GOAL AND STATUS OF THE TLSE PLATFORM

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Outline

- Overview of the GRID-TLSE Project
- Semantic description of services
- Use of scenarios to generate dynamic workflows
- Bibliography
- Status
- Conclusion
GRID-TLSE Project: Tests for Large Systems of Equations

Main purpose: Sparse linear algebra Web expert site.

- GRID-TLSE Project: ACI GRID, 01/03 – 01/06. Academic partners: CERFACS, IRIT, LaBRI, LIP-ENSL;

- Now:
  - ANR-06-CIS6-010 SOLSTICE Project 2007-2010. Partners: INRIA, CERFACS, INPT-IRIT, CEA-CESTA, EADS CCR, EDF, CNRS-CNRM-LA.
  - CNRS / JST REDIMPS Project 2007-2009. Partners: JAEA and academic partners of the TLSE Project (CERFACS, IRIT, LaBRI / INRIA Futurs, LIP ENS Lyon / INRIA)

Sparse Matrices Expert Site?

- Expert site: Help users in choosing the right solvers and its parameters for a given problem
- Chosen approach: Expert scenarios which answer common user requests
- Main goal: Provide a friendly test environment for expert and non-expert users of sparse linear algebra software.
- Easy access to:
  - Software and tools;
  - A wide range of computer architectures;
  - Matrix collections;
  - Expert Scenarios.
- Also: Provide a testbed for sparse linear algebra software
Why do we use a Grid?

- Sparse linear algebra software makes use of sophisticated algorithms for (pre-/post-) processing the matrix.
- Multiple parameters interfere for efficient execution of a sparse direct solver:
  - Ordering;
  - Amount of memory;
  - Architecture of computer;
  - Libraries available.
  - Determining the best combination of parameter values is a multi-parametric problem.
- Well-suited for execution over a Grid.

Additional Benefits of Using a Computational Grid

Provides access to:
  - Large range of software and tools (academic or industrial);
  - Wide range of architectures;
  - Computational resources.
Examples of user request

- Memory required to factor a given matrix.
- Error analysis as a function of the threshold pivoting value
- Minimum time on a given computer to factor a given unsymmetric matrix
- Which ordering heuristic is the best one for solving a given problem?

Two types of users:

- Standards users that want to proceed to some tests over their matrices
- Experts that deploy tools and specify what is the expert procedure

The GRID-TLSE Platform

Execution of a straightforward scenario

- Grid adaptor
- XML description of experiments
- Web Portal
- GridCOM
- WEAVER
Key ideas in describing expert procedures

- We do not want asking an expert in sparse linear algebra to deploy services over the grid at the usual level i.e. describing interfaces, GridRPC calls, 

- We have then introduced:
  - A high level - graphical - description of the expert process that we call scenarios
  - A semantic based description of software, control parameters and matrices based on meta-data

Main Software Issues

- The same interface provides the users with access to
  - several expertise scenarios;
  - several solvers and their parameters (using middleware to access the GRID).

- Experts provide scenarios which
  - reduce the combinatorial nature;
  - produce useful synthetic comparison.

- It should be easy to
  - add new solvers which can be used by old scenarios;
  - add new scenarios which use old solvers;
  - use the characteristics of new solvers in new scenarios.
Semantic-based description

- Meta-data which describe for each package:
  - To describe a service:
    - functionalities: assembled/elemental entries, type of factorisations (LU, LDL^T,QR), multiprocessor, multiple RHS;
    - algorithmic properties: unsymmetric/symmetric solver, multifrontal, left/right looking, pivoting strategy.
  - To describe a scenario in addition to service parameters:
    - metrics: memory, numerical precision, time, …
    - control: type of graph for post-processing, user level
- Addition of new meta-data and possible values should be easy

PRUNE : Web interface for editing abstract parameters
Expert Scenarios

- Scenarios described in a data-flow like way
- Structured hierarchically: a scenario may call existing ones
- Analysis / execution of a scenario may have several steps
- We have introduced:
  - Characteristics (e.g. number of flops, memory, . . .)
  - Operators: Transformation, Filtering, Generation
  - . . .

Graphical Description of Scenarios

Figure: Example of description of an expert scenario corresponding to the Minimum Time Scenario.

Goal: identify the combination of ordering and factorization that provides the minimal execution time.
Graphical Interface for Describing Expertise Scenarios (GEOS)

Relationship between GEOS and PRUNE
Bibliography tool

- Advanced tools for managing bibliography (bibtex, html, ...)
- Allowing:
  - Commit of references
  - Management of bibtex and indexes
  - Checking for duplicated references
  - .....
Status of the TLSE Platform

- Final version is currently be assembled and tested
- Parts of the Web sire are available:
  - Upload for matrices including validation
  - Bibliography tool
Matrix Upload

Fill the fields to submit your matrix:

- Matrix Name
- Source
- Description

Select the groups where you want to add this matrix:
- Collection
- Format
- Type of Values
- Symmetry
- Storage Mode

Matrix Comments

Add a comment to Gr_30_34_21:

- Name
- Comment

Matrix Comments:

Passed by the [User] [12/31/2011 11 AM]

Warning messages:
- a connection across a
- range of ranges will be ignored by the server
- resulting in 250 megabytes by the area out of range
- unrelated information.
Sparse solvers

- Solver packages installations:
  - Currently in TLSE: MUMPS, SuperLU, UMFpack;
  - Being integrated: TAUCS;
  - Future: HSL MAxx, PaStiX, SPOOLES, OBLIO, PARDISO, . . .
Conclusion

- Key points: high level description of scientific software and use of scenarios for generating dynamic workflows
- Practical consequences:
  - Adding / removing solvers does not require to update scenarios (it will be automatically discovered)
  - Introduction of new scenarios make use of deployed software
  - The approach described is intended to be generic: we explore the use of this approach in other areas

REDIMPS Project

- TLSE can be used as a prediction system for sparse solvers -> increased efficiency in solving problems in physics and engineering
- JAEA is promoting grid research (ITBL) and developing sparse solvers
- All partners (JAEA, CERFACS, IRIT, LIP, LaBRI) are / will be involved in validation and testing of the first release of TLSE
- Goal: promotion of an international expert system for sparse linear algebra