FABSCORE: Fine-Grained Evaluation of Fabrications in Automated AI Research

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Abstract

Automated AI research shows great promise for accelerating scientific discovery, but ensuring the integrity of AI-generated research remains a critical challenge. In this work, we introduce FABSCORE, a new framework for fine-grained evaluation of fabrications in automated AI research. Given a research paper and its associated code, FABSCORE extracts numerical results and figure labels as individual claims, employs a coding agent to evaluate each claim through static analysis and code execution, and ultimately assigns one of six verdict categories covering fabricated, reproducible, and unverifiable outcomes. Human evaluation confirms that FABSCORE achieves a high precision of 98.6% in detecting fabrications. Applying FABSCORE to 144 papers from various sources, we find the overall claim-level fabrication rate to be 21.2%. Notably, over 70% of AI-authored real conference submissions contain fabrications, with accepted submissions still reaching a paper-level fabrication rate of 59.3%. Experiment fabrication is the most prevalent type, indicating that AI research systems often struggle to correctly implement the experiments described in the paper. Finally, over 85% of FABSCORE-detected fabrications are missed by AI reviewers, suggesting that our framework can serve as a valuable complementary tool to existing AI review processes.

1. Introduction

As artificial intelligence continues to advance, fully automated scientific research (Lu et al., 2026; Feng et al., 2026c; Mitchener et al., 2025) is rapidly becoming commonplace: AI systems can now autonomously propose novel ideas (Gottweis et al., 2025; Si et al., 2025), implement them as working code (Si et al., 2026; Starace et al., 2025), conduct experiments (Qu et al., 2026; Chen et al., 2026), and synthesize findings into research papers (Song et al., 2026). Yet far less attention has been paid to whether such research is actually rigorous and credible.

To ensure the credibility of AI-driven research outputs, reproducibility has become a more urgent concern. Reproducibility has long been a fundamental challenge: traditionally, reproducing reported results in a paper is both time-consuming and labor-intensive, requiring researchers to manually understand complex methodologies and carefully re-execute experiments. As agentic AI systems increasingly demonstrate the capability to conduct research autonomously, they also hold significant potential to systematically verify reproducibility. Recent work has taken steps in this direction (Bai et al., 2026; Hu et al., 2025), but lacks fine-grained evaluation, making it difficult to quantify the degree of reproducibility and, more importantly, to identify the specific reasons behind irreproducible results.

In this work, we introduce **FABSCORE**, a fine-grained evaluation framework that measures the extent to which AI-generated papers contain fabrications. Fabrications refer to discrepancies between the methods described in the paper and what the code actually implements, or between the reported results and those obtained by running the code. We use FABSCORE to conduct an evaluation of papers from three AI-generated research systems (AI Scientist (Lu et al., 2026), MLR-Agent (Chen et al., 2025a), and FARS [1]), and AI-authored submissions from the 2025 Agents4Science Open Conference (Bianchi et al., 2026), and aim to answer the following research questions:

- **RQ1:** *Can fabrications in AI-generated research be accurately detected?* (§3.2)
- **RQ2:** *What types of fabrications most commonly occur, and what factors account for them?* (§3.3)
- **RQ3:** *How do fabrication rates vary across different AI research systems?* (§3.4)
- **RQ4:** *To what extent can FabScore detect fabrications that AI reviewers fail to identify?* (§3.5)

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[1]https://analemma.ai/blog/introducing-fars/

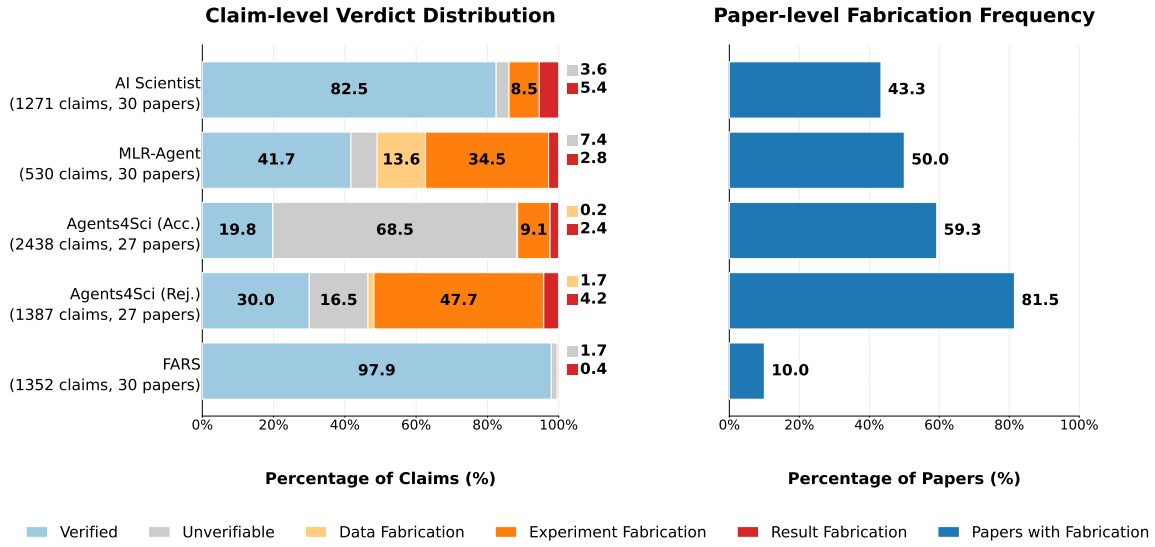


Figure 1. Claim-level verdict distribution and paper-level fabrication frequency across five data sources, where paper-level fabrication frequency is defined as the proportion of papers containing at least one fabrication. Claim-level fabrication rates range from 0.4% to 53.6% and paper-level rates from 10.0% to 81.5%. 70.4% of the 54 real conference submissions contain fabrications.

To address these questions, we design an automatic evaluation pipeline in which a coding agent executes the following four stages: (1) *result extraction*, (2) *static analysis*, (3) *code execution*, and (4) *verdict generation*. We focus on numerical experimental results as the unit of evaluation, as they are concrete and directly verifiable by executing code. Each extracted claim is ultimately classified into one of six verdict categories: (1) *verified*, (2) *data fabrication*, (3) *experiment fabrication*, (4) *result fabrication*, (5) *no code files*, and (6) *insufficient evidence*.

To validate the reliability of FABSCORE (RQ1), we recruit six AI researchers to conduct a thorough human evaluation on 30 randomly sampled papers across all sources. Our results show that FABSCORE demonstrates strong precision and label accuracy in detecting fabrications. In particular, when using Claude Code as the coding agent, FABSCORE attains a precision of 98.6%.

To explore RQ2, we conduct a comprehensive evaluation on 144 papers with accompanying code from all sources. We observe that experiment fabrication is the most common fabrication type, possibly because the proposed methods or experimental setups are too complex for AI systems to fully implement, leading them to take shortcuts such as hard-coding values in place of the required experimental components. Moreover, we observe that among 6,978 claims extracted from our 144 AI-generated papers, the claim-level fabrication rate reaches 21.2%, with only half of all claims successfully reproduced.

To address RQ3, we analyze the evaluation results across data sources and find that all sources contain fabrications, with claim-level rates ranging from 0.4% to 53.6% and paper-level rates from 10.0% to 81.5%. Notably, over 70% of AI-authored real conference submissions contain at least one fabrication, and even among accepted papers, 59.3% still contain fabrications.

Finally, to investigate RQ4, we compare FABSCORE with AI reviewers on Agents4Science papers and find that over 85% of FABSCORE-detected fabrications are missed by AI reviewers, which primarily rely on intra-paper text analysis rather than code analysis. This suggests that FABSCORE can serve as a valuable complement to existing AI review processes. Our contributions include:

- We introduce FABSCORE, a fine-grained fabrication detection framework comprising a four-stage pipeline and six verdict categories, achieving a high precision of 98.6%.
- We conduct a comprehensive evaluation on 144 papers from multiple sources, finding fabrications prevalent across all sources. Notably, over 70% of AI-authored real conference submissions contain at least one fabrication, a rate that remains as high as 59.3% even among accepted papers.
- We compare FABSCORE against AI reviewers on real submissions and find that over 85% of FABSCORE-detected fabrications are missed by AI reviewers, suggesting FABSCORE as a valuable complement to AI-based peer review.

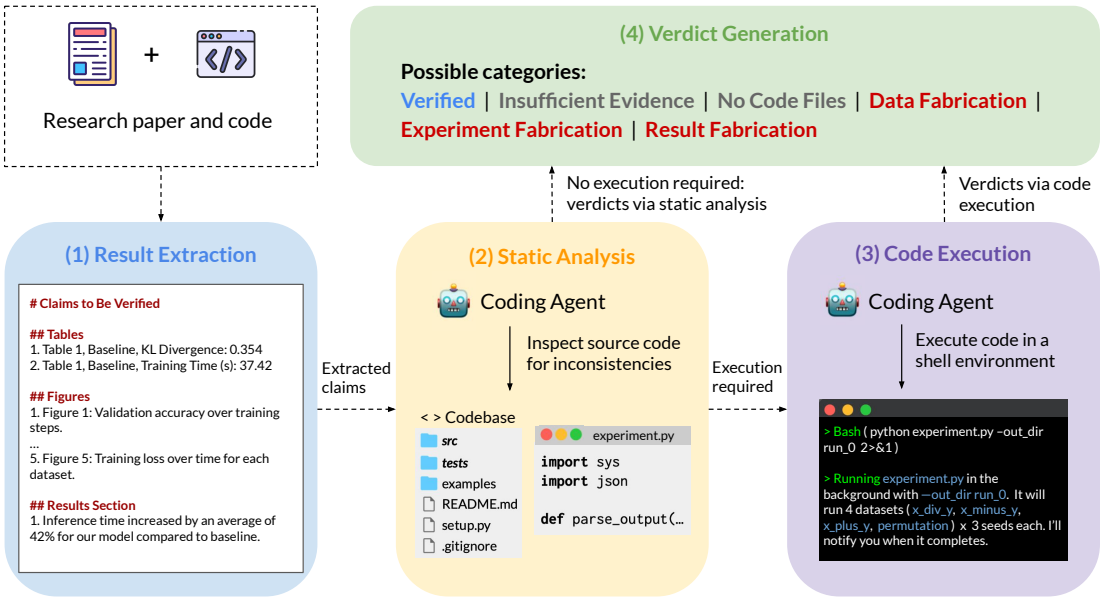


Figure 2. An overview of the FABSCORE framework, illustrating our four-stage evaluation pipeline. Given a research paper and its associated code, FABSCORE automatically extracts numerical experimental results from tables and result sections, as well as figure labels, evaluates them through code analysis and execution, and ultimately produces a verdict.

2. FABSCORE: Evaluating Fabrications in Automated AI research

In this section, we introduce FABSCORE, a new evaluation framework for fine-grained evaluation of fabrications in automated AI research. Figure 2 presents an overview of our FABSCORE framework. To enable fine-grained evaluation, we focus on numerical experimental results as the unit of analysis, since they are concrete and can be verified by code execution or mathematical calculation. Moreover, such results often represent the key contributions of AI research papers. Verifying whether they are reproducible and consistent with the reported code provides a reliable basis for further assessing overall paper quality.

Our evaluation pipeline contains four stages: (1) *result extraction*, (2) *static analysis*, (3) *code execution*, and (4) *verdict generation*. Full prompts for the evaluation pipeline can be found in Section B.1. Each stage is described in detail below:

1. **Result Extraction:** Given a paper and its associated code files, this stage uses a coding agent to extract all numerical experimental results reported in tables and result sections, as well as figure labels, treating each as an individual claim to be verified.

2. **Static Analysis:** For each extracted claim, the coding agent reads and analyzes the paper and associated code files to identify any apparent conflicts or contradictions. For example, this includes cases where the model described in the paper directly conflicts with the one actually implemented in code, or where the reported results contradict those recorded in existing execution logs. Some claims may be resolved directly at this stage, either by identifying clear contradictions or by locating sufficient code evidence to confirm reproducibility, and are thus assigned a verdict without proceeding to code execution.

3. **Code Execution:** For claims that lack sufficient evidence after static analysis, the coding agent executes the relevant experiments by running commands in an automated shell environment, and produces a verdict based on the execution results.

4. **Verdict Generation:** We define six verdict categories to capture all possible verification outcomes, and each claim is ultimately classified into one of them. Specifically, fabrications are distinguished by whether the contradiction lies in the input data, experimental procedure, or reported numerical results. These six verdict categories are described below:

   - **Data fabrication:** The input data referenced in the paper does not match what the code actually uses.
   - **Experiment fabrication:** The experimental procedure described in the paper does not match what the code actually implements.

- **Result fabrication:** The reported results in the paper do not match those produced by actual execution.
- **No code files:** No relevant code files can be located, and the claim is thus *Unverifiable*.
- **Insufficient evidence:** Some relevant code can be located, but is insufficient to reach a definitive conclusion. The claim is thus also considered *Unverifiable*.
- **Verified:** The claim is supported by sufficient evidence from code analysis or execution.

