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HACKATHON PROJECT OVERVIEW

Project Name: MetaView

Problem Statement & ID: Problem Statement 2 - Metastore Viewer for Parquet, Iceberg, Delta & Hudi Tables on S3

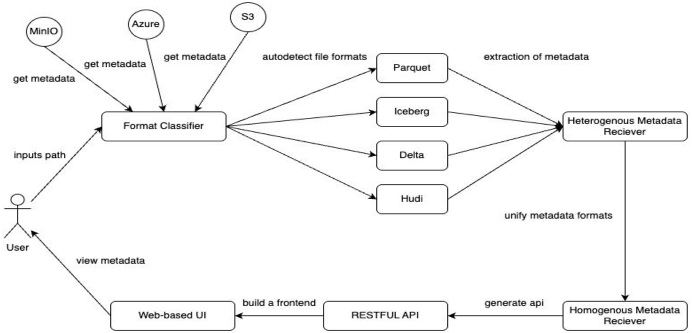
Team Name: Mjolnir

College: COEP Technological University

City: Pune

PROPOSED SOLUTION

Solution Overview & Key Components



Detailed Explanation on how the solution works

1. User inputs Object Store Path,
2. Classifier **Auto-Detects** Table format,
3. **Extract Heterogenous Metadata** which is format specific
4. **Parse it** and convert it to a **homogenous**, unified format,
5. Using a **REST API** send it to website frontend,
6. UI Displays schema, partitions, snapshots and Metrics

How It Addresses the Problem (Advantages)

1. Eliminates Dependency on Traditional Metastores like **Glue** and **Hive**,
2. No need to register tables manually, just provide the **S3** (or equivalent service) **path** and our system retrieves metadata instantly
3. Supports multiple formats – **Parquet**, **Iceberg**, **Delta** and **Hudi**,
4. Extracts rich Metadata to provide valuable insights,
5. Improves data governance by implementing a **uniform** metadata format.

Innovation & Uniqueness

1. No table registration required for Metadata exploration,
2. Has the ability to **visualise** schema evolution over time,
3. **Interactive** UI for **Metadata exploration** instead of users querying in SQL,
4. Built for a combination of Lakehouse formats.

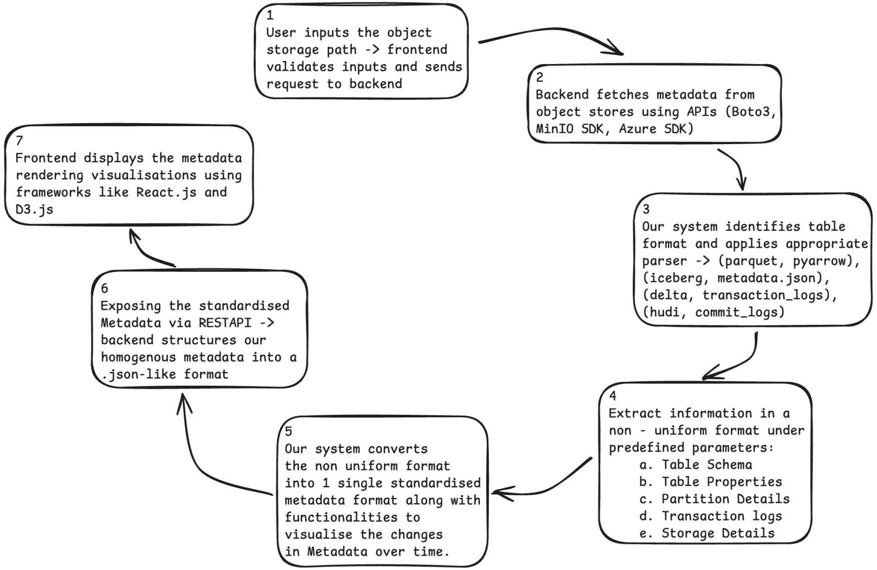
Cutting-edge technologies or novel approaches

1. **Format Classifier**: Automatically Detect the format of the table stored in S3 (or Azure, MinIO) using NLP or and equivalent fine tuned LLM,
2. **AWS SDK and Object Store APIs**: Interact directly with S3, MinIO, or Azure for real time metadata retrieval,
3. **React.js and D3.js**: Provide an appealing GUI for visualising transformations in metadata,
4. **Serverless & Cloud-Native Approach**: Can be deployed as a **Lambda function** or as a **Docker container**.

