

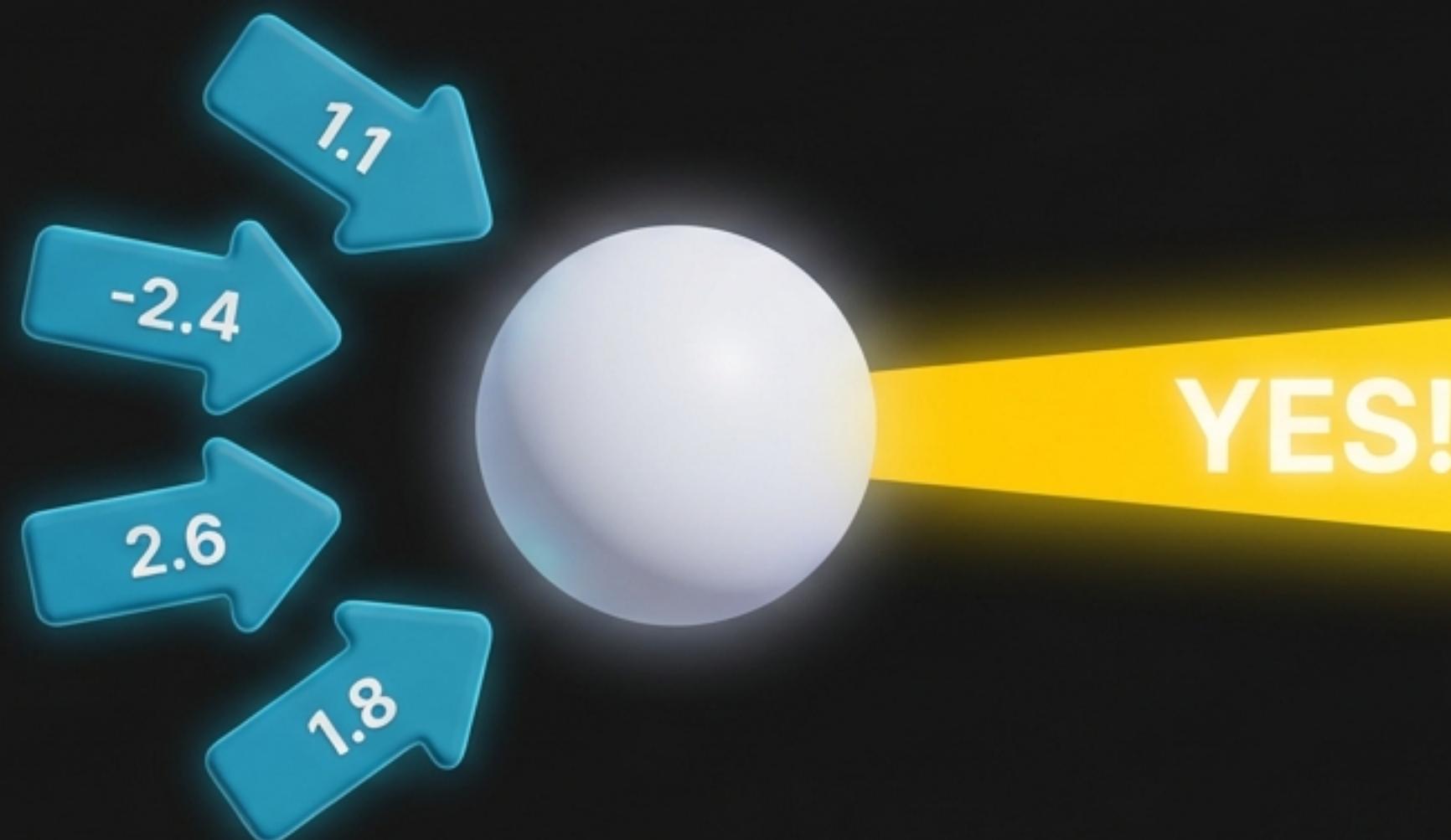


# Let's Build an AI Brain!

A step-by-step guide to how modern AI works, from a single brain cell  
cell to a thinking, planning assistant.

