

# BLAS C prototypes

#include <cblas.h>

All functions are prefaced by cblas\_.

## Level 1 blas: vector, $O(n)$ operations

name	( dim, scalar, vector, vector, scalars, param )	description	equation	prefixes
_rotg	( a, b, c, s )	generate plane rotation		s, d
_rotmg	( d1, d2, a, b, param )	generate modified plane rotation		s, d
_rot	( n, x, incx, y, incy, c, s )	apply plane rotation		s, d
_rotm	( n, x, incx, y, incy, param )	apply modified plane rotation		s, d
_swap	( n, x, incx, y, incy )	swap vectors	$x \leftrightarrow y$	s, d, c, z
_scal	( n, alpha, x, incx )	scale vector	$y = \alpha y$	s, d, c, z, cs, zd
_copy	( n, x, incx, y, incy )	copy vector	$y = x$	s, d, c, z
_axpy	( n, alpha, x, incx, y, incy )	update vector	$y = y + \alpha x$	s, d, c, z
_dot	( n, x, incx, y, incy )	dot product	$= x^T y$	s, d, ds
_dotu_sub	( n, x, incx, y, incy, output )	(complex)	$= x^T y$	c, z
_dotc_sub	( n, x, incx, y, incy, output )	(complex conj)	$= x^H y$	c, z
__dot	( n, x, incx, y, incy )	(?)	$= \alpha + x^T y$	sds
_nrm2	( n, x, incx )	2-Norm	$= \ x\ _2$	s, d, sc, dz
_asum	( n, x, incx )	1-Norm	$= \ \operatorname{Re}(x)\ _1 + \ \operatorname{Im}(x)\ _1$	s, d, sc, dz
i_amax	( n, x, incx )	$\infty$ -Norm	$= i$ such that $ \operatorname{Re}(x_i)  +  \operatorname{Im}(x_i) $ is max	s, d, c, z

## Level 2 blas: matrix-vector, $O(n^2)$ operations

name	( order, options, dim, bandwidth, scalar, matrix, vector, scalar, vector )	description	equation	prefixes
_gemv	( order, trans, m, n, alpha, A, ldA, x, incx, beta, y, incy )	general matrix-vector multiply	$y = \alpha A^* x + \beta y$	s, d, c, z
_gbmv	( order, trans, m, n, kl, ku, alpha, A, ldA, x, incx, beta, y, incy )	(banded)	$y = \alpha A^* x + \beta y$	s, d, c, z
_hemv	( order, uplo, n, alpha, A, ldA, x, incx, beta, y, incy )	hermetian mat-vec	$y = \alpha Ax + \beta y$	c, z
_hbm	( order, uplo, n, k, alpha, A, ldA, x, incx, beta, y, incy )	(banded)	$y = \alpha Ax + \beta y$	c, z
_hpmv	( order, uplo, n, alpha, Ap, x, incx, beta, y, incy )	(packed)	$y = \alpha Ax + \beta y$	c, z
_symv	( order, uplo, n, alpha, A, ldA, x, incx, beta, y, incy )	symmetric mat-vec	$y = \alpha Ax + \beta y$	s, d †
_sbmv	( order, uplo, n, k, alpha, A, ldA, x, incx, beta, y, incy )	(banded)	$y = \alpha Ax + \beta y$	s, d
_spmv	( order, uplo, n, alpha, Ap, x, incx, beta, y, incy )	(packed)	$y = \alpha Ax + \beta y$	s, d †
_trmv	( order, uplo, trans, diag, n, A, ldA, x, incx )	triangular mat-vec	$x = A^* x$	s, d, c, z
_tbmv	( order, uplo, trans, diag, n, k, A, ldA, x, incx )	(banded)	$x = A^* x$	s, d, c, z
_tpmv	( order, uplo, trans, diag, n, Ap, x, incx )	(packed)	$x = A^* x$	s, d, c, z
_trsv	( order, uplo, trans, diag, n, A, ldA, x, incx )	triangular solve	$x = A^{-*} x$	s, d, c, z
_tbsv	( order, uplo, trans, diag, n, k, A, ldA, x, incx )	(banded)	$x = A^{-*} x$	s, d, c, z
_tpsv	( order, uplo, trans, diag, n, Ap, x, incx )	(packed)	$x = A^{-*} x$	s, d, c, z

$A^*$  denotes  $A, A^T$ , or  $A^H$ ;

$A^{-*}$  denotes  $A^{-1}, A^{-T}$ , or  $A^{-H}$ , depending on options and data type.

$A$  is  $m \times n$  or  $n \times n$ .