Verdict Priority. In some cases, a single claim may simultaneously exhibit multiple types of fabrications. To ensure consistent and unambiguous labeling, we define a priority ordering that follows the natural execution order of the experimental workflow, from inputs, through procedures, to outputs: *data fabrication* > *experiment fabrication* > *result fabrication*. When multiple fabrication types are identified, the claim is assigned the label corresponding to the earliest point of failure in this order.

3. Experiments

In this section, we use FABSCORE to conduct a systematic evaluation of fabrications across a collection of AI-generated papers, aiming to address the following research questions (RQs):

- **RQ1:** How accurately can FABSCORE evaluate fabrications, and which agent performs best as verifier?
- **RQ2:** What are the most common types and reasons for the fabrications, and what are some examples of each type?
- **RQ3:** How do fabrication rates differ across different sources, and what are some possible factors explaining these differences?
- **RQ4:** To what extent can FABSCORE detect fabrications that AI reviewers fail to identify?

3.1. Experimental Setup

Evaluation Data. We collect 144 AI-generated papers with available code from multiple sources, including AI Scientist (Lu et al., 2026), MLR-Agent (Chen et al., 2025a), the 2025 Agents4Science Open Conference (Bianchi et al., 2026), and FARS [2]. Among these, AI Scientist, MLR-Agent, and FARS are fully automated research systems, whereas Agents4Science consists of real conference submissions where AI serves as the primary author. Table 1 summarizes these data sources. For Agents4Science, we collect all 27 accepted submissions with available code, and additionally sampled 27 rejected submissions to balance accepted and rejected papers. For AI Scientist, MLR-Agent, and FARS, we collect 30 papers each.

Validation Metrics. We conduct a human evaluation to validate the reliability of FABSCORE. Since manually identifying all fabrications in a paper is extremely labor-intensive, human evaluation is performed only on fabrications detected by FABSCORE. The primary goal is to assess whether each detected fabrication is accurate and supported by clear, sufficient evidence. We therefore design three metrics to measure the agreement between FABSCORE and human evaluators:

- **# Human-Confirmed Fabrications:** The number of fabrications detected by FABSCORE that are confirmed by human evaluators.
- **Precision Score:** The proportion of detected fabrications confirmed by human evaluators:

$$\text{Precision Score} = \frac{\text{\# Human-Confirmed Fabrications}}{\text{\# Detected Fabrications}}. \quad (1)$$

- **Label Accuracy:** Among human-confirmed fabrications, the proportion where the label assigned by FABSCORE agrees with the label given by human evaluators:

$$\text{Label Acc.} = \frac{\text{\# Fabrications w/ Human-Agreed Labels}}{\text{\# Human-Confirmed Fabrications}}. \quad (2)$$

Candidate Agents. To select the optimal coding agent for FABSCORE, we evaluate two candidates: Claude Code (powered by `claude-sonnet-4-6`) and Codex (powered by `gpt-5.4-medium`). The better-performing agent is then adopted for our comprehensive evaluation.

Implementation Details. All experiments are conducted on an Ubuntu 22.04 server with a single NVIDIA H200 GPU. We additionally use GitHub Copilot [3] and an LLM judge, both powered by `claude-sonnet-4-6`, to assist with analysis. LLM judge prompts can be found in Section B.2.

3.2. RQ1: Reliability of FABSCORE

To validate the reliability of FABSCORE, we evaluate it on 30 randomly selected AI-generated papers, comprising 10 from AI Scientist, 5 accepted and 5 rejected papers from Agents4Science, 5 from MLR-Agent, and 5 from FARS. We recruit six human experts with AI research experience to evaluate the detected fabrications. Each detected fabrication

[2] https://analemma.ai/blog/introducing-fars/

[3] https://github.com/features/copilot

Table 1. Comparison of various data sources across five dimensions: (1) released year, (2) backbone models, (3) whether a multi-agent framework is used, (4) whether a code template is provided: i.e., an original codebase that the model edits to implement its method; (5) whether human feedback is involved in the generation process. "-" denotes this information is unavailable.

Data Source	Year	Model	Multi-Agent	Code Template	Human-in-the-Loop
AI Scientist (Lu et al., 2026)	2024	`claude-3-5-sonnet` `gpt-4o` `deepseek-coder` `Llama-3.1-405b`	✗	✓	✗
MLR-Agent (Chen et al., 2025a)	2025	`o4-mini` `claude-3-7-sonnet` `gemini-2.5-pro`	✗	✗	✗
Agents4Science	2025	-	-	✗	✓
FARS	2026	-	✓	-	✗

Table 2. Human evaluation results on 30 randomly selected papers, comparing Claude Code and Codex as the coding agent.

	Claude Code	Codex
# Detected Fabrications	144	337
# Human-Confirmed	142	270
# Label-Agreed	119	249
Precision Score (%)	**98.6**	80.1
Label Accuracy (%)	83.8	**92.2**

is independently evaluated by two experts, who then discuss and reach a consensus verdict. To support human review, we develop a unified interface (see Section A.2) that displays each paper alongside its extracted claims, verdict labels, supporting explanations, and aggregated verdict statistics. Human evaluation results are summarized in Table 2 and further details are provided in Section A.

Regardless of the coding agent used, FABSCORE demonstrates strong precision and label accuracy in detecting fabrications. Both coding agents achieve a high precision, with Claude Code reaching 98.6% and Codex achieving 80.1%, demonstrating that FABSCORE can reliably detect fabrications with minimal false positives. Moreover, both coding agents achieve high label accuracy, with Claude Code reaching 83.8% and Codex achieving 92.2%, indicating that FABSCORE not only detects fabrications reliably, but also correctly categorizes their types in most cases.

Claude Code contains fewer spurious detections than Codex. Comparing the two agents, Claude Code achieves a substantially higher precision score than Codex by a margin of 18.5%, with only 2 false positives out of 144 detected fabrications. While Codex achieves a higher label accuracy by a margin of 8.4% among human-confirmed fabrications, its lower precision limits its practical utility. Error analysis for Claude Code and Codex can be found in Section A.3. Since precision is critical in fabrication detection, we adopt Claude Code as the coding agent for our comprehensive evaluation.

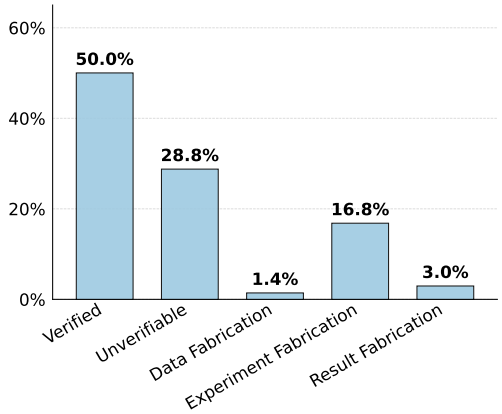


Figure 3. Proportion of each verdict category among 6,978 extracted claims from 144 AI-generated papers. The overall fabrication rate is 21.2%.

3.3. RQ2: Analysis of Fabrication Types and Reasons

Experiment fabrication is the most common fabrication type. We evaluate 144 AI-generated papers with FABSCORE, yielding a total of 6,978 verdicts across all extracted claims. As shown in Figure 3, the overall fabrication rate reaches 21.2%, where *experiment fabrication* accounts for the majority. This suggests a significant gap between research ideation and correct code implementation in current automated AI research.

To explore the underlying reasons behind these fabrications, we used GitHub Copilot powered by `claude-sonnet-4-6` to analyze all the fabricated claims and explanations provided by FABSCORE. We

summarized the most common reasons for each fabrication verdict (three for *data* and *result fabrication*, and five for *experiment fabrication*). Using the same Claude model as an LLM judge, we then classified each fabrication instance into these reason categories. The resulting proportions are detailed in Table 3, and case studies for the leading reason in each category are presented in Figure 4.

Analysis of Data Fabrication. The most common reason is *the use of mock data instead of the real datasets described in the paper* (64.6%). As illustrated in Figure 4, when the required input data cannot be located, AI research systems tend to generate mock data to complete the task. Another common reason is referencing non-existent dataset names (21.2%), likely due to the lack of web search capabilities in these systems.

Analysis of Experiment Fabrication. The most common reasons include *the use of hardcoded or simulated values to replace experimental components* (44.6%) and *incorrect formula or metric implementations* (24.0%), likely due to the complexity of the proposed research ideas exceeding the implementation capabilities of current AI research systems. As illustrated in Figure 4, AI research systems may hardcode metric values in place of a proper implementation when the metric is too complex. Execution logic inconsistent with the paper description is also frequently observed (18.8%), attributable to the same underlying cause.

Analysis of Result Fabrication. The most common reason is *the conflict between reported values and stored execution logs* (85.9%), indicating that AI research systems may not rigorously verify their execution records when reporting results. As illustrated in Figure 4, a reported value can differ from the stored execution log by up to 4.5×.

Takeaway

When research ideas in the paper are too complex to implement, AI research systems tend to take shortcuts, leading to fabrications at the levels of data, experiment, and result.

3.4. RQ3: Fabrication Rates in Different Sources

Figure 1 presents the claim-level verdict distribution and paper-level fabrication frequency across various data sources. To analyze possible factors contributing to differences in fabrication rates, we compare these data sources in Table 1.

All data sources contain fabrications. Overall, fabrications are observed across all data sources, with claim-level rates ranging from 0.4% to 53.6% and paper-level rates ranging from 10.0% to 81.5%. FARS, the most recent system, exhibits the lowest fabrication rate, which may be attributed to its use of more advanced models and a more sophisticated multi-agent architecture. In contrast, MLR-Agent exhibits the highest claim-level fabrication rate exceeding 50%, possibly due to its simpler architecture and lack of code templates for open-ended research. AI Scientist shows a moderate fabrication rate below 14% with no data fabrication, likely due to its use of fixed datasets and code templates.

Over 70% of AI-authored real conference submissions contain fabrications. Most surprisingly, real submissions from Agents4Science exhibit a paper-level fabrication rate exceeding 70% even with human involvement, with rejected submissions reaching 81.5%. This suggests that *AI-authored open-ended research cannot guarantee rigorous results even under human supervision*. Furthermore, rejected papers consistently exhibit a higher fabrication rate than accepted papers, suggesting *a negative correlation between fabrication rate and acceptance outcome*.

3.5. RQ4: Comparison with AI Reviewers

We compare FABSCORE with AI reviewers [4] on Agents4Science papers and investigate the extent to which FABSCORE can detect fabrications that AI reviewers fail to identify. Specifically, we extract all fabricated claims from the 38 papers with FABSCORE-detected fabrications. We then employ an LLM judge powered by `claude-sonnet-4-6` to determine whether each claim is also flagged as problematic in the corresponding AI review. A claim is considered covered by the AI review if the LLM judge finds evidence that the AI review raised concerns about it.

The majority of FABSCORE-detected fabrications are missed by AI reviewers. As shown in Figure 5, AI reviewers cover only 13.8% of the overall fabrications detected by FABSCORE, leaving over 85% of fabrications unidentified. Notably, experiment fabrication—the most prevalent type of fabrication identified by FABSCORE—exhibits the lowest coverage rate at just 10.2%. This suggests that *existing AI reviewers fall far short of verifying reproducibility of research papers*.

To understand how AI reviewers identify fabrications, we analyze all 49 distinct AI reviews that cover FABSCORE-detected fabrications. Using GitHub Copilot powered by `claude-sonnet-4-6`, we first analyze all AI reviews and extract the four most commonly mentioned issues in these reviews. The resulting issues are: (1) *intra-paper*

[4] We download the AI reviews from: https://openreview.net/group?id=Agents4Science/2025/Conference.

Table 3. Most common reasons for each fabrication type across 144 AI-generated papers. Percentages indicate the proportion of each reason within its corresponding fabrication type.

