

Index of Notation

- A^* (free monoid), 4
 A^+ (free semigroup), 4
 $B_d(A^*)$, 204
 $BS(m, n)$ (Baumslag–Solitar group), 34, 113
 \mathcal{CF} , 43, 63
 $C'(\lambda)$, 27
 $C(p)$, 27
 CS , 47, 85
 $DC\mathcal{F}$, 43, 63
 DCS , 47, 85
 dfs_a , 41, 52
 $dfst$, 195
 $d(G)$ (minimal size of generating set), 11
 DOC , 43, 80
 $\mathcal{DP}\mathcal{CF}$, 48, 255
 $DSPACE$, 46, 237
 $DTIME$, 47, 237
 $e(G)$ (number of ends), 25
 ε (empty word), 4
 $f \leq g, f \approx g$, 103
 fsa , 38
 fst , 194
 $G *_A H$ (amalgamated free product), 13
 $\Gamma(G, H, X)$, 21
 $\Gamma(G, X)$, 20
 $\gamma_{G, X}$ (growth function), 22
 $G^*_{A, t}$ (HNN-extension), 16
 $G \times H$ (direct product), 11
 $G * H$ (free product), 10
 $[g, h] = ghg^{-1}h^{-1}$ (commutator), 3
 $g^h = hgh^{-1}$ (conjugate), 3
 $G_{n, r}$ (Higman–Thompson group), 34
 GSM , 50
 $\mathcal{G}(G, X)$ (geodesics), 4, 5
 $G \wr_{\phi} H$ (wreath product), 12
 $G \wr_{R\phi} H$ (restricted wreath product), 13
 $H \rtimes_{\phi} N$ (semidirect product), 12
 H_n (Houghton group), 260
 \mathcal{I} , 48, 249
 $L(M)$, 37
 M_{\exists} , 94
 M_V , 95
 $m(M)$, 214
 $\text{Mon}\langle X \rangle, \text{Mon}(X | \mathcal{R})$, 5, 6
 $N \rtimes_{\phi} H$ (semidirect product), 12
 $NSPACE$, 46, 237
 $NTIME$, 47, 237
 OC , 43, 80
 \mathcal{PCF} , 48, 249, 255
 pda , 41
 $\$$ (padding symbol), 92
 $\text{Ptm}_0(A^*)$, 206
 $\text{Ptm}(A^*)$, 198
 \hat{R} (symmetric closure), 26
 $\mathcal{R}eg$, 38, 53
 $\text{Rist}_G()$, 208
 \mathcal{RT} , 47, 249
 $\text{Sgp}\langle X \rangle, \text{Sgp}(X | \mathcal{R})$, 5, 6
 $<_{\text{slex}}$ (shortlex ordering), 5
 $\text{Syn}(L)$ (syntactic monoid), 52
 $T(q)$, 27
 $v =_G w$, 4
 $w(i)$ (prefix of w of length i), 4
 $WP(G, A)$, 97
 $\langle X \rangle, \langle X | \mathcal{R} \rangle$, 5, 6
 X^{\pm} , 4
 $(x, y)_m$, 30

