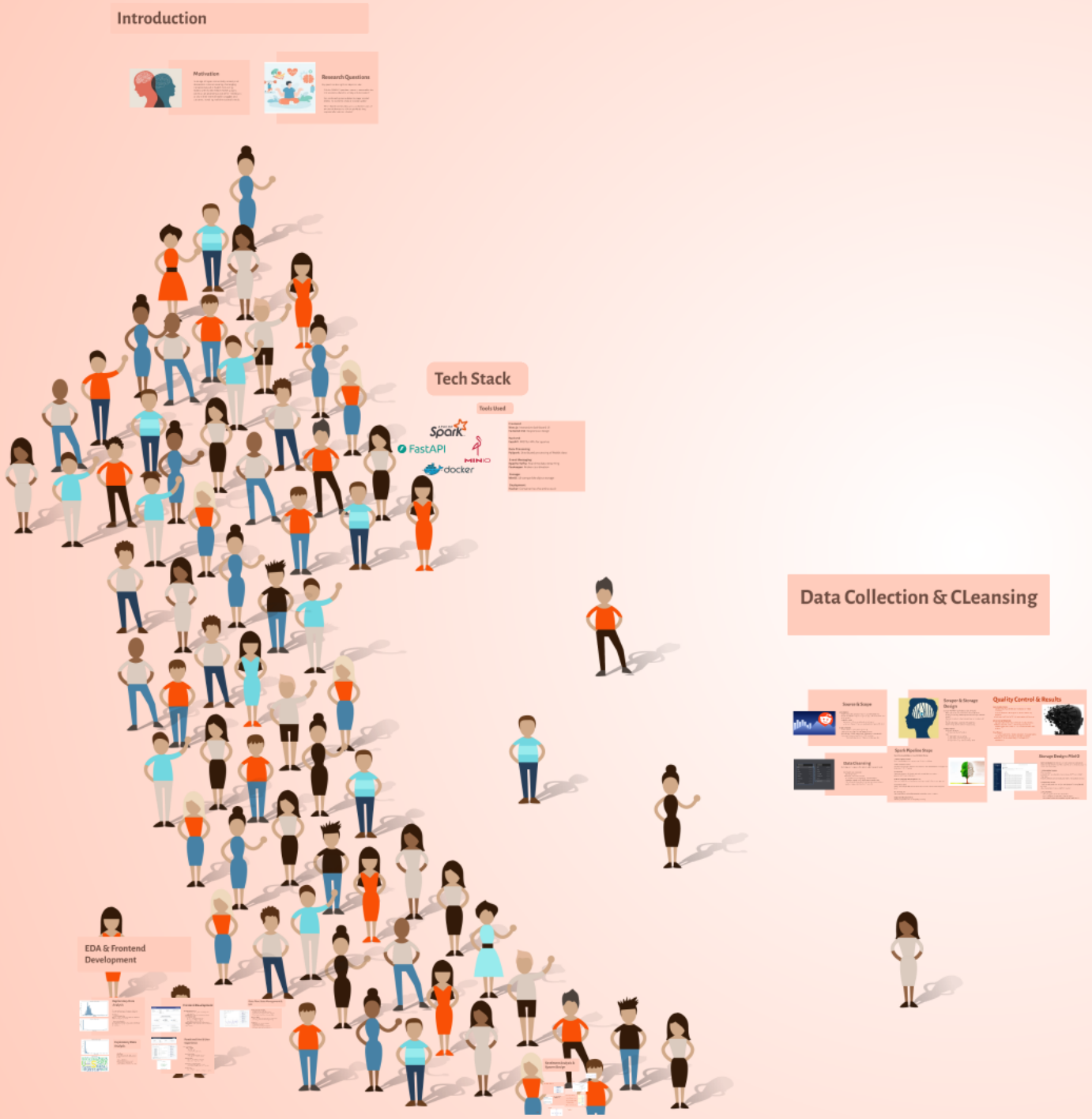

Subreddit Meltdown

Mental Health Trends from Reddit Data

Data 228: Big Data Project

Group: 09
Submitted By: Chandana Rondla, Deeksha Chauhan, Himaja Sree Thota, Moksh Aggarwal, Saurabh Suman, Shivam Mahendru
Submitted To: Professor Sangjin Lee

Introduction

Motivation

In an age of hyper-connectivity, anxiety and depression rates are soaring, challenging conventional public health monitoring. Reddit, with its 430 million monthly users, serves as an anonymous outlet for individuals to share their mental health struggles and concerns, revealing real-time societal trends.

Research Questions

Key questions driving this analysis include:

- Did the COVID-19 pandemic cause a measurable rise in discussions related to anxiety and depression?
- Can sentiment spikes be linked to major societal events like economic crises or election cycles?
- Which Reddit communities act as early indicators of emotional distress—and how quickly do they respond after external shocks?

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- Which Reddit communities act as early indicators of emotional distress—and how quickly do they respond after external shocks?

Tools Used

Frontend:
Next.js: Interactive dashboard UI
Tailwind CSS: Responsive design

Backend:
FastAPI: RESTful APIs for queries

Data Processing:
PySpark: Distributed processing of Reddit data

Event Messaging:
Apache Kafka: Real-time data streaming
Zookeeper: Broker coordination

Storage:
MinIO: S3-compatible object storage

Deployment:
Docker: Containerizes the entire stack

Data Collection & CLeansing

Source & Scope

Data Source

- Reddit data collected using Photon Arctic-Shift (REST API).
- Based on Pushshift corpus – supports high uptime and near real-time updates.
- Endpoints used:
  - /posts/search Post metadata (title, body, etc.)
  - /comments/search Comment metadata (text, parent ID, etc.)

Scope & Volume

- 22 subreddits scraped (see Appendix A).
- Time frame: Oct & Nov of both 2019 and 2020.
- Raw volume: ~25 GB compressed JSONL (posts + comments).
- Focus set: Diverse subreddits (~10 GB) including:
  - r/antiwork, r/feminism, r/fitness, r/worldnews, etc.

Scraper & Storage Design

Scraper Workflow (askreddit_arctic_shift.py)

- Retry logic: Automatic back-off on failures (429/5xx).
- Monthly streaming: Batches posts/comments per calendar month.
- Dynamic bisecting: Halves time window recursively on API errors.
- Restart-safe: Skips already downloaded files.
- Rate limiting: 250 ms delay (~4 requests/sec).

Storage Layout

- Directory hierarchy:
  - F:\<subreddit>\<YYYY_MM>\
- Files:
  - r_<subreddit>_posts.jsonl.gz
  - r_<subreddit>_comments.jsonl.gz
  - Compression: Gzip reduces size by ~80%.

