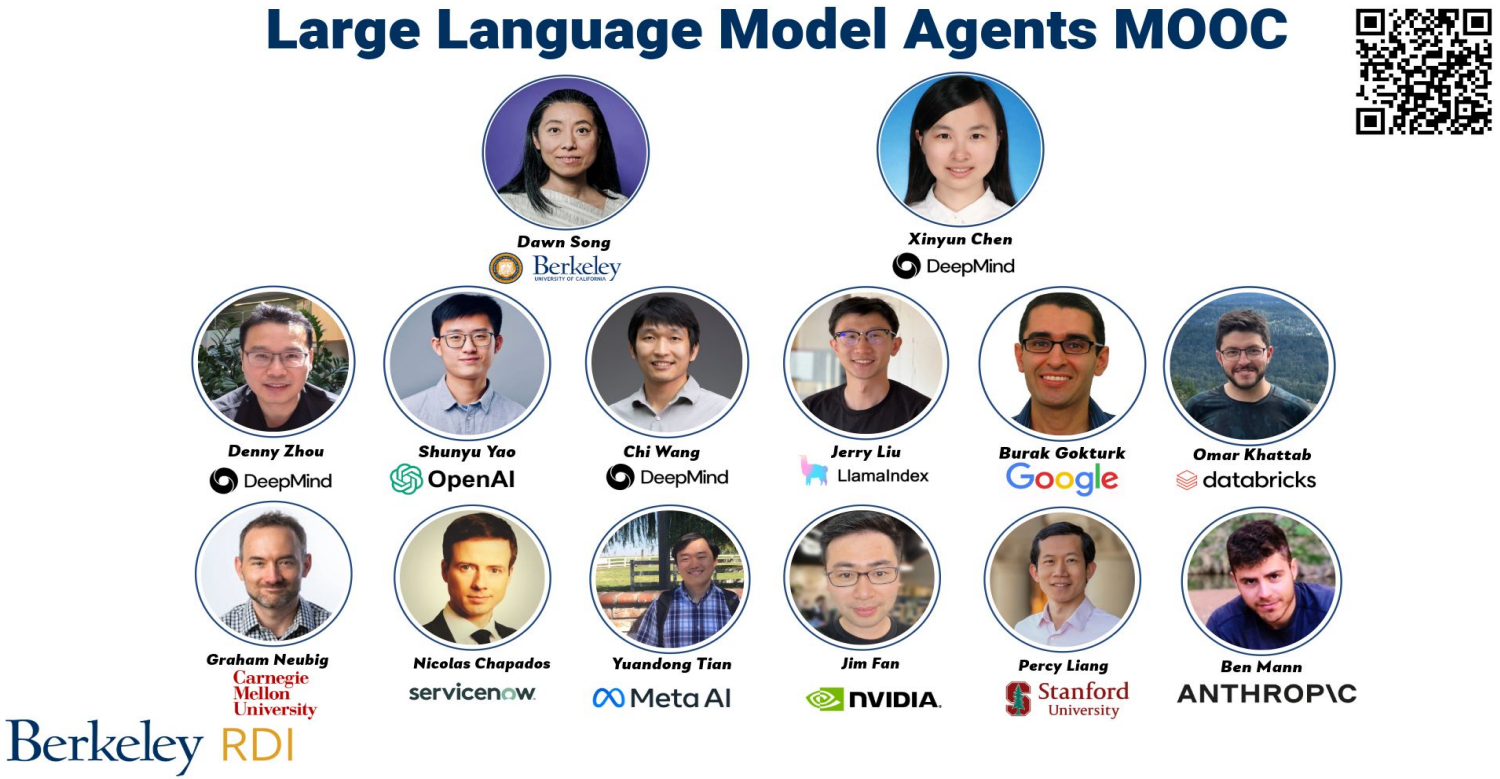
CS 294/194-280:
Advanced Large Language Model Agents

Teaching Staff

- **Instructor: Prof. Dawn Song**
- **(guest) Co-instructors: Dr. Xinyun Chen, Dr. Kaiyu Yang**
- Head TA: Alex Pan
- Readers: Tara Pande, Ashwin Dara, Jason Yan