Index of Names

- Aanderaa, S., 47
 Alešhin, S., 194, 211, 212
 Alonso, J., 103
 Amir, G., 207
 Angel, O., 207
 Anisimov, A., 105, 187
 Antolín, Y., 139, 173, 182, 183
 Avenhaus, J., 226, 237
 Bahls, P., 141
 Bartholdi, L., 207, 213, 216, 217
 Bass, H., 19
 Baumslag, G., 34, 49, 125, 147
 Bendix, P., 118
 Bestvina, M., 129
 Bhattacharjee, M., 212
 Bleak, C., 263
 Bondarenko, E., 208, 214
 Bondarenko, N., 214
 Book, R., 48
 Boone, W., 88, 103, 117, 221, 223, 227
 Bowditch, B., 25, 105, 165
 Brady, N., 105, 129
 Brady, T., 140
 Bridson, M., 105, 128, 129, 141, 142, 146,
 166, 167, 243
 Brieskorn, E., 31
 Briussel, J., 207
 Brink, B., 30, 141, 173
 Brittenham, M., 147
 Britton, J., 18
 Brough, T., 255, 267
 Brunner, A., 207, 212
 Buckley, D., 167
 Burnside, W., 215
 Cannon, Jim, 128, 139, 145, 169, 247
 Caprace, P.-E., 141, 173
 Charney, R., 31, 140, 176
 Chiswell, I., xi, 229
 Ciobanu, L., 139, 173, 182, 183
 Collins, D., 221
 Dahmani, F., 167
 Davis, M., 173
 Day, M., 216
 de la Harpe, P., 139
 Dehn, M., 7, 26, 97
 Dehornoy, P., 32, 140, 176
 Dunwoody, M., 233
 Edjvet, M., 139
 Elder, M., 144, 145, 147
 Epstein, D., 34, 113, 125, 134, 138, 166, 191
 Erschler, A., 216
 Escher, M., 30
 Gersten, S., 102, 125, 134, 140, 141, 143, 184,
 241, 243, 244
 Ghys, É., 139
 Gillibert, P., 214
 Gilman, R., 118, 128, 142, 146, 182, 254
 Glasner, Y., 211, 212
 Godelle, E., 31
 Golod, E., 138, 215
 Goodman, O., 112, 113, 252
 Greendlinger, M., 27, 140, 237
 Gregorac, R., 232
 Greibach, S., 48
 Grigorchuk, R., 194, 209, 216, 217, 239
 Gromov, M., 23, 105, 114, 139, 150, 154, 165,
 184, 217, 235, 241
 Grushko, I., 11, 232
 Guirardel, V., 167
 Gupta, C., 213

Index of Names

285

- Gupta, N., 194, 201, 213
 Haefliger, A., 167
 Hamenstädt, U., 141
 Harkins, A., 140
 Hartmanis, J., 250
 Havas, G., 139
 Herbst, T., 43, 232
 Hermiller, S., 140, 143, 147, 182
 Higman, G., 16, 18, 35, 227
 Holt, D., 92, 113, 118, 125, 134, 138, 139,
 141, 142, 147, 159, 166, 167, 176, 182,
 190, 191, 208, 239, 252, 254, 258, 263,
 268
 Hopf, H., 26
 Howie, J., 166
 Howlett, R., 30, 141, 173
 Humphreys, J., 173
 Hurt, D., 190, 191
 Immerman, N., 86
 Incitti, R., 233
 Juhász, A., 139
 Kaimanovich, V., 207
 Karass, A., 232
 Kharlampovich, O., 147
 Khoussainov, B., 147
 Klimann, I., 214, 215
 Knuth, D., 118
 Krammer, D., 30
 Lakin, S., 236, 237
 Lavreniuk, Y., 209
 Lehnert, J., 260, 263, 268
 Leonov, Yu., 214
 Linnell, P., 217
 Lubotzky, A., 217
 Lyndon, R., 27
 Lysënok, I., 216
 Madlener, K., 103, 226, 227, 237
 Mann, A., 216, 217
 Maslov, A., 262
 Matucci, F., 263
 McCammond, J., 140
 Meier, J., 176
 Mennicke, J., 139
 Miasnikov, A., 147
 Miller, C., 7, 8, 227
 Milnor, J., 153, 216
 Mosher, L., 141, 142
 Moussong, G., 30, 141
 Mozes, S., 211, 212
 Mühlherr, B., 141, 173
 Muller, D., 26, 106, 228
 Muntyan, Y., 213
 Nekrashevych, V., 194, 204, 207–210
 Neumann, B., 16, 18
 Neumann, H., 16, 18
 Neumann, W., 139, 143, 145, 169, 170, 173
 Neunhöffer, M., 263
 Niblo, G., 141, 173
 Novikov, P., 88, 103, 117, 221
 Ol'shanskii, A., 105, 165
 Oshiba, T., 262
 Otto, F., 103, 227
 Owens, M., 233
 Papasoglu, P., 105, 145, 155, 165
 Parikh, R., 74, 75, 235, 255, 263
 Paris, L., 31, 32, 140, 176
 Parkes, D., 108
 Peifer, D., 140
 Picantin, M., 214, 215
 Pietrowski, A., 232
 Pin, J.-É., 49
 Pyber, L., 217
 Rabin, M., 47
 Rebecchi, D., 140
 Redfern, I., 189
 Rees, S., 92, 113, 141, 142, 182, 191, 252,
 258, 263, 268
 Reeves, L., 141, 143, 173
 Riley, T., 240, 241, 243, 247
 Rips, E., 166, 167, 187
 Rivin, I., 183
 Röver, C., 92, 208, 209, 239, 254, 258, 263,
 268
 Rosenberg, A., 48, 251
 Rotman, J., 88, 221
 Rozhkov, A., 214
 Saito, K., 31
 Sapir, M., xi, 103, 227
 Savchuk, D., 212, 215
 Schützenberger, M., 56
 Schick, T., 217
 Schreier, O., 9
 Schupp, P., 26, 28, 106, 228
 Schweitzer, P., 260, 268
 Scott, E., 207
 Segal, D., 217
 Seifert, F., 187
 Sela, Z., 167
 Serre, J.-P., 19
 Shafarevich, I., 138, 215

