

# Agents

## Part II: How to Build an Agent

*Architectures, Protocols, and Technical Evaluation*

Michael J Bommarito II · Daniel Martin Katz · Jillian Bommarito

December 19, 2025

---

### Working Draft Chapter

Version 1.01

This chapter is Part II of a three-part series from the textbook *Artificial Intelligence for Law and Finance*. Part I (What is an Agent?) provides definitions and foundations. Part III (Chapter 08 — Agents Part III: How to Govern an Agent) addresses regulation, risk, and deployment.

The most current copy of the project is available at:

<https://github.com/mjbommar/ai-law-finance-book/>

# Contents

---

<b>1</b>	<b>Introduction</b>	<b>5</b>
1.1	Agents as Professional Teams	5
1.2	The Ten Questions	6
<b>2</b>	<b>How Does an Agent Know When It Has Work to Do?</b>	<b>7</b>
2.1	External Feeds: The World Pushes Work to You	9
2.2	Human Prompts as Events	11
2.3	Scheduled Jobs: Time as Trigger.	12
2.4	Escalation Events: When Agents Reach Their Limits.	14
2.5	Surfaces: How Users Experience Agentic Systems	15
2.6	Evaluating Trigger Systems	19
2.7	From Triggers to Action.	19
<b>3</b>	<b>How Does an Agent Understand What's Being Asked?</b>	<b>20</b>
3.1	Bridging the Gap	22
3.2	Goal Extraction from Natural Language	24
3.3	Ambiguity Detection and Clarification.	25
3.4	Constraint Identification	27
3.5	Validation and Domain Examples	28
<b>4</b>	<b>How Does an Agent Find Things Out?</b>	<b>30</b>
4.1	Perception Tool Categories	31
4.2	In-Context Learning and Retrieval.	32
4.3	Model Context Protocol (MCP)	36
4.4	Memory as Perception into Institutional Knowledge	37
4.5	Domain-Specific Perception Requirements.	38
4.6	Tool Design Principles	38
4.7	Evaluating Perception Capabilities	40
4.8	From Perception to Action	41
<b>5</b>	<b>How Does an Agent Make Things Happen?</b>	<b>41</b>
5.1	Conceptual Foundations of Action.	42
5.2	Action Tool Categories	43
5.3	The Reversibility Framework	44

5.4	MCP Tools and Prompts for Action . . . . .	44
5.5	Action Security . . . . .	45
5.6	Approval Workflows . . . . .	45
5.7	Rate Limiting and Circuit Breakers . . . . .	46
5.8	Evaluating Action Capabilities . . . . .	47
5.9	From Action to Governance . . . . .	47
<b>6</b>	<b>How Does an Agent Remember Things? . . . . .</b>	<b>47</b>
6.1	Memory Types: From Desk to Archive. . . . .	48
6.2	Implementing the RAG Pattern . . . . .	49
6.3	Domain-Specific Memory Considerations . . . . .	50
6.4	Matter and Client Isolation . . . . .	51
6.5	Evaluating Memory Systems . . . . .	52
6.6	Adaptation: Learning and Its Consequences . . . . .	52
6.7	From Memory to Planning . . . . .	55
<b>7</b>	<b>How Does an Agent Break a Big Job into Steps?. . . . .</b>	<b>55</b>
7.1	Planning Patterns . . . . .	56
7.2	Choosing the Right Planning Pattern . . . . .	57
7.3	Understanding the Task Before Planning . . . . .	58
7.4	Budget Architecture. . . . .	59
7.5	Knowing When to Stop . . . . .	60
7.6	Guardrails and Loop Detection . . . . .	61
7.7	From Planning to Termination . . . . .	61
<b>8</b>	<b>How Does an Agent Know When It's Done?. . . . .</b>	<b>61</b>
8.1	Termination Condition Categories. . . . .	62
8.2	Defining Success Criteria . . . . .	63
8.3	Recognizing Failure . . . . .	64
8.4	Guardrails and Loop Detection . . . . .	65
8.5	The Reliability Cliff . . . . .	65
8.6	Graceful Degradation . . . . .	67
8.7	Evaluating Termination Capabilities. . . . .	67
8.8	From Termination to Escalation . . . . .	68
<b>9</b>	<b>How Does an Agent Know When to Ask for Help? . . . . .</b>	<b>69</b>
9.1	When to Escalate . . . . .	69

9.2	How to Escalate. . . . .	70
9.3	Human-in-the-Loop Patterns . . . . .	71
9.4	Domain-Specific Escalation Requirements . . . . .	72
9.5	Evaluating Escalation Mechanisms . . . . .	74
9.6	From Escalation to Delegation. . . . .	75
<b>10</b>	<b>How Does an Agent Work with Other Agents? . . . . .</b>	<b>75</b>
10.1	Why Multi-Agent Architectures? . . . . .	76
10.2	Agent-to-Agent Protocol (A2A) . . . . .	76
10.3	Multi-Agent Patterns . . . . .	77
10.4	Multi-Agent Workflow Examples . . . . .	77
10.5	Multi-Agent Risks. . . . .	79
10.6	Protocol Selection Guidance. . . . .	79
10.7	From Delegation to Governance. . . . .	80
<b>11</b>	<b>How Do We Keep the Agent Safe? . . . . .</b>	<b>80</b>
11.1	Architecture Enables Governance . . . . .	80
11.2	Governance Requirements by Question . . . . .	81
11.3	Security Essentials . . . . .	81
11.4	Transparency and Explainability . . . . .	82
11.5	Auditability vs. Retention . . . . .	83
11.6	Forward to Chapter 8 . . . . .	83
<b>12</b>	<b>Conclusion: From Architecture to Governance . . . . .</b>	<b>84</b>
12.1	What This Understanding Enables. . . . .	84
12.2	Honest Assessment of Current Capabilities . . . . .	85
12.3	From Architecture to Governance . . . . .	85

# 1 Introduction

---

In *What is an Agent?*, the first part of this series (Bommarito et al. 2025), we introduced the GPA+IAT framework—a way to recognize agentic systems through Goals, Perception, Action, Iteration, Adaptation, and Termination. Now, we turn to the practical: *How do you actually build one?*

This chapter is organized around ten architectural questions—the kind you should be asking whenever you’re evaluating, deploying, or governing an agentic system. Each question maps to a core capability that any useful agent needs: receiving work, understanding requests, finding information, taking action, maintaining context, planning complex work, recognizing when it’s done, escalating when it’s stuck, coordinating with other agents, and operating safely. And behind each of these capabilities are design decisions with real tradeoffs—choices that shape not just what the system can do, but how reliably it performs, how it fails, and what controls you have over it.

## The Core Insight

**Agents are not magic; they are architecture.**

Every capability that makes an agent useful—understanding what you asked, finding relevant information, taking action, remembering context, planning complex work, knowing when to stop, asking for help when stuck—corresponds to a concrete design decision. Those decisions have tradeoffs. Those tradeoffs have consequences.

You do not need to build agents yourself. But you need to know what questions to ask—because architectural decisions made at design time determine what the system can do, how reliably it performs, what can go wrong, and what controls are possible.

## 1.1 Agents as Professional Teams

These ten questions are not arbitrary. They emerge from what agentic systems are designed to do: augment human professionals, automate routine workflows, or even eventually replace entire organizational functions. Whatever the ambition, the system must handle the same work those humans and organizations currently perform. For a contract negotiation agent to be successful, it must be able to do what a transactional lawyer does. Similarly, a portfolio monitoring agent must be able to “act like” an analyst.

The capabilities an agent needs are not determined by the technology; they are determined by the work. And work has structure that any system, human or artificial, must accommodate. This yields the design principle that grounds the entire chapter: **an agentic system requires the same structural capabilities as a professional team.**

Consider how a law firm operates. Work arrives through defined channels: a client calls, court filings

appear on the docket, or an originating attorney refers a matter to a specialist. That work typically arrives as instructions that need clarification, and associates quickly learn to read between the lines, developing heuristics for what partners actually want rather than what they literally said. Research demands access to the right databases and thoughtful search strategies. Actions like filing motions or sending client letters have real consequences and require appropriate authorization. Institutional knowledge accumulates in case files and precedent databases. Complex matters break down into workstreams with dependencies, and work products have clear completion criteria. Associates know when to escalate to partners, teams coordinate across practice groups, and compliance controls keep the whole operation within ethical and regulatory bounds.

A discretionary portfolio management team follows the same pattern. Market data and research flow through defined feeds, and analysts must interpret investment committee mandates that leave room for judgment. Research requires access to financial databases, company filings, and market intelligence. Trades have real-world consequences that demand compliance checks before execution. Position history and investment theses persist across quarters, informing future decisions. Portfolio construction breaks down into sector allocation, security selection, and risk management, each with its own completion criteria. Analysts escalate to portfolio managers when positions approach limits, teams coordinate across asset classes, and regulatory controls ensure fiduciary compliance throughout.

These structural parallels are not coincidental. Law firms and investment teams are both *cognitive work systems*: organizations that process information, make decisions, and take consequential actions under uncertainty (Hollnagel and Woods 2005; Hollan et al. 2000). Agentic systems are cognitive work systems too (Wang et al. 2024a; Rao and Georgeff 1995), which means they face the same architectural challenges and require the same structural capabilities.

This mapping has practical implications. When you evaluate an agentic system, you can ask the same questions you would ask about a professional team. When you design governance for an agentic system, you can draw on the same frameworks that govern professional organizations. When you communicate with technical teams, you can use organizational language they will understand.

## 1.2 The Ten Questions

These organizational parallels yield ten questions that any agentic system must answer—the same questions you would ask when onboarding a new professional or evaluating a team’s capabilities. Table 1 lists those questions in the order an agent encounters them during execution.

**Table 1:** Architectural questions for agentic systems

Section	Architectural Question
Triggers	How does the agent know when it has work to do?
Intent	How does the agent understand what is being asked?
Perception	How does the agent find things out?
Action	How does the agent make things happen?
Memory	How does the agent remember things?
Planning	How does the agent break a big job into steps?
Termination	How does the agent know when it is done?
Escalation	How does the agent know when to ask for help?
Delegation	How does the agent work with other agents?
Governance	How do we keep the agent safe?

Each section addresses one question through organizational analogies, architectural concepts, domain-specific considerations for law and finance, and governance implications. You can read sequentially for cumulative understanding, jump directly to whichever question matters most, or skip to the end for synthesis.

Lastly, remember that, like other human processes or software systems, agents require governance. Our next chapter, *Governing Agents*, addresses compliance frameworks and controls in detail.

## 2 How Does an Agent Know When It Has Work to Do?

Consider again a day in the life of an average attorney. How does work reach their desk? Typically, a client calls with a question, a court docket updates with a new filing, a calendar reminds them of an upcoming motion, or a junior associate knocks on their door with a question that exceeds their expertise. Agentic systems operate in the same way. No matter how sophisticated, a system with tools, memory, and planning capabilities remains idle until work “arrives”; the architectural question is how these triggers and channels are defined and designed.

### Triggers

**Triggers** are the events that start agent execution. In practice, a trigger might be a docket alert, a price crossing a threshold, a calendar deadline coming due, or an internal “I can’t proceed safely” signal from the agent itself. Without a trigger, even a highly capable system sits idle.

The distinction between triggers and channels matters for system design. A trigger is the *what*: the event that demands attention. A channel is the *how*: the pathway through which that event reaches the agent. The same trigger, such as an approaching deadline, might arrive through different channels depending on context. It could come from a calendar system, an email reminder, or a human prompt asking “what’s due this week?” Understanding this separation helps you design systems that can receive work from multiple sources while maintaining consistent processing logic.

Triggers also create the audit trail that governance depends on. Every action an agent takes traces back to the trigger that initiated it, and when a regulator asks why the system flagged a transaction, or when a court demands production of the agent’s reasoning, you need to show what event started the chain of analysis. Systems that cannot trace actions back to triggers cannot be meaningfully audited, and in highly regulated fields like law and finance, what cannot be audited likely should not be deployed.

### Channels

**Channels** are how triggers reach the agent. In professional practice, four channels cover almost all work intake:

**External feeds:** The world pushes work to you (court filings, market data, regulatory updates).

**Human prompts:** People request work directly (chat, email, collaboration platforms).

**Scheduled jobs:** Time itself triggers execution (deadlines, periodic checks, end-of-day).

**Escalation events:** Internal signals that ask for human help (budget exhaustion, low confidence).

Each channel type serves a different operational need. External feeds enable reactive monitoring, allowing the system to respond to events as they occur in the world. Human prompts enable interactive collaboration, letting professionals direct the system’s attention as needs arise. Scheduled jobs enable proactive workflows, ensuring that routine tasks happen reliably without requiring someone to remember to initiate them. And escalation events close the loop on human oversight by ensuring the system asks for help when it reaches its limits, a topic we explore in depth in Section 9.

The underlying point is simple but easy to overlook: before an agentic system can reason or act, it must first notice that work exists. Channels are the sensory apparatus of the system, the means by which it becomes aware of its environment and the tasks waiting to be accomplished. A lawyer cannot respond to a redlined contract they never received, and an agent cannot act on a trigger it never observed.

Triggers and channels are architectural concerns—questions about how work reaches the system, how events are routed, and how actions are logged for audit. But architecture alone does not determine whether an agentic system succeeds in practice. Professionals must actually use the system, and



that raises a different set of questions: through what interaction modality do users engage? Is the experience synchronous or asynchronous? Does the system push information or wait to be asked? These are user experience questions, and they center on the concept of *surfaces*.

Consider the difference between a litigator who explores docket alerts through an interactive research session, refining queries as understanding develops, versus one who receives a daily summary email, versus one who gets a polished memo only when something requires attention. The underlying trigger is identical. The channel is the same. What differs is the surface—and surface design is the province of UX professionals, not system architects.

We address surfaces in this section because they complete the picture of the human-agent interface. Triggers, channels, and surfaces together determine whether an agentic system fits naturally into professional workflows or feels like an awkward intrusion. System architects must understand surfaces to design appropriate triggers and channels; UX designers must understand triggers and channels to design effective surfaces. The disciplines are distinct but interdependent. After examining how work arrives through each channel type, we turn to how users experience the system through different surfaces (Section 2.5).

## 2.1 External Feeds: The World Pushes Work to You

External feeds deliver events from systems outside the agentic system’s direct control. The external system pushes notifications when events occur, much like receiving service of process rather than checking the courthouse daily to see if you have been sued.

**Legal and Regulatory Feeds:** Court docket systems and state e-filing platforms can send notifications whenever documents are filed in cases you are monitoring. When an alert arrives, an agentic system can retrieve the filed document, analyze its contents, and trigger the appropriate response, whether that means flagging a motion for attorney review, updating a case timeline, or drafting a preliminary response memo. SEC filing systems offer similar capabilities for corporate disclosures, enabling agentic systems to monitor competitors’ filings and flag material changes. Citator services can notify the system whenever cases you care about are cited or overruled, keeping your legal research current without manual checking.

**Financial Market Feeds:** Financial institutions receive real-time market data through providers like Bloomberg and Reuters. A portfolio management agent can subscribe to price alerts and receive notifications when thresholds are crossed, then evaluate whether rebalancing is warranted and either execute trades within pre-approved limits or escalate to a portfolio manager for approval. News feeds add another layer, delivering headlines, earnings announcements, and analyst ratings that the agent can assess for materiality and surface to managers when developments warrant attention.



**Figure 1:** Four channel types through which work reaches agentic systems. External feeds push events from outside systems; human prompts arrive through interactive interfaces; scheduled jobs trigger on time-based conditions; and escalation events signal internal limits requiring human intervention. All channels converge on the agentic system’s event router.

### Speed vs. Reasoning: A Critical Distinction

Market data arrives at millisecond granularity. LLM-based reasoning operates at second-to-minute timescales. This fundamental mismatch determines where agentic systems add value in financial workflows.

#### Not suited for agentic systems:

- High-frequency trading and market-making
- Latency-sensitive execution
- Any task requiring microsecond response times

#### Well suited for agentic systems:

- Strategic portfolio decisions and rebalancing analysis
- Investment thesis development and research synthesis

- Compliance monitoring

**The architecture pattern:** Fast deterministic systems handle real-time data capture and threshold detection. When a threshold triggers—a position approaching its limit, a price target hit, an anomaly detected—it generates an event that the agentic system processes. Keep the microsecond path deterministic; hand off to the agentic system only once an alert is raised.

**Reliability Matters:** How external feeds connect to agentic systems has real consequences for governance. Some integration approaches prioritize speed but may occasionally miss events; others guarantee delivery and maintain complete logs but add latency. For regulated applications, you generally want the latter: systems that ensure every event is recorded, processed in order, and available for later audit. When evaluating vendor systems, ask whether the integration approach guarantees delivery and maintains audit trails, or whether events can be lost without detection.

## 2.2 Human Prompts as Events

Human prompts feel different from external feeds because they are interactive. You type something and expect a response. But at the architectural level, a human prompt is just another event type: the user generates an event, the system receives it through a channel, processes it, and responds. Treating prompts this way simplifies design, because all events flow through the same routing and prioritization logic rather than requiring separate handling for interactive versus background work.

**Chat interfaces** offer the most direct channel for human interaction, and they are where most professionals first encounter agentic systems. A litigation associate researching a motion to dismiss might type “Find Ninth Circuit cases on personal jurisdiction over foreign corporations with U.S. subsidiaries,” review the results, and then refine the query: “Focus on cases after 2018 where the court found jurisdiction.” On the finance side, a credit analyst evaluating a loan application might ask “Compare this borrower’s debt-to-EBITDA ratio against our portfolio average for manufacturing companies,” review the comparison, and follow up with “Show me how it trends over the last three years.” What makes chat powerful is exactly this kind of iterative refinement. Each message is simply another event, processed through the same loop as everything else, just with tighter expectations for response time.

But that expectation for quick responses creates real design constraints. When you are waiting for an answer, every second of silence feels like something has gone wrong. Systems built for interactive use need to acknowledge requests immediately, show progress as work unfolds, and deliver results incrementally when possible. This might mean streaming partial responses as they are generated, displaying indicators that show which databases the system is searching, or breaking complex research into visible steps. Without this feedback, a blank screen followed by a complete

response thirty seconds later leaves you wondering whether the system is working, stuck, or crashed.

**Email routing** lets agentic systems handle work that arrives through channels people already use. A general counsel might forward a compliance question from a business unit to a monitored inbox, and the system extracts the question, searches relevant guidance, and drafts a response for review. A portfolio manager might forward a client inquiry about sector exposure to a research assistant inbox, receiving back a summary with current allocations and recent changes. The challenge with email is that the requests tend to be unstructured, often buried in forwarded threads with multiple topics and tangential context that the system must parse to find the actual question.

**Collaboration platforms** like Slack and Teams let agentic systems appear as team members in the workflow. A deal team negotiating an acquisition can @mention the system in their working channel to check whether a proposed indemnification cap falls within market norms, without anyone switching applications or breaking the flow of discussion. An investment committee preparing for a meeting can request a quick portfolio risk summary in their coordination channel. Users can also invoke specific capabilities through commands like `/research "material adverse change clauses"`. The convenience comes with a security consideration: collaboration platforms log all messages, and channels often include people with different access levels, so systems need to be careful about what information they surface and where.

**Voice interfaces** are best suited for quick lookups when typing is impractical: checking a position size while walking between meetings, confirming a filing deadline while reviewing documents, or getting a quick summary of overnight market moves during a commute. The tradeoffs are significant, though. Transcription errors can mangle legal and financial terminology, and without a keyboard, verifying identity becomes harder. For anything beyond simple information retrieval, voice interfaces should require explicit confirmation before the system takes action.

These synchronous channels share a common advantage: if the system misunderstands your request, you can clarify immediately. Asynchronous channels like email and background automation do not offer that safety net. When you send a request and walk away, you will not discover a misunderstood instruction until you return to find the wrong output. This is why intent understanding (Section 3) and perception design (Section 4) matter even more for asynchronous workflows. The system must figure out what you actually want from a single message, gather the right information without guidance, and deliver results that match your expectations on the first attempt. And because no one is watching, asynchronous systems need robust logging and notification so that operators can understand what happened after the fact.

### 2.3 Scheduled Jobs: Time as Trigger

Unlike the channels we have discussed so far, some work does not wait for an external event or a human request. End-of-day reconciliation, monthly compliance reporting, quarterly reviews, and annual filings all happen on a calendar. For these recurring tasks, time itself becomes the trigger, and

the system must initiate work without anyone asking.

**Calendar-driven deadlines** govern much of legal and financial practice. Litigators live by deadlines: answer the complaint within 21 days, file motions 30 days before hearings, respond to discovery within 30 days. Missing one can mean default judgment or sanctions. An agentic system can monitor litigation calendars, calculate deadlines while accounting for court holidays and local rules, and escalate as deadlines approach if work remains incomplete. A more sophisticated system might go further, retrieving the complaint a week before the answer is due, extracting the claims, generating a draft answer with standard defenses, and presenting it for attorney review with time to spare. Financial professionals face analogous deadline pressure: quarterly SEC filings, annual audits, covenant compliance certificates due to lenders, and tax submissions that carry real penalties for delay. The same scheduled-trigger architecture that reminds a litigator about an approaching discovery deadline can remind a fund administrator about an investor reporting obligation.

**Periodic compliance checks** run on a schedule even when nothing externally triggers a review. Consider the investment compliance team at an asset manager: every night, the system checks each portfolio against its investment policy statement, looking for positions that exceed concentration limits, securities that fall outside permitted categories, or exposures that have drifted beyond acceptable ranges. Violations get flagged for review before markets open. Law firms face a parallel challenge with conflicts of interest. A conflicts system can retrieve new docket entries and engagement letters each day, extract party names, and check them against the firm's conflicts database. If the same company name appears on both sides of a matter, the system escalates immediately rather than waiting for someone to notice. These scheduled checks enable continuous monitoring that would be impractical to perform manually across thousands of client accounts or active matters.

**End-of-day and end-of-period workflows** are critical in both industries. In finance, end-of-day processing is a well-established ritual: when markets close, systems retrieve final prices, mark positions to market, reconcile trades against counterparty confirmations, calculate profit and loss, and generate the risk reports that will be waiting on desks the next morning. If any step fails or produces unexpected results, the system escalates rather than distributing incomplete data. Law firms have their own periodic workflows, though they tend to run on longer cycles. At month-end, a billing system might remind attorneys to enter unbilled time, generate draft invoices based on matter budgets and fee arrangements, and flag anomalies for partner review before bills go to clients. Quarterly, a matter management system might review open matters for staleness and prompt responsible attorneys to update status or close inactive files. The triggers are different, but the architectural pattern is the same: time fires the event, the system performs its work, and humans receive the output or the escalation.

## 2.4 Escalation Events: When Agents Reach Their Limits

The previous three channel types bring work into the system from outside: external feeds push events, humans make requests, and scheduled jobs fire on the clock. Escalation events are different. They originate inside the system itself, when an agent reaches a limit and cannot proceed autonomously. The system generates an event signaling that it needs human intervention, transferring control to a decision-maker at precisely the moment when human judgment matters most.

Four types of escalation triggers appear most frequently in practice.

**Budget exhaustion** occurs when the system approaches resource limits it has been given. These might be token consumption caps, iteration counts, time limits, or cost thresholds. Imagine a due diligence agent working through a data room with thousands of documents. If it burns through its budget analyzing the first hundred contracts without reaching the financial statements, it needs to stop and ask: should I continue with more resources, or should a human reprioritize what I review first? Without this kind of budget-aware escalation, the system either stops arbitrarily or runs up costs without limit.

**Low confidence** triggers escalation when uncertainty is too high for autonomous action. A research agent might find conflicting authority on a legal question, with a recent circuit court decision that appears to contradict older Supreme Court precedent. Rather than picking one and hoping for the best, the system should surface the conflict and let an attorney decide how to handle it. Similarly, a credit analysis agent encountering a borrower with an unusual corporate structure might recognize that its standard analysis framework does not apply cleanly and escalate for human review rather than forcing the square peg into a round hole.

**Approval requirements** force escalation for actions that require explicit human authorization regardless of the system's confidence. Some actions are simply too consequential to delegate fully, even when the system is certain it knows the right answer. Filing court documents, sending communications to clients or counterparties, executing trades above a certain size, or making public disclosures all warrant human sign-off. The system may draft the motion, compose the email, or prepare the trade ticket, but a human must authorize the action itself.

**Errors and anomalies** require human intervention when something unexpected happens. Tools fail, data sources become unavailable, or results do not make sense. A due diligence agent that finds revenue figures in a company's 10-K that do not match the numbers in its earnings press release should not proceed with potentially inconsistent data. A portfolio monitoring agent that cannot reach the pricing service should escalate rather than working with stale prices. These situations require human judgment to determine whether to wait, retry, use alternative sources, or proceed with acknowledged limitations.

We return to escalation design in depth in Section 9, including how to calibrate when systems should ask for help versus proceed autonomously, and how to design escalation interfaces that give

humans the context they need to make good decisions quickly. The organizational structures that support escalation—tiered response models, accountability pathways, and governance reporting—are addressed in Part III on governance.

