

Linear algebra (scipy.linalg)

Linear algebra functions.

See also:

[numpy.linalg](https://www.numpy.org/devdocs/reference/routines.linalg.html) (<https://www.numpy.org/devdocs/reference/routines.linalg.html>)
 for more linear algebra functions. Note that although **scipy.linalg** imports most of them, identically named functions from **scipy.linalg** may offer more or slightly differing functionality.

Basics

inv (<generated/scipy.linalg.inv.html#scipy.linalg.inv>)(a[, overwrite_a, check_finite])

solve (<generated/scipy.linalg.solve.html#scipy.linalg.solve>)(a, b[, sym_pos, lower, overwrite_a, ...])

solve_banded (generated/scipy.linalg.solve_banded.html#scipy.linalg.solve_banded)(l_and_u, ab, b[, overwrite_ab, ...])

solveh_banded (generated/scipy.linalg.solveh_banded.html#scipy.linalg.solveh_banded)(ab, b[, overwrite_ab, ...])

solve_circulant (generated/scipy.linalg.solve_circulant.html#scipy.linalg.solve_circulant)(c, b[, singular, tol, ...])

solve_triangular (generated/scipy.linalg.solve_triangular.html#scipy.linalg.solve_triangular)(a, b[, trans, lower, ...])

solve_toeplitz (generated/scipy.linalg.solve_toeplitz.html#scipy.linalg.solve_toeplitz)(c_or_cr, b[, check_finite])

det (<generated/scipy.linalg.det.html#scipy.linalg.det>)(a[, overwrite_a, check_finite])

norm (<generated/scipy.linalg.norm.html#scipy.linalg.norm>)(a[, ord, axis, keepdims, check_finite])

lstsq (<generated/scipy.linalg.lstsq.html#scipy.linalg.lstsq>)(a, b[, cond, overwrite_a, ...])

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Previous topic

[scipy.io.arff.ParseArffError](scipy.io.arff.ParseArffError.html) (<generated/scipy.io.arff.ParseArffError.html>)

Next topic

[scipy.linalg.inv](scipy.linalg.inv.html) (<generated/scipy.linalg.inv.html>)

Quick search

Compute the inverse of a matrix.
 Solves the linear equation set $a * x = b$ for the unknown x for square a matrix.
 Solve the equation $a x = b$ for x , assuming a is banded matrix.
 Solve equation $a x = b$.
 Solve $C x = b$ for x , where C is a circulant matrix.
 Solve the equation $a x = b$ for x , assuming a is a triangular matrix.
 Solve a Toeplitz system using Levinson Recursion
 Compute the determinant of a matrix
 Matrix or vector norm.
 Compute least-squares solution to

equation $Ax = b$.

pinv (generated/scipy.linalg.pinv.html#scipy.linalg.pinv)(a[, cond, rcond, return_rank, check_finite])

Compute the (Moore-Penrose) pseudo-inverse of a matrix.

pinv2 (generated/scipy.linalg.pinv2.html#scipy.linalg.pinv2)(a[, cond, rcond, return_rank, ...])

Compute the (Moore-Penrose) pseudo-inverse of a matrix.

pinvh (generated/scipy.linalg.pinvh.html#scipy.linalg.pinvh)(a[, cond, rcond, lower, return_rank, ...])

Compute the (Moore-Penrose) pseudo-inverse of a Hermitian matrix.

kron (generated/scipy.linalg.kron.html#scipy.linalg.kron)(a, b)

Kronecker product.

khatri_rao (generated/scipy.linalg.khatri_rao.html#scipy.linalg.khatri_rao)(a, b)

Khatri-rao product

tril (generated/scipy.linalg.tril.html#scipy.linalg.tril)(m[, k])

Make a copy of a matrix with elements above the kth diagonal zeroed.

triu (generated/scipy.linalg.triu.html#scipy.linalg.triu)(m[, k])

Make a copy of a matrix with elements below the kth diagonal zeroed.

orthogonal_procrustes

(generated/scipy.linalg.orthogonal_procrustes.html#scipy.linalg.orthogonal_procrustes)(A, B[, check_finite])

Compute the matrix solution of the orthogonal Procrustes problem.

matrix_balance (generated/scipy.linalg.matrix_balance.html#scipy.linalg.matrix_balance)(A[, permute, scale, ...])