Quality Control & Results

Data Quality Checks

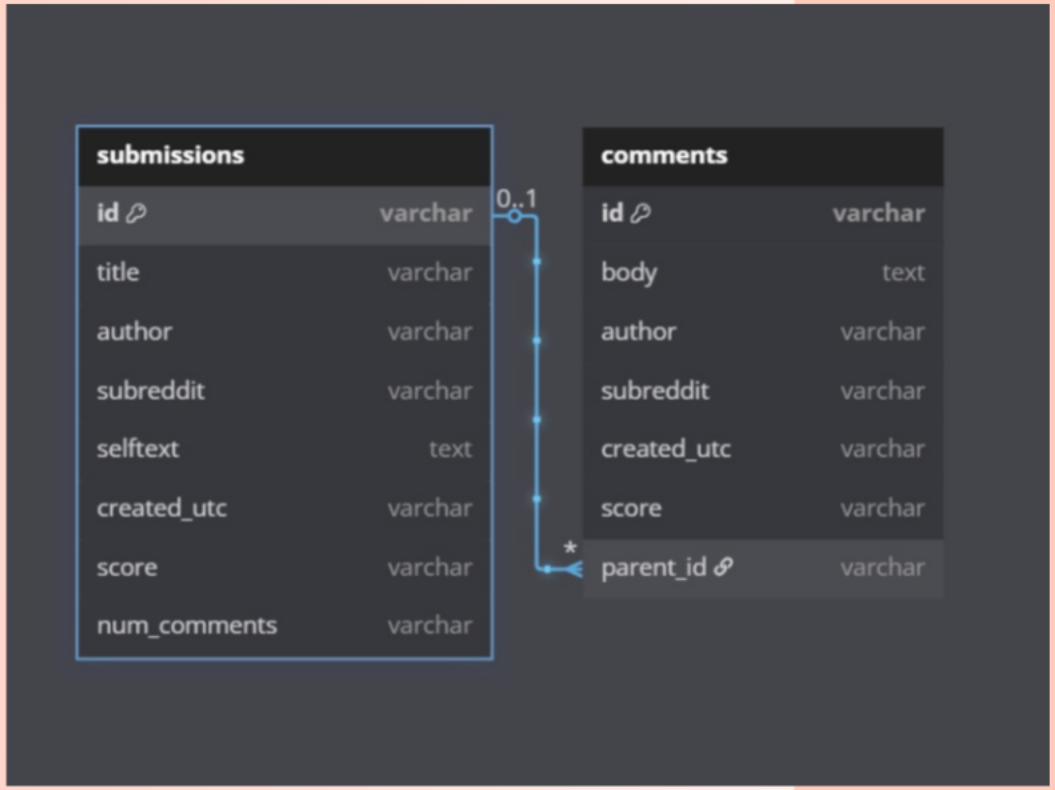
- Completeness flag: Months with < 500 posts or < 5 000 comments.
- Schema validation: 1% sampled per file to check for key presence.
- Duplicate check: Hash of (ID + timestamp) to avoid overlap.

Limitations & Mitigations

- Live-sync lag (< 2 min) - Not relevant for historical months.
- Deleted/removed content - Handled in preprocessing.
- Pushshift gaps before 2005-12 - Do not affect selected data window.

Final Output

- ~1.4 million comments, ~25,000 posts from 11 key subreddits.
- +15 GB archive from broader 22-subreddit collection.
- Ready for NLP, sentiment analysis, and dashboard visualizations.



Data Cleansing

First step was to organise the data to make it analysis ready.

Raw Reddit data contained:

- Non-English text
- Deleted or removed content
- Automated bot messages (e.g., AutoModerator)
- Excessive metadata (e.g., flair, awards, media info)
- Left unfiltered, these records pollute sentiment analysis, waste storage, and slow down Spark jobs.

Spark Pipeline Steps

Spark Cleaning Job Steps on monthly Reddit Dump:-

1. Remove Empty Entries
Drop rows where posts or comment text is blank or missing.

2. Filter Deleted Content
Excluded literal strings *[deleted] and [removed], and AutoModerator messages. cuts down about 11% of the rows.

3. Clean Text
Lowercase, remove URLs/emojis, and strip non-alphabetic characters.
-gives our NLP model a tidy input.

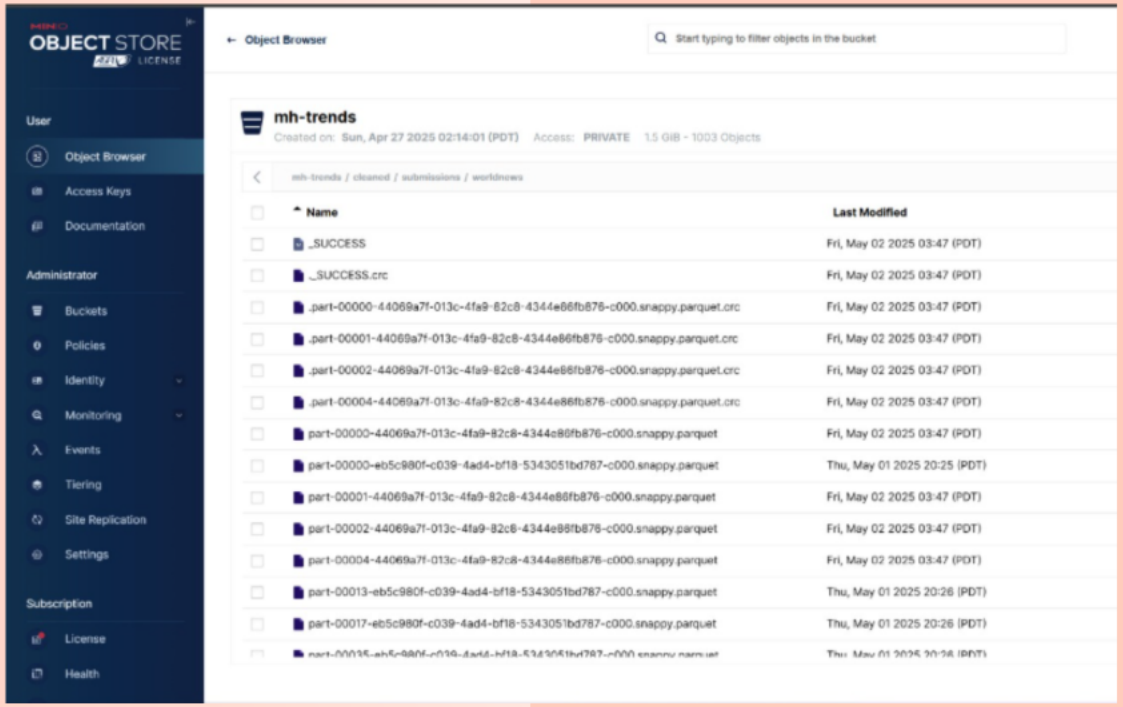
4. Detect Language (UDF;langdetect =en)
Keep only English entries, because our sentiment model is English-only right now.

5. Partition & Save
Convert timestamps, add year/month columns, and save as columnar Parquet to MinIO

6. Track Progress
Log record counts and confirm successful saves with markers *_success*

Output (set of parquet files)
Efficiently organized data for fast Spark processing.