# Block #1: The Simple Brain Cell (A Neuron)

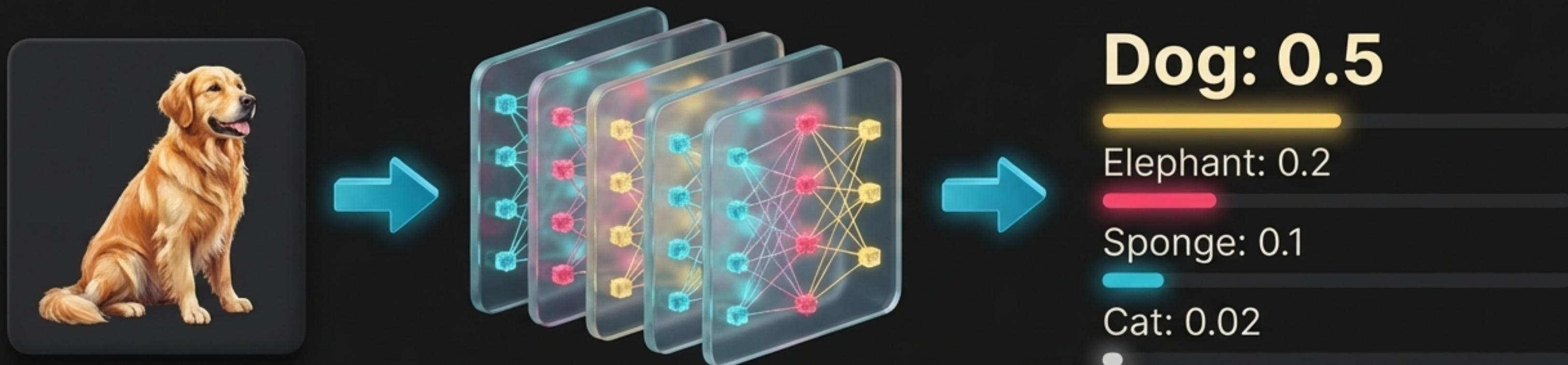
At the heart of every AI is a tiny decision-maker called a neuron. It takes in a bunch of signals, adds them up, and decides if the total is strong enough to fire a 'YES!' signal.



Calculation:  $1*1.1 + 1*(-2.4) + 1*2.6 + 0*1.8 > 0$ . Because the total (1.3) is positive, the output is YES! (or 1).

# Stacking Brain Cells Lets Our AI 'See'

One brain cell is simple. But millions of them connected in layers create a **Neural Network**. This network can learn to recognize patterns, like telling the difference between a dog and a cat. In 2012, a network called 'AlexNet' got so good at this it changed AI forever.



## A Huge Leap!

AlexNet (2012): **15.3% error rate**

Runner-up: **26.2% error rate**

This proved that big networks could solve really hard problems.

