Master Research internship at G-SCOP Laboratory

Applied Artificial Intelligence and Industrial Engineering

**Internship title: An Integrated Case-Based Reasoning, Knowledge Graph, and Large Language Model Approach for Explainable and Sustainable Industrial Quality Problem-Solving**

**Key words:** Quality management, Problem solving, Case-based reasoning, Knowledge graph, Large language models, Recommender system

**Duration:** 5 months, as soon as possible

**Host Laboratory**: G-SCOP (46 avenue Félix Viallet 38031 Grenoble Cedex 1 - France)
**Industrial Partner**: Noet-ia (Grenoble)

**Supervisors:** Abdourahim Sylla, Fabien Mangione (G-SCOP) and Olivier Daniel-Thomas (Noet-ia)

**Description of the research work**

**Research context**

In today's industrial contexts, effective quality management implies explicit and sustainable problem-solving. This is critical for manufacturing companies as it creates a major competitive advantage. However, the complexity of modern industrial processes imposes the need for advanced decision-support tools capable of handling various types of data (structured data, unstructured textual data, images, …) and performing multiple tasks.

Case-Based Reasoning (CBR) is an artificial intelligence (AI) approach that reproduces the human experience-based reasoning to solve new problems by reusing experience from past problems. It is useful in explaining or justifying a solution, reusing and sharing knowledge (M.-K. Park et al., 1998). Knowledge graph (KG) is an intelligent system that integrate knowledge and data, and applies reasoning mechanisms to derive new knowledge. It can be applied to natural language processing, intelligent question answering, intelligent recommendation system (Pei et al., 2025). Large language models (LLMs) is one of the most advanced form of machines' language intelligence (Zhao et al., 2023). LLMs exhibits strong capabilities to understand natural language and solve complex tasks via text generation. However, CBR, KG or LLMs, taken individually, presents some limitations when it comes to concurrently consider multiple factors, such as explainability, efficiency, accuracy, replicability, correctness, and the autonomy of the human.

**Research problem and objective**

Recent research works have integrated LLM with Knowledge graph for the cause analysis of quality defects in aerospace product manufacturing (Zhou et al., 2024), automatic machine fault identification (Wu et al., 2025), fault diagnosis of high-speed train bogies (Miao et al., 2025). Another recent work combined CBR with LLM to improve the accuracy and efficiency of semiconductor fault diagnosis (H. Park et al., 2025). Existing research predominantly addresses individual tasks, such as problem identification, diagnosis, or action recommendation, with a primary focus on decision automation and accuracy. However, these approaches rarely consider the quality problem-solving process as a whole. Furthermore, key aspects of sustainable and human-centered decision support—including human autonomy, decision process efficiency and explainability—remain insufficiently addressed. Therefore, the objective of this internship is to study the potential of an integrated CBR, KG and LLMs approach for sustainable quality problem-solving. In this work, the term "sustainable" encompasses efficiency, accuracy, correctness, explainability, and the autonomy of the human.

## Expected results

The expected results are threefold: (i) a focused literature review on CBR, KGs, and LLMs for industrial quality problem-solving, (ii) a formal specification of an AI powered human-centered quality problem-solving process, and (iii) experimental results from an industrial case study.

The potential impacts of this study are twofold. For research, this study will contribute to the advancement of human-centered AI research through hybrid AI paradigm. For industry, this study will lay the foundation for an end-to-end AI-assisted quality problem-solving that promotes knowledge reuse, efficiency, reliability, explainability, and human autonomy.

## Internship dates and conditions

The 5-month, full-time internship, beginning in February 2026, will be based in Grenoble at the G-SCOP laboratory. An office will be provided for the intern. One or more days of remote work per week may be arranged, depending on the project's requirements and the candidate's constraints (geographical distance).

The intern will be supervised by Abdourahim SYLLA and Fabien MANGIONE and will work closely with an expert from the company noet-ia. He or she will also have the opportunity to interact with doctoral and postdoctoral students.

## Prerequisites

- Mandatory knowledge: Quality management in industry, Data modelling, Basic Data analysis, Basic Machine learning, Conceptual modelling (e.g. UML, Ontology), Python programming.
- Desired knowledge: Automatic language processing, Knowledge graph, Reasoning mechanisms in AI, Information retrieval algorithms, Large language models, Case-based reasoning.