Storage Design: MinIO



MinIO S3 Bucket "mh-trends": an open-source, S3-compatible object storage server. It provides a way to store and access data in a similar manner to AWS.

1. Hierarchical Layout

Files stored as:
cleaned/<entity>/subreddit=<name>/year=YYYY/month=MM/*.parquet.
Enables efficient partitioning by subreddit and date(Fast Lookup)

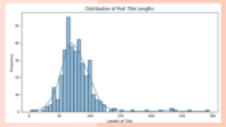
2. Optimized Access

-Spark directly reads the neatly stored parquet file using **boto3** package.
-No intermediate copies or AWS CLI needed.

3. Key Benefits

- Versioning and server-side encryption
- Fast storage for recent data (under 90 days)
- Role-based access with separate keys for each service

EDA & Frontend Development



Exploratory Data Analysis

To understand mental health discussions on Reddit, we conducted EDA using PySpark, Matplotlib, and Seaborn.

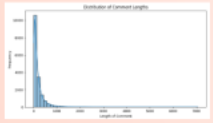
Key Insights:

1. Post Volume Over Time

Significant spikes in posting activity aligned with global stress events, especially during COVID-19.

2. Most Active Subreddits

Communities like r/depression, r/anxiety, and r/mentalhealth had the highest activity, signaling their central role in mental health discourse.



Exploratory Data Analysis

3. Word Clouds

Frequent terms such as "help", "alone", "rope", and "therapy" indicate emotional urgency and shared struggles.

4. Sentiment Distribution

Sentiment varied by time and topic, with noticeable shifts during societal events highlighting Reddit as a reflection of public mood.

Frontend Development

Frontend Architecture:

- Framework: Next.js (React) + TypeScript for maintainability
- **Styling:** Tailwind CSS for fast, responsive design
- **Visualization Tools:**
  - chartjs-2 for sentiment timelines
  - wordcloud for keyword displays
  - react-datepicker for time filtering
- **APIs:** RESTful endpoints from a FastAPI backend
- **Deployment:** Docker containerization for portability across systems

Functionalities & User Experience

Key Functionalities:

- **Filtering Module:**
  - Select subreddit
  - Choose date range
  - Toggle between Posts/Comments
- **Sentiment Timeline:**
  - Dynamic line chart of sentiment over time
  - Tooltip support for exact score and date
- **Keyword Panel:**
  - Displays positive and negative keywords
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- **Event Impact Table & Drill-down:**
  - Shows major events with sentiment scores
  - Click to navigate to related posts/comments with context
- **User Benefits:**
  - Real-time insights
  - Drill-downs from macro trends to individual conversations

Data Flow, State Management & UX

System Integration & Data Flow:

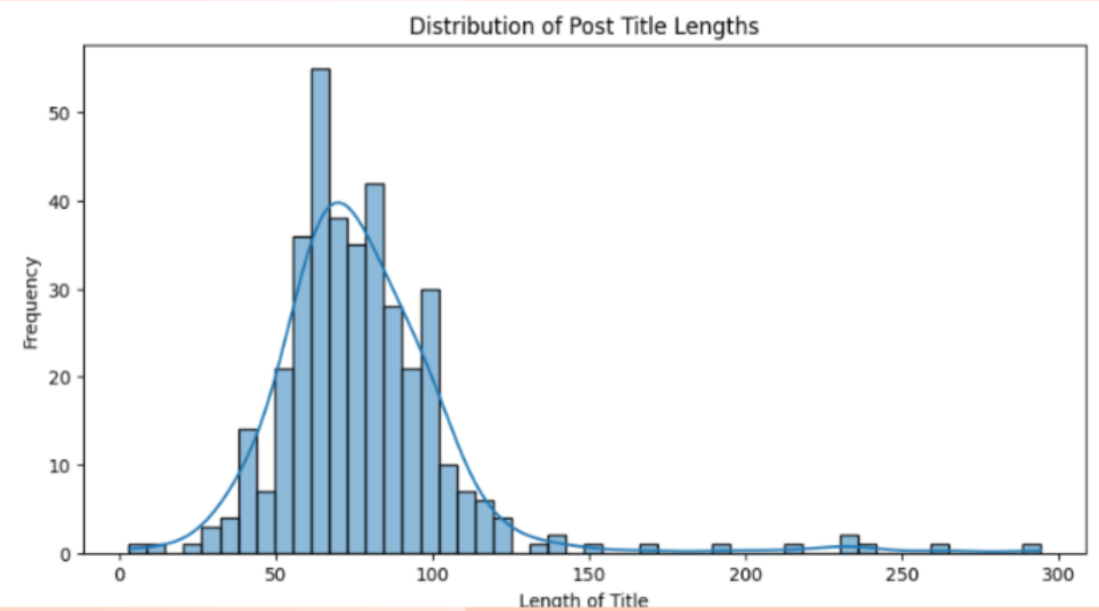
- User selects filters in dashboard
- Frontend sends API request (via fetch/axios)
- Backend returns JSON: sentiment, events, keywords
- UI updates dynamically: charts, tables, word clouds

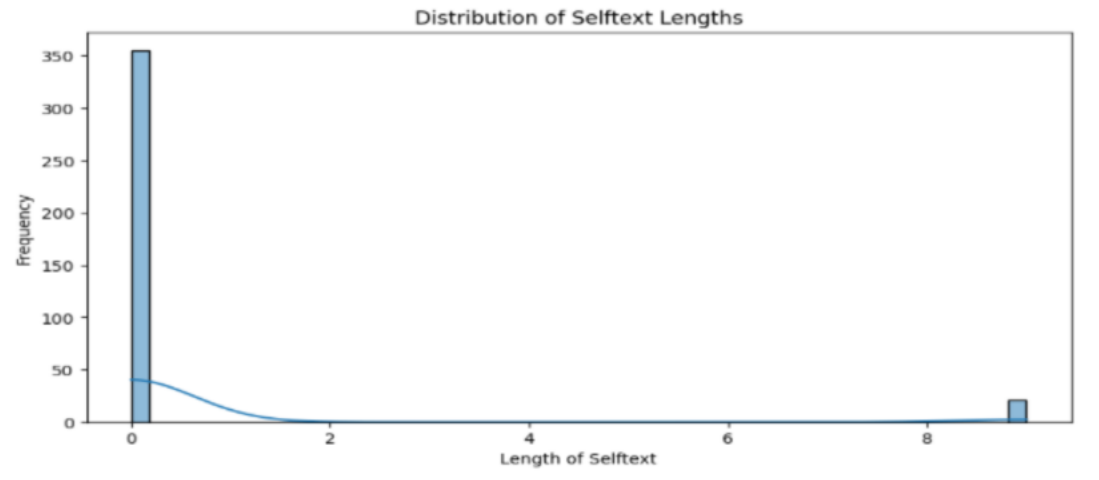
Real-Time Updates:

