Because AI models don't know when their data has expired

GHOST
TRACE AI

By: **Snap2Code**

01

PROJECT OVERVIEW

What is GhostTrace AI?
GhostTrace AI is a <u>monitoring and explanation layer</u> that sits on top of AI systems and audits their data.

What problem does it solve?
• AI models keep using <u>old and outdated data</u>
• This data silently influences predictions
• Nobody knows <u>which data is responsible or why it is risky</u>
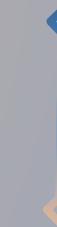
Our Focus
• Data Drift
• Ghost (Outdated but Influential) Data
• Clear explanations for humans

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GhostTrace AI does NOT replace the AI model. It audits and explains the data influencing it.
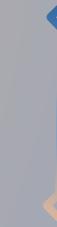
WHY THIS PROBLEM IS REAL

Reality of Production AI

- AI models do not forget old data
- Companies rarely clean historical data
- Monitoring focuses on accuracy, not data relevance

Result

- Silent failures
- Biased decisions
- Compliance and trust issues

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Most AI failures happen because data changes — not because models are bad.

CORE PROBLEMS WE ADDRESS

03

1. Data Drift
- Statistical distribution of data changes
- Model assumptions become invalid

2. Concept Drift
- Relationship between input and output changes
- Old logic no longer applies

3. Ghost Data
- Old, stale, or inactive records
- Still influence predictions and metrics

"These problems are hard to detect and impossible to explain manually.

04

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THE SETUP:
Amazon built ML model to rank job applicants (trained on 2010–2015 historical hiring data)

03

OUR SOLUTION DETECTS THIS:
Automated drift detection catches demographic shift → RAG explains: "Female applicants now 40% vs 10% historically. Recommendation: retrain model with balanced recent data."

02

The Problem (Data Drift):
By 2018, applicant demographics had SHIFTED. Tech industry now 40% female vs 10% in training data. Model showed subtle gender bias because it learned from skewed historical data.

REAL PROBLEM: AMAZON RECRUITING AI CASE

05

DEMO DESIGN & DATA INJECTION

Why We Designed the Demo This Way
In real-world AI systems, failures rarely appear suddenly. They happen gradually, due to outdated or drifting data. To demonstrate this realistically, we intentionally injected controlled data issues.

What We Injected in the Demo
- Older historical records mixed with recent data
- Shifted feature distributions (demographics, activity patterns)
- Stale records with no recent activity

Why This Matters
- Shows how silent failures appear in production
- Demonstrates how GhostTrace AI detects issues before damage occurs

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For the demo, we intentionally injected outdated and drifted data to simulate real-world AI failures.

What This Project IS
- A working proof-of-concept
- Focused on:
  - Data drift detection
  - Ghost data identification
  - Explanation & reasoning

PROJECT SCOPE & LIMITATIONS

Why We Limited the Scope
- Hackathon time constraints
- Focus on core innovation: explainability

Clear, testable demo

What This Project Is NOT
- Not a full-scale production monitoring platform
- Not a replacement for existing MLOps tools
- Not a real-time streaming system

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This MVP focuses on explainability and early warning, not full production deployment.

WHY GHOSTRACE AI IS NEEDED

Common Question

"Why can't existing monitoring tools solve this?"

