"Assignment 3"

Task 1:

S_1, S_2 logically equivelent.

$(S_1 \Leftrightarrow S_2) == (S_1 \Rightarrow S_2) \land (S_2 \Rightarrow S_1)$ } biconditional elimination

$(S_1 \Rightarrow S_2) == (\neg S_1 \lor S_2)$
$(S_2 \Rightarrow S_1) == (\neg S_2 \lor S_1)$ } implication.

```
public boolean check_Equivalence (KB1, KB2) {
    if (!KB1 || KB2) && (!KB2 || KB1)
        Return True

    else
        Return False

}
```

Task 28

(a) the Rule is $\boxed{KB \models S_1}$ [redacted] if KB is TRue that will lead to [redacted] . S_1 TRue as well.

so whenever KB [redacted] is TRue so $\boxed{\text{KB entail } S_1}$.

(b)

$\neg KB \models \neg(S_1)$?

As, we can see in table there are more than one case where KB is false so $\neg(KB)$ will be TRue and S_1 is TRue so, $\neg(S_1)$ will be False. Entailment

so Because $\underset{\text{TRue}}{KB} \not\models \underset{\text{False}}{S_1}$ Proprety Not meet for Row 2 and 4

so $\boxed{KB \not\models S_1}$

Task 3 :

First case : A True , B False, C True, D True.

$(A \land \neg B \land C \land D)$

Second case : $(\neg A \land \neg B \land C \land \neg D)$

$(A \land \neg B \land C \land D) \land (\neg A \land \neg B \land C \land \neg D)$

$\neg(A \land \neg B \land C \land D) \land \neg(\neg A \land \neg B \land C \land \neg D)$ } True

apply De-Morgan

$(\neg A \lor B \lor \neg C \lor \neg D) \land (A \lor B \lor \neg C \lor D)$

: this is CNF form.

Task 4 8

Forward chaining:

- Horn form

KB: $A \Rightarrow B$

$D \Rightarrow A$

$E \Rightarrow D$

$C \land E \Rightarrow F$

$B \Rightarrow C$

$C \Rightarrow B$

E

Keep apply "mp" until find $\underline{F}$

① use "mp"

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

② use "mp"

$$\frac{D \Rightarrow A \qquad D}{A}$$

③ use "mp"

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

$\alpha : F$

④ use "mp"

$$\frac{B \Rightarrow C \qquad B}{C}$$

⑤ $$\frac{C \land E \Rightarrow F \qquad C \qquad E}{\boxed{F}}$$

⑥ $$\frac{B \Rightarrow C \qquad B}{C}$$

already in KB
No Need to
add to KB

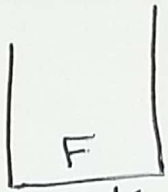
$\therefore \boxed{KB \models \alpha}$

ii- Backward Chaining :

Here we have Stack

α : F

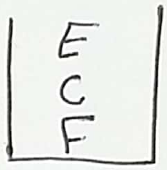
1) initially F will be in stack



Stack

So, we can get f from $C \land E \Rightarrow F$

(2) So, C, E will be in stack



(3) we can get C from $B \Rightarrow C$

So, B will add to stack

(4) E already TRUE.

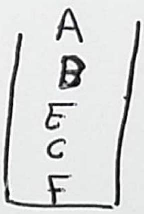
(5) we can get B fro $C \Rightarrow B$

But C already in stack

So, No overlap.