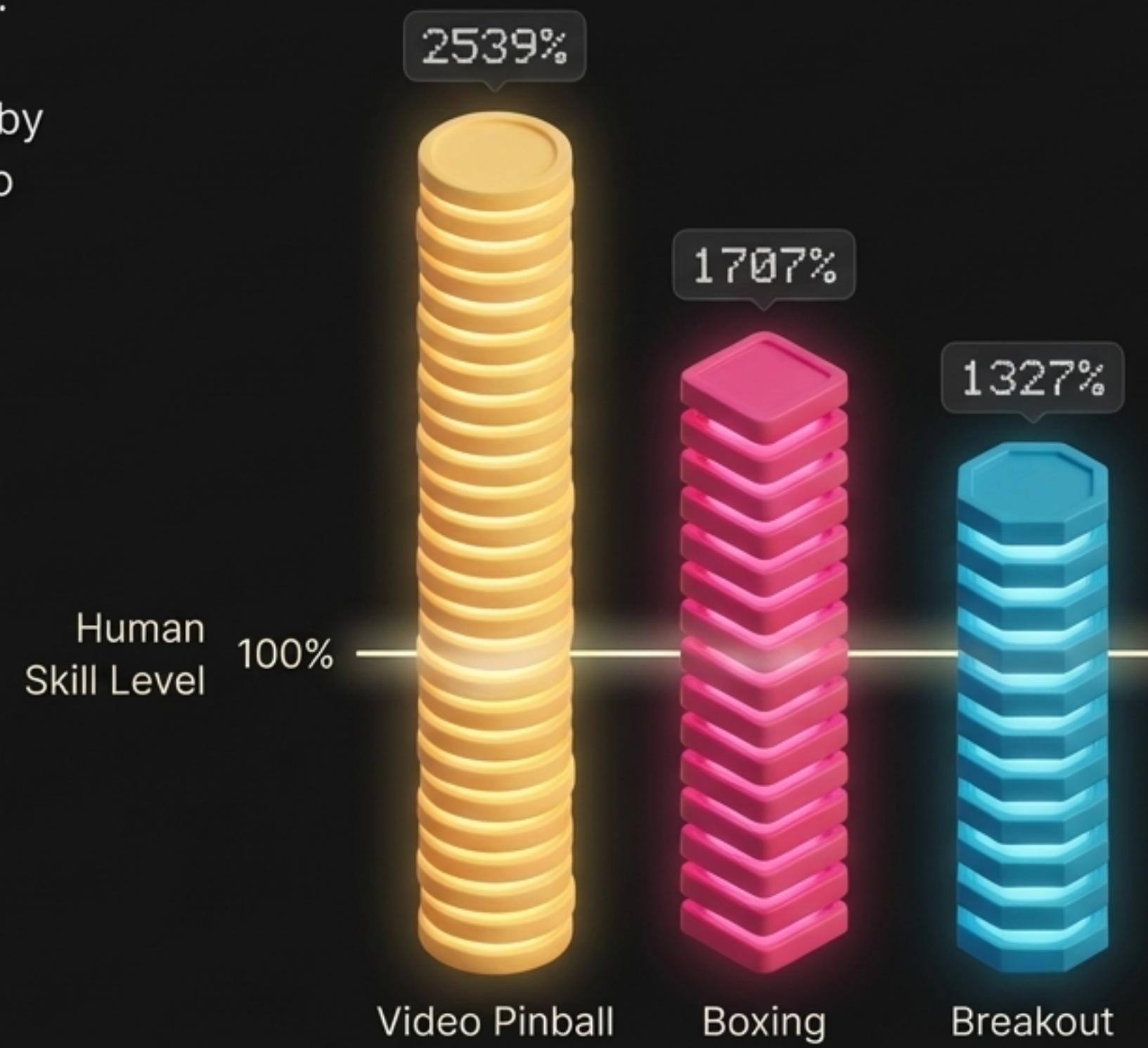
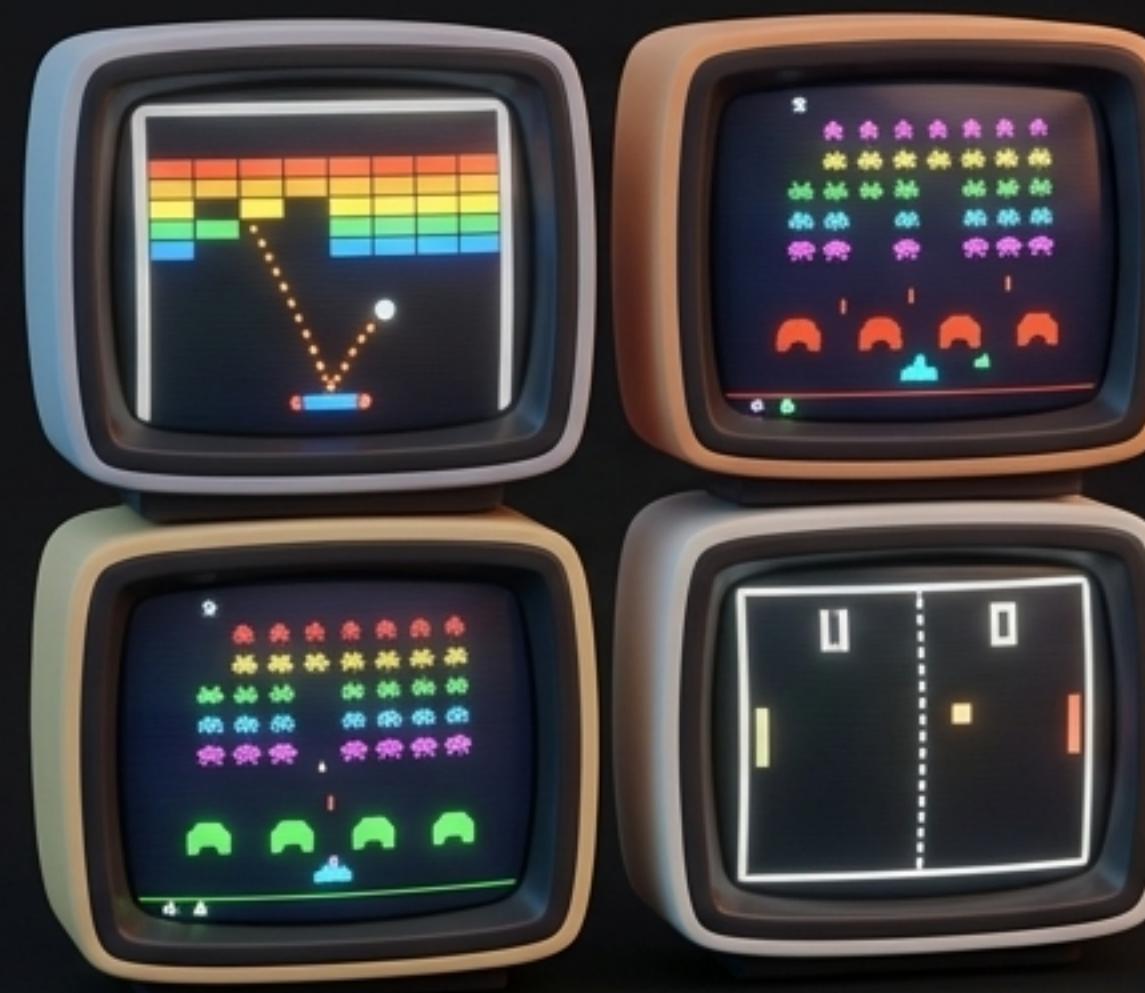
# Block #2: Learning by Scoring Points

