A GFBI Hub at the University of Lleida

From data to knowledge

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Parc Científic i Tecnològic Agroalimentari de Lleida

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Centre Tecnològic de Catalunya

AgriTech
BIG DATA

RESEARCH ARTICLE SUMMARY

FOREST ECOLOGY

Positive biodiversity-productivity relationship predominant in global forests

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INTRODUCTION: The biodiversity-productivity relationship (BPR; the effect of biodiversity on ecosystem productivity) is foundational to our understanding of the global extinction crisis and its impacts on the functioning of natural ecosystems. The BPR has been a prominent research topic within ecology in recent decades, but it is only recently that we have begun to develop a global perspective.

RATIONALE: Forests are the most important global repositories of terrestrial biodiversity, but deforestation, forest degradation, climate change, and other factors are threatening approximately one half of tree species worldwide. Although there have been substantial efforts to strengthen the preservation and sustainable use of forest biodiversity throughout the globe, the consequences of this diversity loss pose a major uncertainty for ongoing international forest management and conservation efforts. The forest BPR represents a critical missing link for accurate valuation of global biodiversity and successful integration of biological conservation and socioeconomic development. Until now, there have been limited tree-based diversity experiments, and the forest BPR has only been explored within regional-scale observational studies. Thus, the strength and spatial variability of this relationship remains unexplored at a global scale.

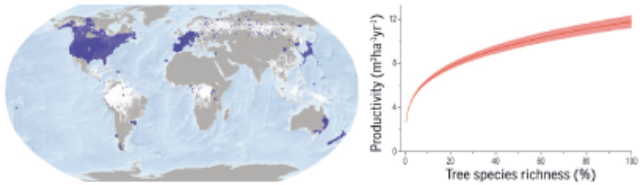
RESULTS: We explored the effect of tree species richness on tree volume productivity at the global scale using repeated forest inventories from 777,126 permanent sample plots in 44 countries containing more than 30 million trees from 8737 species spanning most of the global terrestrial biomes. Our findings reveal a consistent positive concave-down effect of biodiversity on forest productivity across the world, showing that a continued biodiversity loss would result in an accelerating decline in forest productivity worldwide.

The BPR shows considerable geospatial variation across the world. The same percentage of biodiversity loss would lead to a greater relative (that is, percentage) productivity decline in the boreal forests of North America, Northeastern Europe, Central Siberia, East Asia, and scattered regions of South-central Africa and South-central Asia. In the Amazon, West and Southeastern Africa, Southern China, Myanmar, Nepal, and the Malay Archipelago, however, the same percentage of biodiversity loss would lead to greater absolute productivity decline.

CONCLUSION: Our findings highlight the negative effect of biodiversity loss on forest productivity and the potential benefits from the transition of monocultures to mixed-species stands in forestry practices. The BPR we discover across forest ecosystems worldwide corresponds well with recent theoretical advances, as well as with experimental and observational studies on forest and nonforest ecosystems. On the basis of this relationship, the ongoing species loss in forest ecosystems worldwide could substantially reduce forest productivity and thereby forest carbon absorption rate to compromise the global forest carbon sink. We further estimate that the economic value of biodiversity in maintaining commercial forest productivity alone is $166 billion to $490 billion per year. Although representing only a small percentage of the total value of biodiversity, this value is two to six times as much as it would cost to effectively implement conservation globally. These results highlight the necessity to reassess biodiversity valuation and the potential benefits of integrating and promoting biological conservation in forest resource management and forestry practices worldwide. ■

ON OUR WEBSITE

Read the full article at http://dx.doi.org/10.1126/science.aaf8957



Global effect of tree species diversity on forest productivity. Ground-sourced data from 777,126 global forest biodiversity permanent sample plots (dark blue dots, left), which cover a substantial portion of the global forest extent (white), reveal a consistent positive and concave-down biodiversity-productivity relationship across forests worldwide (red line with pink bands representing 95% confidence interval, right).

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777,126
Sample plots

Countries 44

30 million trees

8737 species spanning most of the global terrestrial biomes

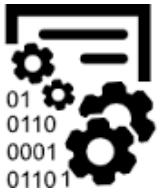
Our findings reveal a consistent positive concave-down effect of biodiversity on forest productivity across the world, showing that **a continued biodiversity loss would result in an accelerating decline in forest productivity worldwide**.