Compute a diagonal similarity transformation for row/column balancing.

subspace_angles (generated/scipy.linalg.subspace_angles.html#scipy.linalg.subspace_angles)(A, B)

Compute the subspace angles between two matrices.

LinAlgError (generated/scipy.linalg.LinAlgError.html#scipy.linalg.LinAlgError)

Generic Python-exception-derived object raised by linalg functions.

LinAlgWarning (generated/scipy.linalg.LinAlgWarning.html#scipy.linalg.LinAlgWarning)

The warning emitted when a linear algebra related operation is close to fail conditions of the algorithm or loss of accuracy is expected.

Eigenvalue Problems

eig (generated/scipy.linalg.eig.html#scipy.linalg.eig)(a[, b, left, right, overwrite_a, ...])

Solve an ordinary or generalized eigenvalue problem of a square matrix.

eigvals (generated/scipy.linalg.eigvals.html#scipy.linalg.eigvals)(a[, b, overwrite_a, check_finite, ...])

Compute eigenvalues from an ordinary or generalized eigenvalue problem.

eigh (generated/scipy.linalg.eigh.html#scipy.linalg.eigh)(a[, b, lower, eigvals_only, ...])

Solve a standard or generalized eigenvalue problem for a complex Hermitian or real symmetric matrix.

eigvalsh (generated/scipy.linalg.eigvalsh.html#scipy.linalg.eigvalsh)(a[, b, lower, overwrite_a, ...])

Solves a standard or generalized eigenvalue problem for a complex Hermitian or real symmetric matrix.

eig_banded (generated/scipy.linalg.eig_banded.html#scipy.linalg.eig_banded)(a_band[, lower, eigvals_only, ...])

Solve real symmetric or complex Hermitian band matrix eigenvalue problem.

eigvals_banded (generated/scipy.linalg.eigvals_banded.html#scipy.linalg.eigvals_banded)(a_band[, lower, ...])

Solve real symmetric or complex Hermitian band

eigh_tridiagonal (generated/scipy.linalg.eigh_tridiagonal.html#scipy.linalg.eigh_tridiagonal)(d, e[, eigvals_only, ...])

matrix
eigenvalue
problem.
Solve
eigenvalue
problem
for a real
symmetric
tridiagonal
matrix.

eigvalsh_tridiagonal
(generated/scipy.linalg.eigvalsh_tridiagonal.html#scipy.linalg.eigvalsh_tridiagonal)(d, e[, select, ...])

Solve
eigenvalue
problem
for a real
symmetric
tridiagonal
matrix.

Decompositions

lu (generated/scipy.linalg.lu.html#scipy.linalg.lu)(a[, permute_l, overwrite_a, check_finite])

Compute pivoted
LU decomposition
of a matrix.

lu_factor (generated/scipy.linalg.lu_factor.html#scipy.linalg.lu_factor)(a[, overwrite_a, check_finite])

Compute pivoted
LU decomposition
of a matrix.

lu_solve (generated/scipy.linalg.lu_solve.html#scipy.linalg.lu_solve)(lu_and_piv, b[, trans, ...])

Solve an equation
system, $a x = b$,
given the LU
factorization of a

svd (generated/scipy.linalg.svd.html#scipy.linalg.svd)(a[, full_matrices, compute_uv, ...])

