Introduction to Agentic AI

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Instructor Information

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- No Teams message, please.

TA Information

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- Office hours: TBA

- Duty:
  - Help with hands-on lectures and grade assignments;
  - Work with students on learning questions and projects.

Learning Strategy: A Top-Down Approach

https://www.youtube.com/watch?v=F3EmKJMaWe4

Thinking Generative AI as A Student with GPA 3.9

- Treat LLM as a student, but use it as an “expert simulator” (knowledge base).
- LLM requires clear, fine-grained, and complete information as the prompt to give you high-quality feedback.
- You need to have accurate logic and a specific mind for the problem to solve when giving your prompts. (**You are the teacher**)
- Multi-round interaction and feedback.
- Do not think LLM can read your mind. Communication is important.

Be Careful about Top-Down Approach

- Generative AI tools can hallucinate
  - Training data can be dirty
  - The model is inherently probabilistic
  - Fine-tuning method encourages hallucinating

- Top-down approach with guidance
  - This course requires finishing a project by independently learning unfamiliar concepts and coding, with the help of instructor/TA, online resources and generative AI tools such as NotebookLM.
  - PhD training is a good way to execute the Top-Down Approach with necessary guidance and feedback.

Talk More About Education

- Alexandr Wang, born in Jan. 1997
  - Meta's chief AI officer since 2025
  - Co-funder of Scale AI
  - Dropped out of MIT

- His family education is excellent
  - His parents are physicists at the Los Alamos National Laboratory
  - His two brothers all have PhD degrees
  - He qualified for the Math Olympiad Program in 2013, the US Physics Team in 2014, and was a USACO finalist in 2012 and 2013

My opinion: university education and guidance (beyond knowledge) are still necessary if we do not have professional guidance from other sources.

https://en.wikipedia.org/wiki/Alexandr_Wang

The History of Artificial Intelligence

- AI is not just machine learning, deep learning or large language models.

- AI Agent, as a subfield of AI, exist from last century, around 80's.

1.2 The Foundations of Artificial Intelligence ... 5
1.2.1 Philosophy ... 6
1.2.2 Mathematics ... 8
1.2.3 Economics ... 9
1.2.4 Neuroscience ... 11
1.2.5 Psychology ... 12
1.2.6 Computer engineering ... 14
1.2.7 Control theory and cybernetics ... 15
1.2.8 Linguistics ... 16
1.3 The History of Artificial Intelligence ... 17
1.3.1 The inception of artificial intelligence (1943--1956) ... 17
1.3.2 Early enthusiasm, great expectations (1952--1969) ... 18
1.3.3 A dose of reality (1966--1973) ... 21
1.3.4 Expert systems (1969--1986) ... 22
1.3.5 The return of neural networks (1986--present) ... 24
1.3.6 Probabilistic reasoning and machine learning (1987--present) ... 24
1.3.7 Big data (2001--present) ... 26
1.3.8 Deep learning (2011--present) ... 26
1.4 The State of the Art ... 27
1.5 Risks and Benefits of AI ... 31
Summary ... 34
Bibliographical and Historical Notes ... 35

Chapter 2 Intelligent Agents ... 36

2.1 Agents and Environments ... 36

https://studylib.net/doc/25618289/full-table-of-contents-for-ai--a-modern-approach

AI Agent: Traditional Agent and LLM Agent

- AI Agents include both traditional AI agent and modern LLM Agent
- Traditional AI Agent

- Modern LLM Agent

ICLR
International Conference On Learning Representations

- To avoid argument, Andrew Ng calls it **Agentic AI**

Agentic AI, AI Agent and Agentic Workflow

- Agentic AI is the **framework**; a broader concept of solving issues with limited supervision. (e.g., Smart Home System)

- AI agents are the **building blocks** within the framework; a specific component within that system that is designed to handle tasks and processes with **a degree of autonomy**. (e.g., Smart Light)

- Agentic workflows are structured, **predefined sequences** of AI steps for predictable tasks (more deterministic).