## 2.5 Surfaces: How Users Experience Agentic Systems

Triggers and channels are architectural concepts—they answer questions about event routing, message delivery, and system integration. **Surfaces** are user experience concepts—they answer questions about interaction modality, workflow integration, and interface design. These are different disciplines asking different questions, even when they address the same system.

We include surfaces in this architectural chapter for two reasons. First, surface choice constrains architectural decisions: a system designed for conversational interaction needs different trigger handling than one designed for background automation. Second, architects and UX designers must communicate: when a UX designer specifies that users need real-time research dialogue, the architect must understand what that implies for channel selection and response latency.

Conversational surfaces deserve special attention because they sit at the intersection of architecture and UX. When a litigator types a research question into a chat window, the interface serves two roles simultaneously: it is the pathway through which the human prompt trigger arrives (an architectural function) and the interaction modality through which the user engages with responses (a UX function). This dual role is unique to conversational surfaces—automation and document surfaces do not receive triggers, they only deliver outputs.

Surface design warrants extended treatment in its own right. Questions of conversational UX, interface affordances, and workflow integration deserve the depth we give them elsewhere in this book. Here, we focus on the essentials that architects need to understand: what surfaces exist, how they differ, and how surface choice shapes system requirements.

Surface choice matters because it shapes workflow integration. An agentic system with identical capabilities will succeed or fail based partly on whether its surface matches how professionals actually work. Usability researcher Jakob Nielsen argues that generative AI represents the first new user interface paradigm in sixty years, marking a shift from *command-based interaction*, where you tell the computer what to do, to *intent-based outcome specification*, where you tell the computer what you want (Nielsen 2023). But intent-based systems still require interfaces, and those interfaces—the surfaces through which users engage—determine whether the system feels natural or intrusive.

### Interaction Surfaces

An **interaction surface** is the user experience modality through which humans engage with an agentic system. Where triggers and channels are architectural concepts describing how work reaches the system, surfaces are UX concepts describing how users experience the system.

Surfaces vary along four dimensions that UX designers use to match interaction paradigms to user needs: synchronicity, initiative, embodiment, and output format.

**Synchronicity** determines when results arrive. Synchronous interactions deliver results while the user waits, as with chat interfaces where you ask a question and watch the response stream in. This suits exploratory work where you refine direction based on what you see. Asynchronous interactions deliver results later through notifications or reports, as with document generation where you specify requirements, do other work, and return when the draft is ready. This suits production tasks where waiting would waste billable time.

**Initiative** captures who starts the conversation. In pull models, the system waits for the user to initiate. A research assistant that answers questions when asked operates this way, giving the user control over when and whether to engage. In push models, the system reaches out when something needs attention. A docket monitor that alerts you to new filings operates this way, deciding when to interrupt based on relevance and urgency.

**Embodiment** refers to whether the system is visible in the workflow. Visible systems appear as explicit participants, like a chat avatar or copilot sidebar that makes the agentic system's presence clear. Users know they are interacting with AI and can direct it consciously. Invisible systems operate as infrastructure, like a compliance screening system that flags suspicious transactions in the background. Users experience the outputs without seeing the system that produced them.

**Output format** determines what the system produces. Conversation turns suit iterative exploration where direction emerges through dialogue, producing chat transcripts from research queries, brainstorming, and strategy discussions. Structured documents suit formal deliverables with defined formats, producing research memos, due diligence reports, and contract summaries ready for distribution. Actions in the world suit automation workflows, where filing a document, sending an alert, or executing a trade produces effects rather than text.

Three primary surfaces dominate current deployments, each suited to different task types and user contexts.

**Conversational surfaces** present the agentic system as an interactive dialogue partner. The user types or speaks, the system responds, and the user refines based on what they see. This is the paradigm of ChatGPT, Claude, and embedded copilots. Conversational surfaces excel at *exploratory tasks* where users refine direction through iteration, such as a partner thinking through case strategy, an analyst exploring market scenarios, or an associate researching an unfamiliar area of law. The interaction is synchronous and user-initiated.

Conversational surfaces have limitations, however. They require users to articulate intent in natural language, which Nielsen calls the “articulation barrier.” They lack the **affordances** (design cues suggesting possible interactions) of graphical interfaces, offering no menus to browse and no buttons



to discover capabilities. And they demand attention, since the user must remain engaged throughout the interaction.

**Automation surfaces** present the agentic system as invisible infrastructure that monitors, analyzes, and acts in the background. Users receive outputs only when something relevant happens. Examples include portfolio surveillance that alerts when positions breach limits, docket monitoring that flags new filings in active matters, and compliance systems that screen transactions against sanctions lists. The interaction is asynchronous and system-initiated.

Automation surfaces suit *monitoring tasks* where continuous human attention is impractical. A compliance officer cannot manually review every transaction, and a litigator cannot check every docket daily. The agentic system handles the routine cases, surfacing only exceptions that require human judgment. The user experience is defined by what *does not* happen, since no alert means no problem.

**Document surfaces** present the agentic system as a drafting assistant that produces structured work products such as research memos, due diligence reports, deposition summaries, and client presentations. The user specifies requirements, the system produces a document, and the user reviews, edits, and distributes. The interaction is asynchronous because the system works while the user does other things, but it remains user-initiated.

Document surfaces suit *production tasks* with defined deliverables. The associate needs a memo for the partner's review, and the analyst needs a report for the investment committee. The output format matters here because you need a polished document that can be filed, sent to clients, or presented to regulators, not a chat transcript.

### Matching Surface to Task

Surface selection is a design decision, not a technical constraint. When choosing how users will interact with an agentic system, match the surface to the task type.

**Exploratory tasks** like research questions, strategy discussions, and ad hoc analysis work best through **chat surfaces** that support iterative refinement.

**Monitoring tasks** like docket surveillance, compliance screening, and portfolio alerts work best through **automation surfaces** that operate in the background.

**Production tasks** like research memos, due diligence reports, and regulatory filings work best through **document surfaces** that generate formal deliverables.

Many deployments combine all three. A litigation support system might offer chat for research, automation for alerts, and document generation for motion drafts. The underlying reasoning capabilities remain constant while only the interaction modality changes.

**Mismatches waste effort.** Forcing chat onto monitoring tasks demands attention no one

can sustain. Forcing documents onto exploratory tasks prevents the iteration that produces good results.

The interplay between triggers, channels, and surfaces creates the complete human-agent interface. Table 2 illustrates how the same trigger arriving through the same channel can manifest through different surfaces depending on workflow context.

**Table 2:** How triggers, channels, and surfaces combine in practice

Trigger	Channel	Surface	Workflow
New court filing	External feed	Automation	Background monitoring; alert when needed
New court filing	External feed	Chat	Interactive research on opposing brief
New court filing	External feed	Document	Case summary memo for partner
Price threshold crossed	External feed	Automation	Background alert to portfolio manager
Price threshold crossed	External feed	Chat	Interactive rebalancing analysis
Price threshold crossed	External feed	Document	Trade recommendation for committee
Research question	Human prompt	Chat	Iterative legal research
Report request	Human prompt	Document	Due diligence memo

**Emerging surfaces** extend beyond these three primary patterns. *Embedded copilots* integrate agentic capabilities directly into existing applications—word processors, spreadsheets, or domain-specific software—combining familiar graphical interfaces with intent-based interaction. Users remain in their primary workflow while accessing agent capabilities through sidebars or inline suggestions. *Ambient interfaces* use voice or environmental sensors to enable hands-free interaction, though transcription errors and authentication challenges currently limit their use in high-stakes professional contexts. *Agentic APIs* expose capabilities to other software systems rather than human users, enabling machine-to-machine orchestration where the “user” is another system—a pattern we revisit in Section 10.

Effective surface design draws on decades of human-computer interaction research, from direct manipulation interfaces to conversational design patterns. A full treatment of interaction design principles belongs to UX practice and extends beyond our scope here. What architects need to understand is that surface selection has architectural consequences: conversational surfaces require low-latency response paths, automation surfaces require robust background processing, and document surfaces require generation pipelines that can produce polished output. The disciplines must collaborate—UX designers choose surfaces based on user needs, and architects build the infrastructure those surfaces require.

## 2.6 Evaluating Trigger Systems

When evaluating agentic systems, whether you are building or buying, you should assess trigger capabilities against five criteria.

**Coverage** asks whether the system receives events from all relevant sources. A litigation system that monitors CM/ECF but not state court dockets has incomplete coverage that could miss critical filings. **Latency** measures how quickly events reach the system. Real-time market data requires sub-second delivery, while docket alerts can tolerate delays of several minutes. **Reliability** addresses what happens when feeds fail. Robust systems need retry logic, fallback sources, and alerting when data goes stale. **Priority mechanisms** determine whether the system can distinguish urgent events from routine ones. During a market crash or litigation crisis, the right events must reach the right handlers immediately. Finally, **auditability** ensures that every trigger is logged. When a regulator asks why the system took action, you need a complete record of the triggering event. The following chapter on governance addresses audit requirements, regulatory compliance frameworks, and governance controls in detail.

## 2.7 From Triggers to Action

This section has examined the human-agent interface from two disciplinary perspectives. From an architectural standpoint, *triggers* are the events that initiate work, and *channels* are the pathways through which those triggers reach the agent. From a user experience standpoint, *surfaces* are the interaction modalities through which users engage with the agent’s capabilities. Architects design trigger routing and channel infrastructure; UX designers choose surfaces that match how professionals actually work. The disciplines address different questions but must align for a system to succeed.

Together, triggers, channels, and surfaces determine how an agentic system fits into professional workflows. A well-designed trigger system ensures no relevant event goes unnoticed. Appropriate channel selection balances latency against reliability. Thoughtful surface choices match interaction modality to task type. And all three must support the audit trails that governance requires—every action traceable to the trigger that initiated it, through the channel that delivered it, via the surface through which it was experienced.

But triggering is only the beginning. Once an event arrives, the agentic system must:

- **Understand intent:** What is being asked?
- **Perceive information:** What does the system need to know?
- **Take action:** What should the system do?
- **Remember context:** What should persist across sessions?
- **Plan execution:** How should work be decomposed?
- **Recognize completion:** When is the task done?
- **Escalate appropriately:** When should humans intervene?

To see how these questions connect, trace a single event through the system. An external feed delivers a court filing notification, and the system routes it based on matter type and urgency. Depending on the configured surface, a litigator might receive a chat prompt inviting interactive research, a background alert waiting in their queue, or a generated memo summarizing the filing’s implications. Whatever the surface, the system retrieves case context from memory, downloads the filed document, analyzes its content, and either proceeds autonomously or escalates for human judgment. Each step in this chain—from trigger to channel to surface to action—represents an architectural decision with consequences for what the system can accomplish and how reliably it performs.

With work arriving through triggers and channels, and users engaging through surfaces, the next question becomes: how does the agentic system understand what is actually being asked? Section 3 takes up this problem of intent.

### 3 How Does an Agent Understand What’s Being Asked?

---

When a partner walks into your office and says “get me up to speed on the Acme acquisition,” your first job is understanding what that actually means. You must determine whether this is a quick status check or a request for deep analysis, whether you should answer a specific question or identify all issues, and whether this is urgent work for today’s call or background work for next week’s meeting. The words you hear are the **instruction**; the underlying purpose that those words point toward is the **intent**.

Every professional develops this skill over time: reading the assignment memo, clarifying ambiguous instructions, and understanding not just what was said but what was meant. Junior associates tend to over-clarify, whereas senior associates internalize firm norms and client expectations and infer appropriately. The best professionals know when to ask and when to proceed.

Agentic systems face the same challenge. The user provides an instruction in natural language, which is inherently ambiguous and sometimes contradictory. Despite this, the agent must extract the user’s intent to determine what goal is being pursued, what constraints apply, and what success looks like. This illustrates the second fundamental question: *How does an agent understand what’s being asked?*

Four concepts structure this process: instruction, intent, goal, and task. Understanding how they relate—and where gaps arise—is essential for building and governing agentic systems.

#### Instruction

An **instruction** is the words the user provides—the raw input that starts the process.

“Review this credit agreement for risks.”

“Rebalance to reduce tech exposure.”

“Get me up to speed on the Acme acquisition.”

Instructions are where work begins, but they are rarely complete specifications. The word “risks” raises immediate questions: risks to whom? The lender or borrower? Material risks or all risks? Legal risks, financial risks, or both? “Reduce tech exposure” leaves open the target level, the mechanism (sales, hedges, or both), and tax and timing constraints. “Get me up to speed” specifies neither depth, urgency, nor deliverable format. Instructions are clear enough to start; they are not clear enough to finish.

Pre-LLM systems handled instructions through rigid steps: matching exact words, filling forms, simple if-then checklists. These systems worked for narrow domains with controlled vocabularies but broke on natural language variation. “Find cases on personal jurisdiction” and “What’s the law on where you can sue someone?” express similar meanings but look nothing alike to a keyword matcher.

### Intent

**Intent** is the underlying purpose, constraints, and success criteria behind an instruction. Intent captures the human meaning—what the user actually wants, not just what they said. Where an instruction might be “review this credit agreement,” the intent might be “identify material risks to the lender by tomorrow for the partner’s client call.”

This framing assumes the user has clear intent that merely needs to be extracted. Often, they do not. A general counsel asking for “a quick overview of the regulatory landscape” may not understand the domain well enough to know what a useful overview would contain or how comprehensive it needs to be. A partner requesting “a one-page memo on the indemnification issues” may be asking for something impossible if the issues genuinely require five pages to explain competently. A portfolio manager who wants “maximum returns with minimal risk” is expressing a preference, not a coherent goal. Users operate under their own constraints—time pressure, cognitive load, incomplete domain knowledge—that shape requests in ways that may conflict with the realities of the underlying work. Intent inference must contend not only with unclear expression but with intent that is itself incomplete, conflicted, or impossible to satisfy.

The gap between instruction and intent has always existed; what has changed is our ability to bridge that gap with technological systems. Early AI research on dialogue established that understanding utterances requires inferring the speaker’s underlying plans and goals (Allen and Perrault 1980). Large language models dramatically improved intent inference from natural language, particularly after techniques like reinforcement learning from human feedback (RLHF) explicitly optimized models to follow user intent (Ouyang et al. 2022). Where rule-based systems required exact matches, LLMs handle variation, implicit context, and domain-specific jargon. Modern LLMs excel at handling noisy input (misspellings, shorthand, tangential information), resolving references using conversational context, inferring domain-specific meaning, and detecting implicit constraints that professionals take for granted.

Despite these capabilities, intent understanding remains imperfect. As conversations extend, LLMs may lose track of earlier context or constraints. When clarification is needed, LLMs sometimes proceed with a default interpretation rather than asking, resulting in a “helpful but wrong” failure: the agent does *something* reasonable rather than confirming it understood correctly. Professionals also communicate through implication. Phrases like “This needs to be right” signal high stakes, while “When you get a chance” signals low urgency. These signals may not be explicitly parsed by current models.

### Goal

A **goal** is the machine-readable specification that intent points toward—the structured outcome that would satisfy the request. Goals connect to the GPA+IAT framework introduced in the previous chapter: an agent pursues goals through perception and action. Where intent is “identify material risks to the lender by tomorrow,” the goal is “produce a lender-risk memo that meets firm policy and is ready for partner review.”

Goals provide the target for planning and the criterion for termination. An agent that understands the goal can determine whether its work is complete: does this memo identify the material risks? Does it meet firm standards? Is it ready for the partner? Without a clear goal, the agent cannot know when to stop—the “runaway associate” problem of endless research without a deliverable.

### Task

A **task** is the concrete unit of work the agent executes to advance a goal. A single goal typically decomposes into multiple tasks. For the lender-risk memo, tasks might include extracting financial covenants, comparing covenant terms to market standards, identifying collateral coverage gaps, flagging cross-default provisions, and drafting the summary memo.

Tasks are where planning meets execution. Section 7 addresses how agents decompose goals into task sequences; Section 8 addresses how agents recognize when tasks—and goals—are complete.

The flow from instruction to task is: **Instruction** → **Intent** → **Goal** → **Tasks**. Inferring intent bridges the gap between what users say and what they mean. Goals give agents targets to aim for. Tasks give agents concrete work to execute. Failures at any stage propagate forward: misunderstood instructions yield wrong intent; wrong intent yields wrong goals; wrong goals yield wasted tasks.

## 3.1 Bridging the Gap

Traditional enterprise systems classified work using explicit **routing rules**: fixed logic that checked message details and forwarded them to the right handler. A court filing tagged `matter_id=12345` goes straight to litigation monitoring; a portfolio company’s SEC filing routes to compliance review. This pattern dominated middleware architecture for decades: message queues, **enterprise**

**service buses (ESBs)**, and workflow engines functioned like a mailroom sorting notices to the right department.

LLM-based agentic systems replace explicit routing logic with semantic reasoning. Rather than maintaining explicit rules for every event type, the model *understands* what kind of work this is. “Review this credit agreement” and “Check this loan doc for problems” express similar intents despite different words; the LLM recognizes both as document review tasks without explicit rules mapping each phrase to a handler.

This architectural shift creates two primary tensions in system design.

The first tension is between flexibility and predictability. Rule-based routing is deterministic: the same input always produces the same classification. LLM-based classification relies on likelihoods and may shift slightly with model updates, prompt phrasing, or context. For regulated applications, this requires additional governance through logging classifications, monitoring for drift, and maintaining override rules for critical categories.

The second tension involves explicit versus implicit knowledge. Routing rules encode domain knowledge explicitly in code, requiring developers to anticipate every category and write rules to match. LLM classification absorbs domain knowledge implicitly through training, recognizing that legal research and case analysis are related without explicit rules. But implicit knowledge is harder to audit because there is no specific rule to inspect, and it may reflect training biases.

Production systems often combine both patterns. Simple, high-volume, time-sensitive classifications use deterministic rules, so a margin call always routes to the trading desk. Complex, ambiguous, or novel requests use LLM reasoning. The rule-based layer handles predictable cases efficiently while the LLM layer handles everything else.

For architects evaluating agentic systems: where must classification be deterministic (regulatory requirements, latency/speed constraints, auditability)? Where does flexibility justify the overhead of LLM reasoning? The answer shapes system design.

### Intent Inference Is Not Mind Reading

LLMs infer *probable* intent from language patterns; they do not read minds. Inference fails when:

- The instruction is genuinely ambiguous (multiple reasonable interpretations)
- The user's intent differs from typical patterns for similar language
- Critical context exists outside the conversation (prior meetings, firm norms)
- The user themselves is unclear about what they want

**Design for clarification, not guessing.** The aim is an agent that surfaces uncertainty and asks, not one that pretends it possesses certainty regarding intent.

## 3.2 Goal Extraction from Natural Language

Once the agent receives an instruction, it must extract structured goals that can guide execution. This extraction transforms natural language into actionable specifications through two main processes: intent classification and constraint recognition.

The first step, intent classification, translates the instruction into task types that determine workflow. This step converts raw words into candidate tasks that can advance the underlying goal:

- **Information retrieval:** “What’s the current NAV (Net Asset Value)?” “Find the latest 10-K”
- **Research and analysis:** “Research whether we can pierce the corporate veil (hold shareholders liable)”
- **Document review:** “Review the acquisition agreement for change-of-control provisions”
- **Document generation:** “Draft an engagement letter for the Smith matter”
- **Calculation:** “Calculate the IRR (Internal Rate of Return) assuming a 5-year hold”
- **Monitoring:** “Alert me if tech exposure exceeds 30%”

Different task types invoke different tools, planning patterns, and success criteria. A research task requires search and synthesis; a calculation task requires structured computation; a monitoring task requires continuous observation.

Beyond classification, the agent must also recognize entities and constraints. Entity recognition identifies what the task concerns: matters, clients, securities, parties, documents, and jurisdictions. When someone says “Review the Smith acquisition agreement,” the agent must recognize a reference to a specific document; “Research Delaware fiduciary duties” references a jurisdiction that shapes which law applies.

Constraint recognition identifies what bounds apply to execution. Temporal constraints include deadlines, as-of dates, and time windows. “By Friday” sets a deadline; “as of year-end 2024” sets a reference date; “over the past quarter” defines a window for analysis. Resource constraints set



budget and effort limits, with phrases like “Spend no more than 2 hours” or “focus on Articles 3 and 4” bounding scope. Format constraints specify how deliverables should appear: “Summarize in one page” constrains length, “prepare a memo for the file” specifies format, and “I need something to show the client” signals an external audience requiring different tone and detail.

Two additional constraint types often remain unstated. Audience and privilege constraints determine who will see the output and what confidentiality must be preserved. Risk and compliance constraints set limits that professionals internalize but rarely articulate: a compliance review implicitly requires flagging violations, and a client communication implicitly requires privilege protection.

Once extracted, these components can be organized into structured goal representations that guide execution. These representations resemble short assignment memos that the planning system can act on (Section 7) and the termination system can measure against (Section 8).

#### Structured Goal Representation: Document Review

<b>Task type</b>	Document review
<b>Document</b>	Smith Acquisition Agreement
<b>Objective</b>	Identify change-of-control provisions
<b>Constraints</b>	
Deadline	January 15, 2025
Scope	Sections 5–8
Deliverable	Summary memo
<b>Success criteria</b>	
•	All CoC provisions identified
•	Triggering events listed
•	Consent requirements noted

### 3.3 Ambiguity Detection and Clarification

Not all instructions can be unambiguously interpreted. The agent must detect ambiguity and decide whether to clarify or proceed. The decision depends on two factors: ambiguity severity and action stakes.

When both stakes and ambiguity are low, the agent should proceed with its best interpretation. If someone asks “What’s Apple’s market cap?” and there is slight uncertainty about whether they mean Apple Inc. or Apple Hospitality REIT, the dominant interpretation is obvious and the cost of being wrong is low since correction is easy. When stakes remain low but ambiguity is high, a brief clarification prevents wasted effort. If someone asks “Research the statute of limitations” without

specifying the claim type, a quick question saves hours of potentially misdirected work.

When stakes are high but ambiguity is low, the agent should confirm before acting. If the instruction is clear but consequential, such as “File this motion,” confirmation prevents irreversible errors even when the agent is confident it understood correctly. When both stakes and ambiguity are high, thorough clarification is essential. If someone says “Handle the regulatory response” for a complex matter, extended clarification is appropriate before taking any action.

	Low Ambiguity	High Ambiguity
Low Stakes	<b>PROCEED</b> <i>“Apple market cap” → Apple Inc.</i>	<b>CLARIFY BRIEFLY</b> <i>“Research SOL” → which claim type?</i>
High Stakes	<b>CONFIRM</b> <i>“File this motion” → verify before acting</i>	<b>CLARIFY THOROUGHLY</b> <i>“Handle the regulatory response”</i>

**Figure 2:** Decision matrix for when agents should clarify user intent. Stakes measure consequence of error; ambiguity measures interpretation confidence.

Effective clarification has four characteristics. It is specific, asking “Which jurisdiction’s statute of limitations: Delaware or New York?” rather than “Can you clarify?” It is contextual, referencing what the agent already understands: “I understand you want me to review the credit agreement. Should I focus on lender protections, borrower obligations, or both?” It is actionable, offering options rather than open-ended questions: “Should I (a) provide a comprehensive review of all provisions, (b) focus on the financial covenants, or (c) flag only provisions that differ from our standard template?” And it is bounded, limiting clarification rounds. If the agent needs extensive clarification, it may be the wrong tool for the task, or the user may need to think through requirements before delegating.

*Poor clarification:* “Can you clarify?”

*Better:* “Should I assess lender risks, borrower risks, or both?”

*Best:* “You asked to reduce tech exposure. Should I (a) sell tech to 25% target, (b) hedge with options, or (c) add non-tech positions? Which deadline matters—this week or month-end reporting?”

Research has documented that LLMs sometimes select a default interpretation rather than asking for clarification, even when ambiguity is significant (Zhang et al. 2024; Wang et al. 2024b). This “proceed without asking” behavior creates real risk: the agent interprets “review the contract” as a surface-level summary when the user expected deep issue-spotting, delivering work product that is technically responsive but wrong.

Several strategies can mitigate this tendency: prompt engineering that emphasizes clarification for

ambiguous requests, confidence thresholds that trigger clarification below a certainty level, user training to provide detailed initial instructions, and checkpoint reviews before significant work begins. From a governance perspective, teams should monitor for cases where the agent proceeded confidently but delivered unexpected results. These cases may indicate calibration problems in ambiguity detection.

#### When Intent Itself Is Unclear or Conflicted

Ambiguity detection assumes the user has clear intent that was merely expressed unclearly. Sometimes the problem runs deeper:

**Domain expertise gaps:** The user may not understand the subject well enough to specify what they need. “Give me the key issues” presumes the user knows what issues exist and which matter most—knowledge they may be asking the agent to provide.

**Conflicted constraints:** The user may want contradictory things. A one-page memo on a complex acquisition may be impossible without sacrificing the accuracy or completeness that makes the memo useful.

**Unexamined tradeoffs:** The user may not have considered tradeoffs they would care about if surfaced—speed versus thoroughness, cost versus quality, brevity versus nuance.

