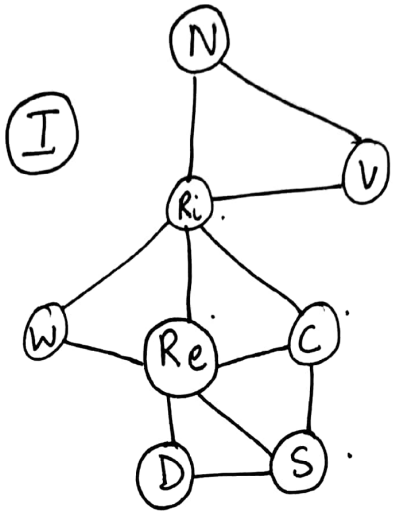
Artificial Intelligence - 1
Assignment - 5

NAME : ESHAN DANAYAKAPURA JAGADEESH
UTA ID : 1001667159

1. a).



b). Re — Degree heuristic = 5
MRV = 3

Ri — Degree heuristic = 5
MRV = 2

C — Degree heuristics = 3
MRV = 1

S — Degree heuristic = 3
MRV = 1

D — Degree heuristic = 2
MRV = 1

W Degree heuristic : 2
MRV = 1

V Degree heuristic = 2
MRV = 2

N Degree heuristic = 2
MRV = 1

I Degree heuristic = 0
MRV = 3

9. N = Green
R_i = Red
V = Blue
Re = Blue
C = Green
W = Green
S = Red
D = Green

I = Red

2). The Psuedocode is :

CHECK_EQUIVALENCE (KB1, KB2) returns True or False:
return TT-Entails? (KB1, KB2) and TT-Entails?(KB2, KB1)

3. a). Yes. KB entails S1 because in whichever case KB is true, S1 is also true and since S1 is also true in all worlds in which KB is true ∴ KB entails S1.

b). No. Statement NOT(KB) does not entail NOT(S1) because there are 2 cases where the NOT(KB) and NOT(S) are not same which are in case 2 and case 4 where they have different values and hence NOT(S1) is not same in all worlds in which NOT(KB) is true and hence NOT(KB) does not entail NOT(S1)

4).

	A	B	C	D	KB
1	True	True	True	True	False
2	True	True	True	False	True
3	True	True	False	True	True
4	True	True	False	False	True
5	True	False	True	True	True
6	True	False	True	False	False
7	True	False	False	True	True
8	True	False	False	False	True
9	False	True	True	True	True
10	False	True	True	False	True
11	False	True	False	True	True
	False	True	False	False	True
	False	False	True	True	True
	False	False	True	False	True
	False	False	False	True	True
13	False	False	False	False	True

From the truth table, the following statement can be derived from that:

$\sim(A \wedge B \wedge C \wedge D) \wedge \sim(A \wedge \sim(B) \wedge C \wedge \sim(D))$

CNF form =>

$(\sim A \vee \sim B \vee \sim C \vee \sim D) \wedge (\sim A \vee B \vee \sim C \vee D)$

5). $A \Leftrightarrow B$

$B \Rightarrow C$

$D \Rightarrow A$

C AND E $\Rightarrow$ F

E

D

Converting to horn form,

$A \Rightarrow B$ $\quad$ $B \Rightarrow A$

$B \Rightarrow C$ $\quad$ $D \Rightarrow A$

C AND E $\Rightarrow$ F

E

D

i). Forward chaining

Given D

Applying Modus Ponens (MP) to $D \Rightarrow A$

D gives A

Applying MP to $A \Rightarrow B$

A gives B

Applying MP to $B \Rightarrow C$

B gives C

Applying MP to C AND $E \Rightarrow F$

C AND E gives F

$\therefore$ KB $\vdash$ F

ii) Backward Chaining

Start with goal state F

Generating goal state (GS)

GS | F | using C AND E $\Rightarrow$ F

GS | C, E, F | using B $\Rightarrow$ C

E is already true

GS | B, C, E, F | using A $\Rightarrow$ B

GS | D, A, B, C, E, F | using D $\Rightarrow$ A

D is already true

Using MP, D $\Rightarrow$ A $\therefore$ A is true

Using MP, A $\Rightarrow$ B $\therefore$ B is true

Using MP, B $\Rightarrow$ C $\therefore$ C is true

Using MP, C AND E $\Rightarrow$ F $\therefore$ F is true

initially D and E are true

$\therefore$ KB $\vdash$ F

iii). Resolution :

