BITS Pilani Hyderabad Campus
CS F214 Logic in Computer Science,
I Semester 2021-2022
Lecture Notes
Lecture 3

3 Propositional Logic

3.1 Declarative Sentences Or Propositions

Sentences that are in principle, either true or false (but not both).
Examples:

1. This is a class on logic.
2. The sun orbits the earth.
3. The sum of 2 and 2 is 5.
4. Every even natural number greater than 2 is the sum of 2 prime numbers. (Goldbach's conjecture. We are not sure whether this statement is true or false.)

3.2 Non-Declarative Sentences

1. Pay Attention!
2. Would you accompany me to class?
3. May fortune come your way.

Non-Declarative Sentences are not propositions.

3.3 Twin Prime Conjecture

- For all the numbers n, there exists an $n_0 > n$, such that n_0 and $n_0 + 2$ are prime numbers.
- Twin prime conjecture has not been proved yet.

3.4 Bounded Gap Theorem

- For all natural numbers n, there exists a constant c, for all natural numbers $n_0 > n$, so that there are two prime numbers in interval $[n_0, n_0 + c]$
- This has been proved by Yitang Zhang.

3.5 Truth Tables

Given these atomic propositions p,q,r,.. or p1,p2,p3.. we can combine them in compositional ways to form other propositions using logical connections.

p	$\neg p$
T	F
F	T

Table 1: Negation ($\neg$)

p	q	$p \wedge q$
F	F	F
F	T	F
T	F	F
T	T	T

Table 2: Conjuction ($\wedge$)

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

Table 3: Disjunction ($\vee$)

p	q	$p \rightarrow q$
F	F	T
F	T	T
T	F	F
T	T	T

Table 4: Conditional (Implication)

$p \leftrightarrow q \implies (p \rightarrow q) \wedge (q \rightarrow p)$