When an agent detects these deeper problems, it should surface the conflict rather than silently resolving it: “You asked for a one-page summary, but covering the indemnification, representations, and covenant issues adequately would require three to four pages. Would you prefer (a) a one-page overview that flags issues without detailed analysis, (b) a longer memo with full analysis, or (c) detailed treatment of just one area?”

This is harder than detecting ambiguous expression because it requires recognizing when the user’s own mental model is incomplete or conflicted—and surfacing that recognition without appearing to second-guess or condescend.

### 3.4 Constraint Identification

Beyond explicit instructions, agents must identify constraints that bound acceptable execution. These constraints fall into several categories that often interact.

Temporal constraints include deadlines and time windows. Some are explicit, like “by Friday.” Others are implicit, such as court filing deadlines calculated from procedural rules. Still others are contextual: “before the board meeting” requires knowing when the meeting is scheduled. Resource constraints set budget and effort limits. Token budgets limit API costs; time budgets limit calendar impact; scope constraints focus effort on high-value areas.

Scope constraints define what is in and out of bounds. “Focus on Articles 3 and 4” excludes other articles; “just the Delaware analysis” excludes other jurisdictions. Format and style constraints

specify how deliverables should appear: memo versus email versus presentation, formal versus casual tone, internal versus client-facing audience. Risk and compliance constraints specify what must be avoided: privilege protection, conflicts of interest, regulatory restrictions, and confidentiality obligations. These constraints often apply implicitly based on context.

Professionals operate under many constraints they rarely state explicitly. When a partner says “research Section 10(b) liability,” implicit constraints include:

- Use authoritative sources (binding precedent, not blog posts)
- Focus on the relevant jurisdiction (probably the circuit where the case is filed)
- Assume current law (not historical analysis unless specified)
- Protect privilege (don’t disclose strategy in external searches)
- Operate within budget norms (don’t spend 40 hours on a 2-hour task)

Agents must infer these constraints from context, domain knowledge, and organizational norms. Memory systems (Section 6) help by preserving firm-specific expectations; user profiles track individual preferences; matter context provides case-specific constraints.

### 3.5 Validation and Domain Examples

Before executing, agents should validate their understanding of intent. Several patterns support this validation.

**Reflection** and summarization involve the agent pausing—much like an associate double-checking their notes—to restate its understanding before proceeding, giving the user an opportunity to correct misunderstandings before work begins. **Chunked validation**, like partner check-ins after each memo section, breaks complex tasks into phases rather than validating all at once. After completing research, the agent summarizes findings and confirms direction before drafting. After drafting, it confirms the approach before finalizing. Each checkpoint prevents error propagation.

Confidence signaling requires the agent to indicate how confident it is in its own understanding. When confidence is high, the agent can proceed with light oversight; when confidence is low, the right move is to pause and ask for clarification rather than press ahead. Clear confidence signaling helps users decide how much review is needed and whether to treat the output as a draft, a starting point, or a near-final product.

Consider how intent extraction and validation work together for a legal task. Given the instruction “Review this credit agreement for risks,” the agent classifies this as a document review task and detects that “risks” is ambiguous (risks to whom? what types?). Context gathering reveals this is a lender-side engagement for a senior secured facility. The agent infers implicit constraints (focus on lender risks, prioritize material issues, assume current market terms as baseline) and clarifies: “I’ll review from the lender’s perspective, focusing on credit risk, collateral coverage, and covenant adequacy. Should I also flag documentation risks (drafting issues, missing provisions) or focus only

on substantive credit terms?”

#### Extracted Goal: Credit Agreement Review

<b>Task type</b>	Document review
<b>Perspective</b>	Lender
<b>Document</b>	Attached credit agreement
<b>Focus areas</b>	Credit risk, collateral, covenants
<b>Deliverable</b>	Risk summary memo
<b>Success criteria</b>	
•	Material risks identified
•	Comparison to market terms
•	Recommendations provided

The agent validates: “I’ll prepare a memo identifying material risks to the lender, comparing key terms to market standards, and recommending negotiation points. I’ll have a draft for your review by tomorrow afternoon.”

The same pattern applies to financial tasks. Given the instruction “Rebalance to reduce tech exposure,” the agent classifies this as a portfolio action task and immediately detects multiple ambiguities: how much reduction? through what mechanism? with what constraints? Context gathering reveals current tech exposure at 35% against a 25% target. Through clarification dialogue, the agent confirms the user wants to reach target through sales while minimizing tax impact (preferring loss harvesting—selling assets at a loss to offset gains—and long-term gains over short-term).

#### Extracted Goal: Portfolio Rebalancing

<b>Task type</b>	Portfolio rebalancing
<b>Objective</b>	Reduce tech exposure
<b>Target</b>	25%
<b>Mechanism</b>	Sales
<b>Constraints</b>	
•	Tax optimization enabled
•	Prefer loss harvesting (offset gains)
<b>Approval required</b>	Yes

The agent validates: “I’ll prepare a rebalancing plan to reduce tech from 35% to 25% through sales,

optimized for tax efficiency. I'll present the plan for your approval before executing any trades."

### Intent Understanding Is Continuous

Intent extraction is not a one-time step at task initiation. As the agent works, it may discover:

- The original understanding was incomplete (new constraints emerge)
- The user's intent has evolved (priorities shift mid-task)
- Implicit constraints conflict (cannot optimize for both)
- The task is impossible as specified (constraints are mutually exclusive)

Effective agents surface these discoveries through clarification rather than proceeding with outdated or impossible goals. Intent understanding is iterative, not instantaneous.

Intent understanding connects to other framework questions. Memory (Section 6) improves intent extraction over time by preserving user preferences, matter history, and firm norms. Planning (Section 7) depends on clear intent; extracted goals feed the planning system, while ambiguous intent propagates through the plan as uncertainty. Governance must address intent misalignment as a core risk, verifying goal alignment before deployment and monitoring for drift during operation. Part III examines these controls through the lens of goal dynamics calibration, distinguishing static, adaptive, and negotiated goals and specifying appropriate oversight for each.

Understanding intent bridges the gap between what users say (instruction) and what they mean (intent), shaping the goals and tasks the agent will plan. Clarification beats guessing when ambiguity is significant and stakes are high. Constraints—time, scope, audience, compliance, and budget—matter as much as goals. Validation prevents wasted effort by confirming understanding before significant work begins.

With triggers delivering work and intent extraction revealing what's being asked, the agent faces a practical problem: extracted goals require information the agent does not yet have. The credit agreement analysis task requires the actual credit agreement. The research question requires access to case law databases. The rebalancing plan requires current portfolio positions and market prices. Understanding what you need to do is not the same as having what you need to do it.

Section 4 examines the next question: how does an agent find things out? Perception tools—the interfaces to external information sources—bridge the gap between understanding a task and executing it.

## 4 How Does an Agent Find Things Out?

---

Understanding what someone wants is not the same as being able to deliver it. The previous section examined how agents interpret instructions, extracting goals, detecting ambiguity, and gathering the

context needed to proceed. But even an agent that perfectly understands “Research Ninth Circuit authority on personal jurisdiction for foreign corporations” cannot help if it lacks access to case law databases. An agent that correctly interprets “Analyze this credit agreement from the lender’s perspective” is useless without the credit agreement itself.

This constraint will feel familiar to anyone who has onboarded a new professional. A junior associate’s effectiveness depends as much on access as on reasoning ability. Can they query Westlaw? Does they have credentials for the Bloomberg terminal? Can they search the firm’s precedent database and document management system? The answers to these questions determine which problems they can solve. A brilliant analyst without access to portfolio data reasons in a vacuum; a talented associate without access to the case file works blind.

Agentic systems face exactly the same constraint. A large language model can reason impressively about legal doctrines and financial concepts, but without integrations into external or internal sources, it cannot access current case law, live market prices, client documents, or regulatory filings. These connections are what we call *perception tools*: the interfaces through which an agent observes the world beyond its training data.

### Tools and Perception

A **tool** is a function that allows an agent to interact with external systems. **Perception tools** are the subset that are read-only: they let the agent observe without changing anything. When an agent queries a database, retrieves a document, or fetches market data, the external system’s state remains unchanged.

Perception implements the “P” in the GPA+IAT framework from Part I. It defines the boundary of what information the agent can access, and that boundary matters enormously. An agent with access to public filings reasons differently than one with access to internal deal documents. An agent that can query real-time market data operates differently than one limited to end-of-day prices.

This section examines perception: the read-only tools that let agents gather the information they need. The next section, on action, examines write tools that let agents change things in the world. The distinction matters for governance. Reading a document and sending an email carry fundamentally different risks, and your controls should reflect that difference.

## 4.1 Perception Tool Categories

Not all perception tools work the same way, and choosing the right tool for the task matters. Perception tools generally fall into three categories: information retrieval, document processing, and computation.

**Information retrieval tools** query external platforms and databases to bring back answers. On

the legal side, these tools connect to research services like Westlaw and Lexis in the United States, Beck-Online in Germany, LawNet in Singapore, and similar platforms in other jurisdictions, allowing agents to search case law, retrieve full opinions, check citing references, and download court filings. On the finance side, similar tools connect to platforms like Bloomberg, FactSet, or Refinitiv, enabling agents to pull real-time prices, retrieve company fundamentals, and access analyst research. Many organizations also have internal knowledge bases, including document management systems, deal archives, and precedent databases, that agents need to search to find prior work product relevant to a current matter.

**Document processing tools** transform raw files into data an agent can actually work with. A credit agreement arrives as a PDF; a financial statement comes as a scanned image; a data room contains thousands of files in mixed formats. Before an agent can reason about this content, it needs to extract the text (using OCR for scanned documents), identify what type of document each file is, and pull out structured information like party names, dates, and dollar amounts. During due diligence, for example, an agent reviewing a data room must distinguish contracts from correspondence, extract key terms from each agreement, and organize findings in a way that supports analysis. Without document processing tools, the agent sees only filenames and metadata.

**Computation tools** generate new information through calculation rather than lookup. Consider deadline calculation: the Federal Rules of Civil Procedure require an answer within 21 days of service (Legal Information Institute 2024), but determining the actual due date requires accounting for weekends, court holidays, and local rules. That is a computational task, not a database query. Citation formatters perform a similar function, converting case information into proper Bluebook or other citation styles. In finance, computation tools normalize security identifiers (mapping between tickers, CUSIPs, and ISINs), calculate risk metrics like Value at Risk from position data, or derive analytics that inform investment decisions. These tools produce new information for the agent to use without changing anything in the external world.

## 4.2 In-Context Learning and Retrieval

Before examining specific retrieval mechanisms, we must understand the fundamental capability that makes retrieval useful: **in-context learning**. This concept is central to how modern language models work and why retrieval matters.



## In-Context Learning

**In-context learning (ICL)** is the ability of large language models to learn from information provided in their input—without any update to the model’s underlying parameters (Brown et al. 2020). When you provide examples, documents, or instructions in a prompt, the model adapts its responses based on that context. This is not “learning” in the traditional machine learning sense of updating weights; it is learning *within the conversation*.

In-context learning is what makes retrieval valuable. When an agent retrieves a relevant statute or prior memo and includes it in its prompt, the model can reason about that specific content even though it never saw it during training. The model’s behavior changes based on what appears in its context window.

In-context learning explains why agents can work with information far newer than their training data. A model trained in 2024 can analyze a regulation enacted in 2025—provided that regulation appears in its context. The limitation is the **context window**: the maximum amount of text the model can process at once. Current models handle roughly 200,000 to 1,000,000 tokens (where a token is roughly three-quarters of a word),<sup>1</sup> but the cost, speed, and quality of results varies widely—and dangerously—when operating on large amounts of input. A model may technically accept a million tokens while producing degraded results on tasks requiring attention to details scattered throughout. Professional knowledge bases contain millions of documents regardless; the gap between what fits in context and what exists in the world creates the need for retrieval.

## Why Agentic Architecture Works

The practical limits of context windows explain much of the value of agentic systems. Rather than attempting to process an entire knowledge base in a single prompt—which would exceed limits and degrade quality regardless—an agent decomposes work into focused steps, retrieves only what is relevant to each step, and reasons over smaller, manageable contexts.

This is not merely automation; it is an architectural solution to a fundamental constraint. Planning (Section 7) breaks complex tasks into subtasks. Retrieval fetches specific information for each subtask. The LLM operates within its effective range on each step, even when the overall task would be impossible to handle monolithically.

This decomposition explains both why agentic systems are powerful and why they fail in predictable ways. The reliability cliff (Section 8) shows that short, focused tasks succeed while long tasks fail—precisely because decomposition keeps individual steps within the model’s effective operating range, but errors compound across many steps.

<sup>1</sup>Context window sizes as of late 2025: Claude Opus 4.5 (200k tokens), Gemini 3 (up to 1M tokens), GPT-5.2 (256k tokens). These specifications change frequently; consult current model documentation.

**Embeddings and Semantic Similarity.** To retrieve relevant information from large collections, we need a way to measure what “relevant” means. **Embeddings** provide this capability.

### Embeddings

An **embedding** is a numerical representation of content as a vector—a list of numbers that encodes semantic meaning. Similar concepts produce similar vectors; different concepts produce distant vectors. The sentence “breach of fiduciary duty” and “violation of trust obligations” should have embeddings close together in vector space, even though they share no words.

Similarity between embeddings is typically measured using **cosine similarity** (the angle between vectors) or **Euclidean distance** (the straight-line distance between points). These mathematical operations are fast, enabling search across millions of documents in milliseconds.

Embedding models vary significantly in quality, size, and design goals. Some optimize for speed and compactness; others prioritize semantic precision at higher computational cost. Domain-specific models trained on legal or financial text may outperform general-purpose models for professional applications. The choice of embedding model affects retrieval quality, latency, and infrastructure costs—tradeoffs we discuss in detail in our treatment of embeddings and retrieval techniques elsewhere in this book.

While we focus on text embeddings here, the same principles apply to other content types. Images, audio, and video can all be encoded as embeddings, enabling similarity search across modalities. A scanned contract can be embedded alongside its text; a recorded deposition can be searched by semantic content rather than transcript keywords. Some embedding models are explicitly multimodal, encoding text and images into the same vector space so that a text query can retrieve relevant images and vice versa. The retrieval infrastructure—vector stores and similarity search—works identically regardless of what the embeddings represent.

For text, embeddings transform the problem of finding relevant documents from keyword matching to meaning matching. A search for “material adverse change” can find documents discussing “MAC clauses” or “significant negative developments” because their embeddings are close, even without shared vocabulary.

**Vector Stores.** Embeddings enable semantic search, but storing and searching millions of embeddings efficiently requires specialized infrastructure.

### Vector Stores

A **vector store** (or vector database) is a system optimized for storing embeddings and performing similarity search. Given a query embedding, a vector store returns the most similar document embeddings from its collection. Vector stores use specialized indexing structures (like HNSW or IVF) that make approximate nearest-neighbor search practical at scale.

Vector stores are *infrastructure*—the retrieval mechanism that powers semantic search. They are not the same as the retrieval pattern itself.

**Retrieval-Augmented Generation (RAG).** With these foundations in place, we can now define RAG precisely.

### Retrieval-Augmented Generation (RAG)

**Retrieval-Augmented Generation (RAG)** is a *prompt pattern*—not a software system or mathematical technique (Lewis et al. 2020). RAG augments a model’s context with retrieved information before generation. The pattern has three steps:

1. **Retrieve:** Given a query, find relevant documents using semantic search (embeddings + vector store) or keyword search.
2. **Augment:** Insert the retrieved content into the model’s prompt as additional context.
3. **Generate:** The model produces a response informed by both its training and the retrieved content.

RAG works because of in-context learning. The retrieved documents appear in the prompt, and the model adapts its response to incorporate that specific information. RAG is a pattern for *using* retrieval infrastructure, not the infrastructure itself.

The distinction matters. When evaluating a system, you should ask: What retrieval infrastructure does it use? (Vector store, keyword index, hybrid?) What RAG pattern does it implement? (Basic retrieval, multi-step, with reranking?) These are separate architectural decisions with different tradeoffs.

### Why Precision Matters

Conflating RAG with vector stores or treating RAG as a “system” obscures important design choices. RAG is a prompt pattern that can use various retrieval backends. A RAG implementation might use:

- Pure semantic search (embeddings + vector store)
- Pure keyword search (BM25, traditional search engines)
- Hybrid search (combining both)
- Multi-stage retrieval (coarse retrieval followed by reranking)

Each choice has implications for precision, recall, latency, and cost. Understanding RAG as a pattern rather than a monolithic system helps you evaluate these tradeoffs.

### 4.3 Model Context Protocol (MCP)

One of the persistent challenges in building agentic systems is integration. Every database, every document management system, every market data feed has its own way of accepting queries and returning results. Historically, connecting an agent to a new information source meant writing custom code for that specific system. Multiply that by the number of agents and the number of tools an organization uses, and the integration burden grows quickly.

The Model Context Protocol (MCP) addresses this problem by standardizing how agents access tools (Anthropic 2024; “[Model Context Protocol Specification](#)” 2025). Instead of learning a different integration pattern for each system, agents learn the protocol once and can then access any compatible tool. For organizations, this means a single point of audit and control rather than dozens of bespoke connections to monitor.

The architecture has three components. The **MCP Host** manages the agent and controls what it can access, functioning like a firm’s IT department deciding which systems a new employee can use. The **MCP Client** is the agent-side component that discovers available tools and makes requests. The **MCP Server** is what each information source runs to expose its capabilities through the standard interface. A document management system, an internal knowledge base, or a proprietary analytics platform can each run as an MCP server, and any MCP-compatible agent can then access them without custom integration work.

For perception specifically, MCP defines **Resources** as read-only data access endpoints. These might include document repositories, market data feeds, regulatory filing databases, or internal knowledge bases. The read-only designation matters: an agent with resource access can retrieve documents but cannot modify or file them. This separation enables fine-grained access control that mirrors how organizations already think about permissions.

### The Integration Landscape Is Changing

Historically, many information providers in law and finance offered no programmatic access at all. Legal research platforms required human users working through web interfaces; market data terminals assumed a person at the keyboard. This created a barrier for agentic systems, which need machine-readable interfaces to function.

That landscape is shifting. Competitive pressure and customer demand are pushing providers to open up. Document management systems, e-discovery platforms, and financial data providers increasingly offer APIs that agents can use. Some legal research providers are beginning to follow. As this trend continues, the range of information sources available to agentic systems will expand significantly.

Standards like MCP accelerate this shift by reducing the cost of integration. Without MCP, connecting 10 agents to 10 tools requires 100 custom integrations. With MCP, the same setup requires only 20 implementations, since each agent and each tool learns the protocol once. Recent benchmarks found over ten thousand MCP servers already in the ecosystem (Mo et al. 2025), and that number will likely grow substantially in the years ahead.

## 4.4 Memory as Perception into Institutional Knowledge

Memory systems (Section 6) serve as perception tools for institutional knowledge. The retrieval concepts introduced above—embeddings, vector stores, and RAG—enable agents to perceive accumulated expertise that would otherwise be inaccessible.

When an agent queries a precedent database using the RAG pattern (Section 4.2), it perceives institutional knowledge through in-context learning. The retrieved content appears in the agent’s prompt, allowing it to reason about specific precedents, prior analyses, and established approaches. A search for “breach of fiduciary duty” retrieves documents about “violation of trust obligations” because their embeddings are similar—not because they share keywords.

This mechanism enables perception into knowledge bases far too large to fit in any model’s context window. A law firm’s precedent database might contain decades of work product; a financial institution’s research archive might span thousands of analyst reports. No agent can hold all of this in active context. RAG allows selective retrieval: the agent perceives only the most relevant fragments, guided by semantic similarity to the current task.

Institutional memory provides access to prior work product. When drafting a new registration statement, an agent can perceive prior S-1 filings (IPO registrations), SEC comment histories, and successful disclosure language. This access allows current work to build on verified precedents rather than starting from first principles.

Memory-as-perception distinguishes experienced agents from novices. A junior associate reasons

from what they learned in law school; a senior associate draws on pattern recognition from hundreds of matters. Memory provides agents with this accumulated experience—but only if the retrieval infrastructure connects them to the right knowledge at the right time.

#### 4.5 Domain-Specific Perception Requirements

Perception for regulated professional services requires specialized enhancements. General-purpose search is insufficient; professional agents require authority tracking, jurisdictional awareness, and confidentiality boundaries.

**Authority and Verification.** Information varies in authority. Perception systems must track provenance to ensure reliability. Authority weighting ranks primary sources (statutes, binding precedent) above secondary sources (law reviews, news). When searching for “insider trading liability,” a Supreme Court opinion outranks a commentary article. Source verification confirms that retrieved information originates from the claimed source. Perception tools must return verifiable citations, not just text. Currency validation ensures the authority remains valid. Integrated citators (like Shepard’s or KeyCite) verify that retrieved cases have not been overruled.

**Jurisdiction and Temporal Scope.** Legal and regulatory information is bounded by jurisdiction. California precedent does not bind Texas courts; SEC rules differ from CFTC rules. Perception tools must filter results by relevant jurisdiction. Temporal validity is equally critical. Laws change, and financial data expires. Perception systems must track effective dates. In finance, validity varies by context: milliseconds for trading prices, quarters for compliance reporting. Identifier resolution manages the proliferation of formats. “123 F.3d 456” and “123 F3d 456” refer to the same case. Financial identifiers include tickers, CUSIPs, and LEIs (Legal Entity Identifiers). Perception must normalize these to ensure consistent retrieval.

#### **Matter and Client Isolation.**

Critically, perception must respect confidentiality boundaries. Whether a human or AI, an agent working on Matter A cannot perceive documents from adverse Matter B. This enforcement of **ethical walls** arguably must occur at the perception layer. In financial contexts, an agent advising Client X cannot perceive material non-public information (MNPI) from Client Y’s engagement. Every perception event must be logged, capturing the agent, the query, and the matter context. This audit trail enables compliance review and breach detection. See Section 6 for detailed treatment of isolation requirements; Part III addresses the professional responsibility obligations—including attorney confidentiality duties and fiduciary obligations—that mandate these controls.

#### 4.6 Tool Design Principles

Robust perception tools follow design principles that enable reliable operation in professional environments.

**Single Responsibility.** Each tool should perform one function well. Poorly designed tools bundle multiple functions—searching, formatting, and validation—into opaque interfaces. Untyped return values obscure what callers can expect.

#### Poor Design: Bundled Functions, Untyped Returns

```
def legal_research(query: str) -> dict:
    """Returns... something. Good luck."""
    ...
```

When such a tool fails, diagnosing the error is difficult. A better approach separates tools by function with typed returns. This allows the agent to compose them and isolates failures.

#### Better Design: Single Responsibility, Typed Returns

```
def search_cases(query: str, jurisdiction: str) -> list[Citation]:
    """Returns matching citations from case law database."""

def retrieve_case(citation: Citation) -> CaseText:
    """Fetches full text for a specific citation."""

def shepardize(citation: Citation) -> CitatorResult:
    """Checks validity: good law, distinguished, overruled."""

def format_citation(case: CaseText, style: str) -> str:
    """Converts to Bluebook, ALWD, or other format."""
```

**Graceful Failure.** Production systems inevitably fail. Tools should return informative errors rather than generic exceptions. A poor approach raises exceptions that provide no context.

#### Poor: Opaque Exception

```
def retrieve_case(citation: str) -> dict:
    result = db.query(citation)
    return result["text"] # raises KeyError if not found
```

A better approach uses typed result objects that make success and failure explicit.

#### Better: Typed Result with Structured Errors

```
class CaseNotFoundError(BaseModel):
    citation: str
    reason: str
    suggestions: list[str]

def retrieve_case(citation: Citation) -> CaseText | CaseNotFoundError:
    """Returns case text or structured error with recovery options."""
    if not (result := db.query(citation)):
        return CaseNotFoundError(
            citation=str(citation),
            reason="Case may not be in database",
            suggestions=["Check citation format", "Try alternative reporter"]
        )
    return CaseText(...)
```

In professional practice, graceful failure prevents malpractice. When an agent cannot find authority, it must report that explicitly rather than proceeding silently.

**Least Privilege and Rate Limiting.** Perception tools should request minimum necessary permissions. A legal research tool requires read access to case databases, not write access to the document management system. If a compromised agent gains perception credentials, damage is limited to information disclosure rather than destruction. Rate limiting addresses a common failure mode: infinite search loops. Tools should track invocation frequency and refuse requests beyond reasonable thresholds. If an agent searches five times without results, the tool should force a stop and escalation.

## 4.7 Evaluating Perception Capabilities

When evaluating agentic systems, you should assess perception against criteria that matter for professional practice.

**Coverage** determines which sources the agent can access. A litigation agent that queries Westlaw but not state-specific databases has incomplete coverage. You must map available perception tools against information needs to identify gaps.

**Retrieval quality** measures whether the agent finds relevant information. Test with known-good queries where the correct result is established. Measure both precision (relevance of results) and recall (completeness of relevant results).

**Verification** confirms that the system distinguishes authoritative from secondary sources. You must ensure that retrieved information is traceable to its source and that citations are independently verifiable.



**Access controls** ensure that permissions are appropriate. The agent must access only what it should, and confidentiality boundaries must hold across matter and client lines.

