

## APPENDIX C

# Index

- ★ Capitalization has been disregarded in the alphabetization of the index. Word boundaries, even those involving hyphens and apostrophes, have also been disregarded.
- ★ All diacritical marks have also been ignored in the alphabetization. Thus, *Möbius* appears at the place where *Mobius* would have appeared.
- ★ A mark of ‘•’ after an entry signifies that, for that particular entry, we have only given page reference to the place where it was first introduced or was discussed in some detail. There are too many appearances of any such entry to record each of them.

- 1-forms 69
- abelian group • 40
- adjoint matrix (*see* adjoint of an operator)
- adjoint of an operator 91–94, 108, 145–148, 169, 494, 538
- adjoint representation 347–349, 355, 357, 369, 379, 397, 404, 413, 415, 417, 447, 448, 453–455, 505, 506, 511, 512, 527, 529, 530, 540, 551, 553, 555, 558, 563
- adjoint-valued indices 417
- algebra • 54, 329
- Boolean (*see* Boolean algebra)
- Lie (*see* Lie algebra)
- algebraic equation 57
- algebraic integer 47–49, 257–258, 283
- algebraic structure • 37–38
- almost everywhere 131
- alternating groups 217, 268
- angular momentum 364, 381, 498, 576
- orbital 381, 576
- spin (*see* spin)
- annihilation operator 571, 586, 591
- anticommutation 340, 426, 429–430, 433, 435, 436, 438, 441, 447, 485, 487–489, 500, 501, 560
- anticommutator (*see* anticommutation)
- anti-Hermitian operators/matrices 94, 110, 116, 233, 360, 476, 477, 486, 500–501, 560
- antisymmetric relation 34
- arithmetic 37
- Grassmannian (*see* Grassmannian arithmetic)
- associative
- property 6, 8, 21, 29–30, 37, 40–42, 48, 53, 55, 56, 156, 157, 174, 190, 339, 343, 634, 636, 638, 656
- ring 43, 46
- automorphism 181, 194, 203, 205–207
- Baker–Campbell–Hausdorff formula 329, 331, 388, 569
- ball
- open (*see* open ball)
- 3-dimensional 459–460, 649–650
- Banach space 84–85, 130
- complex 84
- real 84
- base of a path 638–639, 641, 651
- basis of a vector space • 69
- Betti numbers 671–673
- bijective map 25, 30, 183, 186, 623, 654
- binary map 38
- binary operation/relation 3–13, 28–30, 37, 40–41, 54, 55, 157, 178, 247
- biunitary transformation 124
- Bolzano–Weierstrass theorem 462
- Boolean algebra 55–56
- Boolean logic 56
- Borel sets 61
- Borel  $\sigma$ -algebra 61
- boundary 459, 463, 599, 601, 610, 615, 621–623, 641, 647, 649–653, 657–658, 660–662, 664–670, 672
- operator 657