## Level 2, continued

name ( order, options, dim, scalar, vector, vector, matrix )	description	equation	prefixes
_ger ( order, m, n, alpha, x, incx, y, incy, A, ldA )	general rank-1 update	$A = A + \alpha xy^T$	s, d
_geru ( order, m, n, alpha, x, incx, y, incy, A, ldA )	(complex)	$A = A + \alpha xy^T$	c, z
_gerc ( order, m, n, alpha, x, incx, y, incy, A, ldA )	(complex conj)	$A = A + \alpha xy^H$	c, z
_her ( order, uplo, n, alpha, x, incx, A, ldA )	hermetian rank-1 update	$A = A + \alpha xx^H$	c, z
_hpr ( order, uplo, n, alpha, x, incx, Ap )	(packed)	$A = A + \alpha xx^H$	c, z
_her2 ( order, uplo, n, alpha, x, incx, y, incy, A, ldA )	hermetian rank-2 update	$A = A + \alpha xy^H + y(\alpha x)^H$	c, z
_hpr2 ( order, uplo, n, alpha, x, incx, y, incy, Ap )	(packed)	$A = A + \alpha xy^H + y(\alpha x)^H$	c, z
_syr ( order, uplo, n, alpha, x, incx, A, ldA )	symmetric rank-1 update	$A = A + \alpha xx^T$	s, d †
_spr ( order, uplo, n, alpha, x, incx, Ap )	(packed)	$A = A + \alpha xx^T$	s, d †
_syr2 ( order, uplo, n, alpha, x, incx, y, incy, A, ldA )	symmetric rank-2 update	$A = A + \alpha xy^T + \alpha yx^T$	s, d
_spr2 ( order, uplo, n, alpha, x, incx, y, incy, Ap )	(packed)	$A = A + \alpha xy^T + \alpha yx^T$	s, d

## Level 3 blas: matrix-matrix, $O(n^3)$ operations

name ( order, options, dim, scalar, matrix, matrix, scalar, matrix )	description	equation	prefixes
_gemm ( order, transa, transb, m, n, k, alpha, A, ldA, B, ldB, beta, C, ldC )	general matrix-matrix multiply	$C = \alpha A^* B^* + \beta C$	s, d, c, z
_symm ( order, side, uplo, m, n, alpha, A, ldA, B, ldB, beta, C, ldC )	symmetric mat-mat	$C = \alpha AB + \beta C$	s, d, c, z
_hemm ( order, side, uplo, m, n, alpha, A, ldA, B, ldB, beta, C, ldC )	hermetian mat-mat	$C = \alpha AB + \beta C$	c, z
_syrk ( order, uplo, trans, n, k, alpha, A, ldA, beta, C, ldC )	symmetric rank- $k$ update	$C = \alpha AA^T + \beta C$	s, d, c, z
_herk ( order, uplo, trans, n, k, alpha, A, ldA, beta, C, ldC )	hermetian rank- $k$ update	$C = \alpha AA^H + \beta C$	c, z
_syr2k ( order, uplo, trans, n, k, alpha, A, ldA, B, ldB, beta, C, ldC )	symmetric rank- $2k$ update	$C = \alpha AB^T + \tilde{\alpha} BA^T + \beta C$	s, d, c, z
_her2k ( order, uplo, trans, n, k, alpha, A, ldA, B, ldB, beta, C, ldC )	hermetian rank- $2k$ update	$C = \alpha AB^H + \tilde{\alpha} BA^H + \beta C$	c, z
_trmm ( order, side, uplo, transa, diag, m, n, alpha, A, ldA, B, ldB )	triangular mat-mat	$B = \alpha A^* B$ or $B = \alpha BA^*$	s, d, c, z
_trsm ( order, side, uplo, transa, diag, m, n, alpha, A, ldA, B, ldB )	triangular solve mat	$B = \alpha A^{-*} B$ or $B = \alpha BA^{-*}$	s, d, c, z

$A^*$  denotes  $A$ ,  $A^T$ , or  $A^H$ ;

$A^{-*}$  denotes  $A^{-1}$ ,  $A^{-T}$ , or  $A^{-H}$ , depending on options and data type.

The destination matrix is  $m \times n$  or  $n \times n$ . For mat-mat, the common dimension of  $A$  and  $B$  is  $k$ .

### Prefixes

s – real (float)    d – double  
c – complex        z – complex\*16  
ge – general        gb – general banded  
sy – symmetric    sb – symmetric banded    sp – symmetric packed  
he – hermetian    hb – hermetian banded    hp – hermetian packed  
tr – triangular    tb – triangular banded    tp – triangular packed

† LAPACK provides these complex symmetric routines, but only with Fortran calling conventions.

### Options

order = CblasRowMajor,    CblasColMajor  
tranx = CblasNoTrans:  $A$ ,    CblasTrans:  $A^T$ ,    CblasConjTrans:  $A^H$   
uplo = CblasUpper,        CblasLower  
diag = CblasNonUnit,      CblasUnit  
side = CblasLeft:  $AB$ ,      CblasRight:  $BA$   
ldA is major stride—number of rows (if colwise) or cols (if rowwise) of parent matrix  $A$ . Useful for submatrices.  
For real matrices, CblasTrans and CblasConjTrans are the same.  
For Hermitian matrices, CblasTrans is not allowed.  
For complex symmetric matrices, CblasConjTrans is not allowed.

Updated June 13, 2008. BLAS and LAPACK guides available from <http://www.ews.uiuc.edu/~mrgates2/>.

Reference: *BLAS Quick Reference Guide* from <http://www.netlib.org/blas/faq.html>

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