**Failure handling** reveals system behavior when perception fails. Does it retry, try alternatives, or escalate? It must not crash or proceed with incomplete information.

**Audit capability** confirms that every perception event is logged. You must be able to reconstruct what information the agent accessed during a task for compliance review.

## 4.8 From Perception to Action

Perception enables agents to gather information, but professional value ultimately requires effecting change: filing documents, sending communications, executing trades. This distinction between observing the world and changing it is fundamental to agent architecture, and the protocols we use reflect it. MCP, introduced earlier in this section, explicitly separates **Resources** (read-only data access) from **Tools** (operations that modify state). A single MCP server might expose both capabilities—a document management system could offer read access to files alongside the ability to create, modify, or delete them—but the protocol distinguishes these so that access control and governance can treat them differently.

The distinction matters because the consequences of failure differ fundamentally. When perception tools fail—a search returns wrong results, a document fails to load—the external world remains unchanged. The agent can retry, try alternatives, or escalate to human review without having caused any harm beyond wasted time. Action tools carry different stakes entirely. They file documents that become part of court records, send emails that reach recipient inboxes, execute trades that transfer ownership at market prices. Once executed, many actions cannot be undone, or can only be undone at significant cost. The agent’s mistakes become facts in the world.

Section 5 examines action capabilities in detail, beginning with the conceptual foundations that distinguish actions from observations and developing the governance frameworks that these differences require.

## 5 How Does an Agent Make Things Happen?

---

A junior associate’s role extends beyond research to producing work product. They draft memos, send emails, file documents, and schedule meetings. A trader’s role extends beyond analysis to execution. They enter orders, route trades, and confirm allocations. Value derives from action, not just observation.

Agentic systems face the same imperative. An agent that only reads—searching databases, retrieving documents, analyzing information—produces no deliverable. To complete tasks, agents must *act*: generate documents, send communications, update systems, or execute transactions. Action

implements the “A” in the GPA+IAT framework introduced in Part I (Bommarito et al. 2025).

### Action Tools

**Action tools** enable agents to change the state of external systems. Unlike perception tools (read-only), action tools *write*: they file documents, send messages, execute trades, and update databases. Once executed, some actions cannot be undone.

The distinction between perception and action is fundamental to governance. Perception risks involve internal errors (accessing wrong information). Action risks involve external consequences (harming clients, violating regulations, creating liability).

## 5.1 Conceptual Foundations of Action

Before examining specific action tools, we establish the conceptual foundations that distinguish actions from observations and that shape how we design, govern, and reason about them.

**Actions as State Transitions.** From a logical perspective, actions are state transitions: operations that move the world from one configuration to another. Before the filing, the motion was not on the court docket; after the filing, it is. Before the trade, the portfolio held one set of positions; after the trade, it holds another. This framing—common in computer science, philosophy, and AI planning research—highlights that actions have preconditions that must hold before they can execute and postconditions that describe the world after they complete.

This state-transition view raises a crucial question that philosophers and AI researchers call the **frame problem**: when an action occurs, what exactly changes, and what stays the same (McCarthy and Hayes 1969)? Filing a document changes the court record, but it should not change the client’s contact information, the matter’s billing status, or the contents of unrelated files. The frame problem is surprisingly difficult to solve in general, but well-designed action tools address it by making their effects explicit—specifying what they modify, what they preserve, and what conditions must hold for the action to succeed.

**Performative Actions.** Some actions are *performative* in the sense developed by philosophers of language (Austin 1962): they do not merely describe or report on the world but constitute changes to it. When a judge says “I sentence you to five years,” the utterance does not describe a sentencing—it is the sentencing. When parties sign a contract, the signatures do not report that an agreement exists—they bring the agreement into existence.

Many professional actions share this performative character. Filing a motion is not a report about legal status; it is an act that changes legal status. Executing a trade is not an observation about ownership; it is a transfer of ownership. Sending a legal opinion creates reliance that may give rise to liability. This performative quality explains why action governance must be stricter than perception governance: an agent that retrieves the wrong document has made a research error that can be

corrected, but an agent that files the wrong document has changed legal reality in ways that may be difficult or impossible to undo.

**Idempotency and Safe Retry.** Computer science formalizes an important property of operations called **idempotency**: an operation is idempotent if performing it multiple times produces the same result as performing it once. Reading a file is idempotent—reading ten times leaves the file unchanged. Retrieving a case from Westlaw is idempotent. But sending an email is not idempotent: sending the same message ten times produces ten emails in the recipient’s inbox. Executing a trade is not idempotent: executing the same order ten times produces ten separate transactions.

Idempotency matters enormously for error recovery and system reliability. When an agent’s connection drops mid-operation, or when a timeout occurs before confirmation arrives, the agent faces a difficult question: did the action complete? For idempotent operations, the answer does not matter—the agent can safely retry. For non-idempotent operations, retry might cause duplicate actions with serious consequences: double payments, duplicate filings, repeated client communications. Robust action tools must either be designed for idempotency from the start—typically by using unique transaction identifiers that allow the system to detect and reject duplicates—or must provide explicit confirmation mechanisms that let the agent verify whether the action completed before deciding whether to retry.

**Implications for Tool Design.** These conceptual foundations have practical implications for how we design and evaluate action tools. Tools should document their preconditions (what must be true before the action can execute), their postconditions (what will be true after successful execution), and their effects on system state (what changes and what remains unchanged). Tools should indicate whether they are idempotent and, if not, what mechanisms exist to prevent duplicate execution. Tools should distinguish between actions that are truly performative—creating new legal or financial realities—and those that merely update internal records. These distinctions inform the governance frameworks developed throughout this section.

## 5.2 Action Tool Categories

Action tools vary in consequence. The critical dimension is **reversibility**: the cost and feasibility of undoing an action. Research on rollback-augmented systems demonstrates that selective state rollback reduces catastrophic failures in safety-sensitive environments (Grinsztajn et al. 2021). We categorize action tools along a spectrum from easily undone to permanent.

**Communication tools** send information to others. Internal communications (emails to colleagues, Slack messages) are *partially reversible*. You can follow up with corrections, though you cannot unsend. External communications (emails to clients, letters to counsel) carry higher stakes because recipients are outside your control. Retractions are possible but damage professional reputation. Automated alerts (compliance notifications, reminders) are generally low-risk if templated. Governance typically

relies on post-hoc review for internal actions and pre-approval for external ones.

**Document management tools** create and organize work product. These are *largely reversible*. Drafting memos, generating reports, and filing documents in internal systems occur within the firm’s control. Revisions are possible until distribution. Template application (populating standard forms) is low-risk if the templates are pre-validated. The primary control is review before external release.

**Filing and submission tools** send documents to external authorities. These are *largely irreversible*. Court filings via CM/ECF (Case Management/Electronic Case Files) become public record upon submission. Amendments are possible but the original remains visible. Regulatory submissions via EDGAR (Electronic Data Gathering, Analysis, and Retrieval) or FINRA systems trigger legal obligations. Errors may compel public corrections or enforcement actions. Contract execution creates binding legal obligations that are difficult to unwind. These actions require mandatory pre-approval.

**Transaction execution tools** transfer value or change ownership. These are *effectively irreversible* or costly to reverse. Trade execution involves entering orders and confirming allocations. Reversal requires offsetting trades at market prices, realizing any loss. Payment processing (wire transfers) moves funds immediately; recovery relies on recipient cooperation. System updates (modifying production databases) can disrupt operations. These actions demand the strictest controls: multi-factor approval, segregation of duties, and real-time monitoring.

### 5.3 The Reversibility Framework

Reversibility dictates oversight structure. Consider how you delegate to a junior associate: fully reversible work (research, drafting) proceeds independently with post-hoc review; partially reversible work (internal emails) gets checkpoint review; largely irreversible work (client communications, filings) requires pre-approval; and irreversible work (trades, wires) demands multi-party approval. Table 3 summarizes this mapping. Agent governance must enforce controls corresponding to each action’s reversibility classification.

**Table 3:** Reversibility determines oversight

Reversibility	Examples	Oversight	Recovery
Fully	Research; drafts	Post-hoc	Delete/revise
Partially	Internal emails; alerts	Checkpoint	Correction
Largely irreversible	Filings; client emails	Pre-approval	Amend/retract
Irreversible	Trades; wires	Multi-party	Offset (costly)

### 5.4 MCP Tools and Prompts for Action

The Model Context Protocol (MCP) defines two capability types relevant to action governance.

**MCP Tools** are executable functions that change state. Unlike read-only Resources, Tools create

documents, send communications, submit filings, and execute transactions. Tool manifests should include risk metadata: reversibility classification, approval requirements, and audit logging needs. This allows the MCP Host to enforce controls automatically.

**MCP Prompts** are reusable templates for common tasks. For action workflows, prompts encode Standard Operating Procedures (SOPs).

- **Legal:** Contract review checklists, filing preparation workflows.
- **Finance:** Trade compliance checks, client onboarding sequences.

Prompts standardize action sequences, reducing variation and error. They act as "guardrails" by ensuring the agent follows the approved procedure for high-stakes actions.

## 5.5 Action Security

Every action interface is a security boundary. Actions access external systems and create real-world consequences.

All action tools must implement core security controls:

- **Authentication:** Verify the agent's identity via service accounts with strong credentials.
- **Authorization:** Enforce role-based access control (RBAC) and least privilege.
- **Input Validation:** Reject malformed requests by validating all parameters against strict schemas.
- **Output Confirmation:** Require human approval before executing high-stakes actions.
- **Rate Limiting:** Cap action frequency to prevent runaway execution.
- **Audit Logging:** Record every action with context (agent, timestamp, parameters, matter/client).

Beyond core controls, specific threats require targeted mitigations (OWASP Foundation 2025; Liu et al. 2024):

**Prompt Injection via Action Parameters.** Adversaries may embed malicious instructions in data that the agent processes and passes to tools. Mitigation requires sanitizing all parameters and never passing raw user input directly to sensitive action interfaces.

**Privilege Escalation via Tool Chaining.** An agent might combine multiple low-privilege tools to achieve a high-privilege outcome. Mitigation involves analyzing tool combinations and requiring approval for sequences that cross security boundaries.

**Action Replay.** An attacker might capture a valid action request (e.g., "Pay \$100") and replay it multiple times. Mitigation requires **nonces** (unique, one-time numbers) or timestamps to ensure each request is processed only once.

## 5.6 Approval Workflows

For non-reversible actions, the agent prepares and the human approves (Parasuraman et al. 2000). We define three patterns for this division of responsibility.

The **Single Approver** pattern suits routine actions with clear authority. The agent completes preparation and presents it to one designated human. *Example:* The agent prepares a draft court filing; the supervising attorney reviews and approves; the agent submits.

The **Multi-Party Approval** pattern applies to high-stakes actions with significant exposure. Multiple independent humans must sign off. *Example:* The agent prepares a wire transfer. Operations reviews the amount. Compliance reviews the purpose. A manager provides final approval. Only then does the agent execute.

The **Escalating Approval** pattern adjusts authority based on risk tiers. *Example:* Trades under \$100k require desk manager approval. Trades between \$100k and \$1M require senior trader approval. Trades over \$1M require CIO approval.

Effective approval requests must enable informed decision-making. The agent should present:

- **Action:** Clear description of what will happen.
- **Context:** Why is this needed?
- **Risk:** What are the potential negative outcomes?
- **Reversibility:** Can this be undone?
- **Evidence:** What data supports this decision?

The approver should be able to decide based on the request alone, without needing to investigate the raw data.

## 5.7 Rate Limiting and Circuit Breakers

Agents can fail in loops: repeatedly submitting the same request, sending duplicate messages, or retrying failed transactions.

**Rate Limiting** caps action frequency. The thresholds below are *illustrative*; calibrate them to your workflow, risk tolerance, and regulatory obligations.

- *Per-Action:* e.g., max 5 emails per minute.
- *Per-Matter:* e.g., max 20 actions per day without review.
- *Cost:* e.g., max \$1,000 in transaction fees per session.

When limits are reached, the agent must pause and escalate.

**Circuit Breakers** automatically stop execution upon anomaly detection. These examples are also *illustrative* and should be tuned to baseline behavior and threat models.

- *Failure Count:* e.g., if an action fails three times, stop.
- *Spike Detection:* e.g., if action rate spikes 5× above baseline, pause (potential compromise).
- *Cumulative Limit:* If daily total exceeds safety thresholds, lock the system.

Circuit breakers transform runaway failures into controlled pauses, buying time for human intervention.

## 5.8 Evaluating Action Capabilities

When evaluating agentic systems, assess action capabilities against professional standards.

**Inventory:** Map all available action tools against workflow requirements. Verify that no "unnecessary" tools are enabled (Least Privilege).

**Classification:** Verify that each tool is correctly classified by reversibility. Ensure that "delete database" is not classified as "fully reversible."

**Controls:** Confirm that approval gates exist for all irreversible actions. Verify that approvers receive sufficient context. Check authentication and audit logging.

**Safety:** Test rate limits and circuit breakers. Simulate a "runaway agent" scenario to ensure the system locks down. Verify rollback procedures: if an action fails, can you recover?

## 5.9 From Action to Governance

Action tools are where agentic systems create real-world consequences. Governance here differs in kind from perception governance.

Perception risks (accessing wrong data) are internal. Action risks (sending wrong emails, executing wrong trades) are external and potentially irreversible. This section established the architectural controls: the Reversibility Framework, approval workflows, and circuit breakers.

Section 9 examines when agents should *not* act—recognizing situations that require human decision-making. The interplay between action capability and escalation judgment is central to safety. Section 6 addresses memory: how agents maintain context across sessions and learn from experience.

# 6 How Does an Agent Remember Things?

---

The previous two sections examined how agents gather information (perception) and effect change (action). However, these capabilities operate in the moment: the agent perceives the current state, reasons about it, and acts. Without memory, every interaction resets. The agent cannot recall prior research, successful strategies, or case history. Memory transforms an agent from a stateless tool into a system that learns and adapts.

Every experienced professional knows that institutional memory distinguishes efficient work from reinventing the wheel. When you start a new securities registration, you do not begin from scratch. You pull prior S-1 filings (IPO registrations), review SEC comment history, and check the precedent database for disclosure language. You do not re-research basic questions. The firm maintains templates that incorporate years of accumulated knowledge.

The same principle applies to portfolio management. When you revisit an equity position, you do not rebuild the investment thesis. You retrieve the research file, review prior models, and update



assumptions with new data. Accumulated research enables incremental refinement rather than duplicative work.

Memory in agentic systems serves a parallel function: context retention across sessions and learning from experience. With memory, the agent maintains continuity—building on prior work rather than starting over.

### Agent Memory

**Agent memory** stores and retrieves information across timescales (Park et al. 2023; Wang et al. 2024a).

- **Working Memory:** The documents actively loaded in the agent’s context (like papers on a desk).
- **Episodic Memory:** The history of actions and outcomes for a specific matter (like a case file).
- **Semantic Memory:** The general principles and institutional knowledge available for retrieval (like the firm’s precedent archive).

## 6.1 Memory Types: From Desk to Archive

Law firms use layered filing systems, each suited to different timescales. The associate’s desk holds active work; the matter file contains engagement history; the precedent database archives institutional knowledge. Each layer trades immediacy for capacity. Agent memory systems follow the same pattern.

**Working memory** utilizes the **context window**—the text currently loaded in the LLM’s active attention. Just like desk space, context windows have strict limits. An associate can only have so many documents open at once; an agent can only hold so many **tokens** (units of text, roughly 0.75 words) in active context. As of late 2025, leading models handle roughly 200,000 tokens. When the task exceeds this limit, you need other storage systems. In finance, this parallels the active trading screen: live prices and positions are immediate but transient.

**Episodic memory** corresponds to the matter file. Every memo, correspondence, and research result related to an engagement goes here. The associate does not re-research answered questions; the file provides the history. In agentic systems, episodic memory captures the log of actions and outcomes (Park et al. 2023). The agent records: “I searched for Ninth Circuit venue cases, found three opinions, and drafted the analysis.” When asked a follow-up, the agent retrieves that prior state. This mirrors the financial research file: you pull prior analysis and update it, rather than starting fresh.

**Semantic memory** is the firm’s precedent database. Institutional knowledge accumulates over decades. When you need a force majeure clause, the database offers fifty examples. Agentic systems access semantic memory through the RAG pattern introduced in Section 4.2: retrieve relevant content



from a large corpus, inject it into the prompt, and generate a response informed by that specific knowledge (Lewis et al. 2020).

The retrieval infrastructure powering semantic memory—embeddings and vector stores—was defined in Section 4.2. Here, the key insight is that semantic memory works because of *in-context learning*: the model adapts its behavior based on what appears in its prompt. Retrieved precedents become part of the agent’s working context, allowing it to reason about specific examples even when those examples were created after the model’s training.

## 6.2 Implementing the RAG Pattern

The RAG pattern (Section 4.2) requires careful implementation to work reliably in professional contexts. The basic pattern—retrieve, augment, generate—becomes a pipeline with several stages, each introducing design decisions that affect quality, latency, and cost.

**The RAG Pipeline.** A typical implementation has four stages:

1. **Chunking:** Breaks documents into semantic units (sentences, paragraphs, sections, or sliding windows) while preserving metadata (source, date, jurisdiction). Chunk size affects retrieval: too small loses context; too large dilutes relevance.
2. **Embedding:** Converts each chunk into a vector using an embedding model. Different models have different strengths; legal-specific embeddings may outperform general-purpose ones for professional content.
3. **Retrieval:** Finds chunks similar to the query by comparing vectors (using cosine similarity or similar metrics). Returns the top-*k* most similar chunks.
4. **Augmentation and Generation:** Injects retrieved chunks into the prompt and generates a response. The model’s in-context learning capability allows it to reason about the retrieved content.

**Advanced RAG Patterns.** Robust implementations enhance basic RAG with patterns that improve precision and authority:

- **Hybrid retrieval** combines semantic search (embeddings) with keyword search (BM25) (Robertson and Zaragoza 2009), catching both conceptual matches and exact terms (like specific case citations that must match precisely).
- **Query rewriting** transforms vague questions (“What’s the rule?”) into specific search queries based on conversation history and domain knowledge (Ma et al. 2023).
- **Reranking** scores initial results by authority or relevance, ensuring binding precedent ranks above secondary sources (Yu et al. 2024). A Supreme Court opinion should outrank a blog post, even if both are semantically similar to the query.

- **Filtered retrieval** constrains results by metadata—jurisdiction, date, document type—preventing agents from citing inapplicable authority.

#### Warning: The Hallucination Risk

Fabricated citations remain a critical failure mode even with RAG. Studies show that RAG-enabled tools can hallucinate 17–33% of the time (Dahl et al. 2024). The model may generate plausible-sounding citations that do not exist in the retrieved context—or anywhere.

You must implement verification: before any citation reaches the user, confirm that the source exists in the retrieved context. This is not optional for professional applications.

### 6.3 Domain-Specific Memory Considerations

Memory systems for regulated industries require enhancements that go well beyond generic implementations. Three dimensions matter most: authority, jurisdiction, and time.

Consider how a legal researcher thinks about sources. When investigating insider trading liability, a Supreme Court opinion carries far more weight than a law review article discussing the same topic. The human researcher instinctively applies this hierarchy; an agent’s memory system must do the same. This means tagging documents with their position in the authority hierarchy—primary sources like statutes and binding precedent at the top, secondary sources like treatises and articles below—and ensuring that retrieval algorithms surface higher-authority documents more prominently. Financial systems face analogous challenges: an SEC no-action letter provides more reliable guidance than a client alert summarizing the same issue, and memory systems should reflect that difference.

Jurisdiction adds another layer of complexity. Legal information does not exist in a vacuum; it operates within territorial boundaries. California precedent does not bind Texas courts, and New York banking regulations have no force in London. A memory system that fails to account for these boundaries will produce results that are not merely unhelpful but actively misleading. When an agent researches Delaware corporate law, it must filter results to surface Delaware authorities as controlling while clearly distinguishing persuasive authority from other jurisdictions. This requires rich metadata tagging and retrieval logic that can enforce strict jurisdictional filtering when the task demands it.

Time presents perhaps the most challenging dimension. Law evolves through legislative amendments, regulatory updates, and judicial decisions that overturn or limit prior holdings. A case from 1985 may have been explicitly overruled, limited to its facts, or superseded by statute. Memory systems must integrate with citator services like Shepard’s or KeyCite to validate that retrieved precedents remain good law. Financial data introduces even more varied temporal requirements: market prices become stale in milliseconds, earnings reports remain relevant for quarters, and industry analyses may hold value for years. Effective memory systems tag all data with effective dates and expiration

windows, triggering refresh processes when content ages beyond its useful life.

Finally, professional domains create identifier resolution challenges that generic systems rarely encounter. Legal citations appear in multiple formats—“123 F.3d 456” and “123 F3d 456” refer to the same case, but a naive system might treat them as distinct. Companies accumulate multiple identifiers across different contexts: stock tickers, CUSIPs, ISINs, and Legal Entity Identifiers (LEIs) all point to the same entity but appear in different documents and databases. Without careful normalization, retrieval systems fail to connect related records, fragmenting information that belongs together.

## 6.4 Matter and Client Isolation

Perhaps no aspect of memory architecture matters more for professional services than enforcing strict **ethical walls** between matters and clients. The consequences of failure are severe: if an agent working on Matter A inadvertently accesses privileged information from Matter B—particularly when the matters involve adverse parties—the result may be privilege waiver, disqualification, and malpractice liability. Financial services face parallel risks when Material Non-Public Information (MNPI) leaks across the walls that separate investment banking from trading operations.

Implementing effective separation requires a layered approach that begins with architectural isolation. Each matter should occupy its own namespace within the memory system, creating a logical partition that separates its documents, notes, and work product from all other matters. Retrieval operations must be scoped to respect these boundaries: when an agent queries memory in the context of a particular matter, the system should only search within that matter’s namespace, never reaching across into other partitions regardless of how relevant the results might appear.

Access controls provide the next layer of protection. Role-based permissions determine which agents and human users can access each namespace, mirroring the ethical wall policies that law firms and financial institutions already maintain for their human professionals. An associate staffed on a merger transaction should have access to that deal’s namespace but not to the namespace for litigation against the same company being handled by a different team.

Audit trails complete the picture by creating a verifiable record of every interaction with the memory system. Each read and write operation should be logged with a timestamp, the identity of the requesting agent or user, and the matter identifier. These logs serve multiple purposes: they enable compliance review, support investigations if a breach is suspected, and provide documentation that the organization maintained appropriate controls.

Retention and deletion policies add a temporal dimension to isolation. Organizational policy often requires that matter files be retained for specified periods and then destroyed; legal and regulatory requirements may impose additional constraints depending on the engagement type, jurisdiction, and applicable rules. When a matter closes or a client relationship ends, the associated memory namespace should be archived or deleted according to a documented retention schedule. Critically, deletion must be verifiable—the organization needs confidence that purged data is truly gone, not

merely hidden from normal retrieval.

## 6.5 Evaluating Memory Systems

Evaluating memory systems for professional practice requires metrics that go beyond generic information retrieval benchmarks. The stakes are too high for abstract measurements; testing must reflect the actual demands of legal and financial work.

Retrieval quality remains foundational, but measurement must be grounded in professional standards. The classic metrics of *precision* (what fraction of retrieved documents are actually relevant?) and *recall* (what fraction of relevant documents did we successfully retrieve?) provide a starting point. For legal applications, the gold standard test is comparison against expert work product: given a research question, does the agent find the same authorities that a skilled attorney cited in their research memo? Missing a controlling case is not merely a statistical shortfall—it could mean missing the argument that wins or loses the matter.

Isolation integrity demands its own testing regime. The goal is simple to state: queries executed in the context of Matter A should never return documents from Matter B. Verification requires adversarial testing that deliberately attempts to breach these walls, probing for edge cases where namespace boundaries might leak. Red-team exercises should try cross-matter queries, test whether embedding similarities can surface isolated documents, and verify that access controls hold even when users attempt to escalate privileges.

Temporal validity measures how well the system maintains currency. In legal contexts, this means tracking how often retrieval surfaces precedent that has been overruled, limited, or superseded—and how quickly new developments propagate into the knowledge base after a court issues a significant opinion or a regulator announces a rule change. Financial applications face even tighter requirements: stale pricing data can render analysis worthless or worse, and the lag between a market event and its reflection in the knowledge base may need to be measured in seconds rather than days.

Finally, scale performance ensures that the system remains responsive as data volumes grow. Episodic memory expands rapidly in professional practice—a single complex litigation matter can generate tens of thousands of documents, and a busy practice accumulates matters over years. Retrieval latency must remain low enough for interactive use even as the underlying corpus grows, which requires careful attention to indexing strategies, hardware provisioning, and architectural choices that allow the system to scale horizontally.

## 6.6 Adaptation: Learning and Its Consequences

Memory enables **adaptation**—the “A” in the GPA+IAT framework from Part I. An agent that adapts changes its behavior based on experience, ideally improving over time. This capability transforms agents from static tools into systems that learn. But adaptation also introduces risks that static systems avoid.

