

Revolutionizing Nanofab Knowledge Management with Generative AI

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2024 NSF Nanoscale Science and Engineering Grantees Conference
Nano-AI Convergence

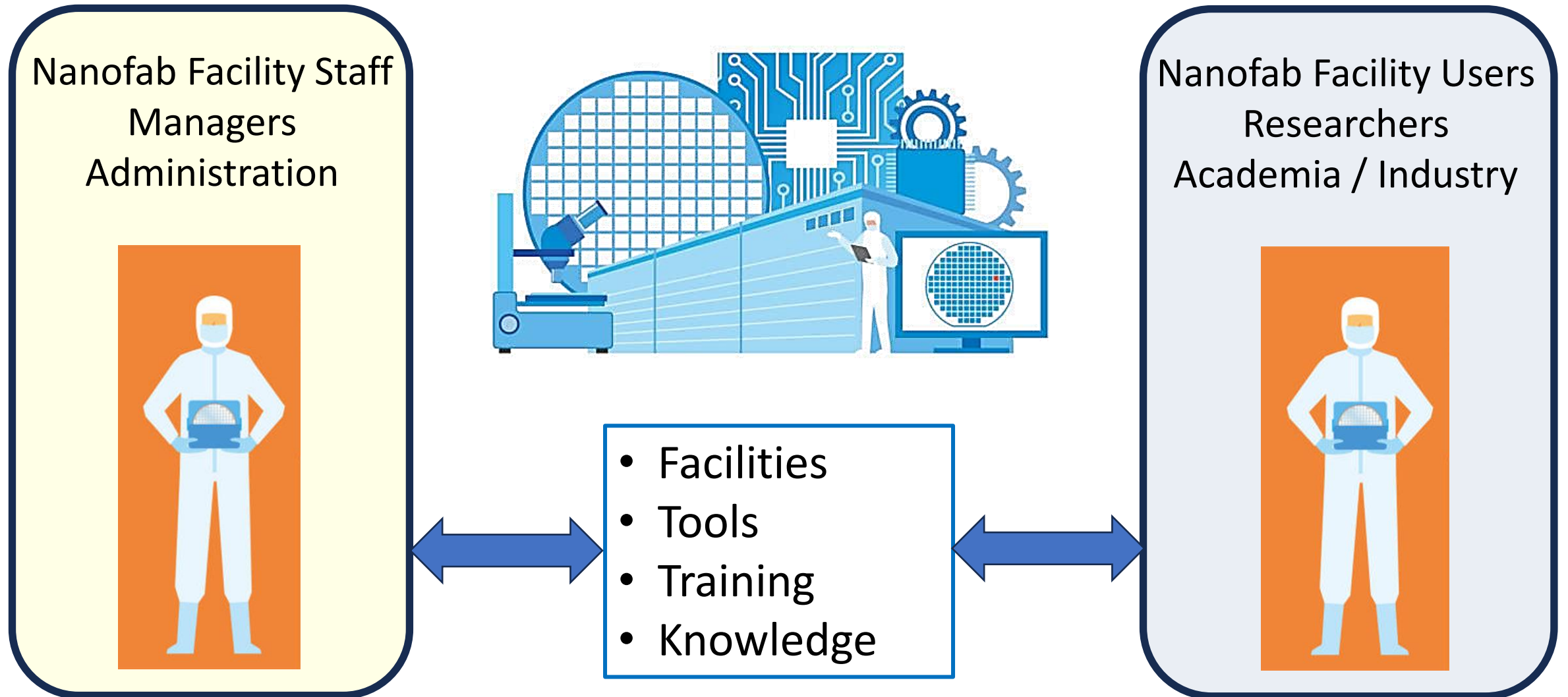
Unprecedented Machine Capabilities

Can AI help us optimize our nanofabrication facilities?



