

AI-Driven Dynamic Integration of Heterogeneous Data for Semantic Cluster Formalization in Human-Centric Intelligent Enterprise Systems

The logistics industry faces increasing challenges in integrating heterogeneous data from various Enterprise Resource Planning (ERP) systems, Manufacturing Execution Systems (MES), and Customer Relationship Management (CRM) systems. These systems often have unique structures, formats, and semantic interpretations, leading to data silos that hinder operational efficiency and informed decision-making.

This PhD thesis focuses on developing an advanced Artificial Intelligence (AI)-driven framework to dynamically integrate heterogeneous data sources and formalize semantic clusters for human-centric intelligent enterprise systems. By leveraging machine learning, formal concept analysis (FCA), and semantic technologies, the research aims to harmonize disparate data formats and address key challenges such as semantic heterogeneity, scalability, and semantic cluster formalization.

Objectives:

1. **Semantic Heterogeneity:** Develop methodologies to identify and resolve semantic inconsistencies across data sources, such as variations in terminology, data representation, and contextual interpretations.
2. **Scalability:** Design an integration framework capable of handling large volumes of diverse data while maintaining performance, supporting real-time updates, and enabling concurrent access.
3. **Semantic Cluster Formalization:** Propose innovative methods for identifying and formalizing clusters of semantically related data elements, adapting dynamically to changes in data patterns.

Methodology:

The research will apply advanced AI techniques, including:

- Machine learning for data transformation and integration.
- Formal Concept Analysis (FCA) for semantic analysis and cluster formalization.
- Ontology engineering to establish a coherent semantic foundation.
- Dynamic data modeling to address evolving business requirements and market conditions.

The expected outcomes include:

- A prototype integration framework capable of real-time heterogeneous data integration and semantic cluster analysis.
- Enhanced methodologies for optimizing storage management and logistics operations.
- Academic contributions in the form of publications and presentations.

The project will directly support MG-IB's R&D goals, offering practical tools to improve operational efficiency and customer satisfaction while addressing broader challenges in the logistics sector.

Working Conditions

Contract Time: Three years.

Employer: Université de Lorraine and MG-IB enterprise.

Salary: Between 1800 and 2000 euros net per month.

Expected Profile:

The ideal candidate should have a Master's degree (or equivalent) in computer science, data science, or a related field. Strong analytical skills and a solid background in Artificial Intelligence, data integration, and semantic technologies are essential. Experience with ontology engineering, formal concept analysis (FCA), and machine learning frameworks will be highly valued.

Candidates should demonstrate:

- Mastery of the English language is mandatory; French would be highly appreciated.
- Proficiency in programming languages such as Python or Java.
- Familiarity with enterprise systems (ERP, MES, CRM).
- Knowledge of semantic web technologies and data modeling tools.
- Excellent communication and teamwork skills, as the project involves close collaboration with the MG-IB R&D department and the CRAN laboratory at Université de Lorraine.

The successful applicant will split their time between MG-IB's Research and Development Department in Épinal and the CRAN laboratory in Nancy, France. Regular visits to MG-IB clients in the Vosges region are expected, ensuring alignment between theoretical research and practical applications.

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