

General Index

- Adams family methods, 338
- Adams-Bashforth method, 338
- Adams-Moulton method, 339
- Abel, Niels Henrik, 108, 109
- Actual error, 24
- Adaptive method, 327
- Admissible function, 427
- Affine transformation, 163
- Algebraic multiplicity, 243
- Approximation, 24
- Associated matrix norm, 226
- Asymptotic error constant, 133
- Augmented matrix, 195
- Autonomous, 357
- Auxiliary condition, 286

- Back substitution, 206
- Backward difference approximation, 509
- Backward Euler method, 332
- Base, 85, 94
- Basin of attraction, 382
- Basis theorem, 193
- Bendixson, Ivar, 382
- Big-O notation, 320
- Binary arithmetic, 85
- Birth rate, 290
- Birthday problem, 70
- Bisection method, 110
- Boundary condition, 475
 - Cauchy, 527
 - Dirichlet, 476
 - Neumann, 476
 - Robin, 637
- Boundary value problem, 355, 399
- Bracket, 116
- Bunyakovsky, Viktor Yakovlevich, 455

- Cantor, Georg F.L.P., 169
- Cantor square, 184
- Cardano, Girolamo, 108
- Carrying capacity, 292
- Cauchy, Augustin Louis, 455
- Cauchy-Bunyakovski-Schwarz inequality, 455
- Cauchy problem, 527
- Center, 362
- Central difference formula, 43, 418-419, 544
- Characteristic polynomial, 241, 342
- Chopped arithmetic, 89
- Clay Foundation, 68
- Cofactor expansion, 76
- Collatz, Lothar, 77
- Collatz conjecture, 67, 68

- Column, 143
- Combinatorics: alternating power sums, 202
- Combinatorics: power sums, 202
- Compatibility condition, 508
- Component-wise operation, 9
- Computed solution, 231
- Computer graphics, 157
- Condition number, 228-230
- Conservation of energy, 537
- Convergence order, 132
- Convergence theorem, 262, 264, 265, 266
- Convex hull, 609
- Contact rate, 366
- Counter, 60
- Courant, Richard, 597-598
- Courant-Friedrichs-Levy condition, 548
- Cramer, Gabriel, 203
- Cramer's rule, 203
- Crank, John, 575
- Crank-Nicolson method, 575-577
- Cycling, 122

- D'Alembert, Jean Le Rond, 525
- Death rate, 290
- Degree, 25
- Delaunay triangulation, 608
- Determinant, 75, 222
- Diagonal matrix, 147
- Diameter, 71
- Differential Equation (DE), 285
- Diffusivity, 469
- Dilation, 172
- Dimension, 171
- Direct method, 252
- Dirichlet's principle, 520
- Discriminant, 379, 474
- Divergence theorem, 519
- Divided difference, 131
- Domain of dependence, 531
- Dot product, 22, 144
- Double root, 130

- Eigendata, 240
- Eigenfunction, 441, 496
- Eigenspace, 243
- Eigenvalue, 240, 496, 497
- Eigenvector, 240
- Element, 598
 - Standard, 633
 - Standard rectangular, 629
- Elementary row operation (ERO), 207
- Epicycloids, 13

- Epidemic, 366
- Equilibrium solution, 299, 362, 373
 - Isolated, 377
- Equivalent linear system, 195
- Error bound via residual, 233
- Error function, 42
- Error term, 231
- Essentially disjoint, 172
- Euclidean length, 224
- Euler, Leonhard, 292-293
- Euler's method, 292-294
- Exact answer, 24, 231
- Expected value, 83
- Existence theorem, 314, 376, 402, 494, 496, 507, 515, 585
- Explicit method, 332

- False, 57
- Fern leaf fractal, 185
- Finite difference schemes
 - Crank-Nicolson, 575-577
 - Elliptic, Sec. 11.3, 11.4
 - Explicit, 542-543
 - Forward-time central-space, 573
 - Backward-time central-space, 574
 - Implicit, 558
 - ODEs, 418-425
 - Richardson, 575
- Finite element interpolant, 607
- Finite element method, 597
- First generation, 170
- Fixed point iteration, 140
- Floating point number, 85
- Flop, 74
- Flop counts (for Gaussian elimination), 226
- Flow, 323
- Fontana, Niccolo 108
- Forward substitution, 207
- Forward difference formula, 43, 508
- Fractals (fractal sets), 169
- Future value annuities, 72, 73