## How to Apply?

Interested candidates must submit the following documents:

- Resume (CV) + Master's degree transcript
- Personal statement
- Letter of recommendation or academic references: optional

Applications must be sent to abdourahim.sylla@grenoble-inp.fr and fabien.mangione@grenoble-inp.fr by October 27, 2026, with the subject line "Internship on Applied Artificial Intelligence and Industrial Engineering"

Shortlisted candidates will be contacted for a videoconference interview.

Candidates with an international background are welcome to apply.

Remuneration: €4.50/hour (the legal minimum wage), or approximately €630/month for a 35-hour workweek

## Pour en savoir plus sur l'environnement du stage

Grenoble, nichée au coeur des Alpes françaises, abrite plusieurs universités et instituts de recherche renommés, dont l'Université Grenoble Alpes. En plus de son offre universitaire, Grenoble est également entourée de magnifiques sites naturels avec un accès facile aux montagnes pour le ski, la randonnée et d'autres activités de plein air. La population de Grenoble est diversifiée et internationale.

L'Université Grenoble Alpes compte 60 000 étudiant.e.s, 6 000 chercheur.e.s et 3 000 doctorant.e.s. Elle est classée chaque année parmi le groupe 100-250 des meilleures

universités mondiales dans les grands classements internationaux et figure parmi les 10 premiers établissements d'enseignement supérieur français.

Le **Cluster IA MIAI** (Institut multidisciplinaire en intelligence artificielle) vise à mener des recherches en intelligence artificielle au plus haut niveau, à proposer des cours attractifs pour les étudiant.e.s et professionnel.le.s de tous niveaux, à soutenir l'innovation dans les grandes entreprises, PME et startups, ainsi qu'à informer et interagir avec les citoyen.ne.s sur tous les aspects de l'IA. Il réunit des partenaires des secteurs public et privé et vise à développer une IA pour les humains et l'environnement. https://miai-cluster.univ-grenoble-alpes.fr/miai-institute/

**G-SCOP** est un laboratoire pluridisciplinaire pour répondre aux défis scientifiques posés par les mutations du monde industriel. Le périmètre du laboratoire va de la conception des produits à la gestion des systèmes de production en s'appuyant sur de fortes compétences en optimisation. https://g-scop.grenoble-inp.fr/

**References**


Miao, R., Wu, T., & Zhang, Z. (2025). Graph RAG-based fault diagnosis for train bogies using knowledge graphs and large language model. *Knowledge-Based Systems*, *331*. https://doi.org/10.1016/j.knosys.2025.114855

Park, H., Yoo, H., Lee, J., Kim, J., Cha, H., Park, M., Lee, D., Cho, S., & Kum, E. (2025). A Knowledge Assistant for Semiconductor Fault Diagnosis Using an LLM-Enhanced Case-Based Reasoning Framework. *IEEE International Conference on Industrial Engineering and Engineering Management*, 178–182. https://doi.org/10.1109/IEEM63636.2025.11357845

Park, M.-K., Lee, I., & Shon, K.-M. (1998). Using case based reasoning for problem solving in a complex production process. *Expert Systems With Applications*, *15*, 69–75.

Pei, F., Jiang, R., Zhuang, C., Liu, J., & Yuan, M. (2025). Knowledge-graph-enhanced disturbance control in manufacturing systems: a state-of-the-art review. *International Journal of Computer Integrated Manufacturing*. https://doi.org/10.1080/0951192X.2025.2509324

Wu, P., Mou, X., Gong, L., Tu, H., Qiu, L., & Yang, B. (2025). An automatic machine fault identification method using the knowledge graph–embedded large language model. *International Journal of Advanced Manufacturing Technology*, *138*(2), 725–739. https://doi.org/10.1007/s00170-025-15555-2

Zhao, W. X., Zhou, K., Li, J., Tang, T., Wang, X., Hou, Y., Min, Y., Zhang, B., Zhang, J., Dong, Z., Du, Y., Yang, C., Chen, Y., Chen, Z., Jiang, J., Ren, R., Li, Y., Tang, X., Liu, Z., … Wen, J.-R. (2023). A Survey of Large Language Models. *ArXiv Preprint ArXiv:2303.18223*, *1*(2). https://www.bing.com/new

Zhou, B., Li, X., Liu, T., Xu, K., Liu, W., & Bao, J. (2024). CausalKGPT: Industrial structure causal knowledge-enhanced large language model for cause analysis of quality problems in aerospace product manufacturing. *Advanced Engineering Informatics*, *59*. https://doi.org/10.1016/j.aei.2023.102333