

AI Commit Ledger: Bridging the AI Transparency Gap in Version Control with Deterministic Session Attribution

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Abstract: *The rapid proliferation of AI-assisted development tools such as Claude Code and Cursor Agent has fundamentally transformed software engineering workflows, dramatically increasing development velocity while simultaneously introducing a critical gap in commit-level transparency, traceability, and governance. Existing version control systems, including Git, capture the final state of code changes but provide no structured mechanism for recording whether a change was AI-generated, which agent was involved, what prompts or reasoning drove the implementation, or whether governance policies were satisfied. This paper presents AI Commit Ledger, a local-first, Git-native provenance system that addresses this gap by generating structured AI Receipts for each commit and persisting them in a dedicated metadata branch within the same repository. The system integrates transparently into the standard Git commit lifecycle through repository-scoped post-commit hooks, employs a multi-phase deterministic matching engine to correlate commits with AI agent session artifacts, and constructs structured provenance records indexed by commit SHA. Experimental evaluation demonstrates that the system achieves 94.2% attribution accuracy, introduces less than 340ms overhead per commit, and operates entirely on-device without external service dependencies. AI Commit Ledger provides a foundational infrastructure layer for AI governance in software development, enabling organizations to enforce AI-related policies, support post-incident analysis, and satisfy regulated reporting requirements.*

Keywords: AI Provenance, Git-Native Governance, AI-Assisted Development, Commit Traceability, Claude Code, Cursor Agent, Software Accountability, AI Receipt, Version Control

