

Index

- /., *Mathematica* concept of “given”, 3
- i , notation for imaginary number, 12
- j , notation for imaginary number, 12
- `[[]]`, to refer to position in list, 3
- `[]`, to contain arguments of functions, 3
- δ -function
 - as Fourier transform of unity, 362
 - as limit of sequence of functions, 360
 - definition, 359, 360
 - in *Mathematica*, 362
- `{ }`, to denote lists, 3
- `//N`, to denote numerical evaluation, 4
- `==`, to denote equality within equation, 3
- `=`, to denote assignment of one quantity to another, 3

- 3-D
 - complex numbers for, 513, 540

- 4-D
 - complex numbers for, 513, 540

- Abs**, modulus function, 18
- absolute convergence, 195
 - in Taylor’s theorem, 270
- aerofoil, 424
 - by a conformal map, 345
- Ahlfors, L.V., 229
- Ahlfors–Struble theorem, 208
 - finding harmonic conjugates with, 231
 - history of, 228
 - implementation with *Mathematica*, 226
 - inverting `ComplexExpand`, 227
- alternating series test for convergence, 198
- analytic functions, 214
- angle-preserving map, 347
- animations
 - making with `Do`, 52, 87
- Appel hypergeometric function, 464
- `AppellF1`, 464
- `ArcCosh`, 170
- `ArcCot`, 170
- `ArcCoth`, 170
- `ArcCsc`, 170
- `ArcCsCh`, 170
- `ArcSec`, 170
- `ArcSech`, 170
- `ArcSin`, 170
 - branching of, 173
 - visualization of, 181, 183
- arcsine
 - visualization of, 181
- `ArcSinh`, 170
- `ArcCos`, 170
- `ArcTan`, 170
- `ArcTanh`, 170
- area-scaling induced by holomorphic function, 348
- Arg**, argument function, 17
- Argand plane, 14
- Argand, J.R., 14
- argument
 - Mathematica* function `Arg`, 17
 - ambiguity in, 16
 - of complex number, 16
 - principal value, 17
 - principle of the, 328
- Asian call option, 446

- assignment, use of =, 3
- Assumptions**
 - use with `FourierTransform`, 358
 - use with `Integrate`, 312
- attraction, basin of, 59
- axis-symmetric solutions of Laplace's equation, 541
- basin of attraction, 59
- Beardon, A.F., 56
- Beta**, 458, 460
- beta function, 458, 460
- bifurcation
 - and symmetry generation, 100
 - diagrams of, 98
 - explained in terms of stable/unstable roots, 86, 88, 91
 - symmetry-increasing, 143
- biharmonic equation, 427
 - complex variable solution, 428
- bilinear transformation, 348
- Black–Scholes equation, 441, 442
- Blasius' theorem, 419
- Boas, H., 208
- Boas, R.P., 229
- boundary condition
 - Dirichlet, 404
 - Neumann, 404
- branch cut, 171
 - Mathematica* conventions, 172
 - detailed investigation of arcsin, 173
- branch point, 171
- C code
 - use with *Mathematica*, 120, 148
- calculus
 - fundamental theorem of, 241
- call option, 441
 - with Asian feature, 446
 - with double barrier, 442
- Cardano, G., 1, 41
- CartesianMap**, 177
- catenoid, 537
- Cauchy inequalities, 271
- Cauchy integral formula, 263
- Cauchy principal value, 313
- Cauchy sequence, 196
- Cauchy's theorem
 - converse to, 274
 - strong (Cauchy–Goursat) form, 250
 - weak form based on Green's theorem, 250
- Cauchy–Goursat theorem
 - for a triangle, 250
 - for star-shaped set, 255
- Cauchy–Riemann equations, 208, 212, 213, 403
 - and orthogonal curves, 214
 - harmonic functions, 215
 - Laplace's equation, 215
 - using to recover function from real part, 221
- Cayley planet
 - for cubic, 74
 - for septic, 75
- Cayley's problem
 - solution for a cubic, 62
 - solution for a simple septic, 73
 - solution for quadratic, 60
- Cayley, A., 59
- celestial sphere, 514
- Chop**
 - example of use, 174, 436
- circle
 - complex equation of, 350
- circline
 - defined, 351
 - explored with *Mathematica*, 351
- closed set, 163
- cobwebbing, 78
 - convergence of, 79
 - error behaviour, 79
 - plots of, 93, 94, 96
- Coefficient**
 - applied to quartic equation, 48
- Collect**
 - applied to expression, 49
- colour function examples, 146
- colouring schemes for fractals, 64
- comparison test for convergence, 197
- complex conjugate

