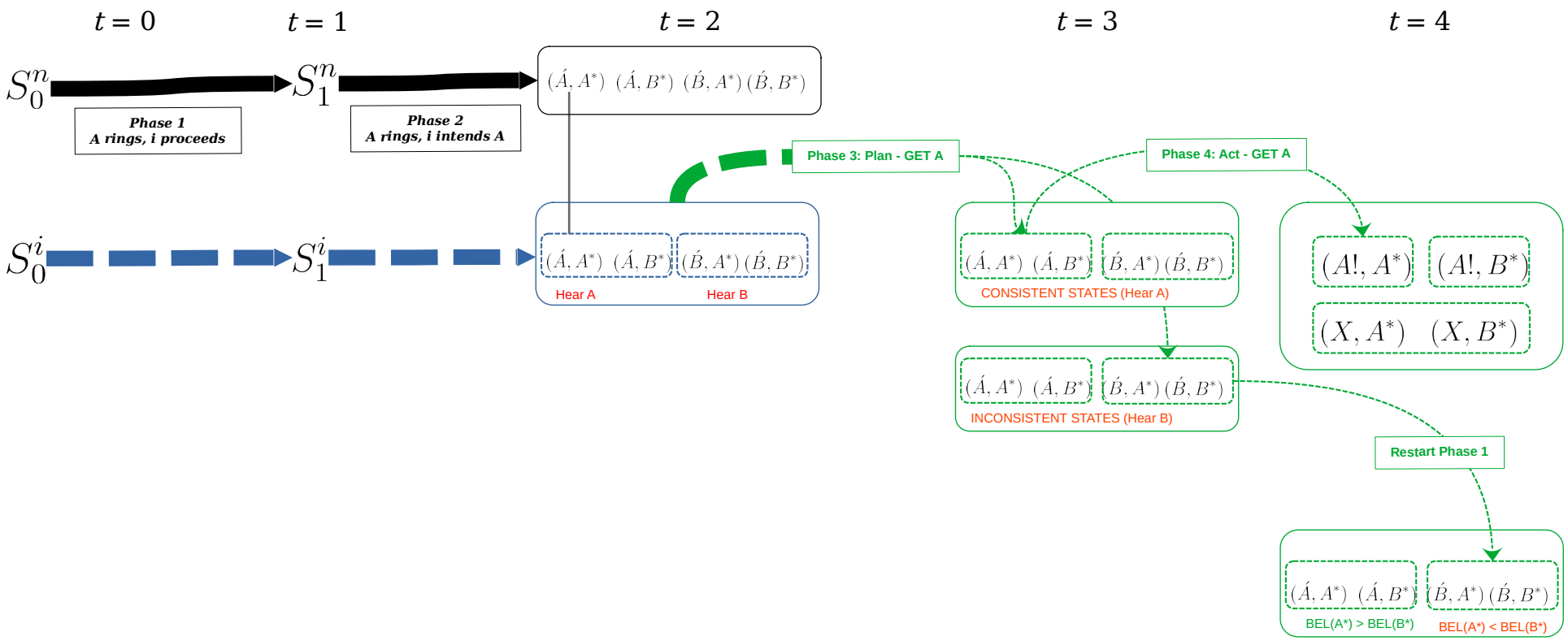

t = 0
t = 1
t = 2
t = 3
t = 4
N
A = Best
B = Best
1A
1B
Analysis
Quit
Quit
Analysis
2A
2B
Analysis
Plan: Get A
Plan: Get B
Quit
Analysis
Plan: Get A
Plan: Get B
Quit
3ApA
3ApB
3BpA
3BpB
Analysis
Plan: Get A
Plan: Get B
Act: Get A
Act: Get B
A obtained
B obtained
A obtained
B obtained

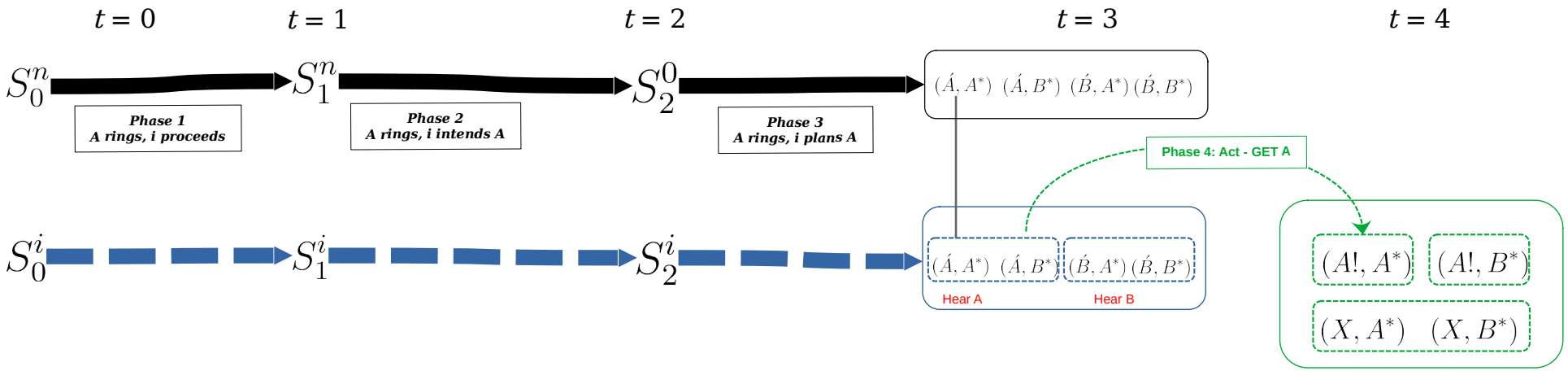

$t = 0$
$t = 1$
$t = 2$
$t = 3$
$t = 4$
$(\acute{A}, A^*)$ $(\acute{A}, B^*)$ $(\acute{B}, A^*)$ $(\acute{B}, B^*)$
S_0^n
Phase 1: Proceed/Organize
Phase 2: Analysis/Intending
Phase 3: Plan - GET A
Phase 4: Act - GET A
Hear A
Hear B
S_0^i
BEL(A*) > BEL(B*)
BEL(A*) < BEL(B*)
CONSISTENT STATES (Hear A)
INCONSISTENT STATES (Hear B)
$(A!, A^*)$ $(A!, B^*)$
(X, A^*) (X, B^*)
Restart Phase 1
Phase 3: Plan – GET B
Phase 4: Act – GET B
CONSISTENT STATES (Hear B)
INCONSISTENT STATES (Hear A)
$(B!, A^*)$ $(B!, B^*)$

