

**eSAAM 2023**

**on Cloud to Edge Continuum**

# **Cognitive Architecture for Process industries**

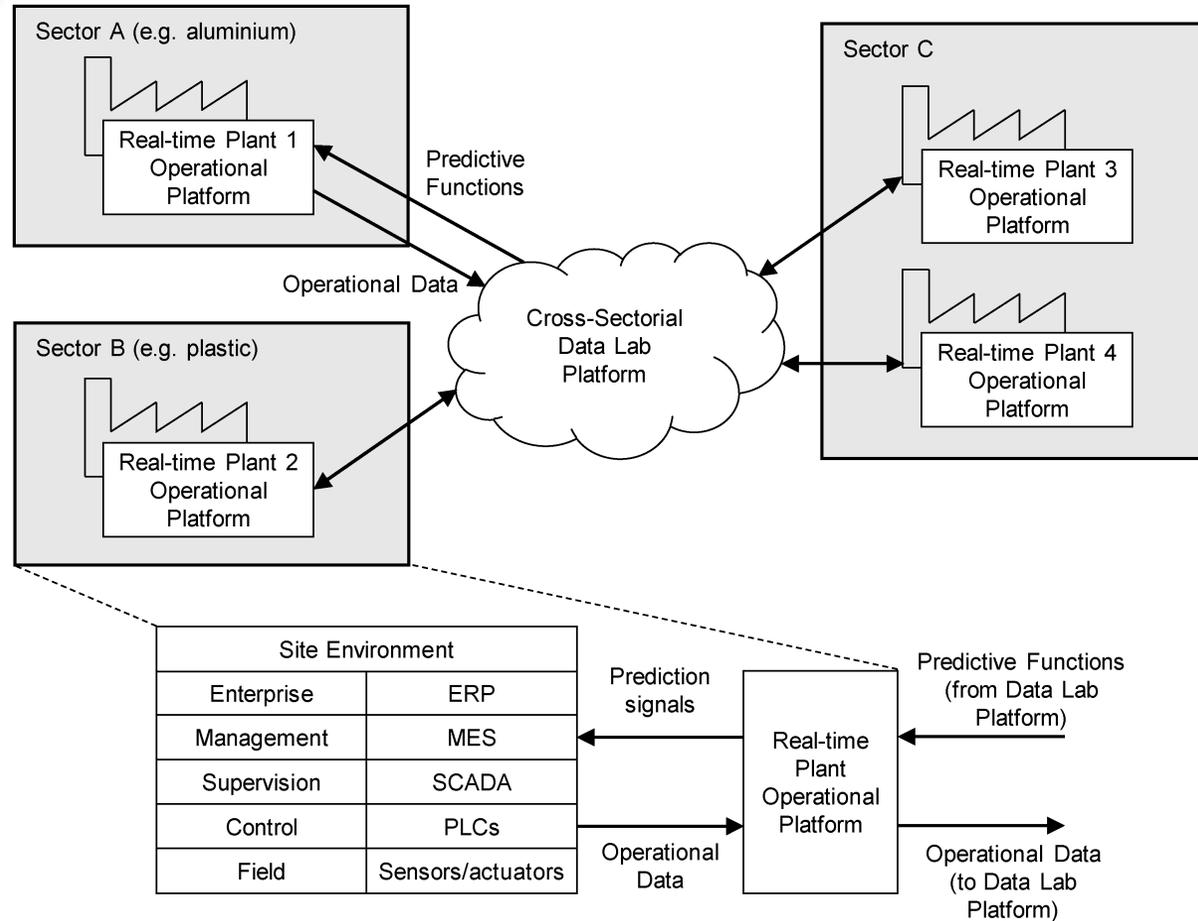