Singular Value
Decomposition.

svdvals (generated/scipy.linalg.svdvals.html#scipy.linalg.svdvals)(a[, overwrite_a, check_finite])

Compute singular
values of a matrix.

diagsvd (generated/scipy.linalg.diagsvd.html#scipy.linalg.diagsvd)(s, M, N)

Construct the
sigma matrix in
SVD from singular
values and size M,
N.

orth (generated/scipy.linalg.orth.html#scipy.linalg.orth)(A[, rcond])

Construct an
orthonormal basis
for the range of A
using SVD

null_space (generated/scipy.linalg.null_space.html#scipy.linalg.null_space)(A[, rcond])

Construct an
orthonormal basis
for the null space
of A using SVD

ldl (generated/scipy.linalg.ldl.html#scipy.linalg.ldl)(A[, lower, hermitian, overwrite_a, ...])

Computes the
LDLt or Bunch-
Kaufman
factorization of a
symmetric/
hermitian matrix.

cholesky (generated/scipy.linalg.cholesky.html#scipy.linalg.cholesky)(a[, lower, overwrite_a, check_finite])

Compute the
Cholesky
decomposition of
a matrix.

cholesky_banded (generated/scipy.linalg.cholesky_banded.html#scipy.linalg.cholesky_banded)(ab[, overwrite_ab, lower, ...])

Cholesky
decompose a
banded Hermitian
positive-definite
matrix

cho_factor (generated/scipy.linalg.cho_factor.html#scipy.linalg.cho_factor)(a[, lower, overwrite_a, check_finite])

cho_solve (generated/scipy.linalg.cho_solve.html#scipy.linalg.cho_solve)
(c_and_lower, b[, overwrite_b, ...])

cho_solve_banded (generated/scipy.linalg.cho_solve_banded.html#scipy.linalg.cho_solve_banded)
(cb_and_lower, b[, ...])

polar (generated/scipy.linalg.polar.html#scipy.linalg.polar)(a[, side])

qr (generated/scipy.linalg.qr.html#scipy.linalg.qr)(a[, overwrite_a, lwork, mode, pivoting, ...])

qr_multiply (generated/scipy.linalg.qr_multiply.html#scipy.linalg.qr_multiply)(a, c[, mode, pivoting, ...])

qr_update (generated/scipy.linalg.qr_update.html#scipy.linalg.qr_update)(Q, R, u, v[, overwrite_qruv, ...])

qr_delete (generated/scipy.linalg.qr_delete.html#scipy.linalg.qr_delete)(Q, R, k, int p=1[, which, ...])

qr_insert (generated/scipy.linalg.qr_insert.html#scipy.linalg.qr_insert)(Q, R, u, k[, which, rcond, ...])

rq (generated/scipy.linalg.rq.html#scipy.linalg.rq)(a[, overwrite_a, lwork, mode, check_finite])

qz (generated/scipy.linalg.qz.html#scipy.linalg.qz)(A, B[, output, lwork, sort, overwrite_a, ...])

ordqz (generated/scipy.linalg.ordqz.html#scipy.linalg.ordqz)(A, B[, sort, output, overwrite_a, ...])

schur (generated/scipy.linalg.schur.html#scipy.linalg.schur)(a[, output, lwork, overwrite_a, sort, ...])

rsf2csf (generated/scipy.linalg.rs2csf.html#scipy.linalg.rs2csf)(T, Z[, check_finite])

hessenberg (generated/scipy.linalg.hessenberg.html#scipy.linalg.hessenberg)
(a[, calc_q, overwrite_a, ...])

cdf2rdf (generated/scipy.linalg.cdf2rdf.html#scipy.linalg.cdf2rdf)(w, v)

coffin (generated/scipy.linalg.coffin.html#scipy.linalg.coffin)(X[, p, q, separate, swap_sign, ...])

Compute the Cholesky decomposition of a matrix, to use in cho_solve

Solve the linear equations $Ax = b$, given the Cholesky factorization of A.

Solve the linear equations $Ax = b$, given the Cholesky factorization of the banded hermitian A.

Compute the polar decomposition.

Compute QR decomposition of a matrix.

Calculate the QR decomposition and multiply Q with a matrix.

Rank-k QR update QR downdate on row or column deletions

QR update on row or column insertions

Compute RQ decomposition of a matrix.

QZ decomposition for generalized eigenvalues of a pair of matrices.