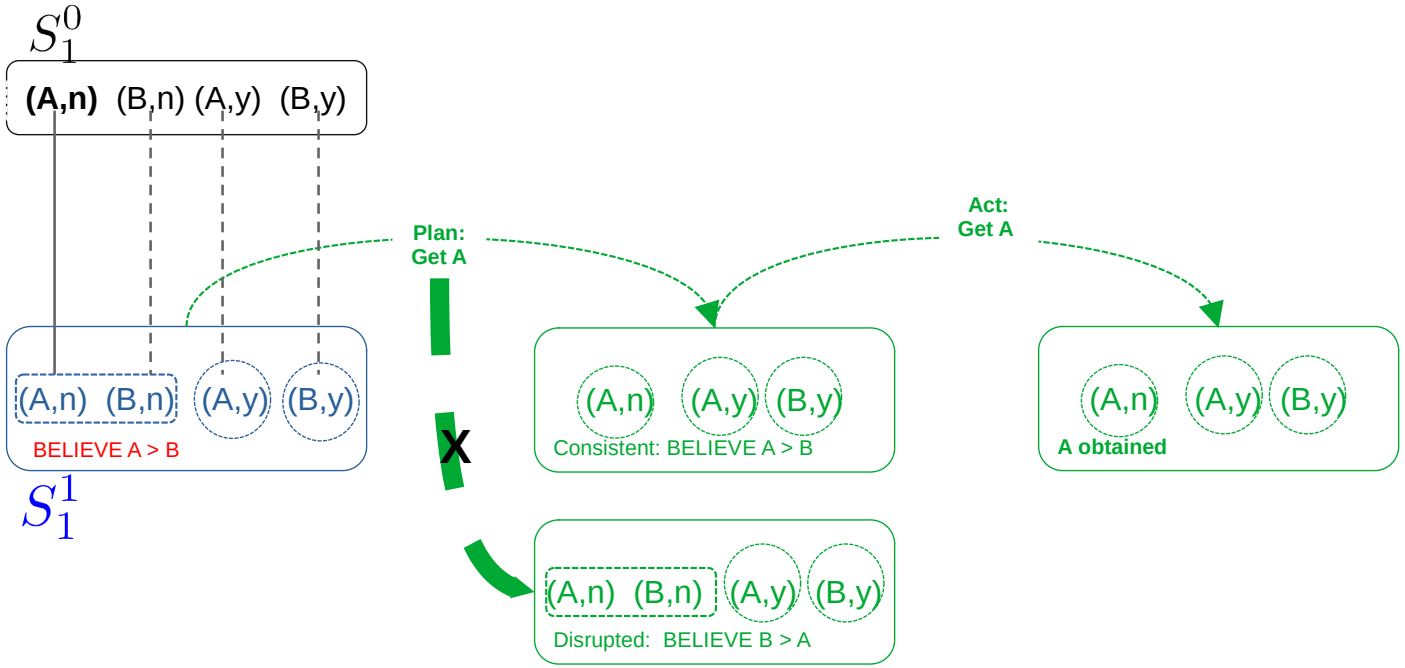

S_1^0
(A,n) (B,n) (A,y) (B,y)
Plan: Get A
Act: Get A
(A,n) (B,n) (A,y) (B,y)
BELIEVE A > B
S_1^1
(A,n) (B,n) (A,y) (B,y)
Consistent: BELIEVE A > B
(A,n) (B,n) (A,y) (B,y)
A obtained
(A,n) (B,n) (A,y) (B,y)
Disrupted: BELIEVE B > A
(A,n) (B,n) (A,y) (B,y)
Consistent: BELIEVE B > A
(A,n) (B,n) (A,y) (B,y)
B obtained
Plan: Get B
Act: Get B
(A,n) (B,n) (A,y) (B,y)
Disrupted: BELIEVE A > B
Plan: Get A

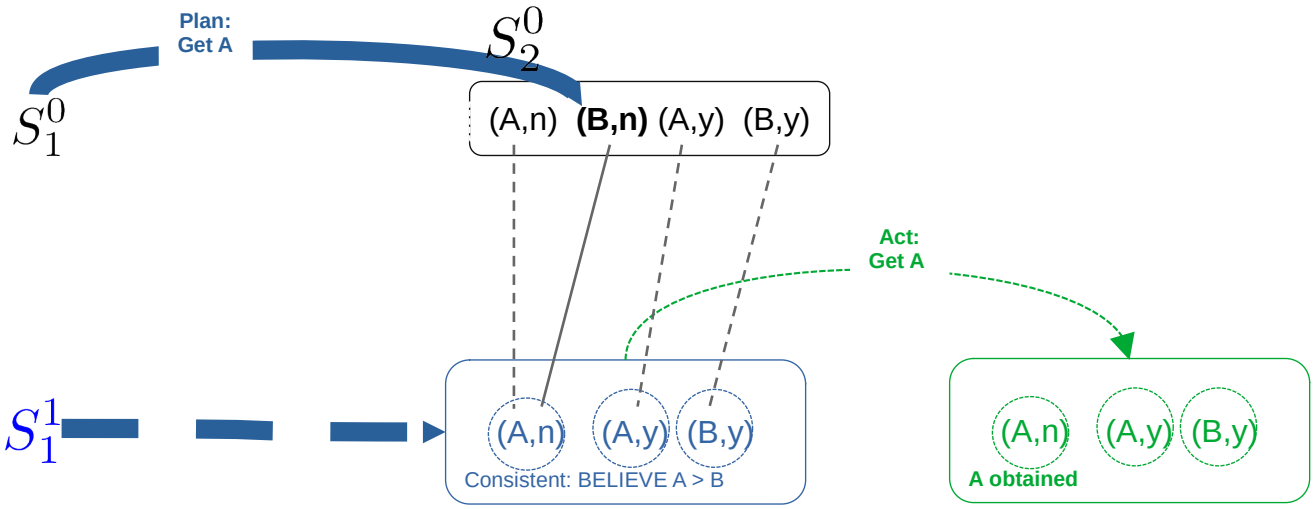

S_1^0
(A,n) (B,n) (A,y) (B,y)
Plan:
Get A
Act:
Get A
(A,n) (B,n) (A,y) (B,y)
BELIEVE A > B
S_1^1
(A,n) (B,n) (A,y) (B,y)
Consistent: BELIEVE A > B
(A,n) (B,n) (A,y) (B,y)
A obtained
(A,n) (B,n) (A,y) (B,y)
Disrupted: BELIEVE B > A
New Plan

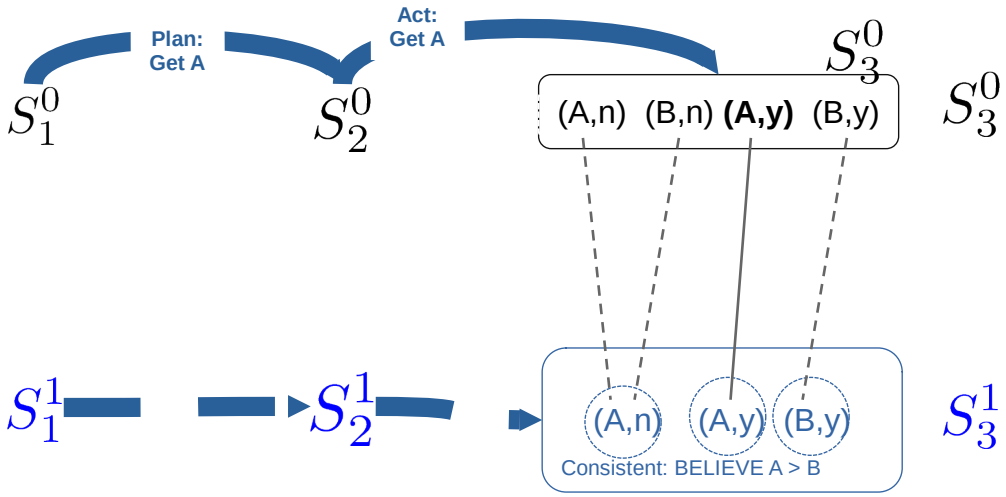

$t = 0$
$t = 1$
$t = 2$
$t = 3$
$t = 4$
S_0^n
S_1^n
$(\acute{A}, A^*)$ $(\acute{A}, B^*)$ $(\acute{B}, A^*)$ $(\acute{B}, B^*)$
Phase 1
A rings, i proceeds
S_0^i
S_1^i
Hear A
Hear B
Phase 2: Analysis/Intending
Phase 3: Plan - GET A
Phase 4: Act - GET A
BEL(A*) > BEL(B*)
BEL(A*) < BEL(B*)
CONSISTENT STATES (Hear A)
$(A!, A^*)$ $(A!, B^*)$
(X, A^*) (X, B^*)
INCONSISTENT STATES (Hear B)
Restart Phase 1
Phase 3: Plan – GET B
Phase 4: Act – GET B
CONSISTENT STATES (Hear B)
$(B!, A^*)$ $(B!, B^*)$
INCONSISTENT STATES (Hear A)
Restart Phase 1

