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Assignment 3

Task-1

Given,

A	B	C	KB	S1
True	True	True	True	True
True	True	false	false	True
True	false	True	True	True
True	false	false	False	True
false	True	True	False	False
false	True	false	false	False
false	false	True	True	True
false	false	false	False	false

Part a:-

The above information provided KB entails S1. Whenever knowledge Base is true then S1 Should be true. If this condition can Satisfies where KB ≠ S1. In the above table we can see the row 1, 3, 7 are the rows where, KB is true and S1 is true. Therefore KB entails S1.

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Part.B

According to the above information NOT(KB) does not entail NOT(S1). Because in the above provided information NOT(KB) is true in atleast one case where NOT(KB) $\neq$ NOT(S1), not(KB) should be true when ever not(S1) is true. So, N(KB) does not entails N(S1).

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Task 2

given the knowledge base contain various propositional logic sentences that utilize Symbol A, B, C, D and are only two cases when the knowledge given:-

first case: when A is true, B is false C is true, D is false. Second case:- when A is false and B is false C is true, D is true, where there are two cases below knowledge base.

A	B	C	D
True	False	True	false.

A	B	C	D
False	False	True	True.

All other known cases KB is true., and for the CNF we consider cases and base is false for which $\neg(A \wedge \neg B \wedge C \wedge \neg D) \wedge \neg(\neg A \wedge \neg B \wedge C \wedge D)$ for the above task we use Demorgan's law, CNF as follow is

$(\neg A \vee B \vee \neg C \vee D) \wedge$
$(A \vee B \vee \neg C \vee \neg D)$.

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Task: 3

Consider the KB:

(A⇒C) AND (B⇔C) AND (D⇒A)
AND E AND [(B AND E) ⇒ G] AND
(B ⇒ F) AND D.

While we take as the given equation we split them

A⇒C, B ⇔ C B⇒ and C⇒B
D ⇒ A, E, (B∧E) ⇒ G B ⇒ F D.

① forward chaining:-

For the forward chaining

(A⇒C) AND (B⇔C) AND (D⇒A)
AND E AND [(B AND E) ⇒ G] AND
(B ⇒ F) AND D.

$\frac{D \Rightarrow A,\ D}{A}$ added to KB

$\frac{A \Rightarrow C,\ A}{C}$ added to KB

$\frac{C \Rightarrow B,\ C}{B}$ added to KB

$\frac{(B \wedge E) \Rightarrow G,\ B,\ E}{G}$ added to KB

∴ KB ⊨ G (Knowledge base entails G)

(ii) Backward chaining :-

we push G to Stack first

| G | → then added B, E to the Stack

⇒

| B, E |
| G |

⇒ push C to the Stack.

| C |
| B, E |
| G |

⇒ push A to the Stack

| A |
| C |
| B, E |
| A |

→ push D to the Stack

| D |
| A |
| C |
| B, E |
| G |

Now

| ~~D~~ |
| A |
| C |
| B, E |
| G |

D is in Knowledge base

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

C
B, E
G

then

$$\frac{C,\ B \Rightarrow C \wedge C \Rightarrow B}{B}$$

~~B~~, E
G

E is in KB

E
G

$$\frac{B, E \cdot B \wedge E \Rightarrow G}{G}$$

G

∴ Knowledge base entails G

(iii) Resolution:-

given equation

$(A \Rightarrow C) \wedge (B \Leftrightarrow C) \wedge (D \Rightarrow A) \wedge E \wedge [(B \wedge E) \Rightarrow G] \wedge (B \Rightarrow F) \wedge D$

(a) Remove $\Leftrightarrow$

$(A \Rightarrow C) \wedge ((B \Rightarrow C) \wedge (C \Rightarrow B) \wedge (D \Rightarrow A) E \wedge [(B \wedge E) \Rightarrow G] \wedge (B \Rightarrow F) \wedge D$

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b) 'Replace ⇒'

$(\neg A \vee C) \wedge ((\neg B \vee C) \wedge (\neg C \vee B))$
$\wedge (\neg D \vee A) \wedge E \wedge [\neg(B \wedge E) \vee G]$
$\wedge (\cancel{A} \neg B \vee F) \wedge D$

c) move '¬'

