

Index

- abscissa
 - absolute conv., 393
 - conditional conv., 393
- accelerator mode, 490
- action, 331, 592, 605, 615
 - helium, 673
 - relation to period, 680
- adjacency matrix, 273, 293, *see* transition matrix
- admissible
 - periodic points, 290
 - trajectories, number of, 286
- Airy
 - equation, 598
 - function, 598
- Airy function, 599, 662, 665, 670
 - at a bifurcation, 599
- Airy integral, 598
- algebra, 753
 - associative, 753
 - Lie, 753
- allowable itinerary, *see* admissible
- alphabet, 203
- alternating binary tree, 221
- analyticity
 - domain, 362
- anomalous diffusion, 498
- Anosov flows, 243
- anti-hermitian
 - generator, 171, 172
- antiharmonic extension, 775
- arc, 275
- area preserving
 - Hénon map, 126
 - map, 829
- Artin-Mazur zeta function, 296
- associative algebra, 753
- attractor
 - basin, 41
 - Hénon, 346
 - strange, 41, 46, 340
- Aubry-Mather theory, 573
- autonomous flow, 43
- average
 - chaotic, 471
 - space, 318, 333
 - time, 318, 331
- averaging, 29
- Axiom A, 447, 454
- baker's map, 139, 235
- Balmer spectrum, 581
- basin of attraction, 41
- basis vector, 752
- BER
 - approximation, 482
- Bernoulli, 733
 - polynomials, 434
 - shift, 212, 429, 434, 442, 453, 455, 462, 480, 497, 736, 737, 882, 939
 - shift eigenfunctions, 449
 - shift return times, 480
- Berry-Keating conjecture, 747
- Bessel function, 653
 - addition theorem, 655
- bi-infinite itinerary, 218
- bifurcation
 - Airy function approximation, 599
 - bizarre, 775
 - generic, 139
 - Hopf, 527
 - saddle-node, 66
- billiard, 134–139
 - map, 135
 - stability, 99, 136
 - stadium, 134, 140, 161, 483, 827, 829, 865
- billiards, 925
- binary
 - prime cycles, 232, 241, 290
 - symbolic dynamics
 - collinear helium, 676
 - tree, alternating, 221
- Birkhoff
 - coordinates, 58, 135, 140
 - ergodic theorem, 319
- Birkhoff coordinates, 925
- block
 - finite sequence, 218
- block, pruning, 220
- Bohr
 - de Broglie picture, 581
 - Sommerfeld quantization, 581, 632, 744
 - helium, 672, 682
 - Uetli Schwur, 744
- Bohr-Sommerfeld quantization, 599
- Boltzmann
 - equation, 24, 501
 - stosszahlansatz, 24
- Boltzmann, L., 24, 735
- boredom, 713, 859
- Borges, J.L., 713
- boundary orbits, 407
- bounded operators, 845
- Bourbaki, N., 65
- Bowen, R., 31
- brain, rat, 5, 32
- branch cut, 466
 - singularity, 467
- Bunimovich
 - stadium, *see* stadium billiard
- Burnett coefficient, 495
- butterfly effect, 66
- $C_{3v} = D_3$ symmetry, 241, 411
- canonical transformation, 124, 125, 763
- Cartan, É., 191
- Cartwright, M.L., 161, 736
- Cauchy criterion, 843
- caustic, 609
- ceiling function, 360, 454
- center, 76
- center manifold, 520
- center of mass, 267
- centralizer, 148
- chain rule
 - matrix, 841
- change
 - of coordinates, 106
- chaology, *see* chaos
- chaos, 7, 9
 - caveats, 10
 - deterministic, 30
 - diagnostics, 48
 - quantum, 31
 - skeleton of, 13, 14
 - spatiotemporal, 508
 - successes, 10
- character
 - representation, 809
- characteristic
 - equation, 758
 - exponent, 77, 97
 - function, 311
 - polynomial, 292, 759, 810
 - value, 77
- chicken heart palpitations, 7
- circle map, 212, 276, 307, 492, 498, 527–529, 534, 541, 544, 711, 879, 1003, 1009
 - critical, 530, 535
- class, 146
- class algebra, 829
- Clebsch-Gordan
 - coefficients, 755
- co-moving frame, 99
- coarse-graining, 311
- coding, *see* symbolic dynamics
- collinear helium, 583
 - symbolic dynamics, 676
- combinatorics
 - teaching, 213
- compact
 - group, 150
 - invariant set, 147
- complete
 - N -ary dynamics, 275
 - symbolic dynamics, 275
- completeness
 - relation, 78, 754, 759, 811
- complex eigenvalues, 79, 766, 993
- complex Lorenz flow, 166, 193
 - equivariance, 174
 - relative periodic orbit, 178
- complexity
 - algorithmic, 305
- confession
 - C.N. Yang, 317
 - Kepler, 733
 - St. Augustine, 311
- configuration space, 48
- conjugacy, 108
 - invariant, 116
 - smooth, 106, 116, 119, 923
 - topological, 214
- conjugate, hermitian, 807
- connection formulas, 598
- connection, method of, 191
- conservation
 - equation, 551
 - phase space volume, 123, 125, 126, 129, 323
- continuity equation, 321, 323, 551, 554, 607
- contour integral, 368
- contracting
 - Floquet multipliers, 97, 351
 - flow, 41, 46, 85

- map, 91, 223
- state space, Rössler, 91, 398
- contraction
 - state space
 - Rössler, 918
- convergence
 - abscissa of, 393
 - mediocre, 837
 - radius, 362
 - super-exponential, 439, 561
- convexity, 345
- coordinate
 - change, 106, 108, 921
 - longitudinal, 617
 - transformations, 119
- Copenhagen School, xi, 744
- correlation
 - decay
 - power law, 460
 - function, 449
 - spectrum, 449
 - time, 424
- coset, 146
- cost function, 562