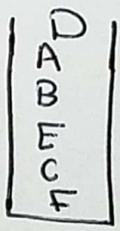
(6) we can get B from $A \Rightarrow B$

add A To stack



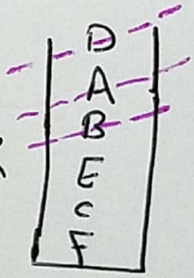
(7) we ~~can~~ can get A from $D \Rightarrow A$

Add D To stack



NOW we use "MP" and Remove from stack until get F

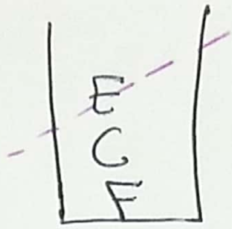
(1) can apply $\frac{E \Rightarrow D\ ,\ E}{D}$ Remove D from Stack



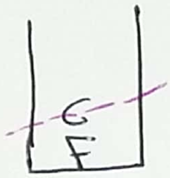
(2) " " $\frac{D \Rightarrow A\ ,D}{A}$ Remove A from stack

(3) " " $A \Rightarrow B\ ,\ A$ To get B Remove B from Stack

(4) Can apply imp To get E
Because E is TRue
So Remove it from
STack



(5) $\dfrac{B \Rightarrow C \;,\; B}{C}$



(6) $\dfrac{C \wedge E \Rightarrow F \;,\; C, E}{F}$

Empty Stack

So, $\boxed{KB \models F}$

iii- Resolution so

KBs

$A \Rightarrow B$

$B \Leftrightarrow C$

$D \Rightarrow A$

$E \Rightarrow D$

$C \wedge E \Rightarrow F$

E

convert to CNF form.

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

① Remove $(\Leftrightarrow)$

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

② Remove $(\Rightarrow)$

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

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

$$\underline{(\neg A \vee B)} \wedge \underline{(\neg B \vee C)} \wedge \underline{(\neg C \vee B)} \wedge \underline{(\neg D \vee A)} \wedge \underline{(\neg E \vee D)} \wedge \underline{(\neg C \vee \neg E \vee F)} \wedge \underline{E}$$ } CNF form

Lets assume $\neg F$ is entails

$\neg F$ $\neg C \vee \neg E \vee F$

$\neg C \vee \neg E$ $\neg B \vee C$

$\neg E \vee \neg B$ $\neg A \vee B$

$\neg E \vee \neg A$ $\neg D \vee A$

$\neg E \vee \neg D$ $\neg E \vee D$

$\neg E$ E

$\emptyset$

Not entail $\neg F$

so $\boxed{KB \models F}$

K5:

ⓐ constants:

john
May
Mary
[redacted]

Predicates:

Rain (x) : it Rain on "x" day
Check (x,y): x gives y check 10,000
Mow (y) : y will Mow the lawn

Rain(May) ⇒ Check(john, Mary)
Check (John, Mary) ⟺ Mow(Mary)

ⓑ logical statement

¬Rain (May) ∧ check(john, mary) ∧ Mow (mary)

ⓒ the symbols:

A - Rain(May)
B - check (john, john)
C - check(john, mary)
D - check(john, may)
E - check (mary, mary)
F - check (mary, john)
J - check (mary, May)
H - check(MAY, mary)
I - check(may, john)
g - check(may, may)
K - Rain (john)

L - Rain(mary)
[redacted]
M - Mow (May)
N - Mow (John)
K - Mow (Mary)

(d) (a)

$(A \Rightarrow C) \land (C \Leftrightarrow K)$

(b) $\neg A \land C \land K$

(e)

From Truly happen we can inference that Rain(May) NOT <u>TRue</u>, that will make our Statement TRue.

$$Rain(May) \Rightarrow Check(John, Mary)$$

$$F \Rightarrow T = \boxed{T}$$

also

$$Check(John, Mary) \Leftrightarrow Mow(Many)$$

$$T \Leftrightarrow T = \boxed{T}$$

So we can Se that contrast is Not <u>Violated</u>

Task 6:

① Taller(x, john), Shorter(John, Mary) { X/Mary }

② Taller(x, Mother(x)), Taller(Bob, y) { X/Bob , Y/Mother(Bob) }

③ Taller(x, y), Taller(Mother(Bob), Bob) { X/Mother(Bob) , Y/Bob }

④ shorter(Bob, mother(Bob)), Shorter(x, mother(y))

{ X/Bob , Y/Bob }

⑤ Shorter(Bob, x), Shorter(john, Mary) NOT unify.