

# Building Software with Agentic Components

csci 7000-005  
Mon/Wed @5:05pm

Danny Dig





**Have you received the welcome email I sent yesterday?**

- ⓘ The Slido app must be installed on every computer you're presenting from



**What do you most want to get out of today's class?**

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# Today's goals

Why learn how to build agents?

What is Agentic AI: practice and research examples

Discovery: learning about each other (Family Occupation Recreation Motivation), expectations

How can I be successful in CSCI 7000-005?

# Why this course now?

LLMs are no longer just:

- Chatbots
- code generators

They are increasingly embedded as:

- Long running services
- Tool-using systems
- Autonomous components

**Are we actually building software, or just demos?**

# Industry reality check

THE © AI  
SUMMIT  
NEW YORK



# Industry reality check

THE ©AI  
SUMMIT  
NEW YORK

## When AIs Team Up: The Rise of the Multi-Agent Stack

📍 Next Generation Stage | 25 mins



## The Enterprise Agent Factory: Building Scalable, Governed AI Systems

📍 Data Excellence Stage | 25 mins



## Creating Delightful Customer Experiences with Voice AI Agents

📍 The AI Playground | 15 mins



## From Assistants to Autonomy: The Rise of AI Workers

📍 AI at Scale Stage | 25 mins



## Under the Hood of The World's Most Advanced AI Data Agent

📍 Data Excellence Stage | 25 mins



## Panel: C-Suite Perspectives on Human-Centered Agentic AI

📍 Headliners Stage | 40 mins



## Panel: Rise of the AgentOps Stack: Building for Autonomy at Scale

📍 Next Generation Stage | 40 mins



