

# RAKI: Rapid Explainable Artificial Intelligence for Industrial Plants

Gefordert durci



Bundesministerium für Wirtschaft und Energie

aufgrund eines Beschlusses des Deutschen Bundestages

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## **Overview**



- **Data Acquisition and Semantic Modeling** •
- Verbalization and Machine Learning ٠
- Further Results •

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### **Motivation**

- Cyber-physical systems for more flexibility, adaptability, and transparency in production, and increased autonomy of machines
- Skill matching assigns operations in a production process to machines
- Need skill descriptions of the machines and skill requirements of the operations
- In some cases, skill descriptions might not be available at all, e.g., in the case of a legacy module
- Defining and digitizing skill descriptions of a production module are typically done manually by a domain expert
- Equip machines with explicit digitized skill descriptions, detailing their capabilities

Automatic skill description learning would minimize the labor time and domain expertise needed to equip production modules with their descriptions.

### Given:

- Production log data instance data
- Production ontology background data



**Desired: skill descriptions of machines** 



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#### **Data acquisition and Semantic Modeling**

- Data Acquisition: BoP and BoM
- **Data Exploration**
- Concept development and modeling
- Semantic annotation and transformation in required format

#### Verbalization and Machine Learning

- Support of concept for verbalizing: data modeling
- Based on industrial requirements and available data



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# **Use Case – Evaluation**





- Functional testing rather than performance testing: to a small data set only
- Reference test with full dataset
- Data preparation:
  - Modification of BoP and BoM
  - Modification of equipment
  - Evaluation tests

#### **Current Status**

- Created ontology for the use case and adapted it for the methodology
- Generated positive and negative examples for all machines and tasks
- First feedback received from UPB
- Hobbit Platform received from UPB installation in progress

#### **Next Steps**

- > Transfer of the RAKI framework to Siemens
- Evaluation of results and discussion (with UPB)
- Technical interpretation of results (with UPB)
- Integration of verbalization (with ULEI)



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## **Further Results**



#### **Related publications**

- "Integrating Logical Rules Into Neural Multi-Hop Reasoning for Drug Repurposing", Yushan Liu, Marcel Hildebrandt, Mitchell Joblin, Martin Ringsquandl, Volker Tresp, ICML 2020, Graph Representation Learning and Beyond Workshop
- "Ontology-based Skill Description Learning for Flexible Production Systems", Anna Himmelhuber, Stephan Grimm, Thomas Runkler, Sonja Zillner, ETFA 2020, Vienna
- "Skill Description Learning: Wissen über Maschinen rekonstruieren", Pressemeldung, siehe https://rakiprojekt.de/news/2020-26-05-Skill-Description-Learning/
- "Neural Multi-Hop Reasoning With Logical Rules on Biomedical Knowledge Graphs", Yushan Liu, Marcel Hildebrandt, Mitchell Joblin, Martin Ringsquandl, Rime Raissouni, Volker Tresp, ESWC 2021

#### **Related internal work**

- RAKI Roadmap under development: Brownfield Initiative
- Work on Use Case for Prototype 2 started: Turbine Package Classification





# Thank you for your attention!

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