- covariant Lyapunov vector, 95
- covering
 - symbolic dynamics, 218
- creeping
 - 1-disk, 663
- critical
 - point, 98, 210, 215, *see* equilibrium point
 - value, 211, 492
- cross-section, 181, 191
- cumulant
 - expansion, 291, 295, 383
 - Plemelj-Smithies, 849
- curvature
 - correction, 380
 - expansion, 28, 380
- cycle, *see* periodic orbit
 - expansion, 19, 380, 631
 - 3-disk, 396
 - finite subshift, 388
 - Lyapunov exponent, 388
 - stability ordered, 389
- fundamental, 292, 380, 835
- limit, 340
- Lyapunov exponent, 97
- marginal stability, 72, 100, 180
- prime, 219, 251, 306, 353
 - 3-disk, 251, 571
 - Hénon map, 564
- pruning, 303
- Rössler flow, 254, 266
- stability, 94–102
 - Gauss map, 538
- stable, 98
- superstable, 98
- weight, 365
- cycle point, *see* periodic point
- cyclic
 - group, 804, 805
 - invariance, 251
 - symmetry, 288
- cyclist
 - Lie groups, 172
- damped Newton method, 256
- Danish pastry, *see* symbol plane
- danish pastry, 236
- de Broglie wavelength, 601
- Debye approximation, 670
- decay
 - rate, 372
 - rate of correlations, 450
- decomposition
 - irreducible, 813
- defining
 - rep, 807
 - vector space, 806
- degenerate
 - eigenvalues, 757
- degree of freedom, 10, 122, 523, 593
- delta function, *see* Dirac delta
 - Dirac, 588, 949, 978
- density, 311, 551
 - evolution, 24
 - phase space, 323
- density of states
 - average, 627
 - Green's function, 589
 - quantum, 589
- desymmetrization
 - 3-disk, 415, 961
 - state space, 181
- determinant
 - for flows, 364
 - Fredholm, 852
 - graph, 305
 - Hadamard, 362
 - spectral, 23, 291, 362
 - trace relation, 291
 - trace-class operator, 846
- deterministic dynamics, 7, 38, 320
- diagonalizing matrix, 810
- differential equations
 - almost ordinary, 50
 - ordinary
 - almost, 914
- diffraction
 - Green's function, 697
 - Keller, 705
 - Sommerfeld, 705
- diffusion
 - anomalous, 498
 - constant, 335
 - equation, 552
 - limited aggregates, 32
- digraph, *see* transition graph
- dihedral group, 804, 805
- dike map, 216, 223
- dimension
 - box counting, 862
 - fractal, 862
 - generalized, 11
 - information, 862, 863
 - intrinsic, 10, 523
- Dirac delta, 21, 23, 297, 313, 326, 338, 353, 360, 373, 443, 552
 - derivatives, 327
 - Jacobian, 321
- Dirac delta function, 590, 610, 622, 949, 978
- Dirac path integral, 621
- Dirichlet series, 392
- dissipative
 - map, 91, 223
- divergence rate
 - local, 343
- divergence ultraviolet, 629
- DLA, 32
- dof, *see* degree of freedom
- dot product, 170
- doubling map, 212, 446
- drift, along group tangent, 167
- dual
 - rep, 752, 806, 807
 - space, 752, 806
 - vector space, 806
- Duffing oscillator, 43, 48, 58, 122
- dynamical
 - system
 - gradient, 914
 - transitivity, 273
 - zeta function, 18, 366
 - Euler product rep., 366
- dynamical system, 37, 38
 - equivalent, 117
 - gradient, 50
 - infinite, 524
 - smooth, 20, 21, 28, 39, 299, 736, 882, 885, 887
- dynamics
 - deterministic, 7, 38
 - hyperbolic, 275
 - irreversible, 42
 - reversible, 42
 - spatiotemporal, 31
 - stochastic, 7
 - symbolic, 12, 202, 217
 - symmetry, 144, 166
 - topological, 202, 217, 219, 274
- edge, 275
- eigendirection, 71
- eigenfunction
 - Perron-Frobenius operator, 432
 - energy, 586
 - Perron-Frobenius, 432
- eigenstate, *see* eigenfunction
- eigenvalue, 372
 - Perron-Frobenius operator, 432
 - complex, 79, 766
 - degenerate, 757
 - exponential spacing, 363
 - zero, 599, 614
- eigenvalues
 - complex, 993
- Einstein
 - diffusion formula, 553
- Einstein, A, 747
- elastic
 - scattering, 638
- elliptic
 - stability, 127
- enemy
 - thy, 462
- English
 - plain, 190, 218
- ensemble
 - microcanonical, 345
- entire function, 432
- entropy
 - barrier, 395
 - Gauss map, 545
 - Kolmogorov, 139, 305, 857, 859, 864, 865, 913, 967
 - topological, 8, 286, 297, 305
- equation
 - of variations, 70
- equilibria
 - Kuramoto-Sivashinsky, 516
- equilibrium, 175
 - Lorenz flow, 44, 60
 - point, 43, 80, 317, 516, 564
 - Rössler flow, 46, 50, 80, 206
 - Rössler system, 915

- relative, 175
- stability, 921
- equilibrium measure, *see* natural measure
- equivalence
 - of dynamical systems, 117
- equivariance, 144
 - complex Lorenz flow, 174
- equivariant, *see* relative
- ergodic
 - average, 319
 - theorem
 - multiplicative, 345
 - theory, 319
- error correlation matrix, 757
- escape rate, 14, 15, 327, 336, 337, 368, 370, 375, 383, 388, 396, 421, 428, 435, 455, 554, 801, 834, 859, 863, 864, 913, 952, 955, 958, 967, 998, 1001
 - 3-disk, 387, 396, 419
 - intermittency, 470
 - vanishing, 327, 386, 773
- essential
 - spectral radius, 442, 451
 - spectrum, 442
- Euler
 - formula, 74, 434, 964
 - limit, 83
 - MacLaurin formula, 450
 - product, 83, 370
 - product rep.