- Generative Pre-Trained Transformers (GPT's)
- Multimodal Foundation Models (MMFM) – Text, Audio, Images
- Eg: OpenAI (ChatGPT), Anthropic (Claude), Google (Gemini)

Anatomy of a Nanofabrication Facility



Unstructured Data in Nanofab Facilities

Operational Knowledge

Process Development Data

Tool / Equipment Data

- Websites
- Wiki pages
- Maintenance logs
- Engineering notes
- Financial data
- Tool Maintenance Manuals
- Safety protocols/Lab Policies
- Fabrication Process recipes
- SOPs
- Procurement information
- Emails

- HTML
- PDF
- Word Files
- Text files
- PPTs
- CSV
- Excel
- Images
- Tables
- Log Files

Multimodal LLMs are Experts at Embedding Unstructured Knowledge

General knowledge MLLM's are great ... But ...

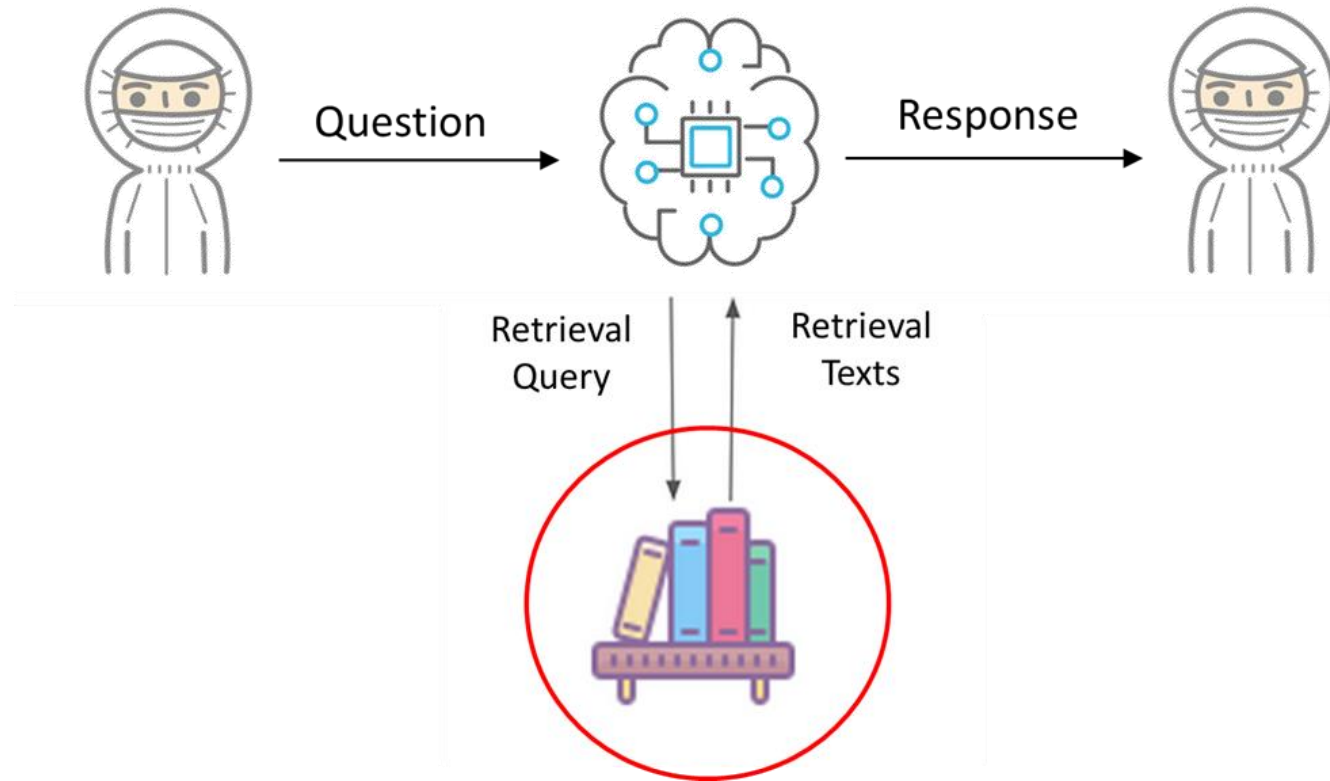
Large Foundation Models (FMs) – eg: ChatGPT, Claude, Gemini, [...]



