UNITED STATES PATENT APPLICATION

TITLE OF THE INVENTION

MULTI-AGENT ARTIFICIAL INTELLIGENCE SYSTEM FOR DISCOVERY, ANALYSIS, GOVERNANCE, AND PARETO-PRIORITIZATION OF NOVEL, HIGH-IMPACT QUESTIONS

FIELD OF THE INVENTION

The invention relates to machine-learning architectures and, more particularly, to distributed multi-agent systems that **pro-actively surface "unknown-unknown" questions**, evaluate them on multi-objective criteria, and output an **auditable, Pareto-optimal frontier** of inquiries for strategic, scientific, ethical, or philosophical exploration.

BACKGROUND OF THE INVENTION

Progress in every discipline is bounded not by the answers we possess, but by the **questions we have not yet imagined**. Existing AI tools excel at (i) retrieving answers to *known* queries and (ii) generating questions only as a by-product of answering tasks. These tools lack:

1. a specialized engine for **detecting conceptual white-space** across heterogeneous corpora;
2. a **multi-agent adversarial/co-operative loop** capable of scoring each new question on *novelty, impact, feasibility, ethical risk,* and *cross-domain leverage*;
3. a **transparent governance layer** that can quarantine bio-security or dual-use hazards *before* public disclosure; and
4. an **immutable, regulator-ready audit trail** that supports reproducibility and compliance.

Consequently, enterprises waste resources exploring redundant or low-impact avenues, while transformative research questions remain undiscovered.

SUMMARY OF THE INVENTION

The invention remedies these limitations through a **five-component architecture**:

1. **Question Discovery Agents (QDAs)** generate candidate inquiries by contrasting predictive gaps in source corpora with anomaly signals from unsupervised models.
2. **Question Analysis Agents (QAAs)** compute a *score vector* 〈novelty, strategic-impact, feasibility, ethical-risk, cross-domain-leverage〉 for each candidate.
3. **Question Governance Agents (QGAs)** enforce policy, resolve scoring disputes via confidence-weighted voting, and **quarantine questions whose ethical-risk exceeds a programmable threshold**.
4. A **Question Ledger**—an append-only, cryptographically signed record—maintains full provenance, including agent rationales.
5. A **Priority Engine** performs a **multi-objective optimization** over the score vectors, generating a **Pareto frontier** and publishing a rank-ordered queue tailored to user-defined weights.

Key technical advantages:

1. **True novelty detection** via adversarial generation–analysis loops plus anomaly metrics.
2. **Policy-aware quarantine workflow** that no prior art discloses.
3. **Explainability module** that attaches a chain-of-thought digest to every prioritized question.
4. **Horizontal scalability** through micro-service deployment of agent instances.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 (see page 2 of the specification) shows the high-level data-flow among Data Ingestion (101), QDAs (102), QAAs (104), QGAs (105), Question Ledger & Priority Engine (106–108), and the User/Down-stream AI interface (109). Solid arrows denote primary data flow; dashed arrows show governance feedback.

DETAILED DESCRIPTION OF THE INVENTION

Priority Engine Algorithm

Upon receiving adjudicated score vectors S_i, the engine solves:

$$max_{Q\_i \in Ledger}; f(S_i, W)$$

Subject to:

1. f implements a Pareto frontier search such that no selected question is dominated on all objectives.
2. W is a user-supplied weight vector enabling dynamic re-ranking without re-analysis.

Quarantine Workflow

If:

$$ethical\_risk(Q_i) > \theta$$

(where θ is a policy-defined threshold), the Question Governance Agent (QGA) moves Q_i to a **quarantine sub-ledger**.

Release is subject to:

1. Applicable human oversight policies
2. A revised risk assessment procedure

EXAMPLE USE CASES

- **Synthetic-biology red-team:** The system auto-quarantines a question whose lab-protocol implications exceed a BSL-3 risk score; human bio-safety officers review and approve partial disclosure.
- **Corporate strategy:** Pareto frontier highlights three cross-domain R&D opportunities that traditional pipeline tools missed, saving 18 months of exploratory spend.
- **National-security foresight:** High-risk cyber-warfare questions are flagged and routed to cleared analysts under sealed audit keys.