## How to Build Trustworthy, High-Quality AI Agents with MLflow

📍 Workshop Room | 60 mins



## Managing the Machines That Manage Themselves: Executive Perspectives on Agentic AI

📍 VisionAIres VIP Lounge | 40 mins



## Building Smarter AI Agents with Azure Databases

📍 Data Excellence Stage | 25 mins



## Lightweight, Heavy Impact: Leveraging Software Design Principles for Multi-Agent AI Systems

📍 Data Excellence Stage | 25 mins



## Accelerating AI adoption in the enterprise: ensuring trust through governed agentic AI

📍 Headliners Stage | 25 mins



## Precision Engagement: How Agentic AI and Predictive Models Cut Through the Pharma Noise

📍 The AI Playground | 15 mins



## The Autonomous Advantage: Unleashing Your Agentic AI Future in Life Sciences & Healthcare

📍 Health & Pharma Stage | 25 mins



## The Agentic Era: What's Really Driving Enterprise AI Adoption

📍 Headliners Stage | 25 mins



## From Pilots to Production - Scaling AI Agents in Regulated Environment

📍 Finance Stage | 25 mins



## Agentic Commerce and the Future of the AI Economy

📍 Data Excellence Stage | 20 mins

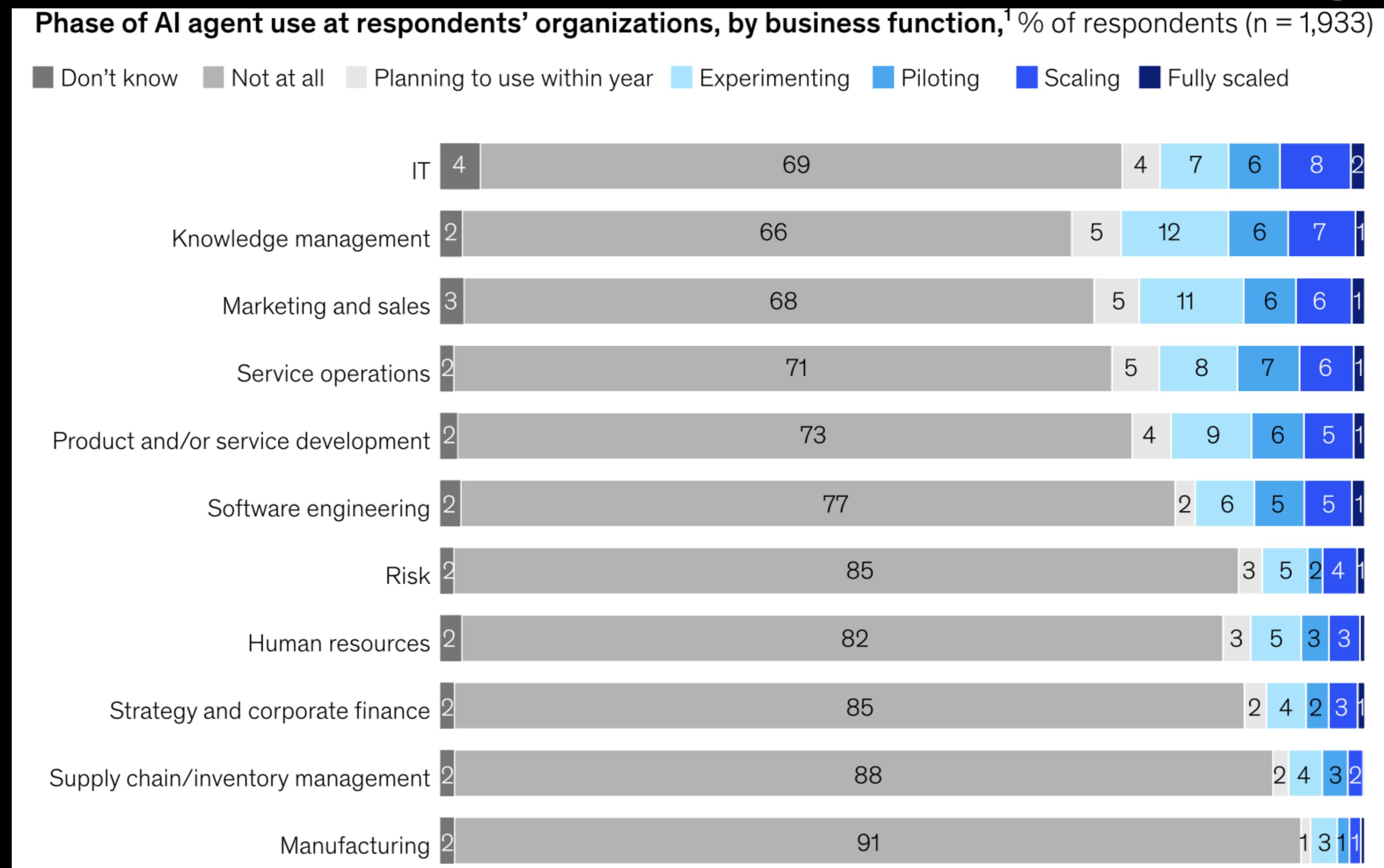


## From Workflows to Agents: Transforming Financial Operations

📍 Finance Stage | 25 mins



# Industry reality check: phase of AI agent use



Source: McKinsey Global Survey on the state of AI, 1,993 participants at all levels of the organization, June 25–July 29, 2025



**Where have you personally seen agent-like systems in the wild?**

- ⓘ The [Slido app](#) must be installed on every computer you're presenting from



