RoboCoach

AI Technologies

ROScribe

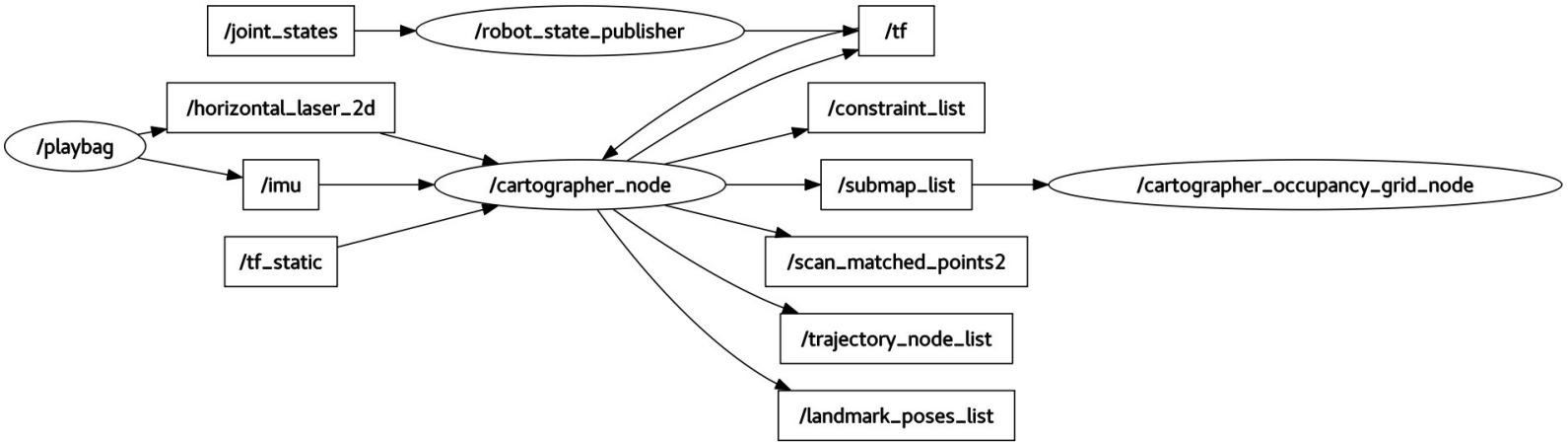
Write your robot software in minutes

https://github.com/RoboCoachTechnologies/ROScribe

October 2023

ROScribe can help you:

- Learn ROS and adopt it for your project
- Quickly create a blueprint for your robot software
- Focus on your own component and leave the rest to ROScribe



ROScribe uses LLM for code generation

- Open AI is the default LLM: GPT 3.5, GPT4
- Both ROS 1 and ROS 2 are supported
- Only python is supported for the code that LLM generates (as of now)

