

# WP5: High Performance Mathematical Computing (HPC)

OpenDreamKit Workpackage Presentations

Clément Pernet

September 2, 2015

# 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 computationally 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)

Offer Jupyter notebook on an HPC cluster

D5.3 Sun Grid Engine support for Project JUPYTER Hub