

Index

- 1-UBC, 29
- B_1^H , 39
- $C'(\lambda)$, 129
- $C(p)$, 129
- C_b^1 , 17
- $C_{*}^{l_1}$, 29
- H_b^* , 26
- Q , 18
- $T(q)$, 129
- $\text{CAT}(\kappa)$, 129
- $\mathcal{C}(S)$, 81
- $\text{Out}(F_n)$, 83
- \mathbb{R} -tree, 83
- $\mathfrak{B}(G)$, 179
- $\mathfrak{C}(G)$, 179
- \overline{Z}_* , 29
- \widehat{Q} , 17
- Acylindricity Theorem, 82
- adjacency matrix, 166
- algorithm
 - polynomial time, 103
- anti-aligned, 74
- area norm, 113
- Arnold, 156
- Arnold tongues, 107
- Artin, 154
- axis, 67
- Banach space, 26, 30
 - nonseparable, 32
- bar complex, 26
- Barge, 21, 147, 149
- Bass–Serre tree, 45, 74
- Bavard, 13, 46, 102
 - duality, 17, 42, 64, 115, 124, 137
- Bavard duality
 - generalized, 39
- Bavard Duality Theorem, 35, 61, 142
- Belyi’s theorem, 7
- Bestvina, 51, 74, 81, 83, 84
- bicombable, 175
- Bieri, 139
- Boltzmann’s constant, 136
- Bootstrap Lemma, 124
- Boshernitzan, 143
- Bouarich, 27
- Bouarich’s Theorem, 42
- boundary norm, 29
- bounded cochain, 26
- bounded cohomology, vii, 13, 14, 26
 - continuous, vii
- bounded generation, 145
- Bowditch, 66, 81, 84
- Boyer, 46
- branch locus, 91
- bridge position, 94, 97
- Broadbent, 83
- Brodskii, 131
- Brooks, 21, 71, 118, 181
- Brown, 138
- Bureau representation, 155
- Burger, 125, 137, 143, 144
- Burns, 46
- Buser, 52
- cactus, 130
- Calabi homomorphism, 157
- Calegari, 51, 70, 75, 82, 140, 163, 170, 182, 194
- Cannon, 174
- carrying map, 93
- Carter, 137, 146
- Cauchy distribution, 172
- causal, 137, 150, 152, 153
- Cayley graph, 65
- cellulation, 2
- Central Limit Theorem, 164, 169, 170, 192, 194
- character variety, 126
- combable function, 163, 174, 175
- combing, 174
- commutator length, 13
- commutators, 5
- Compactness Theorem, 146
- complex length, 63
- complex of curves, 80, 108
- compressibility, 116

- cone, 150, 152
- Coornaert, 184, 187, 188
- copy, 72
- critical exponent, 187
- crossing number, 75, 111
- cubical complex, 138
- Culler, 14, 83, 130
- cylinder, 168

- Dantzig, 102
- Day, 123
- defect, 17
- defect topology, 30
- degree, 15
- Dehn, 77, 128
- Dehn surgery, 52, 53, 61
- Dehn twist, 55, 77–79
- Dehn–Nielsen Theorem, 77
- Delzant, 63
- dessin d’enfant, 7
- diagram, 127
 - reduced, 128
 - van Kampen, 127
- digraph, 166, 169
 - almost semisimple, 185
 - recurrent, 166
- discrete derivative, 164, 165
- DNA, 135
- Domic, 148, 152
- drill, 52
- Duncan, 87, 131

- Edmunds, 14
- elementary matrix, 146
- Endo, 78
- Entov, 159, 160
- Epstein, 21, 71, 163, 181
- Euler characteristic, 4, 15
- Euler class, 28, 91, 116, 125, 142
- exact sequence, 28
- exlp, 102

- face
 - codimension one, 120
 - infinite codimension, 124
 - infinite dimension, 123
- Farb, 83
- fat graph, 127
- Fathi, 158
- Feighn, 51, 83, 84
- fill, 52
- filling norm, 34, 38
 - stable, 34
- finite state automaton, 173
- flowline, 68
- folding, 104
- foliation, 91, 139
- fragmentation, 139, 160

- Fujiwara, 21, 51, 70–72, 74, 75, 81, 82, 163, 170, 181, 194
- fully irreducible, 84