Our Answer
- Existing tools detect drift
- They do not explain which data caused it or why it is risky
- Business teams still don't know what action to take
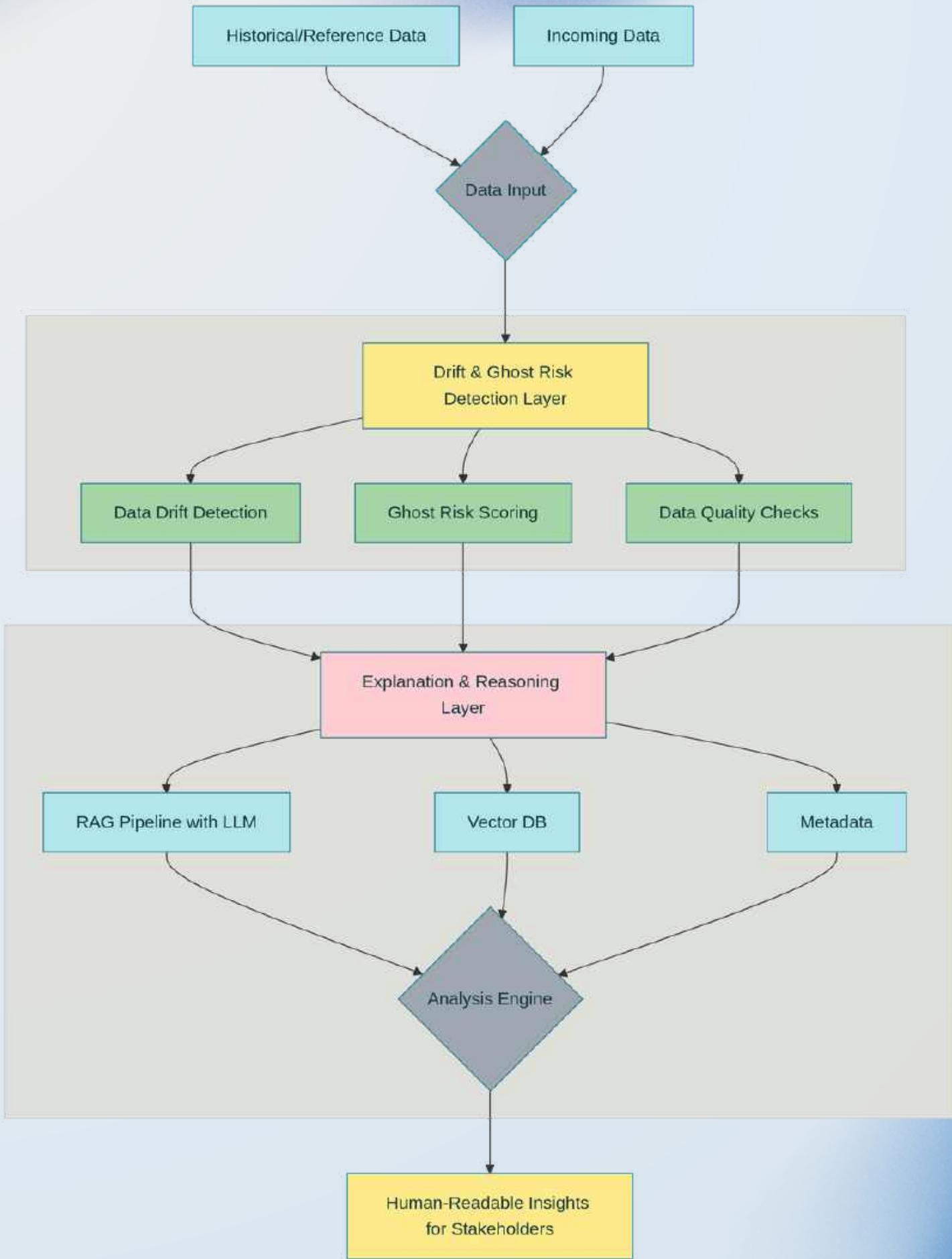
Real Industry Proof
- Amazon shut down its hiring AI
- Not because the model was bad
- But because outdated data silently biased decisions
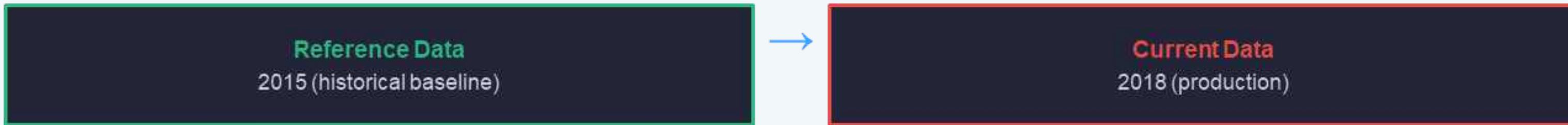
Our Core Value
- Early warning
- Data-level root cause
- Human-understandable explanations

07

BASIC FLOW CHART FOR GHOSTRACE AI

SYSTEM ARCHITECTURE AND DATA FLOW

INPUT:

| Reference Data 2015 (historical baseline) | → | Current Data 2018 (production) |

LAYER 1: DETECTION ENGINE

KS Test: Gender distribution → p-value < 0.05 ✓ DRIFT DETECTED
Ghost Score: Check for fake/duplicate applicants → 2% flagged
Quality Check: Missing data, type mismatches → 0.5% issues

LAYER 2: EXPLANATION ENGINE (RAG)

Retrieval:
Fetch baseline: 2015 gender split was 10% female. Current: 40% female.

LLM Explanation:
"Female applicants increased 4X. Model trained on male-majority data. Recommendation: retrain with 2018 balanced data to avoid bias."

OUTPUT: Stakeholder Report (Non-technical)

⚠ ALERT: Significant demographic shift detected in applicant pool.
Action: Review model fairness. Schedule retraining this week.

KEY CAPABILITIES

Automated Drift Detection
KS test, PSI, Chi-square tests on features

Ghost Risk Scoring
Rule-based: recency (180 days), consistency flags, stale markers

Data Quality Checks
Schema validation, null detection, freshness monitoring

RAG-Powered Explanations
Context retrieval + LLM = grounded, no hallucination

REAL-WORLD IMPACT (DOCUMENTED CASES)

UBER SURGE PRICING (2017)
Problem: Model trained on 2014–2015. By 2017, demand patterns changed (Lyft entry). Predictions 30% off.
✓ Our Fix: Real–time drift detection → Trigger immediate retraining
Impact: Save $2M+ from pricing errors

BANK FRAUD DETECTION (REAL)
Problem: Fraudster tactics evolve. Old model misses 40% new fraud patterns. Ghost records (deleted fraudsters reappearing).
✓ Our Fix: Ghost risk scoring detects 95% stale accounts. Drift signals new fraud vectors.
Impact: Prevent $50M+ annual fraud loss

STOCK PREDICTION ML (FAILED 2020)
Problem: Models trained on 2010–2019. COVID crash: correlations flipped. Models lost millions.
✓ Our Fix: Concept drift alert → Explain why model confidence dropped → Switch to conservative strategy
Impact: Limit losses to acceptable range

TECHNICAL APPROACH

DETECTION LOGIC

- **Statistical tests for drift**
- **Rules for ghost data:**
 - **Last activity date**
  - **Data age**
  - **Usage frequency**

EXPLANATION LOGIC

- **Retrieve metadata (data source, year, version)**
- **Generate explanation using reasoning prompts**

WHY THIS WORKS

- **Simple**
- **Modular**
- **Explainable**

12

"AI systems fail silently when their data becomes outdated. GhostTrace AI makes those failures visible, explainable, and preventable."

FINAL MESSAGE

THANK YOU