Fabrication Type	Specific Reason	%
Data (99)	Synthetic/mock data used instead of real data described in the paper	64.6
	Non-existent or wrong dataset name	21.2
	Data values in the paper conflict with actual data files	14.1
Experiment (1,174)	Simulation or hardcoded values replace an experimental component	44.6
	Formula or metric implementation produces incorrect values	24.0
	Execution logic or order inconsistent with the paper description	18.8
	Unavailable referenced model or dataset	3.8
	Code implementation bug causes incorrect execution	3.5
Result (206)	Reported value conflicts with stored execution logs or artifacts	85.9
	Reported value conflicts with re-execution results	10.2
	Mathematically impossible value	2.9

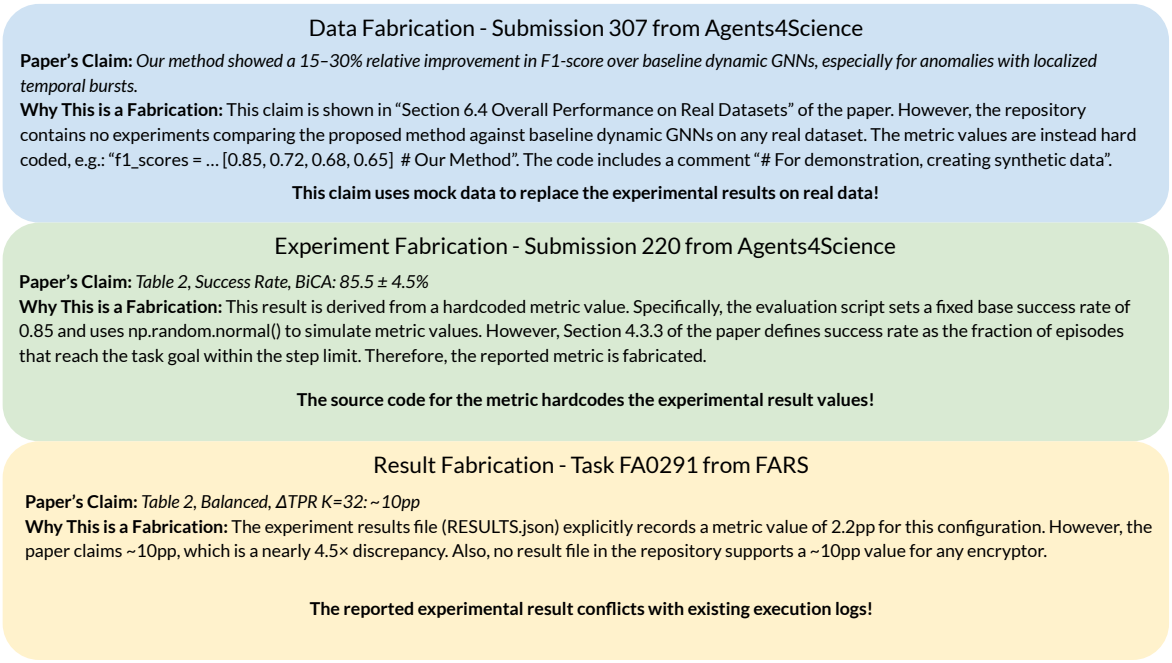
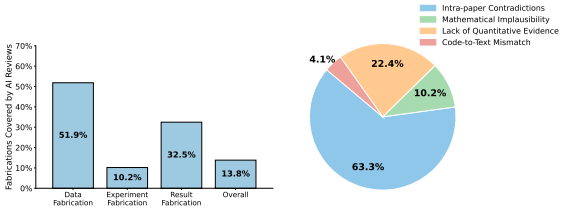


Figure 4. Case study for most common reasons within each fabrication type.

contradictions, where the review identifies inconsistencies within the paper itself; (2) *mathematical implausibility*, where the review flags mathematically unreasonable values; (3) *lack of quantitative evidence*, where the review notes the absence of sufficient quantitative support; and (4) *code-to-text mismatch*, where the review identifies discrepancies between the code and the paper description. We then employ the same Claude model as an LLM judge to classify each review into one of these four most common mentioned issues.

AI reviewers primarily rely on intra-paper text analysis and lack in-depth code analysis. As shown in the right of Figure 5, among the 49 unique AI reviews covering FABSCORE-detected fabrications, 63.3% are identified through intra-paper contradictions, while a mere 4.1% through code-to-text mismatches. This stark contrast indicates that current AI reviewers primarily depend on superficial text analysis rather than examining the underlying code or executing experiments. This makes AI reviews susceptible to manipulation through paper laundering (Baumann et al., 2026). FABSCORE addresses this limitation by providing execution-based evidence that superficial text analysis alone cannot uncover.



(a) AI-Review Coverage (b) Review Mentioned Issues

Figure 5. Analysis of AI-review coverage and mentioned issues on Agents4Science papers. Among the 38 papers with detected fabrications, FABSCORE detects 1,027 fabrications in total (27 data, 883 experiment, and 117 result fabrications), of which only 142 are also identified by AI reviewers. (a) shows the fraction of FABSCORE-detected fabricated claims that are also flagged as problematic in the corresponding AI reviews for each fabrication type as well as overall. (b) shows the four most commonly mentioned issues across 49 distinct AI reviews that cover FABSCORE-detected fabrications.

Takeaway

FABSCORE can serve as a complementary tool to AI reviews, providing objective and systematic evidence through in-depth code analysis and automated experiment execution.

4. Related Work

Automated AI Research Recent work has developed LLM-based AI agents for various aspects of autonomous research (Chen et al., 2025b; Bubeck et al., 2025; Feng et al., 2026a;b), including literature review (Asai et al., 2026), idea generation (Wang et al., 2024; Baek et al., 2025; Si et al., 2025), research plan generation (Goel et al., 2025), experiment execution (Tian et al., 2024; Novikov et al., 2025; Jansen et al., 2025; Hua et al., 2025), paper reproduction (Starace et al., 2025; Seo et al., 2026) and writing (Song et al., 2026; Zhu et al., 2026). Fully automated end-to-end research frameworks have also emerged (Lu et al., 2026; Yamada et al., 2025; Tang et al., 2025; Schmidgall et al., 2025), along with benchmarks for evaluating research and engineering capabilities (Chan et al., 2025; Nathani et al., 2025; Kon et al., 2026; Bragg et al., 2026; Wang et al., 2026; Chen et al., 2025a). Recent work has further shown that execution-grounded frameworks can effectively facilitate research idea generation (Si et al., 2026), inspiring our design of an execution-grounded evaluation framework for detecting fabrications in automated AI research.

Reliability of Research Agents Prior work has consistently shown that AI agents are prone to factual errors and inconsistencies (Farquhar et al., 2024; Min et al., 2023; Rabanser et al., 2026; Baumann et al., 2026; Sriramanan et al., 2024), including hallucinated citations in literature reviews (Rao et al., 2026; Sakai et al., 2026), coding hallucinations that produce invalid experimental scripts (Tian et al., 2025; Zhang et al., 2025), and spurious results on machine learning engineering (Chan et al., 2025; Nam et al., 2025) and math reasoning (Ma et al., 2026; Abouzaid et al., 2026; Glazer et al., 2024). These issues collectively undermine the reproducibility of AI-generated research, yet systematic evaluation of this problem remains limited. Recent work has begun to assess reproducibility in social science (Hu et al., 2025) and machine learning (Bai et al., 2026), but lacks fine-grained evaluation. Our work addresses this gap by introducing a fine-grained framework for detecting fabrications, along with an analysis of their underlying causes.

5. Conclusion

We introduce FABSCORE, a fine-grained evaluation framework that automatically detects and categorizes fabrications in AI-generated research through static code analysis and experiment execution, achieving a precision of 98.6%. Applying FABSCORE to 144 papers across multiple sources, we find fabrications prevalent across all sources, with experiment fabrication being the most common type and over 70% of AI-authored real conference submissions containing at least one fabrication. Furthermore, over 85% of FABSCORE-detected fabrications are missed by AI reviewers, highlighting the value of FABSCORE as a complement to existing AI review processes.

Limitations and Future Work. Our framework relies heavily on the capabilities of the coding agent. A substantial portion of claims remain unverifiable, either due to insufficient code or the limitations of the coding agent itself—for example, experiments that require long execution times are difficult to reproduce within practical constraints. Future work could explore more capable agents to improve verification coverage. Additionally, since exhaustively annotating all fabrications in a paper is prohibitively labor-intensive, our human evaluation is conducted only on FABSCORE-detected fabrications, resulting in high precision but leaving recall unassessed. Future work should investigate methods for more complete fabrication detection.

Impact Statement

Beyond evaluation, we believe this work provides actionable signals for improving AI research systems. For example, fabrication rates can serve as reward signals during training to discourage fabrications and encourage more faithful code implementation. More broadly, ensuring research integrity has long been a fundamental concern in science, and this work draws attention to its growing importance, as AI continues to play an increasingly active role in scientific discovery.

References

Abouzaid, M., Blumberg, A. J., Hairer, M., Kileel, J., Kolda, T. G., Nelson, P. D., Spielman, D., Srivastava, N., Ward, R., Weinberger, S., et al. First proof. *arXiv preprint arXiv:2602.05192*, 2026.

Asai, A., He, J., Shao, R., Shi, W., Singh, A., Chang, J. C., Lo, K., Soldaini, L., Feldman, S., D'Arcy, M., et al. Synthesizing scientific literature with retrieval-augmented language models. *Nature*, pp. 1–7, 2026.

Baek, J., Jauhar, S. K., Cucerzan, S., and Hwang, S. J. Researchagent: Iterative research idea generation over scientific literature with large language models. In *Proceedings of the 2025 Conference of the Nations of the Americas Chapter of the Association for Computational Linguistics: Human Language Technologies (Volume 1: Long Papers)*, pp. 6709–6738, 2025.

Bai, X., Baumgartner, A., Sun, H., Holtzman, A., and Tan, C. The story is not the science: Execution-grounded evaluation of mechanistic interpretability research. *arXiv preprint arXiv:2602.18458*, 2026.

Baumann, J., Pei, J., Koyejo, S., and Hovy, D. Stop automating peer review without rigorous evaluation. In *Post-AGI Science and Society Workshop*, 2026. URL https://openreview.net/forum?id=cJhlquXIuS.

Bianchi, F., Queen, O., Thakkar, N., Sun, E., and Zou, J. Exploring the use of ai authors and reviewers at agents4science. *Nature Biotechnology*, 44(1):11–14, 2026.

Bragg, J., D'Arcy, M., Balepur, N., Bareket, D., Mishra, B. D., Feldman, S., Haddad, D., Hwang, J. D., Jansen, P., Kishore, V., Majumder, B. P., Naik, A., Rahamimov, S., Richardson, K., Singh, A., Surana, H., Tiktinsky, A., Vasu, R., Wiener, G., Anastasiades, C., Candra, S., Dunkelberger, J., Emery, D., Evans, R., Hamada, M., Huff, R., Kinney, R., Latzke, M., Lochner, J., Lozano-Aguilera, R., Nguyen, N.-U., Rao, S., Tanaka, A., Vlahos, B., Clark, P., Downey, D., Goldberg, Y., Sabharwal, A., and Weld, D. S. Astabench: Rigorous benchmarking of AI agents with a scientific research suite. In *The Fourteenth International Conference on Learning Representations*, 2026. URL https://openreview.net/forum?id=M7TNf5J26u.

Bubeck, S., Coester, C., Eldan, R., Gowers, T., Lee, Y. T., Lupsasca, A., Sawhney, M., Scherrer, R., Sellke, M., Spears, B. K., et al. Early science acceleration experiments with gpt-5. *arXiv preprint arXiv:2511.16072*, 2025.

Chan, J. S., Chowdhury, N., Jaffe, O., Aung, J., Sherburn, D., Mays, E., Starace, G., Liu, K., Maksin, L., Patwardhan, T., Madry, A., and Weng, L. MLE-bench: Evaluating machine learning agents on machine learning engineering. In *The Thirteenth International Conference on Learning Representations*, 2025. URL https://openreview.net/forum?id=6s5uXNWGIh.

Chen, H., Xiong, M., Lu, Y., Han, W., Deng, A., He, Y., Wu, J., Li, Y., Liu, Y., and Hooi, B. MLR-bench: Evaluating AI agents on open-ended machine learning research. In *The Thirty-ninth Annual Conference on Neural Information Processing Systems Datasets and Benchmarks Track*, 2025a. URL https://openreview.net/forum?id=JX9DE6colf.

Chen, J., Mishra, B. D., Nam, J., Meng, R., Pfister, T., and Yoon, J. MARS: Modular agent with reflective search for automated ai research. *arXiv preprint arXiv:2602.02660*, 2026.

Chen, Z., Chen, S., Ning, Y., Zhang, Q., Wang, B., Yu, B., Li, Y., Liao, Z., Wei, C., Lu, Z., Dey, V., Xue, M., Baker, F. N., Burns, B., Adu-Ampratwum, D., Huang, X., Ning, X., Gao, S., Su, Y., and Sun, H. ScienceAgentBench: Toward rigorous assessment of language agents for data-driven scientific discovery. In *The Thirteenth International Conference on Learning Representations*, 2025b. URL https://openreview.net/forum?id=6z4YKr0GK6.

Farquhar, S., Kossen, J., Kuhn, L., and Gal, Y. Detecting hallucinations in large language models using semantic entropy. *Nature*, 630(8017):625–630, 2024.

Feng, T., Jung, J., Kim, S.-h., Pagano, C., Gukov, S., Tsai, C.-C., Woodruff, D., Javanmard, A., Mokhtari, A., Hwang, D., et al. Aletheia tackles firstproof autonomously. *arXiv preprint arXiv:2602.21201*, 2026a.

Feng, T., Trinh, T., Bingham, G., Kang, J., Zhang, S., Kim, S.-h., Barreto, K., Schildkraut, C., Jung, J., Seo, J., et al. Semi-autonomous mathematics discovery with gemini: A case study on the erdős problems. *arXiv preprint arXiv:2601.22401*, 2026b.

Feng, T., Trinh, T. H., Bingham, G., Hwang, D., Chervonyi, Y., Jung, J., Lee, J., Pagano, C., Kim, S.-h., Pasqualotto, F., et al. Towards autonomous mathematics research. *arXiv preprint arXiv:2602.10177*, 2026c.

Glazer, E., Erdil, E., Besiroglu, T., Chicharro, D., Chen, E., Gunning, A., Olsson, C. F., Denain, J.-S., Ho, A., Santos, E. d. O., et al. Frontiermath: A benchmark for evaluating advanced mathematical reasoning in ai. *arXiv preprint arXiv:2411.04872*, 2024.

