# HPCLATAM: Hacia la integración de HPC en el Cono Sur Latinoamericano


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High performance scientific computing in cluster, grid, and cloud computing systems
STIC-AmSud Scientific Meeting, Montevideo, Uruguay, 2012

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# Introduction

## High Performance Computing in Latin America initiative

- Motivation: gather the young but growing community of scientist and practitioners of high performance and scientific computing in Latin America.
- Main event: HPCLATAM conference
  - 2008, Córdoba
  - 2009, Mar del Plata
  - 2010, Buenos Aires
  - 2011, Córdoba

  } Within JAIIO
  - 2012, Buenos Aires/La Plata (HPC Day)

- The HPCLATAM conference aims to bring together researchers, developers, and users of HPC to discuss new ideas, experiences, and problems.

# Introduction

## High Performance Computing LATAM

- The main goal of HPCLATAM is to provide a regional forum fostering the growth of the HPC community in Latin America through the exchange and dissemination of new ideas, techniques, and research in HPC.
- The conference proved that the HPC community in the region is steadily growing.
- We also have focused our efforts in human resources formation (graduate and posgraduate courses) and collaborations for developing joint projects.

# High Performance Computing LATAM

## V HPCLATAM Conference

- Buenos Aires, Argentina, July 24 to August 3, 2012
- Promotes research and innovation in high performance computing techniques on clusters, grids, and distributed systems in Latin America
- The symposium featured invited talks from academy and industry, full-paper sessions, and presentation sessions, presenting mature work and new ideas in HPC applied in research and industrial applications.
- Special attention in human resources formation: High Performance Computing School/Escuela de Computación de Alto Rendimiento (ECAR 2012).

# High Performance Computing LATAM

## V HPCLATAM Conference

- Keynote speakers:
  - Mateo Valero (BSC, Spain)
  - Mauricio Marín (Yahoo! Research, Chile)
  - Adrián Cristal (BSC, Spain)
  - Ian Foster (Argonne National Laboratory, Univ. of Chicago, USA)
- Invited talks:
  - Presentation of SNCAD; Javier Príncipe (Univ. Politécnica de Catalunya, Spain); Advances in storage system (NetApp)
- Full paper sessions:
  - FP I: High performance scientific computing
  - FP II: GPU computing
  - FP III: Applications

# High Performance Computing LATAM

## V HPCLATAM Conference

- +80 assistants !!
- +20 presentations and 7 special talks
- 14 posters

- 34 paper submissions, from 7 countries
- Technical program committee
  - 21 researchers, from 7 countries
- Reviewers
  - 41 researchers, from 12 countries
- Acceptance rate (full papers): 32%
- +5000 visits to conference website http://hpc2012.hpclatam.org/, from 60 countries

# High Performance Computing LATAM

## V HPCLATAM Conference

# High Performance Computing LATAM

## V HPCLATAM Conference

# High Performance Computing LATAM

## High Performance Computing School (ECAR 2012)

- Two tracks, 8 courses, 65 students.
- Track “Foundations”:
- Oriented to introduce the current techniques for HPC programming
  - Distributed memory programming/Programación en memoria distribuida (MPI): Pablo Mininni (Universidad de Buenos Aires, Argentina).
  - Shared memory programming/Programación en memoria compartida (OpenMP): Gonzalo Hernández Oliva (Universidad de Valparaíso, Chile)
  - Shared memory programming/Programación en memoria compartida (pthreads): Sergio Nesmachnow y Gerardo Ares (Universidad de la República, Uruguay).
  - GPGPU computing/Utilización de placas de video para cálculo (GPGPU): Nicolás Wolovick y Carlos Bederián (Universidad Nacional de Córdoba, Argentina).

# High Performance Computing LATAM

## High Performance Computing School (ECAR 2012)

- Two tracks, 8 courses
- Track “Applications”:
- Oriented to introduce HPC applications and advanced topics
  - Meshless numerical methods/Métodos numéricos sin malla: Leo González (Universidad Politécnica de Madrid)
  - HPC in bioinformatics/Herramientas de HPC en Bioinformática: Adrián Roitberg (Universidad de Florida, EEUU), Adrián Turjanski y Marcelo Martí (Universidad de Buenos Aires, Argentina).
  - Visualization/Visualización: Juan Hernando (Universidad Politécnica de Madrid, Madrid, España)
  - Other models for parallel computing/Otros modelos de paralelismo: Adrián Cristal (Barcelona Supercomputing Center, España).

# High Performance Computing LATAM

## HPC Day (within JAIIO, La Plata 2012)

- Another forum to bring together researchers, developers, and users of HPC to discuss the ideas and experiences of scientist and practitioners of High Performance Computing in Latin America
- It featured invited talks from academy and industry, presenting both mature work and new ideas about the application of HPC in research and industrial applications, and round-table meetings for the exchange and dissemination of new ideas, techniques, and research in HPC
- Some interesting common lines of work were established
- Science vice-ministers from Brazil and Argentina had a meeting to review the common agenda.
  - The Argentinean Director of International Relationship of Science Ministry established some goals to be met to foster the collaboration.