Data sources

Remote sensing

Data sharing

Data integration



Forest

Forest dynamics

Climate Change

Biodiversity loss

Global analysis

Economy

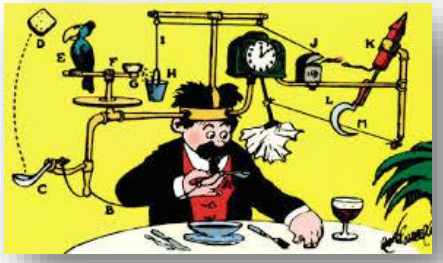
Data Science

Artificial intelligence

Data visualization

Machine learning

Decision making



GBFI Hub

Cloud, security, and service

Vision

A **GFBI Hub** must be more than just a repository of data.

Methods for extracting **meaningful information** are paramount for the **GFBI** community.

Collaborative expertise will be determinant in reaching the long term capabilities of a **GFBI** Hub.

Up-to-date maintenance of information

Integration of data from different sources

Project oriented data

Data validation and standardization

Secure data sharing

Needs

Coordination!

Automatic Follow-up of critical information

Speed-up collaborative projects

Log term vision

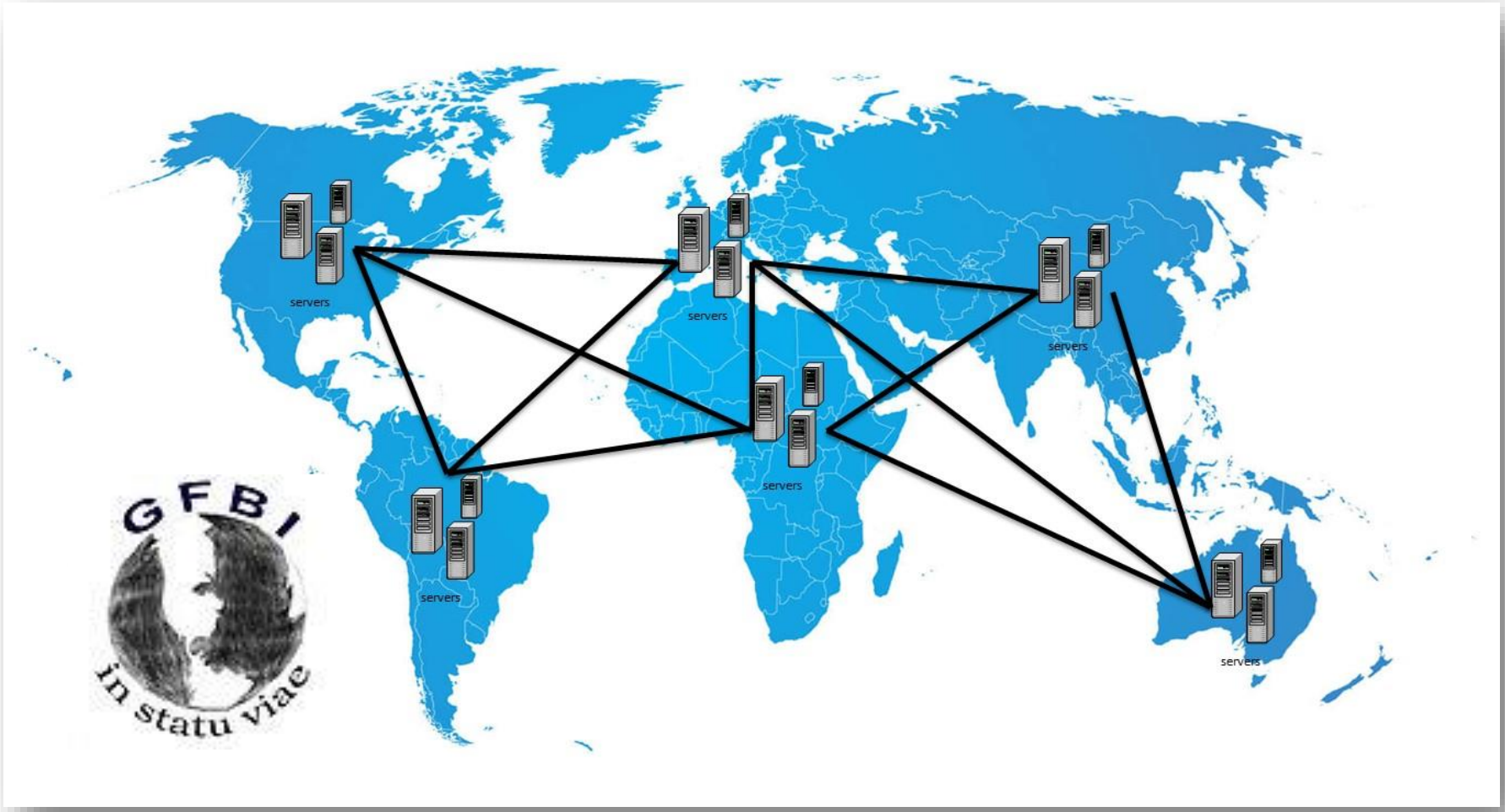
GFBI Hubs