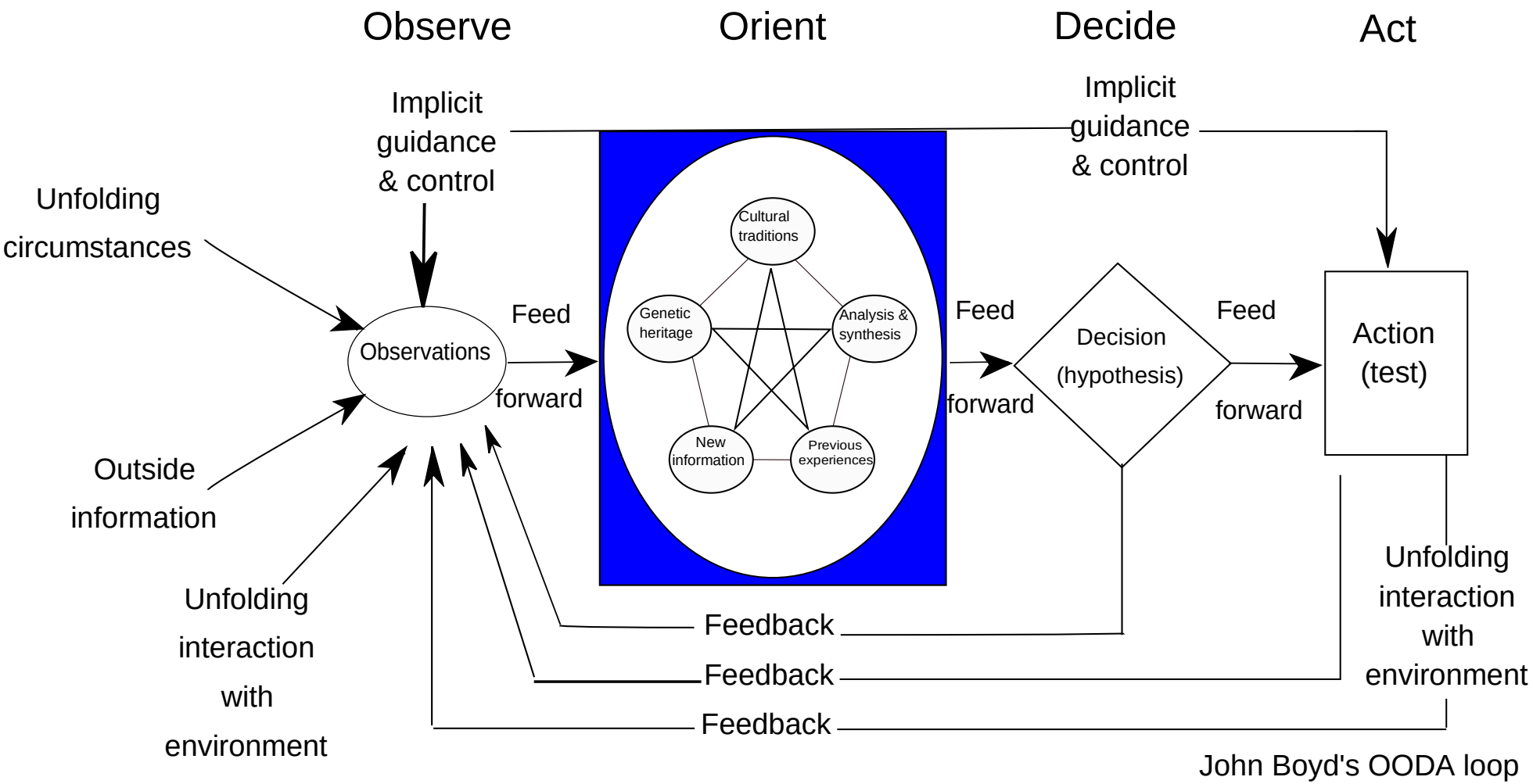

$t = 0$
$t = 1$
$t = 2$
$t = 3$
$t = 4$
S_0^n
S_1^n
Phase 1
A rings, i proceeds
Phase 2
A rings, i intends A
$(\acute{A}, A^*)$ $(\acute{A}, B^*)$ $(\acute{B}, A^*)$ $(\acute{B}, B^*)$
S_0^i
S_1^i
Hear A
Hear B
Phase 3: Plan - GET A
Phase 4: Act - GET A
CONSISTENT STATES (Hear A)
INCONSISTENT STATES (Hear B)
$(A!, A^*)$
$(A!, B^*)$
(X, A^*)
(X, B^*)
Restart Phase 1
BEL(A*) > BEL(B*)
BEL(A*) < BEL(B*)


$t = 0$
$t = 1$
$t = 2$
$t = 3$
$t = 4$
S_0^n
S_1^n
S_2^0
Phase 1
A rings, i proceeds
Phase 2
A rings, i intends A
Phase 3
A rings, i plans A
$(\acute{A}, A^*)$ $(\acute{A}, B^*)$ $(\acute{B}, A^*)$ $(\acute{B}, B^*)$
Phase 4: Act - GET A
S_0^i
S_1^i
S_2^i
$(\acute{A}, A^*)$ $(\acute{A}, B^*)$
$(\acute{B}, A^*)$ $(\acute{B}, B^*)$
Hear A
Hear B
$(A!, A^*)$
$(A!, B^*)$
(X, A^*) (X, B^*)

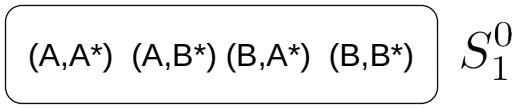

S_1^0
(A,n) (B,n) (A,y) (B,y)
Plan:
Get A
Act:
Get A
(A,n) (B,n) (A,y) (B,y)
BELIEVE A > B
S_1^1
X
(A,n) (A,y) (B,y)
Consistent: BELIEVE A > B
(A,n) (A,y) (B,y)
A obtained
(A,n) (B,n) (A,y) (B,y)
Disrupted: BELIEVE B > A


Plan:
Get A
S_2^0
S_1^0
(A,n) **(B,n)** (A,y) (B,y)
Act:
Get A
S_1^1
(A,n)
(A,y)
(B,y)
Consistent: BELIEVE A > B
(A,n)
(A,y)
(B,y)
A obtained