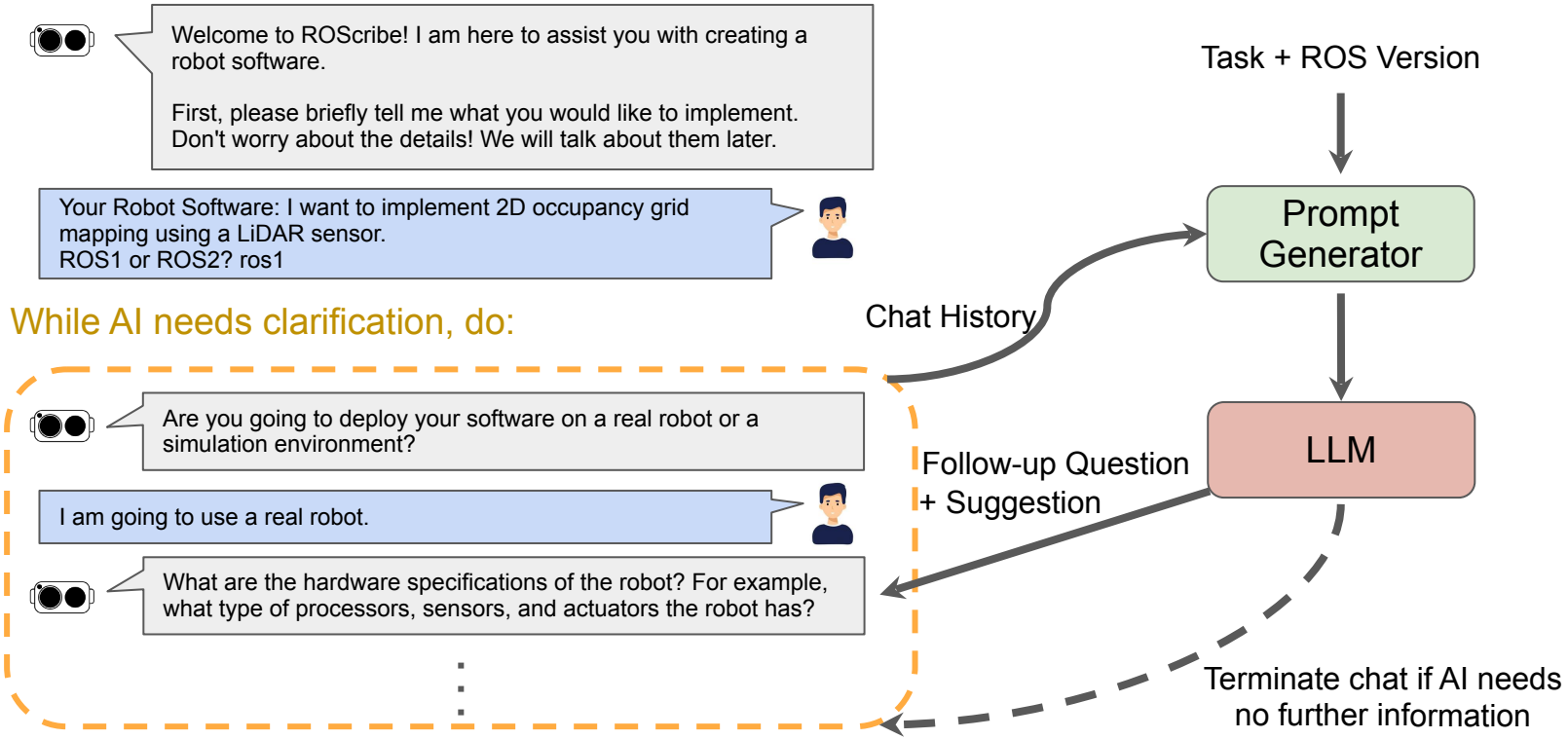
Are LLMs good for code generation?

- Spec vs. source code
  - For the first time ever in computer history, machines can understand us the way we speak
- General domain vs. special domain
  - https://github.com/RoboCoachTechnologies/GPT-Synthesizer
  - https://github.com/RoboCoachTechnologies/ROScribe
- Prompt engineering: LLMs output is only as good as its input
- Keeping human in the driver's seat
  - LLM doesn't design the software; the person who uses it does

ROScribe: Generating ROS using LLM

a. Component synthesis: build a graph of components (called ROS Graph) that controls the communication between the components (ROS nodes)
    i. Human feedback: user can add/remove ROS nodes
b. For every component:
    i. Capture the spec by interacting with the user (prompt synthesis):
        1. Generate a relevant question
        2. Capture user's answer
        3. While the spec is not clear, continue with a follow-up question
    ii. Generate code
c. Generates ROS-specific installation and packaging scripts

ROScribe: ROS Graph Synthesis



ROScribe: ROS Graph Synthesis

While AI needs clarification, do:

I am going to analyze our conversation and identify the ROS nodes and ROS topics that are going to be involved in our project.

Give me a few seconds!