- Keep a secure access to DB
- Explore new opportunities (*there are no dragons!!*)
- Incorporate complementary information
- **DB Marketplace**: promote collaboration and projects
- **Computational issues**: methods, models, parallelization, ….
- **Promote interdisciplinary work**

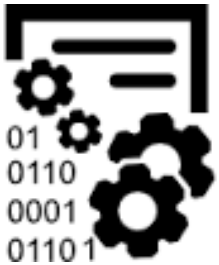
GFBI Hubs coordination

- Consensus on data organization and identification.
- Distributed solutions.
- **Governance** (access control, coordination, data consolidation, etc…).
- Data for large GFBI projects

World-wide service & replication
GFBI Hubs coordination

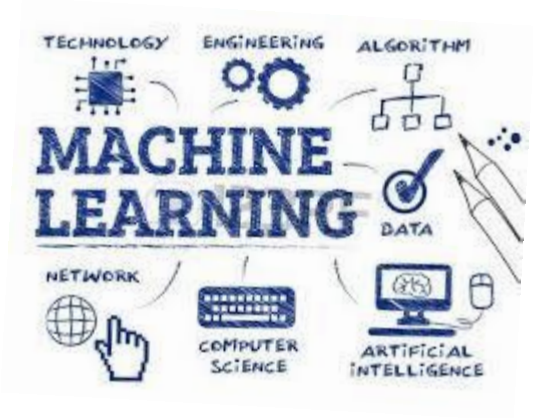


UdL-GFBI Hub Goals



To start a **Data Center** with **added value services** for the GFBI scientific community.

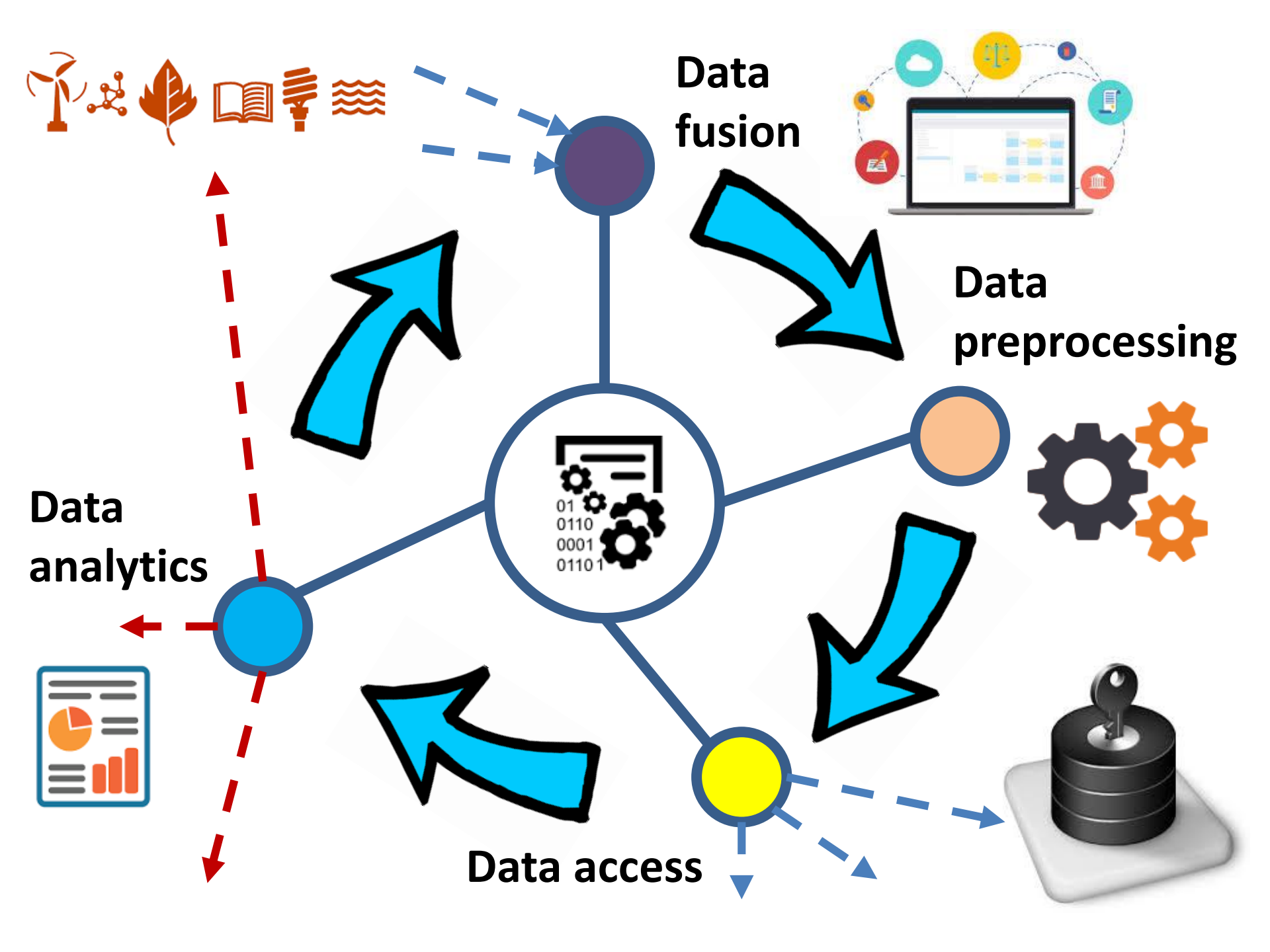
To **become a reference** in data management, integration, and processing so that the **GFBI** can undertake its (***big***) projects.