- React hooks manage state and trigger seamless re-renders
- Visuals stay synchronized with every input change

Design Focus:

- Clean, clutter-free layout for readability
- Mobile-responsive design
- High-performance and minimal load time
- Emphasis on user-driven discovery and clarity





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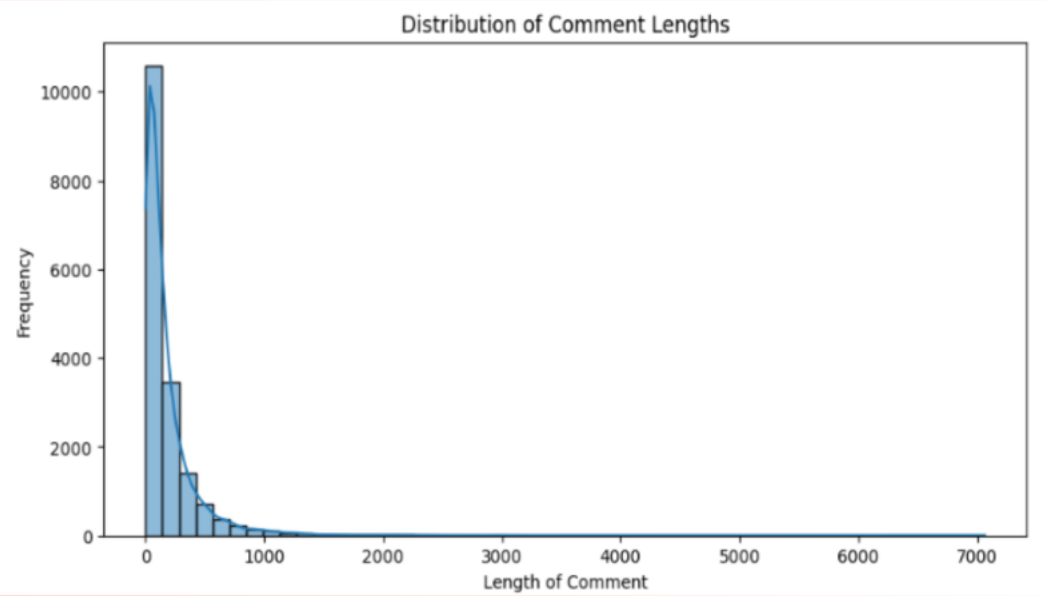

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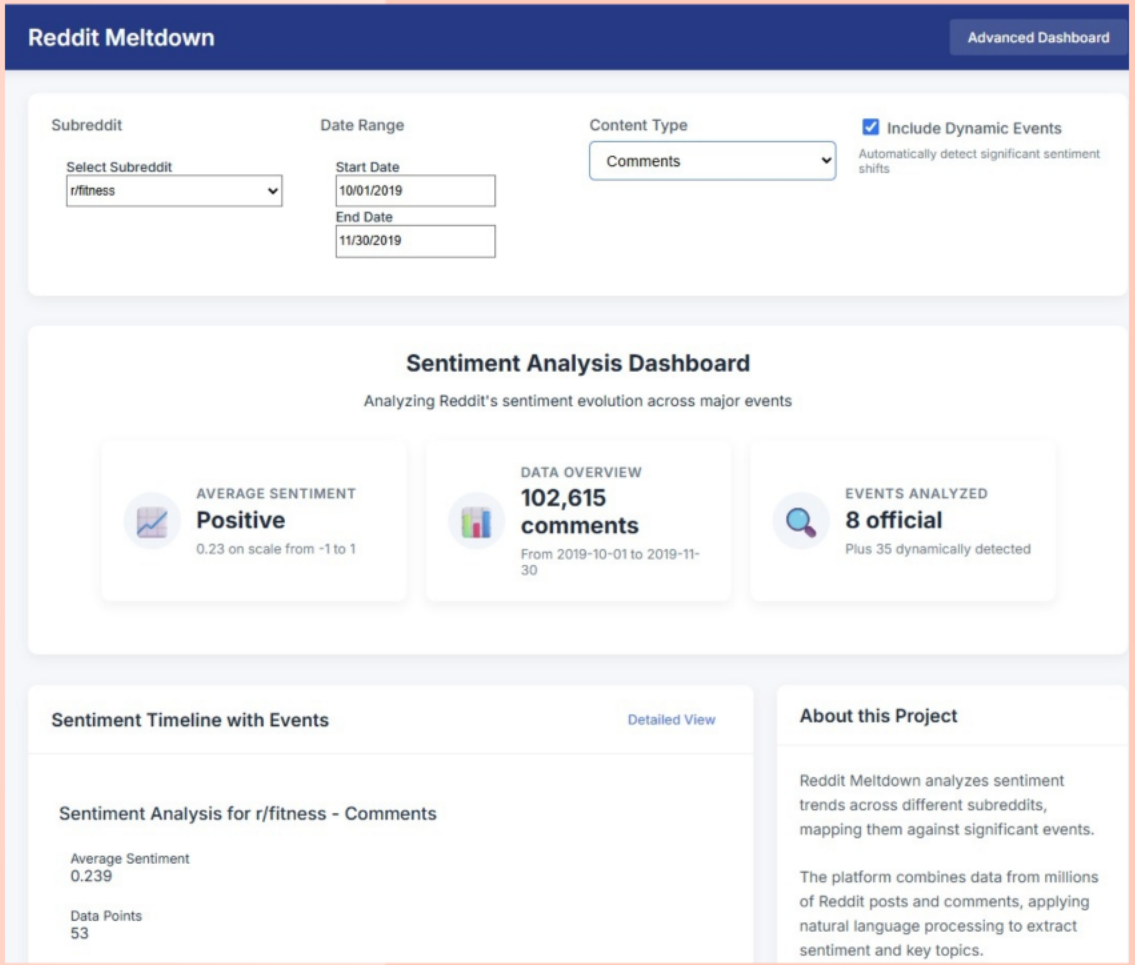

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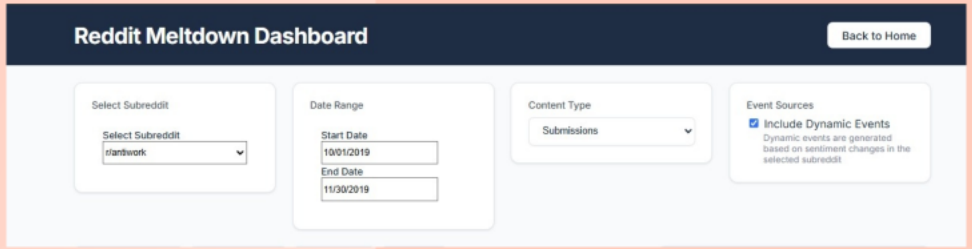