$(\neg A \vee C) \wedge [(\neg B \vee C) \wedge (\neg C \vee B)] \wedge$
$(\neg D \vee A) \wedge E \wedge (\neg B \vee \neg E \vee G)$
$\wedge (\neg B \vee F) \wedge D$

d) Now by applying Demorgan's law

$(\neg A \vee C) \wedge (\neg B \vee C) \wedge (\neg C \vee B) \wedge (\neg D \vee A)$
$\wedge E \wedge (\neg B \vee \neg E \vee G) \wedge (\neg B \vee F) \wedge D$

Now add ¬ at G

$(\neg A \vee C) (\neg B \vee C) (\neg C \vee B) (\neg D \vee A)$
$(\neg B \vee \neg E \vee G) (\neg B \vee F) \wedge D \rightarrow G$

$\therefore$ KB F G

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Task-4

John and Mary sign the following contract. If it rains on Monday, then Jhon must give mary a check for $500 on Tuesday, and if a John gives mary a check for a $100 on Tuesday, Mary must mow the lawn on wednesday.

Part a:-

The first logic statement to Express the contract are

Rains(x) : rains on x day

gives(x,y) : x gives $100 to y

mow(x) : x mows lawn

Contract:-

for the contract of the above statement

Rains(monday) ⇒ gives100(John, mary)

Gives100(John, mary) ⇒ Mow(Mary)

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Part b:- The logical Statement what truely happened is when ~~use~~ possible, use the same predicates and constants ~~as~~ is
~7R (monday) - no rain on monday
Gives 100 (John, mary) where the Jhon gives $100 check to marry on Tuesday.
Mow (mary) - The mary needs ~~mow~~ mowed the lawn on wednesday.
So, the logic statement to Express what truely happened is
~ Rains (monday) ^ gives (Jhon, mary) ^ mow (mary)

Part c:-
The symbols required to convert any KB involved in the above domain from FOl to Propositional logic.

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S1 : RMY : Rains (mary)
S2 : RJ : Rain (John)
S3 : RMD : Rains (monday)
S4 : GJJ : Gives 100 (John, John)
S5 : GJMY : gives 100 (~~John~~, John, mary)
S6 : GJMD : gives 100 (John, monday)
S7 : GMYJ : Gives (Mary, Jhon)
S8 : GMYMY : gives 100 (mary, mary)
S9 : GMDMD : gives 100 (monday, monday)
S10 : GMDJ : gives 100 (monday, John)
S11 : GMDMY : gives 100 (monday, Mary)
S12 : GMYMD : gives 100 (marry, monday)
S13 : MJ : mow (John)
S14 : MMD : mow (monday)
S15 : MMY : mow (mary).

So, as the above information.

$\boxed{\begin{array}{l} S_3 \Rightarrow S_5, \\ S_5 \Rightarrow S_{14} \end{array}}$

Truly Happened Events are

$\boxed{\sim RMD \wedge GJMY \wedge MMY}$

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Part d:-

Was the contract violated or not, the answer to say is NO. We cannot find a Scenario where the events are true and contracts are false. Because there is no events where event entails contract and the contract is not violated. When the contract is true in all Events and based on the result the contract is not broken.

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Task: 5

(i) Taller (x, John); Taller (Bob, y)
So for the given unifers, Exits 'θ' for Sub Situation
$\theta = \{x/Bob, y/Jhon\}$.

(ii) Taller (y, mother(x)); Taller (Bob, Mother (Bob))
$\theta = \{x/Bob, y/Bob\}$

(iii) Taller (Sam, Mary), shorter (x, Sam)
For
a will return true for Sam to than mary
Sorter b will return true if returns for x is Shorter than Sam
∴ $\theta \{x/mary\}$

(iv) Shorter (x, Bob); Shorter (y, z)
$\{x/y, x/Bob\}$

(v) Shorter (Bob, Jhon); sort (x, marry)
For this, unifier doesn't Exists
∴

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Task: 6:-

=> 2 Adults A1, and A2 and 2 childrens C1 and C2 left side of the river.
A1 -> Adult 1, A2 -> Adult 2 and C1 -> Child 1 and C2 -> Child 2
C3 -> children 3.
B -> Boat and left, right.