- boundary condition 137, 146–149, 151, 650  
 bounded 143  
   functions 39, 129–130  
   operators 143–144  
   parameter 461–463, 476  
 braid groups 321–325
- cardinality 201  
   of center of a group 220  
   of commutator subgroup 250  
   of conjugacy classes 219  
   of groups 196, 197, 199, 202–207, 220, 264, 290, 295,  
 296, 301, 308, 312, 326, 433  
   of quotient groups 315  
   of sets 30–32, 195, 312  
   of subgroups 195–199, 201
- Cartan–Killing form 342–345, 347–348, 563, 567
- Cartan subalgebra 503–504, 506, 533, 535, 539
- Cartesian product 23
- Casimir invariants 353–357, 379–382, 415–418,  
 455–457, 494, 499, 563–566, 572–577, 593
- Cauchy–complete spaces 130
- Cauchy–Riemann conditions 583
- Cauchy–Schwarz inequality 76–78, 81, 127
- Cauchy sequence 83–85, 130, 461–462, 476
- Cauchy's theorem 196–199
- Cayley–Hamilton theorem 104, 257
- center of a group 174, 204, 220
- central extension of algebras 587–594
- centralizer of a group element 174–175, 219–220
- characteristic equation of a matrix 103–104, 106, 109,  
 120, 390, 573, 574
- character of a representation 237–241, 243–244, 246,  
 251–271, 281–285, 296–298, 353, 471  
   complex vs real 253, 254, 298
- character table 238, 246, 251–272, 277, 282–285,  
 295–306
- Chebyshev polynomials 135, 143
- circular relations 33
- class function 239, 256
- Clebsch–Gordan coefficients 385, 386
- Clifford  
   algebra 426, 434–435, 441–443, 485, 487, 488  
   group 247, 433–434
- closed function 612–615
- closed interval (*listed under* interval)
- closed path 519, 632, 638–640, 651
- closed set / subset 462–463, 468, 476, 601–604,  
 609–610, 613–615, 626, 629, 633, 653
- closure property / set closed under an operation 40,  
 60, 173, 174, 178, 331, 342, 433, 463, 503
- codomain 25
- cofactor of an element of a matrix 102, 317
- cohomology 655
- commutation relation 333, 336, 338, 342, 344, 347, 349,  
 365, 381, 397, 402, 423, 477, 486, 497, 504, 508, 533,  
 559, 563, 564, 566–567, 570, 585, 587, (*see also*  
 commutator)
- commutative  
   division ring 43, 45–47, 49, 56  
   group 40, 41, 53, 54, 56, (*see also* abelian group)  
   property 5, 8–9, 21, 29–30, 37, 40, 41, 43, 48, 53–57,  
 247, 339  
   ring 43, 44, 50, 51
- commutator 44, 55, 115, 116, 247–249, 328–334, 339,  
 340, 342, 354, 356, 360, 365, 395, 403, 418, 423, 426,  
 428, 438, 450, 476, 497–498, 504, 505, 507–509, 534,  
 535, 560, 563, 565, 568, 569, 581, 582, 584, 586–589,  
 591–594
- subalgebra 333, 587
- subgroup 247–250
- two different definitions 247
- compact  
   algebra 348, 503, 513, 522–524, 532, 536, 548,  
 566, 587  
   group 337, 341, 354, 358, 461, 465, 468–471, 549  
   space 461–463, 468, 629–630  
   subset 462–463
- compactness 358, 460–462, 468, 567
- completeness of a basis 82
- component of a vector • 69
- conclusion • 7
- concrete topology 609, 611, 614
- conformal transformations / group 577–582, 584  
   special 581
- conjugacy class 171–172, 217–226, 238–239, 241, 244,  
 246–247, 255–257, 259–262, 265, 268, 277, 281, 284,  
 293, 295, 297, 298, 309, 335, 433–434, 487
- conjugation (*see* conjugacy), 171
- connected space 625–629, 632, 661
- continuous group • 326
- contraction of indices • 98, 327
- contradiction 5–6, 302, 568, 602  
   proof by 14, 17, 32, 44, 45, 47, 48, 107, 603, 611,  
 627–629
- contrapositive 14, 15, 147
- convergent sequence 83–85, 130, 461, 476, 629
- convolution operator 136
- coset 175–179, 219–220, 249–250, 263, 278–280, 306,  
 314
- countable 30–31, 61, 63, 128, 129, 131, 311–313, 317  
   intersection 60, 609  
   set 62  
   union 60–62, 607
- covectors 69, 78, 79, 86, 97
- cover (*see* open cover)
- Coxeter–Dynkin diagram 310, 526
- Coxeter groups 308–310, 324, 526
- Coxeter matrix 309