Resolution Algorithm

$KB \wedge \neg \alpha$ is unsatisfiable

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

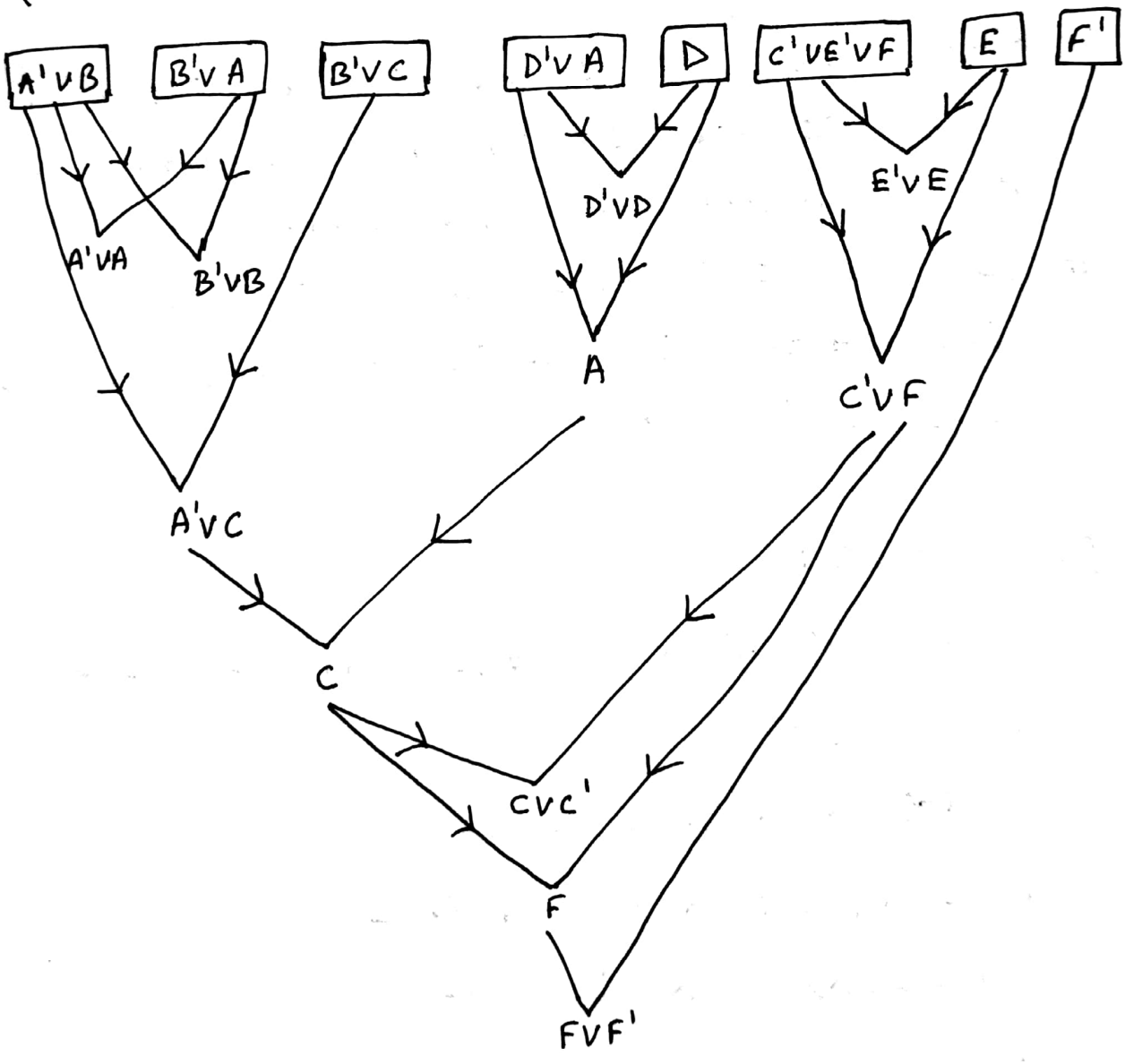
Eliminate $\Leftrightarrow$

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

Eliminate $\Rightarrow$

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

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



$\therefore KB \vdash F$ is true

Empty clause

6). A = Raining on May 1, 2017

B = John gives Mary a check of $10,000 on May 2, 2017

This can be written as Propositional statement as $(A \Rightarrow B)$

C = Mary must mow the lawn on May 3, 2017

$(B \Rightarrow C)$

Part (a) $(A \Rightarrow B) \wedge (B \Rightarrow C)$

Part (b) $\neg A \wedge B \wedge C$

Part (c) Yes contract was violated since even though it did not rain on May 1, 2017. John played $10,000 on May 2, 2017.

Hence contract is false and events are true

i.e $\neg A \Rightarrow B$ is false in contract, but event says it is true

7). Constants:

Shadow, John, Mary, Smartphone, Laptop

Predicates:

Dog (X) : X is a dog

Gave (X, Y, Z) : X gave Y to Z

Male (X) : X is male

Variables : X, Y, Z

Semantics :

- Dog (Shadow)

  Gave (John, shadow, Mary)

  Male (shadow) $\Rightarrow$ Gave (Mary, smartphone, John)

  $\neg$Male (shadow) $\Rightarrow$ Gave (Mary, laptop , John)

  $(\forall x)(\forall y)[\text{Gave}(\text{John}, x, y) \wedge \text{Day}(x) \wedge \text{Male}(x)]$

  Gave (Mary, Laptop , John)

8). - Taller (John, y) taller (x, Son (x))

  Unification $\{ x/\text{John}, y/\text{Son}(x) \}$

- Taller (y, Barry), taller (Barry, x)

  Unification $\{ x/\text{Barry}, y/\text{Barry} \}$

- Taller (x, Jane), taller (Bob, Jane)

  Unfication $\{ x/\text{bob} \}$

- Taller (Son(x), Jane), taller (Bob, Jane)

  Unfication fails for given predicate

- Taller (Barry, Jane), taller (x, y)

  Unification - $\{ x/\text{Barry}, y/\text{John} \}$