 - dynamical zeta function, 366
 - totient function, 531
- Eulerian coordinates, 72
- evolution
 - group, 50, 914
 - kernel probabilistic, 320
 - operator, 21, 339
 - quantum, 588
 - semigroup, 339
- expanding
 - Floquet multipliers, 97, 351
- expectation value, 333, 346
- exponent
 - characteristic, 97
 - Floquet, 97
- exponential
 - convergence, 362, 439
 - decay rate of correlations, 450
 - of a matrix, 75
 - proliferation, 22, 305
- extremal point, 594
- factor group, 146
- false zeros, 370
- Farey
 - map, 205, 460, 482
 - mediant, 532
 - series, 530
 - tree, 532
- Feigenbaum
 - constant, 360
- Feynman path integral, 613, 621
- Fick law, 552
- finite group, 804
- finite subshift
 - cycle expansion, 388
- first return time, 54, 479
- fixed point, 251
 - maps, 67
 - marginally stable, 460
 - under G , 148, 150
- fixed-point subspace, 148
- Floquet
 - exponent, 85, 97, 126
 - multiplier, 77, 84, 95, 97, 226, 351
 - multiplier, metric invariant, 115
 - theorem, 96
 - theory, 97, 103
 - vector, 95
- flow, 37–47
 - autonomous, 43
 - contracting, 41, 46, 85
 - deterministic, 320
 - elliptic, 98
 - generator of, 321, 786
 - Hamiltonian, 122, 829
 - hyperbolic, 98, 127, 372
 - incompressible, 85, 323
 - infinite-dimensional, 507–524
 - invariant subspace, 149
 - inverse hyperbolic, 127
 - linear, 73, 90
 - linearized, 71
 - nonhyperbolic, 98
 - spectral determinant, 364
 - stability, 79
 - stationary, 43
 - stochastic, 320
 - stretch & fold, 210
- Fokker-Planck equation, 554
- form, normal, 114
- Fourier
 - mode
 - truncation, 510
- Fréchet derivative, 71
- fractal, 32, 860
 - aggregates, 11
- dimension, 862
 - geometry of nature, 11
 - probabilistic, 11
 - science, 11
- Fredholm
 - determinant, 852
- Fredholm theory, 439, 440
- Frenkel-Kontorova model, 573
- frequency analysis, 48
- Fresnel integral, 594, 599
- full shift, 275
- function
 - L^2 square-integrable, 451
 - analytic, 450
 - space, piecewise constant, 354
- functional, 318
 - composition, 42
 - Lyapunov, 41
- fundamental
 - cycle, 292
 - cycles, 835
 - domain, 241
 - collinear helium, 675
 - matrix, 71, 755
- fundamental matrix, 789
- G -equivariant, 169
- G -fixed, 148, 150
- G -invariant
 - basis, *see* invariant polynomial basis
 - polynomial basis, 150, 186
- G -invariant
 - polynomial basis, 149, 161, 162, 191
- G_p -symmetric, 151
- Galerkin truncation, 512
- Galilean invariance, 510, 524
- Gatto Nero
 - professor, 211
- gauge fixing, 60
- Gauss map, 327, 482, 531, 532, 542
 - cycle stability, 538
 - metric entropy, 545
- Gauss shift, *see* Gauss map
- Gaussian
 - integral, 326, 494, 558, 622
 - integral, d -dimensional, 558, 610
 - noise, 892
 - probability density, 553
- generating function, 353, 574
- generating partition, 219
- generator
 - anti-hermitian, 171, 172
 - Lie algebra, 170
 - of flow, 321, 786
- Gilmore, R., 161
- $GL(n, \mathbb{F})$, 805
- golden mean, 276, 307
 - pruning, 223, 276, 293, 307, 375, 773, 937, 946, 955, 1007
 - renormalization, 534, 542
- good taste, 221
- gradient
 - algorithm, 562
 - system, 50, 914
- grammar
 - symbolic dynamics, 220
- graph
 - irreducible, 275
 - strongly connected, 275
 - transition, 272
- Gray codes, 221
- Green's function, 590
 - analogue of, 790
 - density of states, 589
 - diffraction, 697
 - energy dependent, 588
 - regularized, 629
 - scattering, 644
 - semiclassical, 619, 621, 622
 - short distance, 618, 619
 - trace, 588
 - long orbits, 618
- group, 804
 - S^1 , 804
 - compact, 150
 - cyclic, 804, 805
 - dihedral, 804, 805
 - dynamical, 42
 - evolution, 50, 914
 - finite, 143, 804
 - general linear, 805
 - Lie, 168, 169, 804
 - matrix, 808
 - not a, 830, 997
 - orbit, 147, 159, 169, 175
 - orbit, equilibrium, 194
 - orbit, marginal eigenvalue, 180
 - orbit, reduction, 181
 - orbit, slice, 176, 182, 185, 188
 - orbit, velocity, 761
 - order of, 143, 804
 - representation, 808
 - semi-, 321, 786
 - symmetric, 804
 - tangent field, 170, 173
- Gutzwiller
 - trace formula, 627
- Gutzwiller path integral, 621

- Gutzwiller, M., 739
- Hadamard determinant, 362
- Hadamard product, 630
- Hamilton
 - Jacobi equation, 602, 619, 900
 - equations, 602
 - principal function, 555, 605
- Hamilton-Cayley theorem, 754, 759
- Hamilton-Jacobi equation, 555
- Hamiltonian, 586, 603
 - dynamics, 121–130
 - flow, 829
 - spectral determinant, 366
 - stability, 123, 764
 - flows, stability, 762
- Hénon map, 126
- repeller, periodic orbits, 267, 942
- Hankel function, 618, 653, 670
- harmonic oscillator, 119
- Harter, W. G., 829
- Heaviside function, 589
- Heisenberg, 744, 745
 - picture, 843
- Heisenberg, W, 785
- Helfand moments, 494
- helium, 672, 744
 - collinear, 51, 67, 123, 583, 691, 916
 - cycles, 267, 691
 - eigenenergies, 692
 - fundamental domain, 675
 - Poincaré section, 691
 - stabilities, 691
 - stability, 267
- Helmholtz equation, 653
- Hénon map, 64, 66, 127
 - attractor, 320, 346
 - cycles, 267, 562
