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Glossary

Chapter 1. Orderings

$\leqslant$	quasi-ordering	12
$\equiv$	equivalent elements w.r.t. quasi-ordering	12
$E \amalg F$	disjoint union of E and F	12
$E \,\dot{\amalg}\, F$	ordered union of E and F	13
$E \times F$	Cartesian product of E and F	13
$E \,\dot{\times}\, F$	anti-lexicographic product of E and F	13
E^*	set of words over E	13
E^+	set of non-empty words over E	13
$\leqslant^!$	ordering defined by $x \leqslant^! y \Leftrightarrow x = y \vee x < y$	14
$E^\diamond$	set of commutative words over E	15
ω	the ordinal number $\omega = \{0, 1, 2, ...\}$	16
$\mathrm{fin}(A)$	final segment generated by A	17
$\mathrm{in}(A)$	initial segment generated by A	17
$\mathrm{root}(T)$	root of T	19
$E^\top$	set of finite E-labeled trees	20
$S^{\geqslant}$	subset of positive or zero elements in S	22
$S^{>}$	subset of strictly positive elements in S	22
$S^{\neq}$	subset of non-zero elements in S	22
$S^{\leqslant}$	subset of negative or zero elements in S	22
$S^{<}$	subset of strictly negative elements in S	22
$\lvert x \rvert$	absolute value of x	22
R^*	subset of non-zero-divisors in R	25
$x \preccurlyeq y$	x is dominated by y	25
$x = O(y)$	Landau's notation for $x \preccurlyeq y$	25
$x \asymp y$	x is asymptotic to y	25
$x \prec y$	x is negligible w.r.t. y	25
$x = o(y)$	Landau's notation for $x \prec y$	25
$x \sim y$	x is equivalent to y	25

$A^{\times}$	elements of A which can be raised to a power	30
$\|x\|$	$\|x\| = x$ if $x \succcurlyeq 1$ and $\|x\| = x^{-1}$ otherwise	30
$x \preccurlyeq\!\!\!\prec y$	x is flatter than or as flat as y	30
$x \prec\!\!\!\prec y$	x is flatter than y	30
$x \asymp\!\!\!\asymp y$	x is as flat as y	30
$x \approxeq y$	x and y are similar modulo flatness	30
$A^{\flat}$	flat subring of A	31
$x \preccurlyeq^{\sharp} y$	$x \preccurlyeq y$ modulo flatness	31
$x \prec^{\sharp} y$	$x \prec y$ modulo flatness	31
$x \preccurlyeq_{\varphi} y$	$x \preccurlyeq y$ modulo elements flatter than φ	31
$x \prec_{\varphi} y$	$x \prec y$ modulo elements flatter than φ	31
$x \preccurlyeq_{\varphi}^{*} y$	$x \preccurlyeq y$ modulo elements flatter than or as flat as φ	31
$x \prec_{\varphi}^{*} y$	$x \prec y$ modulo elements flatter than or as flat as φ	31

Chapter 2. Grid-based series

$\mathfrak{M}$	quasi-ordered monomial monoid	34
$\mathfrak{m}, \mathfrak{n}, \mathfrak{v}, \ldots$	monomials	34
C	ring of coefficients	36
$\operatorname{supp} f$	support of a series f	36
$C[[\mathfrak{M}]]$	ring of grid-based series in $\mathfrak{M}$ with coefficients in C	36
$f_{\mathfrak{m}}$	coefficient of $\mathfrak{m}$ in f	36
$C[[z_1, \ldots, z_n]]$	natural multivariate series in $z_1, \ldots, z_n$	38
$C[[z_1; \ldots; z_n]]$	recursive multivariate series in $z_1, \ldots, z_n$	38
$\mathfrak{d}_f$	dominant monomial of f	40
c_f	dominant coefficient of f	40
τ_f	dominant term of f	40
δ_f	series with $f = \tau_f(1 + \delta_f)$	40
$f_{\succ}$	purely infinite part of f	41
$f_{\asymp}$	constant part of f	41
$f_{\prec}$	infinitesimal part of f	41
$f_{\preccurlyeq}$	bounded part of f	41
$C[[\mathfrak{M}]]_{\succ}$	set of purely infinite elements in $C[[\mathfrak{M}]]$	41
$C[[\mathfrak{M}]]_{\prec}$	set of infinitesimal elements in $C[[\mathfrak{M}]]$	41
$C[[\mathfrak{M}]]_{\preccurlyeq}$	set of bounded elements in $C[[\mathfrak{M}]]$	41
π_{λ}	the series $(1+z)^{\lambda} \in C[[z]]$	42
$f_{\mathfrak{S}}$	restriction of f to $\mathfrak{S}$	42
$f \trianglelefteq g$	f is a truncation of g	43
$\mathscr{F}(S)$	collection of families with values in S	44
$\mathcal{F}, \mathcal{G}, \ldots$	families	44
$(f_i \colon i \in I)$	alternative notation for family $(f_i)_{i \in I}$	44
$\mathcal{F} \amalg \mathcal{G}$	disjoint union of two families $\mathcal{F}$ and $\mathcal{G}$	44
$\mathcal{F} \times \mathcal{G}$	Cartesian product of families $\mathcal{F}$ and $\mathcal{G}$	44