- Gabai, 89, 91
- Gambaudo, 155, 156, 158
- Gauss–Bonnet, 115
- Gauss–Bonnet Theorem, 7, 8, 45, 56, 113, 129, 133
- Gelfond, 142, 145
- genus, 4
- genus problem, 13
- geodesic flow, 68
- geodesic lamination, 53
- Gersten
 - norm, 29, 34, 38
- Ghys, 21, 143, 147, 149, 155, 156, 158, 171
- g_{1psol}, 102
- Goldman, 125
- Gordon, 90, 110
- graph of groups, 109
- graphical calculus, 20, 94, 118
- greedy algorithm, 181
- Grigorchuk, 22
- Gromov, vii, 14, 27, 51, 109, 137
 - norm, 1, 9, 26, 89, 102, 109
 - product, 65, 170
- Gromov–Hausdorff, 53
- group
 - almost simple Lie, 144
 - amenable, 27, 33, 65, 99
 - Baumslag–Solitar, 90
 - boundedly generated, 145
 - braid, 101, 137, 154
 - combable, 174
 - Grigorchuk, 27
 - Hopfian, 49
 - hyperbolic, 51, 56, 65, 128, 163
 - elementary, 66
 - left orderable, 45, 46, 87
 - locally indicable, 46, 133
 - mapping class, 64, 77, 154
 - one relator, 87, 131
 - polycyclic, 48
 - PQL, 99, 137
 - residually free, 133
 - solvable, 27
 - Stein–Thompson, 138, 142
 - symplectic, 125, 137, 147
 - Torelli, 83
 - transformation, 137, 157
 - uniformly perfect, 26

- Hahn–Banach Theorem, 34
- Hale, 46
- Hall, 48, 124
- Hamenstädt, 83
- Hamiltonian, 160
- Harish-Chandra, 153

- Harvey, 80
- Hass, 111
- Hatcher, 2, 77, 80
- Hausdorff, 53
- Heegaard splitting, 108
- Heegaard surface, 13
- Hodgson, 61
- Holliday junction, 136
- Hopf's formula, 5
- Horsham, 163, 171
- Howie, 87, 131
- hyperbolic Dehn surgery, 60
- hyperbolic Dehn surgery Theorem, 53
- hyperboloid model, 8

- ideal boundary, 66, 187
- Immersion Theorem, 120
- integral cycle, 3
- Iozzi, 125
- irreducible, 144

- Jørgensen's inequality, 62
- Johnson, 27
- Jordan curve theorem, 2
- junction, 136
- junction, 22

- Kaneyuki, 154
- Karmarkar, 104
- Keller, 137, 146
- Kellerhals, 52
- Kerckhoff, 61
- Kiyomi, 102
- Korkmaz, 79
- Kotschick, 78, 80

- Lagrangian, 125, 149, 153
- lattice, vii, 137, 143, 144
- Le Roux, 160
- Lefschetz fibration, 78
- length function, 83
- LERF, 48, 121, 124
- Lickorish, 77
- Liehl, 147
- lightlike, 150
- linear programming, 96, 102
- linking number, 112
- Liousse, 142, 143
- LO, 46
- longitude, 52
- Lyndon, 129

- Malcev, 48
- Malestein, 108
- Manning, 32, 90
- Margulis, 117
 - constant, 51, 52, 58, 64
 - Lemma, 51, 52
 - tube, 61

- Markov, 192
- Markov chain, 163, 184
 - ergodic, 168
 - stationary, 168, 192
- Markov property, 168
- Maslov class, 125
- Masur, 80, 82
- Matsumoto, 14, 28, 29
- meridian, 52
- Mess, 108
- Meyerhoff, 52
- Milley, 91
- Milnor–Wood inequality, vii, 28, 91, 116
- Mineyev
 - flow space, 68, 71
 - symmetric join, 68
- Minsky, 80, 82
- Monod, 137, 143, 144
- monotone, 113
- monotonicity, 14
- Moore, 2
- Morita, 14, 29
- Morse Lemma, 66, 73
- Münchhausen trick, 80, 141

- Neumann, 61
- nonuniform, 144

- Oertel, 89
- order topology, 46
- orderable, 46, 47, 131
- Ore, 14
- Ore's conjecture, 14
- Outer space, 83

- Paige, 137, 146
- pair of pants, 53
- Paneitz, 152
- Papadopoulos, 188
- Patterson–Sullivan measure, 184, 187, 188
- Perron–Frobenius, 168, 195
 - matrix, 166
- Perron–Frobenius Theorem, 167, 184
- Picaud, 163
- piece, 128
- ping-pong, 60, 66, 118, 119
- Poincaré, vii, 24
- Poincaré series, 187
- Polterovich, 159, 160
- polygon, 95, 101, 103, 127, 131, 133
- polyhedron, 87
- Powell, 77
- power law, 106
- prefix closed, 173
- primary visual cortex, 1
- product formula, 44
- property (T), 147
- pseudo-Anosov, 81
- Putman, 83