- Mathematica* function `Conjugate`, 18
- of complex number, 14
- complex number
 - n 'th root of, 26
 - $x + iy$ notation, 12
 - $x + jy$ notation, 12
 - `x+Iy` notation, 13
 - algebraic properties, 13
 - Argand plane representation, 14
 - argument, 16
 - as a point in the plane, 14
 - complex conjugate of, 14
 - cube root of, 27
 - exponential form, 29
 - functions of, 159
 - imaginary part, 14
 - modulus of, 14
 - ordered pair notation, 12
 - polar representation, 15
 - real part, 14
 - square root of, 25
 - working in 3-D, 513, 540
 - working in 4-D, 513, 540
- complex plane
 - extended, 175
- complex roots of equations, 5
- `ComplexExpand`, 161
 - applied to trigonometric and hyperbolic functions, 168
 - as function to take real and imaginary parts of expressions, 19
 - inverting with *Mathematica* implementation of Ahlfors–Struble theorem, 227
- complexification
 - issues with, 224
- `ComplexInequalityPlot`, 339, 354
- `ComplexMap` package, 177, 338
- conformal map, 338
 - and Laplace transforms, 395
 - and Laplace's equation, 404
 - on a cylinder, 420
 - visualization of, 341–345
- conformal representation of hyperbolic plane, 498
- conformality of holomorphic functions, 347
- `Conjugate`, complex conjugate function, 18
- connected set, 248, 286
- continuity
 - of a function at a point, 164
 - of sequence of uniformly convergent functions, 199
 - under addition etc., 164
- contour
 - circular, 305
 - defined as a piecewise smooth path, 238
 - deforming, 255
 - for treating branching integrands, 320, 321, 323
 - integral defined, 240
 - length of, 242
 - mousehole, 318
 - rectangular, 324
 - semicircular, 313, 316, 366
 - UHP or LHP?, 316, 367
 - zero theorem, 314
 - semicircular with indentation, 318
- contour integration, 240
 - issues with older versions of *Mathematica*, 245
 - with *Mathematica*, 244
- `ContourPlot`, 414, 416, 418, 419, 422, 423, 425, 429
- convergence
 - absolute, 195
 - in Taylor's theorem, 270
 - Cauchy's condition for, 196
 - of monotone bounded real sequence, 196
 - of subsequence of bounded sequence, 196
 - radius of, 202
 - terms tending to zero, 196
 - tests for, 196
 - uniform, 195
 - in Taylor's theorem, 270