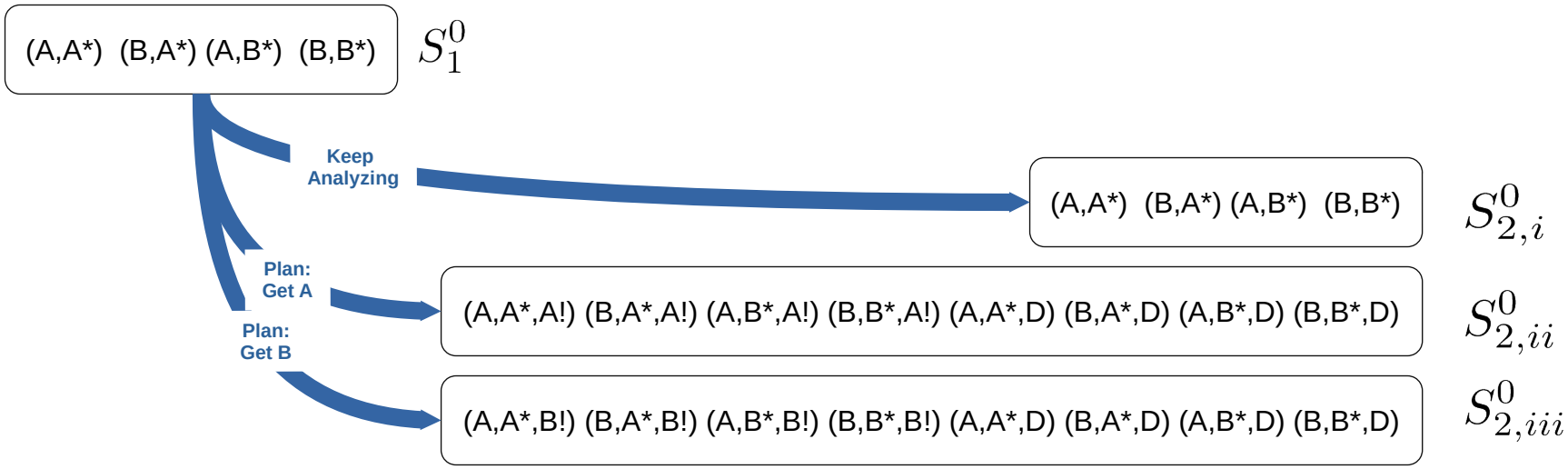

Plan:
Get A
Act:
Get A
S_1^0
S_2^0
S_3^0
(A,n) (B,n) **(A,y)** (B,y)
S_3^0
S_1^1
S_2^1
(A,n)
(A,y)
(B,y)
S_3^1
Consistent: BELIEVE A > B