 - fixed points, 67, 233
 - Hamiltonian, 126
 - horseshoe, 233
 - inverse, 233
 - Lyapunov exponent, 346, 953
 - natural measure, 317
 - prime cycles, 564, 575
 - pruning, 838
 - pruning front, 244
 - stability, 87, 98
 - structural stability, 245
 - symmetries, 829
 - time delay map, 259
 - transient, 564
- Hénon, M., 66
- Hénon-Heiles
 - symbolic dynamics, 161
- hermitian
 - conjugation, 807
 - matrix, 807
- heroes
 - unsung, xi, xvi
- Hessian matrix, 124
- heteroclinic orbit, 207, 213, 222
- Hilbert
 - basis, *see* invariant polynomial basis
 - space, 587
- Hilbert basis
 - SO(2), 186
- Hilbert-Schmidt
 - operators, 845
- Hilbert-Schmidt condition, 440
- Hilbert-Weyl theorem, 150
- Holmes, P., 523
- homoclinic orbit, 207
- Hopf
 - bifurcation, 527
 - Hopf's last hope, 742
 - Hopf, E., 740, 741
 - Hopf, Ebehardt, 527
 - Hopf, Heinz, 689
- horseshoe, 232
 - complete, 235
- hydrodynamical
 - interpretation of QM, 621
- hyperbolic
 - flow, 98, 127, 372
 - non-, 25
 - orbit, partially, 98
- hyperbolicity assumption, 17, 352
- image space, 181, 186
- in/out nodes, 76
- inadmissible symbol sequence, 219
- incommensurate, 40
- incompressible flow, 85
- indecomposability, 273
 - metric, 204
- index
 - Maslov, *see* topological index
- index summation, repeated, 805
- indifferent
 - stability, 71
- induced map, 474
- inertial manifold, 512, 523
- infinite-dimensional flows, 507–524
- inflection point, 528
- information
 - dimension, 862
- information dimension, 863
- initial
 - conditions, sensitivity to, 8
 - point x_0 , 16, 39, 71
 - state x_0 , 16, 39
- injective, 65
- integrable system, 105, 123
- integrated observable, 331, 332, 339, 343, 353, 367, 379, 836
- integration
 - Runge-Kutta, 50
- intermittency, 139, 445, 459
 - escape rate, 470
 - piecewise linear model, 462
 - resummation, 476
 - stability ordering, 391
- invariance
 - cyclic, 251
 - Galilean, 510, 524
 - of flows, 100
 - symplectic, 124, 130, 762
- invariant, 808
 - density, *see* natural measure
 - matrix, 807
 - measure, 317
 - measure, Gauss map, 327
 - metric, 95, 116
 - points, 148
 - polynomial basis, 149, 150, 161, 162, 181, 186–189, 191
 - polynomials, 926
 - set, compact, 147
 - subgroup, 146
 - subspace, 149
 - tensor, 173
 - topological, 95
 - tori, 189
 - vector, 807
- inverse
 - hyperbolic, 96, 127
 - iteration, 255
 - iteration, Hamiltonian repeller, 267, 942
- inversion, 143
- involution, 805
- inward/outward spirals, 76
- irreducible
 - decomposition, 813
 - graph, 275
 - matrix, 273
 - segment, 154
- irrep, 813
- irreversibility, 24, 42
- Ising model, 240, 410, 415, 870, 872, 883, 884, 889, 890
- isotropy, 147, 150, 159, 160
- isotypic decomposition, 160
- iteration, 39
 - inverse, 255
 - Hamiltonian repeller, 267, 942
 - map, 63
- itinerary, 12, 14, 58, 203, 252
 - bi-infinite, 205, 218
 - future, 211, 217
 - past, 218
- Jacobi, C.G.J., 90
- Jacobian, 84, 312
 - matrix, 16, 71, 756
- Jonquière function, 464, 483, 499, 501, 504
- Jordan form, 758
- Jordan normal form, 760
- KAM
 - tori, 459
- Karhunen-Loève, 230
- Keller
 - diffraction, 705
- Keller, J.B., 739
- Keplerian orbit, 581
- kernel
 - resolving, 441
- kneading
 - determinant, 221
 - sequence, 215, 223
 - theory, 215
 - value, 215, 223
- Kolmogorov entropy, 139, 305, 857, 859, 864, 865, 913, 967
- Koopman operator, 785, 790
- Kraichnan, R., 741
- Kramers, 744
- Krein-Friedel-Lloyd formula, 645
- Kronecker delta, 752, 806
- KS, *see* Kustaanheimo-Stiefel
- Kuramoto, Y., 523
- Kuramoto-Sivashinsky
 - equilibria, 516, 518
 - system, 513, 516, 519, 523
- kurtosis, 346, 494
- Kustaanheimo-Stiefel transformation, 111, 673
- L^2 function space, 451
- Lagrangian, 605
 - coordinates, 72
 - frame, 99
 - manifold, 606
- laminar states, 459
- Langevin equation, 553, 557

- Laplace
 - transform, 23, 297, 322, 355, 356, 360, 588, 619, 787
 - transform, discrete, 290, 353, 481
- Laplace, Pierre-Simon de, 6
- Laplacian
 - diagonalization, 831
 - non-local, 831
- last hope, Hopf's, 742
- least action principle, 251, 571
- Legendre transform, 605
- Leibniz, Gottfried Wilhelm, 6
- Letellier, C., 161
- level set, 122
- libration orbit, 678, *see* self-retracing
- Lie
 - algebra, 169, 170, 173, 753
 - bracket, 174
 - derivative, 174
 - group, 168, 169, 804
 - product, 753
- lifetime, 14
- lifetime matrix, 648
- limit
 - cycle, 340
- limit cycle
 - stability, 921
- linear
 - flow, 73, 90
 - space, 751
 - stability, 69, 94, 516
- linearized
 - flow, 71
- link, 275
- Liouville
 - equation, 323
 - operator, 324
 - theorem, 123, 125, 126, 129, 323
- Littlewood, J.E., 736
- local
 - divergence rate, 343
 - stability, 69, 94, 516
- logistic map, *see* unimodal
- longitudinal
 - coordinate, 617
- loop
 - intersecting, 292
- Lorentz gas, 459, 482
- Lorentzian, 590, 978
- Lorenz flow, 44, 60, 81, 83, 85, 152, 155, 163, 207, 926, 997
 - complex, *see* complex Lorenz flow
 - polar coordinates, 162, 830
