

# Master's Internship Offer

**Title:** Towards multimodal machine learning in Healthcare: application to Crohn's Disease

**Duration:** 5-6 months

**Location:** Loria, Nancy

**Start Date:** As soon as possible

## Context

This project is funded by the ANR RHU I-DEAL project.

The healthcare domain increasingly benefits from advancements in Artificial Intelligence (AI) and Machine Learning (ML). Predicting disease severity is crucial for early intervention, optimized treatment planning, and resource allocation. Crohn's disease, a chronic inflammatory bowel disease, presents unique challenges due to its heterogeneous presentation and progression. This internship aims to explore innovative multimodal machine learning approaches to integrate diverse data sources such as clinical text, imaging, and patient-reported data for improving the understanding and prediction of Crohn's disease severity. The healthcare domain increasingly benefits from advancements in Artificial Intelligence (AI) and Machine Learning (ML). Predicting disease severity is crucial for early intervention, optimized treatment planning, and resource allocation. Crohn's disease, a chronic inflammatory bowel disease, presents unique challenges due to its heterogeneous presentation and progression. This internship aims to explore innovative multimodal machine learning approaches to integrate diverse data sources such as clinical text, imaging, and patient-reported data for improving the understanding and prediction of Crohn's disease severity.

## Objective

The main objective of this internship is to develop an AI-based system that leverages multimodal data sources for predicting the severity of Crohn's disease. The intern will focus on:

- **Data Integration:** Designing techniques to preprocess and integrate multimodal data sources.
- **Feature Extraction:** Identifying and extracting meaningful features from clinical text, medical imaging, and patient-reported outcomes.
- **Model Development:** Building and optimizing multimodal learning models tailored to Crohn's disease.
- **Validation:** Evaluating the models on relevant datasets.

## Key Tasks

### Task 1: Literature Review:

- Study existing methods for multimodal data integration and learning.
- Review domain-specific use cases for Crohn's disease severity prediction.

## **Task 2: Data Collection and Preprocessing:**

- Work with open-source or provided datasets consisting of clinical text (e.g., medical reports), imaging data (e.g., MRI, CT scans), and patient-reported outcomes.
- Handle data cleaning, synchronization, and transformation.

## **Task 3: Model Development and performance evaluation:**

- Implement multimodal learning models (e.g., Transformers, Convolutional Neural Networks, or RNNs).
- Experiment with fusion techniques (e.g., early, late, or hybrid fusion).
- Test the models using appropriate metrics (e.g., accuracy, F1-score, ROC-AUC).
- Compare the performance of multimodal models with single-modality baselines.

## **References**

- [1] Felix Krones, Umar Marikkar, Guy Parsons, Adam Szmul, Adam Mahdi. Review of multimodal machine learning approaches in healthcare. *Information Fusion*, Volume 114, 2025, 102690, ISSN 1566-2535, <https://doi.org/10.1016/j.inffus.2024.102690>.
- [2] Soenksen, L.R., Ma, Y., Zeng, C. *et al.* Integrated multimodal artificial intelligence framework for healthcare applications. *npj Digit. Med.* **5**, 149 (2022). <https://doi.org/10.1038/s41746-022-00689-4>
- [3] Fatemeh Behrad, Mohammad Saniee Abadeh. An overview of deep learning methods for multimodal medical data mining, *Expert Systems with Applications*, Volume 200, 2022, 117006, ISSN 0957-4174, <https://doi.org/10.1016/j.eswa.2022.117006>.

## **Required Skills**

- Strong programming skills in Python and/or Java.
- Experience with machine learning frameworks (e.g., TensorFlow, PyTorch, or Scikit-learn).
- Knowledge of NLP, medical imaging analysis, and multimodal learning techniques.
- Familiarity with healthcare data and Crohn's disease is a plus.
- Analytical and problem-solving skills.
- Good communication skills for documenting and presenting findings.

## **Expected Outcomes**

- A multimodal dataset prepared for experimentation.
- A functional prototype capable of predicting Crohn's disease severity based on integrated clinical text, imaging, and patient-reported data.
- Performance benchmarks and a comparative analysis of the developed models.

## **Supervision and Environment**

The intern will work under the supervision of :

- Sabeur Aridhi, MCF, HDR, Loria
- Yannick Toussaint, PU, Loria.

The project will provide access to cutting-edge computational resources and a collaborative environment to support innovation and learning.

## **How to Apply**

Please send your application, including:

- A detailed CV.
- A brief cover letter explaining your interest and relevant skills.
- Academic transcripts.

Send your application to: [sabeur.aridhi@loria.fr](mailto:sabeur.aridhi@loria.fr) and [yannick.toussaint@loria.fr](mailto:yannick.toussaint@loria.fr)