- FMs are trained on “general” knowledge
- FMs are known to Hallucinate
- “One-Shot” Chatbots – No reasoning ability
- FMs are probabilistic, but we need reproducible results

Methods to embed domain expertise

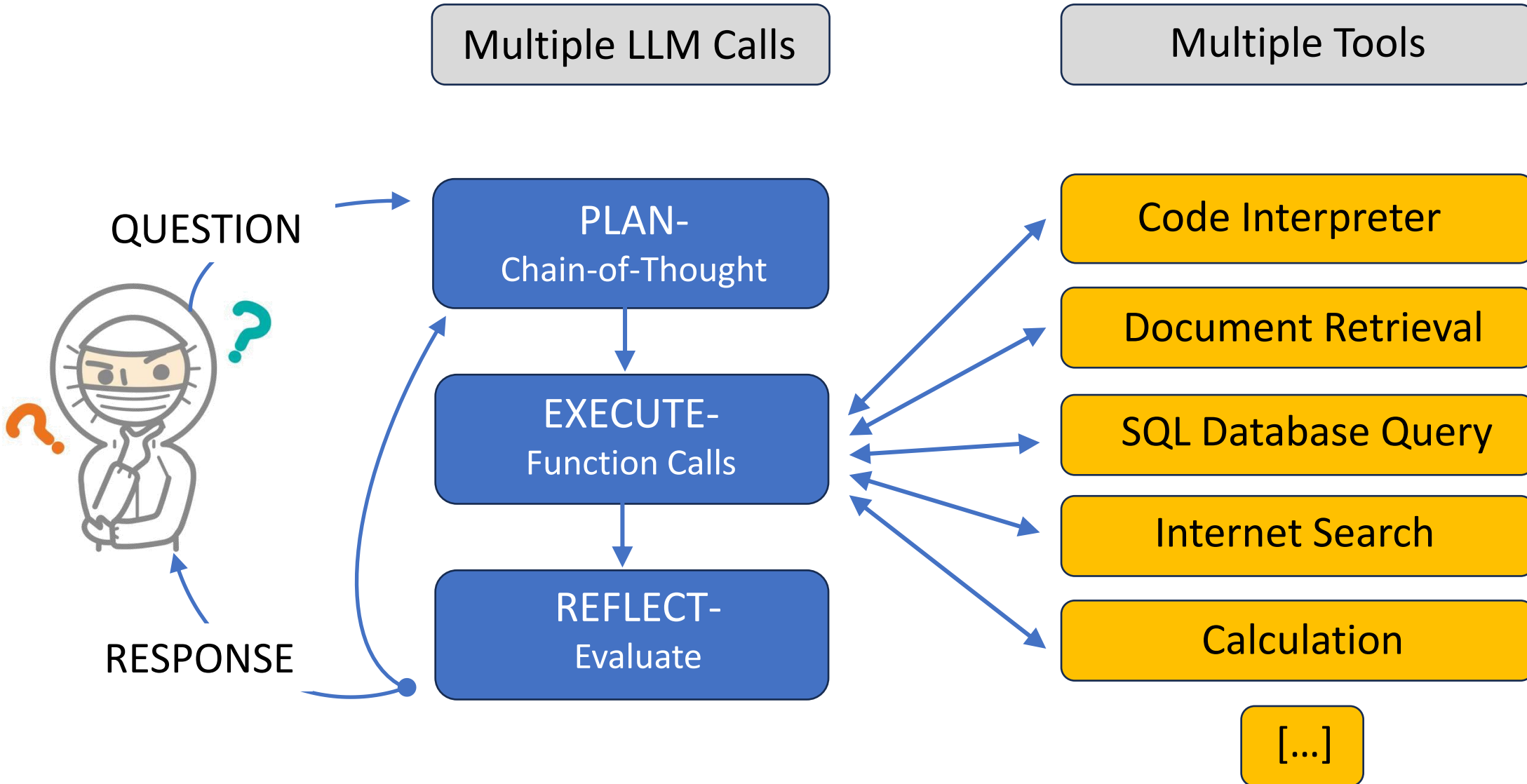
- Fine Tuning – Enhance domain language and knowledge
- Retrieval Augmented Generation (RAG) – Query documents