 - proto-Lorenz, 163, 926
 - symmetry, 145, 162
- Lorenz, E.N., 66, 161
- loxodromic, 764
- quartet, 126, 131
- Lozi map, 65, 66
- Lyapunov
 - covariant vector, 95
 - exponent, 8, 85, 117, 340
 - exponent, cycle, 97
 - exponent, cycle expansion, 388
 - exponent, equilibrium, 517
 - exponent, natural measure, 343
 - exponent, numerical, 345
 - exponent, numerically, 342
 - functional, 41
 - time, 8, 10, 25, 42, 331
- M state space volume, 336
- manifold
 - unstable, 227
- map, 39, 62–65
 - area preserving, 829
 - contracting, 91, 223
 - dike, 216, 223
 - dissipative, 91, 223
 - expanding, 205
 - fixed point, 67
 - Hénon, 64, 562, 829
 - Hamiltonian, 126
 - prime cycles, 564
 - Hamiltonian
 - Hénon, 126
 - iteration, 63
 - logistic, *see* unimodal
 - Lozi, 65, 66
 - once-folding, 232
 - order preserving, 214
 - orientation preserving, 829
 - orientation reversing, 829
 - quadratic, 65
 - return, 16, 54–56, 58, 206, 207, 217, 229, 233
 - sawtooth, 145, 151, 401
 - stability, 86
 - stroboscopic, 921
 - tent, 210
 - unimodal, 210
- marginal
 - stability, 16, 71, 97, 180, 351, 445, 460
 - cycle, 72, 100, 180
 - fixed point, 460
- Markov
 - chain, 218
 - graph, *see* transition graph
- matrix, 273, 314, 388
 - partition, 495
 - finite, 205, 275
 - infinite, 282
 - not unique, 227
- Maslov index, *see* topological index
- material invariant, 551
- Mather, *see* Aubry-Mather theory
- matrix
 - diagonalizing, 810
 - exponential, 75, 788
 - group, 808
 - hermitian, 807
 - invariant, 807
 - irreducible, 273
 - of variations, *see* stability matrix
 - product, 753
 - rep, 753
 - stability, 70, 555
- matrix representation, 144
- Maupertuis, P.L.M. de, 251, 571
- measure, 311
 - continuous, 117
 - invariant, 317
 - natural, 66, 318, 325, 333, 425, 427, 486, 741, 746
- mechanics
 - quantum, 586
 - statistical, 24
- mediocre
 - convergence, 837
- memory
 - m -step, 203
 - finite, 277
- method of connections, 191
- metric
 - indecomposability, 204, 839
 - invariant, 95, 116
 - Floquet multiplier, 115
 - transitivity, 839
- metric entropy
 - Gauss map, 545
- microcanonical ensemble, 345
- Mira, C., 66
- Misiurewicz, M., 66
- mixing, 8, 9, 17, 319
- mode
 - normal, 830
- Moebius inversion, 302
- monodromy matrix, 86, 101, 351, 763
- Morse index, *see* topological index
- moving frame, 181, 182
 - SO(2), 183
- multi-scattering matrix, 656
- multifractals, 879
- multiplicative ergodic theorem, 345
- multiplier
 - Floquet, 77, 97, 226
- multipoint shooting method, 257
- N -disk
 - transition matrix, 275
- natural density, *see* natural measure
- natural invariant, *see* natural measure
- natural measure, 66, 264, 318, 325, 333, 343, 425, 427, 448, 486, 741, 746
- nature
 - geometry of, 11
- Navier-Stokes equation, 507
- neighborhood, 69, 102
- Nero, G., 211
- neutral, *see* marginal
- New York subway map, 227
- Newton method, 256
 - convergence, 256
 - damped, 256
 - flows, 259
 - optimal surface of section, 769
- Newtonian dynamics, 121
- node, 275
- noise
 - Gaussian, 553, 556, 892
 - white, 553
- non-wandering set, 41, 234
- nonequilibrium, 486
- nonhyperbolic
 - flow, 98, 100
- norm, 843
- normal
 - divisor, 146
 - form, 114
 - mode, 830
 - washing machine, 143
- normal modes, 997
- obscure
 - foundations, 744
 - jargon, 190, 202
 - topology, 513, 518
- observable, 318, 325, 331, 351, 424, 471, 479, 486, 498, 739, 785, 867, 872, 889, 890
 - integrated, 331, 332, 339, 343, 353, 367, 379, 836
 - simultaneous, 812
 - vector, 346
- ODEs, 507
- $O(n)$ group, 804

- 1-disk
 - creeping, 663
 - scattering, 654
 - semiclassical scattering, 660
- Onsager-Machlup, 557
- open systems, 14, 335
- operator
 - evolution, 339
 - Hilbert-Schmidt, 845
 - Koopman, 785, 790
 - Liouville, 324
 - norm, 843
 - Perron-Frobenius, 313, 345
 - positive, 845
 - regularization, 851
 - resolvent, 290, 322, 787
 - semigroup
 - bounded, 322, 787
 - shift, 216, 218
 - trace-class, 844
- orbit, 39, 63, 147
 - inadmissible, 215
 - Keplerian, 581
 - periodic, 40, 219, 379, 625, 626
 - returning, 624
- orbit space, 181
- order preserving map, 214
- ordering
 - spatial, 212, 235
- ordinary differential equations, *see* ODEs
 - almost, 50, 914
- partial differential equations, 507
- orientation
 - preserving map, 829
 - reversing map, 829
- orthogonality
 - relation, 78, 754, 759, 811
- Oseledec ergodic theorem, 345
- palpitations, chicken heart, 7
- paradise
 - this side of, 419
- partial differential equations, *see* PDEs
- partial differential equations, 507
- partially hyperbolic invariant tori, 189
- partially hyperbolic orbit, 98
- partition, 203, 219
 - state space, 311
 - generating, 219
 - infinite, 223, 297, 306
 - Markov, 205
- partition function, 344
- passive scalar, 551
- past topological coordinate, 237
- path integral
 - stochastic, *see* Wiener integral
- PDEs, 38, 507
- period
 - relation to action, 680
- periodic
 - orbit, 13, 40, 176, 219, 379, 625, 626