**Have you used any AI-powered tools in your coding projects?**

ⓘ The [Slido app](#) must be installed on every computer you're presenting from

slido



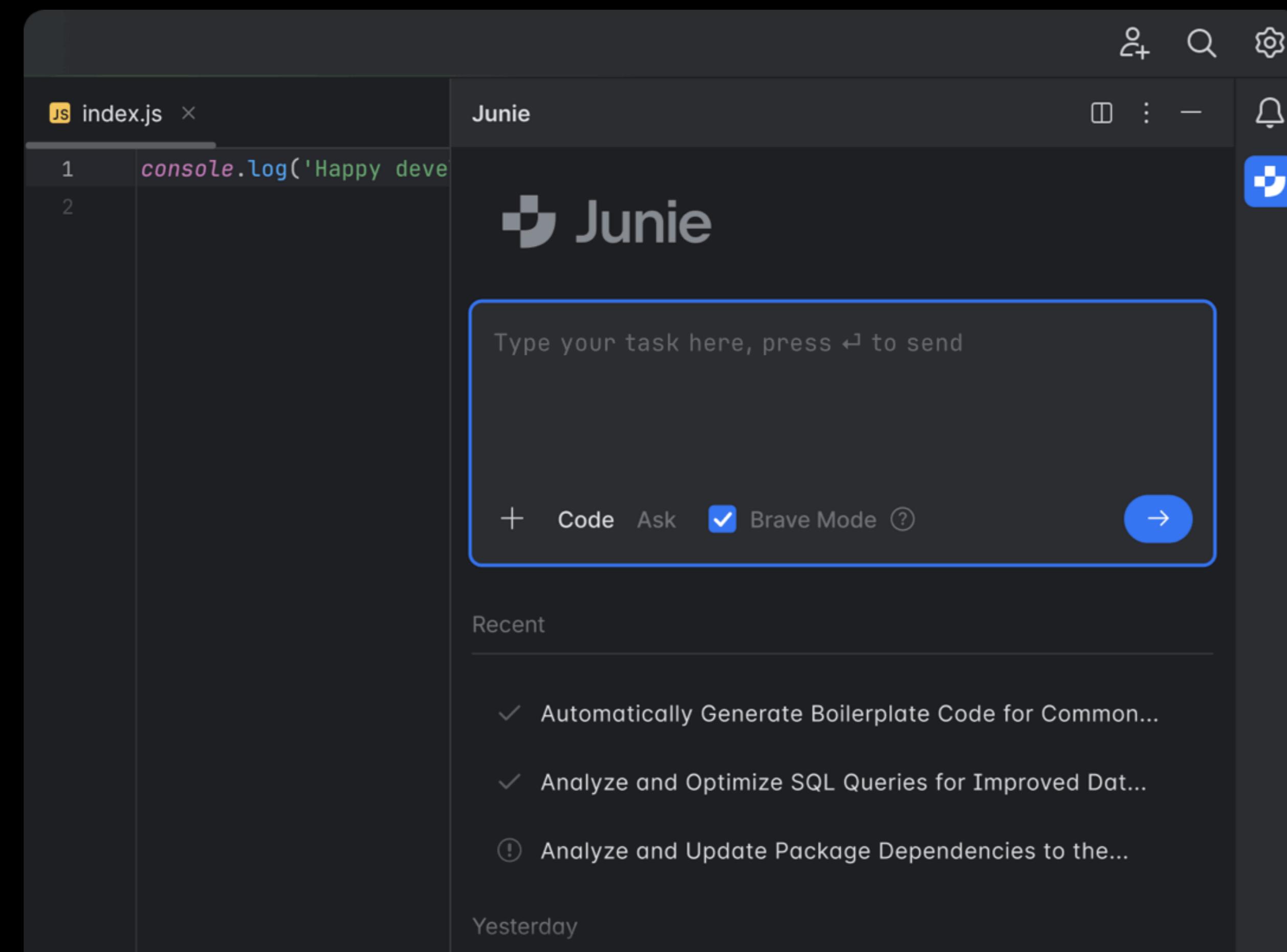
## Which GenAI tools and services did you use for programming?

- ⓘ The Slido app must be installed on every computer you're presenting from



# Smart coding agent in the IDE

Lighten programmer's load





# Code and ASK mode

Lighten programmer's load

The screenshot shows the Junie app interface. At the top, there is a search bar with the text "What\_neural\_network\_model\_works" and a "Junie" logo. The main content area displays a search result for "Neural Network Models for Pose Detection in Low Light Conditions". The result includes a brief description, a list of "Best Options for Low Light", and a detailed section on "MoveNet Thunder" and "BlazePose". A "Response to Your Question" section is present, along with an "Open in Editor" button and a "Brave Mode" toggle. A "Write follow up here" input field is at the bottom, and a navigation bar with "Code" and "Ask" buttons is at the very bottom.

What\_neural\_network\_model\_works Junie

← Web App for Automatic Kettlebell Jerk Rep Tracking

Neural Network Models for Pose Detection in Low Light Conditions

Based on the analysis of the project and current research in pose detection, here are the best neural network models for pose detection in low light conditions that are...

1. **MoveNet Thunder** - Already integrated into TensorFlow.js

- More accurate than Lightning
- Better performance in challenging environments
- Slower but more robust for low light
- Fully compatible with the current Junie API

2. **BlazePose** - Available in TensorFlow.js

- Specifically designed for mobile devices
- Higher accuracy in challenging environments
- Supports 33 keypoints (vs. 17)
- Compatible with TensorFlow.js

Response to Your Question

# Neural Network Models for Pose Detection in Low Light Conditions with TensorFlow.js

Based on the analysis of the project and current research in pose detection, here are the best neural network models for pose detection in low light conditions that are...

Open in Editor

Write follow up here

Code Ask  Brave Mode

# Research Examples: Agentic AI for SE

# AI Agents and Planning @JetBrains

**Objective:** advancing technologies around AI agents with the focus on locality

Infrastructure:

- Platform IDEFormer

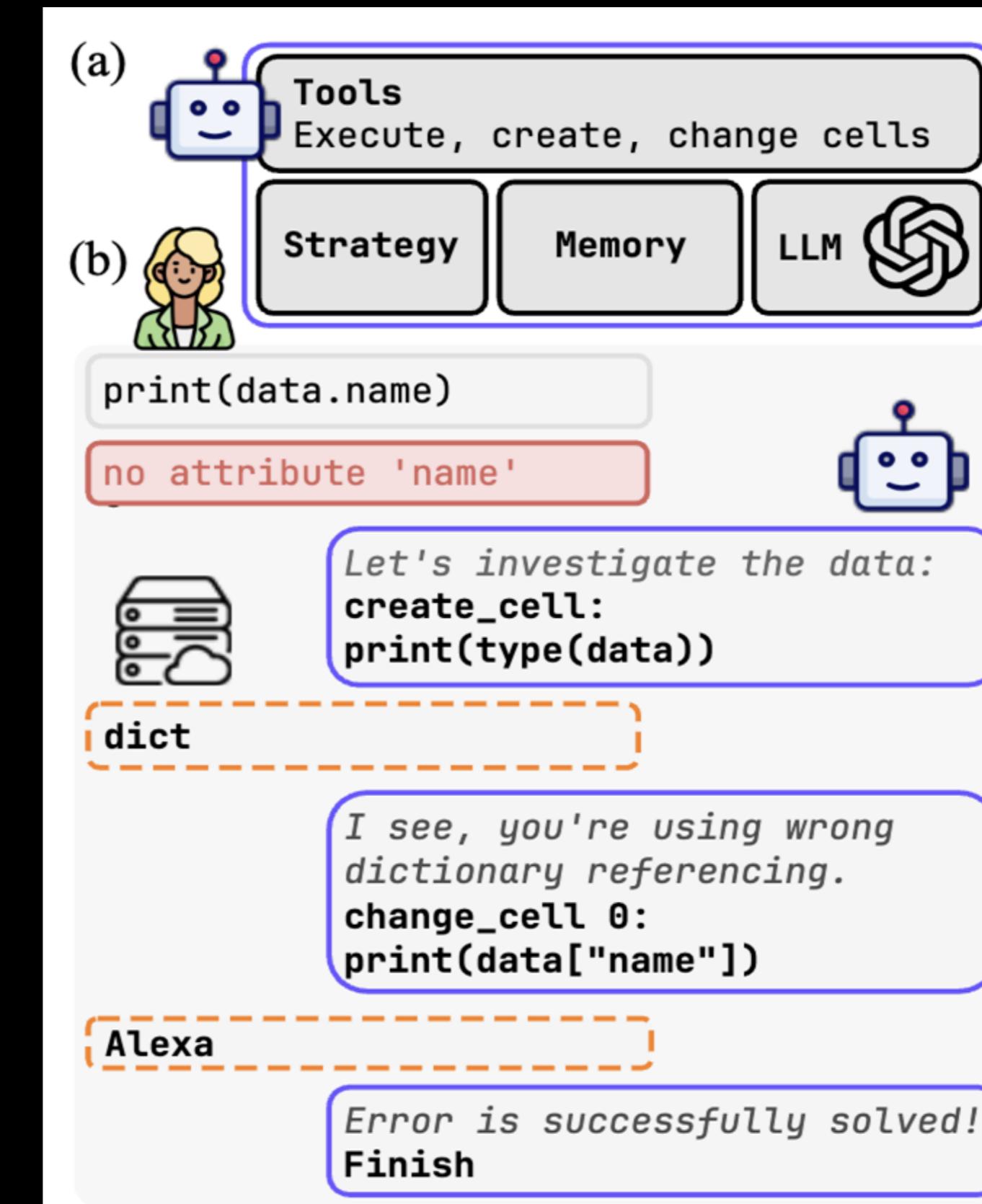
Agents:

- Debugging
- Environment Setup

Research:

- RL to tune models for Environment Setup
- Distillation for on-device models for SWE-agents

# Notebook Debugging (Grotov *et. al*, 2024)

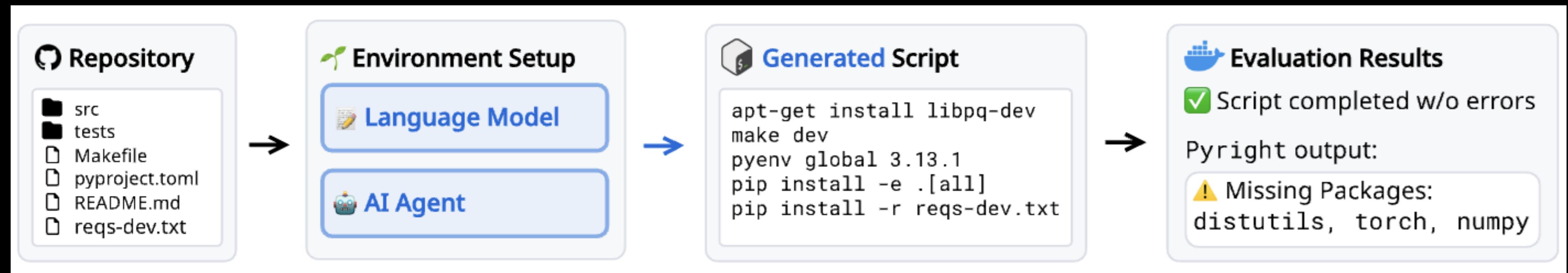


"Debug Smarter, Not Harder: AI Agents for Error Resolution in Computational Notebooks" [EMNLP 2024](#)