To become a reference for developing **new data analysis techniques** that can help the **GFBI** to achieve its goals.

UdL-GFBI Hub
Basic features

- A **data center** for the use of the **GFBI** members and authorized collaborators.
- **Secure storage of information** with an appropriate **control of ownership and information retrieval**.
- Added services for **preprocessing** information according to the specific requirements of a given project.
- Develop a **strategy** for data integration, visualization, and analysis.


Data fusion
Data preprocessing
Data analytics
Data access
01
0110
0001
01101

Global Characteristics

- **External data sources integration** aimed at incorporating, mirroring and/or syncing, when possible, information of external data sources.

- **Transparent and user friendly**
- Easy management and synchronization
- Project oriented protocols
- Data preprocessing and curation

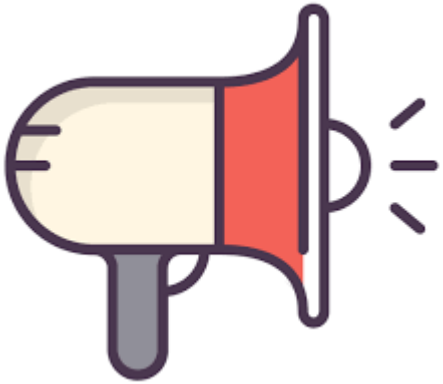
Global Characteristics

- **Frontend** aimed at exploring information and showing indicators dashboards.
- **Backend** aimed at managing platform users, roles, permissions, datasets accesses, etc.
- **Coordination and Governance module** aimed at giving access to resources to privileged requests.

- Follow-up important parameters
- Access control
- Prevent information misuse
- **Facilitate group interactions**

Global Characteristics

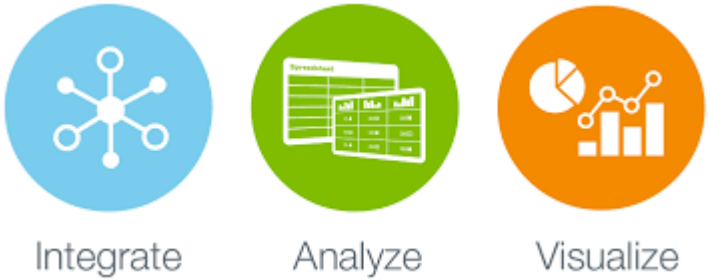
- **Communication module** focused on publisher/subscriber architecture pattern, where consumers may subscribe to certain topics, so that they are informed automatically when an event occurs



