

Glossary of Symbols

symbol	meaning
$::=$	is defined to be
■	end of proof symbol
\neq	not equal
\wedge	and, AND
\vee	or, OR
\longrightarrow	implies, if \dots , then \dots , IMPLIES
\rightarrow	state transition
$\neg P, \overline{P}$	not P , NOT(p)
\longleftrightarrow	iff, equivalent, IFF
\oplus	xor, exclusive-or, XOR
\exists	exists
\forall	for all
\in	is a member of, is in
\subseteq	is a (possibly =) subset of
$\not\subseteq$	is not a (possibly =) subset of
\subset	is a proper (not =) subset of
$\not\subset$	is not a proper (not =) subset of
\cup	set union
$\bigcup_{i \in I} S_i$	union of sets S_i where i ranges over set I of indices
\cap	set intersection
$\bigcap_{i \in I} S_i$	intersection of sets S_i where i ranges over set I of indices
\emptyset	the empty set, $\{\}$
\overline{A}	complement of set A
$-$	set difference
$\text{pow}(A)$	powerset of set, A
$A \times B$	Cartesian product of sets A and B
S^n	Cartesian product of n copies of set S
\mathbb{Z}	integers
$\mathbb{N}, \mathbb{Z}^{\geq 0}$	nonnegative integers
$\mathbb{Z}^+, \mathbb{N}^+$	positive integers
\mathbb{Z}^-	negative integers
\mathbb{Q}	rational numbers
\mathbb{R}	real numbers
\mathbb{C}	complex numbers
$\lfloor r \rfloor$	the <i>floor</i> of r : the greatest integer $\leq r$
$\lceil r \rceil$	the <i>ceiling</i> of r : the least integer $\geq r$

symbol	meaning
$R(X)$	image of set X under binary relation R
R^{-1}	inverse of binary relation R
$R^{-1}(X)$	inverse image of set X under relation R
surj	A surj B iff $\exists f : A \rightarrow B$. f is a surjective <i>function</i>
inj	A inj B iff $\exists R : A \rightarrow B$. R is an injective <i>total relation</i>
bij	A bij B iff $\exists f : A \rightarrow B$. f is a bijection
$[\leq 1 \text{ in}]$	injective property of a relation
$[\geq 1 \text{ in}]$	surjective property of a relation
$[\leq 1 \text{ out}]$	function property of a relation
$[\geq 1 \text{ out}]$	total property of a relation
$[= 1 \text{ out}, = 1 \text{ in}]$	bijection relation
\circ	relational composition operator
λ	the empty string/list
A^*	the finite strings over alphabet A
A^ω	the infinite strings over alphabet A
$\text{rev}(s)$	the reversal of string s
$s \cdot t$	concatenation of strings s, t ; $\text{append}(s, t)$
$\#_c(s)$	number of occurrences of character c in string s
$m \mid n$	integer m divides integer n ; m is a factor of n
gcd	greatest common divisor
log	the base 2 logarithm, \log_2
ln	the natural logarithm, \log_e
lcm	least common multiple
$(k..n)$	$\{i \in \mathbb{Z} \mid k < i < n\}$
$[k..n)$	$\{i \in \mathbb{Z} \mid k \leq i < n\}$
$(k..n]$	$\{i \in \mathbb{Z} \mid k < i \leq n\}$
$[k..n]$	$\{i \in \mathbb{Z} \mid k \leq i \leq n\}$
$\sum_{i \in I} r_i$	sum of numbers r_i where i ranges over set I of indices
$\prod_{i \in I} r_i$	product of numbers r_i where i ranges over set I of indices
$\text{qcnt}(n, d)$	quotient of n divided by d
$\text{rem}(n, d)$	remainder of n divided by d
$\equiv \pmod{n}$	congruence modulo n
\neq	not congruent
\mathbb{Z}_n	the ring of integers modulo n
$+_n, \cdot_n$	addition and multiplication operations in \mathbb{Z}_n
\mathbb{Z}_n^*	the set of numbers in $[0, n)$ relatively prime to n
$\phi(n)$	Euler's totient function $::= \mathbb{Z}_n^* $
$\langle u \rightarrow v \rangle$	directed edge from vertex u to vertex v
Id_A	identity relation on set A : $a \text{Id}_A a'$ iff $a = a'$

symbol	meaning
R^*	path relation of relation R ; reflexive transitive closure of R
R^+	positive path relation of R ; transitive closure of R
$\mathbf{f} \hat{x} \mathbf{g}$	merge of walk \mathbf{f} with end vertex x and walk \mathbf{g} with start vertex x
$\mathbf{f} \hat{} \mathbf{g}$	merge of walk \mathbf{f} and walk \mathbf{g} where \mathbf{f} 's end vertex equals \mathbf{g} 's start vertex
$\langle u-v \rangle$	undirected edge connecting vertices $u \neq v$
$E(G)$	the edges of graph G
$V(G)$	the vertices of graph G
C_n	the length- n undirected cycle
L_n	the length- n line graph
K_n	the n -vertex complete graph
H_n	the n -dimensional hypercube
$L(G)$	the “left” vertices of bipartite graph G
$R(G)$	the “right” vertices of bipartite graph G
$K_{n,m}$	the complete bipartite graph with n left and m right vertices
$\chi(G)$	chromatic number of simple graph G
H_n	the n th Harmonic number $\sum_{i=1}^n 1/i$
\sim	asymptotic equality
$n!$	n factorial $::=n \cdot (n-1) \cdots 2 \cdot 1$
$\binom{n}{m}$	$::=n!/m!(n-m)!$; the binomial coefficient
$o()$	asymptotic notation “little oh”
$O()$	asymptotic notation “big oh”
$\Theta()$	asymptotic notation “Theta”
$\Omega()$	asymptotic notation “big Omega”
$\omega()$	asymptotic notation “little omega”
$\Pr[A]$	probability of event A
$\Pr[A \mid B]$	conditional probability of A given B
\mathcal{S}	sample space
I_A	indicator variable for event A
PDF	probability density function
CDF	cumulative distribution function
$\text{Ex}[R]$	expectation of random variable R
$\text{Ex}[R \mid A]$	conditional expectation of R given event A
$\text{Ex}^2[R]$	abbreviation for $(\text{Ex}[R])^2$
$\text{Var}[R]$	variance of R
$\text{Var}^2[R]$	the square of the variance of R
σ_R	standard deviation of R