 - condition, 250, 264, 561
 - extraction, 250–264, 561–571
 - Hamiltonian repeller, 267
 - inverse iteration, 255
 - multipoint shooting, 257
 - Newton method, 256
 - relative, 177
 - relaxation algorithm, 562
 - orbit extraction
 - Hamiltonian repeller, 942
 - orbit, short, 154, 160
 - point, 13, 16, 21, 22, 40, 214, 219, 777
 - admissible, 290
 - count, 300
 - unstable, 14
- periodic orbit
 - unstable, 98
- Perron-Frobenius
 - matrix, 273
 - operator, 313, 345, 432
 - theorem, 448, 454, 882
- Peter-Weyl theorem, 168
- phase space, 38, 130, *see* state space
 - 3-disk, 839
 - density, 323
 - vs. state space, 48
- piecewise constant function, 354
- piecewise linear map, 482
 - intermittency, 462
 - repeller, 337
- pinball, *see* 3-disk
 - simulator, 140, 925
- plain English, 190, 218
- plane Couette flow
 - energy, 524
 - relative solutions, 179
 - stability, 761
 - symmetries, 146, 150, 161, 168
 - unstable manifold, 229
- Plemelj-Smithies cumulants, 849
- POD, 230
- Poincaré invariants, 129
- Poincaré return map, 54, 55
 - cycle, 101
 - polynomial, 63
 - stability, 87
- Poincaré section, 13, 54–62, 233
 - 3-disk, 135
 - Hénon trick, 66
 - hyperplane, 56, 229
- Poincaré, H., 5, 9, 15
- point
 - non-wandering, 41
 - periodic, 13, 219
 - scatterer, 706
 - wandering, 40
- point-wise invariant, *see* G -fixed
- Poisson
 - bracket, 174, 323, 324, 326, 762
 - resummation, 23, 477
- polar coordinates, 119
- Pollicott, M., 345, 480
- polylogarithm, 464
- polynomial
 - characteristic, 292
 - topological, 296
- Pomeau, Y., 66
- positive operators, 845
- post-processing, 182, 189
- potential
 - problems, 50
- power law
 - correlation decay, 460
- pressure, 344
 - thermodynamic, 344
- prime cycle, 219, 251, 306, 353
 - 3-disk, 232, 306, 571
 - binary, 232, 241, 290
 - count, 302
 - Hénon map, 564, 575
 - ternary, 240
- primitive cycle, *see* prime cycle
- probabilistic zeta function, 480
- probability
 - density, Gaussian, 553
 - matrix, 273
- product
 - Lie, 753
 - matrix, 753
- profile, spatial, 39
- projection operator, 759, 810
- propagator, 588
 - semiclassical, 610
 - short time, 611, 618
 - Van Vleck, 612
- pruning, 12, 460
 - block, 220
 - golden mean, 223, 276, 293, 307, 375, 773, 937, 946, 955, 1007
 - individual cycles, 303
- primary interval, 216
 - rules, 275
 - symbolic dynamics, 219
- pruning front, 238
 - 3-disk, 205, 246
- pseudocycle, 379
- quadratic map, 65
- quantization
 - Bohr-Sommerfeld, 581
 - semiclassical, 624
 - WKB, 591, 595
- quantum
 - chaos, 584, 630
 - evolution, 588
 - interference, 601
 - mechanics, 586
 - potential, 620
 - propagator, 588
 - resonances, 581
 - theory, old, 744
- quantum chaosology, *see* chaos, quantum
- quasiperiodicity, 40
- quotient
 - group, 146
 - state space, 60, 147, 181
- radius
 - of convergence, 362
- random matrix theory, 584
- Rayleigh-Benard flow, 44
- recoding, 220, 232, 240
- rectangle, 236
- rectification
 - flows, 107
 - maps, 113
- recurrence, 41, 202
 - time, *see* return time
- reduced state space, 147, 180, 181
- reducible representation, 168
- reflection, 143
- regular group action, 182
- regularization, 110, 630
 - Green's function, 629
 - operator, 851
- relative
 - equilibrium, 175
 - periodic orbit, 177
 - solutions, 356
- relaxation algorithm, 562
- renormalization, 139
 - golden mean, 534, 542
- rep
 - defining, 807
 - dual, 752, 806, 807

- matrix, 753
 - standard, 805
- repeated index summation, 805
- repeller, 14, 41, 336, 583
 - piecewise-linear, 337
 - single fixed point, 432
- representation
 - character, 809
 - equivalent, 809
 - faithful, 809
 - linear, 168
 - matrix, 808
 - reducible, 168
 - regular, 809
 - space, 805
- representative point, 38
- residue, 129
 - stability, 127, 131
- resolvent
 - kernel, 441
 - operator, 290, 322, 787
- resonances
 - complex, 583
 - quantum, 581
 - Ruelle-Pollicott, 345, 480
- resummation
 - intermittency, 476
- return map, 16, 56, 58, 233
 - Rössler flow, 206
- return time, 480
 - distribution, 480
- returning orbit, 624
- reversible
 - dynamics, 42
- Riemann zeta function, 392, 482, 499
- Rössler
 - attractor, 58
 - cycles, 254, 266
 - equilibria, 50, 80, 206
 - flow, 45, 48, 50, 58, 67, 91, 342
 - Lyapunov exponent, 346
 - return map, 206
 - web diagram, 217
- Rössler system, 915
 - equilibria, 915
- rotating wave, 175
- Roux, Henri, 30, 85
- Ruelle
 - Pollicott resonances, 345, 480
 - zeta function, *see* dynamical zeta function
- Ruelle, D., 31, 345, 480
- Runge-Kutta integration, 50
- running orbit
 - Lorentz gas, 490
 - Rutherford, 672
 - Rydberg series, 682
- S^1 group, 804
- saddle, 76
- saddle point, *see* stationary phase
- saddle-node bifurcation, 66
- sausage, $(N+1)$ -dimensional, 167
- sawtooth map, 145, 151, 401
- scalar multiplication, 751
- scattering
 - 3-dimensional spheres, 139
 - elastic, 638
 - Green's function, 644
 - matrix, 639
 - phase shift, 646
 - point, 706