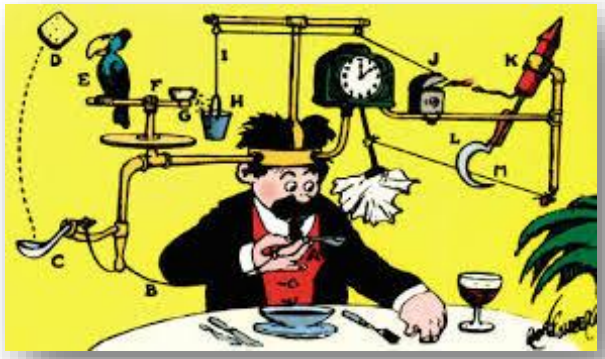
- Facilitate up-to-date information and data.
- Alerts.

Global Characteristics

- ❖ Hybrid IoT/Big Data architecture, able to run **advanced machine learning processes**, but also with classical analytics support
- ❖ **Analytical engine**: made up of stream analytics, batch processing, alerts manager, and reporting
- ❖ **Storage** based on big data (HBase), in memory layer (REDIS or IGNITE) and relational (PostgreSQL)



- Data analytics is fundamental
- Implement advanced methods
- Explore new techniques
- Data visualization



Frontend
Real Time indicators dashboards

Backend

spring io

Apache Tomcat