- uniform and integration, 243
 - uniform behaviour of power series, 204
- convergence test
 - alternating series, 198
 - comparison, 197
 - Dirichlet, 198
 - integral, 198
 - n th root, 197
 - ratio, 197
- convergence-time algorithm for Newton–Raphson, 63
- convergent subsequence in iterated map, 81
- convolution theorem
 - for Fourier transforms, 364
 - for Laplace transforms, 390
 - generalized (Efros), 395
- Cos, 170
 - power series, 29
- Cot, 170
- Cosh, 170
- Coth, 170
- CountRoots, 334
- Csc, 170
- CsCh, 170
- cube root of unity, 27
 - role in solving cubic equation, 43
- cubic equation
 - as iterated logistic map, 81
 - history, 41
 - resolvent for quartic, 48
 - solution, 44
 - solution with *Mathematica*, 42
 - solved via Newton–Raphson, 62, 67
- cyclic group, 138
 - in images generated from polynomial maps, 142
- deforming contours, 255
 - to a circle, 256
- del Ferro, S., 41
- delta-function
 - as Fourier transform of unity, 362
 - as limit of sequence of functions, 360
- definition, 359, 360
 - in *Mathematica*, 362
- derivative
 - complex, 212
 - financial, 441
- differentiability
 - complex, 212
 - complex conjugates, 220
 - implies partial derivatives exist, 209
 - insufficiency of existence of partial derivatives, 209
 - of complex function considered as two real functions, 211
 - of function of two real variables, 209
 - of polynomial, 217
 - of power series, 218
 - other notations, 220
 - relation to Cauchy–Riemann equations, 213
- differential equation
 - solved by Fourier transform, 373
 - solved by Laplace transform, 391, 392
 - solved with DSolve, 392, 393
- differentiation
 - addition rule, 215
 - and Fourier transforms, 365
 - and Laplace transforms, 383
 - and sequences of uniformly convergent functions, 200
 - chain rule, 216
 - product rule, 216
 - quotient rule, 217
 - reciprocal rule, 216
- diffusion equation, 401
 - solved by Fourier transform, 374
 - solved by Laplace transform, 393
- dihedral group, 138
 - in images generated from non-polynomial maps, 142
 - in images generated from polynomial maps, 140
- Dirichlet boundary condition, 404
 - and disk, 408
 - and half-plane, 406, 414

- and quadrant, 415
 - and wedge, 415
- Dirichlet's test for convergence, 198
- disc
 - closed, 163
 - open, 163
 - punctured, 163
- discrete Fourier transform, 433
 - applied to 1-D filtering, 435
 - applied to 2-D filtering, 437
- distribution, 359
- Do
 - for animated graphics, 52
- domain, 159, 248
 - simply connected, 248
- DSolve, 392, 393
- Efros's theorem, 395
- Einstein's equations, 550
- Eisenhart, L.P.
 - minimal surfaces in four dimensions, 533
- ellipse, fluid flow past, 422
- EllipticF, 461
- elliptic function, 461
- Enneper's surface, 536
- equality, use of == to denote equality
 - in an equation, 3
- Erfc, 178
 - visualization of, 179, 181, 184
- error function
 - visualization of, 179, 181, 184
- essential singularity, 288
 - other characterization of, 289
 - visualized, 292
- Exp
 - exponential function, 13
 - power series, 29
- Expand, 160
 - applied to quartic equation, 48
 - with Trig -> True option, 25
- exponential function
 - Mathematica* function Exp, 13
 - complex properties, 31
 - definition for complex variable, 165
 - related to trigonometric functions, 29
- expression
 - imaginary part with ComplexExpand, 19
 - real part with ComplexExpand, 19
 - showing detailed structure with FullForm, 21
- extracting a holomorphic function from
 - its real part
 - Ahlfors–Struble method, 221
 - Cauchy–Riemann method, 221
- Factor, 6
 - applied to quartic equation, 47, 48
- FactorList, 6
- Ferrari, L., 41
 - solution of quartic equation, 47
- Field, M., 138
- filtering noise, 435
- financial derivatives, 441
- FindRoot
 - applied to solving equations, 59
- FixedPoint, 63
 - exercises with, 76
 - for Newton–Raphson problems, 63
- FixedPointList, 63
 - applied to Mandelbrot map, 119
 - exercises with, 76
- fluid
 - conservation of mass, 402
 - detailed flows, 415
 - flow past a flat plate, 423
 - flow past an ellipse, 422
 - force on body, 420
 - incompressible, 402
 - irrotational flow, 403
 - potential flow past a cylinder, 417
 - with circulation, 418
 - source above a half-plane, 416
 - source outside a circle, 417
 - uniform flow, 409
 - viscous flow, 425
 - in 2-D, 427
 - with circulation, 418
 - zero vorticity condition, 403

