ASSIGNMENT 3

TASK 1

(a) From the table, we can see that in all the scenarios where KB is true, S1 is true.

So,

$$KB \models S_1$$

(b) From the table, we can see that there is atleast one scenario where not (KB) is true [KB is False] but not (S1) is false [S1 is True]

So,

$$\text{not}(KB) \not\models \text{not}(S_1)$$

Task 2

The given scentence meets our criteria

not (A ∧ not B ∧ not C ∧ D) ∧
not (not A ∧ B ∧ C ∧ not D)

Convert to CNF

De morgans

(not A or not (not B) or not (not C) or not D) ∧
(not (not A) or not B or not C or not (not D))

D.N

(not A or B or C or D) ∧
(A or not B or not C or D)

Which is in CNF.

Task 3

(i) Convert to Horn Form

KB

$A \Rightarrow B$

$B \Rightarrow A$

$A \Rightarrow C$

$D \Rightarrow E$

$C \wedge E \Rightarrow F$

B

D

α

F

Forward Chaining

$$\frac{B \Rightarrow A,\ B}{A}$$

$$\frac{A \Rightarrow C,\ A}{C}$$

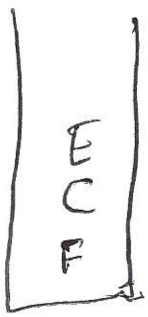
$$\frac{D \Rightarrow E,\ D}{E}$$

$$\frac{C \wedge E \Rightarrow F,\ C,\ E}{F}$$

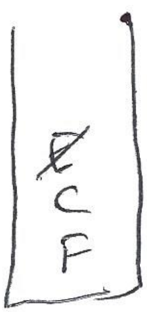
So $KB \models \alpha$

(ii) Backward Chaining

Consider $C \wedge E \Rightarrow F$

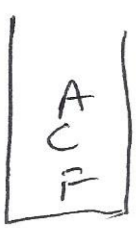


Consider $D \Rightarrow E$, D is true



$$\frac{D \Rightarrow E \quad , \quad D}{E}$$

Consider $A \Rightarrow C$



Consider $B \Rightarrow A$, B is true

$\boxed{\begin{array}{c} \cancel{A} \\ C \\ F \end{array}}$ $\qquad \dfrac{B \Rightarrow A \qquad B}{A}$

$\boxed{\begin{array}{c} \cancel{C} \\ F \end{array}}$ $\qquad \dfrac{A \Rightarrow C \qquad A}{C}$

$\boxed{\begin{array}{c} \cancel{F} \end{array}}$ $\qquad \dfrac{C \wedge E \Rightarrow F \qquad C, F}{F}$

So.

$$KB \models \alpha$$

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Convert to CNF

KB	α
$\neg A \lor B$	F
$\neg B \lor A$	
$\neg A \lor C$	
$\neg D \lor E$	So $\neg\alpha$
$\neg C \lor \neg E \lor F$	$\neg F$
B	
D	

RESOLUTION

$$\frac{\neg C \lor \neg E \lor F \qquad \neg F}{\neg C \lor \neg E} \qquad\qquad \frac{\neg C \lor \neg E \qquad \neg D \lor E}{\neg C \lor \neg D}$$

$$\frac{\neg C \lor \neg D \qquad D}{\neg C} \qquad\qquad \frac{\neg C \qquad \neg A \lor C}{\neg A}$$

$$\frac{\neg A \qquad \neg B \lor A}{\neg B} \qquad\qquad \frac{\neg B \qquad B}{=}$$

So $KB \models \alpha$

TASK 4

CONSTANTS:

(a) May1 - May 1 2020

John - John the person

Mary - Mary the person

PREDICATES:

Rains(x) - It rains on X

GaveChk(x, y) - X gave y a check for $10K

Mow(x) - x mows lawn.