- creation operator 571, 591, (*see also* oscillator generators)  
curve • 631  
cyclic groups 191, 197, 202, 204, 205, 301, 312–314, 316, 663, 671  
infinite 312  
cylinder 622, 625, 641, 643–646, 673, 686
- de Morgan relations 4, 5, 22, 603, 610  
derived subalgebra (*see* commutator subalgebra), 333  
derived subgroup (*see* commutator subgroup), 248  
diagonalization 111–116, 122, 229, 275, 360, 370, 552  
block- 241, 350, 354  
diagonal subgroup 415  
differentiable function 128, 136, 326  
differential equation 139–143, 572–575  
differential operator 136–138, 160, 335, 360  
differential representation of groups / algebras 160, 335, 345–346, 359–360, 363–366, 381, 423, 478–479, 496–498, 581  
dihedral group 193, 194, 200, 205, 280, 302–303, 308  
dimension  
of a Lie group • 340  
of a vector space • 69  
Dirac matrices 485, 487–489, (*see also* gamma matrices)  
Dirac spinor 490–491, 497, 501  
direct product group • 178  
direct sum 332  
Dirichlet function 63, 131  
disc 618, 621, 624–625, 641, 643, 650, 661  
open 618  
disconnected space 626–629  
discrete group symmetry 155–156, 217, 299, 326, 487, 671  
discrete metric 39, 611  
discrete set 421  
discrete topology 608–611, 614, 626  
distance 24, 29, 38–39, 70, 73, 83–85, 462, 464, 597–598, 609, 611–612, 625, 629, 631–632, 642  
distributive property 6, 21, 37, 41, 48, 53, 55–56  
division ring 43, 44  
commutative (*listed under* commutative)  
domain of a map / operator 12, 25, 137, 146–152, 185, 239  
dual polyhedrons 286, 290, 294  
dual space 69–71, 78–80, 91, 93, 145  
dual tensor 484–485  
dummy index • 327  
Dynkin diagram 512, 517–519, 522–526, 531, 536–538, 540, 542, 550–552, 554–556, 558  
extended 536–538, 540, 542, 555  
Dynkin indices (*listed under* Dynkin notation)  
Dynkin notation for irreps 527–533, 539–540, 542, 543
- eigenfunction 137–140, 148, 149  
eigensystem of operators / matrices • 103  
eigenvalue of operators / matrices • 103  
eigenvector of operators / matrices • 103  
left / right (*listed under* left / right)  
empty set 16, 19, 26, 56, 60, 197, 516, 604, 611, 626  
as open/closed set 599–600, 602–604, 607–609, 614, 617, 626  
measure of 61  
equivalence relation / class 33–35, 171, 177, 250, 619–621, 634–636, 638, 640–642, 651, 660  
homotopy 636, 638–640, 642, 653  
equivalent representations 163, 168, 169, 228, 274, 276  
Euclidean  
algebras and groups 500, 562–566, 574, 576  
distance 38  
metric 39, 608, 616  
norm 73, 75, 421  
plane 615, 639  
space 38, 68, 75, 126, 285, 458, 565, 599, 602, 622, 642  
Euler angles 387, 566  
exact sequence 185–186, 651, 653  
exclusive or 6  
existential quantifier 12–13  
extended algebra (*see* central extension)  
extended Dynkin diagram (*listed under* Dynkin diagram)  
extended Lorentz group 495–496  
extended real line 61
- faithful vs unfaithful representation 160, 301, 313, 324, 361–362, 460, 465, 466, 468, 476, 563  
field 45, 49–56, 67, 69, 71, 74–75, 84, 128  
addition 52–54  
multiplication 52–54  
field (in physics) 58, 485, 650  
finite complement topology 609  
Fourier series 129, 587  
Fourier transform 129  
free group 312, 645  
functional 69, 71, 78–79, 91, 94  
function space 127, 128, 130–132, 136, 137, 145–149, 345, 360  
function spaces 127  
fundamental group 638–651, 660  
fundamental representation • 347
- gamma matrices 485–486, (*see also* Dirac matrices)  
Gegenbauer polynomials 135  
Gell-Mann matrices 402, 534  
generators of finite groups • 191–192  
generators of Lie groups • 326–328  
golden ratio 282, 298  
Gram–Schmidt orthogonalization 81, 132, 141, 401, 437

