BLAS Fortran 77 prototypes

Level 1 BLAS: vector, $O(n)$ operations

types	name	(size arguments)	description	equation	flops	data
s, d, c, z	axpy	(n, alpha, x, incx, y, incy)	update vector	$y = y + \alpha x$	$2n$	$2n$
s, d, c, z, cs, zd	scal	(n, alpha, x, incx)	scale vector	$y = \alpha y$	n	n
s, d, c, z	copy	(n, x, incx, y, incy)	copy vector	$y = x$	0	$2n$
s, d, c, z	swap	(n, x, incx, y, incy)	swap vectors	$x \leftrightarrow y$	0	$2n$
s, d	dot	(n, x, incx, y, incy)	dot product	$= x^T y$	$2n$	$2n$
c, z	dotu	(n, x, incx, y, incy)	(complex)	$= x^T y$	$2n$	$2n$
c, z	dotc	(n, x, incx, y, incy)	(complex conj)	$= x^H y$	$2n$	$2n$
sds, ds	dot	(n, x, incx, y, incy)	(internally double precision)	$= x^T y$	$2n$	$2n$
s, d, sc, dz	nrm2	(n, x, incx)	2-norm	$= \|x\|_2$	$2n$	n
s, d, sc, dz	asum	(n, x, incx)	1-norm	$= \|\mathrm{Re}(x)\|_1 + \|\mathrm{Im}(x)\|_1$	n	n
s, d, c, z	i_amax	(n, x, incx)	∞-norm	$= \mathrm{argmax}_i(\|\mathrm{Re}(x_i)\| + \|\mathrm{Im}(x_i)\|)$	n	n
s, d, c, z	rotg	(a, b, c, s)	generate plane (Given's) rotation (c real, s complex)		$O(1)$	$O(1)$
s, d, c, z †	rot	(n, x, incx, y, incy, c, s)	apply plane rotation (c real, s complex)		$6n$	$2n$
cs, zd	rot	(n, x, incx, y, incy, c, s)	apply plane rotation (c & s real)		$6n$	$2n$
s, d	rotmg	(d1, d2, a, b, param)	generate modified plane rotation		$O(1)$	$O(1)$
s, d	rotm	(n, x, incx, y, incy, param)	apply modified plane rotation		$6n$	$2n$

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

types	name	(options	size	arguments)	description	equation	flops	data
s, d, c, z	gemv	(trans,	m, n, alpha, A, ldA, x, incx, beta, y, incy)		general matrix-vector multiply	$y = \alpha A^* x + \beta y$	$2mn$	mn
c, z	hemv	(uplo,	n, alpha, A, ldA, x, incx, beta, y, incy)		Hermitian matrix-vector mul.	$y = \alpha Ax + \beta y$	$2n^2$	$n^2/2$
s, d †	symv	(uplo,	n, alpha, A, ldA, x, incx, beta, y, incy)		symmetric matrix-vector mul.	$y = \alpha Ax + \beta y$	$2n^2$	$n^2/2$
s, d, c, z	trmv	(uplo, trans, diag,	n, A, ldA, x, incx)		triangular matrix-vector mul.	$x = A^* x$	n^2	$n^2/2$
s, d, c, z	trsv	(uplo, trans, diag,	n, A, ldA, x, incx)		triangular solve	$x = A^{-*} x$	n^2	$n^2/2$
s, d	ger	(	m, n, alpha, x, incx, y, incy,	A, ldA)	general rank-1 update	$A = A + \alpha x y^T$	$2mn$	mn
c, z	geru	(	m, n, alpha, x, incx, y, incy,	A, ldA)	general rank-1 update (complex)	$A = A + \alpha x y^T$	$2mn$	mn
c, z	gerc	(	m, n, alpha, x, incx, y, incy,	A, ldA)	general rank-1 update (complex conj)	$A = A + \alpha x y^H$	$2mn$	mn
s, d †	syr	(uplo,	n, alpha, x, incx,	A, ldA)	symmetric rank-1 update	$A = A + \alpha x x^T$	n^2	$n^2/2$
c, z	her	(uplo,	n, alpha, x, incx,	A, ldA)	Hermitian rank-1 update	$A = A + \alpha x x^H$	n^2	$n^2/2$
s, d	syr2	(uplo,	n, alpha, x, incx, y, incy,	A, ldA)	symmetric rank-2 update	$A = A + \alpha x y^T + \alpha y x^T$	$2n^2$	$n^2/2$
c, z	her2	(uplo,	n, alpha, x, incx, y, incy,	A, ldA)	Hermitian rank-2 update	$A = A + \alpha x y^H + y(\alpha x)^H$	$2n^2$	$n^2/2$

Level 2 BLAS, band storage

types	name	(options	size	bandwidth	arguments)	description	equation
s, d, c, z	gbmv	(trans,	m, n, kl, ku,	alpha, A, ldA, x, incx, beta, y, incy)	band general matrix-vector multiply	$y = \alpha A^* x + \beta y$
c, z	hbmv	(uplo,	n, k,	alpha, A, ldA, x, incx, beta, y, incy)	band Hermitian matrix-vector mul.	$y = \alpha Ax + \beta y$
s, d	sbmv	(uplo,	n, k,	alpha, A, ldA, x, incx, beta, y, incy)	band symmetric matrix-vector mul.	$y = \alpha Ax + \beta y$
s, d, c, z	tbmv	(uplo, trans, diag,	n, k,	A, ldA, x, incx)	band triangular matrix-vector mul.	$x = A^* x$
s, d, c, z	tbsv	(uplo, trans, diag,	n, k,	A, ldA, x, incx)	band triangular solve	$x = A^{-*} x$