- Fontana, N., 41
- force on a body in a fluid, 420
- four dimensions
 physics in, 513, 544
- Fourier**, 433–435, 437
- Fourier transform, 357
 and differential equations, 373
 and heat/diffusion equation, 374
 and Laplace's equation, 375
 conventions, 358
 convolution theorem, 364
 defined, 358
 differentiation theorem, 365
 discrete, 433
 in a complex setting, 372
 in older *Mathematica* versions, 377
 inversion theorem, 363
 of Cauchy p.d.f., 369
 of Gaussian function, 370
 of sine function, 368
 of unity, 362
 scaling theorem, 365
 shift theorem, 365
- FourierParameters**, 434
- FourierTransform**, 358
 conventions, 358
 options, 358
- fractal
 from iterated sine function, 189, 191
 Newton–Raphson for cubics, 65, 67
 planet, 73
- fractional transformation, 348
- FullForm**, function to show detailed structure of expression, 21
- function
 analytic, 214
 and conformality, 347
 Appel hypergeometric two variable, 464
 area-scaling induced by, 348
 beta, 458, 460
 checking for being harmonic with *Mathematica*, 230
 defined by power series, 205
 defined formally, 159
 definition by series, 165
 definition by use of real analogues, 165
 domain of, 159
 elliptic, 461
 exponential, 165
 harmonic, 215
 holomorphic, 214
 hyperbolic, 167
 hypergeometric, 460, 463
 integral over a contour, 240
 multi-valued, 171
 range of, 159
 real and imaginary parts of, 160, 161
 regular, 214
 trigonometric, 166
 visualization with *Mathematica*, 176, 183
- fundamental theorem of algebra, 272
- fundamental theorem of calculus, 241
- Gamma**
 visualization of, 185
- gamma function
 visualization of, 185
- Geman-Yor model
 for double barrier options, 443
- geometry
 Euclidean, 474
 hyperbolic, 474
- ghosts and birdies tiling
 of the Euclidean plane, 484
 of the Poincaré disc, 490, 497
- given, /. notation, 3
- Golubitsky, M., 138
- graphics using checkers and holes, 187
- Green's theorem in the plane, 249
 for complex function, 249
- group
 cyclic, 138
 dihedral, 138
 Möbius transforms, 349
- harmonic conjugates

- finding with Ahlfors–Struble theorem, 231
- harmonic function
 - and Cauchy–Riemann equations, 215
 - checking with *Mathematica*, 230
- Head**, function to show type of number or expression, 20
- heat equation, 401
 - solved by Fourier transform, 374
 - solved by Laplace transform, 393
- hedging
 - applied to double barrier call option, 445
- Helmholtz equation
 - twistor solution, 546
- Hitchin, N., 534, 540
- holomorphic 3-D structures, 550
- holomorphic functions, 214
- hyperbolic functions
 - Mathematica* expressions for, 170
 - definition for complex variable, 167
- hyperbolic plane, 473
 - conformal representation, 498
 - projective representation, 498
 - UHP representation, 511
- hypergeometric function, 460, 463
 - Appel two variable, 464
 - confluent, 447
 - in Asian option theory, 447
- Hypergeometric1F1**, 447
- Hypergeometric2F1**, 460, 463
- Im**, imaginary part function, 18, 161
- image processing, 438
- images
 - method of, 413
- imaginary numbers, introduction of, 1
- imaginary part
 - Mathematica* function **Im**, 18
 - of complex number, 14
 - of expression, *Mathematica* function **ComplexExpand**, 19
- inequalities
 - visualizing, 339
- inequality
 - length, 242
 - value, 242
- InequalityGraphics**
 - Mathematica* package, 339
- InequalityGraphicsPlot**, 354
- infinity
 - adding to complex plane, 175
- InputForm**, 5
- integral test for convergence, 198
- Integrate**
 - care with use, 302
 - use to check residue calculation, 308, 312, 316, 317, 323, 324, 326
 - use with **Assumptions**, 302, 312
- integration
 - contour, 240
 - of branching functions, 321, 323
 - of function with periodic singularities, 324
 - of powers of z about the origin, 240
 - of sequence of uniformly convergent functions, 199
 - over arbitrary angle about simple pole, 318
 - over infinite range, 313, 316
 - trigonometric, 305
 - with *Mathematica*, 302
- inverse function
 - for sinh, 169
 - for trigonometric and hyperbolic functions, 170
- inverse hyperbolic functions
 - Mathematica* expressions for, 170
- inverse trigonometric functions
 - Mathematica* expressions for, 170
- InverseFourier**, 433, 434, 436, 437
- InverseLaplaceTransform**, 387, 440
- inversion, 348
- isolated singularity, 287
- isolated zeroes, 287
- iterated map
 - implementation with **Nest**, 82
- Jordan’s lemma, 366
- Joukowski flow, 421, 424
- Joukowski map, 345
 - attack angle variation, 346

