Lesson-1 Logic Statement, Connectives

- **Logic statements** A declarative sentence which can be either true or false, but not both is known as statement. It is also called a proposition.

What are "simple proposition"?
statements which cannot be broken down without a loss in meaning.

Examples of logic statements:
① The only the that divides 7 are 1 and itsef
② Earth is the only planet.
③ $2+3=5$.

Not logical statements : sentences which express wish, request or order.
ex: ① what a beautifu ~~coffe~~ morning !
② Get up and do your exercises.

LOGIC STATEMENTS

↓ Simple Statements
↓ which can not be further broken down

↓ Compound Statements
↓ can be further broken into simpler statements.

"The butterfly counts not months but moments, and has time enough." - Rabindranath Tagore

Simple Statements:

① Joe Biden is the current president of US

② $3+4=7$

③ Canberra is the capital of Australia

Compound Statements:

① 13 is a prime number and $5>6$

② Today is Friday & water is liquid

③ If Jonathan has a pet, then fish has lungs.

★ Connectives → connective, in logic, is a word or group of words that joins 2 or more propositions together to form a compound statement.

Symbol	Name	Function	Translation
$\sim$	tilde	negation	"it is not the case that"
&	ampersand	conjunction	"and"
$\vee$	wedge	disjunction	"or"
$\rightarrow$	arrow	conditional	"if... then.."
$\leftrightarrow$	double arrow	biconditional	"if and only if"

A	B	A&B	A∨B	A→B	A↔B
T	T	T	T	T	T
T	F	F	T	F	F
F	T	F	T	T	F
F	F	F	F	T	T

Lesson-2 Basic logic operations

(a) conjunction (AND) $P \wedge Q$

(b) ~~dg~~ disjunction (inclusive OR) $P \vee Q$

(c) implication (if p then q) $P \rightarrow q$

(d) biconditional (~~p~~ p if and only if q) $p \leftrightarrow q$
or (p iff q)

Lesson-3 Truth Tables

Truth tables show how the truth or falsity of a compound statement depends on the truth or falsity of the simple statements from which it's constructed.

Q construct truth table for $\neg P \wedge (P \rightarrow Q)$

P	Q	$\neg P$	$P \rightarrow Q$	$\neg P \wedge (P \rightarrow Q)$
T	T	F	T	F
T	F	F	F	F
F	T	T	T	T
F	F	T	T	T

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Q $(P \to Q) \land (Q \to R)$

P	Q	R	$P \to Q$	$Q \to R$	$(P \to Q) \land (Q \to R)$
T	T	T	T	T	T
T	T	F	T	F	F
T	F	T	F	T	F
T	F	F	F	T	F
F	T	T	T	T	T
F	T	F	T	F	F
F	F	T	T	T	T
F	F	F	T	T	T

Q conversion of statements to expressions

s: Sam goes out for walk t= moon is out
u: it is snowing.

$(t \land \sim u) \to s$ If moon is out and it is not snowing, then Sam will go out for a walk.

$(u \land \sim t) \to \sim s$ If it is snowing and the moon is not out, then sam will not go out for a walk.

s	t	u	$\sim s$	$\sim t$	$\sim u$	$t \land \sim u$	$(t \land \sim u) \to s$	$(u \land \sim t)$	$(u \land \sim t) \to \sim s$
T	T	T	F	F	F	F	T	F	T
T	T	F	F	F	T	T	T	F	T
T	F	T	F	T	F	F	T	T	F
T	F	F	F	T	T	F	T	F	T
F	T	T	T	F	F	F	T	F	T
F	T	F	T	F	T	T	F	F	T
F	F	T	T	T	F	F	T	T	T
F	F	F	T	T	T	F	T	F	T

"In order to succeed, your desire for success should be greater than your fear of failure." —Narendra Modi

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Lesson-4 Tautologies and Contradictions

- **Logical Equivalence** If two different propositions have the same truth values no matter what the truth values their constituent propositions have

p	q	$\sim p \vee q$	$p \to q$
T	T	T	T
T	F	F	F
F	T	T	T
F	F	T	T

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Since the truth values are same, hence the statements are logically equivalent.

Lesson-5

Validity of arguments An argument is a set of initial statements, called premises, ~~fto~~ followed by a conclusion.

An argument is valid if and only if and only if in every case where all the premises are true, the conclusion is true. Otherwise, the argument is invalid.

Lesson-6

Tautology · is an assertion of propositional logic that is true in all situations

- it is true for all possible values of its variables.

Contradiction · is an assertion of propositional logic that is false in all situations.

- It is false for all possible values of its variables.

*example of tautology:

P	Q	$P \to Q$	$Q \to P$	$(P \to Q) \vee (Q \to P)$
T	T	T	T	T
T	F	F	T	T
F	T	T	F	T
F	F	T	T	T

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* example of contradiction

P	Q	$\sim Q$	$P \wedge \sim Q$	$P \to Q$	$(P \to Q) \wedge (P \wedge \sim Q)$
T	T	F	F	T	F
T	F	T	T	F	F
F	T	F	F	T	F
F	F	T	F	T	F