Project Report: Log analysis with Flask, Prometheus, Loki, and Grafana

1. Requirements

- Real-time monitoring of a Flask application
- Logging and error tracking
- Visualization of metrics and logs
- Simulated log generation with latency and failure tracking
- Exportable metrics for observability
- Grafana dashboard for unified visualization
- API testing and interaction using Postman

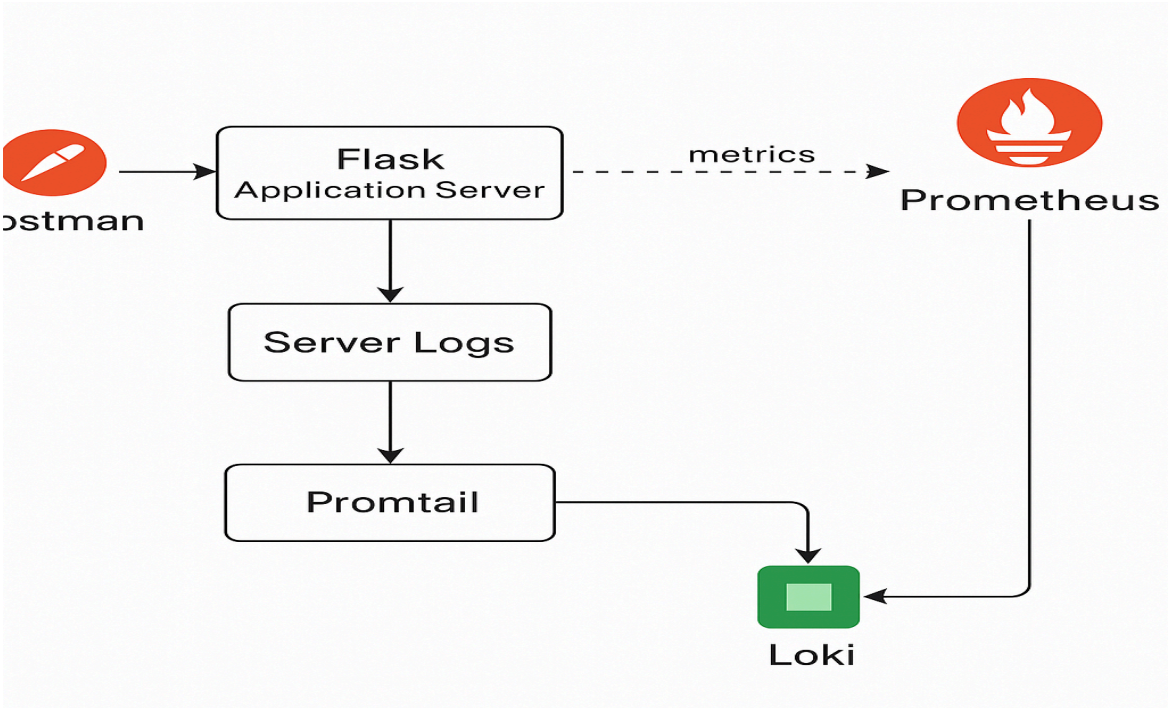
2. Technologies Used

- Flask: Python web framework for building the server.
- Prometheus: Time-series database for monitoring and metrics.
- Grafana: Visualization tool for metrics and logs.
- Loki: Log aggregation system by Grafana Labs.
- Promtail: Agent to collect logs and push them to Loki.
- Postman: API client used to test and trigger server endpoints.

3. Python Libraries Used

Library	One-liner Explanation
Flask	Lightweight web framework for Python
random	For generating randomized delays and IDs
time	To simulate delays and measure request latency
logging	Python standard logging library
prometheus_client	Exposes metrics to be scraped by Prometheus

4. Flow Diagram



5. WorkFlow

1. Flask Server

- Acts as the core application layer.
- Hosts endpoints like `/process` and `/generate_logs`.
- Each request triggers simulated delays, errors, and generates logs.
- Metrics such as request duration, error counts, and request totals are exposed via the `/metrics` endpoint.

2. Prometheus

- Continuously scrapes the Flask server's `/metrics` endpoint every second (as configured in `prometheus.yml`).
- Stores time-series data like request counts, durations, and failure rates.
- Acts as the primary monitoring tool for quantitative metrics.

- Enables alerting rules if desired (e.g., alert if failure count > threshold).

3. Grafana

- Visualizes the metrics collected by Prometheus.
- Connects to Prometheus and Loki as data sources.
- Dashboards show:
    - Real-time latency
    - Error trends
    - Traffic volume
    - Server health
- Provides unified visibility by combining metric graphs and logs.