Fall 2024: broad coverage of topics about LLM agents



https://llmagents-learning.org/f24

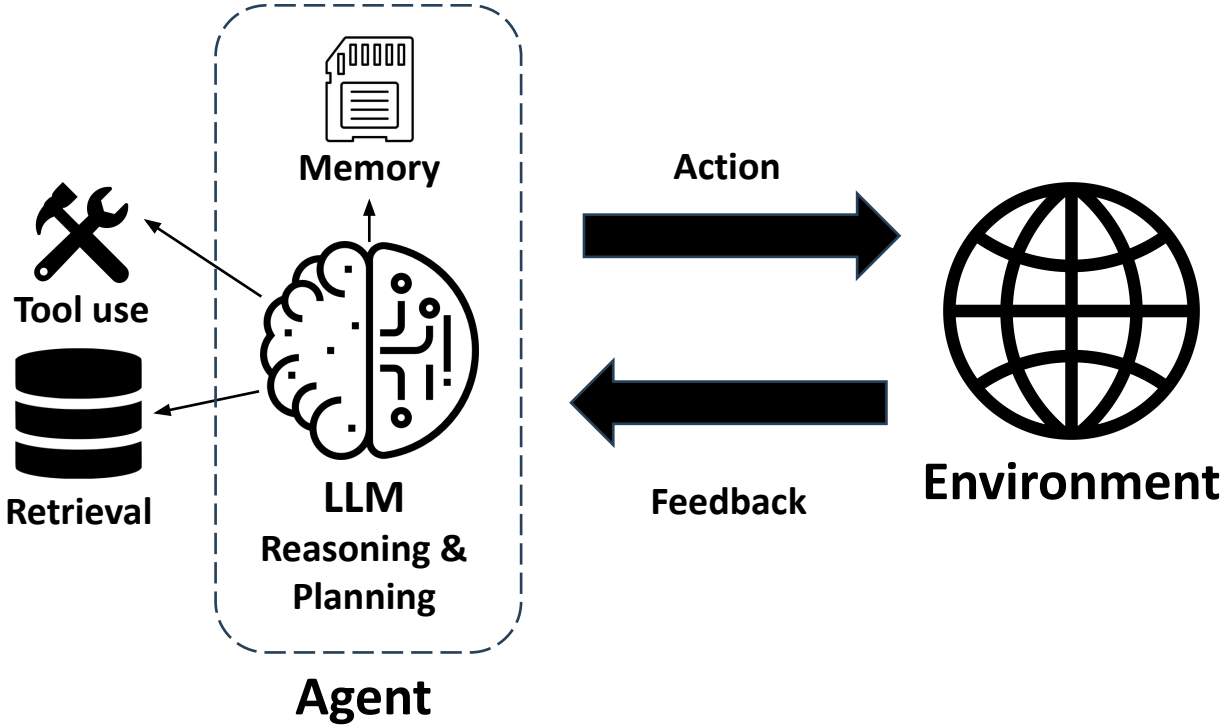
Fall 2024: LLM Agents MOOC Hackathon Overview

- **Participation**: Close to 3000 developers and AI enthusiasts from around the globe
- **Five Tracks**:
  - Applications: Build cutting-edge LLM agents
  - Benchmarks: Create innovative AI agent evaluation benchmarks
  - Fundamentals: Strengthen core agent capabilities
  - Safety: Address critical safety challenges in AI
  - Decentralized & Multi-Agents: Push the boundaries of multi-agent systems
- **Sponsorship**: Supported by industry leaders such as OpenAI, Google, AMD, Intel, and Amazon with more than $200,000 in prizes and resources.
- *Hackathon winners to be announced very soon*

