3-CNF

$3 \text{- CNF}$

\[(v \lor v \lor v) \land (v \lor v \lor v) \land \ldots \land (v \lor v \lor v)\]

"literals" < complemented variable

3-SAT

$3 \text{- SAT}$

\[\in \text{NP}^c\]

NP-complete \quad NP-hard

CLIQUE in NP-complete

Clique of size $k$ is a complete graph of $k$ vertices

\[C = (V, E) \text{- there a subgraph which is a } k \text{- clique?}\]

\[\binom{n}{k} = \frac{n!}{k!(n-k)!}\]

\[E \in \text{NP} \quad \text{cnf}\]

\[\|V\| = n \quad \Theta\left(\left(\frac{n}{k}\right)^k\right) = \Theta\left(k^k\right)\]

Vertex cover is NP-complete \(\in \text{NP}\)
Hamiltonian Cycle $\in$ NP

Given $G = (V, E)$, is there a simple cycle of $|V|$ vertices?

TSP $\in$ NP when $n, (1, 2, \ldots, n)$ permutation such that $e_{i,j}$ from in that order is minimal

$\exists$ tour of unit $\leq C$ $\in$ NP
ENP

\[ S = \{ \text{values} \} \quad t = \text{target} \]

subset of \( S \) that sums to \( t \)

\( \Rightarrow \) algorithm for 3-SAT