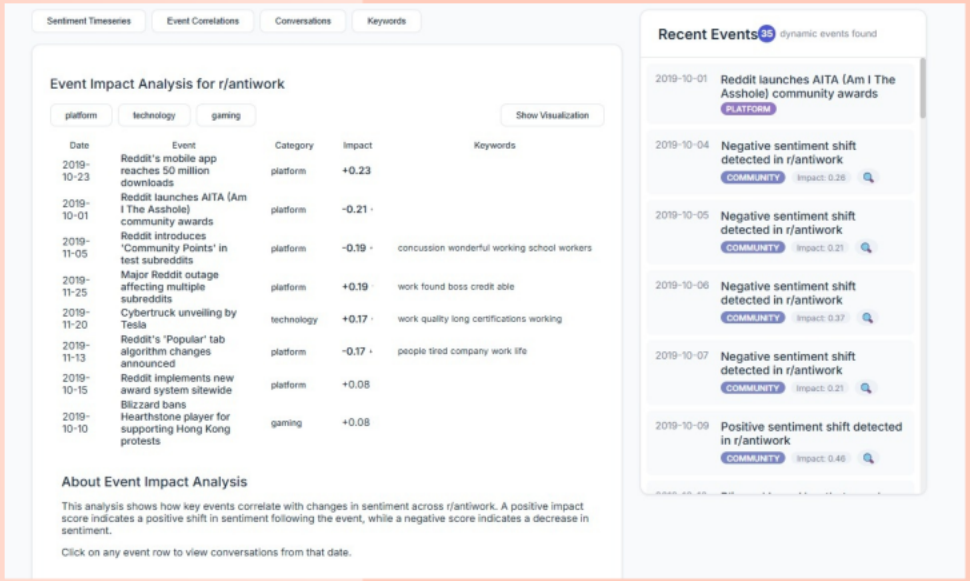

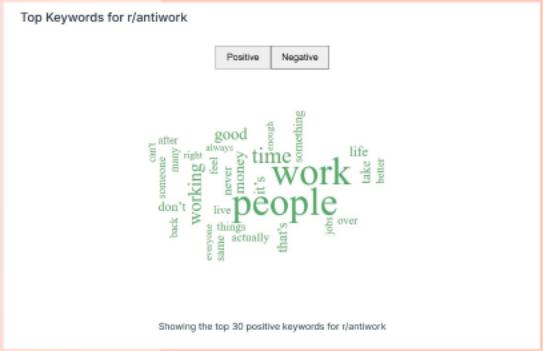

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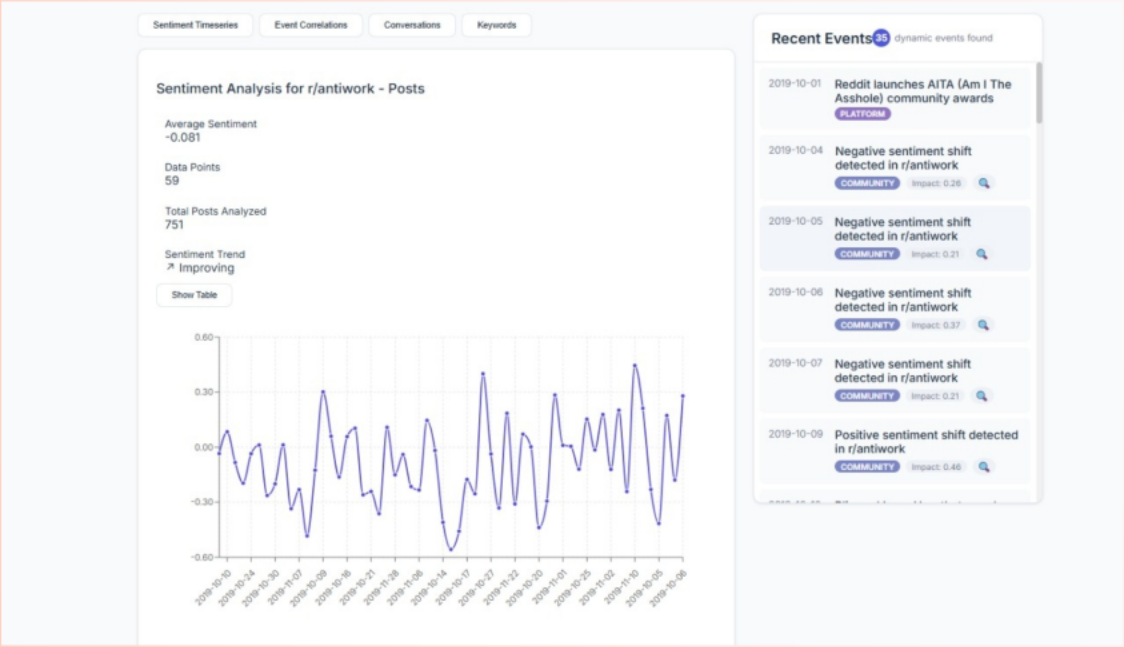

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Sentiment Analysis & System Design

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Event Correlation

Sentiment Analysis

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To analyze emotional tone across Reddit mental health discussions, we applied VADER (Valence Aware Dictionary and sEntiment Reasoner)—a fast, lexicon-based sentiment tool built for social media text. VADER calculates a compound score for each text, classifying it as positive, neutral, or negative.

Key Aspects of Our Approach:

- Applied to titles and comments across subreddits like: r/antiwork, r/feminism, r/fitness, r/personalfinance, etc.
- Focused on daily sentiment averages per subreddit.
- Enabled real-time analysis using Spark and distributed processing

2019-10-04 Negative sentiment shift detected in r/antiwork
COMMUNITY Impact: 0.26

2019-10-05 Negative sentiment shift detected in r/antiwork
COMMUNITY Impact: 0.21

2019-10-06 Negative sentiment shift detected in r/antiwork
COMMUNITY Impact: 0.37

Temporal Shifts & VADER Benefits

Temporal Sentiment Shifts:

- Daily tracking revealed sentiment anomalies
- Example: Early Oct 2019, r/antiwork saw consecutive drops—matching emotional y charged posts

Why VADER is a Good Fit:

- Designed for social media—understands emojis, sla ng, and negations
- Extremely fast and scalable
- Seamless i ntegration with PySpark enabled processing of millions of posts efficien y

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Data Flow Summary:

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Pyspark Jobs

Backend

DEMO

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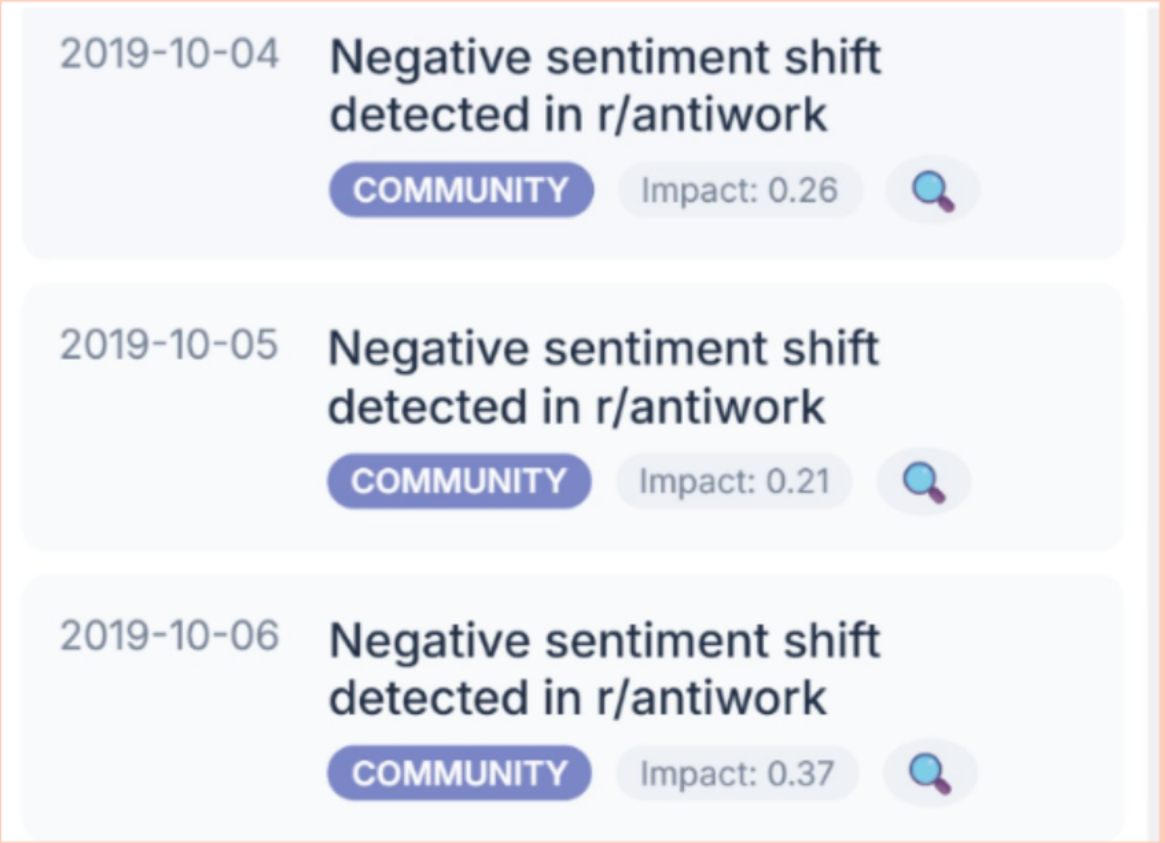