- Shalev, A., 217
Shapiro, M., 49, 112, 113, 125, 133, 139, 143,
145, 147, 169, 170, 173, 236, 246, 252,
254
Short, H., 49, 125, 140, 141, 143, 184
Sidki, S., 194, 199, 201, 204, 206, 207, 212,
214
Sims, C., 118, 120, 124
Solitar, D., 34, 232
Stallings, J., 26, 231, 233
Stearn, R., 250
Steinberg, B., 212
Strebel, R., 140
Šunić, Z., 147, 207, 214
Sushchansky, V., 216
Taback, J., 147
Thomas, R., 108, 233, 258, 263
Thompson, R., 35
Thurston, W., 126, 129, 146
Tits, J., 30
van den Dries, L., 233
van der Lek, H., 31
Ventura, E., 214
Virág, B., 207
Vogtmann, K., 141
Vorobets, M., 212
Vorobets, Y., 212
Wilkie, A., 233
Williams, A., 125, 139, 192
Wilson, J., 209, 214, 217
Yamada, H., 47
Zalesskii, P., 214
Zapata, F., 214
Žuk, A., 217

Index of Topics and Terminology

- 2-tape fsa, 93
- 2-variable fsa, 93
- k -pda, 64
- accepting state, 38
 - of pda, 60
- accessible group, 232, 254
- active state, 198
- algorithm
 - Cannon, 112
 - Dehn, 97, 110, 140, 150
 - generalised, 112, 113, 252
- almost convex group, 240, 247
- alphabet, 4
- ambiguous grammar, 51
- amenable group, 207
- A -quasiconvex subgroup, 187
- Artin group, 31, 140
 - dihedral type, 31
 - extra-large type, 31, 140, 182
 - finite type, 31
 - large type, 31, 140, 141
 - right-angled, 13, 27, 31, 140
 - spherical type, 31, 32
- asynchronous
 - 2-variable fsa, 93
 - automatic structure, 128
 - fellow traveller property, 127
- asynchronously
 - automatic group, 128, 147
 - biautomatic group, 128
 - bicombable group, 128
 - combable group, 128, 142, 240, 243
- atomic monoid, 32
- automatic
 - coset system, 189
 - shortlex, 190
 - strongly, 190
- group, 28, 117, 127, 128, 170, 236, 237
 - asynchronously, 147
 - Cayley graph, 147
 - C -graph, 147
 - strongly geodesically, 145, 150, 155
 - structure, 127, 128
 - asynchronous, 128
 - geodesic, 135
 - shortlex, 135
- automaton, 36, 37
 - n -variable, 91
 - bireversible, 211
 - circuit in, 204
 - dual, 210
 - finite state, 36, 38, 52
 - group, 199
 - index, 123
 - language of, 37
 - nested stack, 48, 239, 254
 - of tree automorphism, 204
 - one-counter, 43
 - pushdown, 41, 60
 - reversible, 211
 - stack, 48
 - synchronous, 198
 - word-difference, 129
- automaton semigroup, 213
- automorphism
 - finite state, 199
- autostackable group, 148
- Bass–Serre tree, 20
- Baumslag–Solitar group, 34, 113, 141, 147, 189, 246, 254, 264
- biautomatic group, 28, 128, 155, 189
- bicombable group, 128