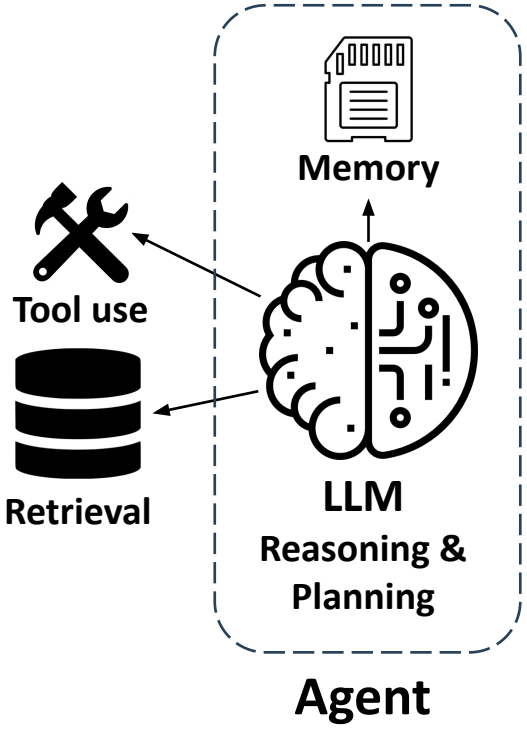
Partners & Sponsors

OpenAI Google AI AMD Lambda intel. tiber. AI Cloud Open Philanthropy Schmidt Sciences SIERRA ORBY Enterprise AI Automation. No Rules. servicenow amazon science

LLM agents: enabling LLMs to interact with the environment

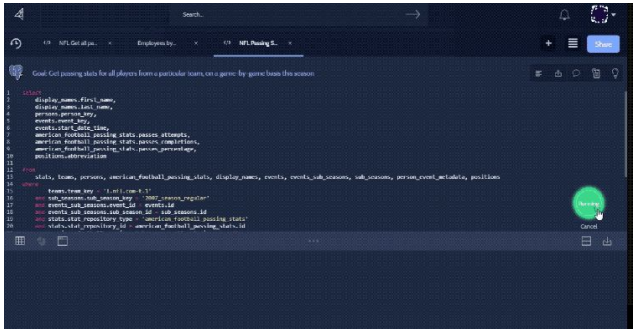


Why empowering LLMs with the agent framework



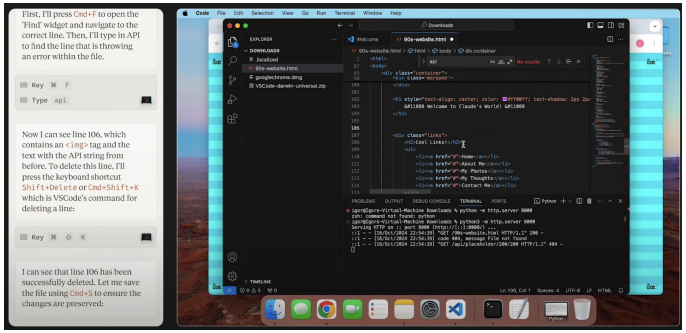
- Solving real-world tasks typically involves a trial-and-error process
- Leveraging external tools and retrieving from external knowledge expand LLM's capabilities
- Agent workflow facilitates complex tasks
  - Task decomposition
  - Allocation of subtasks to specialized modules
  - Division of labor for project collaboration
  - Multi-agent generation inspires better responses