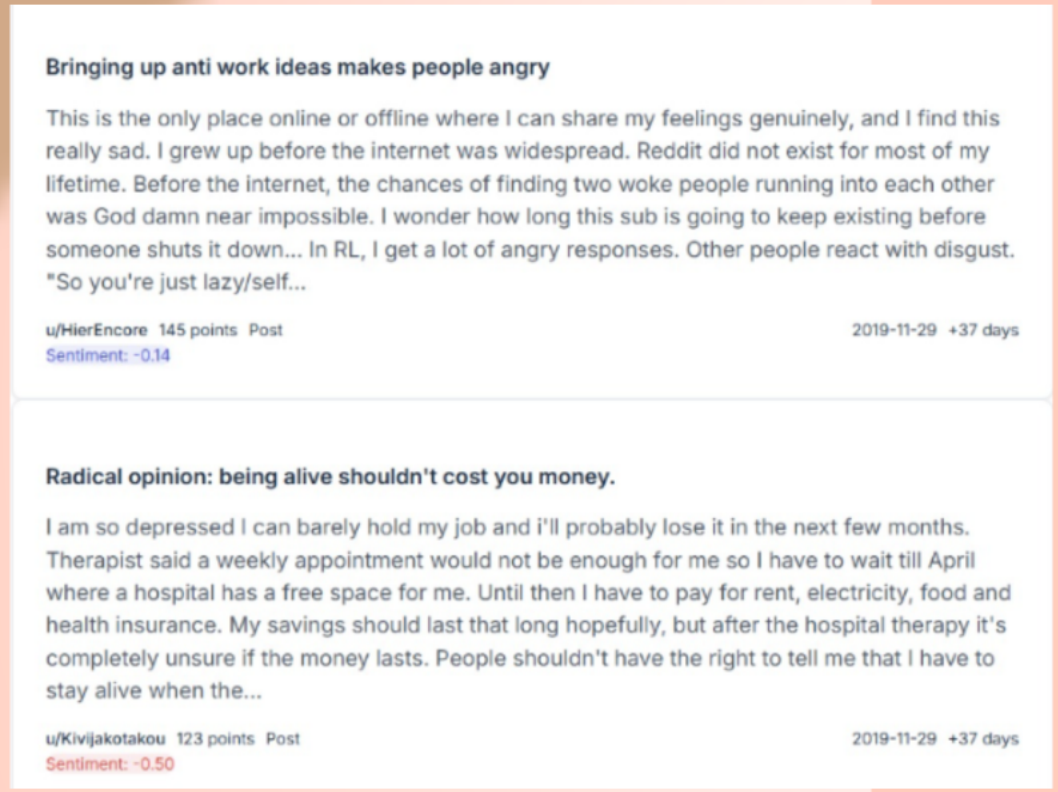

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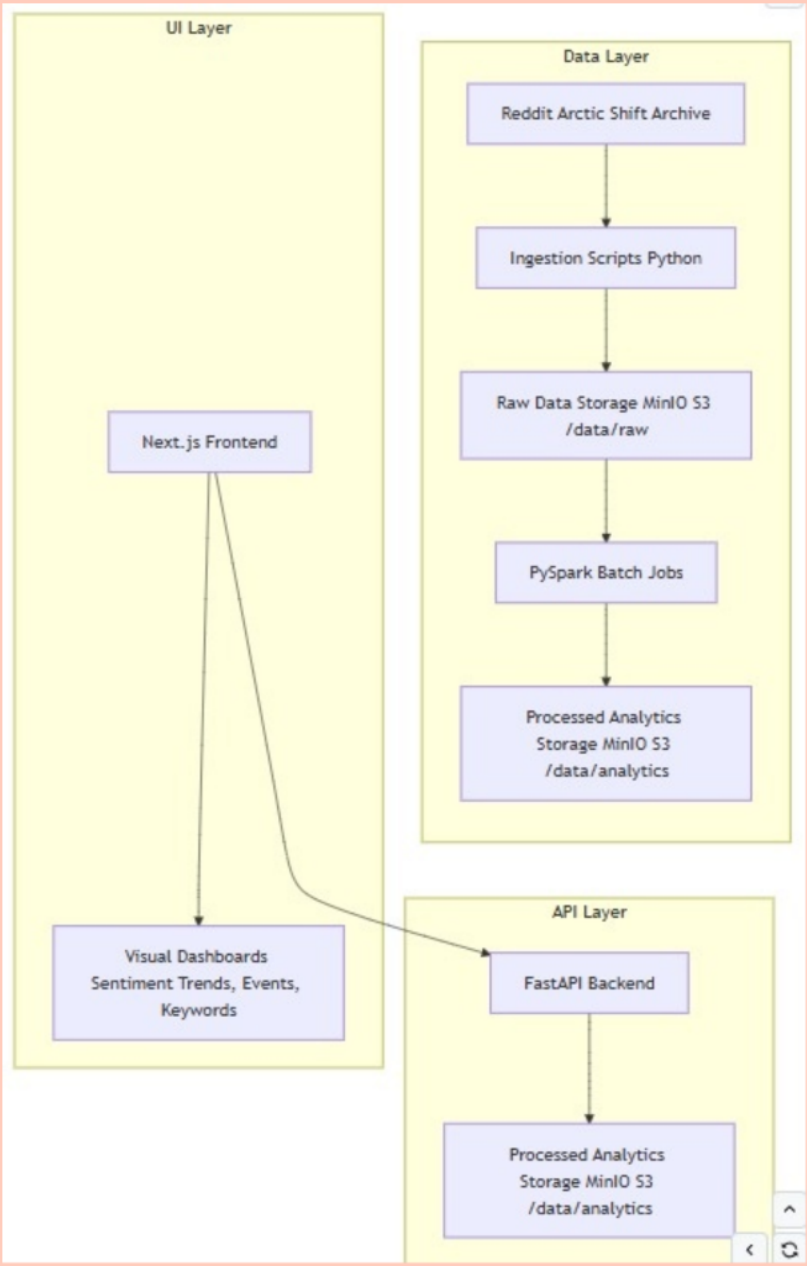
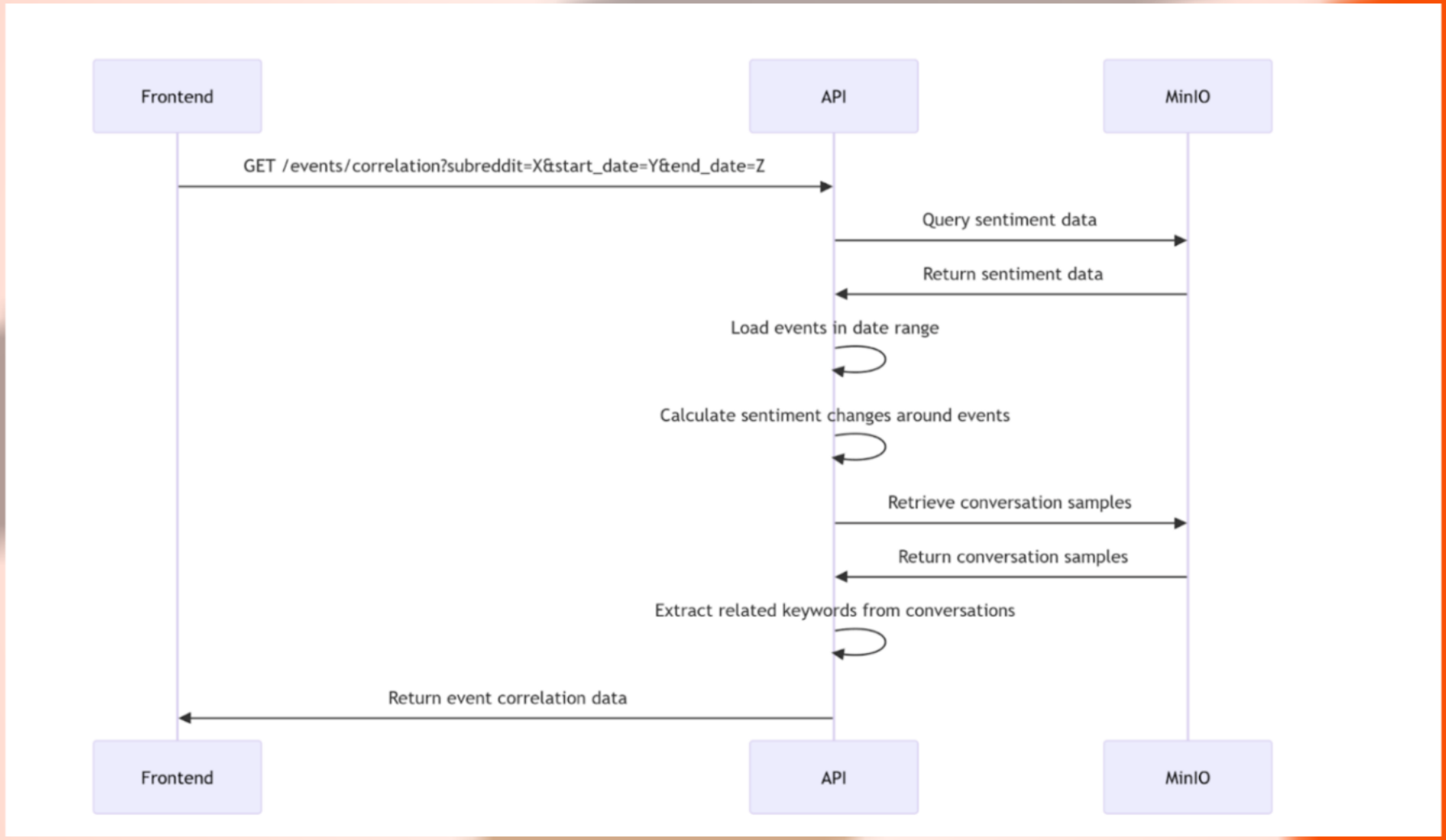