Goel, S., Hazra, R., Jayalath, D., Willi, T., Jain, P., Shen, W. F., Leontiadis, I., Barbieri, F., Bachrach, Y., Geiping,

J., et al. Training ai co-scientists using rubric rewards. *arXiv preprint arXiv:2512.23707*, 2025.

Gottweis, J., Weng, W.-H., Daryin, A., Tu, T., Palepu, A., Sirkovic, P., Myaskovsky, A., Weissenberger, F., Rong, K., Tanno, R., et al. Towards an ai co-scientist. *arXiv preprint arXiv:2502.18864*, 2025.

Hu, C., Zhang, L., Lim, Y., Wadhwani, A., Peters, A., and Kang, D. REPRO-BENCH: Can agentic ai systems assess the reproducibility of social science research? In *Findings of the Association for Computational Linguistics: ACL 2025*, pp. 23616–23626, 2025.

Hua, T., Hua, H., Xiang, V., Klieger, B., Truong, S. T., Liang, W., Sun, F.-Y., and Haber, N. ResearchCodeBench: Benchmarking LLMs on implementing novel machine learning research code. In *The Thirty-ninth Annual Conference on Neural Information Processing Systems Datasets and Benchmarks Track*, 2025. URL https://openreview.net/forum?id=3k70Vt0YFS.

Jansen, P., Tafjord, O., Radensky, M., Siangliulue, P., Hope, T., Dalvi, B., Majumder, B. P., Weld, D. S., and Clark, P. Codescientist: End-to-end semi-automated scientific discovery with code-based experimentation. In *Findings of the Association for Computational Linguistics: ACL 2025*, pp. 13370–13467, 2025.

Kon, P. T. J., Ding, Q., Liu, J., Zhu, X., Peng, J., Xing, J., Huang, Y., Qiu, Y., Srinivasa, J., Lee, M., Chowdhury, M., Zaharia, M., and Chen, A. EXP-bench: Can AI conduct AI research experiments? In *The Fourteenth International Conference on Learning Representations*, 2026. URL https://openreview.net/forum?id=KjgyAm383Z.

Lu, C., Lu, C., Lange, R. T., Yamada, Y., Hu, S., Foerster, J., Ha, D., and Clune, J. Towards end-to-end automation of ai research. *Nature*, 651(8107):914–919, 2026.

Ma, W., Cojocaru, A., Kolhe, N., Zhang, H., Zhuang, V., Zaharia, M., and Min, S. Reliable fine-grained evaluation of natural language math proofs. In *The Fourteenth International Conference on Learning Representations*, 2026. URL https://openreview.net/forum?id=ky5iqwZSXI.

Min, S., Krishna, K., Lyu, X., Lewis, M., Yih, W.-t., Koh, P. W., Iyyer, M., Zettlemoyer, L., and Hajishirzi, H. Factscore: Fine-grained atomic evaluation of factual precision in long form text generation. In *Proceedings of the 2023 Conference on Empirical Methods in Natural Language Processing*, pp. 12076–12100, 2023.

Mitchener, L., Yiu, A., Chang, B., Bourdenx, M., Nadolski, T., Sulovari, A., Landsness, E. C., Barabasi, D. L., Narayanan, S., Evans, N., et al. Kosmos: An ai scientist for autonomous discovery. *arXiv preprint arXiv:2511.02824*, 2025.

Nam, J., Yoon, J., Chen, J., Shin, J., Arik, S. O., and Pfister, T. MLE-STAR: Machine learning engineering agent via search and targeted refinement. In *The Thirty-ninth Annual Conference on Neural Information Processing Systems*, 2025. URL https://openreview.net/forum?id=vS1M06Px6u.

Nathani, D., Madaan, L., Roberts, N., Bashlykov, N., Menon, A., Moens, V., Plekhanov, M., Budhiraja, A., Magka, D., Vorotilov, V., Chaurasia, G., Hupkes, D., Cabral, R. S., Shavrina, T., Foerster, J. N., Bachrach, Y., Wang, W. Y., and Raileanu, R. MLGym: A new framework and benchmark for advancing AI research agents. In *Second Conference on Language Modeling*, 2025. URL https://openreview.net/forum?id=ryTr83DxRq.

Novikov, A., Vũ, N., Eisenberger, M., Dupont, E., Huang, P.-S., Wagner, A. Z., Shirobokov, S., Kozlovskii, B., Ruiz, F. J., Mehrabian, A., et al. Alphaevolve: A coding agent for scientific and algorithmic discovery. *arXiv preprint arXiv:2506.13131*, 2025.

Qu, Y., Huang, K., Yin, M., Zhan, K., Liu, D., Yin, D., Cousins, H. C., Johnson, W. A., Wang, X., Shah, M., et al. CRISPR-GPT for agentic automation of gene-editing experiments. *Nature Biomedical Engineering*, 10(2):245–258, 2026.

Rabanser, S., Kapoor, S., Kirgis, P., Liu, K., Utpala, S., and Narayanan, A. Towards a science of ai agent reliability. *arXiv preprint arXiv:2602.16666*, 2026.

Rao, D., Wong, E., and Callison-Burch, C. Detecting and correcting reference hallucinations in commercial llms and deep research agents. *arXiv preprint arXiv:2604.03173*, 2026.

Sakai, Y., Kamigaito, H., and Watanabe, T. Hallucitation matters: Revealing the impact of hallucinated references with 300 hallucinated papers in acl conferences. *arXiv preprint arXiv:2601.18724*, 2026.

Schmidgall, S., Su, Y., Wang, Z., Sun, X., Wu, J., Yu, X., Liu, J., Moor, M., Liu, Z., and Barsoum, E. Agent laboratory: Using llm agents as research assistants. *Findings of the Association for Computational Linguistics: EMNLP 2025*, pp. 5977–6043, 2025.

Seo, M., Baek, J., Lee, S., and Hwang, S. J. Paper2Code: Automating code generation from scientific papers in machine learning. In *The Fourteenth International Conference on Learning Representations*, 2026. URL https://openreview.net/forum?id=3DcaUTjdKc.

Si, C., Yang, D., and Hashimoto, T. Can LLMs generate novel research ideas? a large-scale human study with 100+ NLP researchers. In *The Thirteenth International Conference on Learning Representations*, 2025. URL https://openreview.net/forum?id=M23dTGWCZy.

Si, C., Yang, Z., Choi, Y., Candès, E., Yang, D., and Hashimoto, T. Towards execution-grounded automated ai research. *arXiv preprint arXiv:2601.14525*, 2026.

Song, Y., Song, Y., Pfister, T., and Yoon, J. PaperOrchestra: A multi-agent framework for automated ai research paper writing. *arXiv preprint arXiv:2604.05018*, 2026.

Sriramanan, G., Bharti, S., Sadasivan, V. S., Saha, S., Kattakinda, P., and Feizi, S. Llm-check: Investigating detection of hallucinations in large language models. *Advances in Neural Information Processing Systems*, 37: 34188–34216, 2024.

Starace, G., Jaffe, O., Sherburn, D., Aung, J., Chan, J. S., Maksin, L., Dias, R., Mays, E., Kinsella, B., Thompson, W., et al. PaperBench: Evaluating ai's ability to replicate ai research. In *International Conference on Machine Learning*, pp. 56843–56873. PMLR, 2025.

Tang, J., Xia, L., Li, Z., and Huang, C. AI-researcher: Autonomous scientific innovation. In *The Thirty-ninth Annual Conference on Neural Information Processing Systems*, 2025. URL https://openreview.net/forum?id=kQWyOYUAC4.

Tian, M., Gao, L., Zhang, S. D., Chen, X., Fan, C., Guo, X., Haas, R., Ji, P., Krongchon, K., Li, Y., et al. Scicode: A research coding benchmark curated by scientists. *Advances in Neural Information Processing Systems*, 37: 30624–30650, 2024.

Tian, Y., Yan, W., Yang, Q., Zhao, X., Chen, Q., Wang, W., Luo, Z., Ma, L., and Song, D. Codehalu: Investigating code hallucinations in llms via execution-based verification. In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 39, pp. 25300–25308, 2025.

Wang, M., Lin, R., Hu, K., Jiao, J., Chowdhury, N., Chang, E., and Patwardhan, T. Frontierscience: Evaluating ai's ability to perform expert-level scientific tasks. *arXiv preprint arXiv:2601.21165*, 2026.

Wang, Q., Downey, D., Ji, H., and Hope, T. Scimon: Scientific inspiration machines optimized for novelty. In *Proceedings of the 62nd Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, pp. 279–299, 2024.

Yamada, Y., Lange, R. T., Lu, C., Hu, S., Lu, C., Foerster, J., Clune, J., and Ha, D. The ai scientist-v2: Workshop-level automated scientific discovery via agentic tree search. *arXiv preprint arXiv:2504.08066*, 2025.

Zhang, Z., Wang, C., Wang, Y., Shi, E., Ma, Y., Zhong, W., Chen, J., Mao, M., and Zheng, Z. Llm hallucinations in practical code generation: Phenomena, mechanism, and mitigation. *Proceedings of the ACM on Software Engineering*, 2(ISSTA):481–503, 2025.

Zhu, D., Meng, R., Song, Y., Wei, X., Li, S., Pfister, T., and Yoon, J. PaperBanana: Automating academic illustration for ai scientists. *arXiv preprint arXiv:2601.23265*, 2026.

A. Human Evaluation Details

A.1. Evaluation Data

We randomly sampled 30 papers from five data sources for the human evaluation. Table 4 presents the specific task names for each source.

Table 4. Evaluation tasks from various sources for the human evaluation.

#	Task Name	Data Source
1	adaptive_dual_scale_denoising	AI-Scientist
2	data_augmentation_grokking	AI-Scientist
3	dual_expert_denoiser	AI-Scientist
4	grid_based_noise_adaptation	AI-Scientist
5	gan_diffusion	AI-Scientist
6	layerwise_lr_grokking	AI-Scientist
7	mdl_grokking_correlation	AI-Scientist
8	multi_style_adapter	AI-Scientist
9	rl_lr_adaptation	AI-Scientist
10	weight_initialization_grokking	AI-Scientist
11	submission_206	Agents4Science (accepted)
12	submission_242	Agents4Science (accepted)
13	submission_258	Agents4Science (accepted)
14	submission_325	Agents4Science (accepted)
15	submission_333	Agents4Science (accepted)
16	submission_202	Agents4Science (rejected)
17	submission_307	Agents4Science (rejected)
18	submission_334	Agents4Science (rejected)
19	submission_341	Agents4Science (rejected)
20	submission_345	Agents4Science (rejected)
21	iclr2025_bi_align_claude	MLR-Agent
22	iclr2025_bi_align_codex	MLR-Agent
23	iclr2025_buildingtrust_codex	MLR-Agent
24	iclr2025_bi_align_gemini-cli	MLR-Agent
25	iclr2025_dl4c_claude	MLR-Agent
26	anisotropic-spectral-error-dressing-weatherbench2	FARS
27	calib-attnsort-onepass	FARS
28	compute-matched-diffusion-planning-audit	FARS
29	cusum-calibrated-rollback-controller	FARS
30	definition-unit-tests-convention-adherence	FARS

A.2. Interface For Human Evaluation

Figure 6 shows the interface we developed for human evaluators to review each paper alongside its corresponding FABSCORE report.

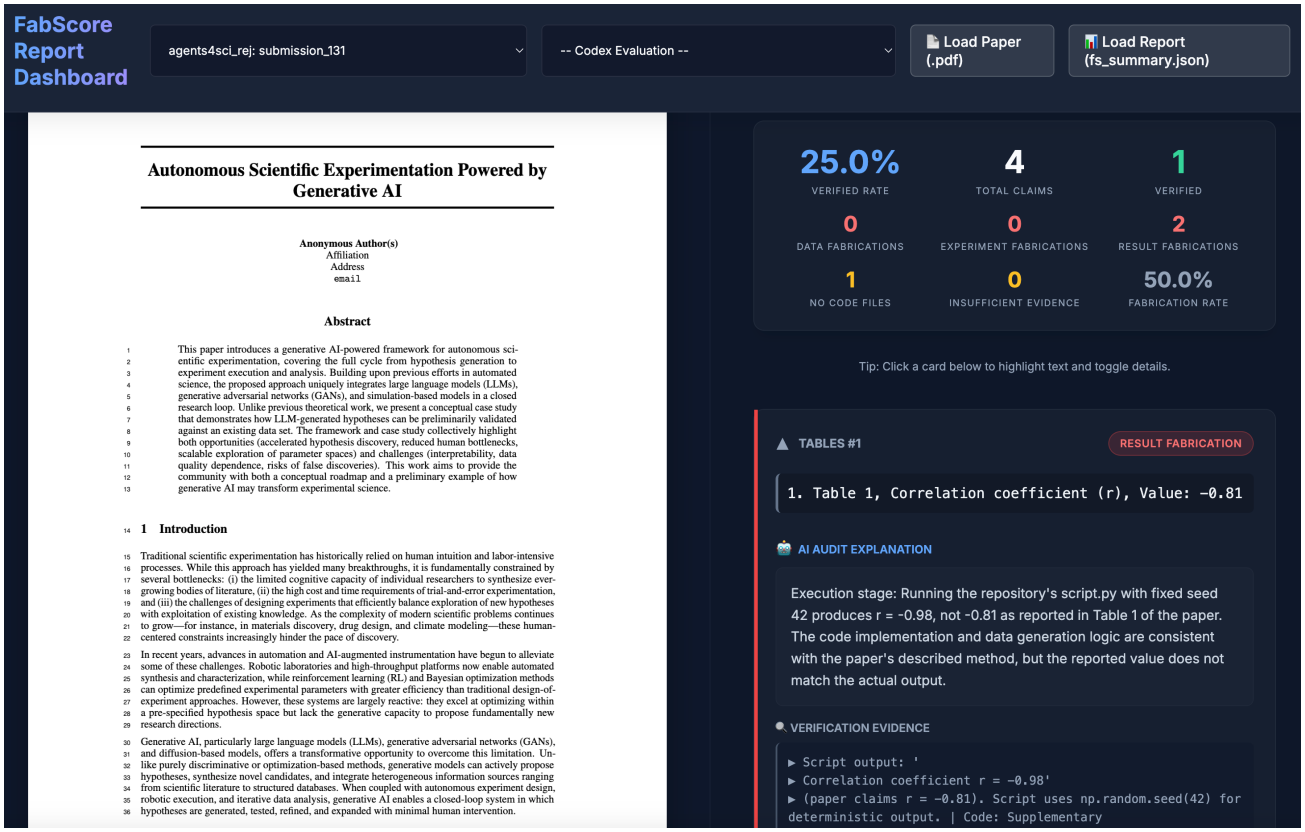


Figure 6. The human evaluation interface for reviewing research papers and their corresponding FABSCORE reports.

