Uses of Greek Letters and Other Symbols in CMPSCI 601

letter	name	typical uses in CMPSCI 601
α	alpha	formula, etc.
β	beta	formula
γ	gamma	formula
Γ	Gamma	alphabet, vocabulary, set of formulas
δ	delta	formula, transition function
Δ	Delta	change = new - old
ϵ	epsilon	empty string, small positive real number
ζ	zeta	constant zero function
η	eta	mapping
θ	theta	formula
Θ	Theta	
ι	iota	
κ	kappa	cardinal number, program counter
λ	lambda	function abstraction, e.g., $\lambda x(x^2)$
μ	mu	interpretation function on terms, minimization function
ν	nu	
ξ	xi	
o	omicron	
π	pi	$3.14159265\cdots$, prime number
Π	Pi	set of predicate symbols, proof, product
ρ	rho	
σ	sigma	successor function, symbol in Σ
Σ	Sigma	alphabet, vocabulary, set of formulas, sum
τ	tau	
Υ	Upsilon	
φ	phi	formula
Φ	Phi	set of formulas, SO formula, set of function symbols
χ	chi	characteristic function
ψ	psi	formula
Ψ	Psi	set of formulas, second-order formula
ω	omega	formula
Ω	Omega	lower bound $\Omega(f(n))$

symbol	name	typical meaning or uses in CMPSCI 601
$\#$	number sign	separator, $\#_a(w) =$ number of a's in w
$\star$	star	$\Sigma^\star =$ set of all finite words from Σ
$\leq$	less than or equal	less than or equal; is reducible to; substructure of
$\cap$	intersection	intersection
$\cup$	union	union
$\square$	box	end of proof, definition, etc.
$\cdot$	cdot	indicates place for an argument, multiplication
$\circ$	circ	composition or concatenation
$\cong$	iso	isomorphic
$\downarrow$	downarrow	$M(w)\downarrow$ means M converges on input w
$\emptyset$	emptyset	emptyset
$\equiv$	equiv	equivalent, semantically equivalent, elementarily equivalent
$\exists$	exists	there exists
$\forall$	forall	for all
$\lceil\cdot\rceil$	ceiling	smallest integer greater than or equal to
$\lfloor\cdot\rfloor$	floor	largest integer less than or equal to
iff	iff	if and only if
$\wedge$	land	logical and
$\vee$	lor	logical or
$\neg$	lnot	logical not
$\rightarrow$	rightarrow	implies in a logical formula
$f : A \rightarrow B$	rightarrow	f is a function from A to B
$\mapsto$	mapsto	$a \mapsto b$ means that the map takes a to b
$\Rightarrow$	Rightarrow	implies in informal (metamathematical) statement
$\leftrightarrow$	leftrightarrow	iff in a logical formula
$\Leftrightarrow$	Leftrightarrow	iff in informal (metamathematical) statement
$\log$	log	log base 2
$\models$	models	$\mathcal{A} \models \varphi$ means "φ is true in $\mathcal{A}$"
$\vdash$	proves	$\Gamma \vdash \varphi$ means "φ can be proved from Γ"
$\nearrow$	nearrow	diverges
$\oplus$	oplus	exclusive or, sum mod 2
$\sim$	sim	has same cardinality, is equivalent to
$\wp$	power set	$\wp(S) = \{A \mid A \subseteq S\}$
$\sqcup$	sqcup	space symbol on TM tape
$\subseteq$	subseteq	subset or equal to
$\subsetneq$	psubset	proper subset of
$\triangleright$	triangleright	left marker on TM tape

other letters	name	typical meaning or uses in CMPSCI 601
$\mathcal{A}$	cal A	logical structure
$\mathcal{B}$	cal B	logical structure
$\mathcal{C}$	cal C	complexity class
$\mathcal{L}$	cal L	language, $\mathcal{L}(M) =$ language accepted by M
N	bf N	the set of natural numbers, $\mathbf{N} = \{0, 1, 2, \ldots\}$
Q	bf Q	the set of rational numbers
R	bf R	the set of real numbers
Z	bf Z	the set of integers, $\mathbf{Z} = \{\ldots, -2, -1, 0, 1, 2, \ldots\}$
$\aleph_0$	aleph 0	cardinality of **N**

name	Complexity Measures
DSPACE	deterministic space
NSPACE	nondeterministic space
DTIME	deterministic time
NTIME	nondeterministic time
ASPACE	alternating space
ATIME	alternating time

name	Complexity Classes
AH	arithmetic hierarchy
r.e.	recursively enumumerable sets
co-r.e.	sets whose complements are r.e.
Recursive	recursive sets
Primitive Recursive	primitive recursive sets
EXPTIME	exponential time DTIME$[2^{n^{O(1)}}]$
PSPACE	polynomial space DSPACE$[n^{O(1)}]$
PH	polynomial-time hierarchy
SO	second-order expressible decision problems
NP	nondeterministic polynomial time, NTIME$[n^{O(1)}]$
P	polynomial time, DTIME$[n^{O(1)}]$
NC	uniform poly-size, depth $(\log n)^{O(1)}$ circuits
sAC^1	uniform poly-size, depth $O(\log n)$ semi-unbounded fan-in circuits
CFL	context-free languages
NL	nondeterministic logspace, NSPACE$[\log n]$
L	logspace, DSPACE$[\log n]$
NC^1	uniform poly-size, depth $O(\log n)$ bounded fan-in circuits
Regular	regular languages
thC^0	uniform poly-size, constant depth unbounded fan-in threshold circuits
AC^0	uniform poly-size, constant depth unbounded fan-in circuits
LH	log-time hierarchy
FO	first-order expressible decision problems