- bigon
 - geodesic, 154
- binary adding machine, 195
- bireversible automaton, 211
- blank symbol, 44
- bounded tree automorphism, 204, 239
- braid group, 31, 113
- braid relation, 30
- branch group, 208
 - regular, 209
 - weakly, 208
- Britton's Lemma, 18, 224, 225
- Cannon algorithm, 112
- Cartan matrix, 29
- Cartesian product, 11
- Cayley graph, 20, 39
- Cayley graph automatic group, 147
- C -graph automatic group, 147
- Chomsky hierarchy, 38, 249
- Chomsky normal form, 69, 229
- Church's Thesis, 44, 45
- Church–Turing Thesis, 44
- circuit in automaton, 204
- circuitous tree automorphism, 206
- co-context-free
 - group, 257, 260
 - universal, 263
 - semi-deterministic, 260, 262
- co-indexed
 - semi-deterministic, 239, 268
- co-word problem, 80, 256
 - context-free, 257, 260
 - indexed, 239
- combable group, 128, 142
- combing, 128
- commutator, 3
- complement (in group), 12
- complete fsa, 41
- complete rewriting system, 120
- complexity, xi, 46
- composite fsa, 96
- computable function, 46
- cone type, 126
- configuration graph (of Turing machine), 45
- confluent rewriting system, 120
- congruence, 5
 - syntactic, 51, 108
- conjugacy geodesic, 182
- conjugacy problem, 7, 27, 134, 166, 214, 256
- conjugate, 3
- context-free grammar, 69
 - context-free group, 258
 - context-free language, 42, 254
 - deterministic, 62
 - context-sensitive grammar, 85, 236
 - context-sensitive language, 47, 85, 113, 236
 - contracting group, 207
 - convergent rewriting system, 120
 - coset multiplier, 189
 - coset word-acceptor, 189, 190
 - Coxeter diagram, 29
 - Coxeter group, 27, 29, 141, 173
 - Euclidean, 29
 - hyperbolic, 29
 - parabolic subgroup, 30
 - spherical, 29
 - standard subgroup, 30
 - word-hyperbolic, 30, 141
 - Coxeter matrix, 29
 - $C(p)$ -group, 27
 - $C(p) + T(q)$ -group, 27
 - critical pair (in rewriting system), 121
 - cyclically reduced form (in free product), 16
 - cyclically reduced word, 7, 26
- defining relation, 6
- defining relator, 6
- Dehn
 - algorithm, 97, 110, 140, 150, 252
 - generalised, 112, 113, 252
 - diagram, 99
 - function, 102, 161
 - linear, 161
 - presentation, 27, 110, 150
- derivation
 - equivalent, 51
 - in grammar, 50
 - left-most, 51
 - right-most, 51
- deterministic
 - fsa, 41, 52
 - pda, 42, 62
 - context-free language, 42, 62
 - context-sensitive language, 47
 - Turing machine, 44
- diameter (of van Kampen diagram), 114, 243
- direct factor, 11
- direct product, 11
 - restricted, 12
- directed tree automorphism, 205
- distance
 - Hausdorff, 25
- divergence function, 155

