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Symbolic Logic

This is a process of using (signs) symbols to represent propositions or statements. Symbolic logic involves general use of symbols rather than propositions. Such symbols are:

For Logical propositions p, q, r, s

For Connectives ie joining propositions, or showing relations b/w two propositions

($\supset$) implication eg. $p \supset q$, i.e. p implies q

($\cdot$) conjunction eg. $p.q$, i.e p and q

($-$) Negation eg. $-p$, ie. not p

($\vee$) Alternative eg. $p \vee q$, ie, either p or q

($\equiv$) Equivalence eg. $p \equiv q$, ie p is equal to q

$-(\cdot)$ Disjunction eg. $-(p.q)$ ie. neither p and q

Let us look at a syllogism

All men are mortal = All S is P or SaP

John is a man = R is S or RiS

Therefore John is mortal = ∴ R is P or RiP

All men are mortal can be symbolised as = All S is P or SaP; S stands for all men, while P stands for mortal. SaP means that it is a universal affirmative because a symbolises a universal affirmative proposition.

The sign $\supset$ is called a sign of implication that is to say when you see S, you expect P.

All S is P (All men are mortal)

What is a Proposition

A proposition is a statement or argument or fact that is either true or false. A proposition is a statement that is verified as either True or false. A proposition or statement is a verbal or written declarative sentence that is either true or false

Nwala (1997) "It usually contains two terms: a subject term and a predicate term joined by a copula (verb). The first term is the subject of which something is asserted. The second term is called a predicate. It asserts or says something about the subject"

Example: A My mother is a woman = T
Obi is a boy = T
10 + 10 + 5 = 25 = T
Nigerians are blacks = T
The earth is a planet = T

B My father is a handsome man = F
11 + 3 + V + 8 = 22 = F
3 + 4 + 5 = 8 = F
Hurray! = Exclamation = F
The moon is a satelite of the Sun = F

A truth statement has a truth value T, while a false statement has a truth value F.

There are three terms in a syllogism (subject predicate and a verb) Example in the statement Nigerians are blacks, the subjects is Nigerians, the predicate is blacks, while the verb is are

In the statement 10+10+5 = 25, the subject is 10 + 10 + 5, the predicate is 25, while the verb is =

Hurray! is an exclamation, not a ~~true~~ statement because it has no subject predicate or verb.

Are you a Nigerian? is a question and not a declarative sentence hence is a statement or proposition.

The moon is a satelite of the sun. This statement or proposition has a truth value of f though is a proposition but because science proved that the moon is the satelite of the earth. It earned this statement the truth value of f

3+4+5 = 8 This statement has a truth value of f because the summation of 3+4+5 = 12 and not 8

Types of Proposition

There are different types of proposition. The main types of propositions are:

Universal Affirmative = A All S is P = SaP
Universal Negative = E No S is P SeP
Particular Affirmative = I Some S are P SiP
Particular Negative = O Some S are not P SoP

All ~~animal~~ Yorubas are Nigerian SaP = A
No ~~Yor~~ Igbo is a white-man SeP = E

Some birds are beautiful   SiP = I

~~No John is~~ Some students are not intelligent

Quantifiers or Distributors

A statement is quantified or distributed when the terms in the proposition has relation between the subject and predicate. All men are mortal or All Nigerians are ~~animals~~ mortal. These two propositions ~~are~~ are universal affirmative. A universal statement makes claim about every member of its subject. The universal affirmative proposition "All Nigerians are ~~animals~~ mortals" means

If your are a Nigerian then you are mortal

Negative Affirmative distribution.

No Nigerian is a white-man. The word "no" is distributed or quantified Nigerian to white-men.

Part of the job of the distributor or quantifier is to determine the degree or extent of distribution quantification or relationship. In the statement "Some dogs are not trainable" shows that some dogs are trainable while some are not. SoP - This is particular negative.

The statement student who read well make first class; is SiP particular affirmative.

Rules governing Syllogism

There are five major rules that enable us recognise a syllogistic arguments.

a) Rules relating to Quantity
b) Rules relating to Quality

Rules relating to Quantity

1) Middle terms must be distributed at least once.

Example: All men are mortal
John is a man
Therefore John is mortal

The middle terms is the term that occurs twice in the argument, often in the two premises of the syllogism. The ~~at~~ term man is the middle term here.

2) No term is to be distributed in the conclusion which is not distributed in the premise

Yemi is a beautiful girl
Yemi is fat
Therefore Yem is good

3 Rules relating to Quality

3) When both premises are negative, no conclusion can validly follow. Example: No human being is mortal
Dogs are not human being
Therefore dogs are mortal

This argument did not follow because the conclusion is not the consequence of the premises.

4) When the premises is negative, the conclusion must be negative. Example; No human being is mortal
John is a human being
Therefore, ~~is~~ John is immortal

5) If both premises are affirmative the conclusion must be affirmative. Example: All Nigerians are black
Taiwo is a Nigerian
Therefore Taiwo is a Black.