- Grassmannian numbers 57–59  
 great orthogonality theorem 235–238, 276, 335, 471  
 group composition rule • 40  
 group composition table 158–161, 171, 172, 176, 178,  
     181, 187–194, 200–201, 206, 209, 220–221, 240, 253,  
     277, 293, 335
- Haar measure 463–466, 468, 470  
 Heisenberg–Weyl algebra / group 566–570, 587, 588  
 helicity 576  
 Hermite polynomials 134, 141  
 Hermitian conjugate / conjugation 59, 92, 109–112,  
     116–118, 120, 231, 233, 337, 342, 349, 354, 362, 494,  
     499, 507, 508, 568, 570  
 Hermitian matrix / operator • 93–94  
 Hilbert space 83–86, 130  
 homeomorphic / homeomorphism 623–625, 641–644,  
     649–650, 654, 662  
 homogeneous functions 70  
 homogeneous operators 88  
 homogeneous transformations 88, 287  
 homology 655–673  
 homomorphism 182–185, 217, 320, 558  
 homotopy 631, 634–655  
     function 635–640  
     groups 650–654, 660, (*see also* fundamental group)
- ideal 330, 332–333  
 identification topology 620, 630  
 identity function 614, 623, 637, 640  
 identity operator • 88  
 identity path 632, 633, 636, 638–641, 643, 649, 650  
 image of a map 24–28, 37, 160, 182–186, 287, 605–606,  
     612–615, 620, 627, 631, 632, 651, 652, 656, 658,  
     665, 668
- implication • 7–10  
 indicator function 62  
 induced representations 277–280, 499, 500, 565, 566  
 induced topology 617–619, 627, 628  
 infinite dimensional vector space / matrix 69, 88,  
     126–152, 160, 335, 345, 346, 564, 567, 568, 570, 571,  
     586
- inhomogeneous groups and algebras 498, 562, (*see also* Euclidean groups)
- injective map 24, 25, 179, 183–186  
 inner product 68, 74–80, 82–83, 85, 90–95, 99, 125,  
     130–132, 139, 145, 167, 337–338, 368, 437–438,  
     469–470, 578
- inner product space (*listed under* inner product)
- integral operators 136  
 interior 610  
 interval • 35  
     closed 463, 468, 602, 621, 623–624, 631–632  
     open 84, 602, 606, 615–616, 624, 626
- invariant subgroup (*see* normal subgroup), 177  
 invariant subspace 165  
 invariant tensor 351–353, 368, 403–405, 417, 424  
 inverse path 632, 633, 636  
 invertible element of a ring 45–47, 50, 51  
 invertible matrix / operator 102, 114, 162, 164, 168,  
     317, 469  
 irreducible representation • 166  
     number of 246–250, 335  
 isomorphic / isomorphism 183, 211, 320, 324, 563
- Jacobian 464  
 Jacobi identity 55, 339–340, 343, 347, 507, 589, 590  
 Jacobi polynomials 135, 143, 390
- Kac–Moody algebra 587–591, 594  
 kernel 182–186, 217, 249, 268, 320, 558, 658, 665, 667,  
     669, 670, 672
- Klein bottle 648, 649, 673  
 Kronecker delta • 80, 87  
 Kronecker product 169–171, 260, 271–273, 335, 346,  
     347, 349–353, 355, 368, 370–374, 378–380, 383–385,  
     397, 404–406, 408–409, 412, 414–415, 424, 445–449,  
     483, 485, 492, 532–533, 545–547, 551, 555, 557–558
- $L^2$ -space 72, 78  
 ladder operators 381, 505, 510, 527, 528  
 Laguerre equation / polynomials 135, 142, 143  
 Lebesgue measure / integral 62–63, 127, 131  
 left eigenvector / eigenstate 120–122  
 Legendre polynomials 133–135, 141  
 Levi-Civita symbol • 100  
 Lie algebra • 54–55, 330  
 Lie group • 326  
 Lie ring 43, 44, 54–55, 330  
 limit point 461–462, 601–603, 609, 629  
 linear space (*see* vector space), 52  
 linear transformation 143  
 little group 499–500, 565  
 Lorentz group / algebra 472–502, 562, 566  
     extended (*listed under* extended)  
     proper (*listed under* proper)
- lowering operator 382, 384, (*see also* ladder operators)
- Majorana spinors 491, 501–502  
 map / mapping • 24  
 matrix group 327  
 matrix representation • 160, 228, 335–337  
 maximal subgroup / subalgebra 175, 413, 535–539,  
     542, 544, 546, 555
- measurable set 60  
 measure of a set 60–63, 131  
 measure space 60–61  
 metric 38–39, 72, 85, 342, 462, 464–466, 473, 548,  
     577–578, 582, 598, 602, 603, 605, 607–608, 610–612  
     discrete (*listed under* discrete)  
     Euclidean (*listed under* Euclidean)

