Thesis title: AI agents for healthcare applications
Host Laboratory: FEMTO-ST, DISC, AND Team, Belfort
Specialty: Computer Science
Keywords: AI agents, LLM, NLP, medical data
PhD Subject

After the numerical revolution that was triggered by generative AI which was based on Large Language Models (LLMs) [1] and initiated by OpenAI and its ChatGPT chatbot, AI agents [2] are expected to be the next big technology in AI and it was the top trending technology in 2024 according to Gartner. AI agents are also based on LLMs but have more capabilities such as decision-making, problem-solving, interacting with external environments and executing actions. Contrary to LLMs, AI agents' response is not limited by the data used to train them. To answer complex requests to which they do not have the full knowledge base, AI agents can perform task decomposition and create a workflow of specific subtasks. These subtasks might be solved using external tools that the AI agent can call.   These tools can include external datasets, web searches, APIs, specialized AI models and even other AI agents. After each subtask, the agent can update its knowledgebase, reassess its plan of action and modify it if necessary. Moreover, AI agents can improve their reasoning and accuracy by learning from the feedback returned by other AI agents and humans. This will allow them to better align their results with the users' intended goals and avoid repeating the same mistakes by storing solutions to previous obstacles in a knowledge base.

One of the main benefits of AI agents is task automation. Indeed, AI agents can automate complex tasks that would otherwise require human resources. This translates to goals being reached inexpensively, rapidly and at scale. In the healthcare field, many tedious and repetitive operations, involving patients, physicians, insurance companies and governments, are still manually done by the physicians. Automating such applications will allow medical professionals to focus on more urgent tasks. AI agents can be used to tackle applications such as disease diagnosis, treatment planning for patients, medical coding, drug management, healthcare claims processing, etc. These applications typically require the analysis of heterogeneous data located in different storage systems. For example, an accurate disease diagnosis for a patient requires the analysis of the chief complaint written by the physician, the history of the patient illness from previous visits to this or other physicians, the laboratory results, the radiology images, etc. The AI model should also be aware of the patient's family health history, his age, gender, ethnicity, work occupation, etc. Moreover, the AI model should know the symptoms of each disease and the risk of contracting it for each population category. No single AI model can efficiently and accurately process this variety of data. An AI agent can decompose this task into multiple subtasks, call on specialized models to analyze each type of data, aggregate the results retrieved from the different tools, lookup for similar cases to refine its diagnosis and iterate until reaching a satisfying answer.

As a case study, the proposed approaches in this PhD thesis will be applied to the pre-authorization in healthcare insurance. It represents a significant administrative burden for healthcare providers, resulting in delays in patientcare, increased operational costs, and clinician burnout. Healthcare insurance pre-authorization processes suffer from several critical issues:

- Time-consuming manual review of patient records and insurance policies, creating significant bottlenecks.
- Inconsistent interpretation of coverage criteria across reviewers, leading to systemic issues requiring internal reforms and enhanced training programs.
- High error rates in clinical documentation and coding, which automated systems like InsightRT have shown promise in reducing by integrating with electronic medical records [3].

- Delays in patient care due to administrative processing time, with orthopedic practices seeing mean approval times extending over 30 days for procedures like total hip and knee arthroplasties [4].

These challenges result in approximately$31 billion in annual administrative waste in the US healthcare system alone (American Medical Association, 2023), with 92% of physicians reporting that preauthorization processes negatively impact patient clinical outcomes.

Bibliography

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Applicant profile

On September 2025, candidates must hold a Master's degree in computer science or an equivalent degree. They must also have high interest and good knowledge in machine learning. To evaluate the skills of the preselected candidates, we will ask them to submit an AI based solution to a complex problem that we will provide. Then, they should be able to present their works and results with convincing arguments both written and spoken.

Funding : MESRI Etablissement

Application deadline : 12/05/2025
Start date : 01/10/2025
Gross Salary : 2200€

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Applicants are invited to submit their application to the PhD supervisors.
Application must contain the following documents:
- CV
- Cover letter
- Academic transcripts