So our AI can see, but how does it learn to \*act? We give it a new skill: Reinforcement Learning. It's like training a puppy. The AI tries an action. If it's a good move, it gets points (a reward). If it's a bad move, it loses points (a penalty). Over time, it learns the best strategy to get the highest score.



# From Tic-Tac-Toe to Superhuman Gamer

This “learning by playing” method is incredibly powerful. AI started by learning simple games like tic-tac-toe. By the 2010s, AI could teach itself to play Atari games just by looking at the screen and the score. It didn’t just learn to play; it became better than the best human players.



# Block #3: The Language Engine

Our AI can see and play, but can it understand what we're saying?

Language is tricky. Words get their meaning from the words around them ("the company it keeps").

The first step is to turn words into number codes, or "embeddings," so that similar words have similar codes.

FURNITURE



This is like a map of words. Words with similar meanings end up close together.

# The Super-Upgrade: Understanding Context with ‘Attention’

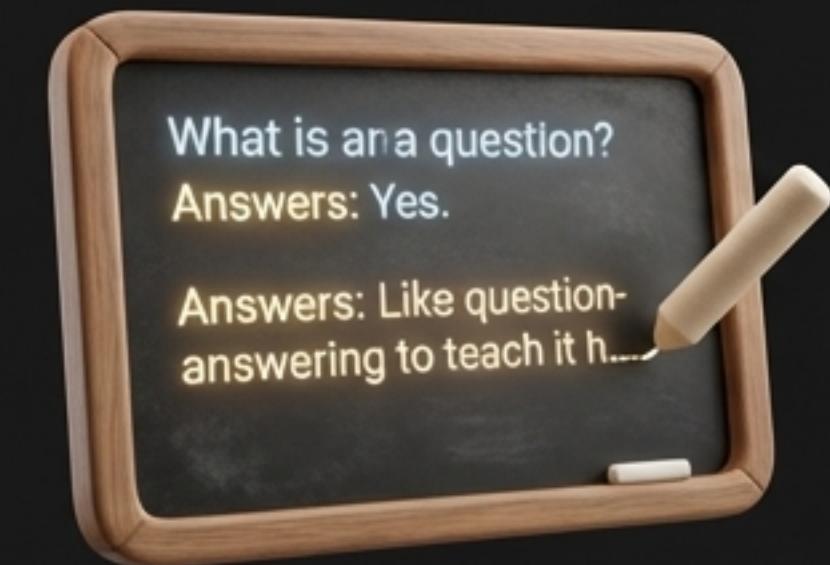
Older AIs would read a long sentence and forget the beginning by the time they reached the end. The big breakthrough was a new design called the **Transformer**. Its secret weapon is “Attention,” which lets the AI look back at every word in the sentence to understand the true context.