Coordination & Governance Module

PostgreSQL

External Data Sources Integration Module

Apache Camel

Load Balancer

Java Micro Services

IoT Integration Module

Communication Module

kafka

Job 1
Streamming

Job 2
Alerts Manager

Job 3
Machine Learning

Job N
Reports

Processing Engine Module

Apache Spark

redis

Apache Ignite

In-memory distributed layer

Apache HBase

Distributed Data base

Apache Hadoop

Alerts Delivery Engine Module

Storage Processes Module

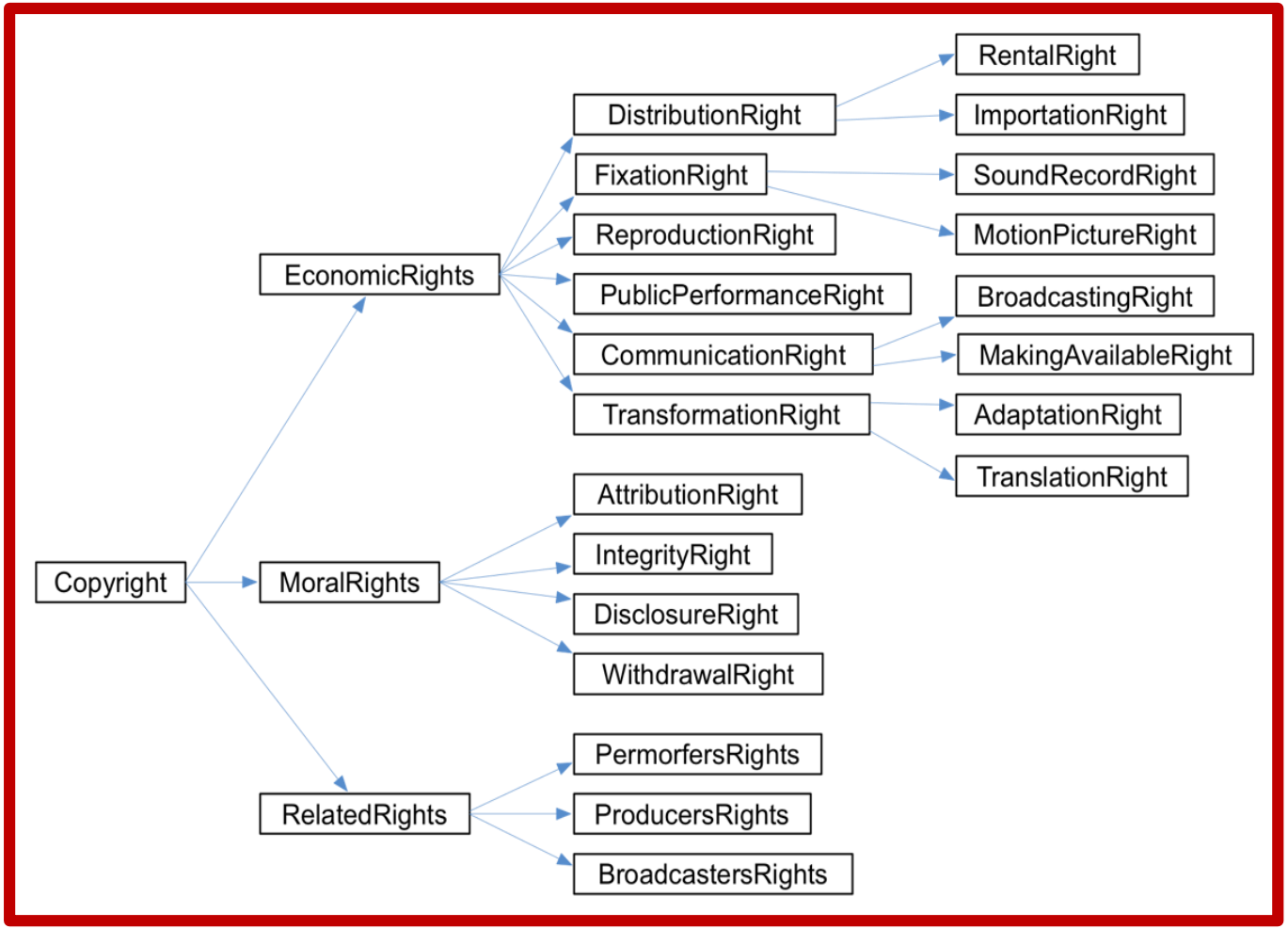
kafka

Store
(tamper-proof and auditable)

Blockchain

Data Access

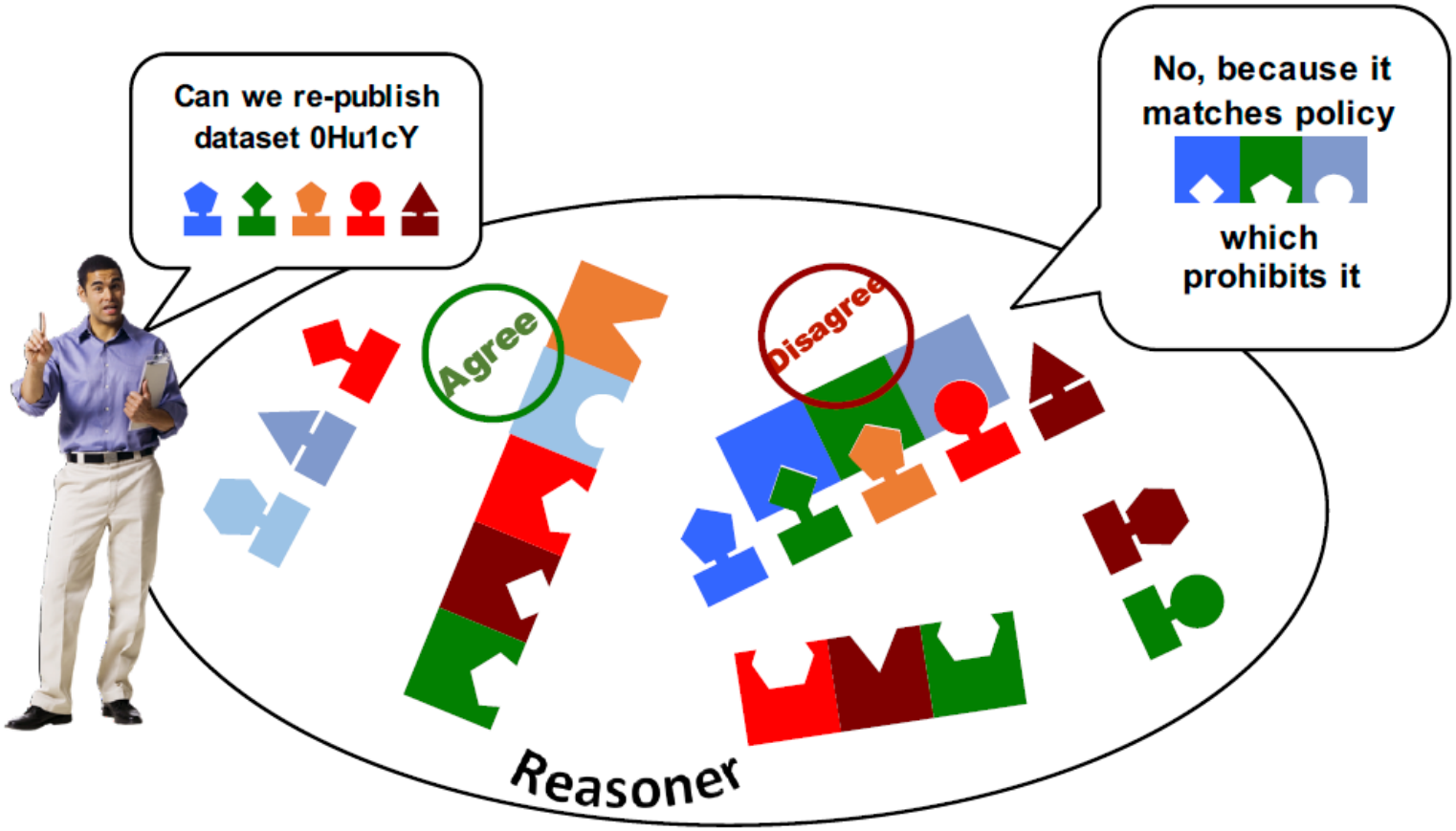
Copyright Ontology (Copyright example)