$\varphi(\mathcal{F}_1, \ldots, \mathcal{F}_n)$	application of a function φ on families $\mathcal{F}_1, \ldots, \mathcal{F}_n$	45
$\mathcal{F} \approx \mathcal{G}$	$\mathcal{F}$ and $\mathcal{G}$ coincide modulo renaming indexes	45
$\mathcal{F} \underset{\sim}{\subseteq} \mathcal{G}$	$\mathcal{F}$ is contained in $\mathcal{G}$ modulo renaming indexes	45
$\mathscr{S}(A)$	collection of strongly summable families over A	46
$\sum \mathcal{F}$	strong sum of $\mathcal{F}$	46
$\operatorname{term} \mathcal{F}$	family of terms occurring in $\mathcal{F}$	49
$\operatorname{mon} \mathcal{F}$	family of monomials occurring in $\mathcal{F}$	49
$\mathcal{F}^*$	family of power products of elements in $\mathcal{F}$	50
$\hat{\varphi}$	extension of φ by strong linearity	50
$g \circ (f_1, \ldots, f_k)$	composition of $g \in C[[z_1, \ldots, z_k]]$ with $f_1, \ldots, f_k \prec 1$	53

Chapter 3. The Newton polygon method

$N_{P,\mathfrak{m}}$	Newton polynomial associated to $\mathfrak{m}$	65
$C[[\mathfrak{M}]]_A$	series in $C[[\mathfrak{M}]]$ with Cartesian representations in A	71
$C\{\{\mathfrak{M}\}\}$	subset of convergent grid-based series in $C[[\mathfrak{M}]]$	73

Chapter 4. Transseries

$\log_n$	the n-th iterate of log with $n \in \mathbb{Z}$	80
$\exp_n$	the n-th iterate of exp with $n \in \mathbb{Z}$	80
$\mathbb{T}$	field of grid-based transseries	84
$\mathfrak{T}^\flat$	flat subset of $\mathfrak{T}$	87
$\mathfrak{T}^\sharp$	steep complement of $\mathfrak{T}^\flat$	87
$\mathbb{T} = C[[[x]]]$	field of grid-based transseries in x	87
$\mathbb{L}$	field of logarithmic transseries in x	88
$\mathbb{T}_{\exp}$	exponential extension of $\mathbb{T}$	88
$C_p^q[[[x]]]$	transseries of exp. height $\leqslant p$ and log. depth $\leqslant q$	89
$\mathbb{E}$	field of exponential transseries	90
$f\uparrow$	upward shifting $f \circ \exp$ of f	90
$f\downarrow$	downward shifting $f \circ \log$ of f	90
$\operatorname{con} f$	contraction $\log \circ f \circ \exp$ of f	91
$\operatorname{dil} f$	dilatation $\exp \circ f \circ \log$ of f	91
$C\{\{\{x\}\}\}$	field of convergent transseries	94

Chapter 5. Operations on transseries

f'	derivative of f	98
$f^\dagger$	logarithmic derivative of f	98
$\int f$	distinguished integral of f	103
$\circ_g$	right composition with g	106
$f \circ g$	composition of f and g	106
g^{inv}	functional inverse of g	111
$\langle f, g \rangle$	scalar product $(f g)_{\asymp}$ of f and g	112