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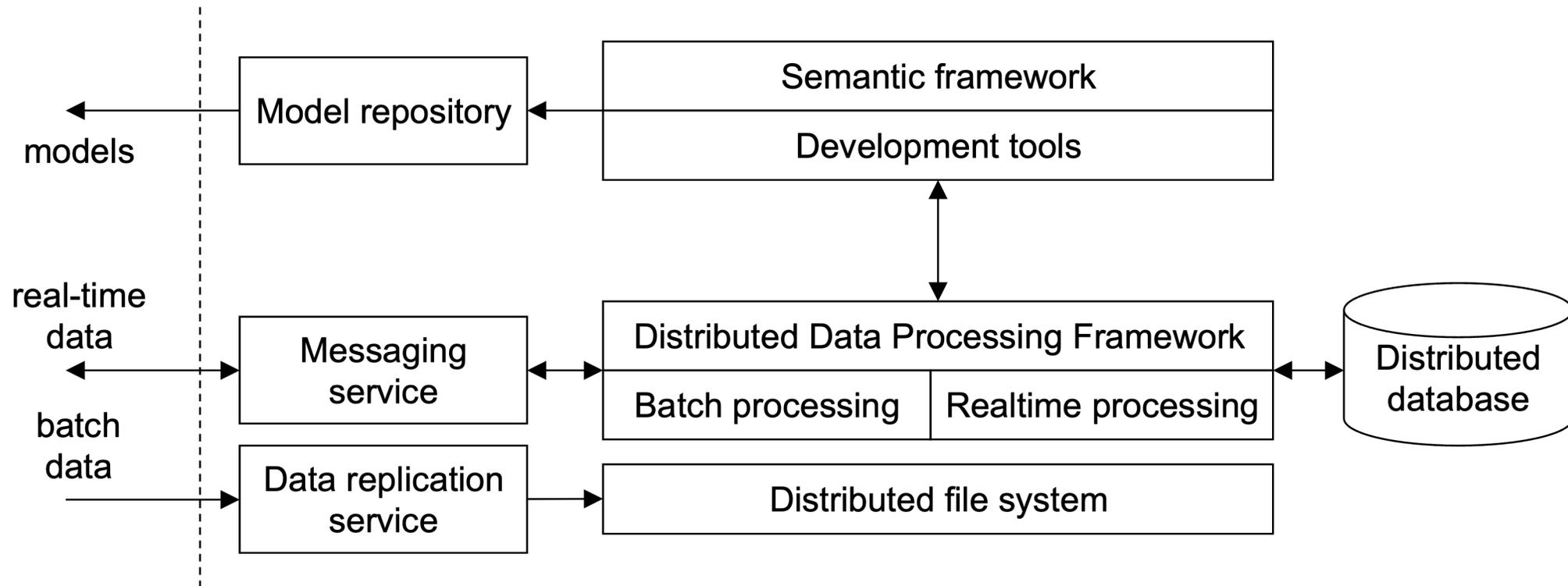
Oct. 17, 2023