**“Attention is  
All You Need”**

# Putting It Together: How to Train an LLM

An LLM (like GPT) is a giant brain built from these Transformer blocks.  
Training it happens in three main phases:



## 1. Pre-training (The Library Phase)

The AI reads a massive amount of text from the internet (45TB for GPT-3!). Its only goal: get really good at guessing the next word.

## 2. Fine-Tuning (The School Phase)

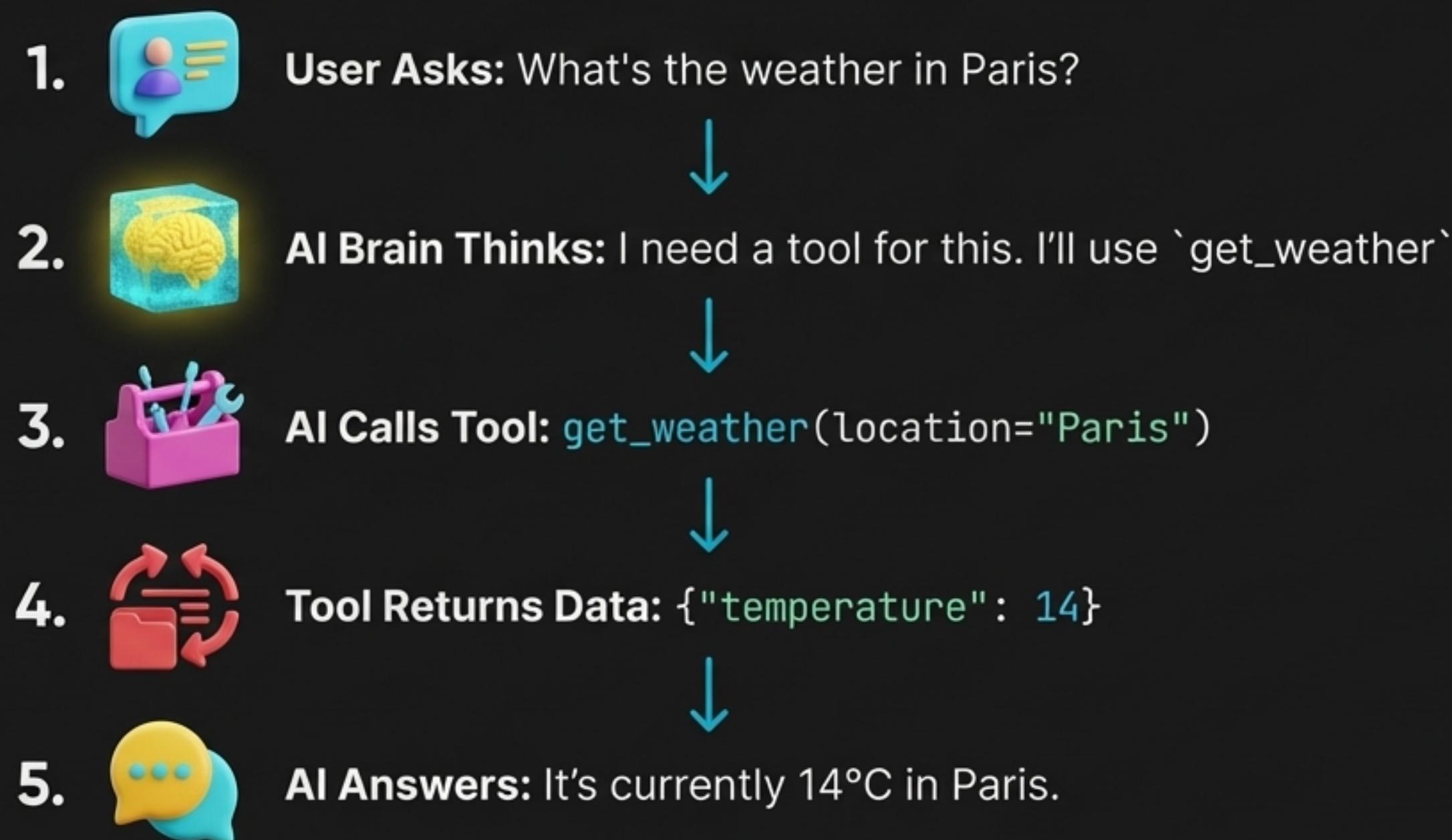
Humans give it specific examples of tasks, like question-answering, to teach it how to be useful and follow instructions.

