

Index

- abelian group, 1
- adjacency matrix, 53
- adjoint matrix, 89
- affine spaces, 60
- algebra, 11
- algebraic element, 92
- algebraic multiplicity, 89
- algebraically closed field, 63
- algebraically simple
 - eigenvalue, 90
- angle, 35
- angle between \mathbf{x} and \mathbf{y} , 139
- annihilator, 38
- anti-self-adjoint, 156
- associativity, 280
- augmented matrix, 15

- balanced bipartite graph, 55
- basis, 3
- big O notation, 255
- bijection, 11
- bilinear form, 161
- binary operation, 261
- bipartite graph, 52
- block diagonal matrix, 23
- block matrix, 13

- CANDECOMP-PARAFAC
 - decomposition, 227
- canonical form, 75
- Carathéodary's theorem, 61
- Cauchy–Binet formula, 110
- Cauchy–Schwarz inequality, 141
- Cayley–Hamilton theorem, 85
- center of a group, 265
- closed set, 173
- codimension, 100
- cofactor, 46
- cokernel, 99

- cokernel of group
 - homomorphism, 99
- column spaces, 21
- columns of a matrix, 279
- commutative group, 32
- commutative ring, 62
- compact set, 61
- companion matrix, 108
- complement, 26
- completion lemma, 11
- complex number, 10
- complex plane, 98
- complex vector space, 162
- continuity of the roots of a polynomial, 211
- convergent sequence, 254
- convex combination, 56
- convex function, 54
- convex hull, 56
- convex set, 56
- convoy principle, 164
- core tensor, 226
- coset, 100
- Courant–Fischer principle, 165
- Cramer's rule, 47
- cross product, 38
- cyclic decomposition
 - theorem, 109
- cyclic group, 66
- cyclic invariant subspace, 108
- cyclic property, 72
- cyclic subspace, 108

- De Moivre's theorem, 273
- decomposable element, 221
- decomposable tensor, 221
- degree of field extension, 63
- determinant of matrix, 42
- diagonal entries, 13

- diagonal matrices, 232
- diagonalizable matrix, 232
- diagonalization, 83
- diagonally dominant, 155
- differential equation, 7
- digraph, 216
- dimension, 3
- direct sum of matrices, 13
- disjoint sets, 257
- disjoint union, 188
- distance formula, 43
- division algebra, 11
- division ring, 263
- dot product, 139
- double dual, 70
- doubly stochastic matrices, 32
- dual space, 38

- edge, 53
- eigenspace, 77
- eigenvector, 63
- elementary matrix, 19
- elementary row operation, 14
- equivalence relation, 21
- Euclidean metric space, 253
- Euclidean norm, 141
- Euclidean space, 1
- Euler's function, 10
- even function, 30
- extreme point, 56

- Fekete's lemma, 53
- Fibonacci numbers, 83
- field, 61
- field extension, 63
- finite field extension, 63
- finite-dimensional vector space, 8
- finitely generated group, 8
- finitely generated vector space, 5