- Galerkin, Boris Grigorievich, 440
- Galerkin method, 440
- Galois, Evariste, 109
- Gauss, Carl Friedrich, 204
- Gauss quadrature, 662
- Gauss-Seidel iteration, 256
- Gaussian elimination, 203-213
- General solution, 286
- Generalized minimum residual method, 273-274
- Geometric multiplicity, 243
- Ghost node, 509
- Global solution, 315
- Global variables, 46
- Gomperz law, 300
- Gosper island fractal, 185, 186
- Green's identities, 519
 - First, 519
 - Second, 520
- Growth rate, 290

- Hamming, Richard Wesley, 348
- Hamming method, 348
- Harmonic function, 476
- Hat function, 432
- Heat conductivity, 469
- Heat (diffusion) equation, 469, 470
 - Fundamental solution, 478
 - With source term, 470
- Heun's method, 303
- Higher-order Taylor methods, 318
- Hilbert, David, 193
- Homogeneous, 401, 472
- Homogeneous coordinates, 163, 164
- Hyper convergence of order α , 133

- IEEE double precision standard, 86
- Ill-conditioned, 102
- Ill-posed, 187
- Implicit method, 332
- Improved Euler method, 303-304
- Infectivity, 364
- Initial condition (IC), 286
- Initial value problem (IVP), 286
- Inline function, 51
- Infinite loop, 16
- Infinity matrix norm, 227
- Infinity (vector) norm, 225
- Initial population, 290
- Inner product, 427
- Input-output analysis, 200, 201
- Internal demand matrix, 201
- Internal elastic energy, 428
- Inverse of a matrix, 148
- Invertible (nonsingular), 148
- Iterative, 109
- Iterative method, 252
- Iterative refinement, 249

- Jacobi-Gauss convergence theorem, 262
- Jacobi iteration, 253
- Jacobian matrix, 378
- Julia, Gaston, 169

- Kinetic energy, 535
- Kronecker delta, 608
- Kutta, Martin W., 305

- Lagrange, Joseph Louis, 471
- Laplace, Pierre Simon, 471
- Laplace equation, 471
- Laplace operator (Laplacian), 470
 - in polar coordinates, 686
- Leading one, 195
- Leontief, Wassily, 200
- Linear convergence, 133

- Linear operator, 473
- Linear ODE, 401
- Linear PDE, 472
- Linear transformation, 160
- Linearization, 378
- Lipschitz condition, 313, 376
- Load potential, 428
- Load vector, 434, 443
- Local basis, 607
- Local solution, 315
- Local truncation error, 317
- Local variables, 46
- Logic, 57
- Logical operators, 58
- Logistical growth model, 291
- Lorenz, Edward N., 387
- Lorenz strange attractor, 387
- Lotka, Alfred, 359
- Lower triangular, 205
- LU decomposition (or factorization), 213
- M-file, 45
 - Function M-files, 45
 - Script M-files, 45
- Machin, John, 43
- Machine epsilon, 86
- Maclaurin, Colin, 39
- Maclaurin series, 38
- Malthus, Thomas, 290
- Malthus growth model, 290
- Mandelbrot, Benoit, 170
- Mantissa, 87
- Matrix, 143
 - Banded, 152, 420
 - Block, 502
 - Diagonally-dominant, 221, 264, 422
 - Elementary, 208
 - Hilbert, 192
 - Identity, 148
 - Nonsingular (invertible), 148
 - Positive definite, 265
 - Sparse, 151, 269-278, 420
 - Stiffness, 434, 443
 - Technology, 201
 - Tridiagonal, 420
- Matrix arithmetic, 144
- Max norm, 225
- Maximum principle, 477, 586, 595
- Midpoint method, 343
- Monte-Carlo method, 173
- Mother loop, 62
- Multiple root, 125
- Multiplicity 1, 55
- Multistep method, 337
- Natural growth rate, 292
- Nearly singular (poorly conditioned), 228
- Necrotic, 300
- Nested loop, 61
- Newton's method, 118, 119
- Newton-Coates formula, 669
- Nicolson, Phyllis, 575
- Node, 602
- Nonautonomous, 357
- Nullclines, 373
- Numerical differentiation, 43
- Numerically stable, 334
- Numerically unstable, 335
- One-step method, 303
- Orbit, 362
 - Closed, 382
- Order, 130, 285, 308, 317
- Ordinary Differential Equation (ODE), 285
- Output matrix, 201
- Overflow, 88
- Parallel, 239
- Parametric equations, 11
- Partial Differential Equation (PDE), 285, 459
 - Divergence form, 637
 - Elliptic, 474
 - Hyperbolic, 474
 - Parabolic, 474
- Partial pivoting, 211
- Path (MATLAB's), 45
- Peano, Guiseppe, 169
- Pendulum model, 389
- Perfect number, 81
- Phase-plane, 362
- Piecewise smooth, 496
- Pivot, 211
- Poincaré, Henri, 378
- Poincaré-Bendixson theorem, 382
- Poisson, Siméon-Denis, 649-649
- Poisson's integral formula, 649
- Poisson equation, 479
- Polynomial, 25
- Polynomial interpolation, 189, 197-199
- Poorly conditioned matrix, 150, 228
- Potential energy, 536
- Potential theory, 476
- Preconditioned conjugate gradient method, 273
- Preconditioning, 273
- Predator-prey model, 358-360
- Predictor-corrector scheme, 339
- Prime number, 81
- Principle of minimum potential energy, 428
- Principle of virtual work, 428
- Prompt, 2
- Pyramid function, 603
- Quadratic convergence, 139
- Quadrature, 51
- Quartic, 108
- Quintic, 108