As a result of the HPC-Day, a letter of intention was signed between the assistants, showing the great compromise of carrying the idea of integration to each local government.

## V HPCLATAM Conference, ECAR 2012, and HPC Day

- Thanks to …
  - Authors, reviewers, TPC, organization staff
  - Students, assistants and public.
  - Organization

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# HPC in Uruguay

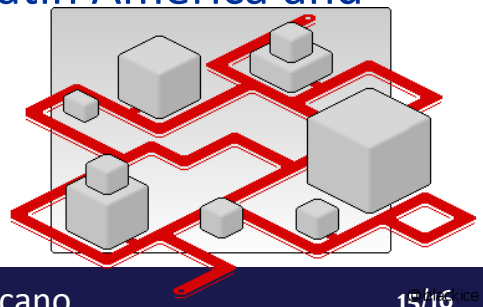
## History

- 1988: Numerical Computing Center (Centro de Cálculo)
- 1993: HPC group
  - Main objectives: research and teaching activities in the areas of parallel computing, computer networks and distributed systems, and its application for solving engineering problems.
- 1993-2012:
  - We developed the research group trying to achieve three main goals:
    - i) implement the High Performance Computing course to present the basic concepts of applied parallel and distributed computing, instructing students and researchers
    - ii) offer to other research groups a service to improve the execution of applications with high computation demand
    - iii) extend the staff working in this area of research, allowing facing more challenging problems, new areas of research and publishing the results in conferences and journals.

# HPC in Uruguay

## History

- 20 years after …
  - the High Performance Computing course is firmly consolidated (it has been uninterruptedly offered for 19 years, and it is valid as graduate and postgraduate course on Informatics);
  - we have a laboratory for research on parallel processing (clusters, shared-memory multiprocessors, GPU platforms, grid and volunteer-based infrastructures) that allows solving highly demanding applications;
  - we extended the research staff, diversifying the studying areas and tackling several applications of parallel computing, numerical modeling, high performance execution and code parallelization (working in our own projects, or in joint projects with other departments/institutions)
  - we have joint works with several research groups from Latin America and Europe



# HPC in Uruguay

## Cluster FING

- Infrastructure for high performance scientific computing, UdelaR.
- Initial funding: Sectorial Comission for scientific Research (CSIC, 2008)
- Main goal: to instrument a computational platform to efficintly tackle complex scientific problems.
- Operational since March 2009, self-managed and self-founded



Cluster FING: 2.000.000 hs of effective computing time
http://www.fing.edu.uy/cluster