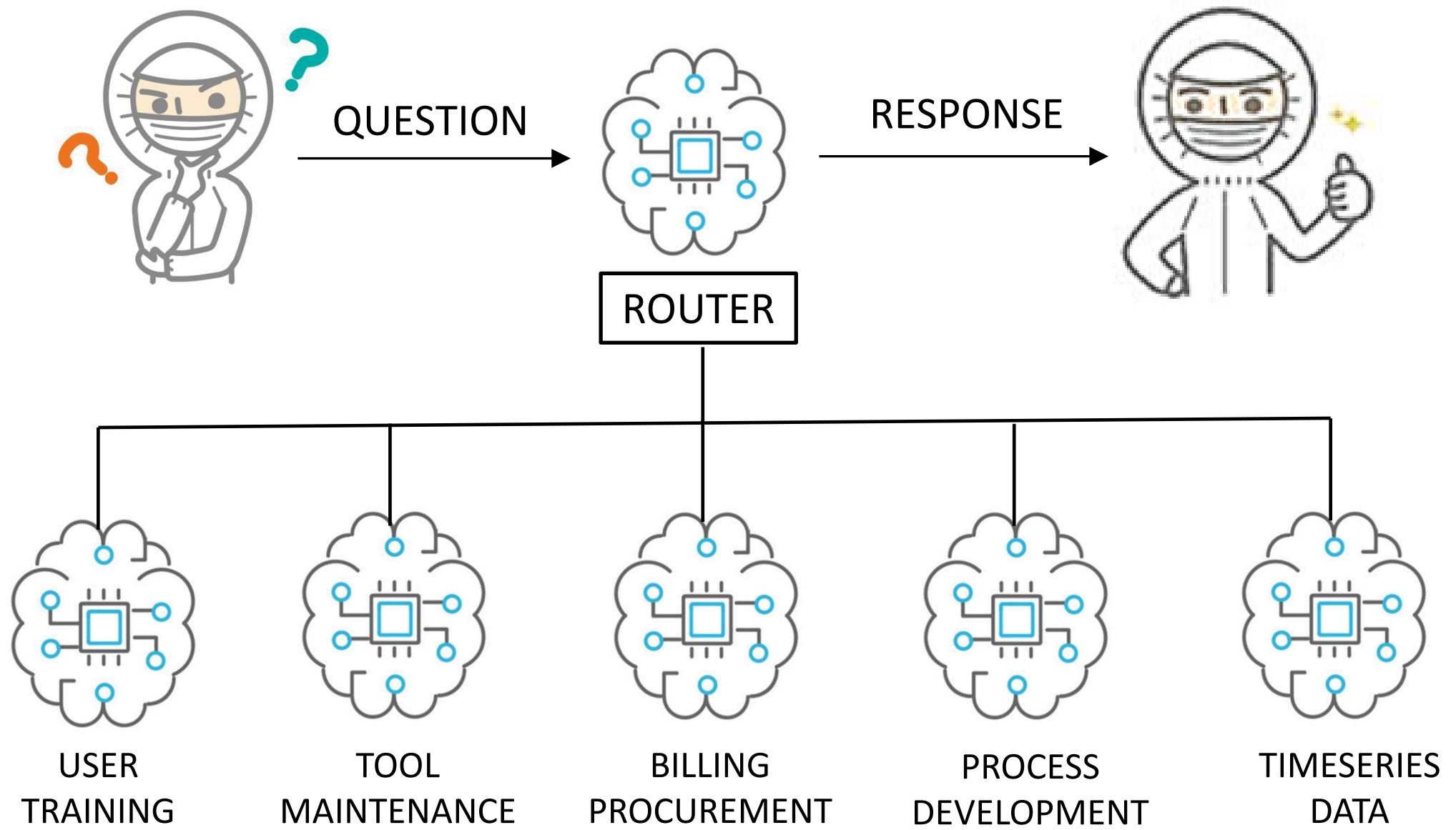
Semantic meaning is embedded in vectors

-0.01011659205 0.0248380769 0.007311150897 0.007304066326 -0.004849304911 0.00625202572 -0.01650

