ICT PHD

Research project for a PhD curriculum in ICT – Electronics and Telecommunication

Tutor: Prof. Giovanni Simonini
(*) Italian Co-tutor:
(**) Foreign Co-tutor:

Proposed Title of the research:
Context-Efficient AI Agents for Scalable Data-Centric Reasoning

Keywords: (5)
AI Agents; Context Management; KV Cache Compression; Data-Centric AI; Scalable Reasoning

Research objectives: --(max 10 rows)
The project aims to study context-efficient techniques for scalable AI agents and long-context AI systems. The research will address the memory, latency, and cost bottlenecks caused by large contexts in modern AI models, with particular attention to KV cache compression, cache reuse, adaptive caching, and efficient context selection. A key objective is to investigate how AI agents can harness relevant context from interaction histories, tools, external memories, retrieved knowledge, and heterogeneous data sources while limiting unnecessary token usage. The project will also focus on data-centric reasoning over tabular and semi-structured data, including records, logs, and time series, with the goal of improving scalability, efficiency, and reliability of agentic AI applications.

Proposed research activity -- (max 10 rows)
The PhD student will study the state of the art in efficient LLM inference, AI agents, context compression, KV cache optimization, and data-centric AI. The research activity will focus on the design of methods for compressing, pruning, reusing, and caching context representations, as well as on adaptive mechanisms to select and harness the most relevant information for each task. The project will investigate agentic workflows involving long interaction histories, tool use, retrieval, external memory, and reasoning over structured or semi-structured data. Prototype systems will be implemented and evaluated on realistic data-intensive AI-agent workloads, considering token usage, memory footprint, latency, throughput, cost, robustness, and output quality.

Supporting research projects (and Department)
The research will be carried out at the Department of Engineering "Enzo Ferrari" and in collaboration with important partners at the national and international level.

Possible connections with research groups, companies, universities.

- *HPI, university of Potsdam*
- *MIT*

(*) optional
(**) optional/to be completed on the second year