SOLVE A LARGE SPARSE LINEAR SYSTEMS: FROM MULTIGRID TO CAF

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Solve $Ax = b$
(A large and sparse)

Currently working with matrices coming from wind farm simulations and ground water modelling.

Develop new algorithms and methods??

MULTIGRID METHOD

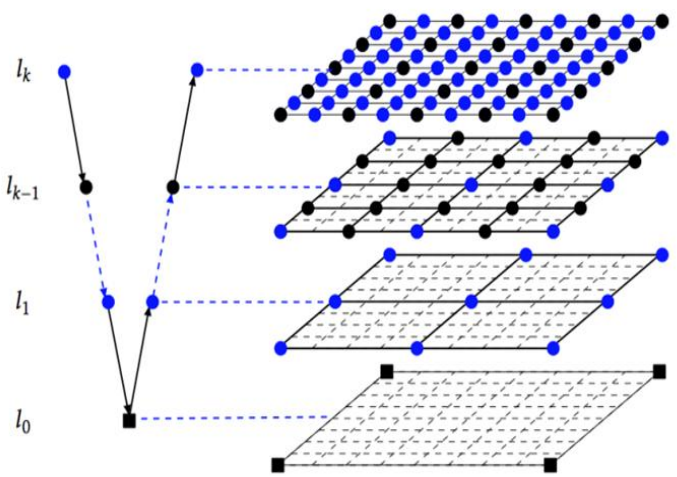
Improve existing softwares and explore new programming paradigm??

CO-ARRAY FORTRAN

Algebraic Multigrid methods

Two level method

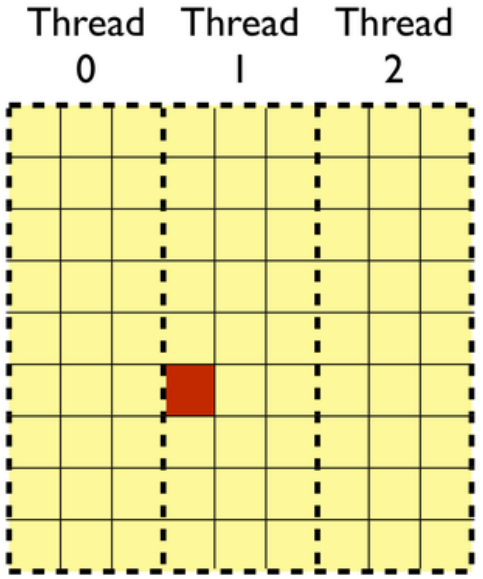
1. Pre-smoothing iterations: compute x_1 solution of $Ax_1 = b$
2. Compute residuals $r_1 = b - Ax_1$
3. Restrict residual to a coarse space: $r_c = P_c^T r$
4. Solve $A_c x_c = r_c$ (re-using the two-level method → multilevel)
5. Interpolate error and update solution $x = x_1 + P_c r_c$
6. Post-smoothing iterations



Algebraic Multigrid

It uses only information about the matrix, without any a priori knowledge of the physical grid.

Co-Array Fortran



Co-Array Fortran or CAF is a syntactic extension of Fortran for parallel processing.

It follows the Partitioned Global Address Space (PGS)) parallel programming model: the gloabl address space is partitioned among processors.

Communications are one-sided, no message-passing

Not many tools available for CAF programmers

We created a Unit Test framework compatible with CAF, by extending the existing PFUnit

Not many real world applications written in CAF

Migrating libraries for sparse linear algebra PSBLA and MLD2P4 in CAF and study the impact on performance and software quality

THANK FOR YOUR ATTENTION

If you are interested in Multigrid methods
or Fortran Coarrays, please contact me at

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