## 3. RLHF (The Manners Phase)

Humans rank its answers (A is better than B). This teaches the AI to be helpful, honest, and harmless.

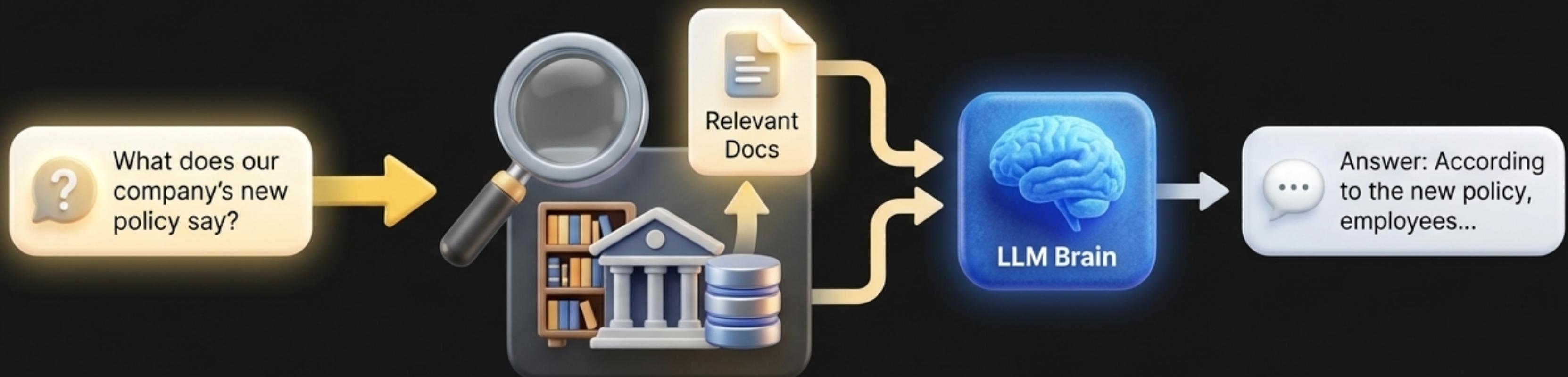
# Block #4: Giving Our Brain Superpowers (Tools)

A brain that can only think isn't very useful. We need to give it hands! We do this by giving giving the AI a set of 'tools(or Function Calls) it can use. When you ask it a question, it can decide on its own to use a tool to get the answer.



# Block #5: An External Brain for Perfect Memory

An LLM's memory is short—it only knows what's in the current conversation and what it was trained on. To give it a long-term memory and access to new information, we add a block called **Retrieval-Augmented Generation (RAG)**. It's like giving our AI a super-fast, searchable library that we can update any time.



