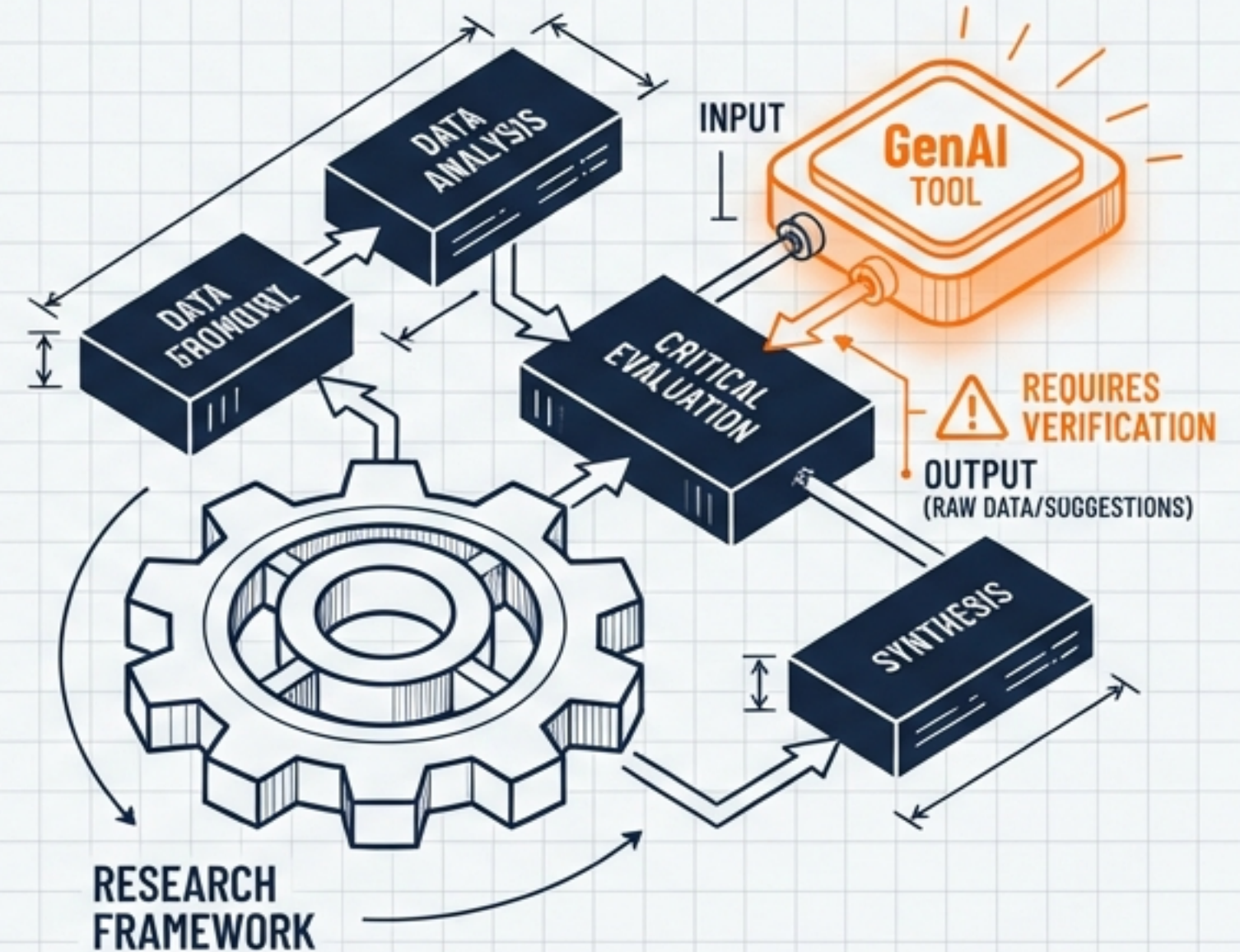


Generative AI in Professional Research: A Structural Analysis of its Core Constraints

GenAI is a powerful new method, not a new form of research.