LLM agents transformed various applications



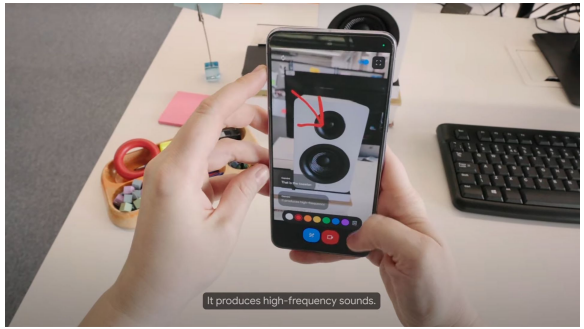
Code generation

Cursor, GitHub Copilot, Devin, Google Jules…



Computer use

Anthropic Claude, Google Jarvis, OpenAI Operator



Personal assistant

Google Astra, OpenAI GPT-4o,…

Robotics

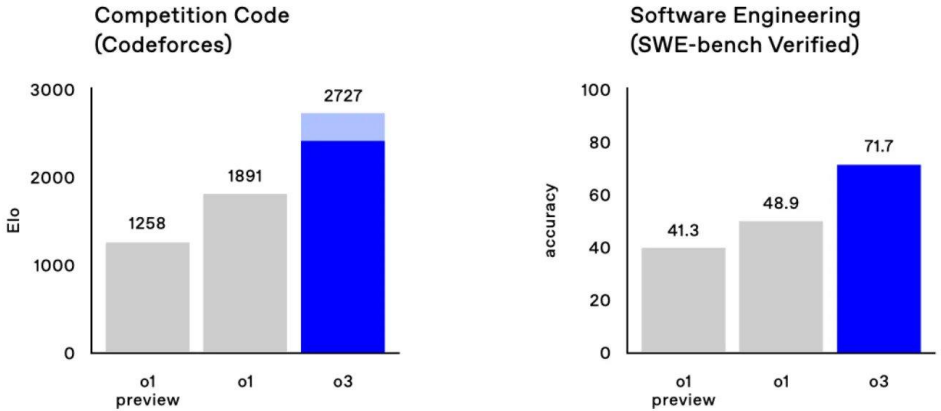
Figure AI, Tesla Optimus, NVIDIA GR00T…

- Education
- Law
- Finance
- Healthcare
- Cybersecurity

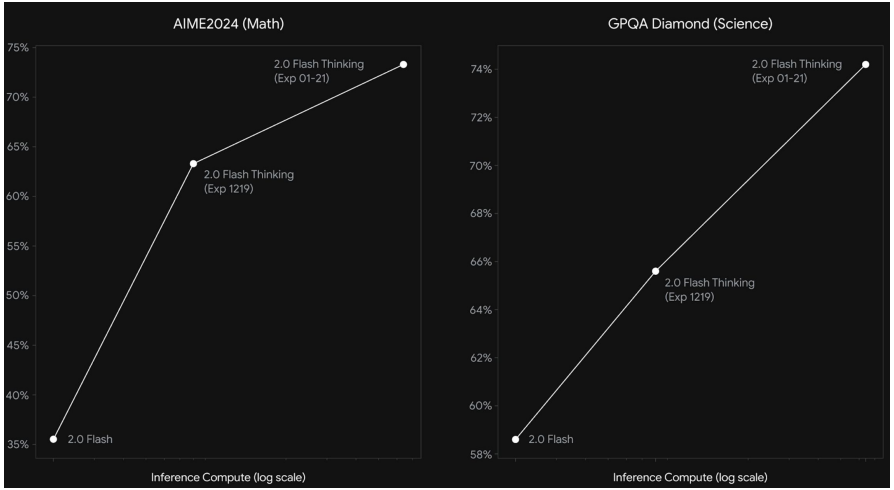
…

Recent rapid progress of reasoning models

- Sep 2024: OpenAI o1
- Dec 2024: Gemini 2.0 Flash Thinking, OpenAI o3
- Jan 2025: DeepSeek-R1, Kimi k1.5