APPROACH

Methodology to Solve the Problem

Step-by-step explanation & Logical Breakdown



1 User inputs the object storage path -> frontend validates inputs and sends request to backend

2 Backend fetches metadata from object stores using APIs (Boto3, MinIO SDK, Azure SDK)

3 Our system identifies table format and applies appropriate parser -> (parquet, pyarrow), (iceberg, metadata.json), (delta, transaction_logs), (hudi, commit_logs)

4 Extract information in a non - uniform format under predefined parameters:
a. Table Schema
b. Table Properties
c. Partition Details
d. Transaction logs
e. Storage Details

5 Our system converts the non uniform format into 1 single standardised metadata format along with functionalities to visualise the changes in Metadata over time.

6 Exposing the standardised Metadata via RESTAPI -> backend structures our homogenous metadata into a .json-like format

7 Frontend displays the metadata rendering visualisations using frameworks like React.js and D3.js

Key Challenges & How they are addressed

1. Handling different table formats
   - Classification of different formats to apply the right parser
   (parquet -> **pyarrow**, delta -> **delta_api**, iceberg -> **metadata.json_parser**)
2. Employing the right parser
   - Scanning metadata files using **Natural Language Processing** to choose the right parser for extracting data
3. Efficiently Extracting Metadata from large datasets
   - Do not scan the whole dataset, instead use the **manifest files** & **transaction logs** to retrieve metadata
4. API Performance & Scalibility
   - Use **FastAPI** (async processing) and deploy in a serverless / cloud – native architecture (**AWS Lambda**, **Kubernetes**)
5. Ensuring a User- Friendly Interface
   - Interactive UI with metadata visualisation features that can **interpolate** the “state” of the data

USPs & Features

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Unique Selling Points

- Unlike Hive/Glue, our tool requires **no table registration**—just provide the object storage path and explore instantly.
- Unlike specialized viewers that focus on one format, **MetaView seamlessly handles** Parquet, Iceberg, Delta and Hudi tables through a **single interface**.
- Automatically **classifies table formats** and processes metadata intelligently, reducing manual effort.
- Provides **quick metadata insights** for decision-making without the need for expensive data warehousing tools.

What makes the solution special?

- **No more Hive or Glue dependency** – Just plug in the storage path & explore metadata.
- **No SQL expertise needed** – Intuitive UI lets users browse metadata visually.
- **Multi-Cloud Support** – Works seamlessly with AWS S3, MinIO, and Azure Blob Storage.
- **Optimized for the Lakehouse** – Handles evolving data lakes **without manual intervention**.

Key Features

1. Auto-Detection and Classification of Table Formats
2. Direct Metadata Access and Instant Retrieval
3. Interactive UI for Metadata Exploration

Technologies & Implementation

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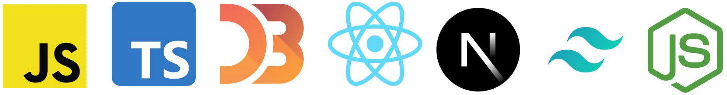
Tech Stack

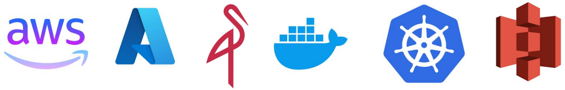
Frontend (UI and Visualization)