Predicates:-

is Child (x) = x is child
is Boat (x) = x is Boat
On (x, y) = x is on y Bank.

Initial State:-

when we Initial state
On (A, left) ∩ on (A2, left) ∩ on (C1, left) ∩ on (C2, left) ∩ on (B, left) ∩ is child (C1) ∩ is child (C2) ∩ is Boat (B)

Actions:-

Actions to be considered are
-> move - 1 - left - to - right (x, y)

Pre cond:-

is Boat (y) ∩ on (x, left) ∩ on (y, left)

Effect:- on (x, Right) ∩ on (y, Right) ∩ -

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on (x, Right) ∧ on (y, Right) ∧
on (x, left) ∧ on (y, left).

move-1-Right-to-left (x, y)

Pre cond:-

is Boat (y) ∧ on (x, left) ∧
on (y, left)

Effect:-

on (x, Right) ∧ on (y, Right) ∧ on
(x, left) ∧ on (y, left)

→ move-2-left-to-Right (x, y, z)

Pre cond:-

is Boat (z) ∧ is child (y) ∧ on
(x, left) ∧ on (y, left) ∧ on (z, left)

Effect:-

On (x, Right) ∧ on (y, Right) ∧ on
(z, Right) ∧ on (x, left) ∧ non (y, left)
∧ non (z, left)

→ move-2-Right-to-left (x, y, z)

Pre cond:-

is Boat (z) ∧ is child (y) ∧
on (x, Right) ∧ on (y, Right) ∧ on (z, Right)

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Effect :-
on (x, left) ∧ on (y, left) ∧ on (z, left) ∧ non (x, Right) ∧ non (y, Right) ∧ non (z, Right)

Goal Test :-

on (A, Right) ∧ on (A2, left) ∧ on (A3, left) ∧ on (C1, Right) ∧ on (C2, Right) ∧ on (C3, Right)

~~A~~ complete plan looks like

move - 2 - left - to - Right (A, C1, B)
move - 1 - Right - to - left (C1, B),
move - 2 - Left - to - Right (A2, C2, B),
move - 1 - Right - to - left (C2, B)
move - 2 - left to - Right (A3, C3, B).
move - 1 - Right - to - left (C3, B)
move - 2 - left - to - Right (C1, C2, B).
move - 1 - Right - to - left (C1, B)
move - 2 - left - to - Right (C1, C3, B).

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Task : 2 :-

The problem for the previous task the modified actions that previously described to account for this if you were going to try and handle this Scenario by

(i) Execution monitoring / online Replaning
There will no change in actions For Execution monitoring that are used in previous task. If there a plan can be generated if and only if any a new plan can is place of old one

(ii) Conditional Planning :-

Move - 1 - left to Right (x, y)
Precondition :-
is Boat (y) ∧ on (x, left) ∧ on (y, left)
effect :- ⇒
L on (x, Right) ∧ on (y, Right) ∧ on (x, left) ∧ on (y, left)
∨ [on (x, left) ∧ on (y, left)]

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move - 1 - Right to left (x, y)

Pre-Condition :-
is Boat (y) $\cap$ on (x . right)
$\wedge$ on (x, right)
Effect
[on (x, left) $\wedge$ on (y, left) $\wedge$ on
(x, right) $\wedge$ on (y, right)]
$\cup$ [on (x, right) $\wedge$ on (y, right)]

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Task: 8

~~Supposing~~ Suppose that they are using PDDL to describe facts and actions in a certain world called JUNGLE world there are 5 constants, given that in JUNGLE there are 3 predicates where there are 1 to 4 arguments. and 15 constants are there so the possible arguments can be $3 \times 5^1 - 3 \times 5^4$ = ~~180~~ 15 - 1874 where the possible states - $[2^{15}\ 2^{1875}]$ from right