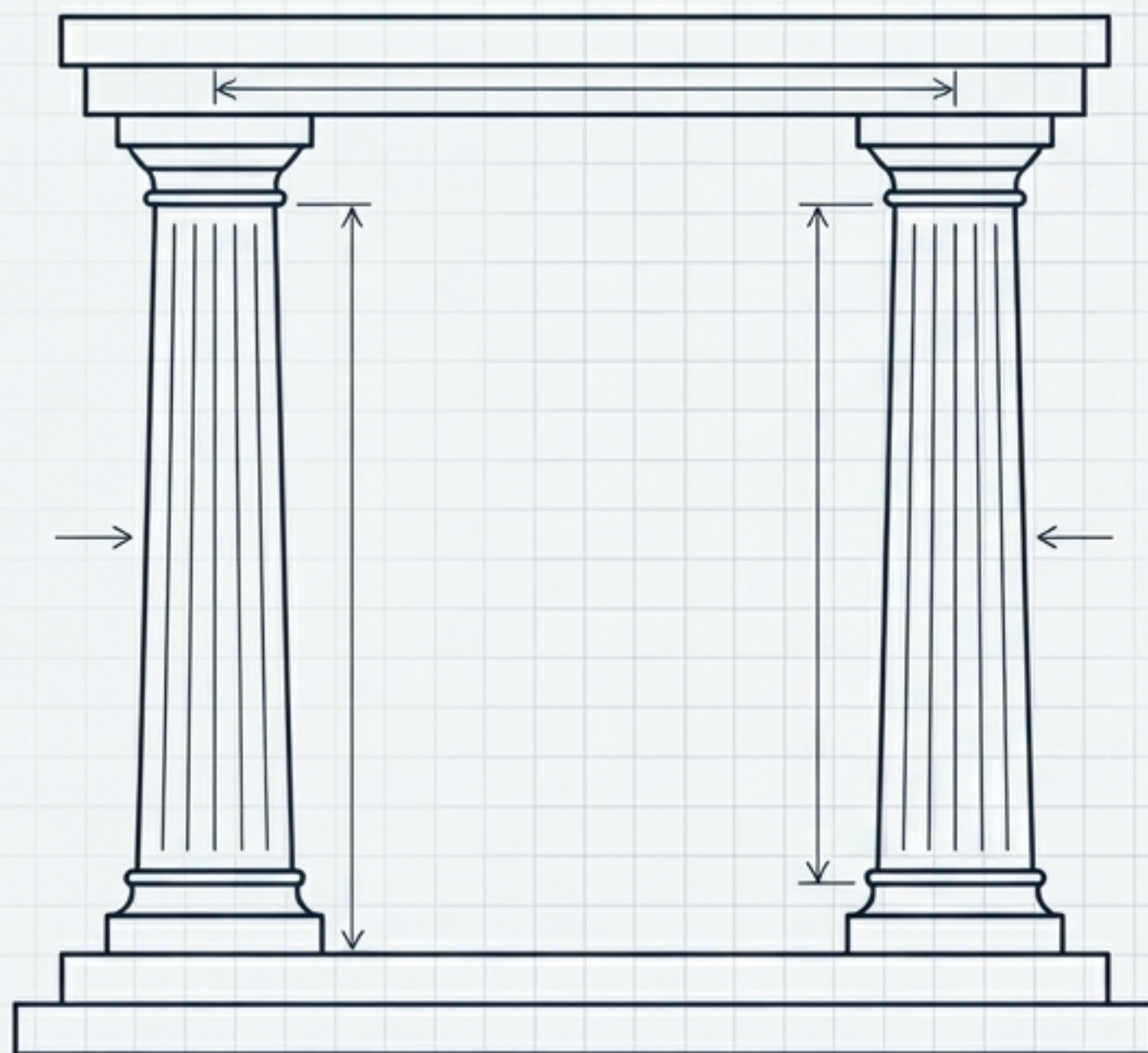
- Generative AI tools, including Large Language Models (LLMs), offer new capabilities for online research.
- However, they are an **additional method** and must not be mistaken for actual analytical research work.
- Understanding their fundamental constraints is essential for responsible and effective application.