- camber variation, 346
 - visualized, 345
- Kummer's function, 447
- Laitone, E.V., 229
- Laplace transform, 381
 - and change of time variable, 397
 - and differential equations, 391, 392
 - and heat/diffusion equation, 393
 - convolution theorem, 390
 - definition, 381
 - differentiation theorem, 383
 - holomorphic property, 384
 - inversion, 387
 - of algebraic function, 389
 - of rational function, 388
 - with branch cut, 389
 - making tables with *Mathematica*, 386
 - numerical inversion, 439, 441, 445
 - scaling theorem, 383
 - shift theorem, 383
- Laplace's equation, 401
 - and fluid flow, 402
 - and heat flow, 401
 - and holomorphic functions, 403
 - axis-symmetric, 541
 - from Cauchy–Riemann equations, 215
 - in three dimensions, 540
 - invariance under conformal maps, 404
 - solved by Fourier transform, 375
- LaplaceTransform, 385
- Laurent series, 278
 - uniqueness of coefficients, 281
 - use of known power series, 283
- Legendre polynomial, 542
- length inequality, 242
- limit
 - of a function at a point, 164
- Limit
 - use to calculate residue, 296, 299
 - use with residue theorem, 308
- line
 - complex equation of, 350
- linear transformation, 348
- Liouville's theorem, 271
- list
 - generating with Table, 7
 - picking an element of a given position within, 3
- Listable, 478
- Log
 - branching of, 172
- logarithm
 - ambiguity in, 32
 - as inverse to exponential, 32
 - branching of, 172
 - modulus-argument form, 32
 - why there is no global form, 241
- logistic map, 78
 - cubic, 80, 81
 - quadratic, 80, 103
- Lorentz contraction
 - invisibility of, 518
- Lorentz transformation
 - angular aberration, 523
 - as Möbius map, 517
 - classification, 520
 - details of velocity change, 522
 - remapping light rays with *Mathematica*, 524
- Mandelbrot map
 - definition of, 106
 - fixed points of, 107
 - Misiurewicz points, 113
 - periodic orbits of, 110
- Mandelbrot set
 - escape-time algorithm, 114
 - pictures of, 119, 123, 127–129
 - problems in drawing it properly, 129
 - purist black and white pictures of, 131–133
 - purist vs pretty pictures, 134
 - what *precisely* is it?, 115
- map
 - conformal, 338
 - logistic, 78
 - Mandelbrot, 106
 - Möbius, 338