# Setting up Environment (Eliseeva *et. al.*, 2024)

EnvBench: A Benchmark for Autonomous Environment Setup



# Coordinated Refactoring Agent (Bellur *et al.*, 2025)

Developers perform more than 50% of refactorings in clusters:

- e.g., 243 renames in a single commit in Apache Flink
- time consuming: ~30 minutes to perform cluster rename

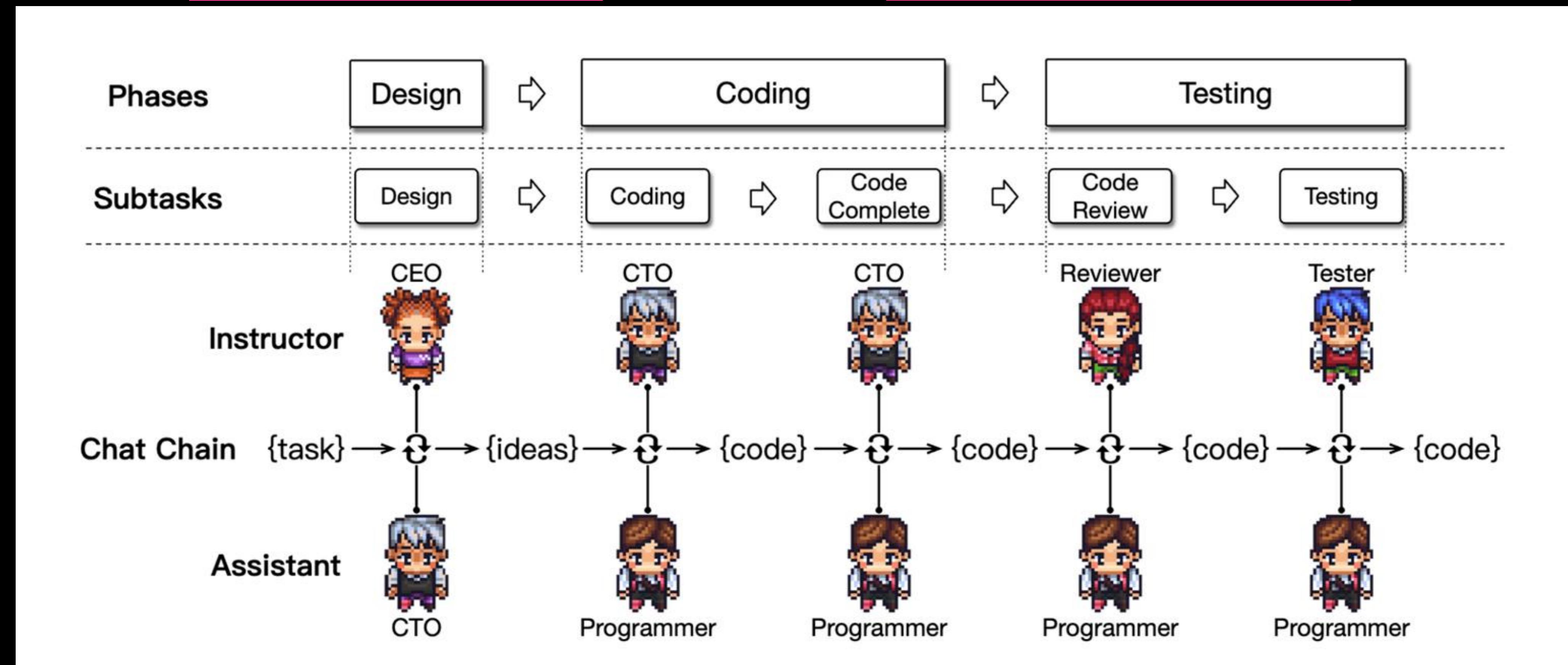
Multi-agent solution with **human in the loop**

Evaluating quality:

- Replicated 1500+ OSS refactorings, improvement over best baseline is **3x**
- **Patches** accepted in open-source projects
- **human in the loop** is crucial to reduce cascading errors by **4x**

# ChatDev (Chen et al., 2024)

+ MetaGPT (Hong et al., 2024), AgileCoder (Nguyen et al., 2024), etc.