## Adaptation

**Adaptation** is behavioral change based on experience. In agentic systems, adaptation occurs through three mechanisms:

- **In-context adaptation:** The agent changes behavior within a session based on instructions, examples, or retrieved content. This is in-context learning in action.
- **Cross-session adaptation:** The agent changes behavior across sessions by persisting information in memory and retrieving it later.
- **Model-level adaptation:** The model's weights are updated through fine-tuning or reinforcement learning. This is less common in deployed systems due to cost and complexity.

In-context adaptation is immediate and powerful. You provide the agent with examples of preferred output format, and it adapts its responses accordingly. You correct an error, and subsequent responses reflect that correction. This is why retrieval matters: by controlling what appears in the agent's context, you control how it adapts.

Cross-session adaptation requires persistent memory. The agent stores information—user preferences, successful strategies, matter-specific context—and retrieves it in future sessions. This creates continuity: the agent “remembers” that this client prefers concise memos, that this portfolio manager wants risk metrics in basis points, that this matter involves a specific contractual provision.

**Opportunities from Adaptation.** Adaptation enables capabilities that static systems cannot match:

**Personalization.** The agent learns user preferences—communication style, level of detail, preferred formats—and tailors responses accordingly. A partner who always asks follow-up questions about procedural history gets proactive procedural context. An analyst who focuses on downside scenarios gets risk-weighted analysis by default.

**Performance improvement.** The agent learns from feedback. Corrections persist: “Actually, this jurisdiction uses different venue rules” becomes part of the agent's knowledge for future queries. Successful strategies are reinforced: the research approach that found relevant authority is remembered and reapplied.

**Domain specialization.** Through accumulated episodic and semantic memory, agents develop expertise in specific practice areas or market segments. An agent that has worked on dozens of M&A transactions “knows” the typical deal structure, common negotiation points, and relevant precedents—not through training, but through memory.

**Continuity across handoffs.** When a professional leaves or a matter transfers, institutional knowledge often walks out the door. Memory-enabled agents maintain continuity. The research history, strategic decisions, and accumulated context persist in retrievable form.

**Risks from Adaptation.** The same mechanisms that enable adaptation create risks that require governance:

**Security: Memory poisoning.** If an adversary can write to an agent’s memory, they can influence future behavior (Clop and Teglia 2024). A document designed to be retrieved—containing misleading instructions or false information—can corrupt the agent’s responses. This is prompt injection via the memory layer. The attack surface expands beyond the current conversation to include everything the agent might retrieve.

**Security: Data leakage through memory.** Memory that persists across sessions can leak information across contexts. If the agent stores sensitive information from Matter A and retrieves it during Matter B, confidentiality is breached. This risk intensifies with shared memory systems that serve multiple users or matters.

**Governance: Behavioral drift.** As agents adapt, their behavior changes in ways that may not be predictable or desirable. An agent that learns from user feedback might learn bad habits—shortcuts that work in routine cases but fail in edge cases. Accumulated memory can shift the agent’s responses away from its original design.

**Governance: Accountability gaps.** When behavior depends on memory state, accountability becomes complex. Which version of the agent produced this output? What was in its memory at the time? If the agent’s behavior changes based on accumulated experience, audit trails must capture not just inputs and outputs but memory state.

**Cost: Storage and retrieval overhead.** Memory consumes resources. Episodic memory for a complex litigation matter can grow to millions of tokens. Semantic memory for a precedent database can require terabytes of embeddings. Every retrieval operation has latency and cost. These costs compound as memory grows.

**Latency: Retrieval time.** RAG adds latency to every query. The agent must embed the query, search the vector store, retrieve results, and inject them into the prompt before generation begins. For real-time applications—trading, live client calls—this latency may be unacceptable.

### The Adaptation Tradeoff

Adaptation is not optional. Any system that uses RAG, maintains conversation history, or persists user preferences is adapting. The question is not whether to allow adaptation, but how to govern it.

Key governance questions:

- **What can be written to memory?** Control the write path to prevent poisoning.
- **What can be retrieved?** Scope retrieval to prevent leakage.
- **How is memory validated?** Review accumulated memory for accuracy and appropri-

ateness.

- **When is memory cleared?** Define retention policies and implement secure deletion.
- **How is drift detected?** Monitor behavior changes over time.

## 6.7 From Memory to Planning

Memory provides the context agents need to plan effectively. Without memory, agents cannot learn from failed strategies, cannot build on prior work, and cannot maintain the continuity that complex tasks require. The adaptation mechanisms discussed above (Section 6.6) transform memory from passive storage into active learning—but that learning must be channeled into productive planning.

Consider how an experienced associate approaches a new research task. They do not start from scratch; they recall similar matters, retrieve relevant precedents, and apply strategies that worked before. Memory-enabled agents can do the same: retrieve prior research, recall successful approaches, and avoid repeating failures.

Section 7 examines the next question: how does an agent break a big job into steps? Just as the case file enables strategic litigation planning, agent memory enables systematic task decomposition. The adaptation capabilities discussed here—personalization, domain specialization, performance improvement—all feed into more effective planning.

## 7 How Does an Agent Break a Big Job into Steps?

---

A litigation partner approaching a new matter understands that the full process from initial consultation to trial and beyond is a long and detailed process involving a series of steps in a particular sequence. To navigate the storm ahead, the partner develops a strategy: discovery first (identifying needed facts), then dispositive motions if the law favors the client, followed by settlement discussions or trial preparation. Discovery breaks into phases: initial disclosures, document requests, interrogatories, and depositions. Tasks distribute across the team: a senior associate handles briefing, a junior associate reviews documents, and a paralegal manages scheduling. Throughout, the partner monitors progress against deadlines and adjusts strategy based on new facts.

This is **planning**: decomposing complex goals into action sequences. It mirrors the litigation roadmap or deal timeline that guides execution. Without planning, agents react to immediate observations without strategy. With planning, they work systematically toward objectives, adapt when circumstances change, and recognize completion.



## Planning

**Planning** decomposes complex goals into sequences of actions (Russell and Norvig 2020). It encompasses:

- **Decomposition:** Breaking large tasks into manageable steps.
- **Sequencing:** Ordering steps logically based on dependencies.
- **Allocation:** Assigning steps to specific tools or sub-agents.
- **Monitoring:** Tracking progress toward the goal.
- **Adaptation:** Adjusting the plan when circumstances change.

Without planning, an agent resembles an associate running searches without a strategy—busy but not progressing toward a deliverable.

### 7.1 Planning Patterns

Three patterns dominate agent planning, each suited to different task types.

**ReAct (Reasoning + Acting).** The most fundamental pattern interleaves reasoning with action (Yao et al. 2022). Consider a partner asking for authority on an unenforceable forum selection clause. The associate reasons: “Key grounds are unconscionability and public policy. I will start with *Atlantic Marine*.” They search, observe results, and reason again: “Unconscionability cases involve consumer contracts, not our commercial context. The public policy line is stronger.” They search again, refining based on results.

Each cycle has three components:

- **Thought:** Explicit reasoning about what to do next.
- **Action:** A tool call to gather information or effect change.
- **Observation:** The tool output that informs the next thought.

Reasoning traces make decisions transparent and auditable. ReAct works well for exploratory tasks where you learn as you go—legal research, fact investigation, and market analysis.

**Plan-Execute.** This pattern separates planning from execution. For a document review task (“Review 50 contracts for choice-of-law provisions”), the associate creates a plan: list the contracts, open each one, extract the provision, and record findings. Then they execute systematically. The plan remains static because the task is well-defined.

Plan-Execute fits established workflows: due diligence checklists, compliance reviews, and document assembly. You create the plan upfront and execute methodically. Research variants like ReWOO (Xu et al. 2023) (separating reasoning from observation) and LLMCompiler (Kim et al. 2024) (optimizing execution graphs) enable parallel tool calling. However, the core pattern remains: plan first, then execute.

**Hierarchical Planning.** Law firms decompose matters into workstreams delegated through layers.



A parent agent receives a high-level goal, breaks it into sub-goals, and delegates to specialists. “Prepare for trial” becomes:

- Finalize witness list (delegated to Agent A).
- Prepare exhibits (delegated to Agent B).
- Draft witness questions (delegated to Agent C).

Each specialist may decompose further. This enables parallelization and specialization, mirroring how litigation teams work. Section 10 details these coordination patterns.

These patterns represent a shift from traditional workflow automation. Traditional engines used **static orchestration**: predefined graphs specifying exact steps and branches (BPM systems). The workflow was designed at build time; the engine merely executed it.

#### Static vs. Dynamic Orchestration

**Static orchestration** executes predefined workflow graphs. The same input always produces the same execution path. It is predictable and auditable but inflexible.

**Dynamic orchestration** reasons about task decomposition at runtime. The LLM examines the goal, considers available resources, and constructs a plan on the fly. It is adaptive but less predictable.

LLM-based orchestration is inherently dynamic. “Prepare for trial” decomposes differently depending on case complexity. The LLM constructs a delegation structure based on the specific context. This adaptability is both the promise and the challenge.

Static workflows handle anticipated scenarios. Dynamic orchestration handles novel situations. Maintenance costs also differ: static workflows require explicit updates, while dynamic orchestration absorbs changes through prompt updates.

#### Auditability Challenge

Static workflows produce predictable execution traces. Dynamic orchestration may produce different decompositions for similar inputs, complicating audit. For regulated applications, you must log the *reasoning* behind orchestration decisions, not just the decisions themselves.

Production systems often combine both. High-volume, well-understood processes use static workflows. Complex, novel tasks use dynamic orchestration. The planning patterns described above—ReAct, Plan-Execute, Hierarchical—are forms of dynamic orchestration.

## 7.2 Choosing the Right Planning Pattern

Selecting the right pattern depends on task structure and required autonomy.

**Table 4:** Planning pattern selection guide

Task Type	Pattern	Autonomy	Example
Well-defined steps, known scope	Plan-Execute	Moderate	Credit review, compliance audit, due diligence checklist
Exploratory, learns as it goes	ReAct	Higher	Legal research, fact investigation, market analysis
Complex, parallel workstreams	Hierarchical	Distributed	M&A transaction, portfolio construction, multi-jurisdiction filing

Higher autonomy requires more sophisticated oversight.

Plan-Execute operates with moderate autonomy. The agent works within bounds defined by the plan. Oversight focuses on plan validation. ReAct involves higher autonomy because the agent decides what to search and when to stop. Oversight requires explicit termination mechanisms and confidence thresholds. Hierarchical patterns distribute autonomy. Oversight requires clear delegation contracts and escalation paths. You must match oversight rigor to autonomy level.

### 7.3 Understanding the Task Before Planning

Before an agent can construct a plan, it must develop a clear understanding of what it has been asked to accomplish. While Section 3 explores intent extraction in detail, the planning system depends on three specific outputs from that process: a classification of the task type, an understanding of the constraints that bound acceptable solutions, and criteria that define what success looks like.

Task classification shapes the choice of planning pattern. An exploratory question—“What are the key risks in this contract?”—calls for the flexible, iterative approach of ReAct. A well-defined multi-step procedure—“Review this document against our standard checklist”—fits the structured decomposition of Plan-Execute. Complex engagements with nested subtasks and dependencies require hierarchical planning with explicit coordination. Choosing the wrong pattern wastes resources or produces inadequate results.

Constraints establish the boundaries within which the plan must operate. These include explicit limits like deadlines and budgets, but also implicit bounds like the scope of the engagement and the level of detail expected. A request to “summarize the key terms” differs fundamentally from a request to “conduct comprehensive due diligence,” even if both involve the same underlying document.

Success criteria complete the picture by defining how the agent recognizes that its work is done. Without clear criteria, agents struggle to terminate appropriately—they may stop too early, leaving important questions unanswered, or continue indefinitely, consuming resources on diminishing returns. The clearer the goal, the more focused the plan; ambiguity at the input stage propagates

through the entire execution.

## 7.4 Budget Architecture

Without resource constraints, agents can run indefinitely—the computational equivalent of asking a junior associate for two relevant cases and receiving fifty, along with a bill for the hours spent finding them. Budget architecture provides the planning mechanism that prevents this outcome, giving agents explicit limits that shape how they allocate effort across tasks.

Resource consumption in agent systems takes several forms, each requiring its own type of constraint. Token budgets limit consumption of LLM API calls, preventing expensive reasoning loops where the agent repeatedly processes the same information or explores unproductive tangents. Time budgets enforce deadlines by halting execution after a specified duration, ensuring that a task expected to take ten minutes does not silently expand to consume an hour. Tool call budgets cap external interactions—limiting an agent to twenty database searches, for instance, forces it to formulate queries carefully rather than issuing dozens of slightly varied requests. Cost budgets provide the most direct control, capping total spending in dollars regardless of how that spending is distributed across tokens, tools, and time.

These budgets operate hierarchically, cascading from broad constraints down to specific allocations. A session budget might constrain an entire client engagement; within that envelope, individual tasks receive their own allocations, which subdivide further into budgets for subtasks and individual operations. A legal research task might receive thirty minutes and fifty thousand tokens; the subtasks that compose it—identifying relevant statutes, finding controlling cases, synthesizing holdings—share this pool rather than each receiving unlimited resources.

Understanding how costs compound is essential for realistic budgeting. Ingesting a 200-page credit facility consumes roughly 80,000 tokens before any analysis begins. The analysis itself requires additional tokens for reasoning, and a comprehensive review of a complex document might reach one million tokens in aggregate. Monitoring must track cumulative consumption across the entire task, not just individual operations, because costs that seem modest in isolation can accumulate rapidly.

The economics of agent assistance vary significantly by task type. Retrieval-heavy work like document review often shows clear return on investment: the agent processes material faster and more consistently than a human reviewer, and the cost savings are straightforward to calculate. Judgment-intensive tasks present a more complex picture, since extensive human review of the agent’s output may be required, potentially reducing the net benefit. Transparency about AI assistance—as encouraged by recent ethics guidance (American Bar Association Standing Committee on Ethics and Professional Responsibility 2024)—enables clients to evaluate this value proposition for themselves.

Well-designed agents degrade gracefully as budgets tighten rather than failing abruptly. The key is tiered output that provides value at every resource level. With a minimal budget, the agent might

return only the controlling statute. A moderate budget allows it to add key holdings from relevant cases. A full budget enables comprehensive analysis with supporting citations and counterarguments. Soft limits—triggered at perhaps eighty percent of the allocated budget—warn the agent to prioritize completion over thoroughness. Hard limits at one hundred percent terminate execution and return whatever results have been assembled. An agent that delivers useful partial results within budget is far more valuable than one that produces nothing when resources run short.

## 7.5 Knowing When to Stop

Knowing when to stop is among the most critical capabilities a planning system must possess. An agent that cannot recognize completion will either terminate prematurely, leaving work unfinished, or continue indefinitely, consuming resources without adding value. Effective termination requires explicit conditions that the agent can evaluate during execution.

The most straightforward stopping condition is success: the agent has achieved its goal. A research question has been answered with adequate support. A document has been reviewed against all required criteria. A filing has been prepared and validated. Recognition of success requires clear criteria established during the planning phase—without them, the agent cannot distinguish “done” from “still working.”

Resource exhaustion provides a harder boundary. When budgets are depleted—whether measured in tokens, time, tool calls, or dollars—the agent must stop regardless of task completion. The appropriate response depends on what has been accomplished: if meaningful partial results exist, the agent should return them with a clear indication of what remains unfinished. If the task cannot be meaningfully decomposed, escalation to human oversight may be the only viable path.

Confidence thresholds trigger a different kind of stopping. Some tasks push agents into territory where their uncertainty becomes too high for autonomous action. A contract clause may be ambiguous in ways the agent cannot resolve. Contradictory authorities may require judgment the agent cannot reliably provide. When confidence drops below acceptable levels, the appropriate response is not to guess but to route the decision to human review, presenting the relevant information and explaining the source of uncertainty.

Error conditions represent the final category. Repeated failures—a database that consistently times out, an API that returns malformed responses, a reasoning loop that circles without progress—indicate problems that additional attempts will not solve. Recognizing these patterns and stopping gracefully, rather than retrying indefinitely, preserves resources for productive work.

Defining these stopping rules explicitly is essential. The instruction should read like guidance to a junior associate: “If you find three consistent opinions from controlling jurisdictions, you have enough support—stop searching. If two hours pass without finding relevant authority, escalate to me rather than continuing to search.” Agents, like associates, benefit from clear expectations about when their work is complete.

## 7.6 Guardrails and Loop Detection

Agents can get stuck in loops despite budgets. Mechanisms like step limits, reflection checkpoints, and external watchdogs prevent this. Section 8.4 examines these in detail.

## 7.7 From Planning to Termination

Planning decomposes work, but every plan must end. The next two questions address the boundaries of autonomous execution.

Section 8 (Termination) addresses how an agent knows it is done. This requires defining success criteria and budget limits. Section 9 (Escalation) addresses how an agent knows when to ask for help. This requires confidence thresholds and authority boundaries.

Without clear termination, agents run forever. Without escalation, they exceed authority. These boundaries define the safe operating envelope for autonomous systems.

# 8 How Does an Agent Know When It's Done?

---

Every professional learns to recognize completion. The research memo is done when you have found sufficient authority and synthesized it. The due diligence is done when you have reviewed all material documents. The trade is done when the order executes and settles. Knowing when work is complete distinguishes effective professionals from those who over-research or under-deliver.

Agents face the same challenge. Without explicit termination conditions, agents can run indefinitely: searching one more database, trying one more approach, refining one more time. We call this the “runaway associate” problem: you ask for two relevant cases, and the associate gives you fifty because they did not know when to stop.

### Termination

**Termination** conditions define when an agent should stop executing. Three outcomes are possible:

- **Success:** The goal is achieved, and the agent delivers the result.
- **Failure:** The goal cannot be achieved; the agent reports why and stops.
- **Escalation:** The agent cannot determine success or failure, transferring the decision to human judgment.

Termination implements the “T” in the GPA+IAT framework. Without it, agentic systems lack the property that distinguishes systems from runaway processes.

## 8.1 Termination Condition Categories

Five categories of termination conditions bound agent execution, each addressing a different aspect of when and why an agent should stop working autonomously.

**Success conditions** represent the ideal outcome: the agent terminates because it has achieved its goal. But recognizing success requires clear criteria. *Completeness* asks whether all required items have been addressed—have all fifty contracts in the review queue been analyzed? *Quality* asks whether the output meets the required standard—are conclusions supported by binding authority rather than secondary sources? *Convergence* recognizes when continued effort yields diminishing returns—if three consecutive searches produce no new relevant authority, the research space is likely saturated. Quality assessment often requires human validation, but completeness and convergence can frequently be evaluated programmatically.

**Resource budgets** provide hard limits that prevent runaway execution. While Section 7.4 details budget architecture in depth, the termination implications are straightforward: when any budget is exhausted, the agent must stop. *Token budgets* halt execution after a specified number of API tokens to prevent expensive reasoning loops. *Time budgets* enforce deadlines, stopping execution after a fixed duration regardless of progress. *Iteration budgets* cap tool calls, preventing an agent from issuing dozens of database queries when a more focused approach would suffice. *Cost budgets* provide the most direct control, halting execution after spending a specified dollar amount. These budgets interact and cascade—a task might hit its time limit before exhausting its token allocation, or vice versa. Crucially, budget exhaustion is not necessarily failure; partial results assembled before the limit was reached are often valuable and should be preserved and returned.

**Confidence thresholds** gate autonomous action on the agent’s certainty about its conclusions. When confidence is high, the agent delivers its answer and terminates normally. When confidence drops below a specified threshold—perhaps eighty percent for routine matters, higher for consequential decisions—the agent should stop and escalate rather than proceeding with uncertain conclusions. This mirrors the behavior expected of a well-trained associate: “I’ve found relevant authority, but I’m not confident it controls here. Let me ask the partner before we rely on this.” Calibrating these thresholds presents a genuine challenge, as research has shown that language models can be systematically overconfident in their outputs (Kadavath et al. 2022). Effective calibration requires testing against known outcomes and adjusting thresholds based on observed reliability.

**Error conditions** require agents to recognize when something has gone wrong and continued execution is unlikely to help. *Repeated failures*—a database that times out on three consecutive attempts, an API that returns malformed responses—indicate problems that retrying will not solve. *Inconsistent data*, such as revenue figures in a 10-K that conflict with the earnings release, suggests either an error in the source documents or a parsing problem that requires human investigation. *Constraint violations* demand immediate termination: if a planned trade would exceed position limits or a proposed filing would miss a regulatory deadline, the agent must stop before taking

the problematic action. Perhaps most important is recognizing *impossibility*—when requirements genuinely conflict or the requested task cannot be completed as specified, the agent should report this finding rather than compromising on some requirements to satisfy others.

**Escalation triggers** require human judgment regardless of whether the agent has succeeded or failed at its immediate task. Novel situations without clear precedent, high-stakes decisions with significant consequences, and actions that would exceed the agent’s authority boundaries must all trigger termination and handoff to human oversight. Section 9 examines these escalation patterns in detail.

## 8.2 Defining Success Criteria

Vague goals produce unclear termination. An instruction to “research the statute of limitations” leaves the agent uncertain about scope, depth, and format. Which statute of limitations—for what claims, in which jurisdiction? How many sources are enough? What form should the output take? Without answers to these questions, the agent cannot recognize when its work is complete.

Effective success criteria take several forms, often used in combination. **Completeness checklists** enumerate the specific deliverables required. A credit agreement review might specify that the agent must identify all financial covenants, compare each to market terms from a reference database, and summarize material risks in a structured format. The agent terminates only when every item on the checklist has been addressed, providing a clear and verifiable completion signal.

**Sufficiency thresholds** define what “enough” means for tasks without exhaustive requirements. Legal research rarely requires finding every case ever decided on an issue; instead, sufficiency might mean identifying three on-point opinions from the controlling circuit, or finding both the majority rule and any significant minority positions. Once the threshold is reached, the agent stops rather than continuing to search every available database. This prevents over-research while ensuring adequate coverage.

**Convergence criteria** recognize when continued effort produces diminishing returns. If three consecutive searches using varied query strategies yield no new relevant results, the research space is likely saturated. The agent can terminate with confidence that additional searching would not materially improve the analysis. This approach works particularly well for exploratory tasks where the scope cannot be fully specified in advance.

**Deliverable specifications** define the expected output format, which itself signals completion. “Produce a two-page memorandum with an executive summary, statement of facts, analysis, and conclusion” tells the agent exactly what success looks like. When the document matches the specification, the task is done.

The most effective approach combines these criteria in instructions that read like guidance to a junior associate:



*“Research the statute of limitations for breach of fiduciary duty claims in Delaware. If you find clear Court of Chancery authority, you are done. If the courts have split or the issue is unsettled, map the competing positions. If you find nothing on point after searching for two hours, stop and report that the issue may be novel. Deliver your findings in a one-page summary with citations.”*

### 8.3 Recognizing Failure

Agents must recognize and report failure honestly, resisting any tendency to mask problems or present incomplete work as complete. This requires a cultural shift in how we think about agent outputs: *negative results are valuable information*, not embarrassing admissions. “I searched all available databases using multiple query strategies and found no authority on point” is a legitimate and useful finding—it suggests the issue may be novel, the search terms may need refinement, or the legal theory may lack support.

The difference between useful and useless failure reports lies in **diagnostic detail**. “Task failed” tells the human supervisor nothing actionable. A proper failure report explains what was attempted and why it did not succeed:

*“I searched Westlaw and Lexis using the following queries: [list]. Westlaw returned twelve results, none addressing the specific issue of whether the duty extends to indirect subsidiaries. Lexis returned zero results. The absence of authority suggests either that the issue is novel, that practitioners use different terminology, or that the question is typically resolved through contract rather than litigation. I recommend manual review with an expanded search strategy.”*

This report enables the supervisor to decide whether to try different approaches, consult additional resources, or conclude that the absence of authority is itself the answer.

**Partial completion** must be preserved and clearly reported. If an agent was reviewing ten articles in a contract and encountered a failure after completing four, it should not discard its work. Instead, it should report: “Analysis complete for Articles 1 through 4; results attached. Articles 5 through 10 remain unanalyzed due to [reason for failure].” This preserves the value already created and gives the supervisor a clear picture of what remains.

**Root cause identification** aids the human response by distinguishing between *transient* and *structural* problems. A database timeout is likely transient—waiting and retrying may succeed. A parsing error on a malformed document may require human intervention to obtain a clean copy. Fundamentally conflicting requirements are structural—no amount of retrying will resolve them. The agent’s diagnosis of the failure mode directly informs what the supervisor should do next.



## 8.4 Guardrails and Loop Detection

Even well-designed termination conditions cannot prevent every failure mode. Agents can become trapped in unproductive loops—repeating the same actions, cycling through equivalent states, or making nominal progress that adds no real value (Zou et al. 2024; Ma et al. 2024). Production systems require explicit guardrails to detect and interrupt these patterns.

**Step limits** provide the simplest and most reliable backstop. Regardless of other conditions, after  $N$  total steps the agent must stop and require human approval before continuing. This prevents unbounded execution even when other detection mechanisms fail. The appropriate limit depends on the task: a simple lookup might warrant only ten steps, while complex research might allow a hundred. The key is that *some* limit exists and is enforced.