✓ Up-to-date knowledge

✓ Fact-checking

✓ Can use private company data

# Final Assembly: The Thinking & Planning Agent

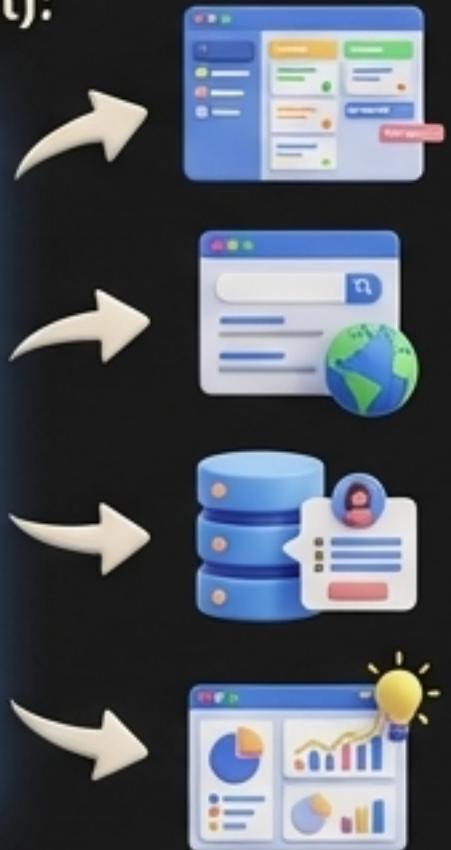
Now we combine all our blocks: a powerful **LLM Brain**, a set of **Tools**, and a **Memory**. This creates an **AI Agent**—a system that doesn't just answer questions, but can break down complex goals into steps, choose the right tool for each step, and learn from the process.



**User Request:** "Review our roadmap and suggest new items."

**Agent Plan (The AI's To-Do List):**

1. What's on the current roadmap? →
2. What are competitors doing? →
3. What are users asking for? →
4. Synthesize all this into suggestions. →



# Inside the Agent's Mind: A Smarter Memory

An advanced agent uses different kinds of memory to think more like a person:



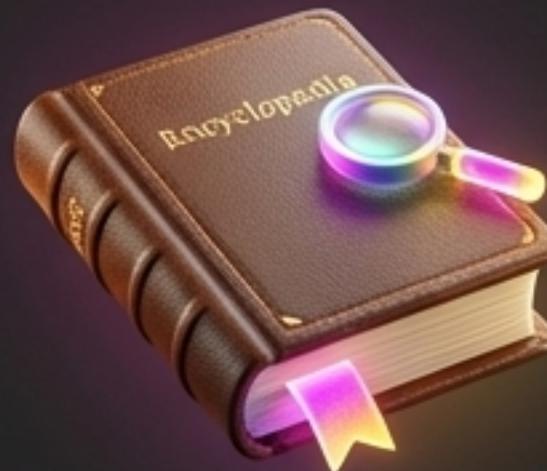
## Working Memory

What I'm thinking about right now.



## Episodic Memory

What I've done before.  
("Last time I helped this user, they liked...")



## Semantic Memory

Facts I know. (ECCO guidelines for colitis, Nancy Index definitions.)