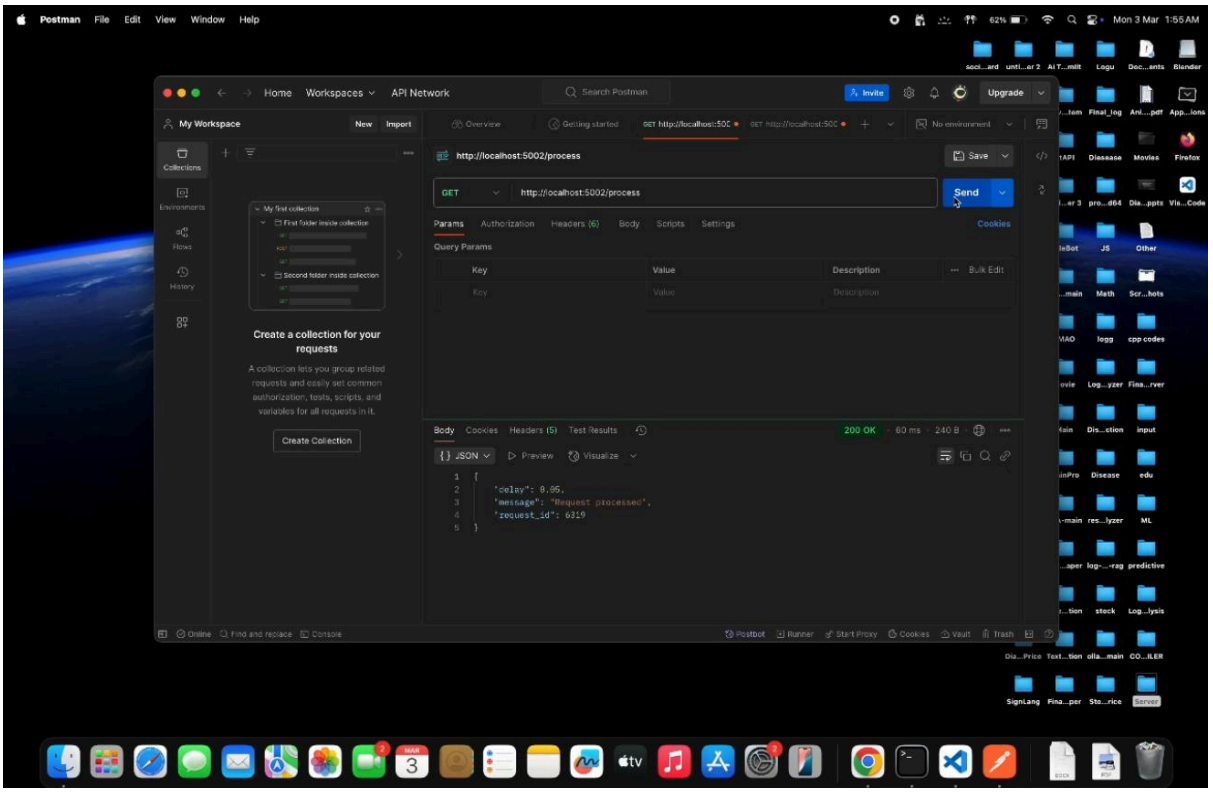
4. Logging with Promtail and Loki

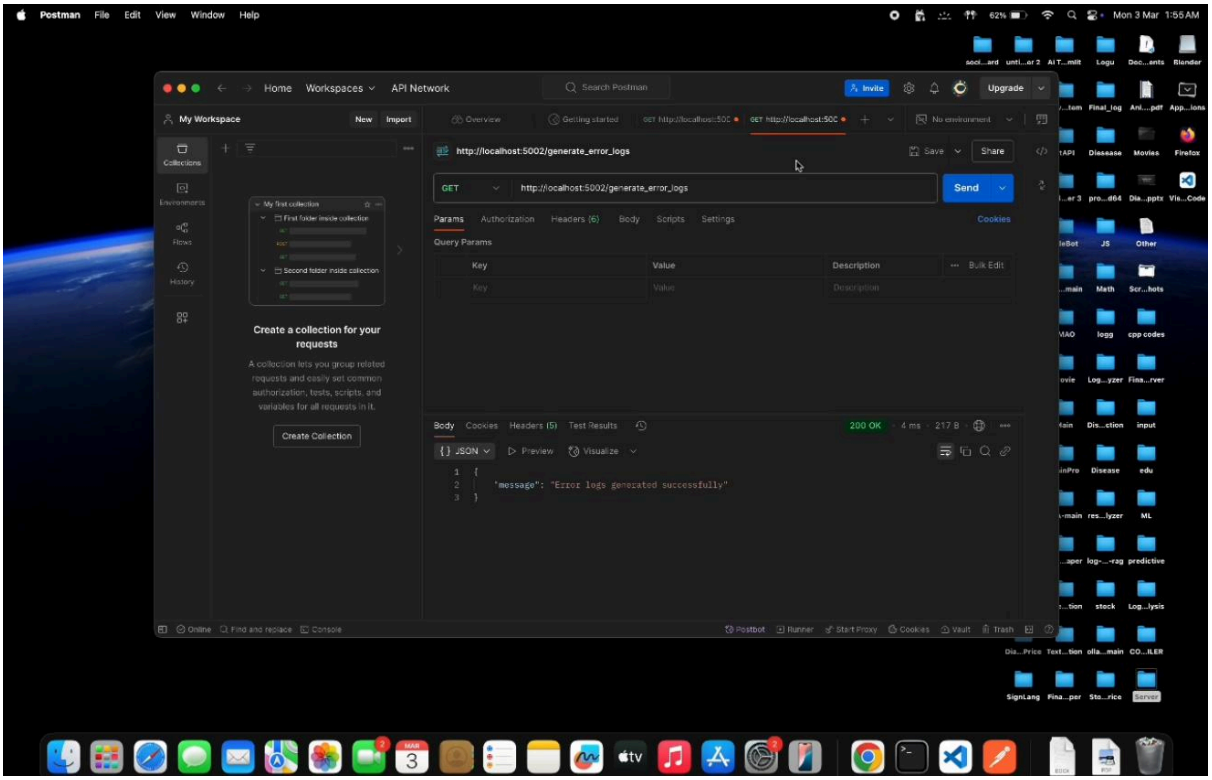
- Flask logs (e.g., in `server.log`) are continuously monitored by **Promtail**.
- Promtail tags and pushes these logs to **Loki**.
- Loki aggregates and indexes logs by job, path, and labels (like `job=service-logs`, etc.).
- Grafana connects to Loki and provides powerful log search and filtering.