**Progress detection** monitors whether recent actions have produced value. If the last five tool calls returned no new information—the same documents retrieved, the same search results, the same analysis repeated—the agent is likely stuck in a loop or has exhausted productive avenues. This pattern should trigger either a reflection step (if the agent has that capability) or escalation to human oversight. Progress detection requires defining what “new information” means for each task type, which can be as simple as tracking whether retrieved documents have been seen before.

**Reflection steps** give agents the opportunity to assess their own behavior. Periodically, or when triggered by apparent lack of progress, the agent pauses to ask itself: “Am I making progress toward the goal? Have my recent actions been productive? Should I try a different approach, or is it time to stop and report what I’ve found?” This metacognitive capability is not yet reliable in all models, but when it works, it can catch problems that simple pattern matching would miss.

**External watchdogs** monitor agent behavior from outside the agent’s own reasoning process. A watchdog might detect that the same tool has been called repeatedly with identical or near-identical parameters—a clear sign of a loop—and intervene to halt execution. Watchdogs can also enforce patterns that would be difficult to specify within the agent’s instructions, such as rate limits on expensive operations or detection of oscillating behavior where the agent alternates between two states without progressing. Without some form of loop detection, agents deployed in production will eventually get stuck, potentially consuming significant resources before anyone notices.

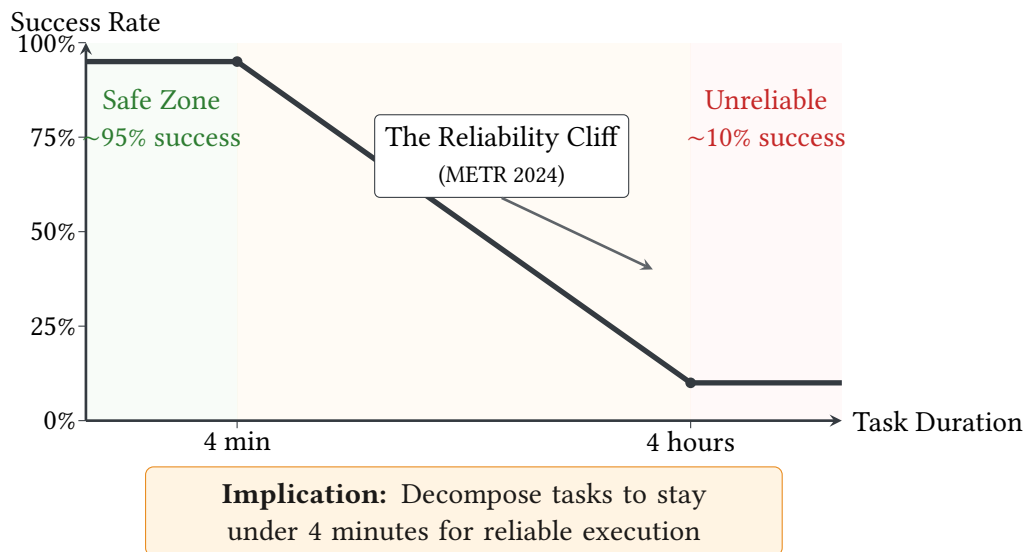
## 8.5 The Reliability Cliff

Empirical benchmarking reveals a striking pattern in agent reliability: performance does not degrade gradually as tasks become more complex, but instead *falls off a cliff*. Research by METR (Model Evaluation and Threat Research), which tests agents across standardized task suites, has quantified this boundary.

### The Four-Minute Cliff

METR’s 2025 study found that agents achieve **near-perfect success on tasks under 4 minutes**, but **under 10% success on tasks over 4 hours** (METR 2025).

This gap defines the current boundary for reliable deployment. You must decompose tasks aggressively, keep agent tasks short, and insert human checkpoints. Do not expect autonomous completion of multi-hour workflows.



**Figure 3:** The Reliability Cliff: Agent success rates drop dramatically as task duration increases. METR (2024) found that agents maintain approximately 95% success on tasks under 4 minutes, but success rates fall to roughly 10% for tasks exceeding 4 hours. This sharp transition motivates the decomposition of complex tasks into shorter subtasks and the use of aggressive timeout policies in agent architectures.

Understanding why this cliff exists is essential for designing systems that work within current limitations. The fundamental problem is **compounding errors** (Press et al. 2023): each step in an agent’s execution has some probability of failure, and these probabilities *multiply* rather than add. A step that succeeds 95% of the time followed by a step that succeeds 90% of the time yields only 85.5% end-to-end reliability. Extend this chain to dozens of steps—as complex tasks require—and failure becomes not just possible but statistically certain.

Two additional factors steepen the cliff. **Planning fragility** means that errors in early steps propagate forward, leading the agent down paths that cannot reach the goal regardless of how well subsequent steps execute. **Integration brittleness**—API timeouts, rate limits, malformed responses—introduces failure modes that have nothing to do with the agent’s reasoning capabilities but become increasingly likely as execution time extends.

The practical implications are clear: design for this reality rather than hoping it will improve.

Decompose complex workflows into subtasks that can complete in minutes rather than hours. Validate intermediate results before proceeding to dependent steps. Insert human checkpoints at natural boundaries. And always assume that any sufficiently long autonomous execution will eventually fail, building systems that preserve partial progress and enable graceful recovery.

## 8.6 Graceful Degradation

When termination occurs before task completion—whether due to budget exhaustion, confidence drops, or error conditions—the agent should not simply stop and report failure. Instead, it should *degrade gracefully*, delivering whatever value it has accumulated and positioning the human supervisor to continue effectively.

The key to graceful degradation is **tiered output design**. Rather than treating tasks as all-or-nothing, effective agents structure their work to provide value at multiple levels of completion. Consider a legal research task: with minimal resources, the agent might deliver only the controlling statute and its citation—a modest but genuinely useful result. With moderate resources, it adds the key holdings from relevant cases, providing context for how courts have interpreted the statute. With full resources, it delivers comprehensive analysis including counterarguments, circuit splits, and practical implications. Each tier represents a complete, usable work product rather than a fragment of an unfinished whole. This structure allows the user to assess whether the partial result suffices or whether additional investment is warranted.

**Progress preservation** ensures that early termination does not waste the work already completed. If an agent stops mid-way through a contract review, it should save its state in a form that allows either itself or a human to resume without starting over. The four articles already analyzed should not require re-analysis; the search queries already executed should not need re-running. This requires deliberate architectural choices—checkpointing intermediate state, maintaining audit trails of completed steps, and structuring tasks as resumable sequences rather than monolithic operations.

**Clear status reporting** transforms an incomplete result into an actionable handoff. Rather than a bare “Task incomplete,” the agent should report its progress precisely: “Completed analysis of Articles 1 through 4 (60% of task). Remaining: Articles 5 through 8. Findings so far: two material deviations from market terms identified in covenant structure.” Critically, the agent should also provide a *recommendation* for next steps: “Recommend allocating 30 additional minutes to complete the remaining articles, or proceed with partial findings if timeline requires.” This enables informed human decision-making about whether to invest additional resources, proceed with partial information, or reassign the task entirely.

## 8.7 Evaluating Termination Capabilities

Assessing whether an agent terminates appropriately requires testing across multiple dimensions, each probing a different aspect of the termination system.

**Success clarity** asks whether termination conditions are explicit and predictable. Given a task specification, can you anticipate when the agent will stop? If termination feels arbitrary or surprising, the conditions are not sufficiently well-defined. Testing should include edge cases: tasks that barely meet success criteria, tasks that fall just short, and tasks with ambiguous completion states.

**Budget enforcement** verifies that limits are actually respected. An agent configured to stop after 50,000 tokens or ten minutes should stop at those boundaries, not run 20% over before noticing. Testing should deliberately push agents toward their limits and verify that enforcement is reliable rather than approximate.

**Loop detection** probes whether the agent recognizes unproductive patterns. Construct test cases designed to induce loops—queries that return the same results repeatedly, tasks with circular dependencies, or prompts that trigger oscillating behavior—and verify that the agent detects and escapes these traps rather than continuing indefinitely.

**Failure reporting** evaluates whether error messages enable effective human response. When the agent fails, does it explain *why* in terms that inform next steps? A message like “Unable to complete research” is nearly useless; a message explaining which sources were searched, what was found, and why the agent concluded it could not proceed further provides a foundation for human follow-up.

**Graceful degradation** tests whether partial results are useful. When an agent terminates early, does it return work product that has standalone value, or does early termination mean total loss? Deliberately trigger early termination at various points and assess the quality of what comes back.

**Escalation handoff** examines whether humans receive sufficient context to take over effectively. When an agent escalates, can the human understand the current state, the work completed, and the reason for escalation without extensive investigation? The handoff should feel like receiving a file from a colleague, not inheriting a mystery.

## 8.8 From Termination to Escalation

Termination and escalation are closely related but distinct concepts. Termination defines *when* an agent stops; escalation defines *what happens next* when stopping requires human involvement. An agent that terminates successfully has completed its task and can deliver results. An agent that terminates due to failure has determined that the task cannot be completed and reports why. But an agent that *escalates* has reached a different conclusion: not “I’m done” or “This is impossible,” but rather “I need help to proceed.”

This third category is critical for safe deployment in professional contexts. An agent researching a legal question might find genuinely conflicting authority that requires judgment to reconcile. An agent reviewing a contract might encounter a provision outside its training distribution that it cannot confidently interpret. An agent executing a financial transaction might face a decision that exceeds its authorization limits. In each case, the correct response is neither to forge ahead (risking error)

nor to report failure (abandoning recoverable work), but to pause and request human input. This is not failure—it is *safety*.

Section 9 examines escalation in depth: when should an agent stop autonomous operation and ask for help? What information should it provide to the human taking over? How should escalation thresholds be calibrated for different risk levels? Together, termination and escalation define the complete boundary of autonomous execution. Without robust termination, agents run indefinitely. Without appropriate escalation, they exceed their authority or make decisions they are not qualified to make. Both capabilities are essential for trustworthy deployment.

## 9 How Does an Agent Know When to Ask for Help?

---

Sometimes the best thing to know is when you do not know something. A wise junior associate knows when to consult their supervising partner. In turn, a deputy corporate counsel can intuit that an issue should be escalated to someone more senior within the organization. Of course, it is a balancing act whereby it is unwise to interrupt the partner or senior lawyer with every question, but they also do not proceed confidently into territory beyond their expertise. In a sense, the most intelligent junior resources recognize authority boundaries: “I can draft this motion, but I need partner review before filing.” They recognize competence limits: “I have researched for two hours and cannot find clear authority—I should ask someone with more experience.” They recognize high-stakes situations: “The client is asking about strategy, not just research—this needs partner involvement.”

Agentic systems require the same judgment. An agent that never escalates will eventually exceed its competence, authority, or the bounds of safe autonomous operation. An agent that escalates everything provides no value: it becomes a complicated way to route work to humans. The challenge is drawing the line.

### Escalation

**Escalation** transfers control from the agent to a human when autonomous execution should stop. Unlike termination, which ends the task (success or failure), escalation pauses the task and requests human input before continuing.

This reflects professionalism, not failure. Recognizing when you need help and asking for it is exactly what we expect from junior professionals. Agents should do the same.

### 9.1 When to Escalate

Three categories of triggers warrant escalation, each reflecting a different reason why autonomous action should pause (Mosqueira-Rey et al. 2023; Gomez et al. 2025).

**Mandatory triggers** require human involvement regardless of the agent’s confidence or the apparent simplicity of the decision. Some situations demand human judgment by their nature, not because the agent is uncertain. When resource limits approach exhaustion, the agent should escalate with a progress summary rather than stopping silently—the human needs to decide whether to allocate additional resources or accept partial results. High-stakes actions like court filings, client communications, and large trades require human approval before execution; these are *approval gates* where the agent prepares but does not act. Actions that would exceed the agent’s authorized thresholds—a trade above a certain size, a commitment beyond a certain value—require human sign-off even if the agent is confident the action is correct. And irreversible actions warrant particular caution: once a motion is filed or a trade is executed, the consequences cannot be undone, making pre-execution review essential.

**Confidence-based triggers** occur when the agent’s uncertainty exceeds acceptable thresholds for autonomous action (Madras et al. 2018; Abbasi Yadkori et al. 2024). An agent researching a legal question might find genuinely conflicting circuit authority and be unable to determine which rule applies—“I found three circuits supporting one approach and two supporting another, and I cannot determine which controls here.” Data sources might disagree in ways the agent cannot reconcile: the revenue figure in the 10-K differs from the earnings release, and the agent cannot determine which is correct or whether both are valid in different contexts. Novel situations—unprecedented fact patterns, unusual market conditions, first-impression legal questions—push beyond the agent’s training distribution, where its confidence estimates become unreliable. And sometimes ambiguity persists despite the agent’s attempts to clarify: the instructions can be read multiple ways, and the agent remains uncertain which interpretation the human intended.

**Error and anomaly detection** triggers escalation when the agent encounters problems it cannot resolve through retrying or alternative approaches. Repeated failures—a database that times out on three consecutive attempts, an API that returns errors despite varied request formats—indicate systemic problems that further attempts will not solve. Data anomalies, such as financial figures that do not reconcile or filing dates that seem implausible, warrant human investigation rather than silent acceptance or rejection. Constraint violations require immediate escalation: if executing a planned action would breach position limits, exceed authorization thresholds, or violate compliance rules, the agent must stop and confirm rather than proceed. And when a task proves genuinely impossible—requirements conflict, necessary data does not exist, or the goal cannot be achieved as specified—the agent should report this finding rather than struggling indefinitely.

## 9.2 How to Escalate

Effective escalation provides the human with everything needed to make a decision without starting from scratch. The difference between good and poor escalation is the difference between receiving a well-organized file from a colleague and inheriting an unexplained mess.

A complete handoff weaves together five elements. The **situation summary** orients the human quickly: what is the matter, what was the agent trying to accomplish, and why does it matter? The **progress report** explains what has been done and what remains, so the human understands where in the workflow the escalation occurred. The **trigger explanation** clarifies why the agent is escalating *now*—what specific condition or finding prompted the handoff. The **gathered information** presents the relevant findings, even if partial or uncertain; the agent should not withhold work product just because it is incomplete. Finally, the **recommendation** proposes a path forward with supporting reasoning, giving the human a starting point for their decision rather than a blank slate.

#### **Example: Legal Research Escalation.**

**Situation:** Researching statute of limitations for Section 10(b) securities fraud claim.

**Progress:** Searched Westlaw and Lexis. Found clear authority on the 2-year discovery period but conflicting authority on the trigger event.

**Trigger:** Low confidence. The Ninth and Second Circuits apply different tests for inquiry notice. I cannot determine which applies to our facts.

**Findings:** [Summary of key cases with citations]

**Options:** (a) Apply the conservative test; (b) research district court authority; (c) seek partner guidance on the fact pattern.

**Recommendation:** Option (c). The question is fact-intensive, and partner judgment is required.

#### **Example: Financial Escalation.**

**Situation:** Executing rebalancing trades to reduce tech exposure from 35% to 25%.

**Progress:** Generated trade list. Compliance check passed. Ready to execute.

**Trigger:** Trade size (\$500K) exceeds single-approver threshold.

**Findings:** Trades realize \$45K in short-term gains and \$12K in losses. Net tax impact: \$8K liability.

**Options:** (a) Approve full list; (b) prioritize tax-loss positions; (c) execute in tranches.

**Recommendation:** Option (a) if reducing exposure is urgent; Option (b) if tax optimization is priority.

### **9.3 Human-in-the-Loop Patterns**

Different tasks and risk profiles call for different patterns of human integration. Five patterns span the spectrum from tight oversight to broad autonomy, and selecting the right pattern is itself a design decision with significant consequences.



**Approval gates** enforce the strictest oversight by separating preparation from authorization. The agent performs all the work—drafting the motion, assembling the trade list, preparing the client communication—but stops short of execution. A human reviews the prepared output and explicitly authorizes the final action. This pattern is essential for irreversible actions where errors cannot be corrected after the fact: court filings, executed trades, sent communications. The cost is latency and human attention; the benefit is a hard guarantee that no consequential action occurs without human review.

**Checkpoint reviews** insert human validation at natural milestones within a longer workflow. A research agent might present its initial findings and proposed authorities before beginning to draft a memorandum. A due diligence agent might summarize its document review before moving to the analysis phase. These checkpoints prevent the agent from investing significant effort in a direction the human would have redirected, catching misunderstandings early when course correction is cheap.

**Confidence-based escalation** ties the level of autonomy to the agent’s certainty about its outputs. When confidence is high—the answer is clear, the authorities are consistent, the data is unambiguous—the agent proceeds autonomously. When confidence drops below a threshold, the agent escalates rather than acting on uncertain conclusions. This pattern allows routine cases to flow without human intervention while ensuring that difficult cases receive appropriate attention. The challenge lies in calibrating both the thresholds and the agent’s confidence estimates.

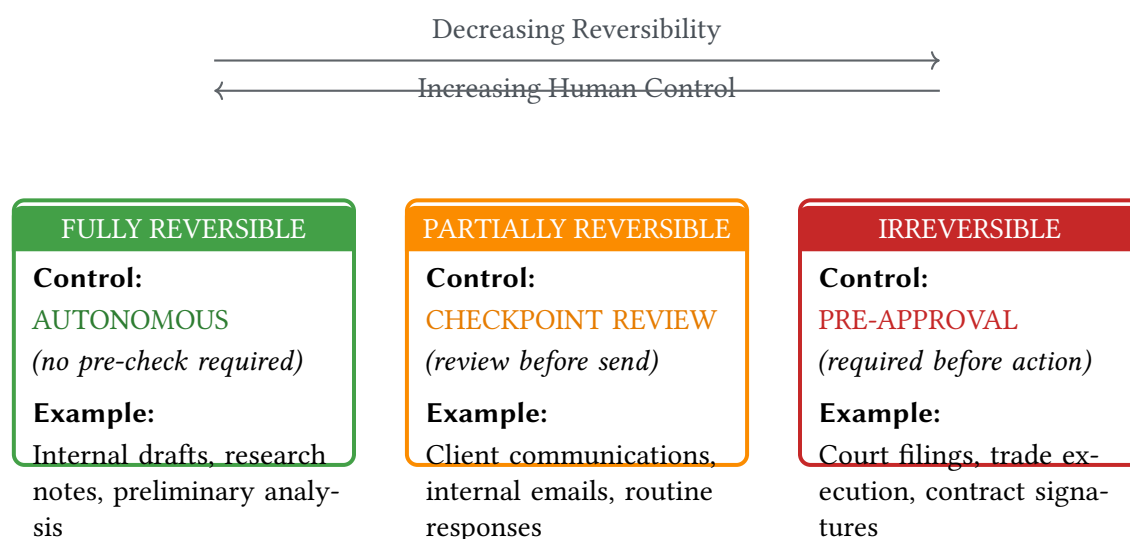
**Human-as-tool** inverts the traditional oversight relationship by treating human expertise as a resource the agent can invoke when needed. Rather than escalating and transferring control, the agent poses a specific question to a human expert, receives the answer, incorporates it into its reasoning, and continues. This pattern works well when the agent needs discrete pieces of human judgment—“Is this clause acceptable under our firm’s standards?”—without requiring the human to take over the entire task.

**Reversibility classification** matches oversight intensity to the stakes of each action. Fully reversible actions—internal drafts, exploratory searches, preliminary analyses—can proceed autonomously because errors can be corrected without consequence. Partially reversible actions warrant checkpoint review. Irreversible actions require approval gates. This framework provides a principled basis for deciding which pattern to apply, grounded in the practical question of what happens if the agent gets it wrong.

## 9.4 Domain-Specific Escalation Requirements

Beyond general principles, regulated industries impose specific escalation duties grounded in professional responsibility rules and compliance requirements. These are not optional design choices but mandatory constraints that any deployed system must respect.





**Figure 4:** Oversight spectrum showing how the reversibility of agent actions determines the level of human control required. Fully reversible actions may proceed autonomously, partially reversible actions require checkpoint review, and irreversible actions demand pre-approval before execution.

**Legal Practice.** Professional responsibility rules create binding escalation requirements for legal agents (American Bar Association 2025; American Bar Association Standing Committee on Ethics and Professional Responsibility 2024). The duty of *competence* under ABA Model Rule 1.1 requires escalation whenever a matter exceeds the agent’s training or capabilities—an agent cannot simply do its best on an unfamiliar issue but must recognize its limits and involve qualified counsel. *Privilege protection* demands escalation before any action that might expose attorney-client communications or work product; the consequences of inadvertent disclosure are severe enough that uncertainty should trigger human review. Potential *conflicts of interest*—whether between current clients, with former clients, or arising from the firm’s other relationships—must be escalated to counsel for proper conflicts analysis rather than resolved by the agent. And the duty of *candor to the tribunal* requires immediate escalation if the agent discovers adverse authority that may require disclosure; this is not a situation where the agent should exercise judgment about materiality.

**Financial Services.** Regulatory obligations and fiduciary duties impose parallel requirements on financial agents (Financial Industry Regulatory Authority 2024; Board of Governors of the Federal Reserve System and Office of the Comptroller of the Currency 2011). *Suitability* obligations require that investment recommendations receive human adviser review before reaching clients, ensuring that a qualified professional has assessed whether the recommendation fits the client’s circumstances. Trades approaching *regulatory thresholds*—beneficial ownership reporting triggers, large trader identification requirements, position limits—must be escalated so that compliance personnel can ensure proper filings and approvals. Any encounter with potential *Material Non-Public Information* demands immediate escalation; the agent cannot assess whether information is material or non-public

with sufficient reliability, and the consequences of trading on MNPI are catastrophic. And actions that would breach *risk limits*—position concentrations, exposure thresholds, leverage constraints—require escalation for explicit authorization rather than autonomous execution.

## 9.5 Evaluating Escalation Mechanisms

Assessing whether escalation mechanisms work correctly requires testing across multiple dimensions, each probing a different failure mode.

**Coverage** asks whether all situations that *should* trigger escalation actually do. Testing should deliberately construct edge cases: conflicting data that falls just below obvious thresholds, novel situations that differ subtly from training examples, and compound conditions where no single factor would trigger escalation but the combination should. Gaps in coverage mean that situations requiring human judgment will instead receive autonomous action—precisely the failure mode escalation is designed to prevent.

**Calibration** asks whether thresholds are set correctly. Escalating too aggressively wastes human attention on decisions the agent could handle, eventually training humans to approve without review. Escalating too rarely exposes the organization to risks that should have received oversight. The goal is a calibrated system where escalation signals genuinely require human judgment, maintaining the value of human attention as a scarce resource.

**Latency** measures whether escalation reaches the human quickly enough to be useful. For time-sensitive matters—a filing deadline approaching, a market moving, a client waiting—escalation that arrives too late is equivalent to no escalation at all. Urgent matters require immediate notification through appropriate channels, not a queue that will be reviewed tomorrow.

**Routing** ensures escalation reaches the *right* person, not just any person. Legal questions should route to attorneys with relevant expertise; risk limit breaches should reach risk managers with authority to approve exceptions; client-facing decisions should involve relationship managers who understand the context. Misrouted escalation creates delay and frustration while failing to bring appropriate expertise to bear.

**Context quality** determines whether the human can actually make a decision based on the escalation message alone. If the recipient must investigate from scratch to understand what the agent was doing and why it stopped, the handoff has failed. The escalation should read like a well-prepared briefing, not a cryptic alert requiring interpretation.

**Response handling** closes the loop by verifying that the agent correctly incorporates human guidance. When the human provides direction—approve this action, reject that recommendation, try a different approach—does the agent actually follow through? Testing should cover the full escalation cycle from trigger through human response through resumed agent action, not just the outbound notification.

## 9.6 From Escalation to Delegation

Escalation moves control *upward* in the hierarchy—from agent to human supervisor, from junior to senior, from execution to oversight. But agents can also move control *sideways* by delegating tasks to peer agents with different capabilities. These horizontal relationships introduce coordination challenges distinct from the vertical relationships of escalation.

Section 10 examines this dimension of agent architecture: how does an agent work with other agents? A coordinating agent might delegate research to a specialist with access to legal databases, drafting to a specialist trained on firm precedents, and financial modeling to a specialist with quantitative capabilities. Each specialist retains its own ability to escalate vertically when it encounters situations requiring human judgment, creating a two-dimensional topology where control flows both upward to humans and sideways to specialists. Understanding both dimensions—escalation and delegation—is essential for designing systems that can handle complex professional workflows while maintaining appropriate human oversight throughout.

## 10 How Does an Agent Work with Other Agents?

---

Complex matters require coordination. An M&A partner does not execute everything personally—they coordinate specialists, with corporate counsel reviewing governance, tax specialists analyzing structure, and antitrust counsel assessing regulatory risk. Each specialist contributes deep domain expertise while the partner orchestrates: defining deliverables, integrating work products, and synthesizing conclusions for the client.

A portfolio manager coordinates similarly, with analysts providing company analysis, traders handling execution, risk managers monitoring exposure, and compliance officers verifying adherence. Complex trades require all these perspectives because no single person possesses all necessary expertise.