The Foundation of Responsible Use Rests on Two Pillars – on Two Pillars

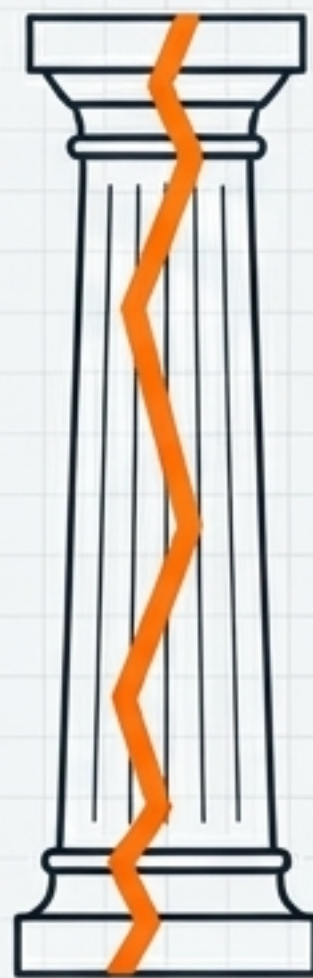
Accuracy & Validity

Technical and factual risks that impact the *validity* of the work.



Ethics & Integrity

Risks to fairness, originality, and security that impact the *integrity* of the work.



Pillar I: Accuracy & Validity

Examining the Technical and Factual Risks
Inherent in LLM Architecture

The Risk of Plausible Fiction: How LLMs Fabricate 'Facts'

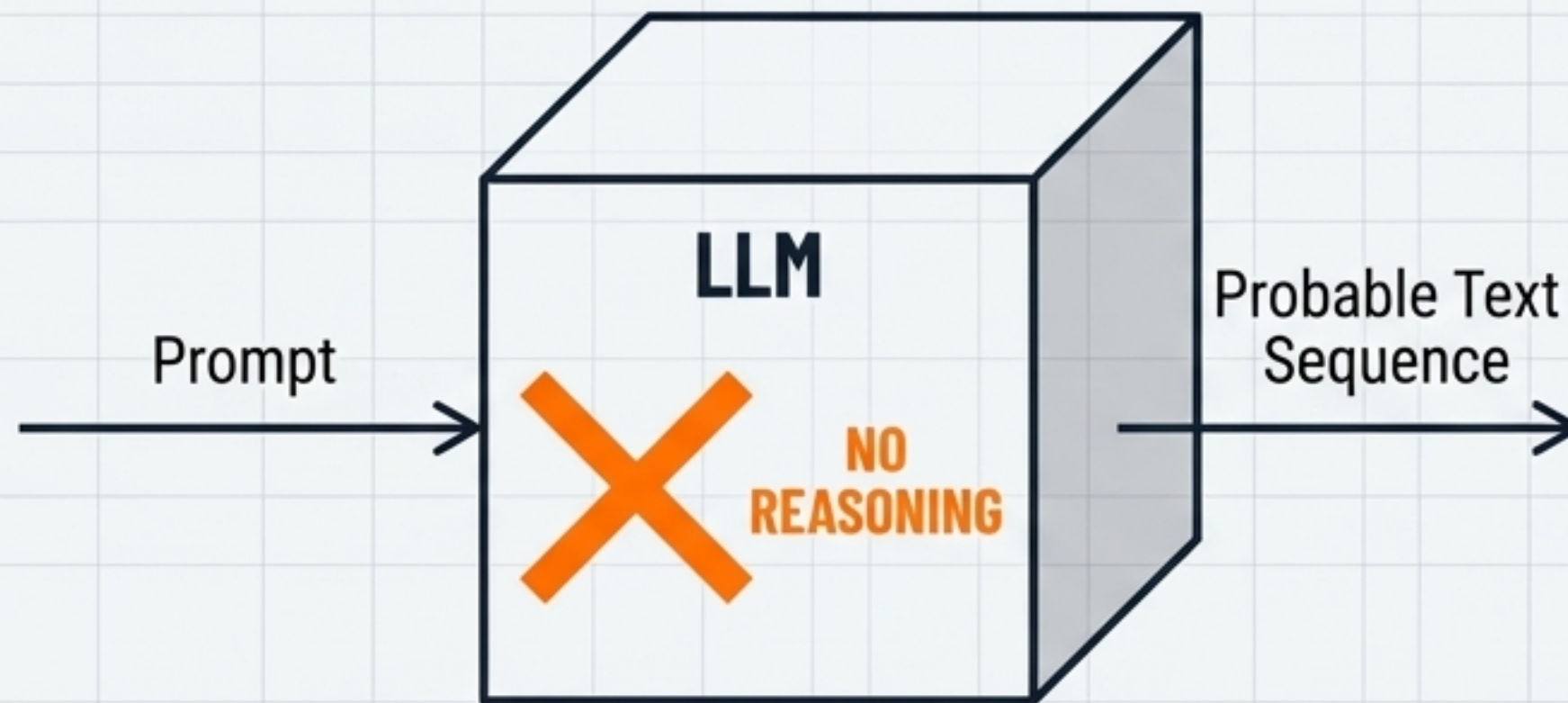
- ✓ LLMs can generate “hallucinations”: responses that appear compelling and accurate but are factually incorrect or nonsensical.
- ✓ Summarization tools often mix up facts; creating a factually consistent summarizer remains a significant technical challenge.
- ✓ **Mandate:** All AI-generated content must be verified, edited, and reformulated by the researcher.