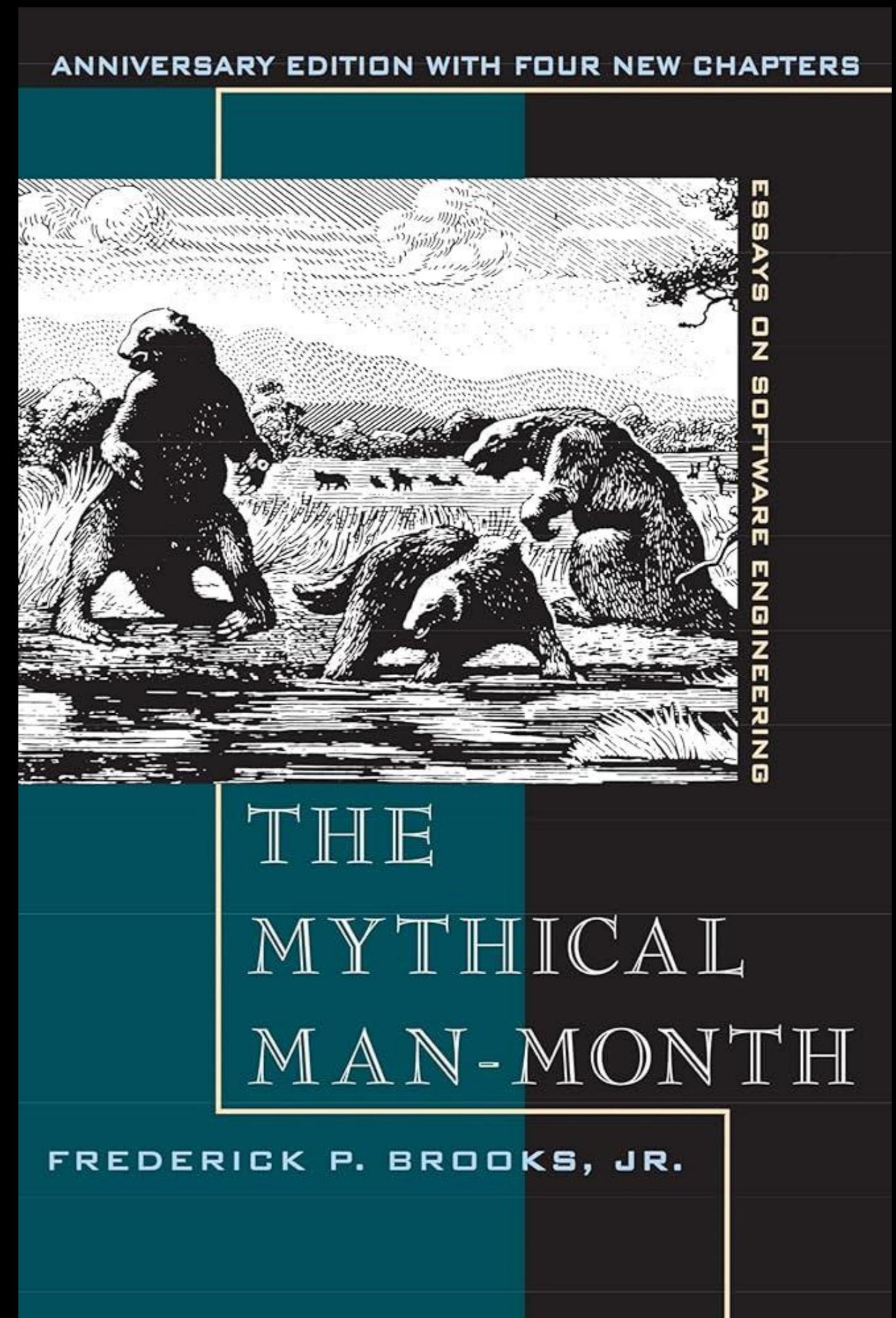


# Why learn to Build AI Agents?

**Essential vs accidental complexity**

**Because agents introduce new software problems**

- Control flow you don't fully own
- State that evolves unpredictably
- Non-deterministic behavior
- Expensive failures at scale



# Course Thesis

**Agents are not prompts.**

**Agents are architectural commitments.**

LLMs are components, not systems

Autonomy increases both power *and* risk

Robust agents require discipline

# What is Agentic AI?

A system is agentic if it:

- Has goals
- Acts in an environment
- Uses tools
- Maintains state
- Operates over time
- Adapts based on feedback