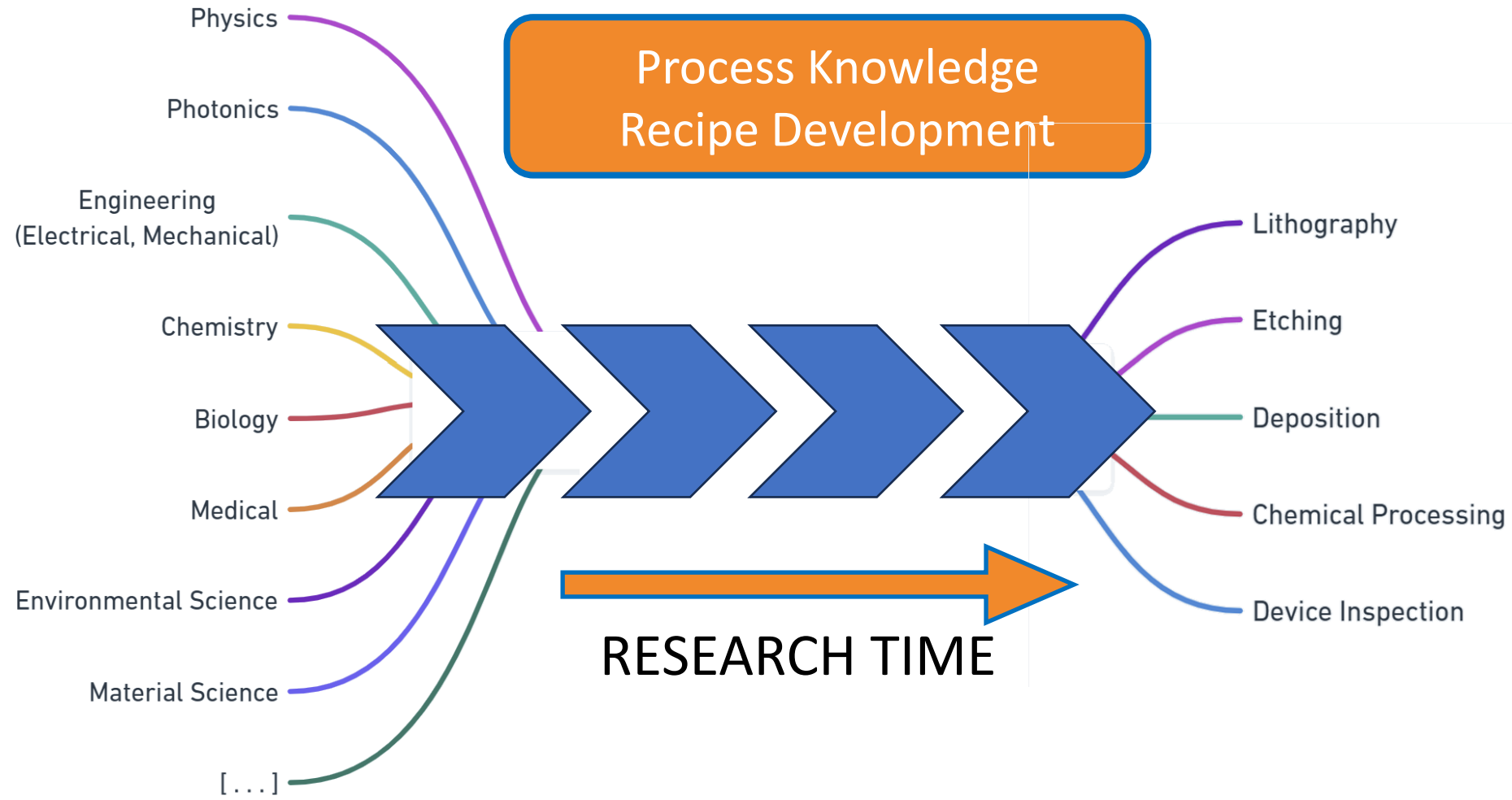
Agentic Reasoning, Tools and Actions



Network of Single-Task Agents



Optimize Process Development for the Facility User



We now have a way to capture and access this knowledge data

Implementing Data Curation and Capture

- Large amount of undocumented knowledge
- Hard to standardize - everyone has their own notetaking system
- This is the case for both staff and facility users

