

Index

0–9

64-bit integer support, 264

A

Active set algorithm, 317
Active set method, 313, 314, 316, 320, 321
Addressing, 107, 118
Algebraic multigrid (AMG), 263, 266, 267
Alliant FX/8, 3, 15
Alternating nonnegativity-constrained least squares, 313
ANLS, 313
Approximate minimum degree, 251, 254–256, 259
ARMS, 242
Atomistic modeling algorithms, 36
Auxiliary-space Maxwell Solver (AMS), 267

B

Balance, 48
Banded matrix primitives, 6
Banded triangular systems, 7
Bandwidth, 47
Bandwidth waste, 48
Barnes–Hut methods, 35
Benchmarking, 5
Berkeley Dwarfs, 5
Biharmonic equation, 13
BLAS, 127
BLAS level-3 primitives, 10
Block Krylov methods, 23
Block principal pivoting algorithm, 318
Block principal pivoting method, 313, 315, 320, 321
Block-coordinate-descent method, 315
Blocking
 multi-level, 11

BoomerAMG, 266, 267

C

CANDECOMP, 312
Canonical decomposition, 312, 328
Capacity equations algorithm, 57
CBLAS, 127
Cedar Fortran, 4
Cedar system, 3, 15
Center for Supercomputing Research and Development, 3
Charge simulation method (CSM), 14
Chebyshev iteration, 23
Cholesky factorization, 128, 129, 136
CLAPACK, 127
Codelet, 50
Codesign
 HW/SW, 48
 multiphase, 61
Column-based algorithm, 6
Complementary basic solution, 316
Computational capacity, 46, 53
Computational kernels, 5
Computational redundancy, 6
Computational science and engineering (CSE), 37
Computer performance, 75
Core BLAS, 127, 128
CP (CANDECOMP/PARAFAC)
 decomposition, 312
Cray T3D, 35, 36
Cyclic reduction, 9

D

DAGuE, 125, 135, 138
Data structure analysis, 100, 119
Davidson method, 20, 22

- Dense matrices, 6
 Dense matrix primitives, 6
 Directed acyclic graph (DAG), 123, 128
 Divide and conquer, 8, 9
 Domain decomposition, 157
 Dominance factor ε , 147
 DPLASMA, 125, 135–143
- E**
 Efficiency, 47
 Error analysis, 34
- F**
 FACR algorithm, 12
 Factorization
 Cholesky, 128, 129, 136
 DS, 24–26
 General DS, 174
 LU, 128, 129, 137
 nonorthogonal, 7
 orthogonal, 7
 QR, 7, 128, 129, 140
 Fast multipole methods, 34
 Fast Poisson solver, 12
 FFT, 12
 Fiedler vector, 176
 Fill-in, 199, 200, 203, 204
 Floating-point arithmetic, 34
 FutureLens, 327, 332
- G**
 Generalized DS factorization, 174
 GMRES, 220–222, 227, 228
- H**
 HALS, 314
 Hierarchical alternating least squares, 314, 320
 Hierarchical approximation techniques, 36
 Hierarchically semiseparable, 199, 200, 202,
 210
 hwloc, 127
 Hybrid methods, 24
 Hybrid programming model, 264, 265, 273,
 275
 Hybrid solvers, 172
 Hypre library, 261–264
- I**
 Illiac IV, 2
 Incomplete Cholesky, 251, 255, 257
 Information retrieval (IR), 22
 Inner–outer iteration, 219, 220, 243, 244
 Instruction level parallelism (ILP), 124
 Intel MKL BLAS, 33
- Interface, 262, 263
 conceptual, 262, 263
 linear-algebraic, 263
 scalable, 264
 semi-structured grid, 263
 structured grid, 263
 Intermediate eigenvalues, 15
- J**
 Jacobi sweeps, 11
 Jacobi–Davidson method, 19, 20
 Job description format (JDF), 139
- K**
 Kaczmarz methods, 23
 Karush–Kuhn–Tucker (KKT) condition, 316
 Khatri–Rao product, 315
 Knowledge discovery, 327, 337
 Krylov subspace methods, 172
- L**
 LAPACK, 32, 126, 127
 LAPACKE, 127
 Latency, 52
 Latent semantic indexing (LSI), 22
 Linear node, 51
 Linear recurrence, 7
 LU factorization, 128, 129, 137
 LU/UL strategy, 30
- M**
 MAGMA, 123, 130–135
 Matlab Tensor Toolbox, 331
 Matrix decomposition (fast Poisson solver), 13
 Matrix reordering, 175
 Maxwell solver, 263, 267
 Measurement, 76, 77
 Mode-n matricization, 314
 Model, 77, 80, 84, 92, 93
 Modified Gram–Schmidt (MGS), 11
 Multigrid solvers, 261–263, 265
 Multilevel preconditioner, 24
 Multiplicative updating, 314, 320
 Multiprocessor, cluster-based, 3
 Multirate node, 70
- N**
 Nested dissection, 199, 200, 203–206
 Nested iterative scheme, 221–223, 228–230,
 241, 246
 Nonnegative Matrix Factorization (NMF), 312
 NNLS (nonnegative or nonnegativity
 constrained, least squares) problem,
 296, 313, 315, 316, 318
 Nonnegative tensor factorization, 327