- δ -slim triangle, 151
- δ -thin triangle, 152
- dual automaton, 210
- elementary amenable group, 216
- empty word, 4
- endomorphc presentation, 217
- endomorphism
 - virtual, 207
- ends (of a graph), 25
- ends (of a group), 25
- ε -move, 53
- ε -transition, 53
- equivalence
 - Nerode, 214
- equivalent fsa, 53
- equivalent derivations, 51
- Euclidean Coxeter group, 29
- Euclidean group, 140
- factorisation (of $w \in \text{WP}(G, X^{\neq})$), 98
- failure state, 39
- falsification by fellow traveller property, 143, 170
- families of languages, 36
- fellow traveller constant, 127
- fellow traveller property, 127, 244
 - asynchronous, 127
 - synchronous, 127
- FFTP, 143, 170, 176
- filling function, 114
- filling length, 240, 242
 - of van Kampen diagram, 114
 - of word, 114
- final state, 38
- finite state automaton, 36, 38, 52
- finite state automorphism, 199
- finite state transducer, 194
- finitely generated (semigroup, monoid, group), 5
- finitely presentable (semigroup, monoid, group), 6
- finitely presented (semigroup, monoid, group), 6
- finiteness problem, 214
- fractal group, 209
- free
 - factors, 11
 - group, 6, 212
 - monoid, 6
 - product, 10, 26
 - with amalgamation, 13, 20, 232
 - semigroup, 6
- fsa
 - 2-tape, 93
 - 2-variable, 93
 - asynchronous 2-tape, 93
 - asynchronous 2-variable, 93
 - complete, 41
 - composite, 96
 - deterministic, 41, 52
 - equivalent, 53
 - non-deterministic, 41
 - partial, 40
 - synchronous 2-tape, 93
 - synchronous 2-variable, 93
- function
 - computable, 46
 - partial, 46
 - total, 46
- fundamental group of graph of groups, 19
- Garside group, 32, 176
- general linear group, 212
- generalised Dehn algorithm, 112, 113, 252
- generalised sequential machine, 49, 195
- generalised sequential mapping, 50
- generalised word problem, 8, 167, 186
- generating set, 5
- generator, 5
 - Schreier, 9, 24
- geodesic
 - conjugacy, 182
- geodesic automatic structure, 135
- geodesic bigon, 154
- geodesic metric space, 20
- geodesic triangle, 150
- geodesic word, 4, 5, 21, 169
- geometrically finite hyperbolic group, 113, 139, 173, 240, 252, 254
- grammar, 36, 37
 - ambiguous, 51
 - context-free, 69
 - context-sensitive, 85, 236
 - growing context-sensitive, 85
 - language of, 37
 - left-regular, 58
 - production rule, 37
 - regular, 59
 - right-regular, 59
 - semi-Thue, 36
 - start symbol, 37
 - terminal, 37
 - Type 0, 36
 - Type 1, 85

- Type 2, 69
- unrestricted, 36
- variable), 37
- graph
 - Cayley, 20
 - Schreier, 21
- graph group, 31
- graph of groups, 19
 - fundamental group of, 19, 20
- graph product, 13, 143, 182
- Greendlinger's Lemma, 237
- Greibach normal form, 69
- Grigorchuk group, 215, 216, 239, 268
- group, 4
 - accessible, 232, 254
 - almost convex, 240, 247
 - amenable, 207
 - elementary, 216
 - Artin, 31, 140
 - dihedral type, 31
 - extra-large type, 31, 140, 182
 - finite type, 31
 - large type, 31, 140, 141
 - right-angled, 13, 27, 31, 140
 - spherical type, 31, 32
 - asynchronously automatic, 128, 147
 - asynchronously biautomatic, 128
 - asynchronously bicomvable, 128
 - asynchronously combable, 128, 142, 240, 243
 - automatic, 28, 117, 127, 128, 170, 236, 237
 - strongly geodesically, 150, 155
 - automaton, 199
 - autostackable, 148
 - Baumslag–Solitar, 34, 141, 147, 189, 246, 254, 264
 - biautomatic, 28, 128, 155, 189
 - bicomvable, 128
 - braid, 31, 113
 - branch, 208
 - regular, 209
 - weakly, 208
 - Cayley graph automatic, 147
 - C-graph automatic, 147
 - co-context-free, 257, 260
 - universal, 263
 - combable, 128, 142
 - complement in, 12
 - context-free, 258
 - contracting, 207
 - Coxeter, 27, 29, 141, 173
 - word-hyperbolic, 141
 - Euclidean, 140
 - fractal, 209
 - free, 6
 - Garside, 32, 176
 - geometrically finite hyperbolic, 113, 139, 173, 252, 254
 - graph, 31
 - Grigorchuk, 215, 216, 239, 268
 - Gupta–Sidki, 215, 216
 - Higman–Thompson, 34, 239, 260, 262, 268
 - Houghton, 260
 - hyperbolic, 28, 105, 111, 117, 139, 145, 150, 170, 182, 187, 191, 240, 252, 254
 - knot, 33
 - lamplighter, 203
 - language for, 4
 - linear, 236
 - mapping class, 31, 141
 - nilpotent, 3, 23, 140, 142, 147, 189, 240, 252, 254, 264
 - non-Hopfian, 34
 - normal form for, 5
 - parallel poly-pushdown, 147
 - poly-context-free, 255
 - polycyclic, 3, 140, 189, 264
 - real-time, 252
 - recurrent, 209
 - recursively presentable, 98
 - relatively hyperbolic, 113, 140, 170, 173
 - residually finite, 216
 - self-similar, 207
 - soluble, 3
 - solvable, 3
 - state-closed, 207
 - strongly geodesically automatic, 145
 - surface, 28
 - virtually abelian, 170, 182
 - word-hyperbolic, 28, 30, 105, 111, 139, 145, 150, 170, 187, 191, 240, 252, 254
- group extension, 12
- growing context-sensitive grammar, 85
- growth
 - function, 22, 183, 216
 - intermediate, 199, 216
 - polynomial, 23
 - rate, 217
 - series, 23, 139, 183
 - subgroup, 217
 - uniformly exponential, 217
- growth series, 118

