

# Index

- adjoint, 132
- affine combination, 10
- angle between  $n$ -vectors, 265
- augmented matrix, 63
- axonometric transformation, 47, 236
  
- barycentric combination, 10
- basis, 176
  - standard, for  $P_n$ , 178
  - standard, for  $R^n$ , 177
- Bernstein basis, 184
- Bézier curve, 201
- block multiplication, 30
  
- cabinet transformation, 47, 236
- Cartesian product, 150
- cavalier transformation, 54
- characteristic equation, 301
- characteristic polynomial, 301
- codomain, 36
- coefficient matrix, 63
- cofactor, 117
- column rank, 206
- column space, 206
- companion matrix, 309
- components of a vector, 2
- composition of linear transformations, 45
- conformal transformation, 358
- consistent system, 66
- contraction, 39
- control points, 201
- control polygon, 201
- coordinate vector, 193
- coordinate-change matrix, 246
- Cramer's rule, 130
- cross product, 15
- cubic spline, 111
  
- degree of precision of quadrature, 233
- determinant, 116
- diagonal matrix, 17
- diagonalizable matrix, 311
- difference
  - of matrices, 19
  - of vectors, 6
- dilation, 39
- dimension, 182
- direct sum, 206
- distance between points, 3
- domain, 36
- dominant eigenvalue, 327
- dot product, 8
  
- eigenspace, 302
- eigenvalue, 296
- eigenvector, 296
- elementary column operations, 130
- elementary matrix, 77
- elementary row operations, 67
  
- exchange matrix, 129, 309
  
- feasible solutions, 102
- fixed vector, 10
- free vector, 10
- fundamental spaces of a matrix, 215
  
- Gauss-Jordan reduction, 72
- Gaussian elimination, 72
- Gaussian quadrature, 236
- generalized eigenvector, 324
- Gram-Schmidt process, 277
  
- Hermite interpolating polynomial, 111
- Hermite-Birkhoff interpolating polynomial, 111
- homogeneous linear system, 82
- homogeneous system
  - solution space, 153
  
- idempotent matrix, 284
- identity matrix, 17
- identity transformation, 39
- image, 218
- inconsistent system, 66
- indexed set, 154
- induction, proof by, 119
- initial point, 2
- interpolating polynomial, 103
- intersection of subspaces, 163
- inverse of a matrix, 87
- inverse transformation, 94
- inversion, 129
- invertible linear transformation, 231
- invertible matrix, 87
  
- Jacobian matrix, 50
- Jordan block, 310
  
- kernel, 225
  
- Lagrange interpolating polynomial, 103
- leading column, 65
- leading entry, 65
- least squares solution, 279
- length of a vector, 3
- linear combination, 6
- linear system, 62
  - solution, 62
- linear transformation, 37, 218
  - matrix of, 37, 237
- linear transformations
  - composition of, 45, 222, 242
- linearly dependent vectors, 163
- linearly independent vectors, 163
- lower triangular matrix, 17
- $LU$  decomposition, 104
  
- magnitude of a vector, 3
- main diagonal, 17

- matrices
  - block multiplication of, 30
  - row equivalent, 67
- matrix, 17
  - addition, 18
  - augmented, 63
  - coefficient, 63
  - column, 17
  - entry, 17
  - inverse, 87
  - invertible, 87
  - multiplication, 26
  - noninvertible, 87
  - nonsingular, 87
  - power, 29
  - product, 26
  - row, 17
  - singular, 87
  - trace, 225
- matrix of linear transformation, 237
- midpoint rule, 236
- minor, 116
- monomial basis, 178
- morphing, 12
- multiplication of matrices, 26
- multiplicity
  - algebraic, 301
  - geometric, 302
- $n$ -space, 2
- $n$ -vector, 2
- natural cubic spline, 111
- negative of a vector, 6
- nilpotent matrix, 33
- noninvertible matrix, 87
- nonleading column, 65
- nonnegative matrix, 326
- nonsingular matrix, 87
- nontrivial solutions of homogeneous system, 82
- normal equations, 280
- null space, 153
- nullity, 210
- nullity of linear transformation, 241
- one-to-one, linear transformation, 230
- onto, linear transformation, 230
- orthogonal complement, 266
- orthogonal diagonalization, 317
- orthogonal matrix, 259
- orthogonal projection, 267
- orthogonal set, 254
- orthogonal vectors, 9
- orthographic transformation, 47
- orthonormal set, 254
- $PA = LU$  decomposition, 107
- particular solution, 84
- partitioned form of matrix, 22
- pentadiagonal matrix, 34
- permutation, 129
- permutation matrix, 108
- pivot, 68
- polynomial interpolation, 103
- polynomials, 144
- position vector, 10
- positive matrix, 326
- power of matrix, 29
- probability vector, 329
- product of matrices, 26
- projection, 38, 42
- projection onto subspace, 267
- pseudoinverse, 347
- $QR$  decomposition, 284
- quadrature formula, 233
- range, 36, 225
- rank, 209
- rank of linear transformation, 241
- reduced row echelon form, 65
- reflection, 39, 42
- regular matrix, 326
- rotation, 43
  - by 90 degrees counterclockwise, 39
  - by an arbitrary angle, 40
- rotation-dilation transformation, 55
- row echelon form, 65
- row equivalent matrices, 67
- row rank, 206
- row space, 206
- scalar multiple
  - of a matrix, 19
  - of a vector, 4
- scaling, 38
- shear transformation, 53
- similar matrices, 311
- Simpson's rule, 236
- singular matrix, 87
- singular values, 289, 341
- singular vectors, 289, 341
- skew-symmetric matrix, 23
- solution of linear system, 62
- solution set, 62
- solution space, 153
- space, 2
- span, 155
- spherical coordinates, 54
- spline interpolation, 111
- square matrix, 17
- stable vector, 329
- standard basis for  $P_n$ , 178
- standard basis for  $R^n$ , 177
- stochastic matrix, 329
- subspace, 151
- sum
  - of matrices, 18
  - of subspaces, 162
  - of vectors, 4
- symmetric matrix, 20
- system of linear equations, 62
- terminal point, 2
- trace of a matrix, 225

- transpose, 20
- tridiagonal matrix, 24
- trivial solution of homogeneous system, 82
- unit vector in the direction of the given vector, 5
- upper triangular matrix, 17
- vector, 2
  - addition, 4
  - vector space, 142
  - vectors
    - linearly dependent, 163
    - linearly independent, 163
  - zero vector, 3