(a)

Rains(May1) $\Rightarrow$ GaveChk(John, Mary)

Mow(Mary) $\Leftarrow$ GaveChk(John, Mary)

(b)

$\neg$ Rains(May1)

GaveChk(John, Mary)

Mow(Mary)

(c)

Symbols

Rains(May1) - R_1

Rains(John) - R_J

Rains(Mary) - R_M

GaveChk(John, Mary) - G_J_M

GaveChk(John, John) - G_J_J

GaveChk(John, May1) - G_J_1

CareChk(Mary, Mary) - G_M_M

CareChk(Mary, John) - G_M_J

CareChk(Mary, May1) - G_M_1

CareChk(May1, Mary) - G_1_M

CareChk(May1, John) - G_1_J

CareChk(May1, May1) - G_1_1

Mow(May1) = M_1

Mow(Mary) = M_M

Mow(John) = M_J

Part a

R_M ⇒ G_J_M

M_M ⇔ G_J_M

Pat b

¬R_1

G_J_M

M_M

d)

In all the scenarios where the events ~~Contract~~ is ~~true~~ ($R\_I = F$, $G\_J\_M = T$, $M\_M = T$)

the contract is also true.

So

Events $\models$ Contract

So

Contract is Not Violated.

Task 5

PREDICATES

InP1 (x) – x is in P1

InP2 (x) – x is in P2

IsBlue (x) – x is Blue

IsRed (x) – x is Red.

CONSTANTS

M1, M2, M3, M4, M5, M6 – Marbles.

INITIAL STATE

IsRed(M1) ∧ IsRed(M2) ∧ IsRed(M3) ∧ IsBlue(M4) ∧ IsBlue(M5) ∧ IsBlue(M6) ∧ InP1(M1) ∧ InP1(M2) ∧ InP1(M3) ∧ InP2(M4) ∧ InP2(M5) ∧ InP2(M6)

ACTIONS

Move12R(x, y)

PRE: $InP1(x) \wedge InP1(y) \wedge IsRed(x) \wedge IsRed(y)$

EFF: $\neg InP1(x) \wedge \neg InP1(y) \wedge InP2(x) \wedge InP2(y)$

Move12B(x, y)

PRE: $InP1(x) \wedge InP1(y) \wedge IsBlue(x) \wedge IsBlue(y)$

EFF: $\neg InP1(x) \wedge \neg InP1(y) \wedge InP2(x) \wedge InP2(y)$

Move21(x, y)

PRE: $InP2(x) \wedge InP2(y) \wedge IsRed(x) \wedge IsBlue(y)$

EFF: $\neg InP2(x) \wedge \neg InP2(y) \wedge InP1(x) \wedge InP1(y)$

GOAL

InP1(M4) ∧ InP1(M5) ∧ InP1(M6) ∧
InP2(M1) ∧ InP2(M2) ∧ InP2(M3)

COMPLETE PLAN

Move12R(M1, M2)
Move21 (M1, M4)
Move 21 (M2, M5)
Move 12R(M1, M2)
Move 21 (M1, M6)
Move 12R(M1, M3)

TASK 6

Number of arguments per predicate : $[1 \quad 4]$
Number of constants : 3
Number of assignments per predicate : $[3^1 \quad 3^4]$
For all predicates : $[3^1 \times 5 \quad 3^4 \times 5]$

$[15 \quad 405]$

Number of possible unique states (defined by number of true predicates) : $[2^{15} \quad 2^{405}]$

TASK 7

EXEC. MONITORING

No changes are made to actions. During planning part we treat the problem as though it is deterministic.

CONDITIONAL PLANNING

The following changes are made:

MOVE12R(x, y)

PRE: $INP1(x) \wedge INP1(y) \wedge ISRED(x) \wedge ISRED(y)$

EFF: $(\neg INP1(x) \wedge \neg INP1(y) \wedge INP2(x) \wedge INP2(y))$

$\vee (\neg INP1(x) \wedge INP2(x)) \vee (\neg INP1(y) \wedge INP2(y))$

Move12B(x,y)

<u>PRE</u>: $InP1(x) \wedge InP1(y) \wedge IsBlue(x) \wedge IsBlue(y)$

<u>EFF</u>: $\left(\neg InP1(x) \wedge \neg InP1(y) \wedge InP2(x) \wedge InP2(y)\right) \vee$

$\left(\neg InP1(x) \wedge InP2(x)\right) \vee \left(\neg InP1(y) \wedge InP2(y)\right)$

Move21(x,y)

<u>PRE</u>: $InP2(x) \wedge InP2(y) \wedge IsRed(x) \wedge IsBlue(y)$

<u>EFF</u>: $\left(\neg InP2(x) \wedge \neg InP2(y) \wedge InP1(x) \wedge InP1(y)\right) \vee$

$\left(\neg InP2(x) \wedge InP1(x)\right) \vee \left(\neg InP2(y) \wedge InP1(y)\right)$