- Grushko's theorem, 11, 232
 Grzegorzczuk hierarchy, 226
 Gupta–Sidki group, 215, 216
 Hausdorff distance, 25
 Higman–Thompson group, 34, 239, 260, 262, 268
 HNN-extension, 16, 20, 34, 142, 223, 232, 246
 multiple, 19, 224
 Houghton group, 260
 hyperbolic Coxeter group, 29
 hyperbolic group, 28, 105, 111, 117, 139, 145, 150, 170, 182, 187, 191, 240, 252, 254
 geometrically finite, 240
 hyperbolic metric space, 153
 inactive state, 198
 index automaton, 123
 indexed co-word problem, 239
 indexed language, 48, 249, 254
 inner product, 154
 instantaneous description (of Turing machine), 45
 interior points (of triangle), 151
 inverse transducer, 197
 isodiametric function, 243
 isodiametric inequality, 243
 isomorphism problem, 7, 167
 isoperimetric function, 102
 isoperimetric inequality, 243
 KBMAG, 118, 125, 186, 192
 Kleene closure, 56
 knot, 32
 fundamental group of, 33
 group, 33
 Trefoil, 33
 Knuth–Bendix completion, 121, 125, 136
 K -step real-time Turing machine, 249
 lamplighter group, 203
 language, 4, 36
 n -variable, 91
 context-free, 42, 254
 context-sensitive, 47, 85, 113, 236
 deterministic context-free, 42, 62
 deterministic context-sensitive, 47
 family, 36
 for a group, 4, 126
 indexed, 48, 249, 254
 locally excluding, 49, 182
 locally testable, 49, 182
 of automaton, 37
 of grammar, 37
 one-counter, 43, 80, 232
 parallel poly-pushdown, 49
 poly-context-free, 48, 249, 254
 quasi-real-time, 48
 rational, 38
 real-time, 47, 240, 249
 recursive, 45
 recursively enumerable, 45
 regular, 38, 53
 star-free, 49, 182
 tidy real-time, 252
 left greedy normal form, 177
 left-most derivation, 51
 left-regular grammar, 58
 lenlex ordering, 5, 120
 letter, 4
 level transitive, 208
 limit space, 210
 linear group, 236
 linearly bounded Turing machine, 47
 locally confluent rewriting system, 120
 locally excluding language, 49, 182
 locally testable language, 49, 182
 L -quasiconvex subset, 184
 L -rational subset, 184
 MAF package, 139, 192
 mapping class group, 31, 141
 Markov–Post theorem, 88, 90, 91
 $m\delta$ -reduction, 215
 Mealy machine, 195
 metric space
 geodesic, 20
 minimisation of transducer, 214
 monoid, 4
 atomic, 32
 free, 6
 syntactic, 52, 108
 transition, 54
 morphism
 syntactic, 52
 Muller–Schupp Theorem, 43, 106, 228, 258
 multiplier automaton, 130
 coset, 189
 Myhill–Nerode theorem, 54
 Nerode equivalence, 214
 nested stack automaton, 48, 239, 254
 Nielsen–Schreier Theorem, 10
 nilpotent group, 3, 23, 140, 142, 147, 189, 240, 252, 254, 264
 Noetherian rewriting system, 120
 non-deterministic