Generative AI and Agentic AI

- Generative AI: creates new content such as text, images, music, or code by learning patterns from vast amounts of existing data.

- Agentic AI: using a digital ecosystem of LLM, ML, NLP to perform autonomous tasks on behalf of the user or another system.

- Agentic AI is focused on decisions as opposed to creating the actual new content and does **not solely rely on human prompts** nor require human oversight.

LLM and Agentic AI

- Large language models (as the Brain)
  - GPT-like (also called *auto-regressive* Transformer models)
  - BERT-like (also called *auto-encoding* Transformer models)
  - T5-like (also called *sequence-to-sequence* Transformer models)
- Autoregressive: language model generates text by predicting the next token based on previous tokens

- While LLMs have enabled more natural interactions, Agentic AI takes it a step further by allowing **OBJECT(Agent)** to make decisions, plan actions, and adapt to changing environments.

LLM and Agentic AI: An NPC Example

- With an LLM: the NPC responds to your questions in a more natural, varied way. But the NPC remains static, it won't act unless you do something first.
- With Agentic AI: the NPC can decide to go look for help, set a trap, or avoid you completely.
- We are moving from scripted responders to autonomous actors within the game world.

NPC, Non-player character, https://learn.microsoft.com/en-us/minecraft/creator/documents/npcdialogue?view=minecraft-bedrock-stable

Agentic AI Empowers NPCs

- **Autonomy**: Making independent decisions based on the game state.
- **Adaptability**: Adjusting strategies in response to player actions.
- **Persistence**: Remembering past interactions to inform future behavior.

This shift means NPCs can now directly interact with their environment through goal-directed behaviors, ultimately leading to **more dynamic and unpredictable gameplay.**

Agentic AI: New Software Era

Software 1.0

computer code

↓ programs

computer

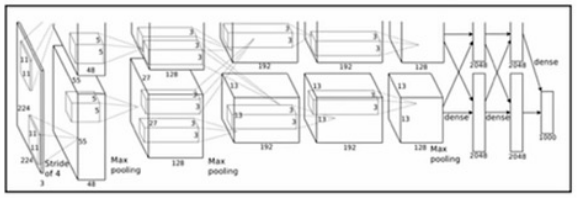
became programmable in **~1940s**

Software 2.0

weights

↓ programs

neural net



fixed function neural net

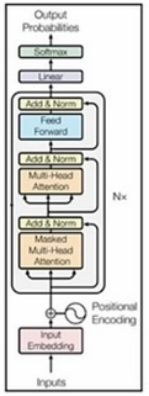
e.g. AlexNet: for image recognition (**~2012**)

