

Propositional Logic

Definitions

Propositions

A proposition in logical is a statement that is either true or false, and it cannot be both.

Propositional Variables

In mathematical logic, a propositional variable (also called a sentential variable or sentential letter) is a variable which can either be true or false. Propositional variables are the basic building-blocks of propositional formulas, used in propositional logic and higher logics.

Logical Connectives

We use symbols called **logical connectives** to build a proposition...:

- \neg = NOT (Negation)
 - Highest precedence
- \wedge = AND (Conjugation)
 - Second highest precedence
- \vee = OR (Compound)
 - Third highest precedence

Example, having some propositional variable represent a true/false (or yes/no) question, similar to a boolean variable in programming...

- p : Is $x > 10$?
- q : Is $x < 100$?
- r : Is password more than 6 characters?

Given a boolean, each of these have only two states: True or False. But, if we combine them with ANDs and ORs, the amount of resulting states from the combination is 2^n , where n is the amount of propositional variables in the statement.

If $(x > 10 \ \&\& \ x < 100)$ = $(p \wedge q)$

Examples:

a. Create a variable for “class is full”, create a variable for “prerequisites are met”, write out different combinations and what they translate to, using AND and OR and NOT.

Diagramming it out with a truth table...

Examples:

- b. $(p \wedge \neg q)$
- c. $p \vee \neg q$
- d. $(p \wedge q) \vee (p \wedge \neg q)$

Multiple variables... when is the result true? False?

- e. $p \wedge q \wedge r$
- f. $p \vee q \vee r$