Data Access

Action: *republish* (governed by Making Available Right)

- **Who**: any research institution
- **What**: *datasets/0Hu1cY* (dataset fingerprint)
- **When**: from *2017-07-30 (start), during 12 months (duration)*
- **How**: *non-exclusive*
- **If**: *attribute*
  (recipient: GFBI, what: “Source: GFBI 2017”)



Why Lleida?

The **University of Lleida (UdL)** is one of the leading institutions in Spain in forest research and is an active member of GFBI.

Universitat de Lleida

CENTRE TECNOLÒGIC FORESTAL DE CATALUNYA

The **Forest Sciences Centre of Catalonia (CTFC)** is a research center of reference in forestry management and related industries in the Mediterranean area.

Parc Científic i Tecnològic Agroalimentari de Lleida

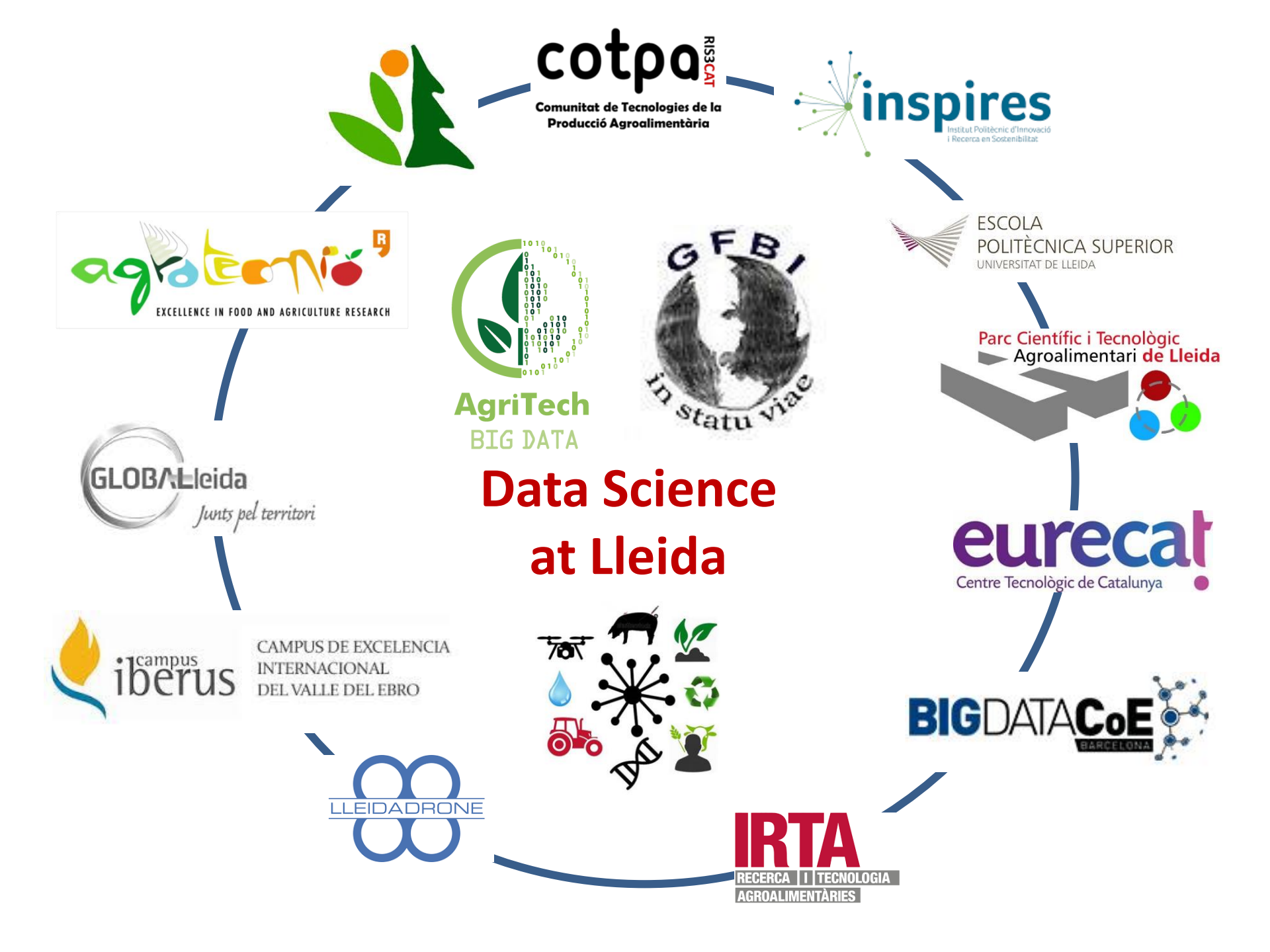
The **Scientific and Technological Park of Lleida** is dedicated to computation and agrifood industry.

