Agentic Science Toolkit for Exoplanet Research - ASTER

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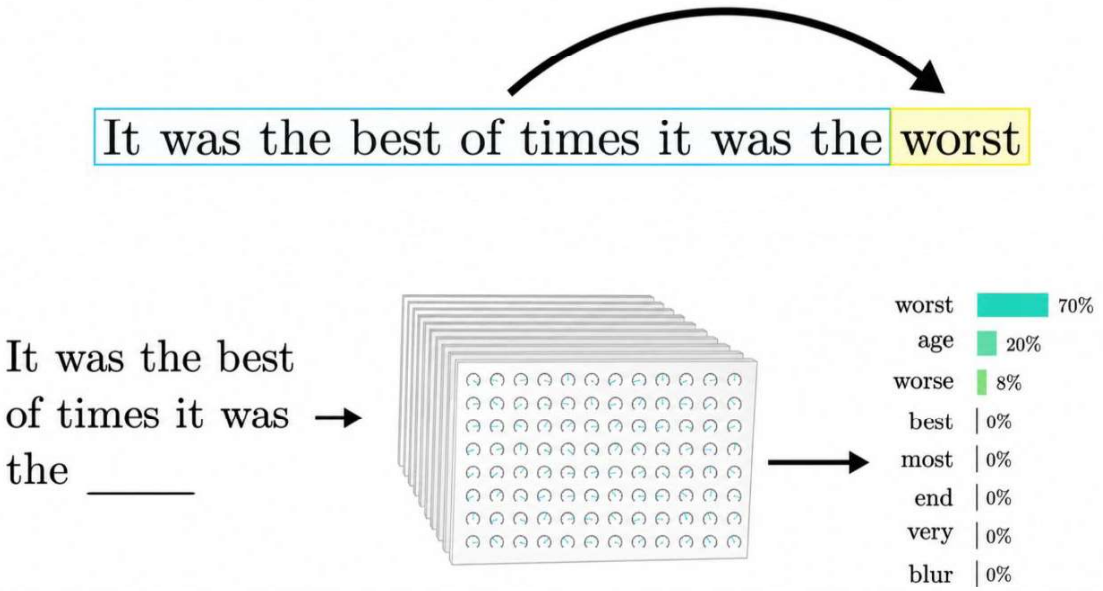
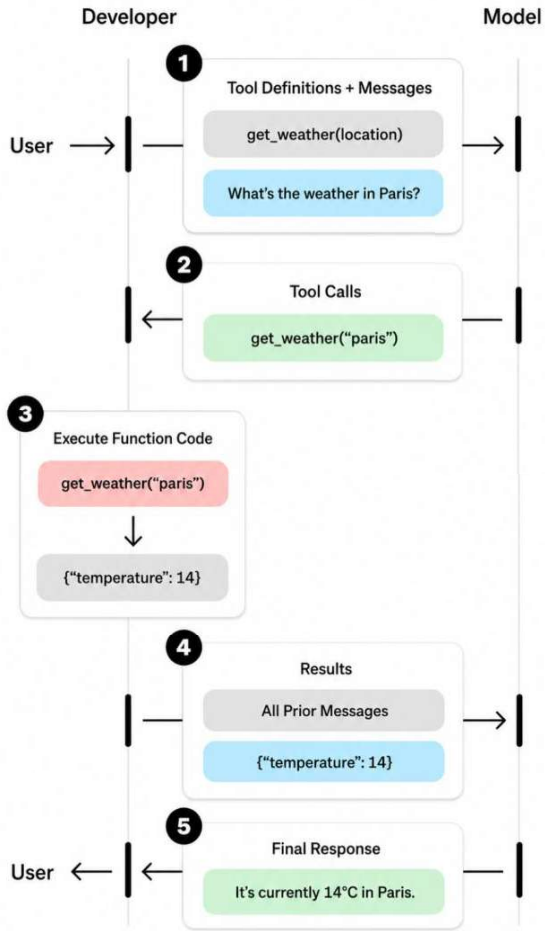
What is an LLM?

- LLM Large Language Models
- Generative pre-trained transformers
- Context: the input of LLMs



What is an agent?

- An agent is a system which:
  - Observes a state
  - Chooses an action
  - The action affects the state
- An AI chatbot like chatGPT trivially takes actions within the context of the chat
- An AI agent takes actions that affects the external state (using tools!)



Orchestral AI

Building agents to accelerate science

Orchestrating LLM agents to solve complex tasks

Philosophy of Abstraction

> *"Civilization advances by extending the number of important operations which we can perform without thinking of them."*
>
> — Alfred North Whitehead

Astrophysics > Earth and Planetary Astrophysics

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ASTER -- Agentic Science Toolkit for Exoplanet Research

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The expansion of exoplanet observations has created a need for flexible, accessible, and user-friendly workflows. Transmi probing atmospheric composition of transiting exoplanets. The analyses of these data require the combination of archival models, and Bayesian retrieval frameworks, each demanding specialized expertise. Modern large language models enable tasks by AI agents with tool integration, structured prompts, and iterative reasoning. In this study we present ASTER, an A an orchestration framework that brings LLM capability to the exoplanetary community by enabling LLM-driven interaction planning and management, and support for common data analysis tasks. Currently ASTER incorporates tools for download from the NASA Exoplanet Archive, as well as the generation of transit spectra from the TauREx radiative transfer model, ar parameters with TauREx. Beyond tool integration, the agent assists users by proposing alternative modeling approaches, r and interpretations. We demonstrate ASTER's workflow through a complete case study of WASP-39b, performing multiple archive. The agent efficiently transitions between datasets, generates appropriate forward model spectra and performs ret characterization of exoplanet atmospheres. Ongoing development and community contributions will continue expanding A exoplanet research.

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