- schmactals, *see* fractal
- Schrödinger
 - equation, 586
 - time independent, 586
 - picture, 843
- Schrödinger, E., 785
- Schwartzian derivative, 117
- section
 - Poincaré, 13, 54, 56, 58, 135
- secular equation, 758, 759, 810
- self-retracing cycle, 678
- self-similar, 22
- semiclassical
 - approximation, 602
 - Green's function, 619, 622
 - propagator, 610
 - quantization, 624
 - spectral determinant
 - collinear helium, 683
 - wave function, 608
 - semiclassical zeta function, 631
- semiclassical resonances
 - 3-disk, 905
- semigroup, 321, 786
 - dynamical, 42
 - evolution, 339
 - operator, 322, 787
- Sensitivity
 - initial conditions, 911
- sensitivity to initial conditions, 8, 34, 66, 340
- set
 - non-wandering, 234
- shadowing, 19, 20, 299
- 3-disk, 387
- shift, 218
 - Bernoulli, 212, 434, 480, 939
 - finite type, 220
 - full, 218, 275
 - map, 529
 - operator, 216, 218
 - sub-, 219
- short periodic orbit, 154, 160
- similarity transformation, 116
- simultaneous observables, 812
- Sinai, Ya., 31
- Sinai-Bowen-Ruelle measure, *see* natural measure
- single fixed point
 - repeller, 432
 - spectral determinant, 433
- singular value decomposition, 75, 90
- singular values, 76
- singularity
 - branch cut, 467
- Sivashinsky, G.I., 523
- skeleton of chaos, 13, 14
- slice, 181, 182, 191
 - condition, 182
 - linear, 182
- Smale
 - wild idea, 364, 374
- Smale, S., 11, 31, 226, 243, 305, 374, 736
- small divisor problem, 352
- S -matrix, 639
- smooth, 170
 - conjugacy, 106, 115, 116, 119, 923
 - dynamical system, 524
 - dynamics, 20, 21, 28, 39, 299, 736, 882, 885, 887
 - approximated, 834
 - dynamics, spectral determinant, 453
 - interaction, 889
 - potential, 139
- $SO(2)$, 170, 183
- $SO(2)$, 80, 119, 168, 171, 174, 186, 193–195, 756
 - irreducible representation, 171
- $SO(3)$, 170, 743
- solution
 - symmetry, 174
- Sommerfeld
 - diffraction, 705
- space
 - analytic functions, 450
 - average, 318
 - averaging, 333
 - configuration, 48
 - defining vector, 806
 - density functions, 354
 - dual, 752, 806
 - linear, 751
 - phase, 48
 - state, 48
 - vector, 751
- span, 752
- spatial profile, 39
- spatiotemporal chaos, 508
- spatiotemporal dynamics, 31
- spectral
 - decomposition, 78, 755, 759, 803, 812
 - determinant, 23, 291, 362
 - 1 – *dimensional* maps, 365
 - 2 – *dimensional* hyperbolic Hamiltonian flow, 366
 - entire, 363, 439
 - for flows, 364
 - infinite product rep., 364
 - single fixed point, 433
 - weighted, 371
- spectral determinant
 - 1-dof, 632
 - 2-dof, 633
- radius, 433, 442
 - essential, 451
- stability, 498
- staircase, 589
- spectrum
 - Balmer, 581
- specular reflection, 134
- Spiegel, E.A., 741
- SRB measure, *see* natural measure
- St. Augustine, 311
- stability, 69–89
 - billiards, 99, 136
 - continuous symmetry, 180
 - eigenvalue, *see* Floquet multiplier
 - elliptic, 352
 - exact, 104, 921
 - exponent, *see* Floquet exponent
 - flow, 79
 - Hamiltonian flow, 764
 - Hamiltonian flows, 123, 762
 - indifferent, 71
 - linear, 69, 94, 516
 - maps, 86
 - marginal, 71, 180
 - matrix, 70, 555
 - multiplier, *see* Floquet multiplier
 - neutral, *see* marginal
 - ordering
 - cycle expansions, 389
 - intermittent flows, 391

- Poincaré map cycle, 101
- Poincaré return map, 87
- residue, 127, 131
- spectral, 498
- structural, 234, 235, 243, 300, 498
- window, 98
- stabilizer, 148, 150, 160
- stabilizer subgroup, *see* isotropy subgroup
- stable
 - cycle, 98
 - manifold, 16, 227–229, 233
- stadium billiard, 134, 140, 161, 483, 827, 829, 865
- stagnation point, *see* equilibrium point
- staircase
 - mean eigenvalue density, 685
 - spectral, 589
- standard map, 127, 131, 460
- standard representation space, 805
- standing orbit
 - Lorentz gas, 490
- standing wave, 43, 179
- state, 202, 275
 - set, 203
- state space, 38
 - discretization, 345
 - partition, 311
 - reduced, 147, 180
 - volume \mathcal{M} , 336
 - vs. phase space, 48
- stationary
 - flow, 43
 - phase, 320, 572
 - phase approximation, 594, 599, 612, 625, 697, 706, 983, 984, 988
 - point, *see* equilibrium point
 - state, 317
- stationary phase, 594, 597, 599, 614, 622, 652, 667, 696, 698, 899, 973
- statistical mechanics, 24
- steady state, *see* equilibrium point
- Sterling formula, 599
- stochastic
 - dynamics, 7, 320
 - matrix, 273
 - path integral, *see* Wiener integral
- Stokes theorem, 130, 606
- stosszahlansatz, 24, 501
- strange attractor, 41, 46, 340
 - Rössler flow, 58
- stretch & fold, 64, 210
- strobe method, 54
- stroboscopic map, 921
- strongly connected graph, 275
- structural stability, 27, 234, 235, 243, 300, 498, 502, 509, 711, 746
 - Hénon map, 245
- structure constant, 173, 753
- subgroup
 - isotropy, 147
- subshift, 219
 - finite type, 220, 243, 274–276, 278
- $SU(n)$ group, 804
- super-exponential
 - convergence, 561
- superstable cycle, 98
- superstable fixed point, 561
- surface of section
 - optimal, 769