Chapter 6. Grid-based operators

$\Psi \circ (\Phi_1, \ldots, \Phi_n)$	composition of multilinear grid-based operators	117
$\operatorname{supp} \Phi$	operator support of Φ	117
$\mathscr{D}_{\mathbb{T}_{\prec\!\!\prec e^x}}, \mathscr{D}_{\mathbb{T}_{\preceq\!\!\preceq e^x}}$	sets of operators $\sum_{n \in \mathbb{N}} L_n \partial^n$ on $\mathbb{T}_{\prec\!\!\prec e^x}$ resp. $\mathbb{T}_{\preceq\!\!\preceq e^x}$	118
Φ_i	homogeneous part of degree i of Φ	122
$\Psi \circ \Phi$	composition of grid-based operators Ψ and Φ	124
$\mathscr{L}(M_1, \ldots, M_m, N)$	set of strongly multilinear $\Phi: M_1 \times \cdots \times M_m \to N$	124
$\mathscr{G}(C[[\mathfrak{M}]], C[[\mathfrak{N}]])$	set of grid-based operators from $\Phi: C[[\mathfrak{M}]] \to C[[\mathfrak{N}]]$	125
$\Omega_{\mathfrak{m}_1, \ldots, \mathfrak{m}_m, \mathfrak{n}}$	atomic m-linear grid-based operator	125
$\lvert\alpha\rvert$	arity of an atomic operator α	126
$\mathfrak{i}_{\alpha,1}, \ldots, \mathfrak{i}_{\alpha,\lvert\alpha\rvert}$	inputs of an atomic operator α	126
$\mathfrak{o}_\alpha$	output of an atomic operator α	126
$\mathcal{D}_{\mathfrak{M}}$	atomic decomposition of $\mathrm{Id}_{C[[\mathfrak{M}]]}$	126
$\mathcal{A} \circ \mathcal{B}$	composition of atomic families $\mathcal{A}$ and $\mathcal{B}$	126

Chapter 7. Linear differential equations

L_*, f_*	alternative notation for dominant coefficient c_L, c_f	136
$\operatorname{supp}_{\mathrm{ser}} L$	serial support of L	136
$L_{\times h}$	multiplicative conjugate of L by h	137
$L\uparrow, L\downarrow$	upward and downward shiftings of L	137
$s_{i,j}$	Stirling numbers of the first kind	137
$S_{i,j}$	Stirling numbers of the second kind	137
$\uparrow_l, \downarrow_l$	l-th iterates of $\uparrow$ and $\downarrow$	138
$\mathscr{D}_{\mathbb{T}^\flat}$	space of operators of the form $\sum_{n \in \mathbb{N}} L_n \partial^n$ on $\mathbb{T}^\flat$	138
U_i	differential polynomial with $f^{(i)} = U_i(f^\dagger) f$	139
R_L	differential Riccati polynomial associated to L	139
$R_{L,\mathrm{alg}}$	algebraic part of R_L	140
$P_{+\varphi}$	additive conjugate of P by φ	140
L'	derivative of differential operator L	140
$\mathfrak{R}_L$	set of regular monomials for L	141
$\mathfrak{H}_L$	set of irregular monomials for L	141
T_L	trace of L	141
$T_{L;\mathfrak{B}}$	trace of L w.r.t. $\mathfrak{B}$	141
L^{-1}	distinguished right inverse of L	146
H_L	set of solutions to $L h = 0$	146
$\tilde{\mathbb{T}}$	complexification $\mathbb{T} \oplus \mathrm{i}\,\mathbb{T}$ of $\mathbb{T}$	158
$\mathbb{O}$	field of oscillating transseries	159
$f_{;\psi}$	spectral part of f associated to $e^{\mathrm{i}\psi}$	159
$L_{;\psi}$	action of L on the spectral component $\tilde{\mathbb{T}}\, e^{\mathrm{i}\psi}$	159

