SUSTAINABLE ARTIFICIAL INTELLIGENCE (SAI)

RESEARCH UNIT

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SUSTAINABLE
ARTIFICIAL INTELLIGENCE

cttc

Centre Tecnològic de
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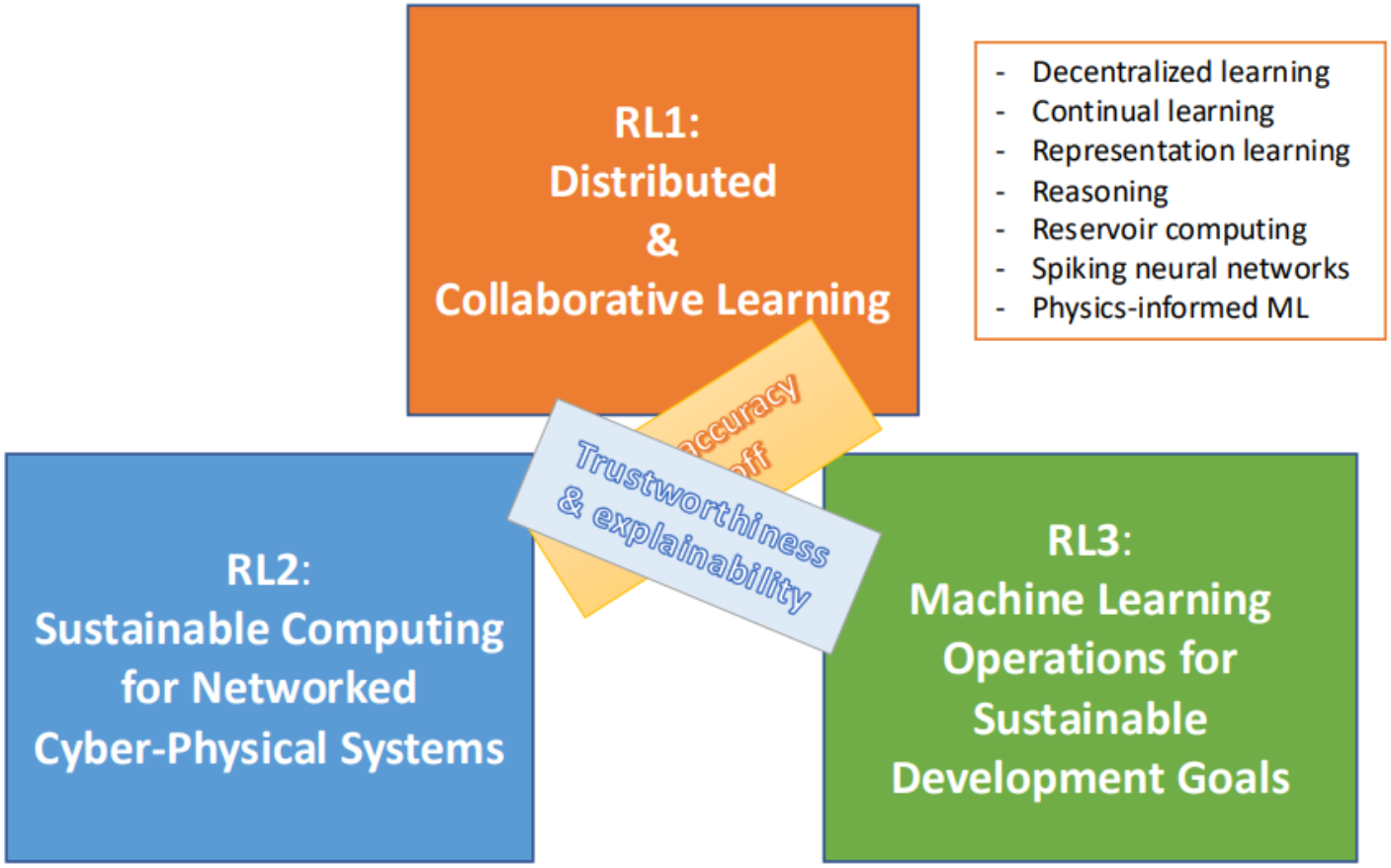
RESEARCH VISION

- **Frugality**
  - Reducing the **resource consumption** of learning systems
    - including model complexity, computations, data usage, memory
    - hardware-aware model design (e.g., neuromorphic processors, organic & bio-degradable materials)

- **Pervasiveness**
  - every device has an **active role in the learning process**
    - sensing and processing its data
    - collaborating with other devices to extract knowledge, regardless of their capabilities
  - lower the **dependency** on energy-hungry **cloud data centres**
  - limit the need for **dense networks** and **higher bandwidth**

- **Trustworthiness**
  - Preventing **misuse** of learning systems
  - Redesign learning systems to incorporate **explainability**, **transparency**, **fairness**, **reasoning, robustness**, **reliability**, **privacy, ethics**