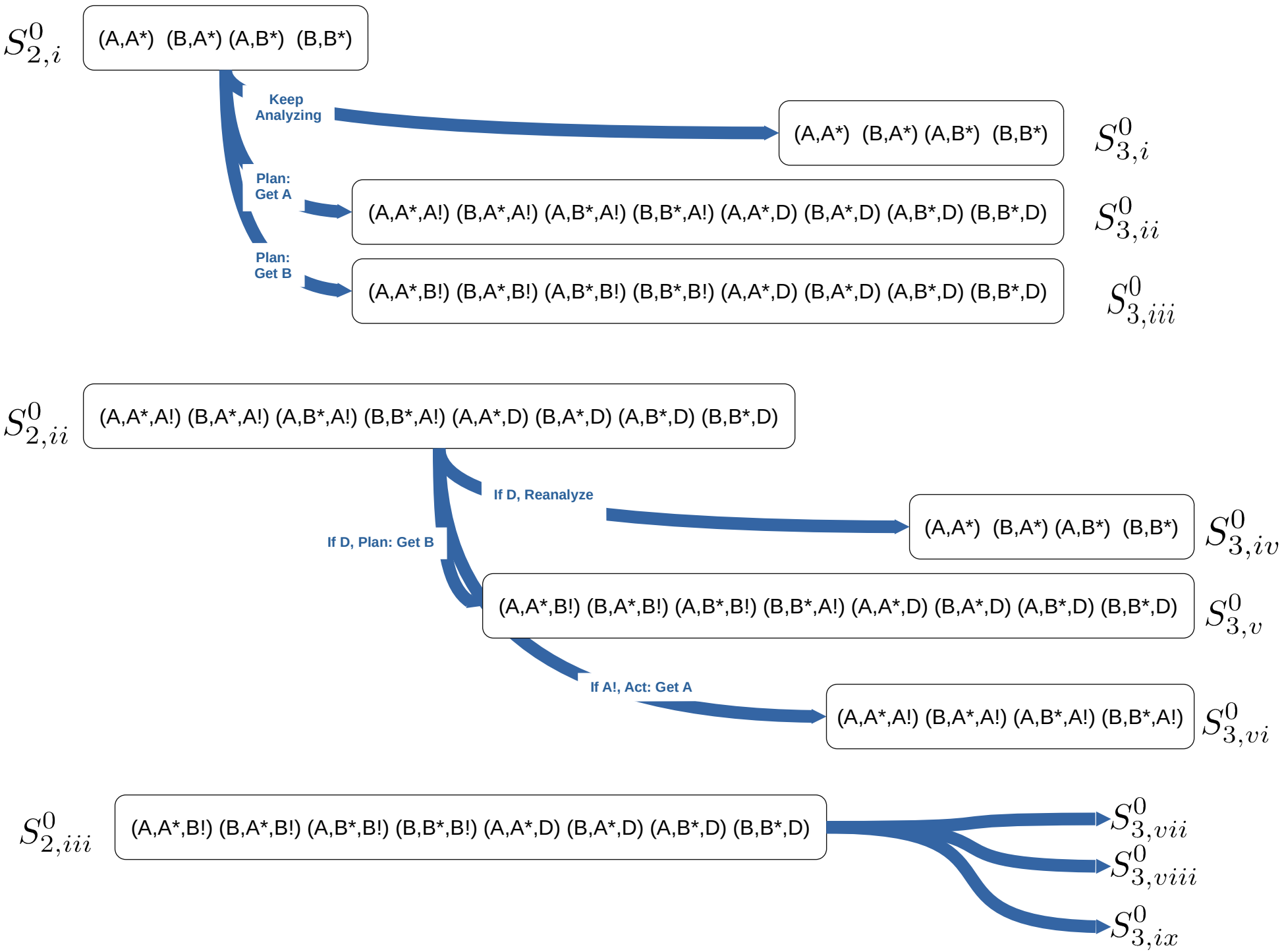


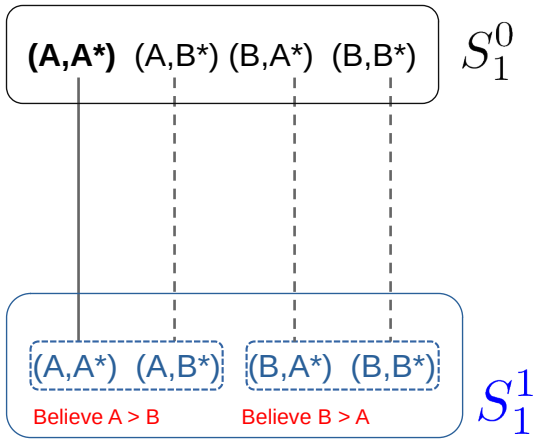
John Boyd's OODA loop



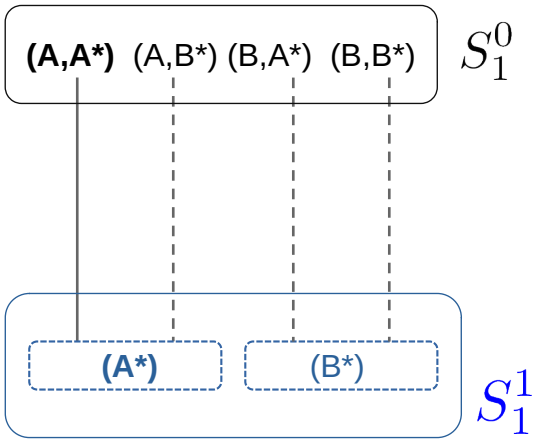
S_1^0

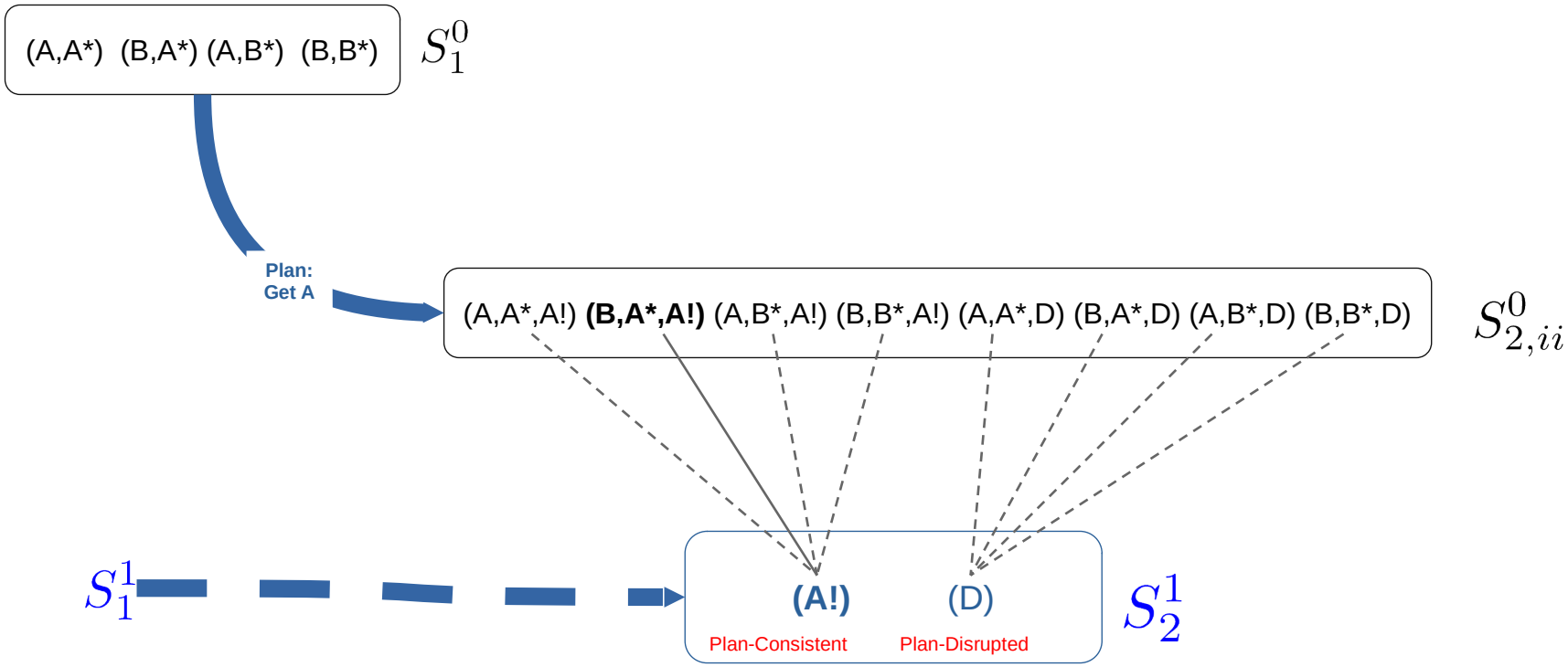

(A,A*) (B,A*) (A,B*) (B,B*)
S_1^0
Keep Analyzing
(A,A*) (B,A*) (A,B*) (B,B*)
$S_{2,i}^0$
Plan: Get A
(A,A*,A!) (B,A*,A!) (A,B*,A!) (B,B*,A!) (A,A*,D) (B,A*,D) (A,B*,D) (B,B*,D)
$S_{2,ii}^0$
Plan: Get B
(A,A*,B!) (B,A*,B!) (A,B*,B!) (B,B*,B!) (A,A*,D) (B,A*,D) (A,B*,D) (B,B*,D)
$S_{2,iii}^0$