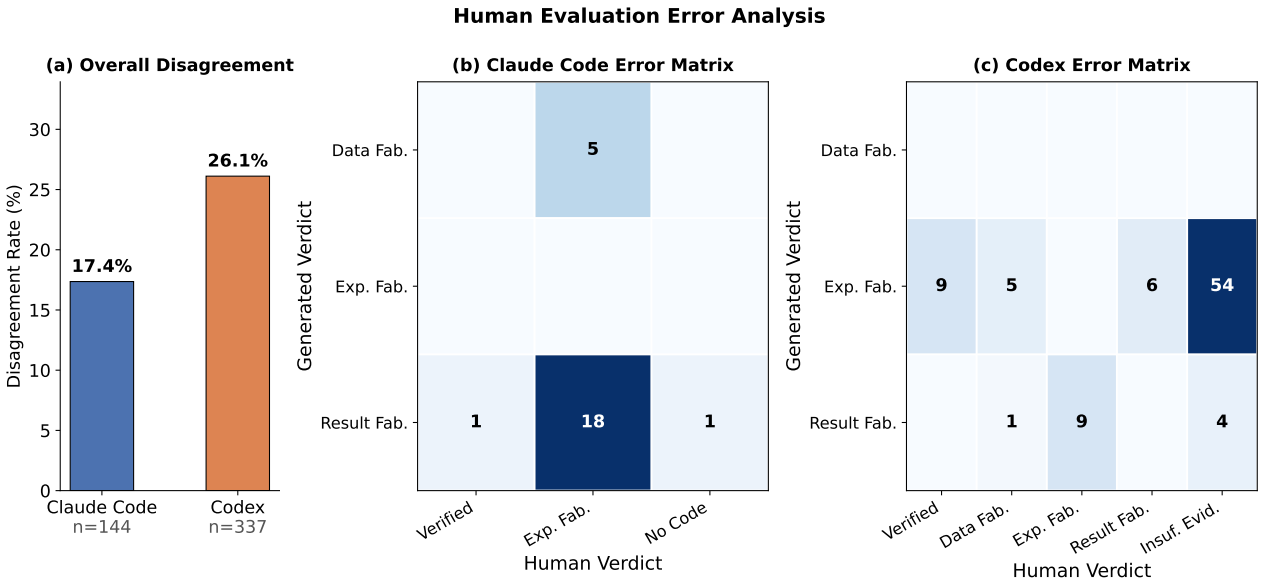


Figure 7. Human evaluation error analysis for Claude Code and Codex. (a) Overall disagreement rate between the generated verdicts and the human verdicts. (b) and (c) Confusion matrices showing the distribution of disagreements, where rows indicate the generated verdicts and columns indicate the human-annotated verdicts. "Fab.", "Exp.", and "Insuf. Evid." are abbreviated forms of "Fabrication", "Experiment", and "Insufficient Evidence", respectively. Claude Code has 25 disagreements out of 144 verdicts, and Codex has 88 out of 337.

A.3. Error Analysis

As shown in Figure 7, Codex exhibits a substantially higher verdict disagreement rate than Claude Code (26.1% vs. 17.4%). The two agents also exhibit distinct error patterns. For Claude Code, the majority of misclassifications stem from labeling claims as *Result Fabrication* instead of the correct *Experiment Fabrication* (18 out of 25 errors), suggesting that Claude Code tends to rely on superficial evidence—such as conflicts between execution logs and reported results—rather than conducting a deeper analysis of the code implementation itself. For Codex, the dominant error is over-predicting *Experiment Fabrication* for claims that human annotators label as *Insufficient Evidence* (54 out of 88 errors), indicating that Codex tends to be overly aggressive in assigning fabrication labels when evidence is limited.

B. Full Prompts of FABSCORE

This section presents the prompts used in our evaluation pipeline in Section B.1 and LLM judge prompts for analysis in Section B.2.

B.1. Evaluation Pipeline Prompts

Result Extraction Prompt

```
You are an expert AI research paper reviewer.

Your task is to extract the experimental results reported in a paper.

Please extract the results point by point from three sources: tables, figures, and claims in the results
↪  section.
The paper is provided as a file in the workspace. It may be a PDF or a Markdown document. Read the specified
↪  paper file directly instead of expecting its contents to be pasted into the prompt. If the paper is
↪  Markdown, image files referenced from that Markdown are available in the workspace. Mathematical formulas
↪  may appear as Unicode symbols (e.g., $\theta$ for theta, $\sum$ for summation, $\propto$ for proportional
↪  to, $\|$ for norm) rather than LaTeX notation. Please interpret them accordingly.

INSTRUCTIONS:
- For tables, extract each numerical value along with its corresponding row and column headers. The recording
↪  format should be like \1. Table X, row name, column name: <value>". Please only record the table number. No
↪  need to record row number and column number.
- For figures:
     Inspect the paper file directly.
     1. **Extract Model Output**:
         - If the paper file is Markdown, for each figure mentioned in the text or embedded as an image in the
         ↪  Markdown, extract its image file path (e.g., "images/figure1.png").
         - If the paper file is PDF, record the figure by its figure label and associated caption from the
         ↪  paper itself (e.g., "Figure 1", "Fig. 2", "Figure 3(a)"). Do NOT invent workspace image paths when
         ↪  the source is only a PDF.
     2. **Recording Format**:
         - If the paper file is Markdown: "1. images/figure1.png: [Caption]"
         - If the paper file is PDF: "1. Figure 1: [Caption]"
     3. **Deduplication Rule**:
        - Please read the paper carefully when you extract figures. When the same figure is reused in multiple
        ↪  places, keep a single entry using the earliest explicit figure reference or the canonical image
        ↪  path/figure label.
- For claims in the results section, please extract numerical results from the **text body** of the
↪  Results/Experiments section (and its subsections) following these guidelines:
1. What to extract:
    - Extract quantitative results that are model outputs or performance metrics (e.g., accuracy, loss, F1
    ↪  score, precision, recall, speed improvements, error rates).
    - Include exact numerical values: "The accuracy is 85.3%".
    - Include comparative numerical values: "We improved F1 score by 2 points".
    - Include numerical values written as words: "eighty-five percent" or "five percentage points".
    - Split multiple results in one sentence into separate bullet points.
    - Preserve the original wording and meaning as much as possible.
    - Prefer copying the original sentence span or the minimal exact clause from the paper instead of
    ↪  paraphrasing it.
    - Do NOT rewrite, normalize, summarize, or restate a result in your own words unless a tiny trim is needed
    ↪  to isolate one numerical claim from a longer sentence.
    - If you split multiple numerical claims from one sentence, each extracted item should still remain as
    ↪  close as possible to the exact original wording of the relevant clause.
2. What NOT to extract:
    - Do NOT extract qualitative statements without valid performance numerical values: "Our method performs
    ↪  better", "significant improvement", "dropped rapidly", "became negligible", "near-perfect".
    - **CRITICAL**: If a sentence describes a result qualitatively (e.g., "error became negligible") and the
    ↪  ONLY numbers in that sentence are setup parameters or trial indices (e.g., "by epoch 5", "in trial 3",
    ↪  "for batch size 64"), you MUST skip it. A setup number does NOT count as a performance metric.
    - Do NOT extract figure or table captions. A CAPTION is the official label identifying a figure/table
    ↪  (e.g., the line "Figure 1: Training loss..."). You MUST ignore these lines entirely. Even if a caption
    ↪  contains a revolutionary result not found anywhere else, YOU MUST DISCARD IT. Do not hallucinate that a
    ↪  caption's result exists in the body text if it's not actually there.
    - Do NOT extract experimental setup, implementation details, or hyperparameters, such as:
      * Training configuration: "epoch 5", "trained for 100 epochs", "3 random seeds", "50 training steps"
      * Hyperparameters: "batch size 32", "learning rate 0.001", "lr = 10^-3", "dropout 0.1"
      * Data setup: "N = 1000 samples", "We sample 50 examples from each dataset", "1k train / 200 test"
      * Hardware: "H100 x 8 GPUs", "trained on 4 A100s"
      * Architecture details: "two hidden layers of size 128", "embedding dimension 768"
      * Meta-update/schedule parameters: "meta-update every T = 10 steps", "K = 20 meta-batches"
    - Only extract metrics/outputs they GET from running experiments, not values they SET.
    - Do NOT extract the same numerical result mentioned in multiple sentences repetitively; only extract it
    ↪  once.
3. Source sections:
```

```
    - Please only focus on the Results/Experiments section and its subsections.

IMPORTANT | Extraction order and deduplication across tables, figures, and results_section:
You MUST follow this strict three-step procedure:
  Step 1: First, extract all "tables" entries.
  Step 2: Then, extract all "figures" entries.
  Step 3: Finally, extract "results_section" claims from the text body. In this step, you MUST cross-check
  ↪  every candidate claim against the tables you already extracted:
    - If a numerical value in the text is **already captured** in a table entry (even if the wording differs),
    ↪  do NOT include it in "results_section".
    - If Table 2 already contains "Model X, Accuracy: 90%", and the text says "Model X achieves 90% accuracy",
    ↪  do NOT add this to "results_section" because it duplicates the table entry.
    - **Note on Figures**: You do NOT need to cross-check against figures. If a claim restates or summarizes
    ↪  data shown in a figure, you SHOULD still include it in "results_section" if it is a valid numerical
    ↪  result mentioned in the text.

Global deduplication rules:
  - If two candidate entries are semantically the same result, keep only one.
  - Treat entries as duplicates when they report the same underlying experiment outcome, metric/value pair, or
  ↪  the same figure content, even if the wording, sentence location, or caption text differs slightly.
  - Prefer the earliest occurrence in the paper, and prefer the more specific/canonical wording when choosing
  ↪  which duplicate to keep.
  - Never output the same figure twice just because it is referenced in two places.
  - Never output the same textual numerical result twice just because it appears once in a paragraph and again
  ↪  in a summary sentence.

Your extracted results should be saved in a JSON file named "fs_extracted.json" with the following format:
```json
{
  "tables": [
    "1. Table 2, Model X, Accuracy: 90%",
    ...
  ],
  "figures": [
        "1. images/figure1.png: [Caption]",
        "2. Figure 2: [Caption]",
        "3. Figure 3(a): [Caption]",
    ...
  ],
  "results_section": [
    "1. We improved the F1 score by 2 points",
    ...
  ]
}
```
- Hard constraints for `results_section`:
1. Every extracted item in "results_section" MUST contain at least one explicit numeric token, such as a digit
↪ (0-9), a percentage sign (%), a decimal number (e.g., 0.85), or words like "percent", "percentage points",
↪ "points", "times", "x faster", etc.
2. Explicit numeric tokens include both numerical digits and written numbers (e.g., "five", "ten percent").
3. If a sentence does NOT contain any explicit numeric token, you MUST NOT include it in "results_section",
↪ even if it describes a trend like "dropped rapidly", "became negligible", or "near-perfect".
4. If a numerical result is already present in "tables", it MUST NOT appear in "results_section" | no
↪ duplicates across these two categories. However, duplication between "figures" and "results_section" is
↪ explicitly ALLOWED.
5. Each extracted item in "results_section" should preserve the paper's original wording as closely as
↪ possible. Prefer verbatim extraction of the relevant clause over paraphrasing.
6. Do NOT include any experimental setup or hyperparameter values (e.g., "epoch 5", "batch size 32", "K = 20",
↪ "N = 1000") in "results_section". These are not experimental results.

NEGATIVE EXAMPLES - DO NOT EXTRACT:
- "Figure 3: Confidence-filtered ... test accuracy remains >98%." -> REASON: This is a figure caption. Discard.
- "Table 1: Performance metrics ... Model A achieves 95%." -> REASON: This is a table caption. Discard.
- "Trust calibration error became negligible by epoch 5." -> REASON: The result "negligible" is qualitative.
↪ "5" is just an epoch index (setup). Discard.
- "We use a batch size of 64 and train for 10 epochs." -> REASON: This is experimental setup/hyperparameters.
↪ Discard.
- "The framework shows significant improvement." -> REASON: No numerical value. Discard.
```