- induced by a norm 84, 130
- Minkowski (*listed under* Minkowski)
- metrically complete space 84
- metric space 38–40, 72, 83–85, 462–464, 597–605, 607–610, 612, 626, 629
  - and continuity 607
  - bounded 462
- metrizable 610–611
- Minkowski metric 473, 582
- Möbius band 622, 648, 649, 671–673
- modular arithmetic 45–47, 51
- modular group 316–321, 586
- modus ponens 14, 16
- modus tollens 15
- monic polynomials 47–48
- multiplicative operator 136
  
- n*-disc (*listed under* disc)
- nilpotent matrices 114
- non-compact
  - algebra 348, 503, 548, 563, 567
  - group 337, 354, 362, 468, 549, 550, 560, 561
  - space 476
- norm 72–76, 80, 84–85, 130–131, 143–145, 151, 337, 384, 576
  - Euclidean (*listed under* Euclidean)
- normal matrix 115–124, 246, 275
- normal subalgebra (*see also* ideal), 331–333, 498
- normal subgroup 175–184, 198, 201–203, 205–208, 217, 225, 248–249, 263, 267–268, 279, 293, 300, 306, 314, 331, 333, 391, 392, 421, 659
- normed vector space 72–75, 84–85, 130, 143–144
- normed vector space 72
- n*-sphere ( $S^n$ ) (*listed under* sphere)
- null operator 88–89
- null set (*see* empty set), 19
- null space 68, 71, 165
- null vector 68, 71, 73, 76–78, 88, 131, 481
  
- one-to-one map / correspondence 24, 30–32, 181, 183–185, 201, 312, 320, 468, 515, 650, 651, (*see also* injective)
- onto 24, 181, 183, 186, 612, (*see also* surjective)
- open ball 39, 598–605, 611, 626
- open cover 629–630
- open function 605, 606
- open path 632
- open set 37, 598–605, 607–617, 619–620, 626–630
- ordered pair 23–24, 180
- order of a group element • 198–199
- order relation 34–35, 528
  - strict 35
  - total 35, 528
- orthogonality theorem (*listed under* great...)
  
- orthogonal matrix / group 275, 334, 358, 366–368, 392, 411, 420–457, 460, 472–474, 486, 488, 491, 494, 560, 562, 577, 582
- orthogonal polynomials 131–135, 138–143
- orthogonal vectors 75–78, 80, 81
- orthonormal
  - basis 80–83, 90, 94–96, 112, 113, 123, 162
  - eigenvectors 112–114, 118
- oscillator 569–571, 586, 590–591, 594
- outer product 98
  
