

MAAI past paper 2023

3)

b)

i.

Person has good health : H

Person has good sleep : S

Person has balanced diet : D

Person does exercise : E

"A person has good health if and only if the person has a good sleep and has a balanced diet."

$H \leftrightarrow (S \wedge D)$

"The person does not have a balanced diet, but he has good sleep."

$\neg D \wedge S$

"If a person does exercises, then it appears as having a balanced diet."

$E \rightarrow D$

"The person does exercise."

E

"Therefore, that person has good health."

H

ii.

$[H \leftrightarrow (S \wedge D)] \wedge [\neg D \wedge S] \wedge [E \rightarrow D] \wedge [E] \rightarrow H$

Methods that can check whether the argument is valid:

1. Truth Table
2. Inference rules
3. Equivalence
4. Conjunctive normal forms

iii.

③ cb) ~~Method~~ *Method of 11 substitutions with truth table*

iii) CNF means we can only have \wedge, \vee, \neg .
 \neg $\rightarrow, \leftrightarrow$. *After converting to CNF, we break the expression formed by the connective "AND".*

Converting to CNF \Rightarrow

1) $H \leftarrow S \wedge D$

$$\begin{aligned}
 &= [H \rightarrow (S \wedge D)] \wedge [(S \wedge D) \rightarrow H] \\
 &= [\neg H \vee (S \wedge D)] \wedge [\neg (S \wedge D) \vee H] \\
 &= [(\neg H \vee S) \wedge (\neg H \vee D)] \wedge [(\neg S \vee \neg D) \vee H]
 \end{aligned}$$

Combining $[\neg H \vee S] \wedge [\neg H \vee D] \wedge [\neg S \vee \neg D \vee H]$

Now, we have CNF's \Rightarrow

① $(\neg H \vee S)$ $\xrightarrow{\text{1}}$ one substitution and out goes out to

② $(\neg H \vee D)$ $\xrightarrow{\text{2}}$

③ $(\neg S \vee \neg D \vee H)$ $\xrightarrow{\text{3}}$ as required

2) $\neg D \wedge S$

④ $\neg D$ $\xrightarrow{\text{4}}$

⑤ S $\xrightarrow{\text{5}}$

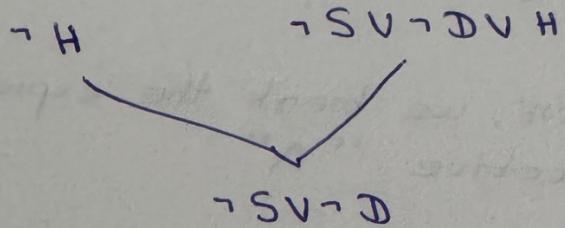
3) $E \rightarrow D$

$$\begin{aligned}
 &= \neg E \vee D \\
 &\textcircled{6} \quad \neg E \vee D \xrightarrow{\text{6}}
 \end{aligned}$$

4) $\textcircled{7} E \xrightarrow{\text{7}}$

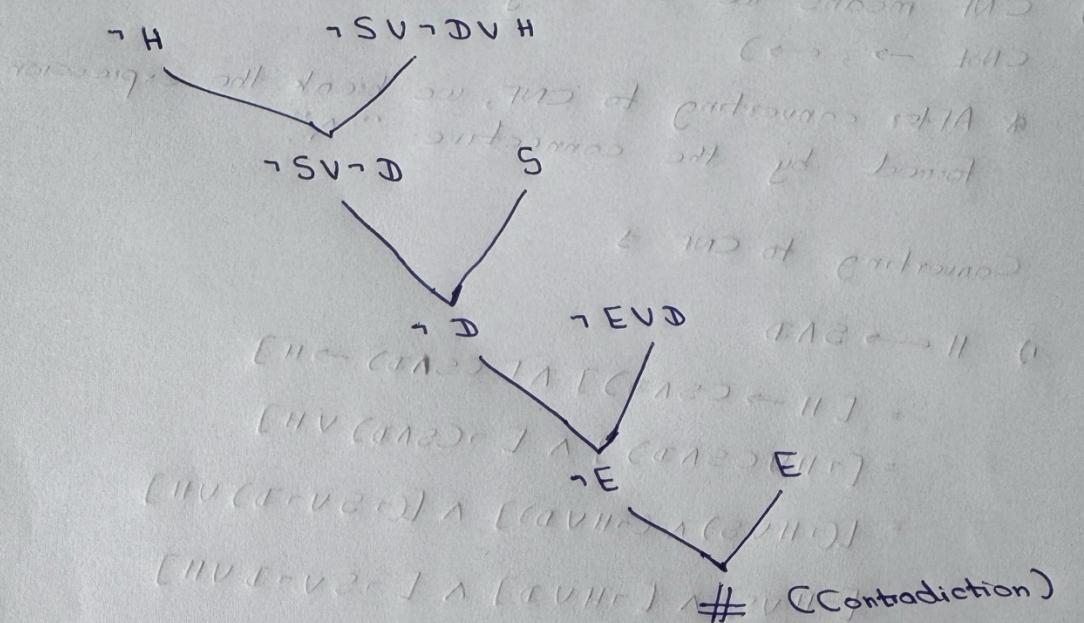
Assume that the conclusion, H is false.

$\therefore, \neg H$ is true



Assume that the conclusion, H is false.

$\therefore, \neg H$ is true



This contradicts, since E and $\neg E$ can't be true at the same time.

\therefore Assumption is false.

\therefore Conclusion is true

iv.

1. Standardization of Logic Representation:

CNF provides a uniform way to represent logical expressions, enabling algorithms to process information systematically and efficiently. This standardization is critical for tasks such as automated theorem proving and logic programming.

2. Efficient Problem Solving:

CNF simplifies logical formulas into a series of parts, making them easy to solve using proof systems. This makes it great for solving problems like constraint satisfaction and knowledge representation