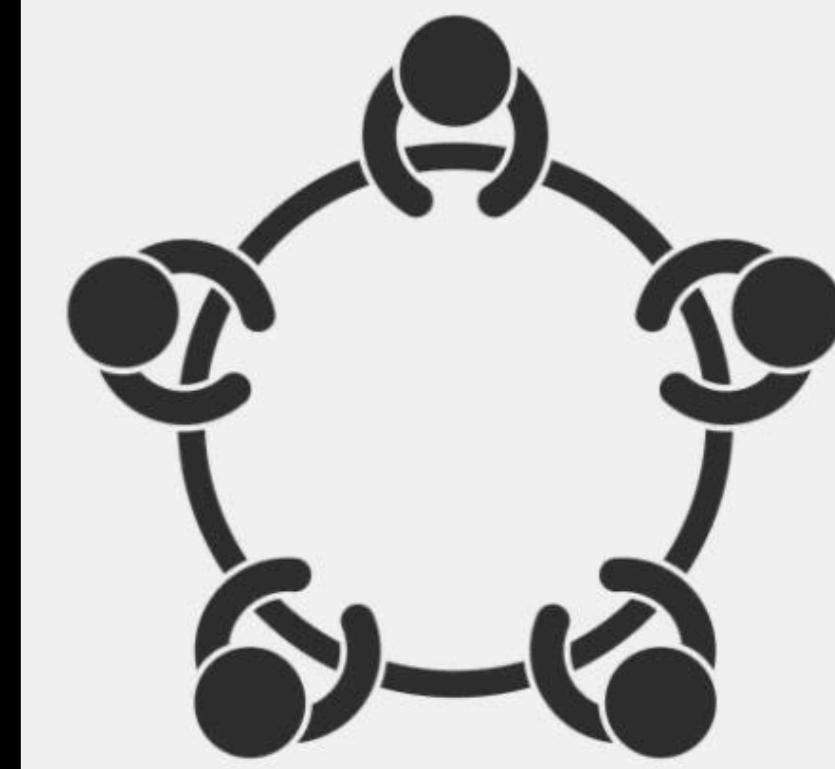
# Getting to know you

# Quiz: About YOU

Your name

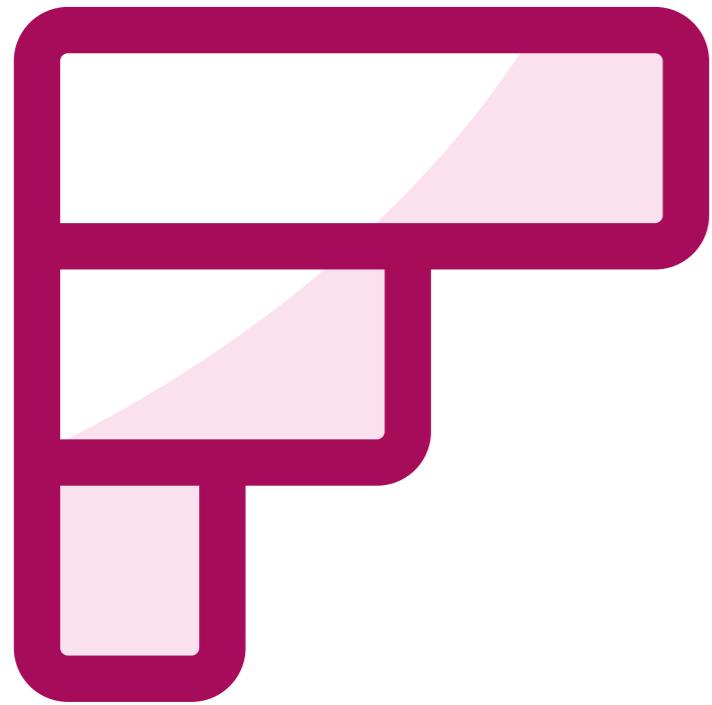
- **FORM** (family, occupation, recreation, motivation)
- **Grad Program** (e.g., CS PhD, MS, MSCP, etc.), year of study, who is your grad advisor
- Your **background** (e.g., industry experience, other CS background – such as strong SE, ML/AI, Systems, etc.)
- What is the **ONE** Thing that you **expect** to take out of CSCI 7000-005?

What are your plans **post graduation**?