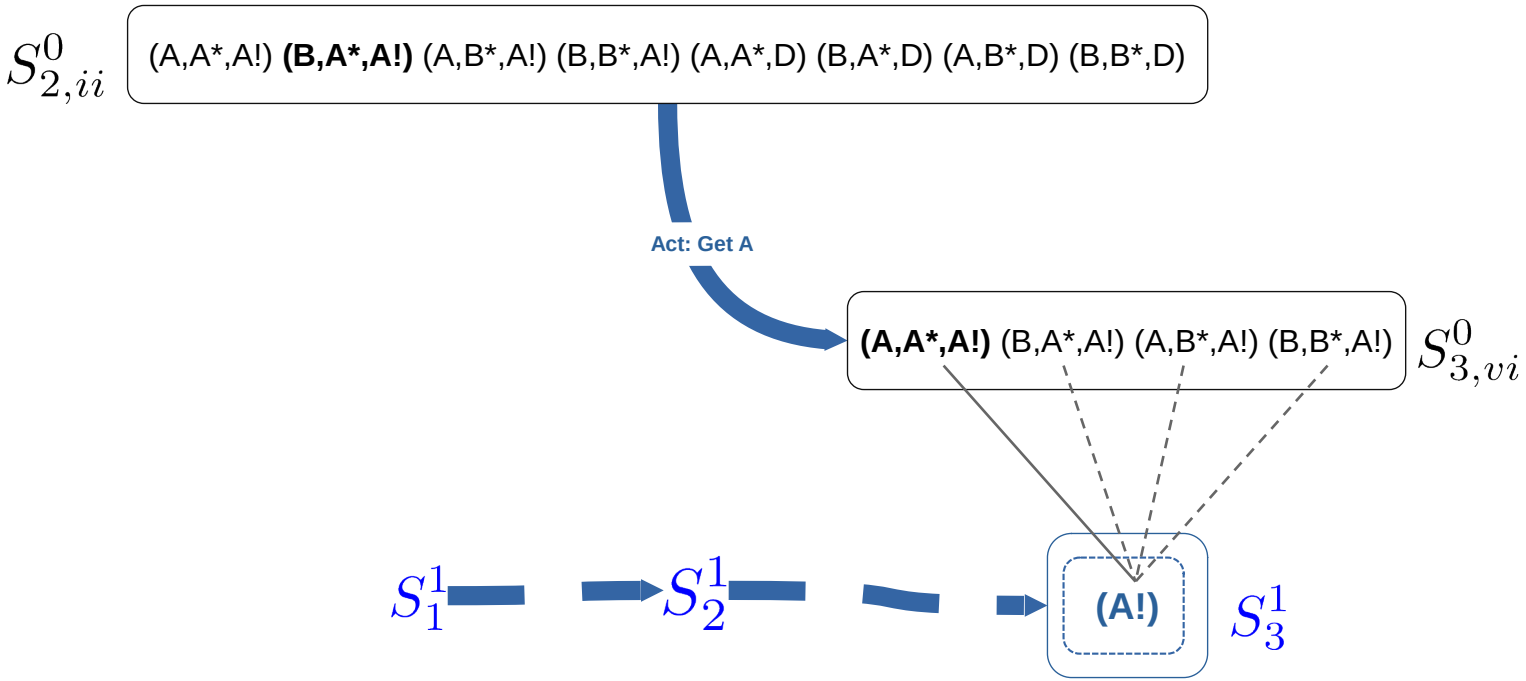

$S^0_{2,i}$
(A,A*) (B,A*) (A,B*) (B,B*)
Keep Analyzing
(A,A*) (B,A*) (A,B*) (B,B*)
$S^0_{3,i}$
Plan: Get A
(A,A*,A!) (B,A*,A!) (A,B*,A!) (B,B*,A!) (A,A*,D) (B,A*,D) (A,B*,D) (B,B*,D)
$S^0_{3,ii}$
Plan: Get B
(A,A*,B!) (B,A*,B!) (A,B*,B!) (B,B*,B!) (A,A*,D) (B,A*,D) (A,B*,D) (B,B*,D)
$S^0_{3,iii}$
$S^0_{2,ii}$
(A,A*,A!) (B,A*,A!) (A,B*,A!) (B,B*,A!) (A,A*,D) (B,A*,D) (A,B*,D) (B,B*,D)
If D, Reanalyze
(A,A*) (B,A*) (A,B*) (B,B*)
$S^0_{3,iv}$
If D, Plan: Get B
(A,A*,B!) (B,A*,B!) (A,B*,B!) (B,B*,A!) (A,A*,D) (B,A*,D) (A,B*,D) (B,B*,D)
$S^0_{3,v}$
If A!, Act: Get A
(A,A*,A!) (B,A*,A!) (A,B*,A!) (B,B*,A!)
$S^0_{3,vi}$
$S^0_{2,iii}$
(A,A*,B!) (B,A*,B!) (A,B*,B!) (B,B*,B!) (A,A*,D) (B,A*,D) (A,B*,D) (B,B*,D)
$S^0_{3,vii}$
$S^0_{3,viii}$
$S^0_{3,ix}$


(A,A*) (A,B*) (B,A*) (B,B*)
S_1^0
(A,A*) (A,B*)
(B,A*) (B,B*)
Believe A > B
Believe B > A
S_1^1

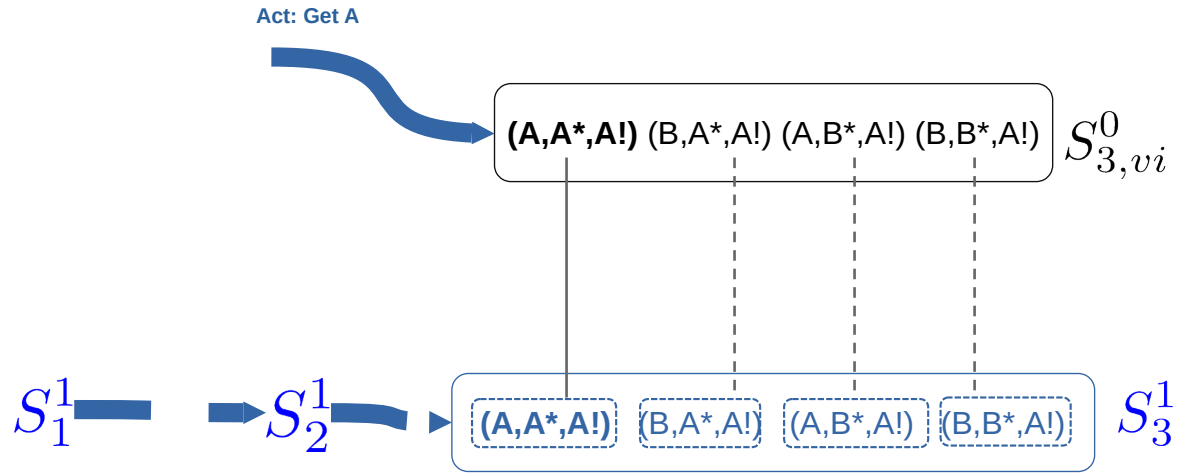
- OR -

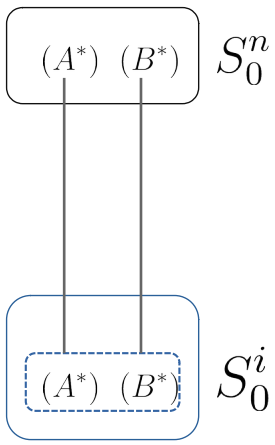

(A,A*) (A,B*) (B,A*) (B,B*)
S_1^0
(A*)
(B*)
S_1^1


(A,A*) (B,A*) (A,B*) (B,B*)
S_1^0
Plan:
Get A
(A,A*,A!) **(B,A*,A!)** (A,B*,A!) (B,B*,A!) (A,A*,D) (B,A*,D) (A,B*,D) (B,B*,D)
$S_{2,ii}^0$
S_1^1
(A!)
(D)
Plan-Consistent
Plan-Disrupted
S_2^1

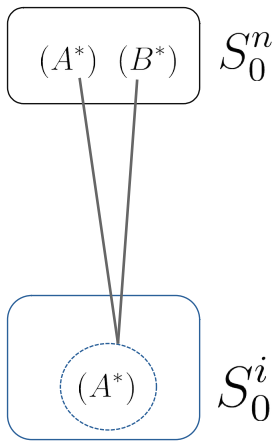

$S^0_{2,ii}$
(A,A*,A!) **(B,A*,A!)** (A,B*,A!) (B,B*,A!) (A,A*,D) (B,A*,D) (A,B*,D) (B,B*,D)
Act: Get A
(A,A*,A!) (B,A*,A!) (A,B*,A!) (B,B*,A!)
$S^0_{3,vi}$
S^1_1
S^1_2
(A!)
S^1_3

- OR -

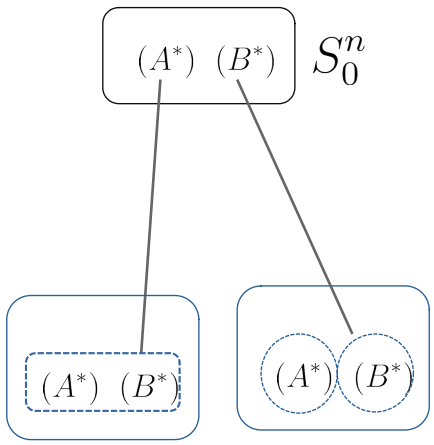

Act: Get A
(A,A*,A!) (B,A*,A!) (A,B*,A!) (B,B*,A!)
$S^0_{3,vi}$
S^1_1
S^1_2
(A,A*,A!)
(B,A*,A!)
(A,B*,A!)
(B,B*,A!)
S^1_3



