

*Project title:*

**Engineering Robust GenAI Systems (Multiple Scholarships)**

*Supervisor(s) Name and E-Mail:*

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*Project Description:*

For decades, the principles of computational thinking have been foundational to how we approach problem-solving, system design, and the development of software systems. This way of thinking has empowered engineers to break down complex problems, identify patterns, abstract essential elements, and devise algorithmic solutions that computers can execute. However, the advent of Generative AI (GenAI), particularly Large Models (e.g. LLMs, LMMs), is promising to revolutionise this established paradigm introducing new layers of cognitive capabilities that extend well beyond traditional algorithmic problem-solving.

GenAI offers a combination of potential problem-solving, reasoning, planning abilities, and code generation. A non-trivial portion of tasks that previously required human effort is now being delegated with a degree of autonomy and promises to increase efficiency and scalability.

Our group is interested in developing a framework that facilitates the engineering of robust GenAI systems across various application domains, including healthcare, finance, manufacturing, etc. One example of such systems is RAG (Retrieval Augmented Generation) systems. These systems involve augmenting LLMs with external knowledge documents (or other data sources) that can be semantically matched to use prompts and then instruct the LLM to extract/generate the answer from the matched documents. RAG systems can reduce hallucination and enable grounding of the answers.

Examples of the challenges that we are interested to explore include (but not limited to):

- ✓ Different data engineering, semantic chunking strategies, and data representation techniques on the performance of the solution.
- ✓ Different multi-modal domain-specific embedding strategies
- ✓ Different embedding and retrieval algorithms and QoS (cost, performance, security and privacy, safety, reliability, ethics, etc.)
- ✓ Different generation strategies, formats and templates, action planning and agency including large action models.
- ✓ Different solution evaluation and testing strategies
- ✓ Online continuous adaptation of these software systems as the context/environment changes or new knowledge (documents) gets added to the system.
- ✓ For software engineering, how do we model and manage the interactions between engineers and code co-pilots - do we use software specs as communication protocol? How do we discover completeness, correctness and consistency as the software evolves?

**Preferred special skills and expertise:**

- ✓ Msc or Bsc(Hons) in computer science, software engineering, mathematics, data science, artificial intelligence.
- ✓ Industry or Research Experience in the same field with strong programming skills
- ✓ Strong Communication and problem-solving skills.
- ✓ Self-motivation and curiosity