CASE STUDY

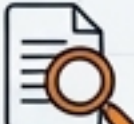
A lawyer cited fake court cases generated by an LLM as precedent, precedent, leading a federal judge to consider sanctions for the attorney.

Prediction, Not Cognition: The Absence of Logical Reasoning

LLM responses are based on **predicting the most likely sequence of tokens** (words, phrases), not on logical construction or genuine language comprehension. The output is not the result of analysis.



Critical Functions LLMs Cannot Perform:

-  Critical thinking
-  Strategic planning and objective setting
-  Evaluating research methods or the relevance of sources
-  Deriving insights from search results

Operating Within a Closed System: Knowledge Cutoffs and Data Dependencies

Key Limitation 1

Knowledge Cutoff: LLMs rely solely on their training data, which is only current up to a specific date.



Key Limitation 2

No Real-Time Data: Models lacking live internet connectivity cannot provide up-to-the-minute information, unlike traditional search engines.



Key Limitation 3

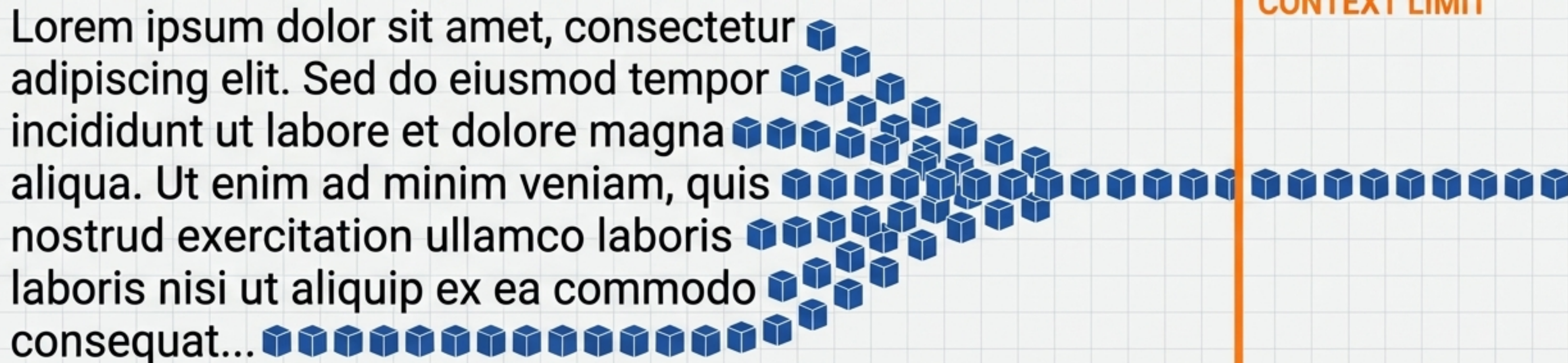
Incompatibility with Structured Data: LLMs do not perform well with structured (tabular) data, such as that in Excel or Google Sheets, requiring specialized analytical tools.