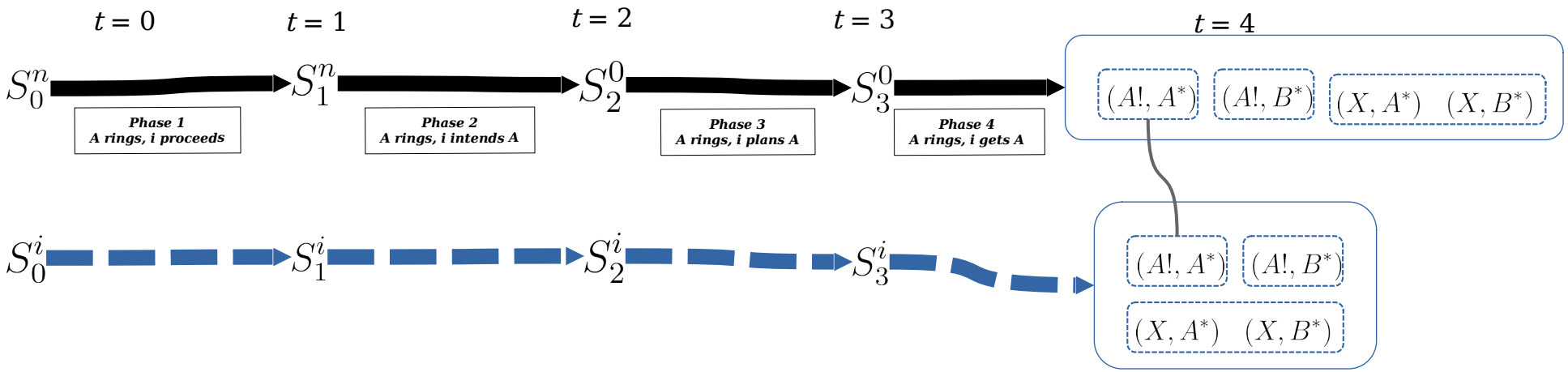
(a)