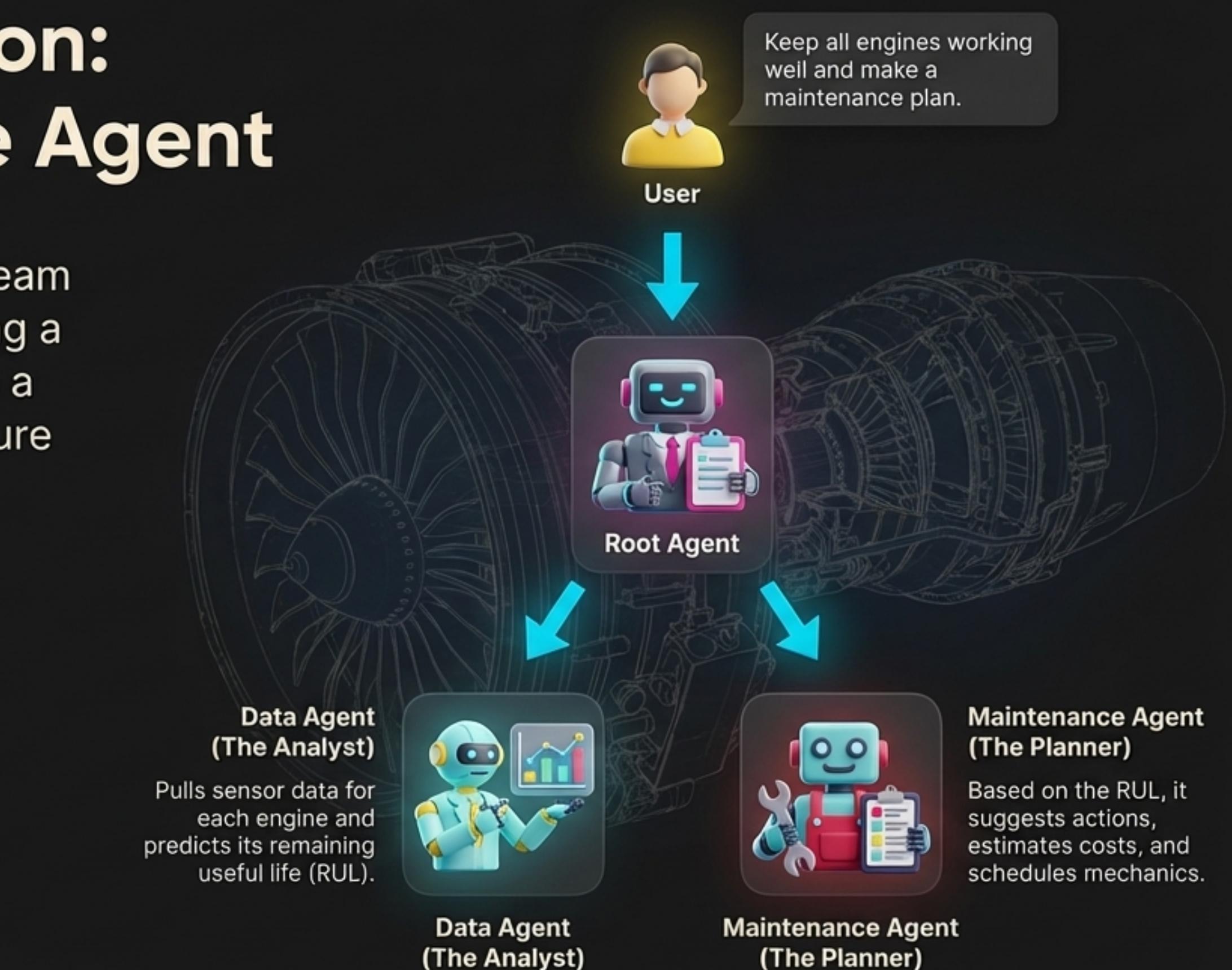
## Procedural Memory

Skills I have. (How to run the image segmentation workflow.)

This allows the agent to use past experience, facts, and skills to solve new problems.

# Real-World Mission: The Maintenance Agent

Let's see our AI brain in action. A team of agents is tasked with maintaining a fleet of jet engines. The user gives a high-level goal, and the agents figure out the rest.



# The Result: An Intelligent, Automated Plan

After analyzing all 20 engines, the agentic system produces a complete, prioritized maintenance plan. It balances risk, cost, and resources automatically. This is something that would have taken a human team hours or days to compile.

Engines	RUL Range	Recommended Action	Priority	Cost (USD)	Assigned Staff	Scheduled Time
15 Engines	82-124 RUL	MONITOR	Low	\$0	-	-
2 Engines	28, 50 RUL	REPAIR	High	\$6,000	TBD	TBD
1 Engine	16 RUL	STOP	Critical	\$15,000	Team Alpha	IMMEDIATE

# The Next Level: From a Single Agent to a Team of Agents

We've built an amazing AI agent.

But the real future is **Agentic AI**: systems of multiple agents collaborating to manage complex goals.

We're moving from single-purpose assistants to fully autonomous systems that can orchestrate entire parts of a business or our lives.

**AI Agent**



**AI Agent**

A smart thermostat that adjusts the temperature based on a simple rule.

**Agentic AI**



**Agentic AI**

A smart home system that coordinates all devices to optimize for comfort, energy cost, and your schedule.