Agentic systems face the same coordination challenge. A single agent trying to do everything quickly exceeds its competence, permission boundaries, or context limits. Multi-agent architectures mirror professional teams: specialized agents with deep expertise, orchestrators that coordinate them, and structured protocols that enable seamless collaboration.

### Delegation

**Delegation** assigns subtasks from one agent (the coordinator) to another (the specialist). Unlike escalation (agent to human), delegation is agent to agent. The coordinator defines *what* needs to be done; the specialist determines *how*. Delegation enables parallelization (multiple specialists work simultaneously), specialization

(each agent is optimized for its domain), and security isolation (each agent has only the permissions it needs).

## 10.1 Why Multi-Agent Architectures?

Several factors drive multi-agent designs (Wu et al. 2023; Guo et al. 2024), each reflecting challenges familiar to professional practice.

**Specialization** allows agents to excel in narrow domains, just as a securities law agent can be optimized for SEC regulations and equipped with EDGAR tools while a tax agent handles tax implications—neither needs expertise in the other’s domain. **Security isolation** enforces least privilege: a research agent can read legal databases but cannot file documents, while a filing agent can submit to CM/ECF but cannot access client financial data; if one agent is compromised, damage is contained. **Parallel execution** lets independent workstreams proceed simultaneously, so a document review agent can analyze contracts while a research agent investigates legal issues without either waiting for the other.

Two additional factors favor multi-agent designs in production settings. **Vendor diversity** enables best-of-breed selection—a specialized legal model handles research, a general model handles drafting, and a fast model handles classification—matching capability to task. **Scale management** addresses context window limits by decomposing tasks across agents, each with focused context, rather than cramming everything into one overwhelmed process.

These benefits come with tradeoffs: coordination overhead increases communication costs, debugging complexity grows when failures span agents, and the attack surface expands with each additional component. The protocols discussed in Section 4.3 and the security controls in Section 5.5 help manage these risks.

## 10.2 Agent-to-Agent Protocol (A2A)

Just as MCP standardizes how agents access tools and data (see Section 4.3), the Agent-to-Agent Protocol (A2A) standardizes how agents delegate work to each other (Google Developers 2025; Anthropic 2024). The distinction is straightforward: MCP handles agent-to-tool communication, A2A handles agent-to-agent coordination.

A2A uses familiar professional concepts. **Agent Cards** function as capability statements—digital résumés listing expertise, accepted inputs, and expected outputs. **Tasks** are units of delegated work, analogous to engagement letters, that specify scope, constraints, and deadlines. **Artifacts** are deliverables returned upon completion: memos, analyses, or structured data. And **Channels** provide communication streams for status updates and clarification during execution.

### Delegation Lifecycle

The A2A task lifecycle mirrors professional delegation: (1) *discovery*—finding the right specialist via Agent Card, like identifying co-counsel with relevant expertise; (2) *delegation*—creating a Task with goals and constraints, like drafting an engagement letter; (3) *execution*—the specialist works independently, requesting clarification if needed; (4) *delivery*—the specialist returns Artifacts; and (5) *completion*—the coordinator reviews and approves the work. This structure ensures that delegated work is scoped, tracked, and auditable.

## 10.3 Multi-Agent Patterns

Three patterns organize multi-agent collaboration, each with distinct tradeoffs (Wang et al. 2024c).

**Sequential Delegation** processes work in series: the Coordinator delegates to a Research Agent, whose output flows to an Analysis Agent, then to a Drafting Agent. This pattern is simple to implement and debug—each handoff is clear—but slow, as each stage must wait for the previous one.

**Parallel Delegation** runs independent workstreams simultaneously. Securities, Tax, and Employment Agents can analyze an acquisition concurrently while the Coordinator integrates findings afterward. This pattern trades coordination complexity for speed, but only works when tasks are truly independent; dependencies between specialists require careful orchestration.

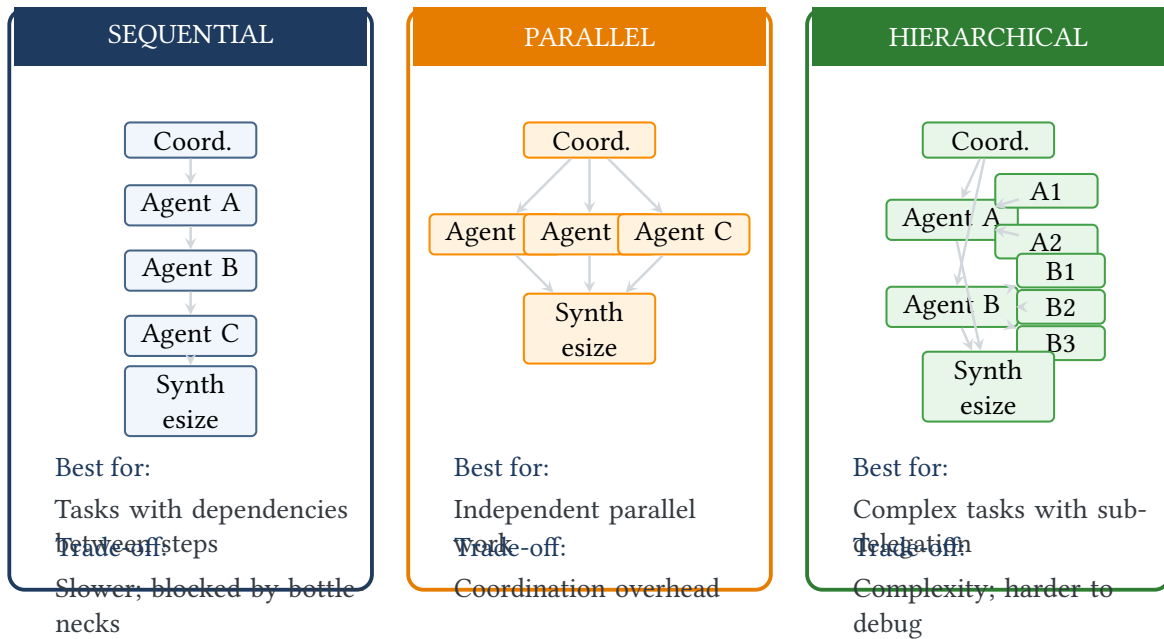
**Hierarchical Delegation** creates nested authority structures: a Lead Due Diligence Agent delegates to Document Review and Legal Research sub-agents, who may further delegate to specialized tools. This pattern enables deep task decomposition for complex matters but introduces orchestration overhead and debugging challenges when failures occur deep in the hierarchy.

Figure 5 illustrates these three approaches. Most production systems blend multiple patterns: parallel agents handle independent analyses while hierarchical structures decompose complex, tightly-coupled tasks. The choice depends on task structure—-independent subtasks favor parallelism, dependent workflows favor sequencing, and complex matters with natural subdivisions favor hierarchy.

Consider M&A due diligence as an example. The Orchestrator delegates to specialists in parallel: a Document Processing Agent accesses the data room while a Financial Analysis Agent queries financial databases. Each specialist may use hierarchical delegation internally, with sub-agents handling specific document types or analysis categories. The specialists return structured Artifacts, which the Orchestrator synthesizes into a unified assessment.

## 10.4 Multi-Agent Workflow Examples

**Legal: Regulatory Assessment.** A fintech company asks about regulatory approvals for a new product. The Orchestrator decomposes the request across four specialists working in parallel. A **Securities Agent** analyzes SEC guidance and identifies potential registration requirements. A **Bank-**



**Figure 5:** Three multi-agent orchestration patterns. Sequential delegation chains agents in order, ideal for dependent tasks but vulnerable to bottlenecks. Parallel delegation runs agents concurrently, maximizing throughput for independent work but requiring coordination. Hierarchical delegation enables sub-agents to handle specialized sub-tasks, providing flexibility for complex workflows at the cost of debugging complexity.

**ing Agent** checks OCC and FDIC rules, flagging money transmitter licensing needs. A **Consumer Agent** reviews CFPB regulations and highlights disclosure requirements. An **AML Agent** analyzes Bank Secrecy Act obligations and determines KYC needs. Each specialist accesses relevant regulatory databases through the tool integrations discussed in Section 4.3. The Orchestrator synthesizes these parallel findings into a prioritized regulatory roadmap, identifying which approvals are prerequisites for others.

**Finance: Block Trade Execution.** A portfolio manager requests a \$50M block trade. The Orchestrator coordinates four specialists with different responsibilities. A **Market Agent** analyzes liquidity conditions and recommends VWAP execution over two days to minimize market impact. A **Compliance Agent** verifies position limits and notes 13F reporting requirements. A **Risk Agent** assesses portfolio impact, confirming that the trade keeps exposure within policy bounds. An **Execution Agent** interfaces with the order management system to place and monitor orders. The Orchestrator tracks progress across all specialists, escalating if any specialist encounters problems that require human judgment (see Section 9).

### 10.5 Multi-Agent Risks

Multi-agent systems introduce failure modes beyond those of single-agent systems (Cemri et al. 2025).

**Coordination failures** manifest in three primary ways. *Deadlock* occurs when agents wait cyclically for each other—Agent A waits for B, B waits for C, and C waits for A—requiring timeouts and dependency analysis to prevent. *Divergence* results when specialists reach incompatible conclusions, such as conflicting legal interpretations or inconsistent financial projections; the orchestrator must reconcile these differences or escalate to human judgment. *Cascading errors* propagate when incorrect output from one specialist becomes flawed input for another, compounding the original mistake; prevention requires validation at each handoff, applying the input validation principles discussed in Section 5.5.

**Security risks** in multi-agent systems require the same rigor applied to human teams (OpenID Foundation AI Identity Management Community Group 2024). Agents must have verifiable, auditable identities to prevent impersonation and enable compliance tracking. Access policies must restrict which agents can delegate to whom, preventing unauthorized capability escalation. Ethical walls must enforce conflict rules across agent boundaries just as they do across human teams—an agent working on one side of a transaction cannot delegate to specialists with access to the other side’s confidential information. And every delegation must be logged (who delegated, what was delegated, when, and with what result) to support the audit requirements discussed in Section 6.4.

### 10.6 Protocol Selection Guidance

Table 5 summarizes how to choose between MCP and A2A based on task characteristics.

**Table 5:** Selecting between MCP and A2A based on task characteristics

Task Characteristic	Protocol	Typical Duration	Examples
Immediate, well-defined operation	MCP	Seconds	Query database; retrieve document; run calculation
Delegated work requiring judgment	A2A	Minutes to hours	Assign research; request analysis; coordinate specialists
End-to-end workflow combining both	MCP + A2A	Varies	Due diligence; portfolio rebalancing; regulatory assessment

The decision rule is straightforward: use MCP for well-defined, auditable operations (“fetch this filing,” “calculate this metric”), A2A for delegated work requiring specialist judgment (“research and synthesize,” “draft and revise,” “coordinate across constraints”), and both together for complex workflows. As of late 2025, MCP is production-ready (“[Model Context Protocol Specification](#)” 2025),



while A2A is maturing with variable cross-vendor reliability (“[Agent2Agent Protocol Specification 2025](#)”). Until A2A standardization solidifies, design systems with fallbacks to human coordination for critical decisions.

## 10.7 From Delegation to Governance

Delegation distributes work, creating governance challenges. Accountability becomes complex: does responsibility lie with the coordinator, the specialist, or the approving human? Information barriers must apply to agents just as they do to humans. Audit trails must span the entire delegation tree.

Section 11 previews these requirements. Chapter 8 (Agents Part III: Governing Agents) develops them in detail, translating multi-agent delegation into concrete controls: delegation policy, identity and authorization, logging and retention, and organizational accountability.

# 11 How Do We Keep the Agent Safe?

---

Every professional organization relies on infrastructure to ensure safety. A law firm does not rely solely on an associate’s ethics; it maintains conflicts committees, billing review systems, and opinion committees. A bank does not rely solely on a trader’s judgment; it deploys risk management engines, compliance monitoring, and internal audit functions. These structures do not perform the work—they ensure the work is done safely.

Agentic systems require equivalent infrastructure. Governance is not a single question but a lens through which every capability must be viewed. Each architectural choice either enables or constrains oversight. This section synthesizes the governance implications across all ten framework questions.

### Agentic System Governance

**Agentic system governance** encompasses the policies, controls, and oversight mechanisms that ensure agents operate safely, ethically, and in compliance with applicable requirements. Governance is not optional for regulated services (American Bar Association Standing Committee on Ethics and Professional Responsibility [2024](#); Financial Industry Regulatory Authority [2024](#)). Professional duties are non-delegable: attorneys remain liable for AI-assisted work product, and fiduciaries remain accountable for AI-informed recommendations.

## 11.1 Architecture Enables Governance

The architectural choices in this chapter are not merely technical decisions; they are the *infrastructure* that makes governance possible.

You cannot audit what you did not log. You cannot enforce privilege boundaries that were never implemented. You cannot demonstrate bounded operation without termination mechanisms. When



a regulator asks how the compliance agent detected a breach, or when opposing counsel demands the agent’s reasoning, architecture determines whether you can answer.

This chapter provided the technical architecture. The following chapter details the policy obligations. Section 12.1 maps these choices to their governance implications.

## 11.2 Governance Requirements by Question

Each of the ten questions creates specific governance requirements:

**Table 6:** Ten-question governance mapping

Q	Question	Governance Requirement
1	Triggers	Event authorization, audit logging of all triggers
2	Intent	Purpose limitation, goal alignment verification
3	Perception	Data governance, access controls, provenance tracking
4	Action	Actuation controls, approval gates, roll-back capability
5	Memory	State integrity, retention policies, isolation enforcement
6	Planning	Bounded operation, resource budgets, plan validation
7	Termination	Exit protocols, success criteria, graceful degradation
8	Escalation	Human oversight, escalation triggers, response tracking
9	Delegation	Agent identity, delegation contracts, barrier enforcement
10	Governance	Meta-governance, audit architecture, compliance monitoring

## 11.3 Security Essentials

Five security controls are essential for regulated agentic systems (OWASP Foundation 2025; “Information technology — Artificial intelligence — Management system” 2023):

### Security Controls for Regulated Practice

**Input Separation** isolates user inputs from system prompts to prevent prompt injection attacks. By maintaining strict boundaries between instructions and data, systems can resist

adversarial manipulation that attempts to override safety constraints. This control directly protects the intent determination process described in Section 3.

**Output Validation** verifies agent outputs before execution to detect hallucinations and policy violations. Every proposed action must pass validation gates that check both factual accuracy and compliance with operational boundaries. This control governs the action execution mechanisms detailed in Section 5.

**Least Privilege** grants only the minimum necessary tool access to limit the blast radius of failures. Rather than providing agents with unrestricted capabilities, we expose only those tools required for legitimate tasks. This principle constrains both perception (Section 4) and action (Section 5) subsystems.

**Audit Logging** maintains comprehensive action logs for accountability and investigation. Every trigger, decision, and tool invocation must generate structured records that support retrospective analysis. This enables effective review of termination decisions (Section 8) and escalation events (Section 9).

**Matter and Client Isolation** enforces confidentiality boundaries to protect privileged information. Agents must respect the same ethical walls that govern human professionals, preventing information leakage across matters or clients. This control enforces the memory isolation requirements described in Section 6.

## 11.4 Transparency and Explainability

Regulators and clients require explanations for agent decisions (Zhong and Goel 2024). We define four transparency levels serving different audiences and purposes. At Level 0, users receive only the output itself—for example, “Suspicious transaction flagged.” This minimal disclosure suffices for low-stakes, high-trust contexts where the user needs only the conclusion. Level 1 adds supporting evidence: “Flagged transaction #45921; exceeds Rule 203(b)(1).” By including specific citations and identifiers, this level enables independent verification of the agent’s reasoning without exposing internal deliberations.

Level 2 provides a reasoning outline that articulates the key analytical steps: “Flagged because: (1) \$150K exceeds \$100K threshold under Rule 203(b)(1), (2) counterparty appears on sanctions watchlist.” This structured explanation is appropriate for substantive work product where stakeholders must understand not just the conclusion but the logical path that led there. Finally, Level 3 captures a complete execution trace—a full structured record of tool calls, retrieval operations, planning steps, and reasoning chains. This comprehensive audit trail is essential for debugging, regulatory examination, and post-incident investigation.

The architecture must capture Level 3 traces for all operations, then generate audience-appropriate summaries at Levels 0–2 on demand. This approach balances transparency obligations with opera-

tional efficiency and confidentiality constraints.

### 11.5 Auditability vs. Retention

Tension exists between comprehensive logging for audit and data minimization for privacy. The solution is not “log everything forever.” We apply four practices to balance these competing demands.

**Structured Logging** captures decisions rather than raw chain-of-thought. This enables selective retention of decision points while discarding ephemeral reasoning. By focusing on *what* the agent decided and *why*, rather than every intermediate reasoning step, we preserve auditability without drowning in data.

**Tiered Retention** implements purpose-specific periods tailored to operational needs. Short-term retention (measured in days) maintains full operational logs for debugging and immediate issue resolution. Medium-term retention (measured in months) preserves structured decision logs sufficient for audit and quality review. Long-term retention (measured in years) archives only the minimal compliance records required by regulation or professional standards. This tiered approach ensures that data persists only as long as it serves a defined purpose.

**Redaction at Capture** applies privacy filters before logging. Once sensitive data enters logs, systematic removal becomes difficult and error-prone. By redacting protected information—such as personally identifiable information or attorney-client privileged material—at the point of capture, we prevent downstream exposure.

**Legal Hold Integration** ensures retention schedules yield to preservation obligations when litigation is reasonably anticipated. Automated destruction must halt when legal hold triggers activate, preventing spoliation while maintaining routine hygiene for non-preserved materials.

### 11.6 Forward to Chapter 8

This chapter answered *how to build an agentic system*. The ten questions provided the architectural foundations; each created governance requirements the system must support.

The following chapter answers: *how do we govern these systems?* ?? introduces dimensional calibration for scaling governance controls based on system capabilities and risk profiles. ?? examines the five-layer governance stack—legal, model, system, process, and culture—that translates regulatory obligations into operational controls. ?? details audit logging requirements for compliance and investigation. ?? explores human oversight patterns that balance automation with accountability. Finally, ?? establishes accountability structures for when agents fail or cause harm, including Federal Reserve guidance (Board of Governors of the Federal Reserve System and Office of the Comptroller of the Currency 2011) and the NIST AI RMF (National Institute of Standards and Technology 2023).

Architecture provides the foundation. Governance provides the controls. Together, they enable responsible deployment.

## 12 Conclusion: From Architecture to Governance

---

This chapter opened with a claim: **agents are not magic; they are architecture**. Ten sections later, that claim should feel concrete.

You now know how work reaches an agent (triggers), how instructions become goals (intent), how agents gather information (perception) and take action (action), how context persists (memory), how complex work decomposes (planning), how agents recognize completion (termination), when they hand off to humans (escalation), how they coordinate (delegation), and what controls keep them safe (governance).

Each capability involves tradeoffs. Richer memory improves context but increases latency. Aggressive escalation improves safety but reduces autonomy. Tighter approval gates reduce risk but slow execution. There are no free lunches, only choices that must be calibrated to your context, risk tolerance, and professional obligations. Additional resources, including protocol specifications, regulatory guidance links, and research references, are available on the book's companion website. Chapter 8 (Agents Part III: Governing Agents) provides a risk-based calibration approach rather than a one-size-fits-all checklist.

The organizational analogy is not merely pedagogical. Law firms and investment teams are cognitive work systems that have evolved infrastructure for exactly these challenges: distributing work, maintaining context, and ensuring quality. When you evaluate an agentic system, ask the same questions you would ask about a professional team.

### 12.1 What This Understanding Enables

With architectural literacy, you can evaluate vendor claims. When a vendor says their agent “handles legal research,” ask: What triggers it? How does it understand the question? What databases does it access? How does it know when it is done? What happens when confidence is low? The ten questions provide your evaluation framework.

You can participate meaningfully in procurement. Assess whether a system meets requirements: Does it enforce matter isolation? Maintain audit trails? Integrate with approval workflows? Escalate appropriately? You have the vocabulary to specify requirements.

You can demand governance artifacts, not promises. Ask vendors to demonstrate action gating, escalation behavior under low confidence, and reconstruction via logs. If a system cannot show you what it accessed, what it did, and why it stopped, it is not deployable in regulated practice.

You can design governance that maps to architecture. Governance is enabled by architecture. If you want audit trails, the system must log reasoning. If you want approval gates, the system must pause before action. If you want confidentiality, the system must isolate context. You can design systems where governance is built in, not bolted on.

Finally, you can communicate with technical teams. Describe requirements precisely: “I need perception tools for these databases, action tools behind approval gates, escalation triggers for low confidence, and memory isolation between matters.” Shared vocabulary enables collaboration.

## 12.2 Honest Assessment of Current Capabilities

Architectural understanding requires honest acknowledgment of limitations.

**The reliability cliff** (Section 8.5) is the most significant constraint. Agents exhibit near-perfect success on short tasks but fail frequently on multi-hour workflows. Design systems that decompose work aggressively and checkpoint progress frequently.

**Judgment limitations** constrain value. Agents excel at retrieval and pattern matching but struggle with nuance and novelty. The effective deployments pair agent capabilities with human judgment.

**Brittleness** causes failures due to API changes or edge cases. Build monitoring and graceful degradation into every deployment.

**Compounding errors** affect multi-step workflows. Error probabilities multiply, so long autonomous chains fail. Shorter workflows with human checkpoints perform better.

## 12.3 From Architecture to Governance

This chapter answered: *How do you build an agent?* The next chapter answers: *How do you govern one?*

As Section 11 demonstrated, every architectural decision has governance implications. Architecture enables governance: if you did not architect for logging, you cannot audit; if you did not architect for isolation, you cannot enforce boundaries.

The governance imperative is that agents are not just tools. They interpret goals, select what to perceive, and take actions that can create liability. That shift introduces predictable accountability problems: purpose drift (misaligned goals), perceptual opacity (bad or manipulated inputs), and actuation risk (high-consequence actions). ?? provides dimensional calibration for matching controls to risk, while ?? presents a five-layer framework that translates these challenges into concrete controls: calibrated autonomy, input and action constraints, auditability, retention, escalation and override mechanisms, and accountability structures.

