

TUTORIAL – 1

(LOGIC)

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Problem-1

Which of the following sentences are valid (tautology), unsatisfiable, or neither.

(a) $(\text{Smoke} \rightarrow \text{Fire}) \rightarrow (\neg \text{Smoke} \rightarrow \neg \text{Fire})$

(b) $(\text{Smoke} \rightarrow \text{Fire}) \rightarrow ((\text{Smoke} \wedge \text{Heat}) \rightarrow \text{Fire})$

Problem-2

Prove the following logical deduction.

$$(\neg p \vee q) \rightarrow r$$

$$r \rightarrow (s \vee t)$$

$$\neg (s \vee u)$$

$$t \rightarrow u$$

$$q \leftrightarrow v$$

$$(v \wedge \neg w) \vee (\neg v \wedge w) \rightarrow \neg p$$

$$\therefore \quad \neg w$$

Problem-3

Encode and reason about the following.

If a scarcity of commodities develops, then the prices rise. If there is a change of government, then fiscal controls will not be continued. If the threat of inflation persists, then fiscal controls will be continued. If there is over-production, then prices do not rise. It has been found that there is over-production and there is a change of government. Therefore, neither the scarcity of commodities has developed, nor there is a threat of inflation.

Problem-4

Prove that:

$\forall x [P(x) \rightarrow (Q(x) \leftrightarrow R(x))]$ is equivalent to
 $[\forall x [(P(x) \wedge Q(x)) \rightarrow R(x)]] \wedge [\forall x [(P(x) \wedge R(x)) \rightarrow Q(x)]]$

Problem-5

Formalize the following sentences in first-order logic using only the following predicates.

$\text{love}(x, y) : x \text{ loves } y$

$\text{diff}(x, y) : x \text{ differs from } y$

- (a) There is at least one person who loves Mary.
- (b) There is exactly one person who loves Mary.
- (c) There is at most one person who loves Mary.

Problem-6

Translate the following into idiomatic/concise English statement:

$$\forall x [[H(x) \wedge \forall y \neg M(x, y)] \rightarrow U(x)]$$

where:

H(x): x is a man

M(x, y): x is married to y

U(x): x is unhappy

and x and y range over people.

Problem-7

Encode the following logical statements using predicate logic (formulate suitable predicate and function symbols as required), and conclude on the validity of the last statement.

No man who is a candidate will be defeated if he is a good campaigner. Any man who runs for office is a candidate. Any candidate who is not defeated will be elected. Every man who is elected is a good campaigner. Therefore, Any man who runs for office will be elected if and only if he is a good campaigner.



THANK YOU !

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