Chapter 8. Algebraic differential equations

$P_{\mathfrak{m}}$	coefficient of $\mathfrak{m}$ in differential polynomial P	166
D_P	dominant coefficient of P	167
$f^{\boldsymbol{i}}$	shorthand for $f^{i_0} \cdots (f^{(r)})^{i_r}$	167
$P_{\boldsymbol{i}}$	coefficient of $f^{\boldsymbol{i}}$ in P	167
P_i	i-th homogeneous part of P	167
$\deg P$	(total) degree of P	167
$\operatorname{val} P$	differential valuation of P	167
$f^{[\boldsymbol{\omega}]}$	shorthand for $f^{(\omega_1)} \cdots f^{(\omega_l)}$	168
$P_{[\boldsymbol{\omega}]}$	(normalized) coefficient of $f^{[\boldsymbol{\omega}]}$ in P	168
$P_{[\omega]}$	ω-th isobaric part of P	168
$\operatorname{wt} P$	weight of P	168
$\operatorname{wv} P$	weighted differential valuation of P	168
$f^{\langle i \rangle}$	i-th iterated logarithmic derivative $f^{\dagger \cdots \dagger}$	168
$f^{\langle \boldsymbol{i} \rangle}$	shorthand for $f^{i_0} (f^{\dagger})^{i_1} \cdots (f^{\langle r \rangle})^{i_r}$	168
$P_{\langle \boldsymbol{i} \rangle}$	coefficient of $f^{\langle \boldsymbol{i} \rangle}$ in P	168
P_{+h}	additive conjugation of P with h	169
$P_{\times h}$	multiplicative conjugation of P with h	170
$P\uparrow, P\downarrow$	upward and downward shiftings of P	170
$s_{\boldsymbol{\tau}, \boldsymbol{\omega}}$	generalized Stirling number of the first kind	170
$S_{\boldsymbol{\tau}, \boldsymbol{\omega}}$	generalized Stirling number of the second kind	171
N_P	differential Newton polynomial for P	173
$\deg_{\mathfrak{V}} P$	Newton degree of $P(f) = 0$ $(f \in C[[\mathfrak{V}]])$	174
$\mathfrak{e}_{P,i,j}$	(i,j)-equalizer for P	178
R_{P_i}	differential Riccati polynomial associated to P_i	179
$\mathfrak{E}$	set of exponential transmonomials	184
$\mathfrak{L}$	set of logarithmic transmonomials	197

Chapter 9. The intermediate value theorem

M_x	maximal open interval containing x	203
$(\leftarrow, z)$	the interval $\{u \in E : u < z\}$	203
$(z, \rightarrow)$	the interval $\{u \in E : u > z\}$	203
$\overline{E}$	compactification of a total ordering E	203
$\overline{f}$	a typical element of $\overline{E}$	203
$\bot_{\overline{E}}$	minimal element of $\overline{E}$	203
$\top_{\overline{E}}$	maximal element of $\overline{E}$	203
$\overline{\varpi}$	shorthand for $\sup C$	206
$\mathbb{S}$	totally ordered grid-based algebra $C[[\mathfrak{M}]]$	208
$\overline{\ni}$	shorthand for $\inf C^{>}$	208
$\overline{\mho}$	shorthand for $\sup \mathbb{S}$	208
$\overline{C}^{\#}$	set $\overline{C} \setminus (C \cup \{-\overline{\varpi}, \overline{\varpi}\})$ of finite cuts in C	208

$\overline{\mathfrak{M}}$	set of monomials and monomial cuts	208
$\overline{\mathfrak{d}}_{\overline{f}}$	dominant monomial of $\overline{f}$	209
$\overline{\mathfrak{w}}_{\overline{f}}$	width of $\overline{f}$	209
$\varphi_{\overline{f}}$	initializer of $\overline{f}$	210
$\hat{\mathbb{S}}$	serial completion of $\mathbb{S}$	210
$\hat{f}$	typical serial cut	210
$\overline{\varkappa}_k$	shorthand for $\sup \{f \in \mathbb{T}: \exp(f) = k\}$	212
$\overline{\gamma}$	the cut $(x \log x \log_2 x \cdots)^{-1}$	219
$\mathcal{L}_{\varphi_0, \ldots, \varphi_{k-1}, g, h}$	basic integral neighbourhood	220
$f_0, \ldots, f_k$	integral coordinates of f	221
σ_P	sign of P	227
σ_P^+	sign of P at the right of a point	227
σ_P^-	sign of P at the left of a point	227
$\sigma_{P,\mathfrak{W}}$	sign of P modulo $\mathfrak{W}$	228
$\sigma_{P,\mathfrak{W}}^+$	sign of P at the right of a point modulo $\mathfrak{W}$	228
$\sigma_{P,\mathfrak{W}}^-$	sign of P at the left of a point modulo $\mathfrak{W}$	228

Index

Lecture Notes in Mathematics

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