We lead the **Agritech BIG DATA** platform which provides support for the agrifood industry in collecting, processing, and analyzing data from many different sources.

AgriTech BIG DATA

EURECAT is the leading technological center in Catalonia, with headquarters in Lleida.

eurecat Centre Tecnològic de Catalunya


cotpa
RIS3CAT
Comunitat de Tecnologies de la Producció Agroalimentària
inspires
Institut Politècnic d'Innovació i Recerca en Sostenibilitat
agrotecnio
EXCELLENCE IN FOOD AND AGRICULTURE RESEARCH
AgriTech
BIG DATA
GFBI
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MONTES VASCOS
PIRINEO
ANDORRA
Cabo de Creus
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SISTEMA CENTRAL
SISTEMA DE GUADARRAMA
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Cabo Trafalgar
GIBRALTAR (R.U.)
Pta. de Europa
Estrecho de Gibraltar
CEUTA (Esp.)
Isla de Alborán
Melilla (Esp.)
Más de 2000 m.
De 1500 a 2000 m.
De 1000 a 1500 m.
De 500 a 1000 m.
De 200 a 500 m.
De 0 a 200 m.
1000 m.
2000 m.
4000 m.


LA CORUÑA
SANTIAGO DE COMPOSTELA
VIGO
ORENSE
VARIANTE DE PAJARES
SANTANDER
BILBAO
SAN SEBASTIÁN
VITORIA
LEÓN
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ZAMORA
MEDINA DEL CAMPO
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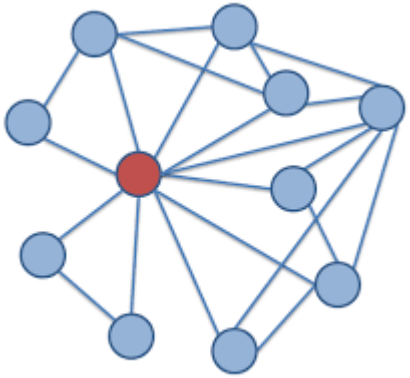
MURCIA
PUENTE GENIL
SEVILLA
GRANADA
ANTEQUERA
CÁDIZ
MÁLAGA
ALMERÍA

FUENTE: ADIF

Added Values

- Office space for temporal stay of researchers in Lleida (shared space in **Agritech BIG DATA** headquarters).
  - A controlled computer room for students.
  - Access to UdL services.
- **Technical meetings**
  - Coordination with other GFBI Hubs
  - Explore new analytical solutions
  - **Incorporate expertise from technical disciplines**
- **Project planning**
  - Prepare data for specific projects
  - Coordinate world-wide initiatives
- **Support for mid term stays of a GFBI designated person as affiliated to UdL**

UdL-GFBI Hub activities



- Focus on exploring new techniques
- Open to complementary disciplines
- Project meetings
- Data Science collaborative courses
- Annual UdL-GFBI Hub meeting
- Hands-on Ph.D. students mentoring
- Open to society

北京林业大学
Beijing Forestry University

Universitat de Lleida

See you soon in the opening of our GFBI Hub in Lleida!!!