Static Analysis Prompt

```
You are an expert AI research code auditor.
Your task is to perform STATIC ANALYSIS only. Do not run experiments.

You are given:
1. The extracted numerical claims from the paper.
2. The paper file path.
```

```
3. The repository for the paper, which may contain code, scripts, data pipelines, logs, checkpoints, and other artifacts that could support or contradict the claims.
4. A progress markdown file at `{progress_md_path}`, where you can see the actions taken in previous sessions. Please append your actions and findings in this file as well, so that future sessions can build on them.

Research Paper File:
{paper_file}

Extracted Claims:
{results_json}

Repository Path:
{task_path}


Important: When analyzing code that implements probabilistic data augmentation or randomization, you MUST carefully distinguish between mutually exclusive (if/elif) and independent (if+if) probability implementations. For example, in an if/elif structure, each branch is exclusive and the probability for each augmentation is as specified. In an independent if+if structure, each augmentation is applied independently, so the probability of both being applied can be nonzero. Always base your probability judgment on the actual code logic, and explain your reasoning.

You must read the paper and analyze the repository, and then classify EVERY claim into exactly one of these buckets:

1. `no_code_files`
Meaning: there is no identifiable code, script, data pipeline, or claim-relevant execution record in the repository that could plausibly support this result. Use this only when the reported result appears unsupported because you cannot find any corresponding implementation path and you also cannot find any claim-relevant artifact or run output at all.
- Example situation:
    - There is neither a matching script or implementation path nor any claim-relevant artifact such as logs, saved outputs, checkpoints, or metric files. This should be `no_code_files`.

2. `obvious_hallucination`
Meaning: the repository does contain related code, but static inspection already reveals a clear and concrete conflict with the paper, so the reported result is unreliable or fabricated.
You MUST assign one `fabrication_type`:
- Priority rule: `data_fabrication` > `experiment_fabrication` > `result_fabrication`. If multiple fabrication types appear to apply, you MUST assign only the highest-priority one. For example, if a claim has both a data conflict and an experiment conflict, classify it as `data_fabrication`.
- If exactly one fabrication type is supported by the evidence, assign that type directly without applying any extra priority logic.
- In normal reasoning, prefer checking fabrication in this order: data-level conflicts first, then experiment/procedure conflicts, then result-level conflicts.
- `data_fabrication`: use this only when static evidence is already sufficient to establish a concrete conflict between the claim and the data object used by the code, including clear conflicts in dataset identity, composition, source, labels, or splits. For example:
    - Dataset names clearly conflict between the paper and the repository. For example, the dataset name used in the repository is `data1` while the paper describes it as `data2`.
    - Dataset sources clearly conflict between the paper and the repository. For example, the paper describes the dataset as a real-world dataset, but the dataset shown in the repository is synthetic data.
    - Dataset size or splits clearly conflict between the paper and the repository. For example, the dataset shown in the repository is a dataset with 10 samples, but the paper describes it as a dataset with 1000 samples.
    - A claimed dataset identifier has never existed in the stated source (for example Hugging Face), so the data object itself is fabricated or unsupported.
- `experiment_fabrication`: use this only when static evidence is already sufficient to establish a concrete conflict between the paper and the experimental object or procedure in repository's implementation. Identify a claim as `experiment_fabrication` if you find:
    - Experimental setup clearly conflicts between the paper and the repository. For example, the paper describes one training or inference setup, but the repository uses a different setup.
    - Model implementation clearly conflicts between the paper and the repository. For example, the paper claims model `A`, but the repository actually implements model `B`.
    - Evaluation protocol clearly conflicts between the paper and the repository. For example, the paper describes one evaluation procedure, benchmark setting, or comparison protocol, but the repository implements a different one.
    - The repository provides the claimed model but its performance or internal state clearly disagrees with the paper's description (e.g., paper says it's a 100M model, but code is 10M). (Note: Wrongly reporting a different run's result for a correctly implemented model is `result_fabrication`).
    - There are obvious logical inconsistencies in the experimental procedure.
    - Evaluation Metric Implementation Error: The code includes obvious and deliberate malfeasance or logical traps to hallucinate results, such as bypassing the actual model execution to **hardcode** a static number as the final evaluation result, or using synthetic generation (e.g., `np.random`) to fabricate output metrics.
    - A claimed model identifier has never existed in the stated source (for example Hugging Face), so the claimed experimental object itself is fabricated or unsupported.
```

```
- If the issue is about what data object is used or how the data is defined/composed/split and static evidence
↪  already establishes a concrete conflict, classify it as `data_fabrication`. If the data object is not the
↪  issue but the training, evaluation, model, or metric computation statically establishes a concrete
↪  conflict, classify it as `experiment_fabrication`.
- `result_fabrication`: use this when static analysis shows that the **output values** reported in the paper
↪  conflict with the actual results produced by the repository.
  CRITICAL RULE ON SCALE: If the repository's code implementation, evaluation logic, and experimental settings
  ↪  appear internally consistent and match the methodology described in the paper, but the final reported
  ↪  numbers are simply different (even if they are 100x larger or mathematically impossible given the
  ↪  formula), you MUST classify this as `result_fabrication`. Use `result_fabrication` ONLY when the
  ↪  implementation and data have no conflict with the paper and there is no obvious logic error, but the
  ↪  final reproduced numbers explicitly fail to match the paper, OR when the paper reports metrics from a
  ↪  DIFFERENT model/run than the one specified (a "mis-mapping" or "cherry-picking" of results). If the paper
  ↪  mentions which code file implements the exact claim, please analyze the specific code file. For example:
    - The paper claims the result is from Model A (Run 5), but you find the result actually matches the output
    ↪  of Model B (Run 4) in the repository. This is a deliberate mis-mapping of result metrics, so it is
    ↪  `result_fabrication`.
    - The paper mentions that `run5.py` implements the exact claim, but you find the execution result of
    ↪  `run4.py` is the same as the reported result, while the execution result of `run5.py` is different from
    ↪  the reported result. You shoud classify the claim as `result_fabrication`.

3. `static_verifiable`
Meaning: STATIC inspection alone is sufficient to conclude that the claim is reproducible or consistent with
↪  the implementation, without needing to run code. IMPORTANT: For figures, finding only a generated final
↪  image artifact (e.g. .png, .pdf) is NOT sufficient. You MUST also find the underlying data files or metrics
↪  (e.g. .csv, .npy, .json) whose values correspond to the data plotted in the figure to map it as
↪  `static_verifiable`.

4. `insufficient_evidence`
Meaning: there is some claim-relevant evidence in the repository, such as logs, saved outputs, checkpoints,
↪  cached metrics, or other artifacts, but static inspection still cannot establish a reliable support chain
↪  from the repository to the exact paper claim, and there is no suitable code path, entrypoint, or intact
↪  implementation available for the next verification step. Use this only when the currently available
↪  evidence is too incomplete, indirect, ambiguous, or provenance-unclear to justify `static_verifiable`,
↪  `obvious_hallucination`, or `no_code_files`, and when no execution can be run to verify the claim.
If a claim depends on a missing plotting input or intermediate artifact (such as all_results.npy), and the
↪  repository contains a plotting script, evaluation script, training script, or any plausible upstream code
↪  path that may regenerate it, do NOT classify the claim as insufficient_evidence at analysis stage. In that
↪  case, classify it as execution_required and let execution attempt the repo-native regeneration path first.
Use insufficient_evidence only after you have determined that no suitable repo-native code path exists for
↪  generating the missing claim-relevant artifact.
- Example situations:
    - For example, there is a `final_info.json`, log file, or saved metric table containing claim-relevant
    ↪  numbers, but you cannot find the corresponding script or implementation that generated those numbers.
    ↪  This should be `insufficient_evidence`, not `no_code_files`.
    - If a pre-generated figure artifact exists but there is also a plotting or regeneration script that can
    ↪  still be run to test the claim, do NOT use `insufficient_evidence`; use `execution_required`.

5. `execution_required`
Meaning: the repository appears to contain a plausible execution path, but static inspection alone is not
↪  enough; code execution is required to determine whether the claim is reproducible.
- Use this when the remaining uncertainty is genuinely execution-dependent and a repo-native run still has a
↪  realistic chance to resolve it.
- If the issue is missing data, missing checkpoints, missing logs, missing caches, missing `all_results.npy`,
↪  or any other missing intermediate/generated artifact, do NOT classify it as fabrication at analysis stage
↪  solely because it is absent. Instead, classify it as `execution_required` when the repository still appears
↪  able to regenerate the needed evidence through its own execution path. Otherwise, if no such path exists,
↪  classify it as `no_code_files`.

6. `error`
Meaning: use this only when the analysis output itself is incomplete or malformed for a claim, such as when the
↪  claim was not classified reliably due to judge/output issues. Do not use this as a scientific judgment
↪  about repository support.

Rules:
- CRITICAL GUARDRAIL FOR MISSING CODE: If the specific model implementation, experimental setting, or results
↪  corresponding to a claim are completely absent from the provided repository, you MUST classify it as
↪  `no_code_files` or `insufficient_evidence`. Do NOT classify it as `experiment_fabrication` or
↪  `data_fabrication` solely based on the absence of code/artifacts. Fabrication verdicts require concrete,
↪  visible code or artifacts that explicitly contradict the paper.
- Perform STATIC ANALYSIS only. Do not execute commands.
- Read the paper content using the paper file path directly.
- Every claim index must appear exactly once across the six buckets.
- Keep stage boundaries clear: analysis is allowed to inspect existing files and static repository structure,
↪  but it must not assume the outcome of a future regeneration attempt that has not been executed yet.
- If a result looks invented, first check whether there is a corresponding implementation path and whether
↪  there are any claim-relevant artifacts or run outputs. Use `no_code_files` only when both are absent. If
↪  some claim-relevant artifact or execution record exists but the code path is missing or unclear, prefer
↪  `insufficient_evidence` rather than `no_code_files`.
```

```
- If static inspection already reveals a clear experiment-side defect, such as metric misuse, a broken training
↪  or evaluation procedure, failed control flow, model or experimental-variant mismatch, a statistical formula
↪  error, or a wrong default output directory that mixes runs or variants, classify the claim immediately as
↪  `obvious_hallucination` with `experiment_fabrication`.
- Use `insufficient_evidence` only when there is some claim-relevant artifact or execution record, but static
↪  inspection cannot establish a trustworthy provenance chain for the exact claim and there is no suitable
↪  repo-native code path or entrypoint left for meaningful next-step verification. If no such artifact or code
↪  path exists at all, use `no_code_files`.
- Use `execution_required` whenever the remaining uncertainty is genuinely execution-dependent and there is
↪  still a plausible repo-native code path to run, such as when the relevant result has not been generated
↪  yet, a dataset or an intermediate artifact is missing but appears plausibly reproducible from the
↪  repository's own code path, or fresh execution is needed to determine the actual output value.
- If the issue is about what data is used or how the data is defined, composed, labeled, sourced, or split, use
↪  `data_fabrication` only when static evidence already establishes a concrete conflict. If the data is the
↪  same but the training setup, model selection, evaluation protocol, control flow, or metric computation
↪  statically establishes a concrete conflict, use `experiment_fabrication`.
- If both a higher-priority and lower-priority fabrication type are supported by the evidence, always keep only
↪  the higher-priority one according to `data_fabrication` > `experiment_fabrication` > `result_fabrication`.
- If the issue is missing data, missing checkpoints, missing logs, missing caches, missing `all_results.npy`,
↪  or any other missing intermediate/generated artifact, do NOT classify it as fabrication (including
↪  `data_fabrication` or `experiment_fabrication`) at analysis stage solely because it is absent. Classify it
↪  as `execution_required` if the repository still appears able to regenerate the needed evidence and there is
↪  a suitable code path for doing so, but use `insufficient_evidence` only if the repository already contains
↪  partial artifacts or outputs whose provenance remains too unclear for static resolution and there is no
↪  suitable code path for further claim-level verification. If no claim-relevant artifacts or code paths
↪  exist, use `no_code_files`.
- Use analysis-stage `result_fabrication` only when static evidence is already decisive and further execution
↪  is not needed or not meaningful for resolving the exact claim. If there is still a suitable repo-native
↪  code path that can directly test the claim, prefer `execution_required` rather than analysis-stage
↪  `result_fabrication`.
- If a figure, table, or saved artifact looks suspicious but there is still a repo-native plotting, evaluation,
↪  or regeneration path that can directly test the claim, do NOT stop at analysis; classify it as
↪  `execution_required`.
- Use `obvious_hallucination` only when the static evidence is strong.
- Use `error` only for analysis-stage output failures, not for repository-side scientific judgments.
- For each item, cite concrete repository evidence such as filenames, scripts, functions, or missing
↪  components.
- For `static_verifiable`, explain why static inspection is already sufficient.
- For `insufficient_evidence`, explain why the existing evidence is claim-relevant but still too incomplete or
↪  provenance-unclear for a reliable conclusion, and why additional execution is unlikely to resolve it,
↪  including whether the next-step code path is missing, incomplete, or not identifiable.
- For `execution_required`, provide likely entrypoints or candidate files when possible. If you cannot identify
↪  any suitable next-step code path, do not use `execution_required`.
- When you defer a claim because required supporting artifacts are absent, explicitly say that execution must
↪  first attempt to regenerate those artifacts with the repository's own code before any fabrication verdict
↪  is made.

Your analyzing process might be like this:
1. First, read the paper and understand the claims.
2. For each claim, check the paper if there are specific code files mentioned, and look for corresponding
↪  implementation paths in the repository.
3. If there is no corresponding implementation path and no claim-relevant artifact or execution record at all,
↪  classify the claim as `no_code_files`.
- For example, if you cannot find either the relevant code or any claim-relevant logs, outputs, checkpoints, or
↪  saved metrics, use `no_code_files`.
4. If there is a corresponding implementation path, analyze the code and static artifacts. If static inspection
↪  already establishes a concrete conflict between the paper and the code or artifacts, classify the claim as
↪  `obvious_hallucination` with a specific `fabrication_type`.
- For example, if the conflict is about what data object is used or how the data is defined/composed/split,
↪  classify it as `data_fabrication`.
- If the data object is not the issue but the training, evaluation, model selection, or metric computation
↪  statically establishes a concrete conflict, classify it as `experiment_fabrication`.
- If both apply, keep only the higher-priority label: `data_fabrication` > `experiment_fabrication` >
↪  `result_fabrication`.
- If static evidence is already decisive for the reported output itself and there is no suitable remaining
↪  repo-native code path to directly test the exact claim, classify it as `result_fabrication`. Otherwise
↪  prefer `execution_required`.
5. If there is some claim-relevant evidence but its provenance or mapping to the exact claim remains too
↪  unclear for a reliable conclusion, and additional execution is unlikely to resolve that ambiguity because
↪  the next-step code path is missing, incomplete, or not identifiable, classify it as
↪  `insufficient_evidence`.
- For example, if you can see claim-relevant run outputs or saved metrics, but you cannot find the script or
↪  implementation that produced them, use `insufficient_evidence` rather than `no_code_files`.
6. If there is any suitable repo-native code path that can still meaningfully test the claim, classify it as
↪  `execution_required` and cite the relevant repository paths and likely entrypoints for execution, even if
↪  the current static evidence suggests a possible mismatch.
- For example, if a figure PNG already exists but there is a plotting script or data-generation path that can
↪  still be run to verify whether that figure matches the paper, use `execution_required` rather than
↪  `insufficient_evidence`.
```

```
7. If static inspection is already sufficient to verify the claim, classify it as `static_verifiable` and
↪  explain why. For figures, explicitly state which underlying data file matches the plotted data.
8. If the analysis output is incomplete or malformed for a claim, classify it as `error` and explain that the
↪  analysis output was unreliable for this claim.

Requirements of progress.md:
- You are running in an independent coding-agent session.
- You MUST update `{progress_md_path}`.
- If the file does not exist, create it.
- Append a new session entry containing:
  - session purpose: `analysis`
  - what files/context you inspected
  - what JSON files you created or updated in this session
  - a concise summary of the classifications you made
  - the recommended next step for the next session
- Do not overwrite previous session entries; append a new dated section.

You MUST save a JSON object to `fabscore_{judge_type}/{output_analysis_path}` with this schema:
{{
    "no_code_files": [
    {{
      "index": 1,
      "category": "table|figure|results_section",
      "content": "...",
      "reason": "...",
      "code_evidence": ["path/or/symbol", "..."]
    }}
  ],
  "obvious_hallucination": [
    {{
      "index": 2,
      "category": "table|figure|results_section",
      "content": "...",
      "reason": "...",
      "fabrication_type": "data_fabrication|experiment_fabrication|result_fabrication",
      "code_evidence": ["path/or/symbol", "..."]
    }}
  ],
  "static_verifiable": [
    {{
      "index": 3,
      "category": "table|figure|results_section",
      "content": "...",
      "reason": "...",
      "code_evidence": ["path/or/symbol", "..."]
    }}
  ],
  "insufficient_evidence": [
    {{
      "index": 4,
      "category": "table|figure|results_section",
      "content": "...",
      "reason": "...",
      "code_evidence": ["path/or/symbol", "..."]
    }}
  ],
  "execution_required": [
    {{
      "index": 5,
      "category": "table|figure|results_section",
      "content": "...",
      "reason": "...",
      "candidate_files": ["path/to/file.py"],
      "suggested_entrypoints": ["python eval.py --config ..."]
    }}
  ],
  "error": [
    {{
      "index": 6,
      "category": "table|figure|results_section",
      "content": "...",
      "reason": "Analysis output was incomplete or malformed for this claim.",
      "code_evidence": []
    }}
  ],
  "summary": {{
    "total_claims": 0,
    "no_code_files": 0,
    "obvious_hallucination": 0,
    "data_fabrication": 0,
    "experiment_fabrication": 0,
```

```
    "result_fabrication": 0,
    "static_verifiable": 0,
    "insufficient_evidence": 0,
    "execution_required": 0,
    "error": 0
  }}
}}

Return valid JSON only through the file write. Do not rely on stdout as the final artifact.
```