Level 2 BLAS, packed storage

types	name	(options	size arguments	)	description	equation	flops	data
c, z	hpmv	(uplo,	n, alpha, Ap,	x, incx, beta, y, incy)	packed Hermitian matrix-vector mul.	$y = \alpha Ax + \beta y$	$2n^2$	$n^2/2$
s, d †	spmv	(uplo,	n, alpha, Ap,	x, incx, beta, y, incy)	packed symmetric matrix-vector mul.	$y = \alpha Ax + \beta y$	$2n^2$	$n^2/2$
s, d, c, z	tpmv	(uplo, trans, diag,	n, Ap,	x, incx)	packed triangular matrix-vector mul.	$x = A^* x$	n^2	$n^2/2$
s, d, c, z	tpsv	(uplo, trans, diag,	n, Ap,	x, incx)	packed triangular solve	$x = A^{-*} x$	n^2	$n^2/2$
s, d †	spr	(uplo,	n, alpha, x, incx,	Ap)	packed symmetric rank-1 update	$A = A + \alpha xx^T$	n^2	$n^2/2$
c, z	hpr	(uplo,	n, alpha, x, incx,	Ap)	packed Hermitian rank-1 update	$A = A + \alpha xx^H$	n^2	$n^2/2$
s, d	spr2	(uplo,	n, alpha, x, incx, y, incy,	Ap)	packed symmetric rank-2 update	$A = A + \alpha xy^T + \alpha yx^T$	$2n^2$	$n^2/2$
c, z	hpr2	(uplo,	n, alpha, x, incx, y, incy,	Ap)	packed Hermitian rank-2 update	$A = A + \alpha xy^H + y(\alpha x)^H$	$2n^2$	$n^2/2$

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

types	name	(options	size	arguments	)	description	equation	flops	data
s, d, c, z	gemm	(transA, transB,	m, n, k,	alpha, A, ldA, B, ldB, beta, C, ldC)		general matrix-matrix multiply	$C = \alpha A^* B^* + \beta C$	$2mnk$	$mk + nk + mn$
s, d, c, z	gemmtr	(uplo, transA, transB,	m, n, k,	alpha, A, ldA, B, ldB, beta, C, ldC)		general matrix-matrix multiply	$\text{uplo}(C) = \text{uplo}(\alpha A^* B^* + \beta C)$	mnk	$mk + nk + mn/2$
s, d, c, z	symm	(side, uplo,	m, n,	alpha, A, ldA, B, ldB, beta, C, ldC)		symmetric matrix-matrix mul.	$C = \alpha AB + \beta C$	$2m^2n$	$m^2 + mn$ (left)
c, z	hemm	(side, uplo,	m, n,	alpha, A, ldA, B, ldB, beta, C, ldC)		Hermitian matrix-matrix mul.	$C = \alpha AB + \beta C$	$2m^2n$	$m^2 + mn$ (left)
s, d, c, z	trmm	(side, uplo, transA, diag,	m, n,	alpha, A, ldA, B, ldB	)	triangular matrix-matrix mul.	$B = \alpha A^* B$ or $B = \alpha BA^*$	m^2n	$m^2 + mn$ (left)
s, d, c, z	trsm	(side, uplo, transA, diag,	m, n,	alpha, A, ldA, B, ldB	)	triangular solve matrix	$B = \alpha A^{-*} B$ or $B = \alpha BA^{-*}$	m^2n	$m^2 + mn$ (left)
s, d, c, z	syrk	(uplo, trans,	n, k,	alpha, A, ldA,	beta, C, ldC)	symmetric rank-k update	$C = \alpha AA^T + \beta C$	kn^2	$n^2/2$
c, z	herk	(uplo, trans,	n, k,	alpha, A, ldA,	beta, C, ldC)	Hermitian rank-k update	$C = \alpha AA^H + \beta C$	kn^2	$n^2/2$
s, d, c, z	syr2k	(uplo, trans,	n, k,	alpha, A, ldA, B, ldB,	beta, C, ldC)	symmetric rank-$2k$ update	$C = \alpha AB^T + \bar{\alpha} BA^T + \beta C$	$2kn^2$	$n^2/2$
c, z	her2k	(uplo, trans,	n, k,	alpha, A, ldA, B, ldB,	beta, C, ldC)	Hermitian rank-$2k$ update	$C = \alpha AB^H + \bar{\alpha} BA^H + \beta C$	$2kn^2$	$n^2/2$

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 matrix-matrix, the common dimension of A^* and B^* is k.
Flops and data are most significant term only. Where applicable, flops and data are for side=left; swap m, n for side=right.
In complex, each mul becomes 6 flops and each add becomes 2 flops.

Prefixes

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

† LAPACK adds complex routines [cz]rot,
and complex-symmetric routines for symv, spmv, syr, spr,
but only with Fortran calling conventions, not in CBLAS.

Options

trans = 'N'o transpose: A, 'T'ranspose: A^T, 'C'onjugate transpose: A^H
uplo = 'U'pper triangular, 'L'ower triangular
diag = 'N'on-unit triangular, 'U'nit triangular
side = 'L'eft: AB, 'R'ight: BA
ldA is leading dimension of matrix A (major stride, number of rows of parent matrix A). Use for submatrices.
For real matrices, trans = 'T' and 'C' are the same.
For Hermitian matrices, trans = 'T' is not allowed.
For complex symmetric matrices, trans = 'C' is not allowed.

References

Basic Linear Algebra Subprograms for Fortran Usage. Lawson, et al., 1979.
An Extended Set of Fortran Basic Linear Algebra Subprograms. Dongarra, et al., 1988.
A Set of Level 3 Basic Linear Algebra Subprograms. Lawson, et al., 1990.