- Random integer matrix generator, 152
- Random walk, 82
- Rayleigh-Ritz method, 426-458
- Recursion formulas, 15
- Reduced row echelon form, 195
- Reflection, 162
 - Method of, 531
- Region of numerical stability, 335
- Relative error bound (via residual), 233
- Relaxation parameter, 258
- Remainder (Taylor's), 35
- Repelling, 382
- Reproduction rate, 367
- Residual, 116
- Residual matrix, 250
- Residual vector, 232
- Rhind Mathematical Papyrus, 107
- Richardson's method, 575
- Ritz, Walter, 426
- Root, 110
- Rossler, Otto, 395
- Rotation, 161
- Rounded arithmetic, 89
- Row, 143
- Runge, Carle D. T., 205
- Runge-Kutta method,
 - Classical, 304-305
 - Higher order, 350
- Runge-Kutta-Fehlberg method (RKF45), 327

- Scalar, 240
- Scalar multiplication, 144
- Scaling, 161
- Schwarz, Hermann Amandus, 455
- Secant method, 128, 129
- Self-similarity property, 169
- Separation of variables, 302
- Shearing, 181
- Shift transformation, 162
- Shooting method, 399
 - Linear, 403-411
 - Nonlinear, 411-418
- Sierpinski, Waclaw, 170
- Sierpinski carpet fractal, 184, 185
- Sierpinski gasket fractal, 170
- Significant digits, 85
- Similarity transformation, 172
- Simple root, 125
- Simpson's Rule, 325
- Simulation, 79
- Single-step method, 337
- Singularity, 527
- SIR model, 363
- SIRS mode, 367
- Solution, 285
- SOR (successive over relaxation), 258
- SOR convergence theorem, 264
- Special function, 693
- Specific heat, 468

- Spectrum, 251, 497
- Spline, 449
- Stability, 323, 381
- Stability condition, 574
- Stable, 299, 323, 376
 - Conditionally, 586
 - Neutrally, 323
 - Unconditionally, 586
 - Weakly, 342
- Standard local basis, 608
- Statement, 57
- Steady-state solution, 336
- Stencil, 481, 542, 576
- Step size, 293
- Stiff, 335
- Strutt, John William, 426
- Submatrix, 76
- Superposition principle, 473
- Symbolic computation, 689
- Symmetric matrix, 243

- Tartaglia, 108
- Taylor, Brook, 34
- Taylor polynomial, 25
- Taylor series, 38
- Taylor's theorem,
 - One variable, 35
 - Two variables, 350
- Tessellation, 186
- Thomas, Llewellyn H., 220
- Thomas method, 220
- Three-body problem, 391
- Tolerance, 24
- Torricelli, Evangelista, 312
- Torricelli's law, 312
- Traffic logistics, 199, 200
- Transient part, 335
- Transpose, 7
- Trapezoid method, 337
- Triangulation, 598
- Tridiagonal matrix, 150
- Triple root, 126
- True, 57
- Truth value, 57
- Two-body problem, 391

- Unconditional numerical stability, 336
- Underflow, 88
- Uniqueness theorem, 314, 376, 402, 421, 494, 496, 507, 515, 585
- Unit roundoff, 86
- Unstable, 299, 323, 376, 548
- Upper triangular matrix, 204

- van der Pol, Balthasar, 396
- van der Pol equation, 396
- Vandermonde matrix, 197
- Variable precision arithmetic, 689
- Vector, 7

General Index

813

- Vector norm, 225
- Verhulst, Peirre François, 292
- Volterra, Vito, 358-359
- von Koch, Niels F.H., 179
- von Koch snowflake, 179
- Voronoi diagram, 610
- Voronoi region, 609
- Vortex, 362
- Wave equation, 474, 523, 524
- Weierstrass, Karl, 179
- Weights, 662
- Well-conditioned, 102
- Well-posed, 187
- Zero divisors, 105
- Zeroth generation, 170