Event Correlation



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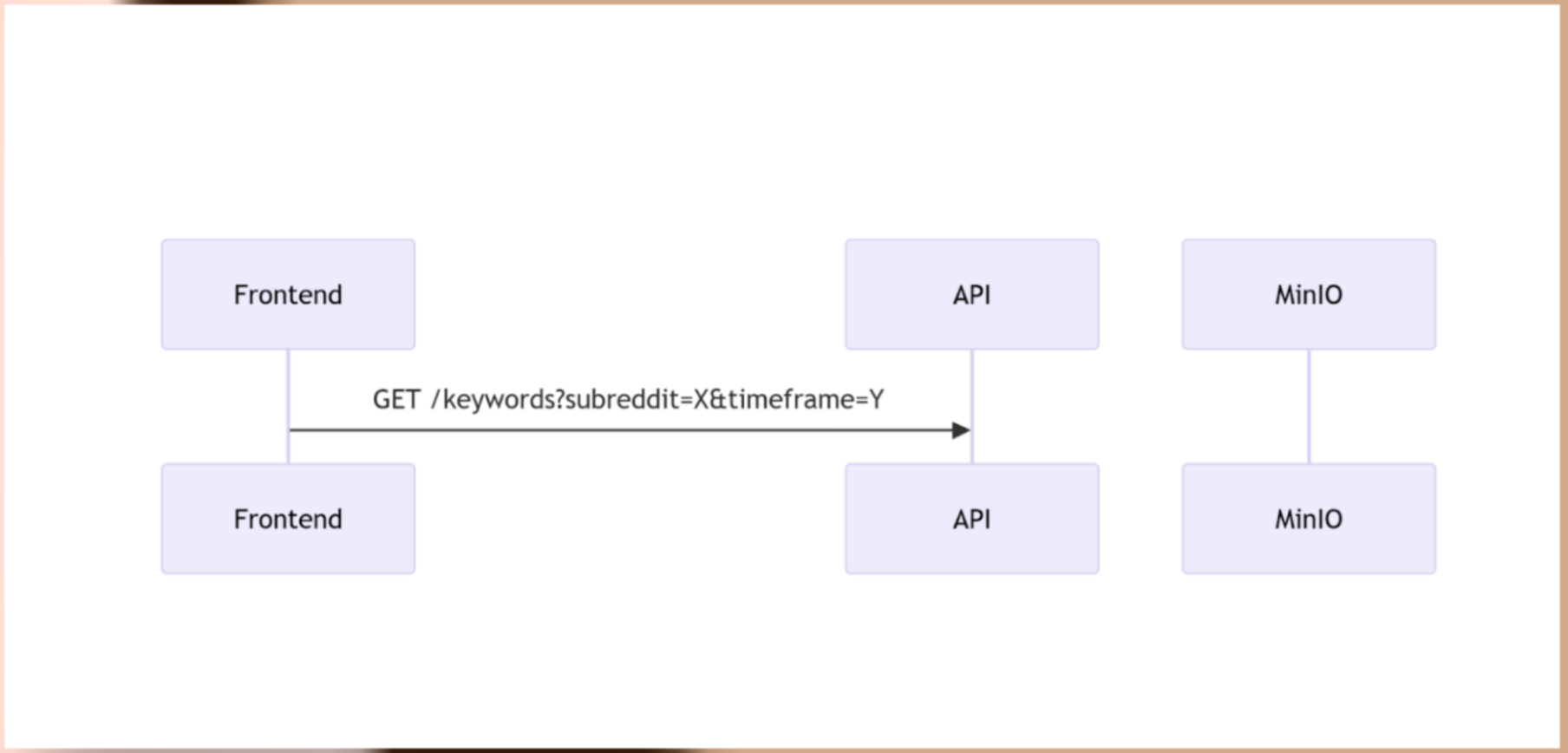


Backend

Framework: FastAPI (+ Uvicorn)

Auto-docs / validation: Swagger UI & Pydantic models

Key endpoints (GET):

/sentiment (daily scores) **/events (external stressors)**

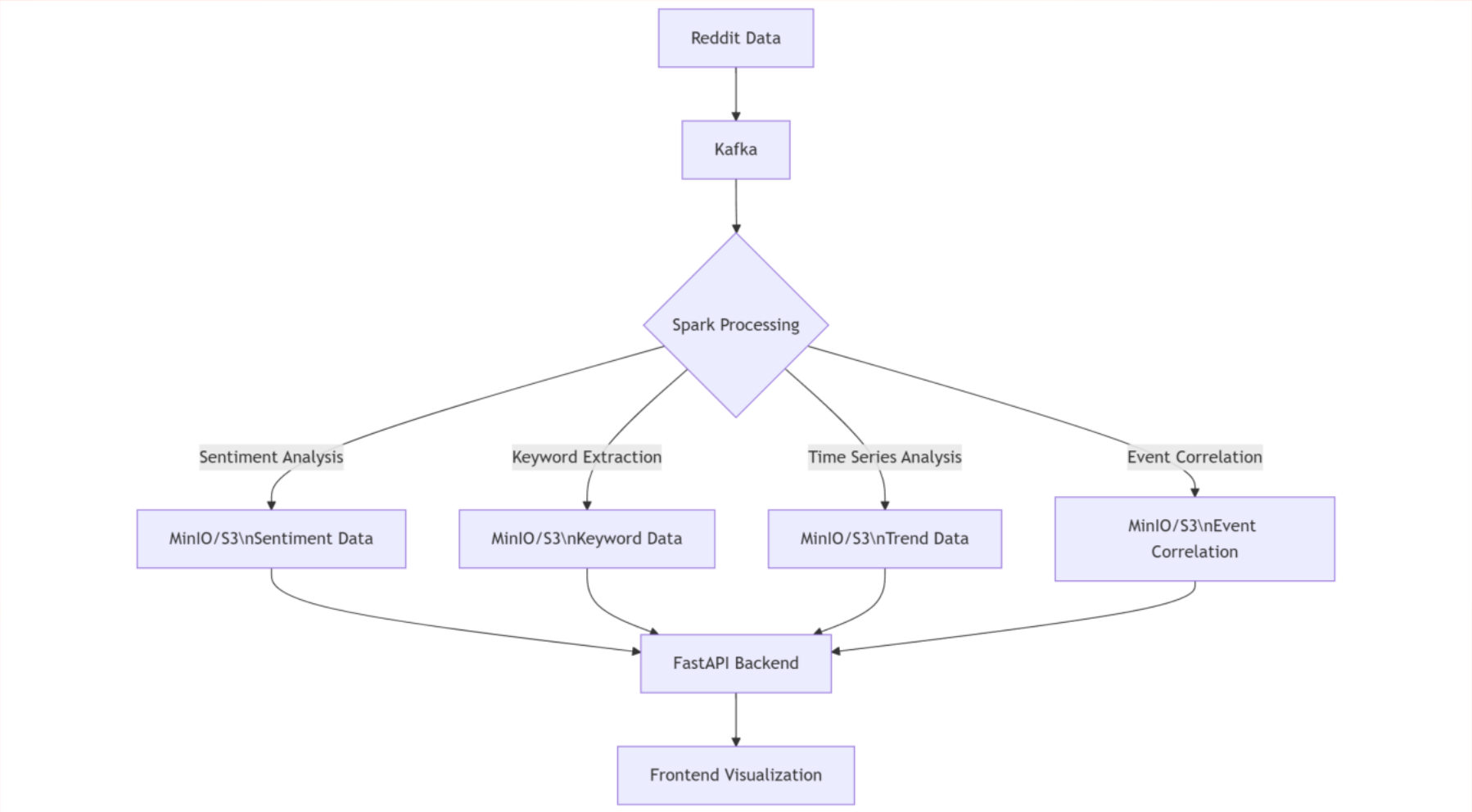
/keywords (trending terms) **/events/correlation (match mood w. events)**

Domain models:
SentimentData, EventData, KeywordData, EventCorrelationData

Data source:
Parquet in MinIO S3 bucket mh-trends

Access layer:
boto3 reads only requested partitions

Pyspark Jobs



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