ICMAT

INSTITUTO DE CIENCIAS MATEMÁTICAS

Data Science for Safety and Security

ICMAT – DataLab

David Ríos, AXA-ICMAT and Royal Academy

On behalf of David G.Ullate, ICMAT and Physics-UCM

December 2nd 2016

Outline

1. ICMAT – Our Institute
2. DataLab at ICMAT – Our group
3. What can we offer ?
4. What are we looking for ?

ICMAT – Institute of Mathematical Sciences

- Founded in 2007.
  New building in 2011.

- A joint research center:
  CSIC + UCM + UAM + UC3M

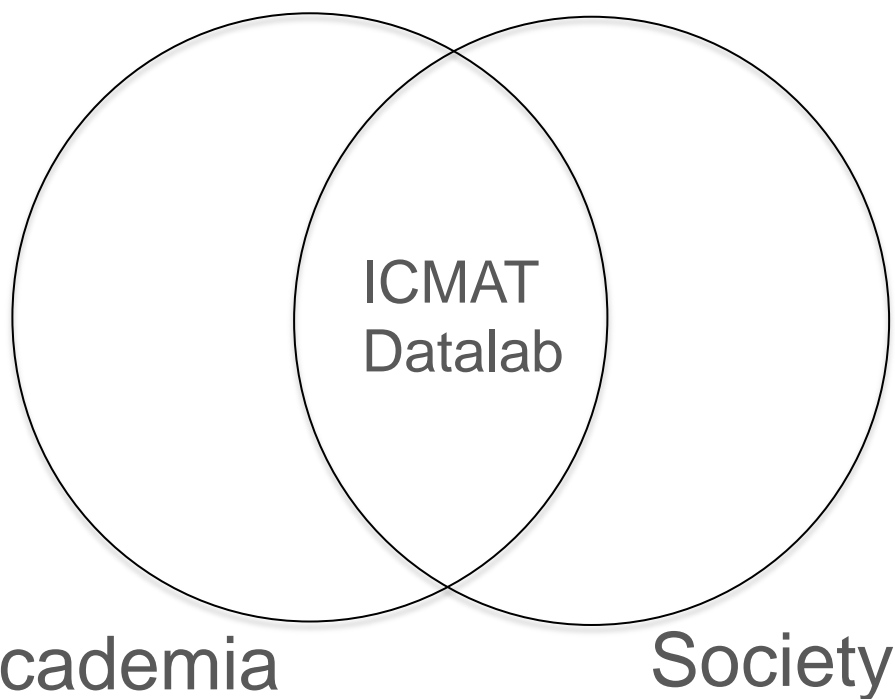- Severo Ochoa Excellence Center
  (2011, 2016)

Research funding

- **11 ERC grants:** 8 Starting + 3 Consolidator

- **4 Marie Curie Fellowships**

- **2 BBVA Foundation projects**

- **1 AXA Chair**

- **22 National projects** (including 2 EXPLORA)

- **Severo Ochoa** (1M €/year)

- **5 Projects** from private sector

ICMAT

DataLab

Improving the world through data science & analytics

Our vision

ICMAT
Datalab

Academia

Society

Tackle complex mathematical problems to address real society demands.

Build bridges between academia and industry.

Achieve highest standard research and postgrad training in data science

Staff

David Ríos

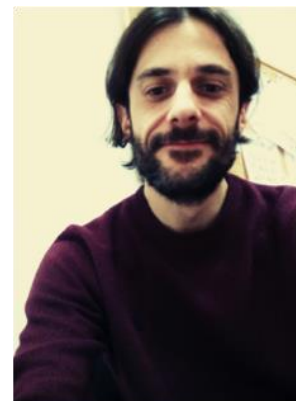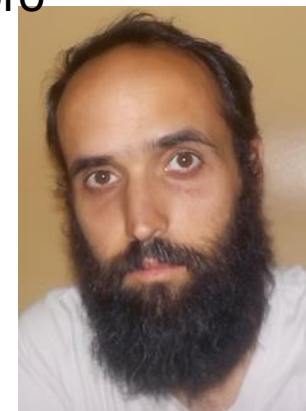Kurusch Ebrahimi-Fard

Esteban Moro

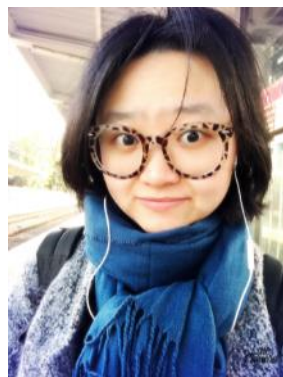Antonio Gómez-Corral

David Gómez-Ullate

Pablo Suárez

Pablo Angulo

PhD Students

Jorge González

April Liu

Alberto Redondo

Victor Gallego

Roi Naveiro

Simón Rodríguez

Datalab Research lines

Theory

- Machine learning
- Bayesian statistics
- Decision theory
- Optimization
- Network theory
- Mathematical modelling
- Financial mathematics
- Stochastic processes
  Risk analysis
  Adversarial risk analysis

Applications

- Prediction of human behaviour
- Decision support for complex systems under uncertainty
- Cybersecurity
- Fraud detection
- Aviation safety