Ludwigsburg, Germany

# Cross-sectorial Data Lab

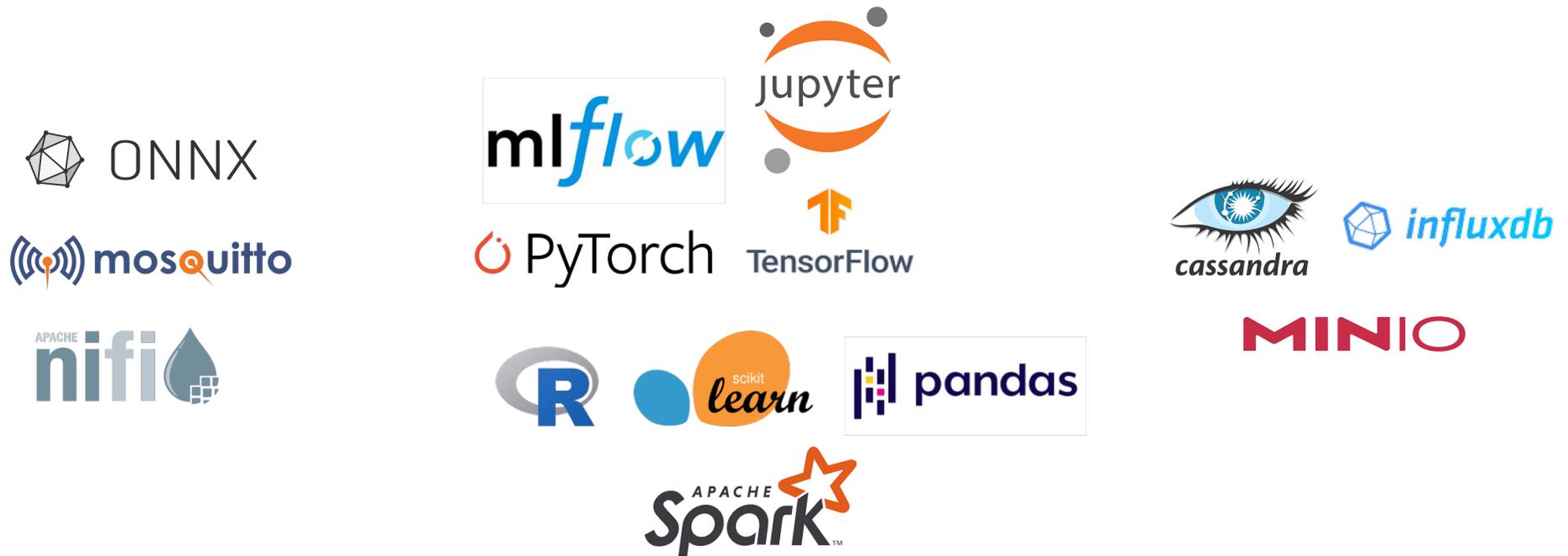


# Cross-sectorial Data Lab



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# Semantic tools

- **Knowledge sharing**
  - Problem understanding
  - Data understanding
  - Validation
- **Coding**
  - Notebooks combining code, documentation and data/model visualization
  - Repetitive tasks – constrained by data

- **Problem and Data understanding**
  - Domain problems -> Data mining tasks
  - Data elements
  - KPIs
- **Data pre-processing, modelling, model validation**
  - Automatic code generation

The screenshot displays a web-based interface for managing predictive functions. The left sidebar shows a hierarchical tree of processes, including 'Green anode' with sub-items like 'Mixing', 'Forming', and 'Cooling'. The main panel is titled 'Predictive Functions' and contains a list of functions: 'EXOTIC\_COKE\_PROPS\_PREDICTION', 'ANODE\_QUALITY\_PREDICTION', and 'VIBROCOMPACTOR\_PARAM\_PREDICTION'. Below this, a table lists the inputs, outputs, and KPIs for these functions.

Inputs	Outputs	KPIs
D110-C030_MES_VIT D110-D030_MES_INT_ELEVATEUR D110-E100_INT_BROYEUR D110-G120_FREQUENCE_ALTIVAR	ANODE_QUALITY	Raw material consumption Energy consumption

# Problem understanding

- **Narrative description**
- **Inconsistent formulation of the problem**
  - Highly depends on the experience of the data scientist
  - Consistency about 80-85% for task definition, inputs, outputs and KPIs
- **Can we use LLMs to extract task definition from the textual description of the problem?**

# Prompts

**problem:** The anodes used in aluminum smelting process are made by mixing petroleum coke with coal tar pitch (binder) to form a paste. Recycled anode butts are also used as filler aggregates and added to the mixture of coke and pitch. Anode is then formed to the compact block using the vibration process and then baked at high temperature around 1200°C. ...

**task:** classification

**input data:** material ratio, time course of vibration, ...

**output data:** predicted anode quality

**KPIs:** material/energy savings, emissions, ...

# Testing problems

example problem 1  
example problem 2  
example problem 3  
example problem 4  
target problem  
task: ?  
input data: ?  
output data: ?  
KPIs: ?

- 5 problems from various domains (industry, economy, astronomy and medicine)
- 50 variants for each description generated by Open AI gpt-4

# Preliminary results

- **Precision >95**
- **Average cross-domain recall 87**
  - Problematic input data and domain KPIs
- **Average intra-domain recall 87.4**
  - Medical domain
- **More use cases needed for validation**

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# Thank You

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