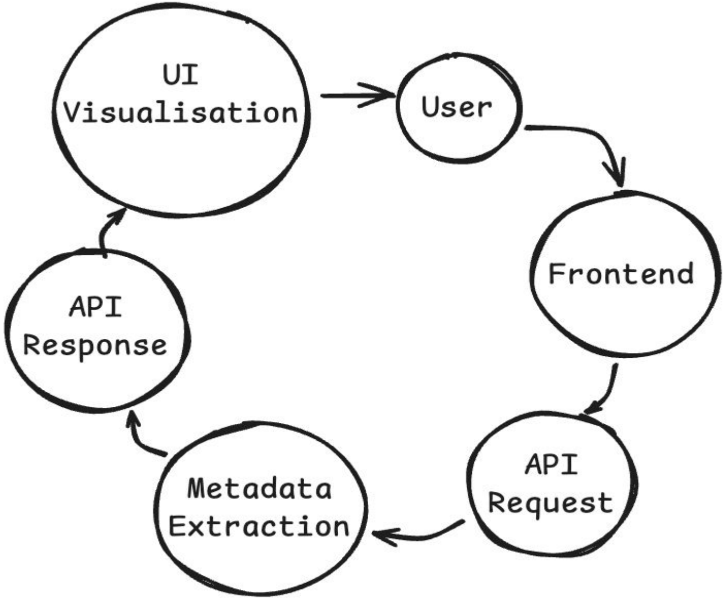
Backend (Metadata Extraction and API Layer)

DELTA LAKE
Flask

Frameworks and Additional Tools



Data Flow Diagram (Implementation Methodology)



UI Visualisation → User → Frontend → API Request → Metadata Extraction → API Response → UI Visualisation

Potential Impact

Impact on Target Audience

1. Gain instant metadata insights without needing a meta store (**data engineers** & **analysts**)
2. Quickly explore table schema and structure before running queries (**data scientists**)
3. Optimise storage and performance with metadata driven insights (**cloud architects**)
4. Manage tables without complex infrastructure (**organisations** & **data lakes**)

Social Impact

1. Encouraging **Open Source** & **Cloud Native Communities** by reducing dependencies on proprietary meta stores,
2. Making large-scale metadata easily accessible
3. Increasing adoption of **modern data lake technologies**

Economic Benefits

1. Cost savings as no need to use expensive meta store services like **AWS Glue**, **Databricks Unity**, or **Hive Metastore**,
2. Quick metadata access improves **data pipeline efficiency**,
3. Better resource utilisation leading to optimise storage and compute costs

Benefits of the Solution

1. No meta store required – directly read metadata from object store,
2. **Faster** metadata **retrieval** – no need to scan full tables,
3. **Multi – format support** – works with Parquet, Iceberg, Delta, and Hudi,
4. Scalability & Flexibility – **Cloud based**, **serverless** architecture,
5. User-Friendly Interface – Interactive UI for schema browsing, version tracking & **visualisation**
6. **Agentic Environment** – An agent-like system that redirects metadata retrieval based on the various formats and then converts into a single unified metadata format

Environmental Contribution

1. Enables **efficient data pruning** by leveraging metadata insights,
2. Reducing **unnecessary data scans** & processing, leading to **lower cloud energy consumption**,

References & Additional Links

Links to References & Research Papers

Lakehouse Architecture & Metadata Management

1. https://iceberg.apache.org/
2. https://delta.io/
3. https://hudi.apache.org/
4. https://www.databricks.com/glossary/what-is-parquet

Research Paper Links

1. "Delta Lake: High-Performance ACID Table Storage over Cloud Object Stores" - https://dl.acm.org/doi/pdf/10.14778/3415478.3415560

Additional Documentation

Official API & SDK Docs for Storage & Table formats

1. https://boto3.amazonaws.com/v1/documentation/api/latest/reference/services/s3.html
2. https://min.io/docs/minio/macos/index.html
3. https://learn.microsoft.com/en-us/azure/storage/blobs/
4. https://devdocs.io/fastapi/

Code Repositories & Open Source Projects for Reference

1. https://github.com/apache/iceberg
2. https://github.com/delta-io/delta
3. https://github.com/apache/hudi
4. https://github.com/trinodb/trino

Team Details

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