  Counterterrorism

Some Academic Partners

- MIT Media Lab
- IBM Thomas J. Watson Research Center
- Duke University
- George Washington University
- CNR - IMATI Milano
- Vrije Univesiteit Brussels
- LAMSADE - Université Paris Dauphine
- London School of Economics
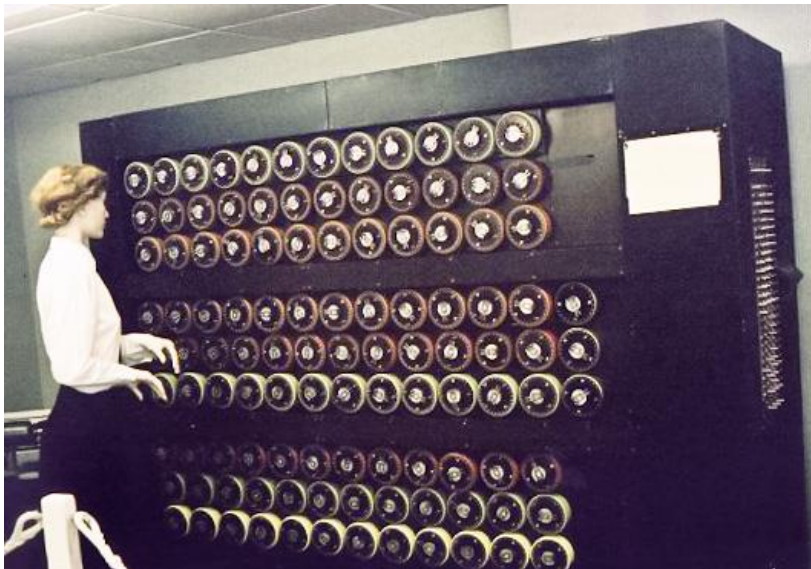- NTNU Trondheim

Some Industrial Partners
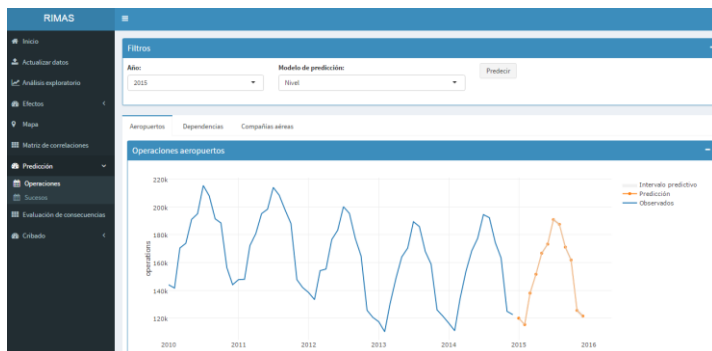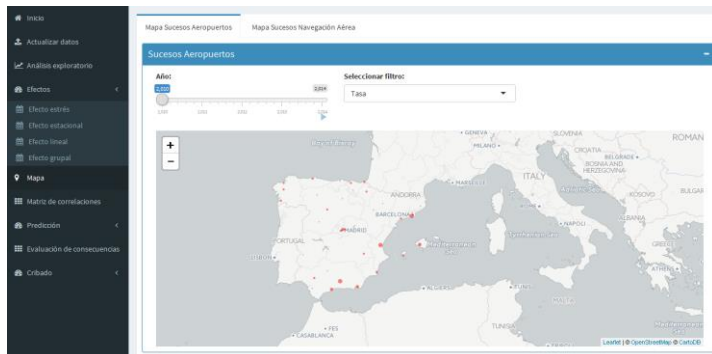
High Performance Computing

HPC Cluster at ICMAT

20 nodes (8C, 32GB RAM, 500GB)
1 node with Xeon-Phi co-processors
1 node with GPGPU (Tesla K40)
3 fat nodes (8C, 512GB RAM, 500GB).
Lustre storage technology
Infiniband network.

Sample projects

Development of the national aviation safety plan

Prediction of 90 different event types
Prediction of severity (1-5).
Prediction of 8 types of consequences
Multi-attribute utility function
Risk maps and risk matrices
Optimal resource allocation to mitigate safety risks
Production of aviation safety reports
RIMAS

Sample projects

Detection of malicious behaviour on social networks

Detect criminal activities on social networks
(pedophilia, bullying, drug & arms trade, etc.)

Malware detection
(phishing, exploit kits, etc.)

Natural language processing
Machine learning
Adversarial Risk analysis
Network theory

Sample projects

Fraud detection in electronic payments

Fundación **BBVA**

Detect CNP fraudulent payments in a large database of credit card transactions.

Develop an integral security plan for banks & credit card companies taking all costs & benefits into account

Bayesian networks
Random forests
Decision theory
Adversarial classification

Sample projects

Attribution models and bid strategies in online advertising

Design attribution models that take into account the effect of offline channels

Optimize resource allocation to maximize expected number of conversions.

Bidding strategies for advertising campaigns from an adversarial point of view.

Hidden Markov models
Machine learning
Optimization
Adversarial risk analysis

Sample projects

Social robotics

Aisoy1 **V5**
The emotional robot.

Interacts with persons and other machines through voice, vision and touch

Simulates and displays emotions which influence its decisions

Used for
- Supporting kids with autism
- Teaching sciences in a more fun way
- Companion pet

Artificial Intelligence
Voice recognition
Affective computing
Affective decision making

What can we offer ?

- A thriving new team of talented young researchers

- An open mind to tackle problems

- Very good mathematical & hacking skills

- Financial support for PhDs and postdocs

- In-House HPC cluster

What are we looking for ?

- Interesting projects to collaborate

- Joint partnership to apply for large project funding

- Opportunities for student exchange

- Inspiring ideas

- Advice & fruitful discussions

¡Muchas gracias por su atención!

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