A Summary of Commonly Used Math Notations

- $\in$: This indicates an element belonging to a set. Example: "5 is a natural number" can be written as "$5 \in \mathbb{N}$". Compare with the subset notation below.
- $\subset$: This indicates the containment relationship between sets. For instance, "$\{1, 2\}$ is a subset of $\{1, 2, 3, 4\}$" can be abbreviated as $\{1, 2\} \subset \{1, 2, 3, 4\}$. There are some variations of this notation, like $\supset$ (containment), $\subseteq$ (subset, may be equal), $\supseteq$ (containment, may be equal), $\subsetneq$ (subset and not equal) $\supsetneq$. Notice that this is a relationship between sets, while the notation $\in$ is between an element and a set. For instance,

$$\{5\} \subset \{1, 2, 3, 4, 5\}, \qquad 5 \in \{1, 2, 3, 4, 5\}$$

  both tell you that the element 5 is in the set $\{1, 2, 3, 4, 5\}$. But $\{5\} \in \{1, 2, 3, 4, 5\}$ is NOT mathematically correct.
- $\forall$: This means "for any" or "for all." Example: "For any vector v in a vector space V, a scalar multiple of it is still in the vector space" can be written as "$\forall v \in V$, and $\forall c \in \mathbb{F}$, $cv \in \mathbb{F}$."
- $\exists$: This means "there exists." For example: "For any $\epsilon > 0$, there exists a $\delta > 0$ such that..." can be written as "$\forall \epsilon > 0$, $\exists \delta > 0$ s.t. ..." A negation of this symbol is $\nexists$, meaning "there does not exist."
- $\Rightarrow$ means the statement before the arrow implies the statement after the arrow. $\Leftrightarrow$ indicates the equivalence of statements.
- $\mathbb{N}$: the set of natural numbers $\mathbb{N} = \{0, 1, 2, 3, 4, \dots\}$. $\mathbb{Z}$: the set of integers. $\mathbb{Q}$: the set of rational numbers (this is the first example of a field). $\mathbb{R}$: the set of real numbers. $\mathbb{C}$: the set of complex numbers.
- $\sum$ and $\prod$: meaning taking sum/product of all terms behind the symbol satisfying some conditions. For instance, summing over all natural numbers from 0 to 100 can be written as

$$0 + 1 + \cdots + 100 = \sum_{k=0}^{100} k.$$

- Greek letters : $\alpha, \beta, \gamma, \delta, \epsilon, \zeta, \eta, \theta, \kappa, \lambda$ etc. Used as alternatives for English letters. In math different alphabets are usually used to represent concepts of different nature.
- $\cup$: union of sets $A \cup B = \{x | x \in A \text{ or } x \in B\}$.
- $\cap$: intersection of sets $A \cap B = \{x | x \in A \text{ and } x \in B\}$.