- Newton–Raphson, 56
- non-linear with symmetry, 138
- Schwarz–Christoffel, 451
- Map**
 - applied to solving an equation, 59
- Margolis, B., 229
- Mathematica* older versions
 - Fourier transforms in, 377
- MathLink*
 - use in drawing fractals, 120
 - use in drawing images of symmetric chaos, 148
- maximum modulus theorem, 275
- Maxwell’s equations, 550
- May, R., 80, 104
- Mean value theorem for the modulus, 237
- mean-value theorem, 275
- method of images, 413
 - for circle, 417
 - for half-plane, 414, 416
 - for quadrant, 415
 - for wedge, 415
- metric
 - relativistic, 514
- Milne-Thomson, L.M., 229
- minimal surface, 531
 - and holomorphic null curves, 532
 - in four-space, 533
 - in three-space, 534
 - Montcheuil–Eisenhart formula, 533
 - visualized with *Mathematica*, 535
 - Weierstrass formula, 534
- Minkowski space, 514
- Mittag-Leffler theorem, 328
- Module**
 - use of in graphics program, 27
- modulus
 - Mathematica* function `Abs`, 18
 - of complex number, 14
- Montcheuil, M.
 - minimal surfaces in four dimensions, 533
- Morera’s theorem, 274
- movies
 - making with `Do`, 52, 87
- multi-valued function, 171
- Möbius map, 338
 - and Poincaré disc, 474
 - as a group, 349
 - as Lorentz transformation, 517
 - inverted with *Mathematica*, 61
 - link to Newton–Raphson and Cayley’s problem, 60
 - simple components of, 348
 - simple example, 340
 - to map three points as specified, 352
- N**, to denote numerical evaluation, 4
- Navier–Stokes equations, 425
 - complex 2-D form, 428
- neighbourhood, 163
 - deleted, 163
- Nest**
 - applied to iterated map, 138
 - applied to logistic map, 82
- NestList**
 - applied to iterated map, 91, 138
- Neumann boundary condition, 404
 - and half-plane, 414, 416, 417
 - and quadrant, 415
 - and wedge, 415
- noise filtering with Fourier transform, 435
- NResidue**
 - use of package, 297, 308
- NSolve**, 332
 - applied to quartic equation, 52
- n*th root test for convergence, 197
- null
 - holomorphic curve, 532
 - twistor construction, 533
 - vector, 514
- Ockendon, J.R., 229
- open set, 163
- option pricing, 441
- Options**, 7
- order of pole, 288

- ParametricPlot, 421
- path
 - closed, 237
 - defined, 237
 - drawing in *Mathematica*, 238
 - length of, 242
 - piecewise smooth, 238
 - simple, 237
 - smooth, 238
- Penrose, R., 473, 529, 540
- physics
 - in four dimensions, 513, 544
 - in three dimensions, 513, 540
 - in two dimensions, 401
 - relativistic, 545
- plane
 - Euclidean, 473
 - hyperbolic, 473
- plate
 - fluid flow past, 423
- Plot, 9
- Plot3D
 - applied to complex functions, 171
 - use of, 406
- PlotGradientField, 410
- PlotGradientField3D, 412
- PlotRange, 9
- polar representation of complex number, 15
- PolarMap, 178
- pole, 288
 - order of, 288
 - other characterization of, 289
 - residue at, 292
 - residue for simple case, 293
 - visualization of, 291
- polynomial
 - complex differentiability, 217
- polynomial equations
 - have all roots complex, 272
 - iteration solution, 56
 - numerical solution, 56
- Poisson's formula for the disk, 408
- potential theory, 401
- power series
 - behaviour on circle of convergence, 203
 - convergence of, 202
 - defining functions by, 205
 - uniform convergence of, 204
- PowerExpand
 - applied to quartic equation, 50
- Prime, 7
- principal value, of the argument, 17
- principle of the argument, 328
- projective representation of hyperbolic plane, 498
- quadratic equation
 - as motivation for i , 2
 - solution of, 2
 - solved by Newton–Raphson, 60
 - treated as iterated logistic map, 103
- quartic equation
 - history, 41
 - solution by Ferrari's method, 47
 - solution with *Mathematica*, 46
 - solved by Newton–Raphson, 71
- quintic equation
 - issues with, 51
 - numerical solution with `NSolve`, 52
 - solved by Newton–Raphson, 71
- range, 159
- ratio test for convergence, 197
- rational numbers, motivation from solving equations, 11
- Re, real part function, 18, 160, 161
- real numbers, motivation from solving equations, 10
- real part
 - Mathematica* function `Re`, 18
 - of complex number, 14
 - of expression, *Mathematica* function `ComplexExpand`, 19
- Reduce, 25
- regular functions, 214
- relativity
 - and complex numbers, 515
 - metric of, 514
- removable singularity, 288