- fsa, 41
- pda, 42
 - Turing machine, 44
- non-Hopfian group, 34
- normal form, 5, 117, 126
 - Chomsky, 69, 229
 - Greibach, 69
 - left greedy, 177
 - rational, 184
 - shortlex, 5
- Novikov–Boone theorem, 88, 91
- nucleus, 207
- null string, 4
- n -variable automaton, 91
- n -variable language, 91
- one-counter
 - pda, 43
 - automaton, 43
 - language, 43, 80, 232
- ordering
 - lenlex, 5, 120
 - recursive path, 120
 - reduction, 9, 119
 - shortlex, 5, 120
 - wreath product, 120
- padding symbol, 92
- parallel poly-pushdown group, 147
- parallel poly-pushdown language, 49
- Parallel Wall Theorem, 173
- Parkih's theorem, 75
- parse tree (of grammar), 30
- partial fsa, 40
- partial function, 46
 - recursive, 46
- path
 - geodesic, 20
- pda, 60
 - deterministic, 42, 62
 - non-deterministic, 42
 - one-counter, 43
 - stack of, 41
- permutational transducer, 197
 - mapping, 198, 239, 268
- phrase structure, 36
- piece (in group presentation), 26
- pinch (in HNN-extension), 18, 224
- ping-pong lemma, 14
- poly-context-free
 - group, 255
 - language, 48, 249, 254
- polycyclic group, 3, 140, 189, 264
- positive word, 30
- prefix property (of language), 63
- presentation
 - Dehn, 27, 110, 150
 - endomorphlic, 217
 - recursive, 98
 - recursively enumerable, 98
 - Wirtinger, 33
- product
 - Cartesian, 11
 - direct, 11
 - free, 10
 - graph, 13, 143
 - semidirect, 12
 - wreath, 12, 147
- production rule (of grammar), 37
- pumping lemma
 - for context-free languages, 72
 - for regular languages, 60
- pushdown automaton, 41, 60
- quasi-isometric
 - embedding, 22, 23
 - groups, 24
 - spaces, 23
- quasi-isometry, 23
- quasi-real-time language, 48
- quasiconvex subgroup, 166, 187, 191
- quasiconvex subset, 184
- quasigeodesic, 160, 165
 - path, 24
 - word, 24
- radius (of van Kampen diagram), 114
- rank (of free group), 6
- rational
 - expression, 57
 - language, 38
 - normal form, 184
 - structure, 184
 - subgroup, 166
- real-time
 - K -step Turing machine, 249
 - group, 252
 - language, 47, 240, 249
 - tidy language, 252
 - Turing machine, 47, 249
- recurrent group, 209
- recursive
 - language, 45
 - partial function, 46
 - path ordering, 120
 - presentation, 98