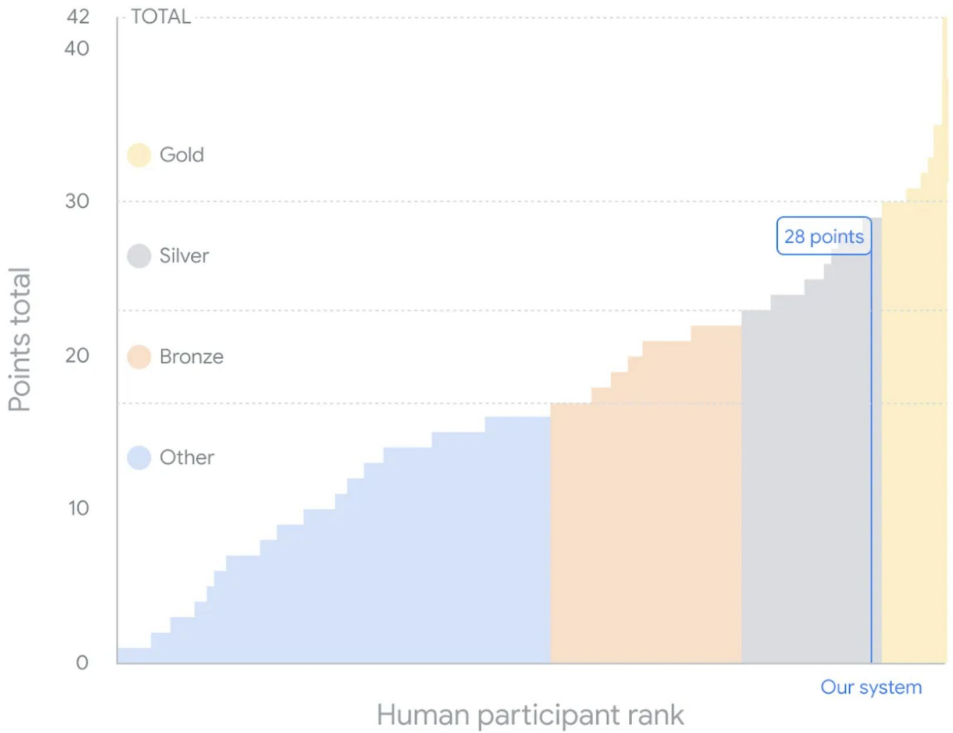


Progress from o1 -> o3

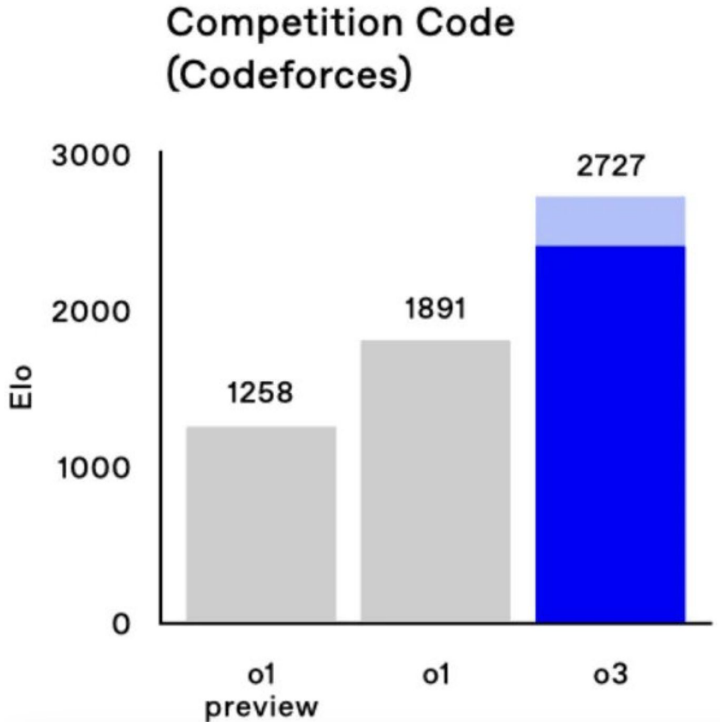


Progress from Gemini Thinking 1219 -> 0121

Impressive performance on competitive math and coding



Google DeepMind AlphaProof and AlphaGeometry 2 achieve silver-medal performance in IMO 2024



OpenAI o3 is ranked top 200 in Codeforces competitive programming contests

Topics covered in this course

- Fundamental reasoning techniques
  - Inference-time techniques
  - Training techniques
  - Search and planning
- LLMs for software engineering
  - Code generation
  - Code verification
  - Web applications
- LLMs for mathematics
  - Fundamental training techniques
  - Autoformalization and theorem proving
- Agentic workflows, real-world applications
- Safety and ethics

Course Work

- Weekly reading assignments & take-home quizzes
  - Due midnight PT Sunday before the next Monday's lecture
- 1 hands-on lab (released later in the semester)
- Semester-long course project
  - Applications Track
  - Research Track

Grading

lecture attendance & weekly readings/quizzes

+

- 1 unit: article about the topic of a lecture (at least 2 pages)
- 2 units: lab + project (implementation not required)
- 3 units: lab + project with implementation
- 4 units: lab + project with significant implementation and end-to-end demo

Grading

	1 unit	2 units	3/4 units
Participation	40%	16%	8%
Reading Summaries & Q/A	10%	4%	2%
Quizzes	10%	4%	2%
Article	40%		
Lab		16%	8%
Project			
Proposal		10%	10%
Milestone 1		10%	10%
Milestone 2		10%	10%
Presentation		15%	15%
Report		15%	15%
Implementation			20%

Class Project

- Applications Track:
  - 3-4 students per group
  - Focus on applied use cases of LLMs
  - Does not necessarily need to contribute novel research
- Research Track:
  - 2-3 students per group
  - Conduct novel research under the supervision of postdocs and graduate students
  - Goal of publishing in a workshop or conference
  - Students must apply to participate via a forthcoming Google Form

Timeline

	Released	Due
Project group formation	1/27	2/17
Project proposal	2/3	2/17
Project milestone #1	2/17	3/24
Project milestone #2	3/24	4/28
Lab	3/31	4/28
Project final presentation	4/28	5/9
Project final poster	4/28	5/9
Project final report	4/28	5/16

Course Website

https://rdi.berkeley.edu/adv-llm-agents/