- Riemann's theorem, 288
- residue
 - defined from Laurent series, 282
 - example calculations of, 293
 - formula for pole, 292
 - formula for simple pole, 293
 - theorem for integrals, 302
- Residue**
 - at essential singularities, 296
 - examples of use, 294–296, 298
- residue theorem
 - and branching integrands, 320
 - and indented semicircular contour, 318
 - and rectangular contour, 324
 - and semicircular contour, 313, 316
 - and series summation, 326
 - applications, 304
 - trigonometric integrals, 305
- resolvent cubic, 48
- Reynolds number, 427
- Riemann
 - mapping theorem, 452
 - sphere, 175
 - zeta function
 - visualization of, 182
- rocket science, 441
- RootIsolation**
 - Mathematica* package, 334
- roots
 - branching of, 171
 - of complex numbers, 26
 - of unity, 27
- rotation, 348
- Rouché's theorem, 330
- scaling theorem
 - for Fourier transforms, 365
 - for Laplace transforms, 383
- Schwarz–Christoffel map, 451
 - advanced numerical methods, 470
 - defined, 452
 - for hexagon, 467, 468
 - for pentagon, 469
 - for rectangle, 461
 - for regular polygon, 466
 - for trapezoid, 465
 - for triangle, 456, 468
 - for vertical strip, 455
 - from circle, 465, 466
 - point at infinity, 453
 - power of *Mathematica*, 451
- Sec**, 170
- Sech**, 170
- semicircle integration, 314
 - with complex exponentials, 366
- septic equation
 - solved by Newton–Raphson, 71
- sequence
 - of complex functions, 194
 - of complex numbers, 194
- series
 - Laurent, 278
 - of complex functions, 195
 - power series, 202
 - summation, 326
- Series**
 - function for generating power series, 29
 - in computing Laurent expansion, 283
- set
 - closed, 163
 - connected, 248, 286
 - open, 163
 - star-shaped, 254
- SetAttributes**, 478
- SetOptions**, 429
- shift theorem
 - for Fourier transforms, 365
 - for Laplace transforms, 383
- silly face picture, 70
- simple pole, 293
- Sin**, 170, 177
 - iterated, 189, 191
 - power series, 29
 - visualization of, 181, 184
- sine
 - iterated to make a fractal, 189, 191
 - visualization of, 181, 184
- singularity
 - classification of (isolated), 288

- essential, 288
- isolated, 287
- pole, 288
- removable, 288
- Sinh**, 170
- sink, 409
- soap bubble, 531
- Solve**, 332
 - applied to cubic equation, 42
 - applied to quadratic equation, 3
 - applied to quartic equation, 46
- source, 409
- spinor, 516
 - two-component, 516
- Sqrt**, 7
 - branching of, 171
- square roots of complex numbers, 25
- StandardForm**, 5
- stereographic projection, 175, 515
- Stokes flow, 427
 - and cylinder, 429
- stream function
 - for viscous flow, 427
- stretching, 348
- Struble, R.A., 229
- summation of infinite series
 - by residue method, 326
 - with *Mathematica*, 327, 328
- symmetric chaos, 138
 - high-resolution imagery, 150
- symmetry in complex non-linear map, 138