Code Execution Prompt

```
You are an autonomous research execution-verification agent.
Your current task is to verify the claim below using the repository at {task_path}. The overall pipeline will
↪  invoke this execution step separately for each claim that requires execution, so in this invocation you
↪  should focus only on the current claim below. There is a progress markdown file at {progress_md_path},
↪  where you can see the actions taken in previous sessions. Please append your actions and findings in this
↪  file as well, so that future sessions can build on them.

Research Paper File:
{paper_file}

Claim To Verify:
{json.dumps(claim, indent=2, ensure_ascii=False)}

Execution Requirements:
- Verify this claim only.
- Please read the paper and understand the claim in its full context before you decide how to verify it. You
↪  may refer to the paper file as needed during verification.
- This claim was already classified as `execution_required`: when evidence is still missing, insufficient, or
↪  not specific enough, run the minimal useful command; when existing artifacts already suffice for this exact
↪  claim, reuse them without rerunning instead of repeating the same work.
- Analyze the repository at `{task_path}`, and run repository commands from the repository root `{task_path}`.
↪  Use `{workspace_dir}` only as the place to store fresh verification artifacts produced during this session.
- Before executing any new command, first inspect existing code and artifacts under `{task_path}`, under
↪  `{fabscore_judge_dir}` (for example `execution_log.json`, `fs_execution.json`, and `progress.md`), and under
↪  `{workspace_dir}` (for example plots, metrics, checkpoints, or other verification outputs from prior runs).
- If the existing artifacts already provide sufficient and claim-relevant evidence to verify the current claim,
↪  reuse them directly and do not rerun the same command to generate them again.
- Reuse an existing artifact only if you can justify that it matches the exact claim. Please do not reuse an
↪  existing artifact if it is not clearly relevant to the claim, or if it is unclear whether it corresponds to
↪  the claim, or if it is from a different execution path than the one relevant to the claim.
- If you decide to reuse an existing artifact instead of rerunning a command, explicitly state which artifact
↪  you reused and why it is sufficient for this claim.
- If you decide to run a command, find the relevant code path, run the minimal useful command, and compare the
↪  fresh result with the claim.
- If verification encounters a missing dataset, model, checkpoint, log, cache, trajectory, or other
↪  intermediate/generated artifact, do not classify it immediately. First identify the claim-relevant
↪  repository-native path that should load or generate the missing artifact, then attempt the minimal
↪  reproduction command for that exact blocker, such as `python experiment.py --out_dir ...`, `python train.py
↪  ...`, `python main.py ...`, a relevant `run_*.py`, or another project script.
- Distinguish carefully between claim-level objects and supporting artifacts:
  - A missing or unresolvable dataset can be a `data_fabrication` issue if the dataset object itself clearly
  ↪  conflicts with the paper.
  - A missing generated artifact such as `all_results.npy`, a plotting input, a cached metric file, a saved
  ↪  output, or another intermediate result is usually not by itself a fabrication verdict. If the code path
  ↪  is plausible but the supporting evidence remains incomplete after reasonable repo-native attempts, use
  ↪  `Insufficient Evidence` unless you can establish a concrete conflict with the paper.
- After reasonable inspection and execution attempts, classify the claim using the definitions below.
- If execution cannot proceed because of external environment issues, set `verdict` to `Error` in your JSON and
↪  give the concrete blocker in `explanation`.
- Save any fresh outputs under `{workspace_dir}` so the run is recorded.
- Do not modify existing source files under `{task_path}`.
- Before you print your final verdict JSON to stdout, you MUST update `{progress_md_path}`.
- Append a new session entry with session purpose `execution`, what files/context you inspected, what execution
↪  artifacts you created or updated in this session, a concise verdict summary for this claim, and what the
↪  next session should do.
- Use that exact file path. Do not write to a different relative path such as a nested `fabscore_*` directory
↪  inside the workspace.
- Do not overwrite previous entries; append only.
- Primary output contract: print the final verdict to stdout as parseable JSON for claim_index
↪  `{claim['index']}`|either one object or a one-element array; avoid extra prose (a single ```json``` fence or
↪  an outer CLI JSON wrapper is OK if the verdict object is still extractable).
- Create `{command_output_path}` ONLY if you actually run at least one repository command from `{task_path}`
↪  (for example `python`, `python3`, `bash`, `make`, etc.). Append the raw stdout and stderr for each such
↪  command, with clear separators (command line, then output).
- If you do not run any such command, you MUST NOT create `{command_output_path}` (do not create an empty
↪  file).
```

```
{retry_guidance}

Print to stdout a JSON object with this shape (or a one-item JSON array containing only that object). For
↪  `verdict`, use exactly one label from the list after the field|not the whole `A|B|C` literal:
{{
    "claim_index": {claim['index']},
    "verdict": "<one of: {_execution_verdict_options()}>",
    "evidence_extracted": "Fresh files, values, or concrete blocker used for the verdict",
    "explanation": "Short explanation of the verdict",
    "command_executed": "Exact command or commands run; if missing data or generated artifacts are part of your
    ↪  reasoning, include the attempted regeneration command here",
    "code_reference": "Relevant code path or exact blocker location, preferably file:line or function name",
    "execution_classification": {{
        "fabrication_type": "<one of: data_fabrication, experiment_fabrication, result_fabrication; include
        ↪  when verdict is a fabrication>",
        "reason": "Include when the verdict is Data Fabrication, Experiment Fabrication, or Result Fabrication"
    }}
}}

Use Title Case in `verdict` (e.g. `Data Fabrication`). Use snake_case only in
↪  `execution_classification.fabrication_type` (e.g. `data_fabrication`), matching the classification bullets
↪  below|not the display labels.

Classification rules for execution-stage outcomes:
- Use `Data Fabrication`, `Experiment Fabrication`, or `Result Fabrication` when execution reveals a concrete
↪  repository-side conflict with the paper.
- CRITICAL GUARDRAIL FOR MISSING CODE: If the specific model implementation, experimental setting, or results
↪  corresponding to a claim are completely absent from the provided repository, you MUST classify it as `No
↪  Code Files` (if completely absent with no trace) or `Insufficient Evidence` (if partial). Do NOT classify
↪  it as `Experiment Fabrication` or `Data Fabrication` solely based on the absence of code/artifacts.
↪  Fabrication verdicts require concrete, visible code or execution outputs that explicitly contradict the
↪  paper.
- Priority rule: `data_fabrication` > `experiment_fabrication` > `result_fabrication`. If multiple fabrication
↪  types appear to apply, you MUST assign only the highest-priority one. For example, if a claim has both a
↪  data conflict and an experiment conflict, classify it as `data_fabrication`.
- If exactly one fabrication type is supported by the evidence, assign that type directly without applying any
↪  extra priority logic.
- In normal reasoning, prefer checking fabrication in this order: data-level conflicts first, then
↪  experiment/procedure conflicts, then result-level conflicts.
- Use `data_fabrication` when the blocker is about the dataset itself rather than the experiment implementation.
↪  This includes cases where the claimed dataset cannot be imported or resolved, the dataset name cannot be
↪  found from the repository's claimed source (for example Hugging Face), the dataset file is corrupted, or
↪  the loaded dataset clearly conflicts with the paper in identity, source, size, labels, composition, or
↪  splits. A claimed dataset identifier that has never existed in the stated source (for example Hugging Face)
↪  should be treated as `data_fabrication`, because the data object itself is fabricated or unsupported. If
↪  the paper describes the dataset as a real-world dataset, but the dataset shown in the repository is
↪  synthetic data, it should be treated as `data_fabrication`. NOTE: Distinguish this accurately from
↪  fraudulent metric implementation (e.g., `np.random` outputs), which should be classified as
↪  `experiment_fabrication`. Note that if a dataset name ever exists in the stated source but now the dataset
↪  name cannot be found, this may be a transient issue rather than fabrication, and you may classify it as
↪  `Insufficient Evidence`; please classify as `data_fabrication` only if the dataset name has never existed
↪  in the stated source.
- Use `experiment_fabrication` when the blocker is about the experiment implementation or claimed experimental
↪  object rather than the dataset. This includes cases where the claimed model cannot be imported or resolved,
↪  the model name cannot be found from the repository's claimed source (for example Hugging Face), the loaded
↪  model clearly conflicts with the paper in identity, size, version, or architecture, or the
↪  implementation/method/training/inference/evaluation/metric pipeline clearly conflicts with the paper or is
↪  internally self-contradictory. A claimed model identifier that has never existed in the stated source (for
↪  example Hugging Face) should be treated as `experiment_fabrication`, because the claimed experimental
↪  object itself is fabricated or unsupported. Note that if a model name ever exists in the stated source but
↪  now the model name cannot be found, this may be a transient issue rather than fabrication, and you may
↪  classify it as `Insufficient Evidence`; please classify as `experiment_fabrication` only if the model name
↪  has never existed in the stated source.
- Use `result_fabrication` when the claim-relevant implementation matches the paper's description, but the
↪  reported values conflict with reproduced results or are internally consistent but externally/mathematically
↪  impossible. Use `result_fabrication` when the implementation and data have no conflict with the paper and
↪  there is no obvious logic error, but the final numbers fail to match.
  CRITICAL RULE ON SCALE: If the code implementation and logic match the paper, but the final numbers are
  ↪  different or mathematically impossible, you MUST classify this as `result_fabrication` regardless of the
  ↪  scale (e.g., even a 100x difference).
- Use `Insufficient Evidence` when there is a plausible claim-relevant implementation path and some relevant
↪  code, execution, or artifact evidence, but the currently available evidence is still not specific,
↪  complete, or reliable enough to justify `Verified`, `Data Fabrication`, `Experiment Fabrication`, or
↪  `Result Fabrication`.
  GENTLE RULE ON MISSING ARTIFACTS: If a required checkpoint or artifact is missing, but the repository
  ↪  provides a training or regeneration script, you MUST first attempt to run the script to reproduce it.
  ↪  Only if reproduction fails or it is too difficult to reproduce should you conclude `Insufficient
  ↪  Evidence`.
```

```
- Do not use `data_fabrication` merely because logs, checkpoints, caches, saved outputs, or plotting artifacts are missing. Those are not datasets. Missing supporting artifacts should not by themselves be treated as fabrication; use `Insufficient Evidence` unless execution establishes a concrete conflict with the paper. If the main blocker is an incompatible model/checkpoint/implementation path, use `experiment_fabrication`. If the blocker is external infrastructure rather than the repository itself, use `Error`.
- Decision rule:
  1. If the problem is which dataset is used or whether the dataset can be loaded and this establishes a concrete conflict with the paper, use `data_fabrication`.
  2. If the problem is which model/method is used or whether the experiment pipeline can be executed as described in the paper, and this establishes a concrete conflict with the paper, use `experiment_fabrication`.
  3. If the code implementation and calculation logic are consistent with the paper but the reported numbers are simply wrong, unsupported, or mathematically impossible, use `result_fabrication`.
  4. If more than one of the above applies, keep only the highest-priority label: `data_fabrication` > `experiment_fabrication` > `result_fabrication`.
  5. If there is some claim-relevant evidence but it remains inconclusive after sufficient analysis or execution and artifact inspection, use `Insufficient Evidence`.
- Examples:
    - Corrupted dataset file, `load_dataset(...)` points to a dataset identifier that has never existed in the stated source (e.g. Hugging Face), or the paper describes using a real-world dataset but the repository implementation uses synthetic data instead => `data_fabrication`.
    - A claimed model identifier has never existed in the stated source (e.g. Hugging Face), the wrong model implementation/architecture is used in evaluation, checkpoint/model pairing is incompatible, metric implementation is fraudulent (e.g., the code bypasses actual execution to **hardcode** a static result or uses synthetic generation (e.g., `np.random`) to fabricate output metrics), or the claimed script crashes due to fundamental implementation defects => `experiment_fabrication`.
    - The repository's code implementation and evaluation logic match the paper's description, but the paper says 0.742 and the actual limit or output of the code is 0.007 (mathematically impossible) => `result_fabrication`.
    - The paper reports a metric as belonging to Model A (Run 5), but it actually matches the saved output of Model B (Run 4). This "mis-mapping" or "cherry-picking" of results from other runs is `result_fabrication`.
- A plotting script is plausible, but the required generated input such as `all_results.npy` is missing and reasonable repo-native attempts still do not produce enough evidence to verify the plotted claim => `Insufficient Evidence`.
- Use `Verified` when claim-relevant existing artifacts or a successful fresh execution provide sufficiently specific evidence that supports the paper's claim.
    - IMPORTANT FOR FIGURES: Finding a pre-existing final image (e.g., .png, .pdf) in the repository is NOT sufficient for a `Verified` verdict. A pre-existing image could be a manually uploaded artifact from a previous experiment. To achieve `Verified`, you MUST either (a) find the underlying raw data files, logs, or metrics (e.g., .npy, .csv, .json, tensor logs) whose values correspond to the visual data plotted in the figure, OR (b) successfully execute a script that re-generates these data files or the image from scratch.
    - PERFORMANCE TIP: When verifying large data files (like `.npy` arrays), focus on confirming their shape, existence, and representative values. Do NOT print the entire contents of large arrays/logs to stdout, as this causes parser errors.
- Reserve `Error` for external execution failures, such as agent/CLI failure, infrastructure issues, missing GPU resources, timeout, or other environment problems that do not indicate fabrication in the repository itself.
```