- Py, 159, 160
 quadratic word, 129
 quasi-isometry, 65
 quasimorphism, 13, 17
 antisymmetric, 18
 bicomposable, 180, 194
 Calabi, 157
 continuity of, 160
 counting, 21, 32, 41, 71, 72, 118, 120, 135, 163, 181
 de Rham, 21, 41, 51, 61, 158, 161
 extremal, 41, 46, 117
 Hölder, 170
 homogeneous, 18
 rotation, 24, 44, 91, 116
 Ruelle, 159
 symplectic, 149, 150, 155
 translation, 24
 quaternion algebra, 144

 \mathbb{R} -split torus, 144
 Radó, 2
 Rademacher function, 156, 171
 ramified embedding, 145
 random walk, 163
 Rationality Theorem, 87, 99, 137
 rationally bounds, 114
 real rank, 144
 realizing path, 72
 rectangle, 95, 101, 103, 127, 131, 133
 recurrent, 151
 reduced picture, 131
 reducible, 81
 refinement, 169
 regular language, 128, 173
 Reidemeister 3, 111, 154
 retraction, 14
 Reznikov, 61
 ribbon graph, 127
 Rigidity Theorem, 87, 120
 Rips, 51
 Rolfsen, 46
 rotation, 138
 rotation number, vii, 24, 44, 115, 142
 Rotation number formula, 119
 Rudin, 28
 Ruelle, 156

 Sarnak, 171, 172
 scallop, 106, 123
 Schneider, 142, 145
 Schupp, 129–131
 scl spectrum, 106
 Scott, 48, 111
 sector, 91
 Seiberg–Witten, 78
 self-product formula, 47
 Separation Theorem, 75, 82

 Sergiescu, 143
 Serre, 109
 Sharp, 163, 171
 shift map, 167
 Shilov boundary, 153, 154
 Shtern, 160
 Siegel upper half-space, 148, 153
 small cancellation, 60, 65, 127, 128
 solution, 130
 source-sink dynamics, 66
 spacelike, 150
 Spectral Gap Theorem, 59, 71
 spectral sequence, 43
 Hochschild–Serre, 6
 spinning, 53
 Squier, 155
 stable commutator length, viii, 13
 norm, 36, 38
 staircase, 20
 Stallings, 48, 104
 stationary measure, 168, 188, 191, 195
 Stein, 137–139
 stochastic matrix, 190
 straightening map, 8
 Strebel, 139
 Sullivan, vii, 156
 surface
 admissible, 15
 branched, 89, 91
 classification of, 4
 conformal, 6
 extremal, 16, 37, 98, 107, 124, 133
 harmonic, 56
 hyperbolic, 7, 49, 53
 immersed, 114, 121
 injective, 107
 isometric, 107
 minimal, 14, 56
 monotone, 16
 normal, 94
 pleated, 53, 64, 69, 113
 simple branched, 91
 symmetric bounded domain, 153
 tube type, 153
 symplectic
 rotation number, 149
 symplectic form, 147

 Taubes, 78
 Teichmüller space, 83, 115
 temperature, 136
 thick-thin decomposition, 51, 52, 56
 Thompson, 137
 Thurston, 14, 53, 77, 80, 88, 115, 116
 norm, 14, 88, 90, 102, 137
 tile set, 177
 timelike, 150
 Toledo, 148, 152

- train, 153
- translation length, 66, 81, 84
- translation number, 24
- Trauber, 27
- trefoil knot, 101, 172
- Tresser, 156
- triangulation, 2
- Tsuboi, 139

- uniform, 144
- Uniformization Theorem, 7
- unit ball, 87
- universal circle, 91

- van Kampen, 127
 - soup, 135
- Vignéras, 144
- virtually bounds, 114, 117
- Vogtmann, 83

- weakly combable, 175
- weakly properly discontinuous, 51, 74, 81, 84
- Weierstrass point, 111
- weight, 92
- Weinbaum, 129
- Whitehead link, 91
- Wienhard, 125
- Wiest, 46
- wife
 - my lovely, ix
- Wilton, 90, 110
- winding number, 118
- Witt identities, 108
- Witte-Morris, 137, 146
- word
 - alternating, 94
 - compatible family, 24
 - geometric, 90
 - monotone, 23
 - reduced, 166

- Zagier, 61
- Zariski dense, 125
- Zariski topology, 1
- Zeno of Elea, 80
- Zhuang, 137, 139, 143
- Zimmer, 161