Software 3.0

prompts

↓ programs

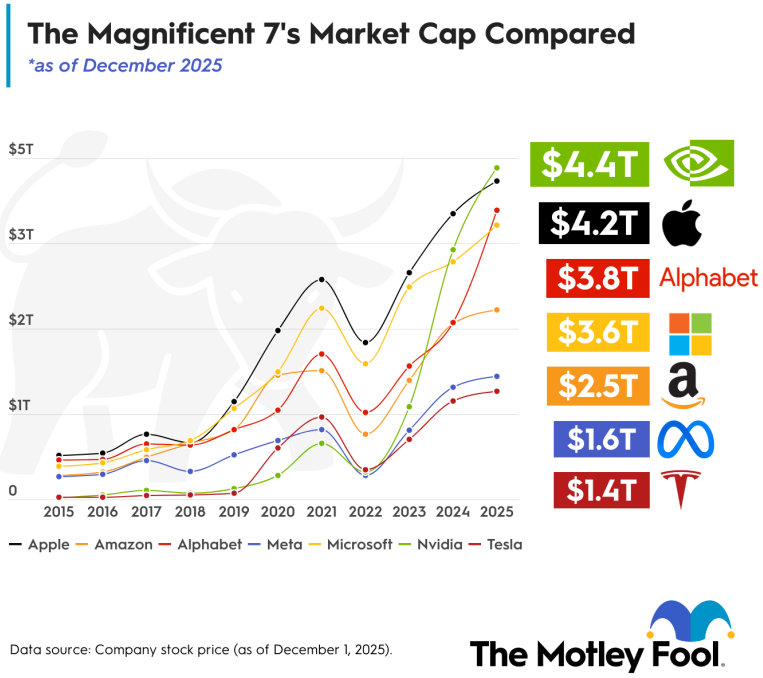
LLM

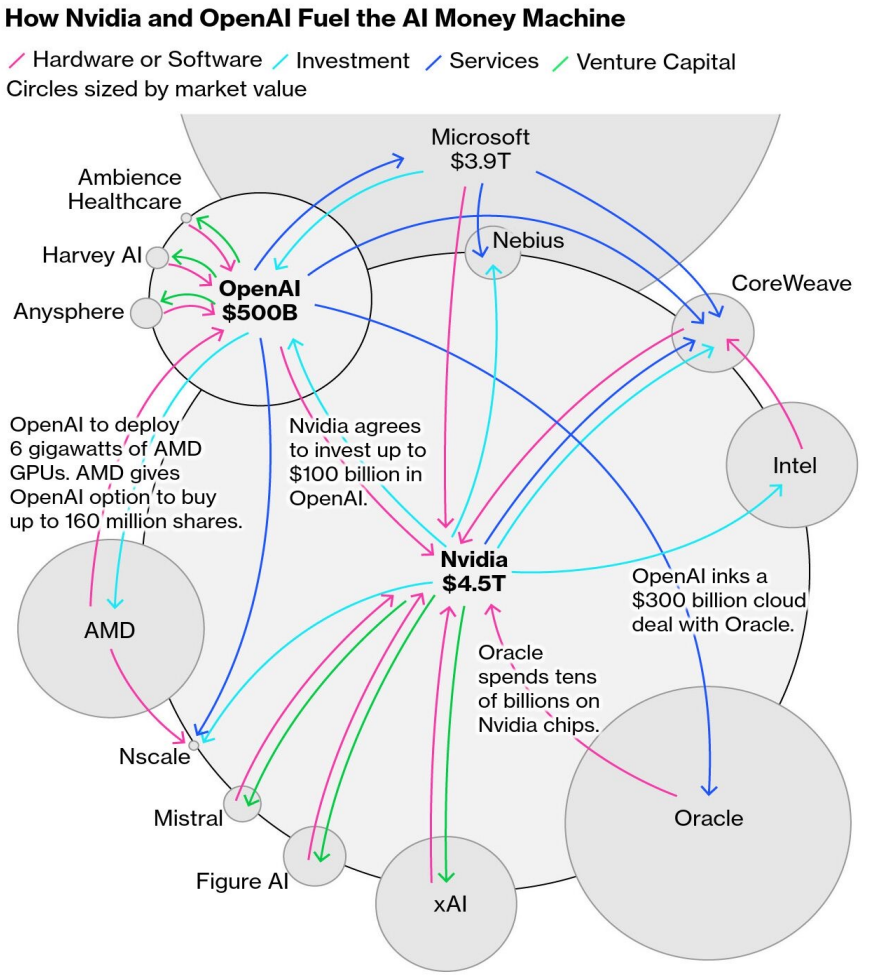


~2019

Image from Andrej Karpathy, Co-founder of OpenAI, PhD from Stanford, Advised by Feifei LI