- parallelogram law 68, 70, 75, 315
- parameter space of a Lie group 458–471, 476, 561, 629, 649–650, 653
- parity 214
  - as space inversion 392, (*see also* space inversion)
  - of a function 133–134
  - of a permutation 214–217, 224, 252, 260, 261
- partition 34, 177, 217, 250, 619
- path • 631
- path-connected space 632, 638–639
- Pauli–Lubansky construction of Casimir invariants 499, 576
- Pauli matrices 372–376, 379, 391, 397, 401, 428, 430, 475, 559, 560
- permutation 208–209, 217, 221–227, 242, 257, 265, 290–291, 293, 298, 309
  - cyclic notation 213, 293
  - double-row notation 212, 216
  - even 214–215, 217, 223–225, 227, 252–253, 257, 264, 281, 656
  - odd 214–215, 217, 224, 227, 252–253, 257, 264, 281, 656
  - single-row notation 212–216
- permutation group 194, 209, 211–217, 252, 253, 304, 309, 324
- permutations 211
- $\Pi$ -system of vectors 517–524
- point groups 299–307
- polynomial (*see* monic polynomials and various
  - named polynomials)
- positive roots / weights 512–516, 528–531, 552, 554
- predicate 11–13
- pre-image 24–27, 604–605, 612–613, 619, 620, 627, 652
- premise • 7
- presentation of groups 192–195, 200, 204–205, 207, 216, 217, 259–260, 262, 265, 280, 284, 293, 308–310, 312–313, 315, 318, 320, 323, 325, 645, 647, 648, 663
- Coxeter 324
- prime numbers 18, 51, 182, 192, 194–198, 202–204, 207–208, 220, 306
- relative 48, 51, 192, 208, 256
- product topology 615–616, 621
- projective plane / space 622, 623, 669, 670
- proper Lorentz group 478, 496

- proper subgroup 217, 290, 297, 304, 478  
 proper subset 23  
 proper subspaces 71  
 propositional logic 7, 11–15  
 propositions • 7  
 Pythagoras theorem 76–77
- quantum 83, 85–86, 109, 125, 360, 364, 381, 566, 568, 570  
 quaternionic groups 194, 205  
 quotient group 177–178, 248–250, 263, 267, 300, 314–316, 659, 661, 663, 669, 671  
 quotient topology 619–623
- raising operator 382  
 range of a function • 25  
 rank of an algebra 370, 503, 507, 509, 511–513, 515, 517, 518, 523, 527–530, 532, 537, 539, 542, 552, 554–555  
 real representation 169, 274, 276, 277, 349, 350, 361, 368, 425, 447, 481, 542, 555, 557, 558  
 real vector spaes 67, 71–73, 75, 77, 78, 81, 105, 367–368, 373, 421, 423  
 reducible representation 166–168, 170, 227, 230, 232, 240–241, 280, 335, 338, 361, 446, 466, 481, 488, 490, 495  
 reflexive property 33–34  
 regular representation 242–244  
 regular subalgebra (*listed under* subalgebra)  
 relative homotopy 651–654  
 relativity 472  
 representation of groups • 160–169  
 Riemann integration 63  
 right eigenvector / eigenstate 120–122  
 ring 40–51, 54, 56, 330  
 ring with identity 43  
 root space 507, 509, 513, 515, 516, 525  
 root vector 507–530, 536, 540–542, 549–556
- scalar 52–54, 67–72, 74–75, 77, 80–81, 86, 88–90, 93, 103, 105, 106, 328, 329, 337, 368, 376  
     multiplication 52–54, 77  
 scalar invariant / representation 481, 483, 486  
 scale transformation 581  
 Schläfli matrix 310  
 Schur's lemmas 231–235, 244, 274, 354, 441, 489, 568  
 self-adjoint operators / extensions 145–152  
 self-antidual 425, 447, 484  
 self-conjugate representation 169, 274–277, 348–350, 368, 373, 378, 408, 423–425, 435, 442–444, 446, 449, 453, 455, 491, 532, 553  
 self-dual 425, 447, 484  
 self-reciprocity of conjugacy classes 254–256, 266, 298
- semidirect product 179–182, 194, 201–203, 205–208, 217, 267, 306, 333, 422, 498  
 semigroup 157  
 semisimple  
     algebra 334, 344–345, 348, 536, 537, 542, 555, 563  
     group 182  
 semi-simplex 666  
 sentence 3–7, 10, 12–13, 32  
 sentences 3  
 sequence • 83, (*see* Cauchy sequence, convergent sequence)  
 setoid 37  
 $\sigma$ -algebra 60–62  
 simarity 417  
 similarity transformation 97–102, 104, 115, 122, 162, 167, 171, 228–230, 233, 235, 237, 260, 275, 288, 313, 335, 336, 367, 369, 435, 469, 534  
 similar triangles 33  
 simple algebra 330, 333–334, 449, 452, 517, 546  
 simple group 181–182, 207, 268, 333, 394  
 simple root 512–518, 524–531, 551–555  
 simplex 655–658, 660, 662, 664, 666–668, 670–672  
 singleton set 61–63, 611, 614  
 singlet representation 160, 259, 379, 404, 405, 407, 412, 414, 415, 424, 446–448, 450, 454–455, 471, 534, 540, 544–546, 556, 558  
 singular element in a ring 45–46, 49  
 singular simplex / chain 655–658  
 skew-Hermitian (*see* anti-Hermitian)  
 space groups 299–300  
 space inversion 496  
 special linear group 549, 558–561, 574  
 sphere 459–460, 618, 621, 622, 650, 666–667  
 spin 381–383, 390, 392, 485, 492–494, 576  
 spinor / spinorial representation 372–378, 425–449, 451–452, 454–457, 479, 480, 485–494, 501–502, 546–547  
 states • 161  
 subalgebra  
     regular 533–539  
     special 533–535, 538–539  
 subcover 630  
 subgroup • 172  
 subset • 23  
 summation convention • 327  
 surjective map 24–26, 183, 186, 612, (*see also* onto)  
 Sylow theorems / subgroups 197–199, 201–203, 206–207  
 symmetric operator 147, 149–152  
 symmetric relation 33–34  
 symplectic groups / algebras 523, 548–552
- target of a map 25, 26, 29, 353, 621  
 tautology 5–6, 8, 11, 14–15  
 taxicab norm 73