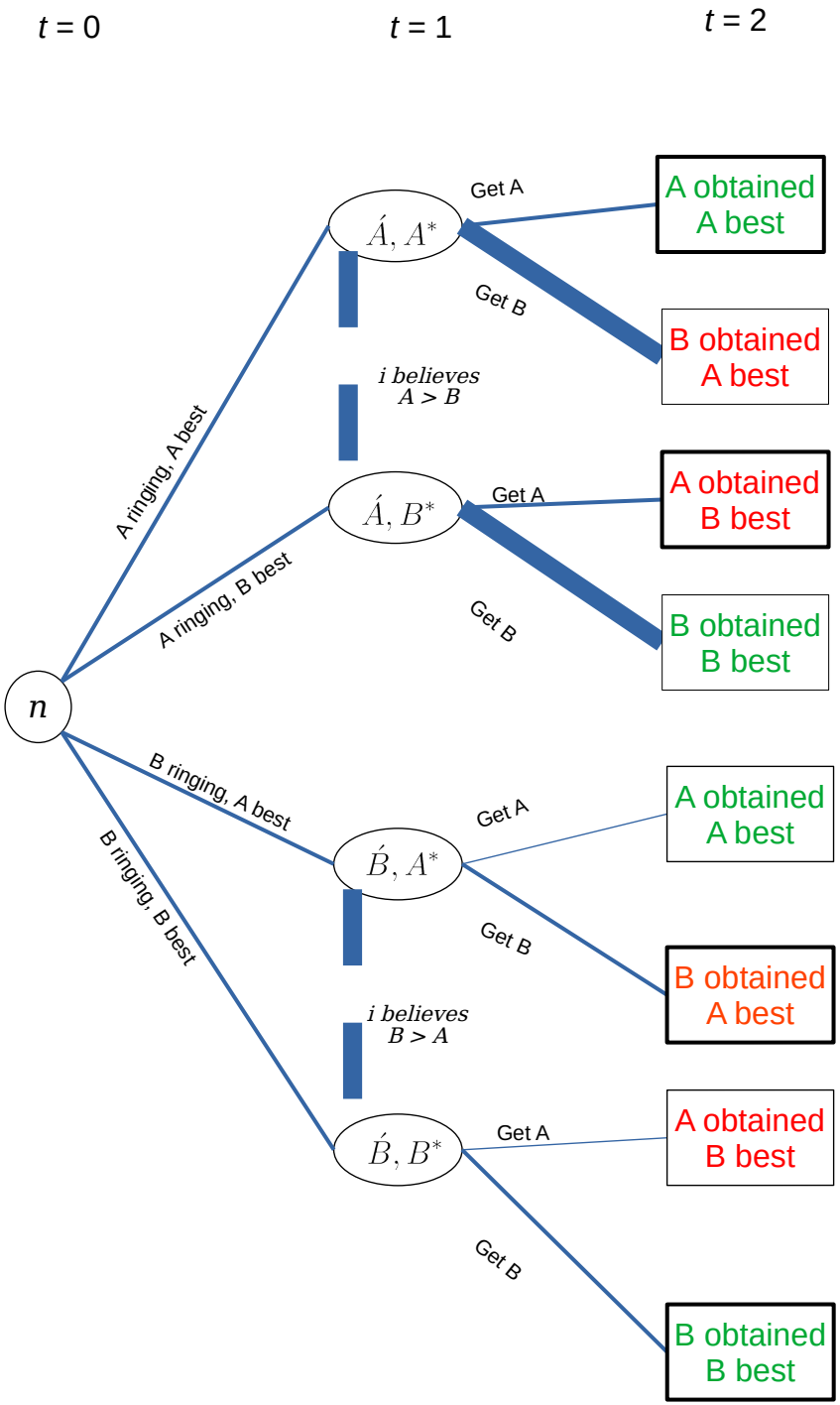


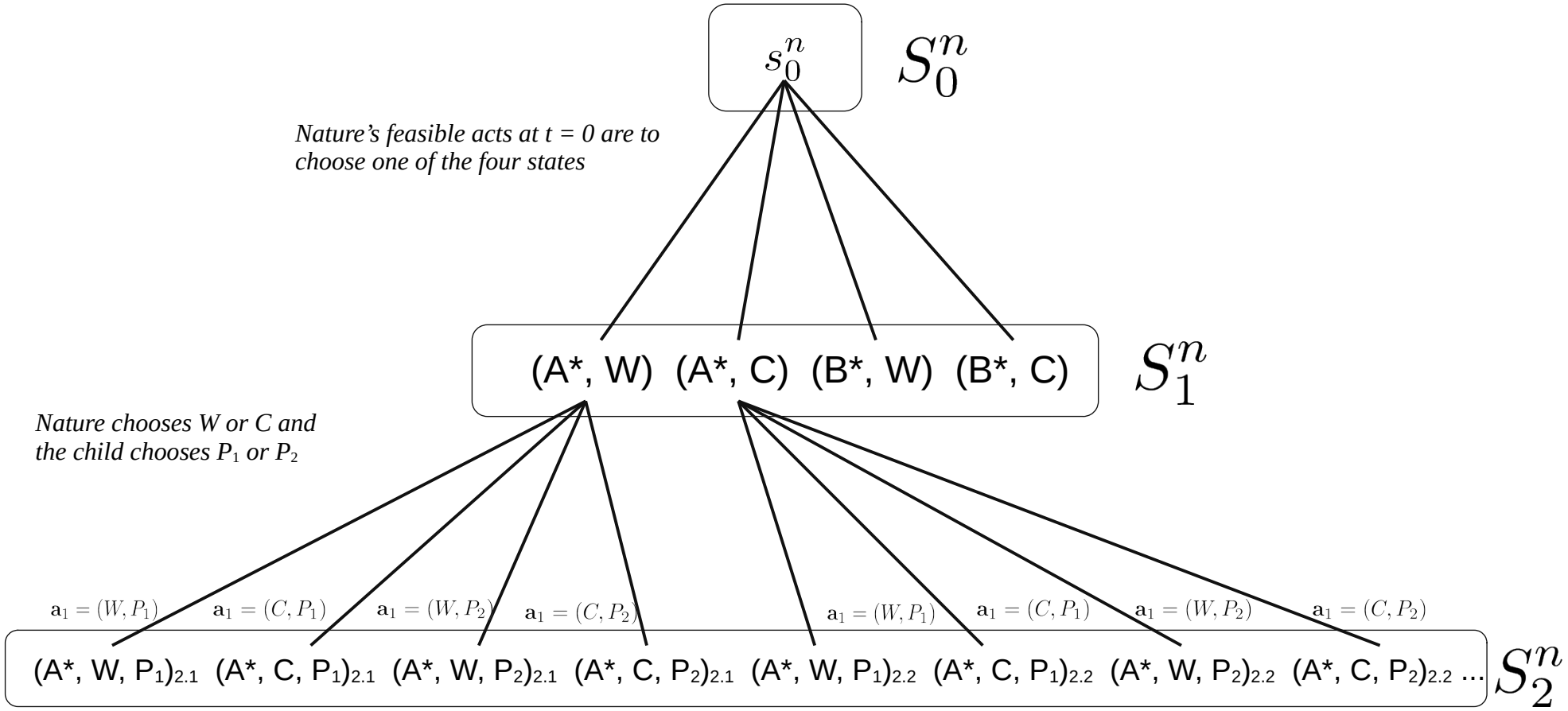
(b)

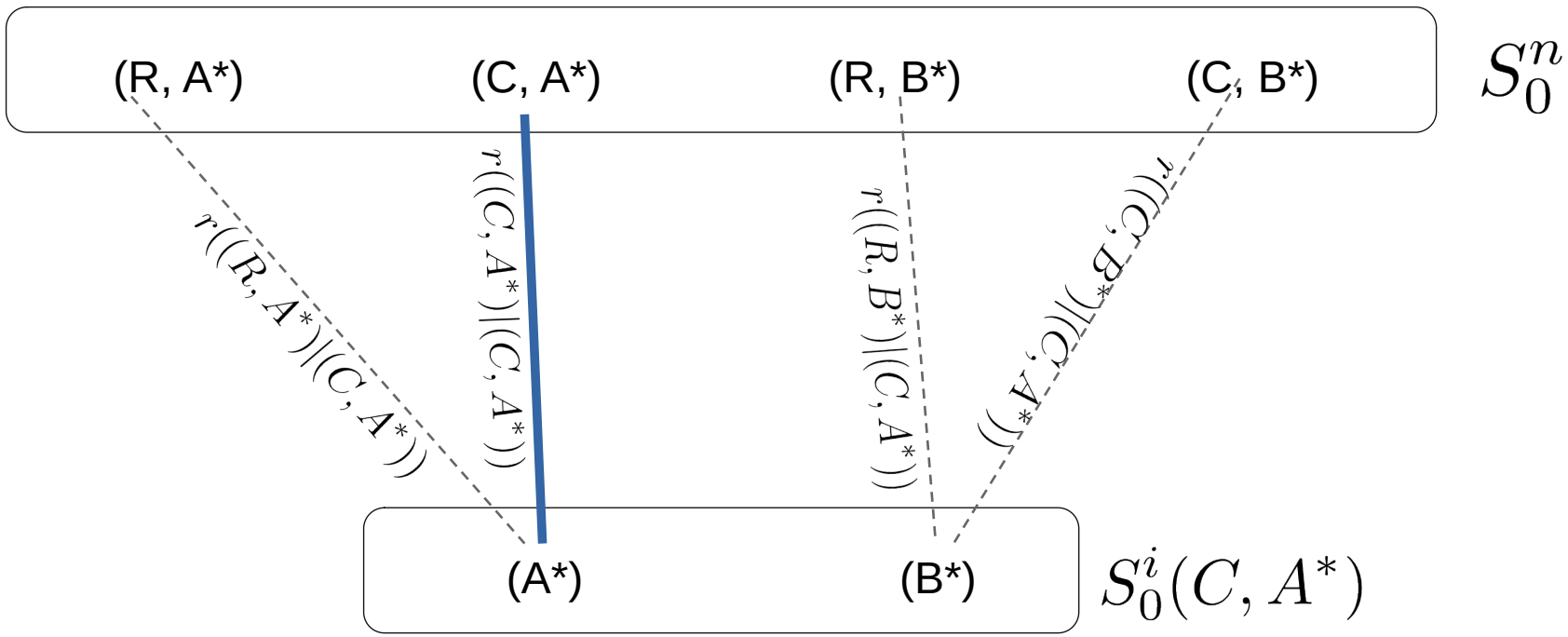


(c)


$t = 0$
$t = 1$
$t = 2$
$t = 3$
$t = 4$
S_0^n
S_1^n
S_2^0
S_3^0
Phase 1
A rings, i proceeds
Phase 2
A rings, i intends A
Phase 3
A rings, i plans A
Phase 4
A rings, i gets A
$(A!, A^*)$
$(A!, B^*)$
(X, A^*) (X, B^*)
S_0^i
S_1^i
S_2^i
S_3^i
$(A!, A^*)$
$(A!, B^*)$
(X, A^*) (X, B^*)


t = 0
t = 1
t = 2
n
A ringing, A best
A ringing, B best
B ringing, A best
B ringing, B best
Á, A*
Á, B*
B́, A*
B́, B*
i believes A > B
i believes B > A
Get A
Get B
A obtained A best
B obtained A best
A obtained B best
B obtained B best
A obtained A best
B obtained A best
A obtained B best
B obtained B best


s_0^n
S_0^n
Nature's feasible acts at t = 0 are to choose one of the four states
(A*, W) (A*, C) (B*, W) (B*, C)
S_1^n
Nature chooses W or C and the child chooses P_1 or P_2
$\mathbf{a}_1 = (W, P_1)$
$\mathbf{a}_1 = (C, P_1)$
$\mathbf{a}_1 = (W, P_2)$
$\mathbf{a}_1 = (C, P_2)$
$\mathbf{a}_1 = (W, P_1)$
$\mathbf{a}_1 = (C, P_1)$
$\mathbf{a}_1 = (W, P_2)$
$\mathbf{a}_1 = (C, P_2)$
(A*, W, P1)2.1 (A*, C, P1)2.1 (A*, W, P2)2.1 (A*, C, P2)2.1 (A*, W, P1)2.2 (A*, C, P1)2.2 (A*, W, P2)2.2 (A*, C, P2)2.2 ...
S_2^n


(R, A*)
(C, A*)
(R, B*)
(C, B*)
S_0^n
$r((R,A^*)|(C,A^*))$
$r((C,A^*)|(C,A^*))$
$r((R,B^*)|(C,A^*))$
$r((C,B^*)|(C,A^*))$
(A*)
(B*)
$S_0^i(C,A^*)$