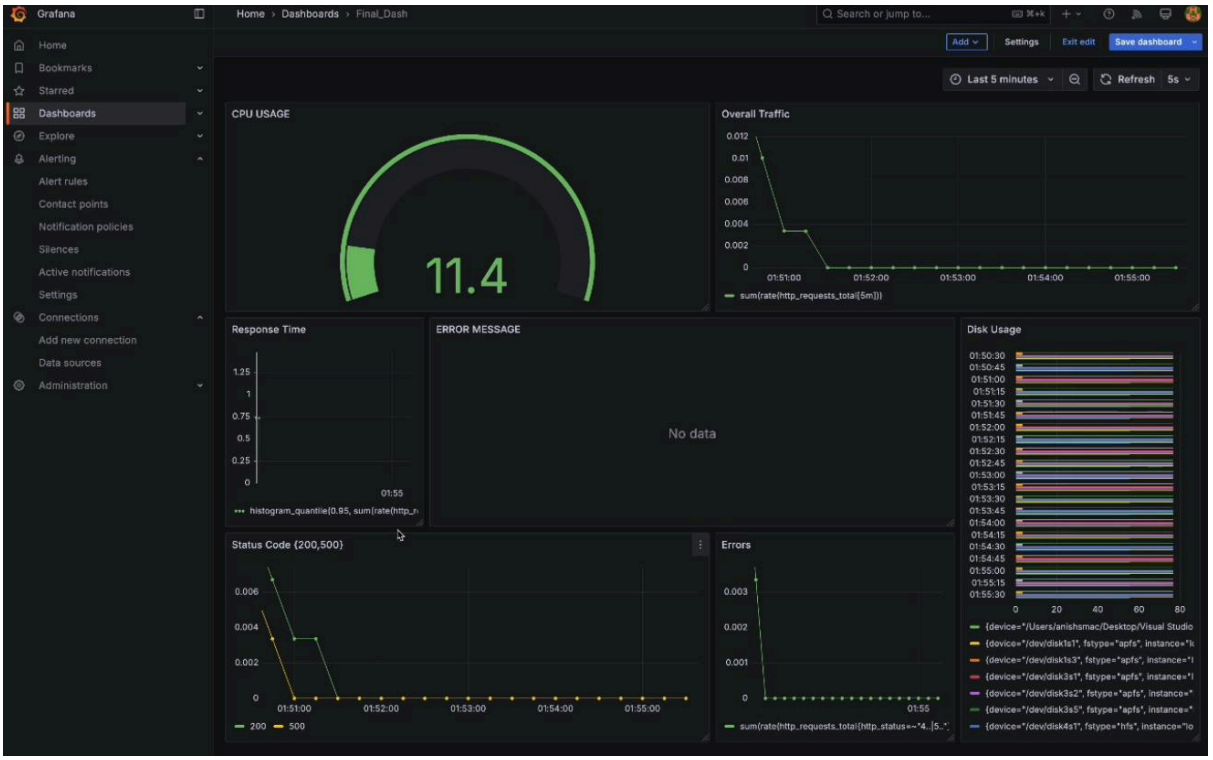
5. Postman

- Used as a testing tool to trigger various Flask routes:
    - `/process` simulates a request that may randomly succeed or fail.
    - `/generate_logs` creates simulated log entries for analysis.
- Helps verify that logs and metrics are generated properly.
- Useful during development and testing for endpoint validation and manual QA.

6. Screenshots



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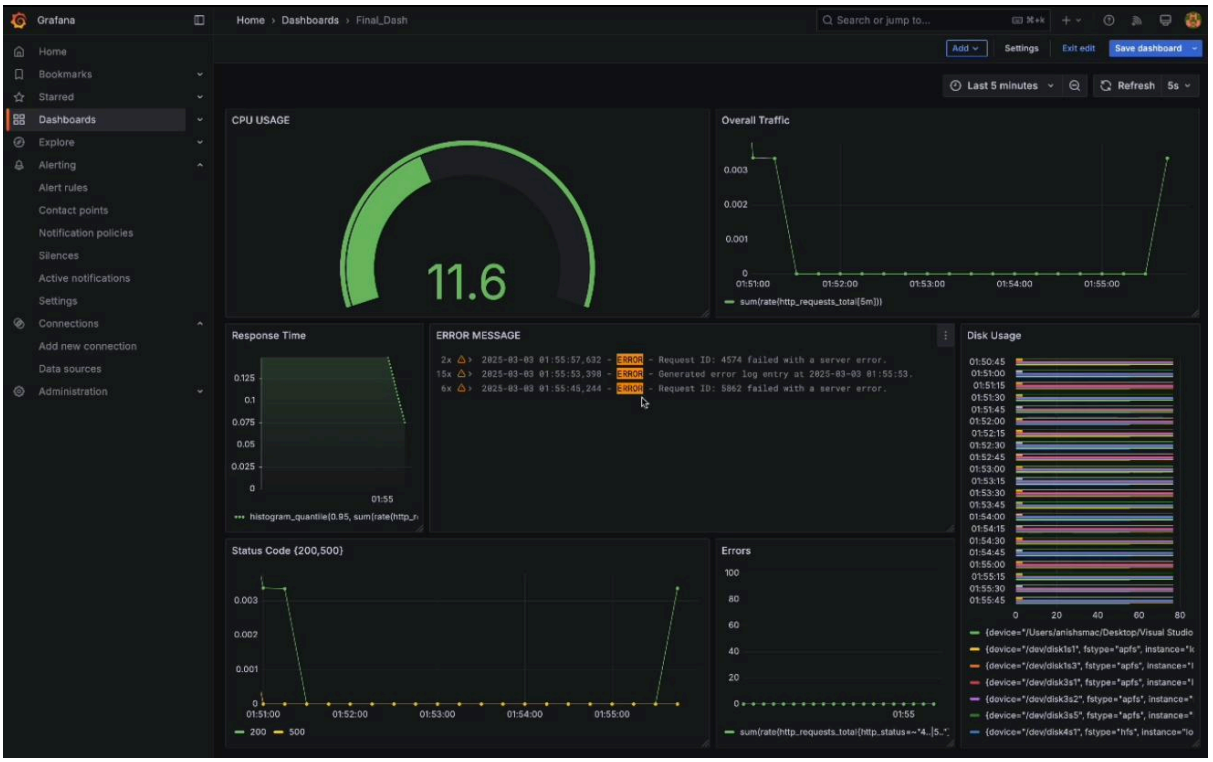
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Data sources
Administration
CPU USAGE
11.6
Overall Traffic
sum(rate(http_requests_total[5m]))
Response Time
histogram_quantile(0.95, sum(rate(http_r
ERROR MESSAGE
2x 2025-03-03 01:55:57,632 - ERROR - Request ID: 4574 failed with a server error.
15x 2025-03-03 01:55:53,398 - ERROR - Generated error log entry at 2025-03-03 01:55:53.
6x 2025-03-03 01:55:45,244 - ERROR - Request ID: 5862 failed with a server error.
Disk Usage
Status Code {200,500}
200
500
Errors
sum(rate(http_requests_total{http_status=~"4..|5..",