Use of Symbols or signs in Logic (Symbolic Logic)

Propositions, statement or arguments can be represented with symbols as in mathematics. Simple statements or propositions are represented by the letter P, Q, R, S . . . . . which are called propositional variables. These variables are attached true or false values. These variable represent logical propositions.

There are other symbols known as Connectives.

Connectives join or link propositions, they show logical link between any two propositions. They are represented thus

Connective word	Symbol	Compound statement formed	Symbolic form
Not	$\sim$	Conjuction	$\sim p$
And	$\wedge$	Disjunction	$P \wedge q$
OR	$\vee$	Implication	$P \Rightarrow q$
If then	$\equiv, \Rightarrow, \supset$	Equivalence	$P \Leftrightarrow q$
If and only if			

Implication ~~Conjuction~~ e.g. $P \supset q$, that is P implies q
Conjuction e.g. $P \cdot q$ that is P and q
Negation e.g. $-P$ that is not-P
Alternative e.g. $P \vee q$ that is P or q
Equivalence e.g. $P \equiv q$ that is P is equal to q
Disjunction e.g. $-(p \cdot q)$ that is neither P nor q

~~Implication~~ Implication

If today is Sunday, then my mother will cook rice. This is $P \supset q$. If it is Sunday P, then $\supset$ mother will cook rice q (implication)

Conjuction

It is Sunday and mother cooked rice P and q
It is Sundand (P) (.) mother cooked rice (q)
~~It is no~~ (Conjuction)
Today is not sunday (Not-P), mother did not cook rice not-P (Negation)
Either that today is sunday or mother will cook rice ($P \vee q$) ~~Disjunctive~~ alternative
It is not that today is sunday, mother cooked rice
Disjunctive

Compound Proposition

Conjuction, Disjunction, alternative, implication

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Disjunction Syllogism

$-(p \cdot q)$ neither p and q

It is not the case that today is a lecture day and Taiwo is ~~gone~~ at home $\cdot(p \cdot q)$. It is a lecture day p. Therefore, Taiwo is not at home $-q$

$$(-p \cdot q)$$
$$p$$
$$\therefore -q$$

There is two valid arguments in a disjunction. When one is affirmed, the other is denied

$$-(p \cdot q) \qquad -(p \cdot q)$$
$$p \qquad q$$
$$\therefore -q \qquad \therefore -p$$

Alternative Syllogism

Either today is a lecture day or Taiwo is at home $(p \vee q)$. Today is not a lecture day, $-p$. Therefore Taiwo is at home

$$p \vee q$$
$$-p$$
$$\therefore q$$

We have two valid arguments in an alternative syllogism. Affirm either and deny the other consequence or antecedance.

$$p \vee q \qquad p \vee q$$
$$-p \qquad -q$$
$$\therefore q \qquad \therefore p$$

Question

Write on both sides of the paper

Do not write in either margin

Conjuction

It is a lecture day and Taiwo is gone to lecture (p.q). It is a lecture day p. Therefore, Taiwo is gone to lecture q.

$$(p \cdot q)$$
$$p$$
$$\therefore q$$

Hypothetical, Alternative and Disjunctive Syl

From Hypothetical Syllogism: This type of argument employ "if - then" propositions or conditional propositions. It is an argument in which something is said to be the case on condition that another thing obtains. And if that first thing (usually called the antecedent) obtains, then we assert that second thing (called the consequent). But we cannot assert the antecedent because the consequence is true

Example:

Hypothetical Proposition. If ~~it rains~~ students read their courses well, they will pass their examination i.e. if p then q or $p \supset q$

Hypothetical Argument. If Taiwo read well, he will pass his JAMB. Taiwo read well ∴ Taiwo passed JAMB

$$p \supset q$$
$$p$$
$$\therefore q$$

In this argument, once we assert the antecedent, the consequent follows. It is called modus ponendo ponens

How it follow that if the consequent, we as well deny the antecedent. It is called Modus Ponendo Tollens

~~The~~ However, the proposition if P then q has the following alternative meanings.
- P implies q
- P is sufficient for q
- q is necessary for P
- P only if q
- q if P
- q follows P
- q is consequent of P

TRUTH TABLES

The validity of arguments can be shown by assigning truth values (T or F ie True or false) to the constituent propositions. Between two propositions there are only for possible truth relations. For example, P and Q

	P	Q
Both is true	T	T
P is true and Q is false	T	F
P is false and Q is true	F	T
Both are false	F	F

If we relate the truth relations of propositions to their logical relations (conjuction, disjunction, alternative, implication, etc) we have the following truth tables

P	Q	P . Q Conjunction	P V Q Alternative	P ⊃ Q Implication	−(P . Q) Disjunction
T	T	T	T	T	F
T	F	F	T	F	T
F	T	F	T	T	T
F	F	F	F	T	T

Truth table for conditional proposition

p	q	$p \vee q$
T	T	T
T	F	F
F	T	T
F	F	T