Chat History

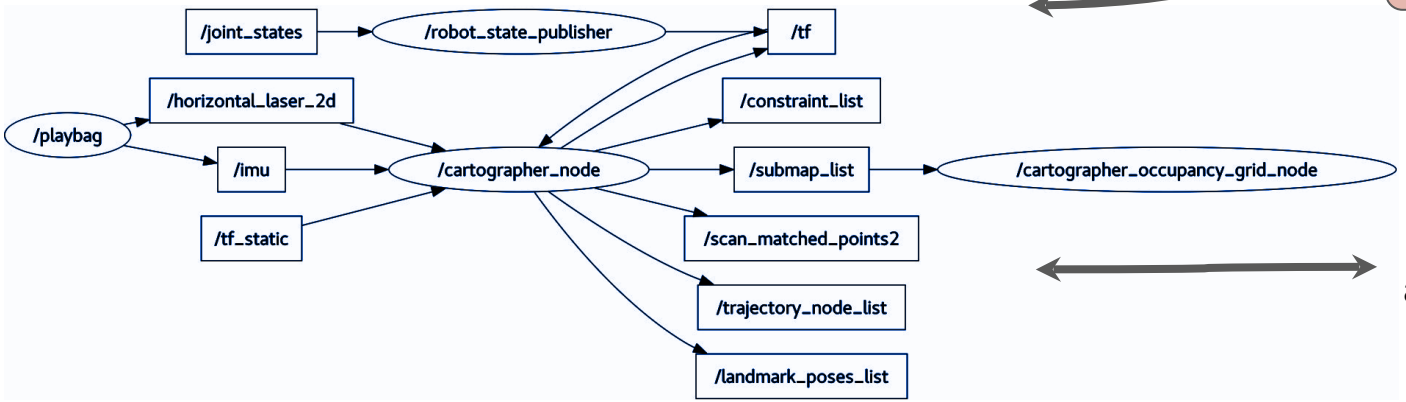
ROS Graph Format Instructions

Task + ROS Version

Prompt Generator

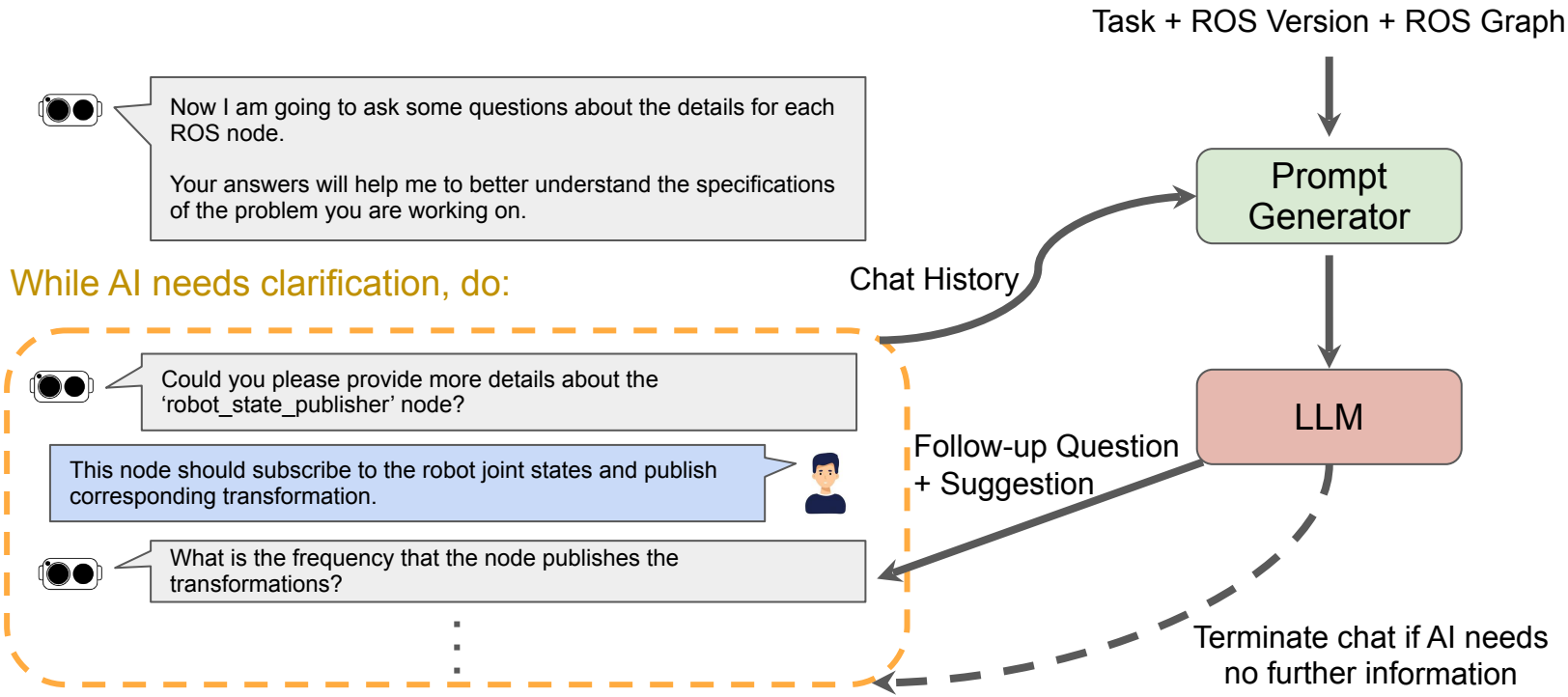
LLM

Output ROS Graph

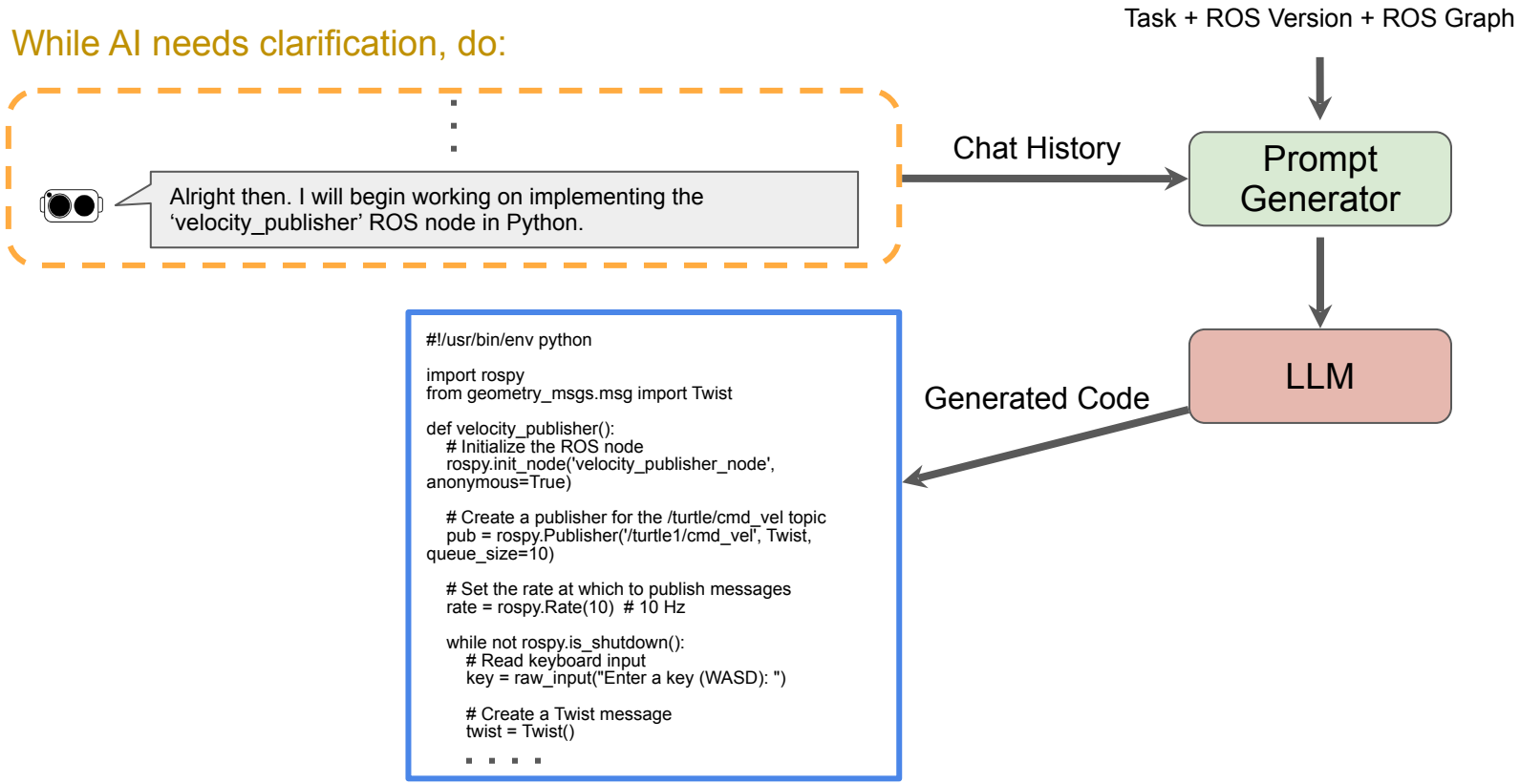


Human feedback can alter the graph structure

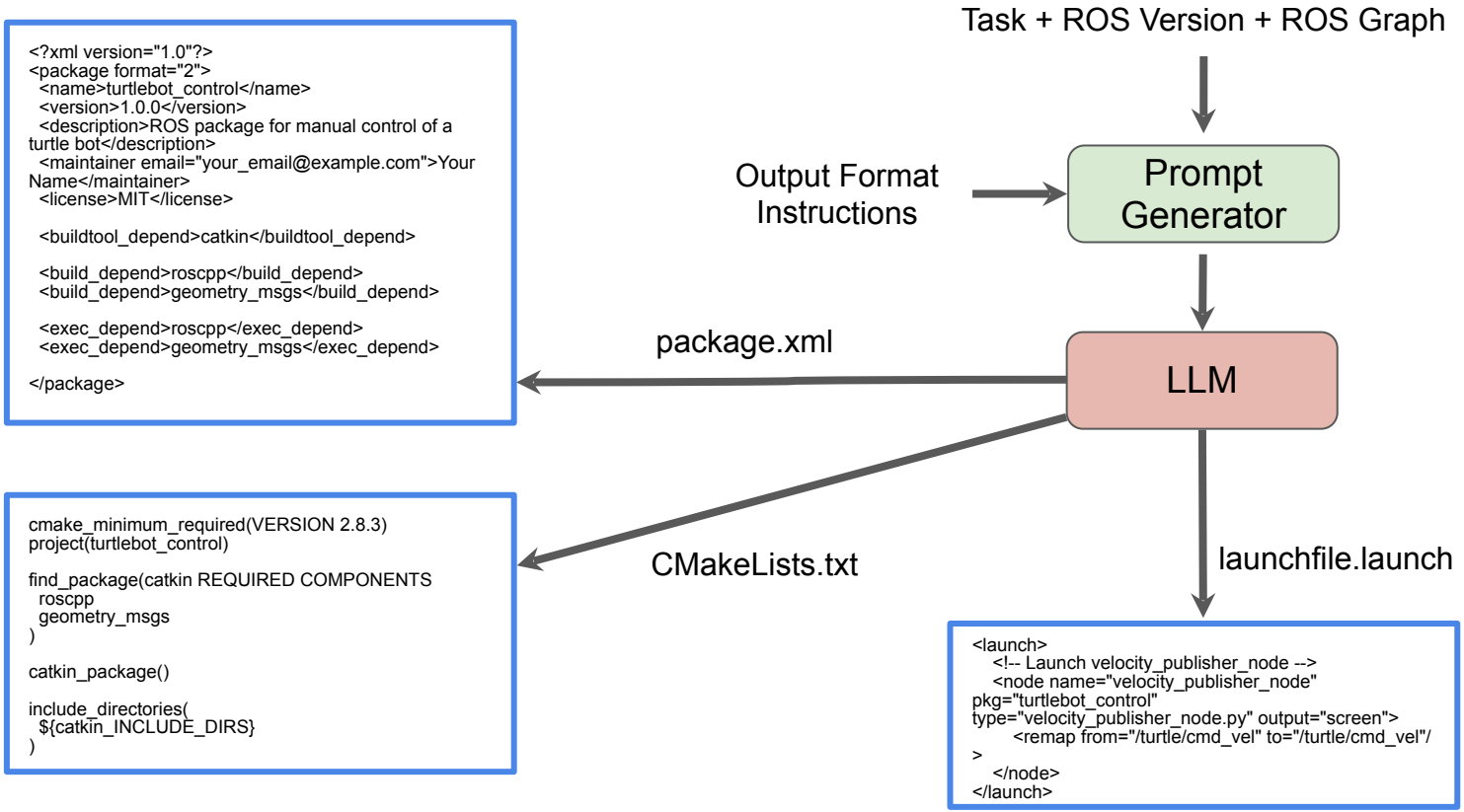
ROScribe: ROS Node Specification



ROScribe: ROS Node Code Generation



ROScribe: ROS-specific Script Generation