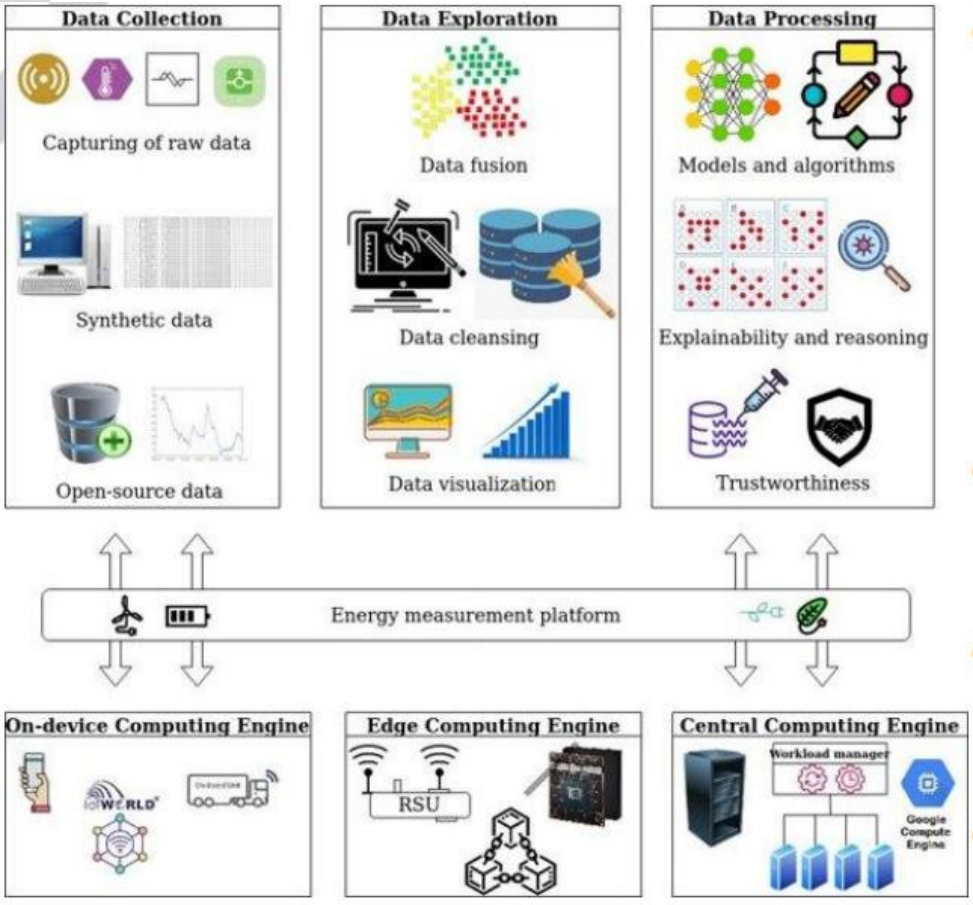
RESEARCH LINES



RESEARCH TOPICS

- **Collaborative and federated learning systems**
  - Energy-aware optimization
  - Decentralized peer-to-peer learning
  - Robustness in presence of attacks
  - Orchestration of AI-based services
  - Continual learning
- **Brain-inspired learning models**
  - Ultra-low power and hardware-aware design
  - Reservoir computing (Echo State Networks & Liquid State Machines)
  - Spiking Neural Networks (object detection)
- **Physic-informed learning models**
  - Guiding learning process with prior knowledge of the underlying physical system
  - Data-centric approaches
  - Model-centric approaches
  - Causal reasoning

EXPERIMENTAL PLATFORM



- **Su**stainable & high-**per**formance **com**puting platform
  - Heterogenous computing platform
  - Fully automatic experiment setup
  - Data generation, exploration & processing
  - Energy measurements
  - Integration with O-RAN+CN for wireless connectivity
- **IoTWorld**
  - Deployment of different types of sensors
  - Integration with SUPERCOM
- **GitLab**
  - Data
  - Software libraries
- **https://supercom.cttc.es/**

SNS JU 2026/2027

- **HORIZON-JU-SNS-2026-STREAM-B-01 – Collection, Generation and Validation of Datasets suitable for training AI models for 6G Networks (Type of Action: RIA)**
  - Distributed/federated learning, continual learning, robustness to attacks, data-centric approaches and physics-informed ML directly address creation and curation of high-quality real/synthetic datasets for AI-native 6G systems and vertical AIaaS use cases.
  - Energy-aware, hardware-aware and neuromorphic computing work in SAI supports frugal, sustainable pipelines for dataset generation, labelling and training across edge and cloud resources, which matches the WP's emphasis on efficient AI for networks.

- **OPEN TO OTHER CALLs - e.g. Testbed Integration**
  - Stream C – SUPERCOM & IoTWorld validation infrastructure

Thanks for your attention!

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HR EXCELLENCE IN RESEARCH

FRUGALITY RESEARCH TOPICS

- **Learning in Federated Settings**
  - Energy aware optimization
    - Client clustering with semantics of the data
    - Client selection
  - Decentralized settings
    - Parallel: energy aware distributed stochastic gradient descent
    - Sequential: federated continual learning
- **Model-agnostic client Selection**
  - Real-time detection of malicious data
- **Brain-inspired computing**
  - Reservoir computing
  - Spiking Neural Networks: Spike-Yolo for event-based camera
- **Physic-informed**
  - Reduced order modeling with physics-guided (e.g., parsimony) constraints
  - Physics-informed neural networks