The IBM-BSC Deep Learning Center

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Centro Nacional de Supercomputación

**BSC-CNS objectives:**
- Supercomputing services to Spanish and EU researchers
- R&D in Computer, Life, Earth and Engineering Sciences
- PhD programme, technology transfer, public engagement

**BSC-CNS is a consortium that includes:**
- Spanish Government 60%
- Catalanian Government 30%
- Univ. Politècnica de Catalunya (UPC) 10%

*447 people from 44 countries *31th of December 2015

<table>
<thead>
<tr>
<th>Source</th>
<th>Funding (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EUROPE</strong></td>
<td>64.7M</td>
</tr>
<tr>
<td><strong>NATIONAL</strong></td>
<td>30M</td>
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<tr>
<td><strong>COMPANIES</strong></td>
<td>31.2M</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>126.9M</td>
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One of the 23 Severo Ochoa Centres
The MareNostrum 3 Supercomputer

Over $10^{15}$ Floating Point Operations per second

- Nearly 50,000 cores
- 100.8 TB of main memory
- 3 PB of disk storage

70% PRACE
24% RES
6% BSC-CNS
Mission of BSC Scientific Departments

Computer Sciences
To influence the way machines are built, programmed and used: programming models, performance tools, Big Data, computer architecture, energy efficiency

Earth Sciences
To develop and implement global and regional state-of-the-art models for short-term air quality forecast and long-term climate applications

Life Sciences
To understand living organisms by means of theoretical and computational methods (molecular modeling, genomics, proteomics)

CASE
To develop scientific and engineering software to efficiently exploit super-computing capabilities (biomedical, geophysics, atmospheric, energy, social and economic simulations)
BSC and the Global IT Industry 2016

- IBM-BSC Deep Learning Center
- NVIDIA GPU Center of Excellence
- Intel-BSC Exascale Lab
- BSC-Microsoft Research Centre
- Cisco
- Fujitsu
- LG
- Lenovo
- Samsung
BSC and the Industrial Sector

Repsol-BSC Research Center

Research into advanced technologies for the exploration of hydrocarbons, subterranean and subsea reserve modelling and fluid flows

Iberdrola Renovables
Collaborations with OpenPOWER members

Processor architecture, programming models, performance tools, resource management, applications

Other collaborations (EU projects)

Programming models, operating system, applications (GPU Center of Excellence) (PUMPS Summer School)

FPGA programming models

Memory architecture, programming models

Novel memory architectures for HPC
IBM-BSC research collaboration

CEPBA-IBM Research Institute (CIRI)

Research collaboration agreement - IBM Innovation Initiative at BSC

Technology Center for Supercomputing, a BSC-IBM initiative

MareIncognito Project

IBM-BSC Deep Learning Center

Upgrade to MareNostrum II and creation of the Spanish Network for Supercomputing (RES)

Official creation of the Barcelona Supercomputing Center (BSC)

Installation of first MareNostrum, ranked 4 in world Top500 list, first in EU
IBM-BSC MareIncognito project (2007-11)

- 4 relevant applications from BSC:
  - Materials: SIESTA
  - Geophysics imaging: RTM
  - Comp. Mechanics: ALYA
  - Plasma: EUTERPE
- General kernels

- BSC’s tools and research
  - (automatic analysis, sampling, clustering, …)
- Integration with IBM’s tools (Peekperf)

- BSC’s research on inter- and intra-application contention, and computation/communication overlap
- Integration of BSC’s Dimemas and IBM’s Venus simulators

- BSC’s programming models (OmpSs)
- BSC’s implementations of OpenMP for IBM compiler (Cell B./E.)

- BSC’s research on coordinated Scheduling (execution and power efficiency)

- Contributions to new Cell B./E. design
- BSC research on architectural support to programming models and their runtime implementation
But we Need to Go One (Big) Step Further

IT companies in the HPC/Cognitive convergence

Sector-specific companies tackling societal challenges

Interdisciplinary cutting-edge research institutions

Government and funding agencies

End-users

Strong Alliances
• In June 2014, the University of Illinois at Urbana-Champaign, INRIA, Argonne National Laboratory, Barcelona Supercomputing Center and Jülich Supercomputing Centre formed the Joint Laboratory on Extreme Scale Computing.

• The Joint Laboratory focuses on software challenges found in extreme scale high-performance computers.

• JLESC workshops organized twice per year. Next one in Riken AICS (December 2016)
Selected Centers for the Storage, Analysis and Distribution of PanCancer data

- Barcelona Supercomputing Center, Spain
- University of California, San Diego
- Deutsches Krebsforschungszentrum, Germany
- Ontario Institute of Cancer Research, CA
- University of California, Santa Cruz
- University of California, San Diego
- IMSUT RIKEN, Japan
- ETRI, Korea
- European Bioinf. Institute, UK
- The Sanger Institute, UK
- International Cancer Genome Consortium
- PanCancer Analytic Working Group (PCAWG)

- 2500 tumor-normal WG pairs for more than 20 tumor types
- ~1500 RNAseq samples
- ~1500 expression arrays
- ~1400 methylation data
- Clinical records
The Example of Precision Medicine

Data generators

Data transfer, storage, processing, analysis and access

Enabling ...

Pharmaceutical Companies
Drug Development
Health Systems
Precise Medicine
Personalised Healthcare
Next generation Human-Computer (molecular) Design Tools
A first initiative with IBM

National Collaboration Center for Research on Cognitive Precision Medicine
Joint IBM-BSC Deep Learning Center (2016-19)

Cognitive Precision medicine

- Genomic Analytics
- Text Analytics
- Biochip and organ simulation

Data models and algorithms (representation, approximate computing)

Programming models and runtimes (HPC and BigData intersection)

Hw acceleration of cognitive workloads (from Cloud to the Edge)
Open Precision Medicine

The big alliance BSC is looking for
Looking forward for collaboration!

For further information please contact
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