# What are your expectations from CSCI 7000-005: Building AI Agents?

- A. Do a cool Agentic Project that helps programmers/society
- B. Learn about exciting Agentic Applications for SE
- C. Exposure to research on Agentic AI for SE
- D. Learn about the Challenges in building Agentic software
- E. Learn how Agentic software differs from classical software
- F. How and when to build agentic systems
- G. Future-proof my SE career
- H. How to scale agentic systems
- I. Understand agents infrastructure
- J. How to integrate agents with existing applications



**Rank these topics based on what you want to learn most in this course.**

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# Course Administration

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**Check webpage:**

**[https://danny.cs.colorado.edu/courses/csci7000-005\\_Sp26](https://danny.cs.colorado.edu/courses/csci7000-005_Sp26)**

**Work items due before next class Wed (01/14):**

- Familiarize with class webpage**
- sign up on Piazza (all communications through Piazza, no email after this week)**
- Read and write critiques for two research papers (see template on webpage). Submit on Canvas before 12pm.**

**Check prerequisites: computing background (either practical experience or undergrad-level knowledge of SE, Systems, ML), please check with me after the class**



Boulder

# CS 7000-005 is Different!!!

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**This class is NOT:**

- an introduction to Software Engineering (take instead CSCI 5828)
- a tutorial on GenAI APIs/tools (see free resources on the internet)
- a prompt-engineering class
- a LangChain/MCP tutorial
- a chatbot-building workshop
- an asynchronous course (you need to participate live each class)

**This class IS:**

- a grad level seminar on agentic software systems
- a place to build serious agentic prototypes
- a space for critique and experimentation



Boulder

# CS 7000-005 is Different!!!

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## Research-based course:

- at times it would feel it is not "organized"
- there are lots of choices, you need to select
- structure is fixed, but content is dynamic

Complete a research or industrial-novel project of your choice (teams of 4 students) [50% of grade]

- follow the iterative steps of open-ended/risky research (proposal, fit in literature, evaluate empirically)
- at the end of semester you produced a research paper that you can submit to conference, showcase portfolio
- WHY: equips you to lead **novel R&D**



# Projects on Agentic AI

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**Showcase in your job application portfolio**

**For new grad student, project gives ideas for dissertation**

**For experienced grad student, project advances your research**

**Technological shifts/opportunities for Agentic SE:**

**- any process & tool we use in software development lifecycle (requirements, design, coding, testing, evolution)**

**Academic-research:** generate new insights and knowledge

**Industrial-innovation:** application of established practices to produce a novel agentic software

# CS 7000-005 is Different!!!

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**Participate in **live** class discussion and activities. [10% of grade]**

**Read 1-2 research papers for every class meeting (11 pages each, double column => total of 500+ research pages)**

- later on, you choose papers that match your project**

**Paper Critiques: for each class meeting, for each research paper, submit before class (by 12pm) [20% of grade]**

- WHY: equips you with **critical thinking****

**Research presentation: you prepare and deliver for the selected research papers [20% of grade]**

- WHY: equips you to **communicate** your ideas**



# What Happens Next

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## Next class:

- **What is an agent, really?**
- **Architectures vs prompts**
- **First research paper discussion**

## Before next class:

- **Read the webpage, signup on Piazza**
- **Read two papers**
- **Submit Paper Critique + Questions in Canvas (by Wed at 12pm)**

## Office hours: right after the class



Boulder

## Testimonials

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“The most effective aspects of this course are that Prof Dig challenged students to broaden their GenAI vocabulary and skillset. He used his strengths as a researcher and leader to facilitate great group conversations. I enjoyed the paper presentations where we got to lead class discussions and learn in depth about the topics. **The course workload felt very heavy at times; especially once the group project started.**

... Prof Dig was receptive to hearing feedback and make course adjustments to support our learning and wellbeing. The course content was great, and I am happy with my learnings from this semester.”

**[student from GenAI for SE, Fall'25]**



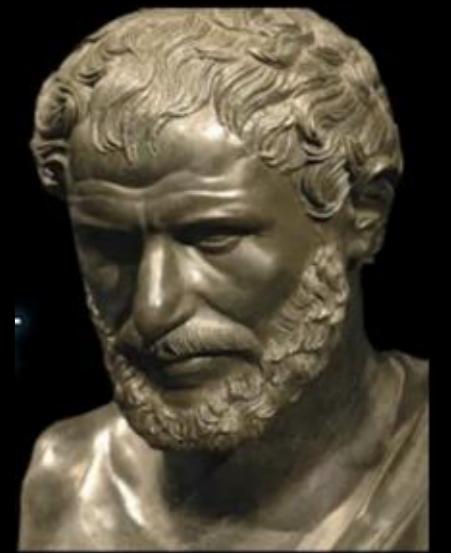
# Executive Summary

Agentic AI + Human

"...Game changer! Enter the AI assistant, the great equalizer." -Lenovo CTO

"AI **will not** displace programmers. But programmers who use AI **will** displace programmers who do not use AI." – Prof Danny Dig

Change is the only guaranteed constant



**Together We Go Further**