- Table**, 7
- Tan**, 170
- Tanh**, 170
- Tartaglia, 41
- Taylor's theorem, 265
 - absolute convergence, 265, 270
 - differences from real case, 266
 - uniform convergence, 265, 270
- tests for convergence – see convergence test, 196
- Thomas, V., 473
- three dimensions
 - physics in, 513, 540
 - reduction to two, 548
 - holomorphic properties, 550
- tiling, 473
 - of Euclidean plane with ghosts and birdies, 484
 - of Euclidean plane with other shapes, 481
 - of Euclidean plane with triangles, 475
 - of Poincaré disc with ghosts and birdies, 490, 497
 - of Poincaré disc with heptagons
 - conformal representation, 509
 - projective representation, 510
 - of Poincaré disc with hyperbolic squares
 - conformal representation, 501, 503, 504, 506
 - projective representation, 502, 503, 505, 507
 - of the Poincaré disc with triangles, 485, 490
 - projective representation, 499
 - UHP representation, 512
- TraditionalForm**, 5
- transform
 - Fourier, 357, 358
 - Laplace, 381
- translation, 348
- Trefethen, L.N., 451
- triangle subdivision, 251
 - with *Mathematica*, 259
- TrigExpand**, 24, 168
- TrigFactor**, 25
- trigonometric functions
 - Mathematica* expressions for, 170
 - Mathematica* function **Cos**, 24
 - Mathematica* function **Sin**, 25
 - converting multiple angles to powers, 23
 - with **TrigExpand**, 24
 - converting powers to multiple angles, 23
 - with **TrigReduce**, 25
 - definition for complex variable, 166
 - factorizing with **TrigFactor**, 25

- power series, 29
- related to exponential function, 29
- TrigReduce**, 169
- twistor
 - and minimal surfaces in four dimensions, 533
 - and minimal surfaces in three dimensions, 534
 - as pair of spinors, 530
 - theory, 529, 540, 544, 550
- two-component spinor, 516
- uniform convergence, 195
 - and continuity, 199
 - and differentiation, 200
 - and integration, 199, 243
 - continuity and integration counterexamples, 201
 - in Taylor's theorem, 270
 - M-test, 200
- upper half-plane representation of hyperbolic plane, 511
- value inequality, 242
- vector
 - null, 514
 - spacelike, 514
 - timelike, 514
- viscous fluids, 425
 - equation for stream function, 427
- visualization
 - alternative 3D schemes, 185, 187
 - of aerofoil, 345
 - of angular aberration, 524
 - of arcsine function, 181, 183
 - of catenoid, 537
 - of complex functions, 176
 - of complex functions in three dimensions, 183
 - of conformal map, 341–345
 - of discontinuous function with partial derivatives, 210
 - of double pole, 291
 - of Enneper's surface, 536
 - of essential singularity, 292
 - of flow around a flat plate, 424
 - of flow around ellipse, 423
 - of fluid flow past a cylinder, 418
 - with circulation, 419
 - of fundamental theorem of algebra, 273
 - of gamma function, 185
 - of ghosts and birdies tiling of Poincaré disc, 497
 - of heptagon tiling of Poincaré disc
 - conformal representation, 509
 - projective representation, 510
 - of inequalities, 339, 354
 - of Joukowski map, 345
 - of Lorentz transformation, 524
 - of minimal surfaces, 535
 - of potential flows, 410
 - of power series, 205
 - of SC map
 - for hexagon, 468
 - for pentagon, 469
 - for rectangle, 462
 - for trapezoid, 465
 - for triangle, 459, 468
 - for vertical strip, 456
 - of simple pole, 291
 - of sin function, 177
 - of sine function, 181, 184
 - of singularities, 290
 - of source above half-plane, 416
 - of square tiling of Poincaré disc
 - conformal representation, 501, 503, 504, 506
 - projective representation, 502, 503, 505, 507
 - of Stokes flow in cylinder, 429
 - of triangle tiling of Poincaré disc, 490
 - projective representation, 499
 - UHP representation, 512
 - of vector field, 410, 412
 - using contour plots, 176
 - using surface plots, 183
 - using surfaces with holes, 187
 - with **CartesianMap**, 177
 - with **PolarMap**, 178

- vortex, 410
- vorticity equation, 426

- wave equation
 - twistor solution, 545
- Weierstrass, K.
 - M-test, 200
 - minimal surface formula, 534
- Wessel, C., 14
- Wessel–Argand plane, 14
- winding number, 264

- zeroes
 - isolation of, 287
 - locating with Rouché’s theorem, 332
 - locating with *Mathematica*, 332
 - location of, 330
- Zeta**
 - visualization of, 182
- zeta function
 - visualization of, 182