- first isomorphism theorem, 101
 Fredholm alternative, 146
 free transversal, 53
 free variable, 16
 Frobenius norm, 141
 fundamental theorem of algebra, 274
 fundamental theorem of invertible matrices, 19
 Gauss–Jordan algorithm, 20
 Gaussian elimination, 14
 Gaussian field of rationals, 11
 Gaussian integers domain, 11
 general linear group, 67
 generalized singular value decomposition, 202
 geometric multiplicity, 90
 Gram–Schmidt (G–S) algorithm, 153
 graph, 52
 group, 1
 Hölder inequality, 179
 Hadamard conjecture, 154
 Hadamard determinant inequality, 150
 Hadamard matrix, 154
 Hermitian form, 161
 homogeneous linear equation, 6
 homogeneous polynomial, 12
 homomorphism, 31
 hyperplane, 60
 idempotent matrix, 199
 index of nilpotency, 102
 induced norm by inner product, 141
 infinite-dimensional vector space, 7
 inner product, 37
 inner product space (IPS), 37
 invariant polynomials, 110
 invariant subspace, 91
 invertible matrices, 8
 involution, 11
 IPS (inner product space), 139
 irreducible matrix, 208
 irreducible polynomial, 63
 isometry, 155
 isomorphism, 34
 Jordan block, 80
 Jordan canonical form, 75
 Kronecker delta function, 13
 Kronecker product, 224
 Krylov subspace, 160
 Lagrange–Sylvester interpolation polynomial, 123
 Laplace expansion, 43
 lead variable, 16
 leading entry, 14
 least squares system, 147
 least squares theorem, 152
 left coset, 265
 linear combination, 3
 linear functional, 38
 linear isomorphism, 34
 linear operator, 34
 linear system, 16
 linearly dependent, 3
 linearly independent, 3
 lower triangular matrix, 29
 LU decomposition, 52
 Maclaurin expansion, 132
 mapping, 101
 Markov matrices, 56
 matching, 55
 matrix, 1
 matrix addition, 1
 matrix function, 121
 matrix multiplication, 1
 matrix of inner product, 140
 matrix of the change of basis, 8
 matrix polynomial, 87
 max–min characterizations of eigenvalues, 164
 maximal orthogonal set, 142
 metric, 141
 metric space, 141
 minimal polynomial, 91
 Minkowski’s criterion, 52
 modified Gram–Schmidt algorithm, 146
 modular law for subspaces, 30
 module, 87
 Moore–Penrose generalized inverse, 198
 multilinear operator, 34
 neutral element, 9
 nilpotent matrix, 102
 noncommutative division algebra, 11
 noncommutative ring, 262
 nonnegative matrices, 61
 nonpivot column, 29
 nontrivial invariant subspace, 94
 norm, 140
 normal subgroup, 265
 normalization condition, 43
 normed linear space, 140
 numerically unstable, 145
 odd function, 30
 open ball, 253
 ordered bases, 69
 ordinary differential equations (ODE), 130, 132
 orthogonal complement, 142
 orthogonal matrix, 150
 orthogonal projection, 145
 orthonormal basis, 142
 orthonormal k -frame, 166
 orthonormal sets, 142
 parallelogram identity, 152
 path, 170
 perfect matching, 57
 permutation, 30
 permutation group, 30
 permutation matrix, 32
 Perron–Frobenius eigenvector, 214
 Perron–Frobenius theorem, 207
 pivot, 14
 pivot column, 14
 pivot position, 14
 pivoting, 14
 polar decomposition, 198
 positive definite operators, 173
 primary decomposition theorem, 94
 primitive matrix, 214
 primitive unity root, 10
 principal minor, 47
 projection, 35
 projection of \mathbf{x} on \mathbf{U} , 142
 pseudospectrum, 98
 QR algorithm, 153

- QR factorization, 144
- quaternions, 11

- rank, 14
- rank 1 tensor, 221
- rank insensitivity lemma, 30
- rational canonical form, 112
- Rayleigh quotient, 164
- reduced row echelon form, 14
- reduced SVD (singular value decomposition), 198
- REF (row echelon form), 6
- reflection, 36
- representation matrix, 69
- ring, 61
- ring of polynomial, 62
- root of unity, 10
- rotation, 35
- row echelon form (REF), 6, 14

- s-numbers, 102
- scalar, 1
- scalar matrix, 24
- Schur's unitary triangularization, 160
- second isomorphism theorem, 101
- second-order linear differential systems, 132
- Segre's characteristic, 105
- self-adjoint linear transformation, 156

- sequence, 20
- similar matrices, 112
- similarity class, 76
- singular value, 181
- singular value decomposition (SVD), 181
- skew-symmetric matrix, 24, 168
- skew-symmetric tensor, 225
- span, 27
- spanning set, 4
- special linear group, 67
- spectral decomposition, 158
- spectral norm, 141
- spectral radius, 207
- spectral theorem, 157
- spectrum, 75
- standard basis, 8
- stochastic matrix, 32
- subgroup, 8
- submatrix, 279
- subring, 68
- subspace, 53
- Sylvester's criterion of positivity, 180
- Sylvester's inequality, 50
- symmetric matrix, 64
- symmetric product, 225
- symmetric tensor, 225
- symmetric tridiagonal matrix, 50
- system of differential equations, 135
- system of distinct representative, 52

- tensor product of two vector spaces, 221
- third isomorphism theorem, 101
- transition matrix, 227
- transpose matrix, 13
- transposition, 31
- triangular matrix, 24
- trivial combination, 3
- trivial subspace, 3
- trivial vector space, 5
- Tucker model, 226

- universal property, 222
- upper diagonal matrix, 194
- upper triangular matrix, 29

- Vandermonde determinant, 49
- Vandermonde matrix, 50
- Vandermonde, Alexander-Theophile, 50
- vector, 1
- vector projection, 155
- vector space, 1
- vertex, 57

- walk, 216
- wedge product, 225
- Weyl inequality, 166
- Weyr characteristic, 105