Historical Perspective on the BLAS

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What are the BLAS?

The Basic Linear Algebra Subprograms (BLAS) are a set of Fortran 77 computational kernels for basic operations in linear algebra

Their specifications have become *de facto* standards

Level 1 BLAS

[1] R. J. Hanson, F. T. Krogh, and C. L. Lawson. A proposal for standard linear algebra subprograms. *ACM Signum Newsletter*, 8:16, 1973.

[2] C. L. Lawson, R. J. Hanson, D. Kincaid, and F. T. Krogh. Basic Linear Algebra Subprograms for FORTRAN usage. *ACM Trans. Math. Software*, 5:308–323, 1979. (Algorithm 539).

Level 2 & 3 BLAS

[1] J. J. Dongarra, J. Du Croz, S. Hammarling, and R. J. Hanson. An extended set of FORTRAN Basic Linear Algebra Subprograms. *ACM Trans. Math. Software*, 14:1–32, 1988. (Algorithm 656).

[2] J. J. Dongarra, J. Du Croz, I. S. Duff, and S. Hammarling. A set of Level 3 Basic Linear Algebra Subprograms. *ACM Trans. Math. Software*, 16:1–28, 1990. (Algorithm 679).

Sparse Level 1 BLAS

[1] D. S. Dodson, R. G. Grimes, and J. G. Lewis. Sparse extensions to the FORTRAN Basic Linear Algebra Subprograms. *ACM Trans. Math. Software*, 17:253–272, 1991. (Algorithm 692).

Level 2 & 3 Sparse BLAS

Coming soon!!

Motivation for the BLAS

The Level 1 BLAS were intended to:

- be a design tool for the development of software in numerical linear algebra
- improve readability and aid documentation
- aid modularity and maintenance, and improve robustness of software calling the BLAS
- promote efficiency
- improve portability, without sacrificing efficiency, through standardization

Discussion of the BLAS

[1] D. S. Dodson and J. Lewis. Issues relating to extension of the Basic Linear Algebra Subprograms. *ACM Signum Newsletter*, 20:2–18, 1985.

Motivation for the Level 2 & 3 BLAS

In addition to the aims of the Level 1 BLAS, the Level 2 & 3 BLAS were motivated by the need to raise the level of granularity on vector, hierarchical memory and parallel shared memory machines.

The BLAS provide a portability layer between higher level software and the underlying machine architecture.

Specification of the BLAS

- The published papers provide the *specification* of the BLAS
- Model implementation available
- Testing and timing software for implementors and installers
- Scope limited to allow manufacturers to implement the routines efficiently

Users and Providers of the BLAS

- LINPACK (Level 1 BLAS)
- LAPACK
- The IMSL Library, The NAG Library, ...
- Numerical software developers
- Manufacturers and other implementors

The Level 2 BLAS Standardization Process

- Background experience (SMXPY, SXMPY, NAG kernels, . . .)
- Gatlinburg, June 84; IFIP WG 2.5
- Parvec IV Workshop, October 84; . . .
- . . . ; SIAM Parallel Conference, November 85
- Proposals in Technical Reports and SIGNUM Newsletter
- Publication in TOMS, March 88

Summary of Standardization

- Background experience
- Extensive consultation on facilities and specification
- Preparation of model and associated software
- Publication
- Promotion

Hopes for this Workshop

- Constructive and stimulating discussion
- Realistic aims
- Emergence of proposals for parallel BLAS
- Consideration of data structures, classes, . . .
- Future plans