- tensor • 86–87, 97–99  
tensorial representations 347, 372, 378, 397, 406, 424–426, 446, 449, 451, 453–455  
time-reversal 125, 496  
topological space 37, 38, 60, 605, 607–633, 635, 638–639, 641–643, 650–653, 655–657, 659–661, 666, 668, 671, 673  
topology • 607  
torsion 671, 673  
torus 618, 619, 640, 648, 649, 668–670  
trace • 99  
transformation • 143  
transitive relation 33, 34  
translation group and its generators 299–300, 358–362, 460–462, 497–499, 562–563, 565–566, 574, 575, 581  
transposed matrix • 108  
transposition (a kind of permutation) • 214–216  
triangle inequality 38, 73, 83, 144, 600, 611  
triangle in topological space 642–647, 656, 657, 666–667  
triangulation 642–648  
trivial representation 160, 164, 227, 238, 239, 251, 255, 259, 264, 268, 273, 347, 349, 380, 395, 404, 460, 481, 556, (*see also* singlet representation)  
truth value / table 3–11, 14–15, 21–22  
  
unbounded  
  operators 143–145  
  parameter space 462, 561  
uncountable 30–32, 128, 129, 311, 317, 326  
unitary matrices 94–97, 111–113, 115–117, 120, 122–124, 152, 162, 228–233, 237, 246, 274–275, 327, 335, 347, 348, 360, 367, 368, 392–420, 422–423, 432, 433, 435, 443, 448, 460, 465, 468–470, 480, 487, 494, 534, 550, 684  
unitary representation 167–168, 227, 230, 233, 236, 240, 245, 313, 324, 335, 336, 349, 360, 362, 368, 460, 462, 468–470, 564, 567–568  
unitary space 74, 76, (*see also* inner product space)  
unitary transformation 97, 115–116, 122, 360, 368, 423, 487  
universal quantifier 12–13  
universal set 20–21, 56  
  
vector representation 347, 414, 445, 446, 481–483  
vectors • 52  
vector space • 38, 52  
  complex 67, 75  
Virasoro algebra 582, 584, 586–587, 589–594  
von Dyck groups 193, 216  
  
weight function 130–135, 139–142  
weight vector 509, 512, 527–529, 532  
Weyl dimension formula 530, 553  
Weyl reflections / group 525–526  
Weyl spinor 490–491, 497, 501–502  
Wigner matrices 388–390  
winding number 640  
Wronskian 128  
  
Young tableaux 406–409, 532–533, 545  
  
zero divisor 46–47, 50