QZ decomposition for a pair of matrices with reordering.

Compute Schur decomposition of a matrix.

Convert real Schur form to complex Schur form.

Compute Hessenberg form of a matrix.

Converts complex eigenvalues w and eigenvectors v to real eigenvalues in a block diagonal form wr and the associated real eigenvectors vr, such that.

Compute the cosine-sine (CS) decomposition of

an
orthogonal/unitary
matrix.

See also:

scipy.linalg.interpolative ([linalg.interpolative.html#module-scipy.linalg.interpolative](#)) – Interpolative matrix decompositions

Matrix Functions

expm ([generated/scipy.linalg.expm.html#scipy.linalg.expm](#))(A)

Compute the
matrix
exponential
using Pade
approximation.

logm ([generated/scipy.linalg.logm.html#scipy.linalg.logm](#))(A[, disp])

Compute
matrix
logarithm.

cosm ([generated/scipy.linalg.cosm.html#scipy.linalg.cosm](#))(A)

Compute the
matrix cosine.

sinm ([generated/scipy.linalg.sinm.html#scipy.linalg.sinm](#))(A)

Compute the
matrix sine.

tanm ([generated/scipy.linalg.tanm.html#scipy.linalg.tanm](#))(A)

Compute the
matrix
tangent.

coshm ([generated/scipy.linalg.coshm.html#scipy.linalg.coshm](#))(A)

Compute the
hyperbolic
matrix cosine.

sinhm ([generated/scipy.linalg.sinhm.html#scipy.linalg.sinhm](#))(A)

Compute the
hyperbolic
matrix sine.

tanhm ([generated/scipy.linalg.tanhm.html#scipy.linalg.tanhm](#))(A)

Compute the
hyperbolic
matrix
tangent.

signm ([generated/scipy.linalg.signm.html#scipy.linalg.signm](#))(A[, disp])

Matrix sign
function.

sqrtm ([generated/scipy.linalg.sqrtm.html#scipy.linalg.sqrtm](#))(A[, disp, blocksize])

Matrix square
root.

funm ([generated/scipy.linalg.funm.html#scipy.linalg.funm](#))(A, func[, disp])

Evaluate a
matrix
function
specified by a
callable.

expm_frechet ([generated/scipy.linalg.expm_frechet.html#scipy.linalg.expm_frechet](#))
(A, E[, method, compute_expm, ...])

Frechet
derivative of
the matrix
exponential of
A in the
direction E.

expm_cond ([generated/scipy.linalg.expm_cond.html#scipy.linalg.expm_cond](#))(A[, check_finite])

Relative
condition
number of the
matrix
exponential in
the Frobenius
norm.

fractional_matrix_power

([generated/scipy.linalg.fractional_matrix_power.html#scipy.linalg.fractional_matrix_power](#))(A, t)

Compute the
fractional
power of a
matrix.

Matrix Equation Solvers

solve_sylvester (generated/scipy.linalg.solve_sylvester.html#scipy.linalg.solve_sylvester)(a, b, q)	Computes a solution (to the Sylvester equation $AX + XB = Q$.
solve_continuous_are (generated/scipy.linalg.solve_continuous_are.html#scipy.linalg.solve_continuous_are)(a, b, q, r[, e, s, ...])	Solves the continuous time algebraic Riccati equation (CARE).
solve_discrete_are (generated/scipy.linalg.solve_discrete_are.html#scipy.linalg.solve_discrete_are)(a, b, q, r[, e, s, balanced])	Solves the discrete-time algebraic Riccati equation (DARE).
solve_continuous_lyapunov (generated/scipy.linalg.solve_continuous_lyapunov.html#scipy.linalg.solve_continuous_lyapunov)(a, q)	Solves the continuous Lyapunov equation $AX + XA^H = Q$.
solve_discrete_lyapunov (generated/scipy.linalg.solve_discrete_lyapunov.html#scipy.linalg.solve_discrete_lyapunov)(a, q[, method])	Solves the discrete Lyapunov equation $AXA^H - X + Q =$