Bound by Design: Context and Length Limitations

LLMs have strict length limitations for both the input prompt and the output they can generate. These are measured in “tokens,” which are fragments of words. For example, ChatGPT-4 has a context limit of 128,000 tokens. This constrains the volume of information that can be processed in a single interaction.

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Pillar II: Ethics & Integrity

Navigating Risks to Fairness, Originality, and Confidentiality

The Unsettled Landscape of Authorship and Intellectual Property



Copyrighted Training Data

The use of copyrighted material for training LLMs under the “fair use” doctrine is still in legal flux.



IP Protection

It is unclear if GenAI-generated content can be protected by IP rights. A U.S. legal decision determined AI-generated work is ineligible for copyright as it lacks human authorship.



Academic Integrity

LLMs cannot be credited as authors on a research paper. The use of an LLM must be properly documented in the Methods section or another appropriate part of the manuscript.

Inherited Flaws: How AI Adopts and Reproduces Human Bias

LLMs learn from vast text datasets and reproduce the existing biases within them, leading to discriminatory, stereotypical, or erroneous outputs.

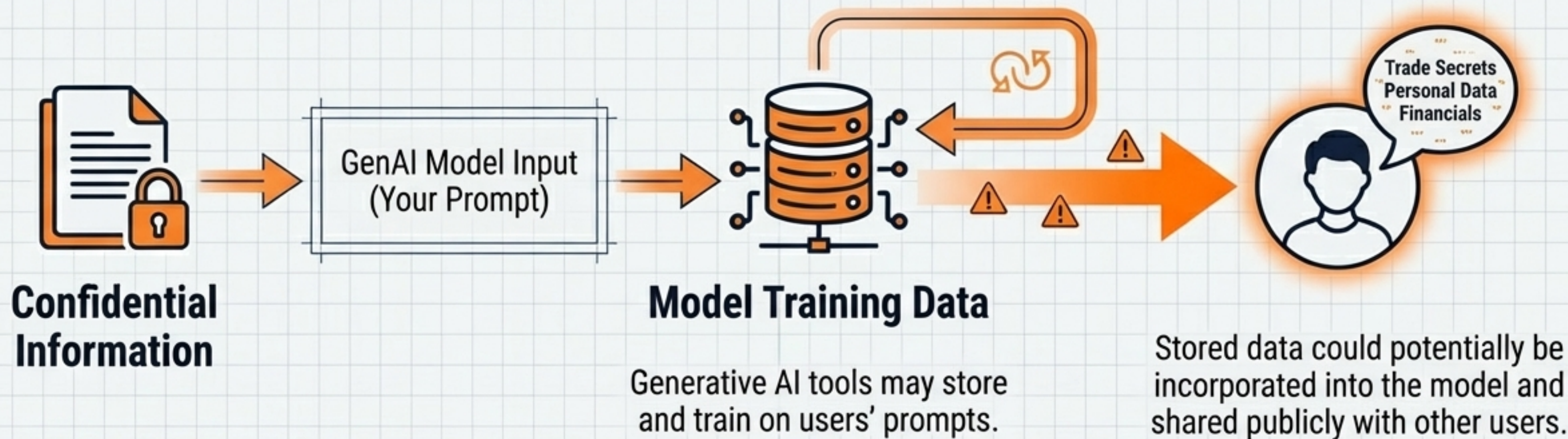
⚡ These tools are also capable of generating offensive or toxic content.

****Example of Gender Bias****



An LLM might statistically associate 'soldier' with 'he/his' and 'teacher' with 'she/her', reinforcing outdated stereotypes.

The Confidentiality Paradox: Your Input Becomes Their Data



Be mindful of sharing confidential information, as any input becomes accessible to the AI model and its developers.

GenAI's Defined Role: Powerful for Language, Not for Truth

GenAI tools are powerful for **specific language tasks**:



Summarizing content



Drafting text

However, their **professional research application** is **strictly limited** by:



An inability to **critically verify** facts or sources.



Unresolved **ethical issues** around data ownership, bias, and authorship.

The Researcher as Architect: The Primacy of Human Judgment

Final Takeaway

To ensure the integrity and validity of professional research, human oversight is not just recommended; it is indispensable. The researcher must retain the final and most critical roles:

- **Human Judgment**
- **Source Corroboration**
- **Ethical Consideration**