Next Step for ROScribe

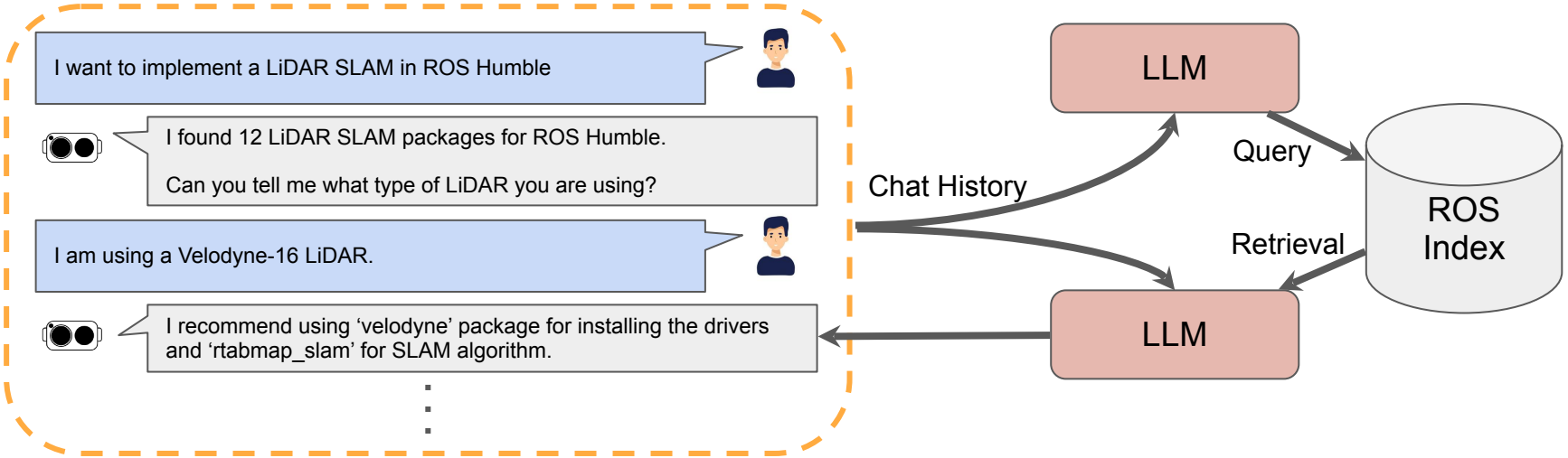
Retrieval Augmented Generation (RAG)

- Restrict the ‘attention’ of LLM to a class of objects, stored in a database
- Objects can be API calls (public or private), internal data, etc.
- This is done via enriching the prompt with information retrieved from the database
- The information retrieval step can be also carried out by another LLM
- It has been shown that RAG significantly reduces hallucination rate of LLMs [1]
- Furthermore, the performance would be extremely improved when an LLM is fine-tuned on the database with a retrieval method [1]
- RoboCoach plans to implement RAG as a core technology, which can be employed in a variety of use cases, such as CRM, real estate, financial advising, and most importantly, robotics.

[1] Patil, Zhang, Wang, Gonzalez, “Gorilla: Large Language Model Connected with Massive APIs,” 2023

Retrieval Augmented Generation (RAG)

- RAG can be utilized by ROScribe in order to design a personal robotics consultant
- The database in this example would be ROS Index, which is a collection of all ROS packages, containing documentations, dependencies, etc.



Demos

Repo: https://github.com/RoboCoachTechnologies/ROScribe

Turtle sim demo: https://www.youtube.com/watch?v=H2QaeelkReU
RAG demo: https://youtu.be/3b5FyZvlkxI