Sketches and Random Projections

clarkson_woodruff_transform (generated/scipy.linalg.clarkson_woodruff_transform.html#scipy.linalg.clarkson_woodruff_transform)(input_matrix, ...)	"
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Special Matrices

block_diag (generated/scipy.linalg.block_diag.html#scipy.linalg.block_diag)(*arrs)	Create a block diagonal matrix from provided arrays.
circulant (generated/scipy.linalg.circulant.html#scipy.linalg.circulant)(c)	Construct a circulant matrix.
companion (generated/scipy.linalg.companion.html#scipy.linalg.companion)(a)	Create a companion matrix.
convolution_matrix (generated/scipy.linalg.convolution_matrix.html#scipy.linalg.convolution_matrix)(a, n[, mode])	Construct a convolution matrix.
dft (generated/scipy.linalg.dft.html#scipy.linalg.dft)(n[, scale])	Discrete Fourier transform matrix.
fiedler (generated/scipy.linalg.fiedler.html#scipy.linalg.fiedler)(a)	Returns a symmetric Fiedler matrix
fiedler_companion (generated/scipy.linalg.fiedler_companion.html#scipy.linalg.fiedler_companion)(a)	Returns a Fiedler companion matrix
hadamard (generated/scipy.linalg.hadamard.html#scipy.linalg.hadamard)(n[, dtype])	Construct an Hadamard matrix.
hankel (generated/scipy.linalg.hankel.html#scipy.linalg.hankel)(c[, r])	Construct a Hankel matrix.
helmert (generated/scipy.linalg.helmert.html#scipy.linalg.helmert)(n[, full])	Create an Helmert matrix of order n .

hilbert (generated/scipy.linalg.hilbert.html#scipy.linalg.hilbert)(n)	Create a Hilbert matrix of order n .
invhilbert (generated/scipy.linalg.invhilbert.html#scipy.linalg.invhilbert)(n[, exact])	Compute the inverse of the Hilbert matrix of order n .
leslie (generated/scipy.linalg.leslie.html#scipy.linalg.leslie)(f, s)	Create a Leslie matrix.
pascal (generated/scipy.linalg.pascal.html#scipy.linalg.pascal)(n[, kind, exact])	Returns the $n \times n$ Pascal matrix.
invpascal (generated/scipy.linalg.invpascal.html#scipy.linalg.invpascal)(n[, kind, exact])	Returns the inverse of the $n \times n$ Pascal matrix.
toeplitz (generated/scipy.linalg.toeplitz.html#scipy.linalg.toeplitz)(c[, r])	Construct a Toeplitz matrix.
tri (generated/scipy.linalg.tri.html#scipy.linalg.tri)(N[, M, k, dtype])	Construct (N, M) matrix filled with ones at and below the k th diagonal.

Low-level routines

get_blas_funcs (generated/scipy.linalg.get_blas_funcs.html#scipy.linalg.get_blas_funcs)(names[, arrays, dtype])	Return available BLAS function objects from names.
get_lapack_funcs (generated/scipy.linalg.get_lapack_funcs.html#scipy.linalg.get_lapack_funcs)(names[, arrays, dtype])	Return available LAPACK function objects from names.
find_best_blas_type (generated/scipy.linalg.find_best_blas_type.html#scipy.linalg.find_best_blas_type)([arrays, dtype])	Find best-matching BLAS/LAPACK type.

See also:

scipy.linalg.blas (linalg.blas.html#module-scipy.linalg.blas) – Low-level BLAS functions

scipy.linalg.lapack (linalg.lapack.html#module-scipy.linalg.lapack) – Low-level LAPACK functions

scipy.linalg.cython_blas (linalg.cython_blas.html#module-scipy.linalg.cython_blas) – Low-level BLAS functions for Cython

scipy.linalg.cython_lapack (linalg.cython_lapack.html#module-scipy.linalg.cython_lapack) – Low-level LAPACK functions for Cython