Multimodal LLMs are Experts at Data Curation

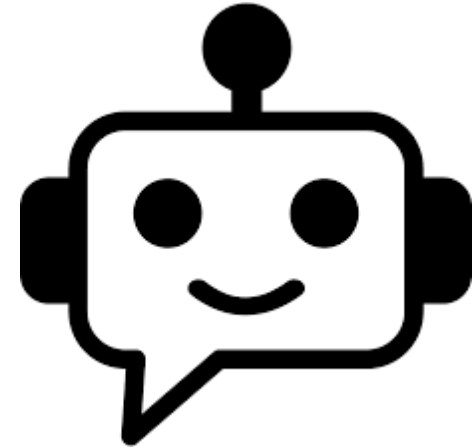
- Summarize
- Categorize
- Label
- Text, Audio and Image Input
- Reduce the barrier to data collection
- Create culture for data sharing

Need to get “buy in” and create the culture

This is already happening

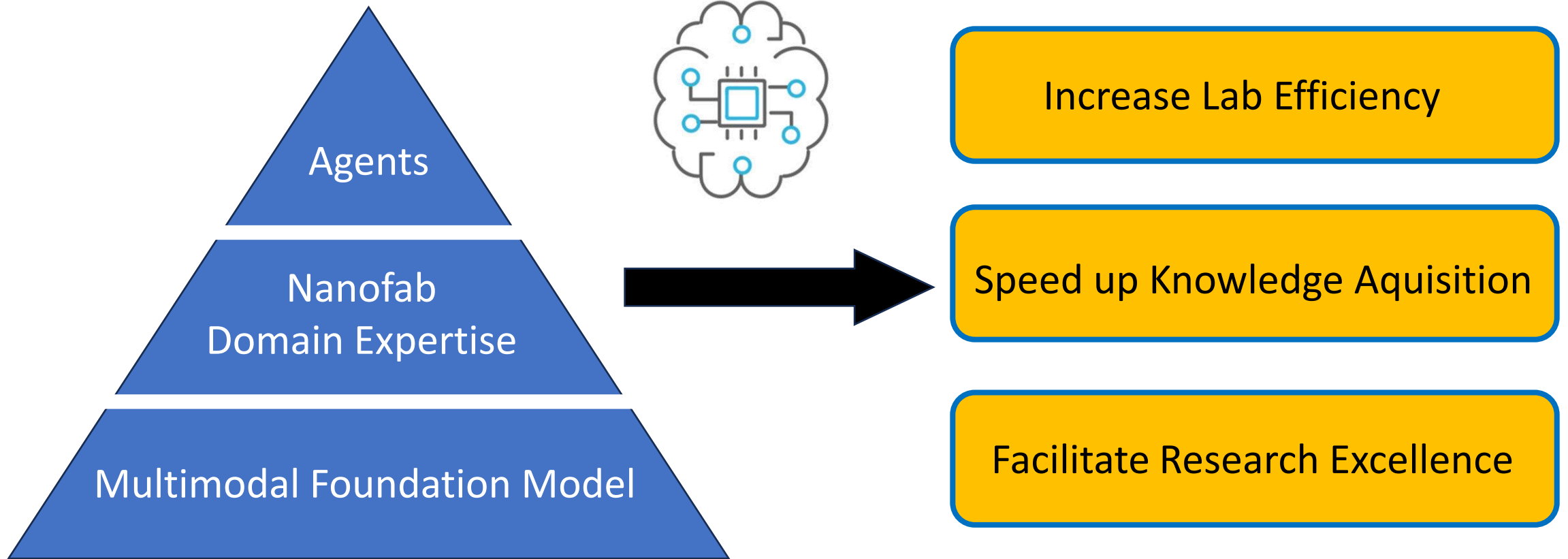
- Legal
- Medical
- Science
- SemiKong FM
- AI Alliance

labnetwork@mtl.mit.edu



www.nanobot.chat

Rewards of Implementing Knowledge Agents



AI Agents for Nanofab – Lets Start Now!

Thank You

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