# HPC in Uruguay

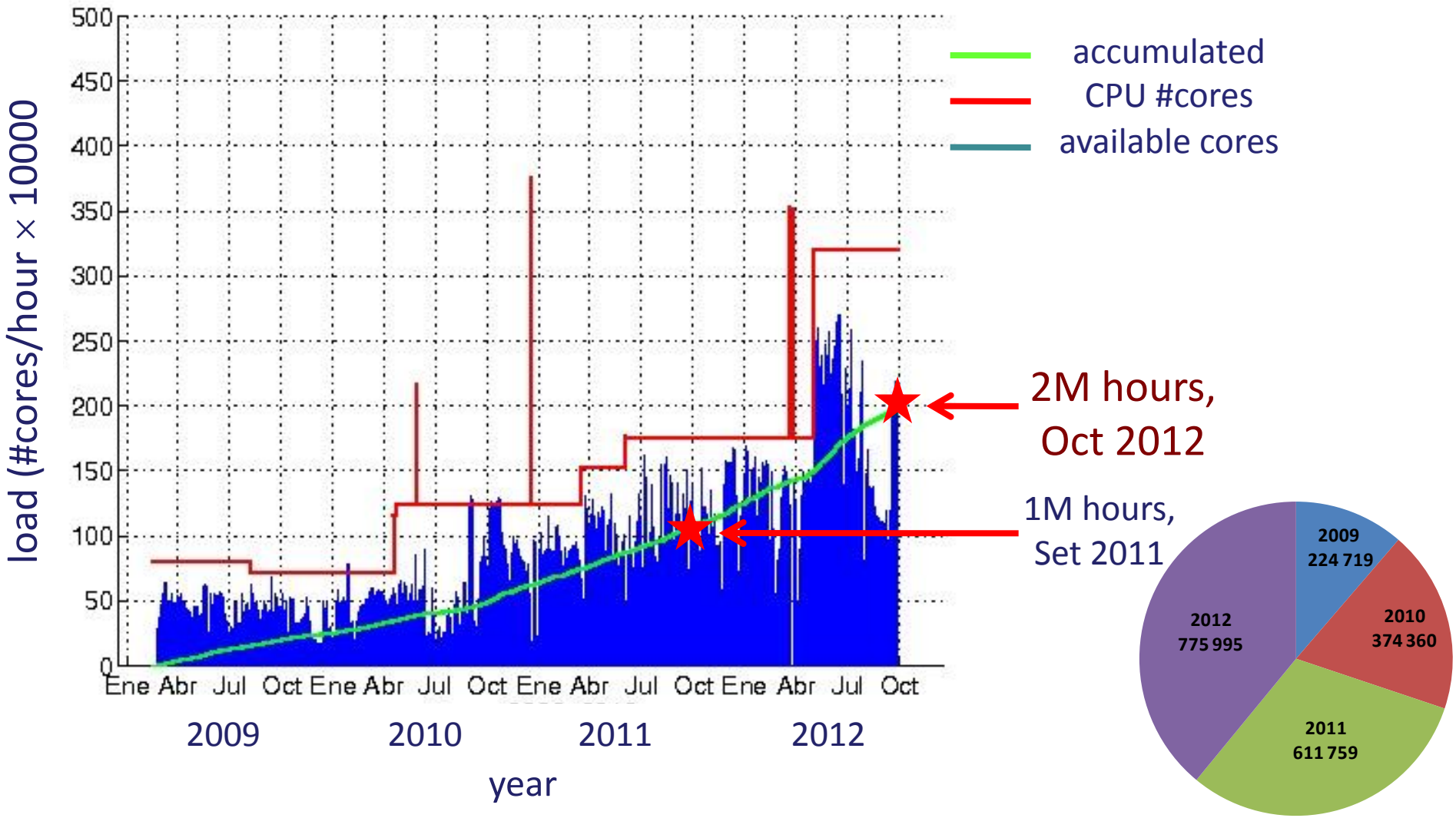
## Cluster FING

- 24 servers (Dell Power Edge 2950, HP Proliant DL180) with processors Intel Xeon quad core y AMD Magny Cours, 24 cores)
- 1 Tesla GPU server (procesors Xeon quad core y 4 NVIDIA C1060 [960 cores de 1.33 GHz.])

- TOTAL: **1364** processing cores
  - 404 CPU cores and 960 GPU cores
  - 880 GB RAM memory
  - 30 TB RAID storage, 30 kVA battery backup
  - Peak performance: 4000 GFLOPS (4×1012 floating point operations per second), ***the largest computing power available in the country***

# HPC in Uruguay

## Cluster FING



# HPC in Uruguay

## NICCAD

- High Performance Scientific Computing Interdisciplinary group / Núcleo Interdisciplinario de Computación Científica de Alto Desempeño
- Created in 2010 by 20 research groups
  - Faculties of Science, Engineering, and Chemistry, Universidad de la República
  - Institut Pasteur Montevideo
- Research groups working on mathematical models and computational models applied to solve complex scientific problems using high performance computing techniques.

NICCAD
UdelaR

http://www.fing.edu.uy/grupos/niccad

# HPC in Uruguay

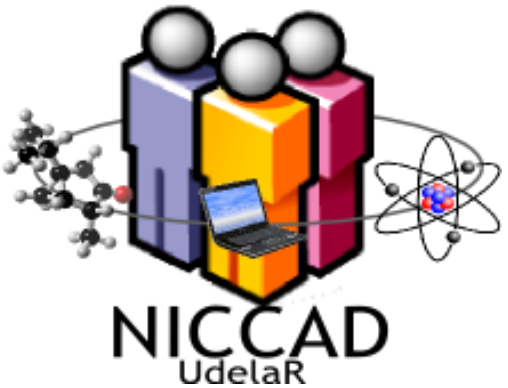
## NICCAD

- Main goals
  - Promote interdisciplinary research on efficient methods for solving complex scientific problems.
  - Work towards the integration of researchers from diverse disciplines to create an integrated vision of scientific and hogh performance computing techniques.
  - Develop teaching activities on applied mathematics, numerical models, simulation and high performance computing.
  - Disseminate the use of high performance computing techniques and high performance computing infrastructures (clusters, distributed and volunteer computing, grid, and cloud).

# HPC in Uruguay

## NICCAD: some research areas

- Computational fluid dynamics
- Climate research and prediction
- Combinatorial optimization
- Theoretical and computational chemistry
- Planetary geophysics
- Computational physics
- Biomolecular simulations
- Winf energy and renewable energies
- Systems biology
- Stochastic and statistical models
- Networks, robotics, and artificial intelligence
- Energetic converters simulation
- Electric energy systems planification
- Bioinformatics



# HPC in Uruguay

## NICCAD: events

- High Performance Computing Symposium
  - Editions 2010, 2011, 2012
- Interdisciplinary Event (PEDECIBA), Oct 2012
  - High Performance Scientific Computing Conference
  - Postrgradute course:
    - Mecánica Computacional de Altas Prestaciones: Aplicaciones Industriales. Prof. Dr. Mariano Vázquez, Barcelona Supercomputing Center, España
- STIC-AmSud Scientific Meeting
  - Conference:"High performance scientific computing in cluster, grid, and cloud computing systems“
  - 20 talks, 15 speakers from 7 countries.