Industrial Investment





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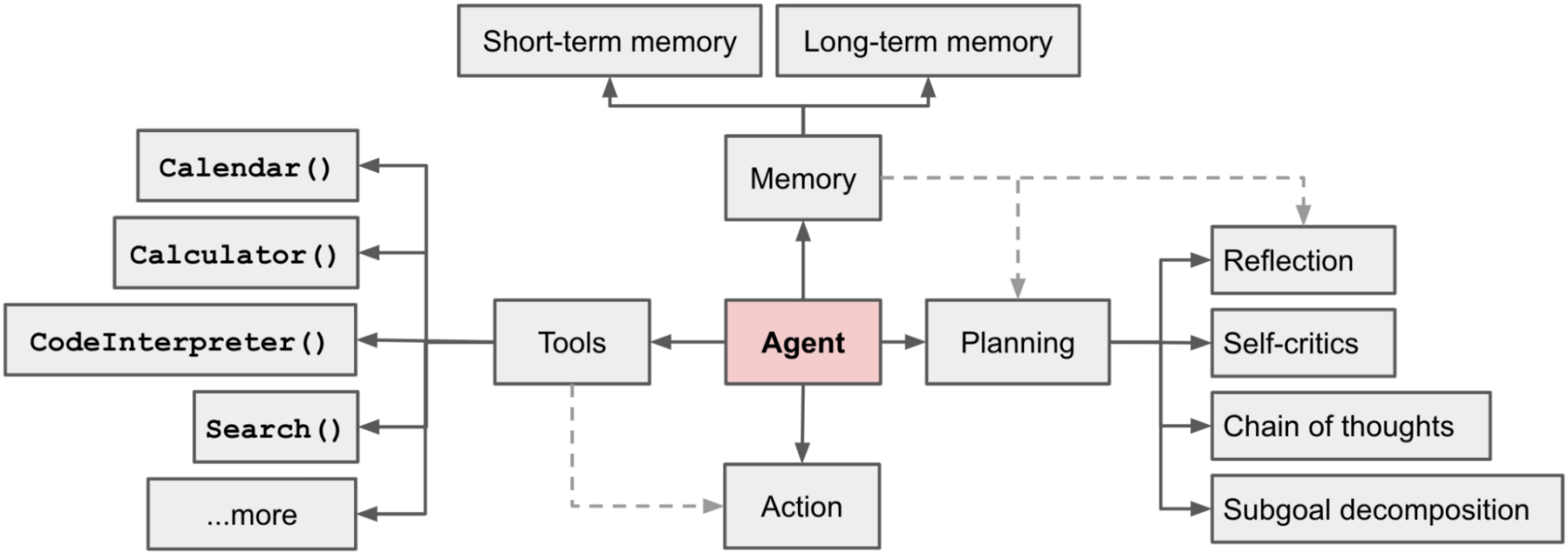
[2] https://www.bloomberg.com/news/features/2025-10-07/openai-s-nvidia-amd-deals-boost-1-trillion-ai-boom-with-circular-deals

Agentic AI: LLM Agent



Agentic AI: Vibe Coding

- Use natural language prompts to guide large language models to generate, refine, and debug entire code.

- When “I” gets error messages “I”just copy paste them in with no comment, usually that fixes it.

- Sometimes the LLMs can't fix a bug so “I” just works around it or ask for random changes until it goes away.

“I” from Andrej Karpathy: https://x.com/karpathy/status/1886192184808149383

Agentic AI Extends Automation

Agentic AI ?=? repeated LLM API calls + memory + the ability call other pieces of code (Tool)

Agentic AI ?=? Vibe Coding

The benefit of using agentic design is to automate the complex task that requires reasoning.

CS/AI Changing Fast! You Need Top-Down Training!

- New programmable layer of abstraction to master, in addition to traditional layers.
  - agents, subagents, their prompts, contexts, memory, modes, permissions, tools, plugins, skills, hooks, MCP, workflows, IDE integrations

- Powerful alien tools are handed around except it comes with no manual and everyone has to figure out how to operate it;

- Build an all-encompassing **mental model** for the strengths and pitfalls of fundamentally stochastic, fallible, unintelligible and changing entities suddenly intermingled with what used to be good old-fashioned engineering.

https://x.com/karpathy/status/2004607146781278521

Some Reminders about the Course

- Cover both the theory and practice of agentic AI, while avoiding overemphasis on the details of any single framework;
- Use the concepts you learn in this course in your own projects, using any framework you like;
- **First Day Attendance Assignment.**

Time to Talk about Syllabus

- Two Versions:
  - Undergraduate Version
  - Graduate Version (with extra Take-home Final Exam)

- Totally New Course
  - Comprehensive content
  - No textbook available
  - Hybrid students: Undergraduates, Master's, PhD students