- recursively enumerable language, 45
- recursively enumerable presentation, 98
- recursively presentable group, 98
- reduced
 - form (in free product), 16
 - word, 7
 - word (in rewriting system), 119
- reduction ordering, 9, 119
- regular
 - branch group, 209
 - expression, 57
 - grammar, 59
 - language, 38, 53
- Reidemeister–Schreier rewriting, 9
- Reidemeister–Schreier Theorem, 10
- relation, 6
 - braid, 30
 - defining, 6
- relatively hyperbolic group, 113, 140, 170, 173
- relator, 6
 - defining, 6
- residually finite group, 216
- restricted
 - direct product, 12
 - standard wreath product, 13
 - wreath product, 13
- reversible automaton, 211
- rewrite rules, 111, 119
- rewriting
 - Reidemeister–Schreier, 9
- rewriting system, 37, 111, 118
 - complete, 120
 - confluent, 120
 - convergent, 120
 - locally confluent, 120
 - Noetherian, 120
 - terminating, 120
- right-angled Artin group, 13, 27, 31, 140
- right-most derivation, 51
- right-regular grammar, 59
- rigid stabiliser, 208
- rooted tree automorphism, 205
- roots
 - fundamental, 174
 - negative, 174
 - of Coxeter group, 174
 - positive, 174
- Schreier generator, 9
- Schreier graph, 21, 184, 210
- Schreier transversal, 9
- section of tree automorphism, 204
- Seifert–van Kampen Theorem, 14, 16
- self-similar group, 207
- semi-deterministic co-context-free, 260, 262
- semi-deterministic co-indexed, 239, 268
- semi-Thue grammar, 36
- semidirect product, 12
- semigroup, 4
 - free, 6
- shortlex
 - automatic coset system, 190
 - automatic structure, 135
 - normal form, 5
 - ordering, 5, 120
- slim triangle, 151
- small cancellation, 26, 140, 182, 237
- soluble group, 3
- soluble word problem, 7
- solvable group, 3
- spherical Coxeter group, 29
- split extension, 12
- square complex, 211
- stack
 - of pda, 41
- stack automaton, 48
- standard wreath product, 13
- star-free language, 49, 182
- start state, 38
 - of pda, 60
- start symbol (of grammar), 37
- state
 - accepting, 38
 - accepting of pda, 60
 - active, 198
 - failure, 39
 - final, 38
 - inactive, 198
 - start, 38
 - start of pda, 60
- state-closed group, 207
- stratified
 - linear set, 76
 - semilinear set, 76
- string, 4
- strongly automatic coset system, 190
- strongly geodesically automatic group, 145, 150, 155
- subgroup
 - A-quasiconvex, 187
 - quasiconvex, 166, 187, 191
 - rational, 166
- subgroup growth, 217

- surface group, 18, 28
- symmetric closure (of group presentation), 26
- symmetric closure (of relators), 110
- synchronous
 - 2-variable fsa, 93
 - automaton, 198
 - fellow traveller property, 127
- syntactic congruence, 51, 108
- syntactic monoid, 52, 108
- syntactic morphism, 52
- terminal (of grammar), 37
- terminating rewriting system, 120
- thin triangle, 152
- Thompson's group F , 35, 113, 196
- Thurston's Geometrisation Conjecture, 146
- tidy real-time language, 252
- total function, 46
- transducer
 - deterministic, 195
 - finite state, 194
 - inverse, 197
 - minimisation of, 214
 - permutational, 197
- transition function
 - of fsa, 52
 - of pda, 61
- transition monoid, 54
- transversal
 - Schreier, 9
- tree automorphism
 - automaton of, 204
 - bounded, 204, 239, 268
 - circuitous, 206
 - directed, 205
 - rooted, 205
 - section of, 204
- triangle
 - δ -slim, 151
 - δ -thin, 152
 - geodesic, 150
- Turing machine, 36, 44, 82
 - K -step real-time, 249
 - deterministic, 44
 - linearly bounded, 47
 - non-deterministic, 44
 - real-time, 47, 249
- Type 0 grammar, 36
- Type 1 grammar, 85
- Type 2 grammar, 69
- unique word-acceptor, 118
- unrestricted grammar, 36
- useful variable, 69
- useless variable, 69, 229
- van Kampen diagram, 27, 99
 - diameter, 114, 243
 - filling length, 114
 - radius, 114
- variable
 - of grammar, 37
 - useful, 69
 - useless, 69, 229
- virtual endomorphism, 207
- virtually abelian group, 170, 182
- weakly branch group, 208
- Whitehead problem, 167
- Wirtinger presentation, 33
- word, 4
 - cyclically reduced, 7, 26
 - empty, 4
 - geodesic, 4, 5, 21, 169
 - positive, 30
 - quasigeodesic, 24
 - reduced, 7
 - reduced (in rewriting system), 119
- word metric, 153
- word problem, 7, 39, 133, 166, 213
 - generalised, 8, 167, 186
 - of group, 97
 - soluble, 7
- word-acceptor, 117, 118, 127
 - coset, 189, 190
 - unique, 118
- word-difference, 127
 - automaton, 129
- word-hyperbolic Coxeter group, 30, 141
- word-hyperbolic group, 28, 30, 105, 111, 139, 145, 150, 170, 187, 191, 240, 252, 254
- words over X , 4
- wreath product, 12, 147
 - restricted, 13
 - restricted standard, 13
 - standard, 13
- wreath product ordering, 120