- Non-uniform memory access (NUMA), 268, 275
Nonlinear node, 52
Nonlinearity, 80
Nonnegative CP (NNCP) decomposition, 312
Nonnegative matrix factorization (NMF), 312
Nonnegativity-constrained (or nonnegative) least squares (NNLS) problem, 296, 313, 315, 316, 318
- O**
Object Identifier, 108
One-sided block Jacobi SVD algorithm, 189
 dynamic ordering, 194
 principal angles, 192
Optimization on manifolds, 281
- P**
Pairwise pivoting, 8
PARAFAC, 312, 328
Parallelism
 limited, 6
 loop based, 4
 task based, 4
 unlimited, 6
Parallel factor analysis, 312
PARDISO, 32
Particulate flows, 219, 221, 223
Partition
 assumed, 264, 271, 274, 275
 global, 264, 271, 273, 274
Perfect Club, 5
Performance instability, 66
Permutation vector, 110
PFMG, 263, 266, 268
Phase, SW, 51
PLASMA, 123, 125–129
Pointer tracking, 104, 105, 117
Polyalgorithm, 25, 28
POSIX threads, 127
Precision and recall, 299
Preconditioned conjugate gradient (PCG), 24, 251, 255, 257
Problem solving environments, 5
Product form, 6
Projection-based initialization for NNLS (PiNNLS), 303–304
Python, 327
- Q**
QR factorization, 128, 129, 140
Quadratic transformation, 15
QUARK, 127, 128
- R**
Rank relaxation, 199, 201, 210–212
Rapid elliptic solver, 13
Read after Write (RaW), 128
Recursive doubling, 9
Reduced system, 29
Reduced system, iterative solution of the, 147, 152
Restructuring, 113
Retraction, 283
Reverse Cuthill–McKee, 251, 254–256, 259
Richardson, 219–222, 229, 230, 233, 234
Riemannian Dennis–Moré condition, 289
Riemannian Newton equation, 283
Riemannian quasi-Newton algorithm, 284
Row-based algorithmic, 6
Row-projection methods, 23
- S**
Saddle-point, 219–247
Sameh table, 5
Saturation, 54
Scalability, 219, 223, 242
ScALAPACK, 126, 127
Sensitivity analysis, 64
Shadow stack, 104, 106, 118
Shift-and-Invert technique, 15
SIMD, 2
Singular value decomposition (SVD)
 algorithms, 22
SMG, 266
Solomon I, 2
Sparse linear systems, 171
Spike, 9
Spike algorithm, 24, 172
 recursive, 26
 recursive, for non-diagonally dominant systems, 30
 truncated, 26, 29
 truncated, for diagonally dominant systems, 29
Spike solvers, 10, 14
Spike-ADAPT, 32
Spike-PARDISO, 32
Stack, 104, 112, 115
Stack map, 104, 106, 118
Structural mechanics, 251, 259
Structure splitting, 101, 103
Structured matrices, 15
Structured multifrontal, 200, 207, 211–213
Sturm sequences, 11
SVD computations, 22
SW design, 63
Symmetric tridiagonal matrix, 11

SysPFMG, 266

System cost, 63

System optimization, 63

Systolic array, 8

T

Tensor, 311

Text analysis, 335

Thinking machines CM5, 35

Thomas algorithm, 12

Thread-level parallelism (TLP), 124

Toeplitz solvers, 13, 14

Trace Min, 16, 17, 19, 20, 22

Trace minimization, 16, 176

Triangular matrix primitives, 6

Tridiagonal systems, 8

Two-sided block Jacobi SVD method, 188

dynamic ordering, 188, 189

U

Uzawa, 221, 222, 229, 246

V

Vector transport, 283

associated retraction, 283

W

Weak scalability, 261

Write after Read (WaR), 128

Write after Write (WaW), 128

X

Xylem, 4