- surjective, 65
- survival probability, 15, *see* escape rate
- symbol
 - sequence
 - inadmissible, 219
 - square, 236
- symbol square, 235
- symbolic dynamics, 12, 202–220, 771–779
 - 3-disk, 34, 205, 246, 926
 - at a bifurcation, 139
 - binary
 - collinear helium, 676
 - coding, 220
 - transition graph, 388
 - complete, 210, 221, 234, 275
 - complete N -ary, 275
 - covering, 218
 - grammar, 220
 - Hénon-Heiles, 161
 - pruned, 219
 - recoding, 220, 232, 240
 - unimodal, 211
- symmetric group, 804
- symmetry
 - D_3 , 241, 411
 - 3-disk, 155, 158, 241, 411, 415, 961
 - cyclic, 288
 - dynamical system, 144, 166
 - Hénon map, 829
 - solution, 174
 - under G_p , 151
- symmetry, continuous, 166–188
- symmetry, discrete, 142–158, 232, 239
- symplectic
 - form, 124
 - group $Sp(2D)$, 763
 - Hénon map, 126
 - integrator, 789
- invariance, 124, 130, 762
 - map, 125
 - transformation, 124, 232, 324
- systems
 - open, 335
- syzygy, 149, 162, 186, 187, 926
- tangent
 - bundle, 43, 70
 - field, 170
 - field, group, 173
 - space, 70
- Tauberian theorem, 482
- teaching
 - combinatorics, 213
- template, 206, 255
- tensor
 - invariant, 173
- tent map, 117, 119, 210
- ternary
 - prime cycles, 240
- tessalation
 - smooth dynamics, 834
- thermodynamical
 - pressure, 344
- 3-body problem, 108, 583, 672, 733, 745
- 3-dimensional sphere
 - scattering, 139
- 3-disk
 - boundary orbits, 407
 - convergence, 444, 834
 - cycle
 - analytically, 266
 - count, 159, 413, 784
 - expansion, 396
 - escape rate, 346, 387, 396, 419
 - fractal dimension, 860
 - geometry, 135
 - hyperbolicity, 352
 - phase space, 839
 - pinball, 6, 136, 139
 - point scatterer, 706
 - prime cycles, 18, 232, 251, 306, 571
 - pruning front, 205, 246
 - semiclassical resonances, 905
 - shadowing, 387
 - simulator, 140
 - state space, 14, 58, 860
 - symbolic dynamics, 12, 34, 205, 246, 926
 - symmetry, 155, 158, 241, 411, 415, 961
- time
 - arrow of, 24
 - as parametrization, 107
- average, 318, 331, 342
- ceiling function, *see* ceiling function
- ordered integration, 84, 89
- turnover, 80, 82, 757
- time delay
 - Wigner, 646
- time- t forward map, 48, 174
- topological
 - conjugacy, 214
 - dynamics, 202, 217, 219, 220, 274
 - entropy, 8, 286, 297
 - future coordinate, 214
 - index, 609
 - topological index, 745
 - invariant, 95
 - Markov chain, 218
 - parameter, 217
 - polynomial, 296
 - trace formula, 290
 - transitivity, 273
 - zeta function, 296, 297
- topological index, 627
- torus, 40
- totient function, 531
- t_p cycle weight, 365
- trace
 - class operators, 657
 - formula
 - classical, 23
 - flows, 355
 - Gutzwiller, 627
 - maps, 353, 433
 - topological, 290, 297
 - local, 288
- trace-class operator, 844
- determinant, 846
- trajectory, 39, 74
 - discrete, 63
- transfer
 - matrix, 314, 337
 - operator, 374
 - spectrum, 363
- transformation
 - canonical, 232
 - coordinate, 119
 - symplectic, 232
- transient, 40, 204, 281
- transition
 - graph, 272–282
 - infinite, 295
 - matrix, 272, 288
 - matrix, N -disk, 275
- transition matrix, 286

- transversality
 - condition, 55
- transverse
 - stability, 618
- traveling wave, 175, *see* relative equilibrium
- Trotter product formula, 843
- truncation
 - Gählerkin, 512
- truncations
 - Fourier, 510
- turbulence, 9, 10, 523
 - problem of, 507
- turnback point, 231
- turnover time, 80, 82, 757
- Ulam map, 117, 119, 210, 266, 267
 - skew, 314, 429, 952
 - tent, 327, 376
- ultraviolet divergence, 629
- unimodal
 - kneading value, 223
 - map, 210
 - map, symbolic dynamics, 211
 - well ordered symbols, 223
- unstable
 - cycle, 98
 - manifold, 16, 227–229, 233
 - periodic orbit, 98
 - periodic point, 14
- unsung
 - heroes, xi, xvi
- UPO (Unstable Periodic Orbit), *see* periodic orbit
- van Kampen, N. G., 557
- Van Vleck
 - propagator, 612
- variational principle, 556
- vector
 - basis, 752
 - field, 42
 - field, singularities, 107
 - invariant, 807
 - observable, 346
 - space, 751
 - defining, 806
 - dual, 806
- velocity gradients matrix, 70
- vertex, 275
- visitation frequency, 318
- visitation sequence, *see* itinerary
- volume preservation, 138
- von Neumann
 - ergodicity, 790
- Waleffe, F., 742
- walk, *see* itinerary
- wandering point, 40
- wave
 - standing, 43, 179
- wave function
 - semiclassical, 608
 - WKB, 609
- web diagram
 - Rössler flow, 217
- weight
 - multiplicative, 29
- well ordered symbols
 - unimodal, 223
- Wentzel-Kramers-Brillouin, *see* WKB
- Weyl
 - Peter-Weyl theorem, 168
- Weyl rule, 628
- Weyl, H., 810
- white noise, 553
- Wiener integral, 556
- Wigner delay time, 646
- winding number, 129, 528, 529
- WKB, 591, 602
 - connection formulas, 598
 - quantization, 591, 595
 - wave function, 609
- Yang, C.N., 317
- Young, L.-S., 66
- zero eigenvalue, 599, 614
- zeros
 - false, 370
- zeta function
 - Artin-Mazur, 296
 - dynamical, 18, 366
 - probabilistic, 480
 - Ruelle, *see* dynamical
 - topological, 296, 297