Hackathon Theme 1: AIML, Agentic AI, Data Science

Problem Statements for KuruKshetra-25 Hackathon

---

1. Tool-Integrated AI Agents

Description:
Build an AI agent that interacts with real-world tools (APIs, databases, IoT devices) to complete tasks end-to-end.

- Example: An agent that monitors stock prices via an API and automatically generates investment recommendations.
- Key challenges: ensuring secure/reliable connections, handling asynchronous responses, and keeping knowledge up-to-date.

---

2. Self-Directed Planning and Reasoning Agents

Description:
Develop an LLM-based agent that autonomously plans and executes multi-step tasks using reasoning loops (ReAct, chain-of-thought).

- Example: An AI planner that organizes a multi-day event (venue booking, schedule creation, invitations).
- Key challenges: prompt/loop design and dynamic re-planning when unexpected events occur.

---

3. Explainable AI (XAI) for Deep Models

Description:
Create tools to make complex AI decisions transparent and trustworthy.

- Example: For a CNN diagnosing medical images, build a module that highlights the image regions driving its decision.
- Key challenges: visualizing attention/feature importance, generating human-readable justifications, avoiding misleading explanations.

---

4. AI for Climate and Energy Optimization

Description:
Develop an AI solution to improve sustainability.

- Example: Predict renewable energy output (solar/wind) and optimize grid dispatch to minimize carbon footprint.
- Alternate: Track supply chain emissions data and flag carbon hotspots.
- Key challenges: accurate forecasting with noisy weather data and real-time optimization.

---

5. Smart Manufacturing (Predictive Maintenance)

Description:
Build a predictive maintenance system using industrial IoT sensor data.

- Example: Predict which machine will fail soon and schedule proactive repairs to reduce downtime.
- Key challenges: time-series modeling, anomaly detection, cost/benefit optimization.

---

6. AI-Enhanced Education Platforms

Description:
Create an AI tutor that personalizes learning content or assessments.

- Example: An adaptive math tutor that adjusts difficulty dynamically and provides instant feedback.
- Alternate: Automatic essay grading with constructive feedback.
- Key challenges: personalization at scale, fair evaluation, NLP accuracy.

---

7. TinyML with Quantization and Pruning

Description:
Develop a compact AI model that runs efficiently on resource-constrained devices (simulated if hardware is not available).

- Example: Quantize a speech command recognition model to 8-bit while keeping high accuracy.
- Key challenges: size/latency tradeoffs, compression without performance loss, memory footprint estimation.

---

8. Automated Data Cleaning and Augmentation

Description:
Create a pipeline that improves data quality using AI.

- Example: Detect and fix typos, normalize inconsistent labels, fill missing values, and generate synthetic samples for rare classes.
- Key challenges: balancing automation with accuracy, preserving data privacy.

---

9. Multi-Modal AI Search Agent

Description:
Build an AI agent that can search across text, images, and documents simultaneously.

- Example: A research assistant that finds relevant text, tables, and diagrams about a topic in PDFs and websites.
- Key challenges: multi-modal embedding, semantic ranking, result summarization.

---

10. AI-Powered Knowledge Graph Builder

Description:
Automatically construct a knowledge graph from raw documents or datasets.

- Example: Given a folder of research papers, build a graph of key entities (authors, methods, findings) and their relationships.
- Key challenges: entity resolution, relation extraction, scalable indexing.

---

11. Synthetic Data Generation for Privacy-Preserving ML

Description:
Develop a system to create realistic synthetic datasets that preserve patterns but hide sensitive details.

- Example: Generate synthetic patient records for healthcare ML without leaking real identities.
- Key challenges: fidelity vs. privacy, differential privacy guarantees, evaluation metrics.

---

12. Agentic AI for Real-Time Decision Support

Description:
Create an AI agent that makes quick operational decisions from streaming data.

- Example: An AI logistics dispatcher that reroutes delivery vehicles based on live traffic or weather updates.
- Key challenges: streaming inference, latency, handling incomplete information.

---

13. AutoML for Tabular Data Pipelines

Description:
Design a lightweight AutoML system that automatically selects features, models, and hyperparameters.

- Example: Given a structured dataset (sales, healthcare), output an optimized model with minimal manual tuning.
- Key challenges: balancing speed and accuracy, interpretable feature selection.

---

14. LLM-Based Data Analyst Assistant

Description:
Build an AI assistant that answers natural language questions by analyzing datasets.

- Example: “What were last quarter’s top-selling products?” → Generates SQL queries, retrieves results, and explains insights.
- Key challenges: translating ambiguous questions to precise queries, data security.

---

15. AI-Powered Document Summarization with Citation Tracking

Description:
Create a summarizer that compresses lengthy reports while preserving references and source traceability.

- Example: Summarize legal contracts or research articles with links to exact paragraphs.
- Key challenges: factual consistency, source alignment, multi-document aggregation.

---

16. Reinforcement Learning for Process Optimization

Description:
Use RL to optimize a dynamic process or workflow.

- Example: Train an agent to minimize factory energy usage while maintaining output quality.
- Key challenges: defining reward functions, safe exploration, simulation of realistic environments.

---

17. Agentic AI for Code Generation & Testing

Description:
Develop an AI agent that writes code, runs it, debugs errors, and refines automatically.

- Example: Build a system that generates Python scripts for data cleaning tasks, tests correctness, and fixes issues in a loop.
- Key challenges: reliable execution, sandboxing, verifying correctness automatically.

---

18. AI-Based Time-Series Forecasting with Anomaly Alerts

Description:
Build a system that predicts future values and flags deviations.

- Example: Forecast retail sales and trigger alerts when unusual demand spikes occur.
- Key challenges: robust prediction during seasonal shifts, false positive reduction.

---

19. Human-in-the-Loop Model Feedback System

Description:
Create a platform where humans review AI predictions and provide corrections to retrain models continuously.

- Example: A fraud detection system where analysts approve/reject model alerts, and feedback improves future accuracy.
- Key challenges: active learning, efficient retraining, tracking annotation quality.

---

20. Multi-Agent Collaboration for Complex Tasks

Description:
Design a system where multiple specialized AI agents work together.

- Example: One agent gathers data, another analyzes it, a third creates a report, and a coordinator combines outputs.
- Key challenges: agent communication protocols, task allocation, conflict resolution.