*You cannot govern what you do not understand.*

*You cannot control what you did not architect.*

*Now you can do both.*

## References

---

- Abbasi Yadkori, Yasin, Ilja Kuzborskij, David Stutz, András György, Adam Fisch, Arnaud Doucet, Iuliya Beloshapka, Wei-Hung Weng, Yao-Yuan Yang, Csaba Szepesvári, Ali Taylan Cemgil, and Nenad Tomasev (2024). *Mitigating LLM Hallucinations via Conformal Abstention*. Develops principled procedure for determining when LLMs should abstain (say “I don’t know”) instead of hallucinating; uses conformal prediction to provide theoretical guarantees on hallucination rates. arXiv: 2405.01563 [cs.LG]. URL: <https://arxiv.org/abs/2405.01563> (visited on 12/19/2025).
- Agent2Agent Protocol Specification (2025). Official specification for A2A protocol; supports HTTP, SSE, gRPC transports; security card signing added November 2025. URL: <https://a2a-protocol.org/latest/> (visited on 11/27/2025).
- Allen, James F. and C. Raymond Perrault (1980). “Analyzing Intention in Utterances”. In: *Artificial Intelligence* 15.3. Foundational paper on plan-based inference of speaker intentions in cooperative dialogue; establishes framework for understanding how listeners infer goals from utterances, pp. 143–178. DOI: 10.1016/0004-3702(80)90042-9. URL: [https://doi.org/10.1016/0004-3702\(80\)90042-9](https://doi.org/10.1016/0004-3702(80)90042-9) (visited on 12/19/2025).
- American Bar Association (2025). *Model Rules of Professional Conduct, Rule 1.1: Competence*. Primary authority establishing duty of competence including technology competence (Comment 8 amended 2012). URL: [https://www.americanbar.org/groups/professional\\_responsibility/publications/model\\_rules\\_of\\_professional\\_conduct/rule\\_1\\_1\\_competence/](https://www.americanbar.org/groups/professional_responsibility/publications/model_rules_of_professional_conduct/rule_1_1_competence/) (visited on 12/13/2025).
- American Bar Association Standing Committee on Ethics and Professional Responsibility (July 2024). *Formal Opinion 512: Generative Artificial Intelligence Tools*. Tech. rep. Addresses ethical obligations when using generative AI; covers competence, confidentiality, supervision, and billing. American Bar Association. URL: [https://www.americanbar.org/groups/professional\\_responsibility/publications/ethics\\_opinions/formal-opinion-512/](https://www.americanbar.org/groups/professional_responsibility/publications/ethics_opinions/formal-opinion-512/) (visited on 11/27/2025).
- Anthropic (Nov. 2024). *Introducing the Model Context Protocol*. Open standard for connecting AI systems to data sources; pre-built servers for Google Drive, Slack, GitHub, Postgres; SDKs for Python, TypeScript, C#. URL: <https://www.anthropic.com/news/model-context-protocol> (visited on 11/27/2025).
- Austin, J. L. (1962). *How to Do Things with Words*. Posthumously published William James Lectures (Harvard, 1955) establishing speech act theory; introduces performative utterances—utterances that constitute actions rather than describe them (e.g., “I promise,” “I sentence you”). Second edition edited by J. O. Urmson and Marina Sbisa, Harvard University Press, 1975, ISBN 978-0-674-41152-4. Oxford: Oxford University Press.
- Board of Governors of the Federal Reserve System and Office of the Comptroller of the Currency (Apr. 2011). *Supervisory Guidance on Model Risk Management*. Tech. rep. SR Letter 11-7 / OCC Bulletin

- 2011-12. Foundational guidance on model risk management for financial institutions; defines model risk, validation requirements, and governance standards; increasingly relevant to AI/ML models. Federal Reserve Board. URL: <https://www.federalreserve.gov/supervisionreg/srletters/sr1107.htm> (visited on 12/13/2025).
- Bommarito, Michael James, Jillian Bommarito, and Daniel Martin Katz (Nov. 2025). *What is an Agent? A Conceptual Primer and History of Agents and Agentic AI*. Working Paper 5806982. Part I of the Agents series from *Artificial Intelligence for Law and Finance*; establishes GPA+IAT framework synthesizing seven decades of agency scholarship from philosophy, psychology, law, economics, and computer science. SSRN. DOI: 10.2139/ssrn.5806982. URL: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=5806982](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5806982) (visited on 12/14/2025).
- Brown, Tom, Benjamin Mann, Nick Ryder, Melanie Subbiah, Jared D. Kaplan, Prafulla Dhariwal, Arvind Neelakantan, Pranav Shyam, Girish Sastry, Amanda Askell, Sandhini Agarwal, Ariel Herbert-Voss, Gretchen Krueger, Tom Henighan, Rewon Child, Aditya Ramesh, Daniel Ziegler, Jeffrey Wu, Clemens Winter, Chris Hesse, Mark Chen, Eric Sigler, Mateusz Litwin, Scott Gray, Benjamin Chess, Jack Clark, Christopher Berner, Sam McCandlish, Alec Radford, Ilya Sutskever, and Dario Amodei (2020). “Language Models are Few-Shot Learners”. In: *Advances in Neural Information Processing Systems (NeurIPS)*. Vol. 33. Seminal paper introducing GPT-3 (175B parameters) and establishing in-context learning: the ability of large language models to adapt to new tasks from examples provided in the prompt without parameter updates, pp. 1877–1901. URL: <https://papers.nips.cc/paper/2020/hash/1457c0d6bfc4967418bfb8ac142f64a-Abstract.html> (visited on 12/19/2025).
- Cemri, Mert, Melissa Z. Pan, Shuyi Yang, Lakshya A. Agrawal, Bhavya Chopra, Rishabh Tiwari, Kurt Keutzer, Aditya Parameswaran, Dan Klein, Kannan Ramchandran, Matei Zaharia, Joseph E. Gonzalez, and Ion Stoica (2025). *Why Do Multi-Agent LLM Systems Fail?* Introduces MAST taxonomy with 14 failure modes in 3 categories (system design, inter-agent misalignment, task verification); analyzes 1600+ annotated traces across 7 MAS frameworks; high inter-annotator agreement ( $\kappa = 0.88$ ). arXiv: 2503.13657 [cs.AI]. URL: <https://arxiv.org/abs/2503.13657> (visited on 12/19/2025).
- Clop, Cody and Yannick Teglia (2024). *Backdoored Retrievers for Prompt Injection Attacks on Retrieval Augmented Generation of Large Language Models*. Demonstrates corpus poisoning and backdoor attacks on RAG systems; achieves high attack success rates with minimal poisoned documents; security implications for memory-based agents. arXiv: 2410.14479 [cs.CR]. URL: <https://arxiv.org/abs/2410.14479> (visited on 12/19/2025).
- Dahl, Matthew, Varun Magesh, Mirac Suzgun, and Daniel E. Ho (2024). “Hallucination-Free? Assessing the Reliability of Leading AI Legal Research Tools”. In: *Journal of Empirical Legal Studies*. Finds RAG-based legal tools (Lexis+ AI, Westlaw AI) hallucinate 17–33% of the time; challenges vendor claims of hallucination-free performance. DOI: 10.1111/jels.12394. URL: [https://law.stanford.edu/wp-content/uploads/2024/05/Legal\\_RAG\\_Hallucinations.pdf](https://law.stanford.edu/wp-content/uploads/2024/05/Legal_RAG_Hallucinations.pdf) (visited on 12/13/2025).



- Financial Industry Regulatory Authority (June 2024). *Regulatory Notice 24-09: FINRA Reminds Member Firms of Regulatory Obligations When Using Artificial Intelligence*. Tech. rep. Official guidance establishing supervision and governance requirements for AI in financial services under Rule 3110. FINRA. URL: <https://www.finra.org/rules-guidance/notices/24-09> (visited on 12/13/2025).
- Gomez, Camilo, Seong Mi Cho, Sue Ke, Chien-Ming Huang, and Mathias Unberath (2025). “Human-AI collaboration is not very collaborative yet: a taxonomy of interaction patterns in AI-assisted decision making from a systematic review”. In: *Frontiers in Computer Science* 6. Systematic review of 105 articles developing taxonomy of human-AI interaction patterns; identifies limited bidirectional collaboration in current AI-assisted decision systems, p. 1521066. DOI: 10.3389/fcomp.2024.1521066. URL: <https://www.frontiersin.org/journals/computer-science/articles/10.3389/fcomp.2024.1521066/full> (visited on 12/19/2025).
- Google Developers (Apr. 2025). *Announcing the Agent2Agent Protocol (A2A)*. Open protocol for agent-to-agent communication using JSON-RPC 2.0 over HTTP; donated to Linux Foundation; features Agent Cards for capability discovery; 50+ launch partners. URL: <https://developers.googleblog.com/en/a2a-a-new-era-of-agent-interoperability/> (visited on 11/27/2025).
- Grinsztajn, Nathan, Johan Ferret, Olivier Pietquin, Philippe Preux, and Matthieu Geist (2021). “There Is No Turning Back: A Self-Supervised Approach for Reversibility-Aware Reinforcement Learning”. In: *Advances in Neural Information Processing Systems (NeurIPS)*. Vol. 34. Self-supervised approach for learning reversibility in RL; agents learn to distinguish reversible from irreversible actions without explicit labels; foundational for safety-aware autonomous systems, pp. 1898–1911. URL: [https://papers.nips.cc/paper\\_files/paper/2021/hash/0e98aeeb54acf612b9eb4e48a269814c-Abstract.html](https://papers.nips.cc/paper_files/paper/2021/hash/0e98aeeb54acf612b9eb4e48a269814c-Abstract.html) (visited on 12/19/2025).
- Guo, Taicheng, Xiuying Chen, Yaqi Wang, Ruidi Chang, Shichao Pei, Nitesh V. Chawla, Olaf Wiest, and Xiangliang Zhang (2024). “Large Language Model Based Multi-agents: A Survey of Progress and Challenges”. In: *Proceedings of the Thirty-Third International Joint Conference on Artificial Intelligence (IJCAI-24)*. Comprehensive survey on LLM-based multi-agent systems covering architectures, coordination mechanisms, and problem-solving capabilities. URL: <https://arxiv.org/abs/2402.01680> (visited on 12/13/2025).
- Hollan, James, Edwin Hutchins, and David Kirsh (2000). “Distributed Cognition: Toward a New Foundation for Human-Computer Interaction Research”. In: *ACM Transactions on Computer-Human Interaction* 7.2. Seminal paper proposing distributed cognition as framework for HCI; cognition extends beyond individuals to include artifacts, environment, and social structures, pp. 174–196. DOI: 10.1145/353485.353487. URL: <https://doi.org/10.1145/353485.353487> (visited on 12/19/2025).
- Hollnagel, Erik and David D. Woods (2005). *Joint Cognitive Systems: Foundations of Cognitive Systems Engineering*. Foundational text establishing cognitive systems engineering framework; introduces joint cognitive systems as units of analysis for human-technology interaction. Boca Raton, FL: CRC



- Press. DOI: 10.1201/9781420038194. URL: <https://doi.org/10.1201/9781420038194> (visited on 12/19/2025).
- Information technology — Artificial intelligence — Management system* (Dec. 2023). Standard. First international standard for AI management systems (AIMS); provides structured approach for governance using PDCA methodology. International Organization for Standardization. URL: <https://www.iso.org/standard/81230.html> (visited on 12/13/2025).
- Kadavath, Saurav, Tom Conerly, Amanda Askell, Tom Henighan, Dawn Drain, Ethan Perez, Nicholas Schiefer, Zac Hatfield-Dodds, Nova DasSarma, et al. (2022). *Language Models (Mostly) Know What They Know*. Anthropic study on LLM confidence calibration; finds models can predict their own accuracy but require careful prompting; relevant to confidence thresholds for agent escalation. arXiv: 2207.05221 [cs.CL]. URL: <https://arxiv.org/abs/2207.05221> (visited on 12/13/2025).
- Kim, Sehoon, Suhong Moon, Ryan Tabrizi, Nicholas Lee, Michael W. Mahoney, Kurt Keutzer, and Amir Gholami (2024). “An LLM Compiler for Parallel Function Calling”. In: *International Conference on Machine Learning (ICML)*. Compiler-inspired architecture for parallel function execution in agents; demonstrates up to 3.7x latency speedup and 6.7x cost savings vs. ReAct. URL: <https://arxiv.org/abs/2312.04511> (visited on 12/13/2025).
- Legal Information Institute (2024). *Rule 12. Defenses and Objections: When and How Presented*. Federal rule establishing 21-day deadline for responsive pleadings; critical for deadline calculation in litigation agents. URL: [https://www.law.cornell.edu/rules/frcp/rule\\_12](https://www.law.cornell.edu/rules/frcp/rule_12) (visited on 12/13/2025).
- Lewis, Patrick, Ethan Perez, Aleksandra Piktus, Fabio Petroni, Vladimir Karpukhin, Naman Goyal, Heinrich Küttler, Mike Lewis, Wen-tau Yih, Tim Rocktäschel, Sebastian Riedel, and Douwe Kiela (2020). “Retrieval-Augmented Generation for Knowledge-Intensive NLP Tasks”. In: *Advances in Neural Information Processing Systems (NeurIPS)*. Vol. 33. Original RAG paper introducing the paradigm of combining parametric (LLM) and non-parametric (retrieval) memory for generation tasks, pp. 9459–9474. URL: <https://arxiv.org/abs/2005.11401> (visited on 12/13/2025).
- Liu, Yupei, Yuqi Jia, Runpeng Geng, Jinyuan Jia, and Neil Zhenqiang Gong (2024). “Formalizing and Benchmarking Prompt Injection Attacks and Defenses”. In: *Proceedings of the 33rd USENIX Security Symposium*. First formal framework for prompt injection attacks; comprehensive benchmark of attack vectors and defense mechanisms; peer-reviewed security venue. USENIX Association. URL: <https://www.usenix.org/conference/usenixsecurity24/presentation/liu-yupei> (visited on 12/19/2025).
- Ma, Chang, Junlei Zhang, Zhihao Zhu, Cheng Yang, Yujiu Yang, Yaohui Jin, Zhenzhong Lan, Lingpeng Kong, and Junxian He (2024). “AgentBoard: An Analytical Evaluation Board of Multi-turn LLM Agents”. In: *Advances in Neural Information Processing Systems (NeurIPS)*. Vol. 37. NeurIPS 2024 Oral; introduces fine-grained progress rate metric that captures incremental advancements in multi-turn agent tasks. arXiv: 2401.13178. URL: <https://arxiv.org/abs/2401.13178> (visited on 12/19/2025).

- Ma, Xinbei, Yeyun Gong, Pengcheng He, Hai Zhao, and Nan Duan (2023). “Query Rewriting for Retrieval-Augmented Large Language Models”. In: *Proceedings of the 2023 Conference on Empirical Methods in Natural Language Processing (EMNLP)*. Introduces Rewrite-Retrieve-Read framework; uses trainable rewriter to transform queries for better retrieval; demonstrates improved QA accuracy through query adaptation. Association for Computational Linguistics. URL: <https://aclanthology.org/2023.emnlp-main.322/> (visited on 12/19/2025).
- Madras, David, Toniann Pitassi, and Richard Zemel (2018). “Predict Responsibly: Improving Fairness and Accuracy by Learning to Defer”. In: *Advances in Neural Information Processing Systems (NeurIPS)*. Vol. 31. Foundational work on learning when AI should defer to human decision-makers; frames deferral as joint optimization of accuracy and fairness; basis for confidence-based escalation. URL: <https://proceedings.neurips.cc/paper/2018/hash/09d37c08f7b129e96277388757530c72-Abstract.html> (visited on 12/19/2025).
- McCarthy, John and Patrick J. Hayes (1969). “Some Philosophical Problems from the Standpoint of Artificial Intelligence”. In: *Machine Intelligence 4*. Ed. by B. Meltzer and D. Michie. Foundational paper introducing the frame problem in AI: when an action occurs, what changes and what stays the same? Also introduces situation calculus for reasoning about actions and their effects. Edinburgh: Edinburgh University Press, pp. 463–502. URL: <https://www-formal.stanford.edu/jmc/mcchay69.pdf> (visited on 12/19/2025).
- METR (Mar. 2025). *Measuring AI Ability to Complete Long Tasks*. Empirical study finding AI agent success rates inversely correlated to task duration; 100% success on tasks under 4 minutes, under 10% for tasks over 4 hours; capability doubling time approximately 7 months. URL: <https://metr.org/blog/2025-03-19-measuring-ai-ability-to-complete-long-tasks/> (visited on 11/27/2025).
- Mo, Guozhao, Wenliang Zhong, Jiawei Chen, Xuanang Chen, Yaojie Lu, Hongyu Lin, Ben He, Xianpei Han, and Le Sun (2025). “LiveMCPBench: Can Agents Navigate an Ocean of MCP Tools?” In: *arXiv preprint arXiv:2508.01780*. Benchmark evaluating agent performance over large MCP tool ecosystems; discusses MCP server ecosystem scale (10,000+ servers). DOI: 10.48550/arXiv.2508.01780. URL: <https://arxiv.org/abs/2508.01780> (visited on 12/15/2025).
- Model Context Protocol Specification* (2025). Official MCP documentation and specification; server and client SDKs; community server directory. URL: <https://modelcontextprotocol.io/> (visited on 11/27/2025).
- Mosqueira-Rey, Eduardo, Elena Hernández-Pereira, David Alonso-Ríos, José Bobes-Bascarán, and Ángel Fernández-Leal (2023). “Human-in-the-loop machine learning: a state of the art”. In: *Artificial Intelligence Review* 56. Comprehensive survey of HITL-ML covering active learning, interactive ML, machine teaching, curriculum learning, and explainable AI; includes confidence-based escalation approaches, pp. 3005–3054. DOI: 10.1007/s10462-022-10246-w. URL: <https://link.springer.com/article/10.1007/s10462-022-10246-w> (visited on 12/19/2025).
- National Institute of Standards and Technology (Jan. 2023). *Artificial Intelligence Risk Management Framework (AI RMF 1.0)*. Tech. rep. NIST AI 100-1. Voluntary framework for managing AI risks;

- organized around governance, mapping, measuring, and managing AI risks; referenced by EU AI Act and other regulatory frameworks. U.S. Department of Commerce. URL: <https://www.nist.gov/itl/ai-risk-management-framework> (visited on 12/13/2025).
- Nielsen, Jakob (June 2023). *AI: First New UI Paradigm in 60 Years*. Introduces concept of intent-based outcome specification as the third UI paradigm after batch processing and command-based interaction; argues AI shifts locus of control from user specifying commands to user specifying desired outcomes. URL: <https://www.nngroup.com/articles/ai-paradigm/> (visited on 12/13/2025).
- OpenID Foundation AI Identity Management Community Group (2024). “Identity Management for Agentic AI: The New Frontier of Authorization, Authentication, and Security for an AI Agent World”. In: *arXiv preprint arXiv:2510.25819*. Addresses authentication, authorization, and identity management in multi-agent systems; proposes DIDs, Verifiable Credentials, and Zero Trust principles. URL: <https://arxiv.org/abs/2510.25819> (visited on 12/13/2025).
- Ouyang, Long, Jeff Wu, Xu Jiang, Diogo Almeida, Carroll L. Wainwright, Pamela Mishkin, Chong Zhang, Sandhini Agarwal, Katarina Slama, Alex Ray, John Schulman, Jacob Hilton, Fraser Kelton, Luke Miller, Maddie Simens, Amanda Askell, Peter Welinder, Paul Christiano, Jan Leike, and Ryan Lowe (2022). *Training Language Models to Follow Instructions with Human Feedback*. Introduces InstructGPT and RLHF methodology; explicitly frames alignment as following user intent across diverse tasks; foundational for modern instruction-following LLMs. arXiv: 2203.02155 [cs.CL]. URL: <https://arxiv.org/abs/2203.02155> (visited on 12/19/2025).
- OWASP Foundation (2025). *OWASP Top 10 for Large Language Model Applications*. Security vulnerabilities in LLM applications; ranks prompt injection as critical vulnerability #1. URL: <https://owasp.org/www-project-top-10-for-large-language-model-applications/> (visited on 11/27/2025).
- Parasuraman, Raja, Thomas B. Sheridan, and Christopher D. Wickens (2000). “A Model for Types and Levels of Human Interaction with Automation”. In: *IEEE Transactions on Systems, Man, and Cybernetics—Part A: Systems and Humans* 30.3. Foundational framework defining 10 levels of automation across four information-processing stages; canonical reference for human-automation interaction and approval gate design, pp. 286–297. DOI: 10.1109/3468.844354. URL: <https://ieeexplore.ieee.org/document/844354> (visited on 12/19/2025).
- Park, Joon Sung, Joseph C. O’Brien, Carrie J. Cai, Meredith Ringel Morris, Percy Liang, and Michael S. Bernstein (2023). “Generative Agents: Interactive Simulacra of Human Behavior”. In: *Proceedings of the 36th Annual ACM Symposium on User Interface Software and Technology (UIST)*. Introduces memory stream architecture with reflection for long-term agent behavior; foundational for episodic memory and learning in agent systems. ACM. DOI: 10.1145/3586183.3606763.
- Press, Ofir, Muru Zhang, Sewon Min, Ludwig Schmidt, Noah A. Smith, and Mike Lewis (2023). “Measuring and Narrowing the Compositionality Gap in Language Models”. In: *Findings of the Association for Computational Linguistics: EMNLP 2023*. Quantifies compositionality gap where models correctly solve sub-problems but fail on overall compositional tasks; demonstrates perfor-

- mance degradation as composition steps increase; gap remains constant at 40% across model sizes. Singapore: Association for Computational Linguistics, pp. 5687–5711. arXiv: 2210.03350. URL: <https://arxiv.org/abs/2210.03350> (visited on 12/19/2025).
- Rao, Anand S. and Michael P. Georgeff (1995). “BDI Agents: From Theory to Practice”. In: *Proceedings of the First International Conference on Multi-Agent Systems (ICMAS-95)*. Foundational work on Belief-Desire-Intention cognitive architecture for agents. AAAI Press, pp. 312–319. URL: <https://cdn.aaai.org/ICMAS/1995/ICMAS95-042.pdf> (visited on 12/13/2025).
- Robertson, Stephen and Hugo Zaragoza (2009). “The Probabilistic Relevance Framework: BM25 and Beyond”. In: *Foundations and Trends in Information Retrieval*. Vol. 3. 4. Comprehensive review of BM25 probabilistic ranking algorithm, widely used for keyword search in hybrid RAG retrieval. Now Publishers, pp. 333–389. doi: 10.1561/15000000019. (Visited on 12/13/2025).
- Russell, Stuart and Peter Norvig (2020). *Artificial Intelligence: A Modern Approach*. 4th ed. Foundational textbook establishing agent architecture: perception-action loop, rational agents, and agent type taxonomy (simple reflex, model-based reflex, goal-based, utility-based). Pearson. URL: <https://aima.cs.berkeley.edu/> (visited on 12/13/2025).
- Wang, Lei, Chen Ma, Xueyang Feng, Zeyu Zhang, Hao Yang, Jingsen Zhang, Zhiyuan Chen, Jiakai Tang, Xu Chen, Yankai Lin, Wayne Xin Zhao, Zhewei Wei, and Ji-Rong Wen (2024a). “A Survey on Large Language Model based Autonomous Agents”. In: *Frontiers of Computer Science* 18.6. Peer-reviewed survey proposing unified framework for LLM-based agents covering profile, memory, planning, and action modules, p. 186345. doi: 10.1007/s11704-024-40231-1. URL: <https://link.springer.com/article/10.1007/s11704-024-40231-1> (visited on 12/19/2025).
- Wang, Wenxuan, Juluan Shi, Zixuan Ling, Yuk-Kit Chan, Chaozheng Wang, Cheryl Lee, Youliang Yuan, Jen-tse Huang, Wenxiang Jiao, and Michael R. Lyu (2024b). *Learning to Ask: When LLM Agents Meet Unclear Instruction*. Proposes Ask-when-Needed (AwN) framework prompting LLMs to ask questions when encountering unclear instructions; creates NoisyToolBench benchmark for imperfect instructions. arXiv: 2409.00557 [cs.CL]. URL: <https://arxiv.org/abs/2409.00557> (visited on 12/13/2025).
- Wang, Yaoxiang, Zhiyong Wu, Junfeng Yao, and Jinsong Su (2024c). “TDAG: A Multi-Agent Framework based on Dynamic Task Decomposition and Agent Generation”. In: *Neural Networks*. Addresses dynamic task decomposition in multi-agent systems; demonstrates complex task breakdown with specialized subagents. URL: <https://arxiv.org/abs/2402.10178> (visited on 12/13/2025).
- Wu, Qingyun, Gagan Bansal, Jieyu Zhang, Yiran Wu, Shaokun Zhang, Erkang Zhu, Beibin Li, Li Jiang, Xiaoyun Zhang, and Chi Wang (2023). “AutoGen: Enabling Next-Gen LLM Applications via Multi-Agent Conversation”. In: *arXiv preprint arXiv:2308.08155*. Foundational framework for multi-agent conversation systems; covers customizable agents, flexible conversation patterns. URL: <https://arxiv.org/abs/2308.08155> (visited on 12/13/2025).
- Xu, Binfeng, Zhiyuan Peng, Bowen Lei, Subhabrata Mukherjee, Yuchen Liu, and Dongkuan Xu (2023). *ReWOO: Decoupling Reasoning from Observations for Efficient Augmented Language Models*. Modular paradigm separating reasoning from tool observations; achieves 5x token efficiency

- and 4% accuracy improvement over ReAct on HotpotQA. arXiv: 2305.18323 [cs.CL]. URL: <https://arxiv.org/abs/2305.18323> (visited on 12/13/2025).
- Yao, Shunyu, Jeffrey Zhao, Dian Yu, Nan Du, Izhak Shafran, Karthik Narasimhan, and Yuan Cao (2022). “ReAct: Synergizing Reasoning and Acting in Language Models”. In: *arXiv preprint arXiv:2210.03629*. Introduces ReAct pattern: alternating reasoning and acting in language models.
- Yu, Yue, Wei Ping, Zihan Liu, Boxin Wang, Jiaxuan You, Chao Zhang, Mohammad Shoeybi, and Bryan Catanzaro (2024). *RankRAG: Unifying Context Ranking with Retrieval-Augmented Generation in LLMs*. Instruction-tunes single LLM for both context ranking and answer generation; outperforms GPT-4 on knowledge-intensive benchmarks; demonstrates reranking integrated into generation. arXiv: 2407.02485 [cs.CL]. URL: <https://arxiv.org/abs/2407.02485> (visited on 12/19/2025).
- Zhang, Michael J. Q., W. Bradley Knox, and Eunsol Choi (2024). *Modeling Future Conversation Turns to Teach LLMs to Ask Clarifying Questions*. Finds LLMs often respond by presupposing a single interpretation of ambiguous requests rather than asking clarifying questions; proposes preference labeling using simulated future turns to teach when clarification is needed. arXiv: 2410.13788 [cs.CL]. URL: <https://arxiv.org/abs/2410.13788> (visited on 12/13/2025).
- Zhong, Chen and Sunita Goel (2024). “Transparent AI in Auditing through Explainable AI”. In: *Current Issues in Auditing* 18.2. Focuses on explainable AI as mechanism for transparency and trustworthiness in audit applications, A1–A14. URL: <https://publications.aaahq.org/cia/article/18/2/A1/12271/Transparent-AI-in-Auditing-through-Explainable-AI> (visited on 12/13/2025).
- Zou, Andy, Long Phan, Justin Wang, Derek Duenas, Maxwell Lin, Maksym Andriushchenko, Rowan Wang, Zico Kolter, Matt Fredrikson, and Dan Hendrycks (2024). “Improving Alignment and Robustness with Circuit Breakers”. In: *Advances in Neural Information Processing Systems (NeurIPS)*. Vol. 37. Introduces circuit breakers as interrupt mechanisms for AI agents; demonstrates reductions in harmful actions under attack; extends to agent function-calling safety. arXiv: 2406.04313. URL: <https://arxiv.org/abs/2406.04313> (visited on 12/19/2025).