WP5: High Performance Mathematical Computing (HPC)

OpenDreamKit Workpackage Presentations

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WP5: High Performance Mathematical Computing

Site	UPSud	CNRS	UJF	UK	USHEF	USTAN	LogiLab	Total
Effort	6	40	52	60	12	18	12	200

Objectives

Improve the performance of the computational components of OpenDreamKit.

- Parallelization:
  - Fine grain on many-core architectures
  - Coarse grain on clusters, grids and cloud
- Compilation of high level interpreted code
- HPC infrastructure for combinatorics
- Code composition
- Exchange expertise et best practices

Organization: 1 Task per component

WP5 Tasks

T5.1: PARI (CNRS)

Internal use of pthreads and MPI, but lacks a clean exposition of parallel features to outside software (e.g. SageMath)

D5.10 Devise a generic parallelisation engine for PARI and use it to prototype selected functions

D5.16 PARI suite release supporting parallelization

T5.2: GAP (USTAN)

- a library of parallel algorithms for algebraic computations
- interfaces between GAP and std Cloud and HPC infrastructures

D5.15 Final report

WP5 Tasks

T5.3: LinBox (UJF)

- D5.9 DSL for code composition and hardware abstraction
- D5.12 New algorithms and implementations with close integration in SageMath
- D5.14 Support distributed computing and heterogeneous architectures

T5.4: Singular (UK)

- D5.6 Parallel relation sieving and Block-Wiedemann
- D5.7 Parallel Matrix FFT and SIMD optimizations
- D5.13 Parallel Sparse polynomial arithmetic

WP5 Tasks

T5.5: MPIR (UK)

Need for an assembly expert to keep up with software evolution

- D5.5 AVX support
- D5.7 Parallel Matrix FFT and SIMD optimizations

T5.6: HPC for Combinatorics (UPSud)

Need to optimize and parallelize computationnally intensive parts of SageCombinat, including tree exploration techniques

- D5.1 Pythran/Cython based tree exploration
- D5.11 Refactor Sage combinat to exploit Pythran/Cython/Cilk++ parallelization tools

WP5 Tasks

T5.7: Pythran (LogiLab)

Compiling Python code to (parallelized, vectorized) C++, and exposes OMP directives in Python

- D5.1 Pythran/Cython based tree exploration
- D5.2 Smooth integration of Pythran based kernels in SageMath
- D5.4 Better support for object oriented types

T5.8: SunGrid (USHEF)

- D5.