B.2. LLM Judge Prompts for Analysis

Case Study Prompt

```
Data Fabrication": """\
You are an expert in AI research integrity and reproducibility auditing.

We have examined an ML paper and flagged the following claim as a \
**Data Fabrication** | meaning the data used in the experiment does not match what the \
paper claims. Your task is to read the claim and our explanation carefully, \
then determine which of the following specific reasons best describes WHY this is a \
data fabrication:

D1. Synthetic/mock data used instead of real data described in the paper
    | The code generates data programmatically (e.g. np.random, generate_mock, \
synthetic_cohort) or uses a mock formula to produce numbers, rather than loading the \
real-world dataset the paper describes.

D2. Non-existent or wrong dataset referenced in the paper
    | The dataset file, Hugging Face repository, or external resource the paper claims \
to use does not exist, cannot be found, or is an entirely different dataset from what \
was actually used in the code.

D3. Data values in the paper conflict with actual data files
    | The paper states specific statistics, counts, or numeric values (e.g. class sizes, \
prevalence rates, revenue figures, dataset sizes, split ratios), but the actual \
```

```
CSV/database/config/log files on disk show different values, or the code hardcodes \
numbers that do not match the real data.

D4. Others
    | The fabrication involves a data-related issue that does not clearly fit D1{D3.

Now read the following:

Claim (what the paper reports):
{claim}

Our explanation (why we flagged this as fabricated):
{explanation}

Based on the claim and explanation above, select the single most fitting category D1{D4 \
that explains the root cause of this data fabrication.

Reply in JSON exactly like this (no other text):
{{"category": "D1. Synthetic/mock data used instead of real data described in the paper", "reason": "One
↪  sentence citing specific evidence from the explanation."}}
""",

    "Experiment Fabrication": """\
You are an expert in AI research integrity and reproducibility auditing.

We have examined an ML paper and flagged the following claim as an \
**Experiment Fabrication** | meaning the experimental result reported in the paper \
cannot be reproduced because the experiment itself was not properly implemented or run. \
Your task is to read the claim and our explanation carefully, then determine \
which of the following specific reasons best describes WHY this is an experiment fabrication:

E1. Simulation or hardcoded values replace an experimental component
    | A key part of the experiment (e.g. training loop, human-AI interaction, policy \
evaluation) is replaced by a programmatic simulation, stub, or hardcoded output, so no \
real experiment was ever conducted. The code produces the numbers directly rather than \
by running the described method.

E2. Formula or metric implementation produces incorrect values
    | The experiment is run, but the formula or metric used to compute the reported \
number is mathematically wrong (e.g. wrong F1 formula, incorrect CI calculation, \
misapplied Jaccard similarity), so the output is systematically incorrect regardless \
of the inputs.

E3. Execution logic or order inconsistent with paper description
    | The code runs, but a critical step described in the paper (e.g. ablation variant, \
fairness penalty, evaluation phase) is missing, ignored, or always bypassed due to a \
logic flaw (e.g. condition always true, variable computed but never used).

E4. Code implementation bug causes incorrect execution
    | The code crashes or silently fails due to a software bug (e.g. AttributeError, \
dimension mismatch, device mismatch, wrong tensor shape) before producing valid results, \
so the reported numbers could not have come from running this code.

E5. Unavailable referenced model or dataset
    | The code references an external resource (e.g. a Hugging Face model ID, checkpoint \
file, pretrained weight) that does not exist or is incorrect, so the experiment cannot \
have been run as described.

E6. Others
    | The fabrication involves an experimental issue that does not clearly fit E1{E5.

Now read the following:

Claim (what the paper reports):
{claim}

Our explanation (why we flagged this as fabricated):
{explanation}

Based on the claim and explanation above, select the single most fitting category E1{E6 \
that explains the root cause of this experiment fabrication.

Reply in JSON exactly like this (no other text):
{{"category": "E1. Simulation or hardcoded values replace an experimental component", "reason": "One sentence
↪  citing specific evidence from the explanation."}}
""",

    "Result Fabrication": """\
You are an expert in AI research integrity and reproducibility auditing.

We have examined an ML paper and flagged the following claim as a \
```

```
**Result Fabrication** | meaning the numeric result reported in the paper does not \
match what the code actually produces. Your task is to read the claim and our \
explanation carefully, then determine which of the following specific reasons best \
describes WHY this is a result fabrication:

R1. Reported value conflicts with stored execution logs or artifacts
    | Without re-running anything, we found a stored file (e.g. final_info.json, \
results CSV, experiment log, embedded figure in the PDF) that already records a value \
contradicting the paper, or a run is mislabeled / results from different runs are mixed.

R2. Reported value conflicts with re-execution results
    | We actually ran the code and obtained a different number from what the \
paper reports. The discrepancy is discovered at execution time and would not be visible \
without running the code (e.g. "running the script produces X, not the claimed Y").

R3. Mathematically impossible value
    | The reported number is impossible given the paper's own methodology: it exceeds a \
theoretical bound (e.g. probability > 1, F1 > 1), contradicts the paper's own formula \
when applied to the stated inputs, or violates a mathematical constraint such as a BH \
correction ceiling.

R4. Others
    | The fabrication involves a result discrepancy that does not clearly fit R1{R3.

Now read the following:

Claim (what the paper reports):
{claim}

Our explanation (why we flagged this as fabricated):
{explanation}

Based on the claim and explanation above, select the single most fitting category R1{R4 \
that explains the root cause of this result fabrication.

Reply in JSON exactly like this (no other text):
{{"category": "R1. Reported value conflicts with stored execution logs or artifacts", "reason": "One sentence
↪  citing specific evidence from the explanation."}}
```

AI Review Coverage Prompt

```
You are auditing an AI-generated peer review of a scientific paper.
We have extracted the following atomic claims from the paper | each
one is a specific data point, table value, figure observation, or
experimental result stated in the paper.

Your task: for each atomic claim, determine whether the AI review
BOTH (a) refers to this specific claim or data point AND (b) flags it as
problematic using language such as: inconsistent, incorrect, mismatch,
hallucinated, fabricated, unsupported, not reproducible, does not match,
not found, wrong value, has problems, or similar criticism.

A claim is only considered caught (airev_caught=true) if the review
explicitly mentions it AND criticises it. If the review merely mentions
the value without criticism, set airev_caught=false.

AI Review text:
\"\"\"
{review_text}
\"\"\"

Atomic claims:
{claims_list}

Reply ONLY with valid JSON | one entry per claim in the same order:
{{
  "judgments": [
    {{
      "idx": <0-based index>,
      "airev_caught": true/false,
      "airev_evidence": "<the relevant sentence(s) from the review that flag this claim, or empty string>"
    }}
  ]
}}
```

AI Review Issue Analysis Prompt

```
You are an expert meta-reviewer analyzing AI-generated peer reviews.
Your task is to classify the following 'evidence' provided by an AI reviewer into exactly ONE of the following four categories:

1. Intra-paper Contradictions: The evidence points out numbers or statements that contradict each other within the text, tables, or figures of the paper (e.g., abstract vs. table, impossible sum).
2. Mathematical Implausibility: The evidence points out a mathematical error, incorrect calculation, or violation of basic formulas (e.g., NPV calculation is wrong).
3. Lack of Quantitative Evidence: The evidence criticizes the paper for missing details, absent tables, or lacking statistical variability to support a claim.
4. Code-to-Text Mismatch: The evidence explicitly compares the paper's text to a provided code snippet and notes a discrepancy.

Evidence to classify:
"{evidence}"

Reply in JSON format exactly like this:
{{
  "category": "1. Intra-paper Contradictions",
  "reason": "A brief 1-sentence explanation of why it fits this category."
}}
```