Logic of Propositions and Predicates

Ivana Lucia Kharisma, M.Kom

Basic Logic

Logic propositional consists of sentences, especially abstract sentences (abstract sentences).

Propositions (statements) are the basic components of logical sentences (sentence) in propositional logic. The sentences are formed from propositions are called declarative sentences, namely sentences whose truth value can be determined, true or false, but not both at the same time. Also called a sentence or declarative sentence.

On the other hand, a sentence whose truth value cannot be determined is either true or false, it is called an open sentence (not a proposition).

Basic Logic

Proposition	Open Sentence
Yogyakarta is the capital city of Indonesia	Is there a test today?
The population of Malaysia is more than the population of Indonesia	X+5>10
Indonesia experienced 6 presidential changes	Herlya is divisible by 5
3 is the first prime number	The number 10 and number 100 already love

Sentences in propositional logic are built from propositions by applying propositional connectives:

not, and, or, if-then, if-and-only-if, if-then-else

Sentences are formed according to the following rules:

 Each proposition, namely a symbol of truth or a symbol of a proposition is a sentence.

 If F is a sentence, then so is its negation (not F).

 if F and G are sentences, so are their conjunctions, namely (F and G), then F and G are called conjuncts and (F and G).

 If F and G are sentences, then so is the disjunction, i.e. (F or hereinafter F or G are called disjuncts and (F or G)).

 If F and G are sentences, so are their implications, i.e. (if F then G). Furthermore, F is called the antecedent and G is called consequent and (if F then G). Sentences (if G then F) are called converse and sentence (if F then G).

 if F and G are sentences, then so are their equivalences, namely (F f and onfy f G), hereinafter F is called the left-hand side and G called the right-hand side and (F if and only if G).

 If F, G and H are sentences, so are conditional it, namely (if F then G else H). Then F, G, and H respectively **called if-clause, then-clause, and else-clauses and conditionals (if F then G else H).**

Notation

several sentences need to be combined to make a larger sentence long

Simbol	Arti	Bentuk
¬	Tidak/*Not*/*Negasi*	Tidak…………
∧	Dan/*And*/*Konjungsi*	……..dan……..
∨	Atau/*Or*/*Disjungsi*	………atau…….
→	*Implikasi*/*if-then*	Jika…….maka…….
↔	*Bi-Implikasi*/*if-and-only-if*	…bila dan hanya bila…
tidak ada	*if-then-else*	Jika...maka…yang lain...

Interpretation

Interpretation is the assignment of a truth value (true or false) to each propositional symbol of a logical sentence. For example, consider the sentence:

not p or q

One interpretation of the sentence above assigns a **false** value to p and a **true** value to p The interpretation of the p and q values can be written:

$\mathbf{p} \leftarrow \mathbf{false}$

$\mathbf{q} \leftarrow \mathbf{true}$

Semantic Rule

Negation (Not)

- Uner operator (uner operation is an operation with only one operand, i.e. one input)

Simbol ~

P	~ P
T	F
F	T

P : "It's raining today"

~ P : "Today is not raining"

Semantic Rule

Conjunction (and)

- Binary Operator (a binary operation is an operation with two operands i.e. two inputs)

P	Q	P ^ Q
T	T	T
T	F	F
F	T	F
F	F	F

Semantic Rule Disjunction (or)

- Binary Operator (a binary operation is an operation with two operands i.e. two inputs)

- Simbol v

P	Q	P v Q
T	T	T
T	F	T
F	T	T
F	F	F

Semantic Rule

Exclusive or (xor)

Simbol ⊕

P	Q	$P \oplus Q$
T	T	F
T	F	T
F	T	T
F	F	F

PROPERTIES OF LOGICAL ALGEBRA

Rule	$\wedge$ (AND) form	$\vee$ (OR) form
Identity	$1 \wedge p = p$	$0 \vee p = p$
Null	$0 \wedge p = 0$	$1 \vee p = 1$
Idempotent	$p \wedge p = p$	$p \vee p = p$
Inverse	$p \wedge \neg p = 0$	$p \vee \neg p = 1$
Commutativity	$p \wedge q = q \wedge p$	$p \vee q = q \vee p$
Associativity	$(p \wedge q) \wedge r = p \wedge (q \wedge r)$	$(p \vee q) \vee r = p \vee (q \vee r)$
Distributivity	$p \vee (q \wedge r) = (p \vee q) \wedge (p \vee r)$	$p \wedge (q \vee r) = (p \wedge q) \vee (p \wedge r)$
Absorption	$p \wedge (p \vee q) = p$	$p \vee (p \wedge q) = p$
De Morgan's Law	$\neg(p \wedge q) = \neg p \vee \neg q$	$\neg(p \vee q) = \neg p \wedge \neg q$

Semantic Rule -Implication (if -then)

- Implication is a compound statement which is a series of two statements which is connected by the conjunction "if... , then...". implication two
- the p and q statements are written p → q (read: if p, then q). The p statement is called the antecedent and the statement q are called the consequent.
  - The implication p q is a proposition that is false if p is true and q is false, and is true otherwise.

P	Q	P → Q
T	T	T
T	F	F
F	T	T
F	F	T

Semantic Rule -Conditional (if -then-else)

- The truth value of the conditional (i.e. if p then q else r) is equal to the truth value of q (if the value of p is "true") and is equal to r (if p-value is “false”). In other words, if p is true q applies and if p is false then what applies is r

p	*q*	*r*	**if *p* then *q* else *r***
True	*True*	*True*	***True***
True	*True*	*False*	***True***
True	*False*	*True*	***False***
True	*False*	*False*	***False***
False	*True*	*True*	***True***
False	*True*	*False*	***False***
False	*False*	*True*	***True***
False	*False*	*False*	***False***

Semantic Rule

BiImplication (if and only if)

P	Q	$P \longleftrightarrow Q$
T	T	T
T	F	F
F	T	F
F	F	T

Table of Truth

The truth table is a method for determining the truth value of a logical sentence by interpreting each proposition symbol and using semantic rules.

2^ n : variabel

not (p and (not p)) or q

p	q	$\neg p$	$p \wedge \neg p$	$\neg(p \wedge (\neg p))$	$\neg(p \wedge \neg p) \vee q$
T	T	F	F	T	T
T	F	F	F	T	T
F	T	T	T	F	T
F	F	T	F	T	T

What is the validity of this sentence ? Use truth table

(if p then q) or (r and (not p))