URL Shortener

Technologies: React, Node.js, PostgreSQL, Docker, Kubernetes, Prometheus, Grafana, GitHub Actions

Team Members

- Youssef Reda Mohamed
- Hager Salah El-dien Youssef
- Ahmed Nasser Abdullatif
- Sarah Ibrahim Abdallah Shawky

Project Supervisor

Eng. Ahmed Gamil

Problem Overview

The **URL Shortener** is a cloud-ready, scalable application that converts long URLs into short, shareable links.

The project demonstrates:

- Full-Stack development
- Containerization
- Kubernetes deployment
- Monitoring & observability
- CI/CD automation

Project Objectives

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By building this system, we aimed to:

Create a ***full-stack*** URL shortening service

Build a simple and intuitive ***React*** frontend

Develop a scalable ***Node.js*** backend

Use ***PostgreSQL*** for persistent storage

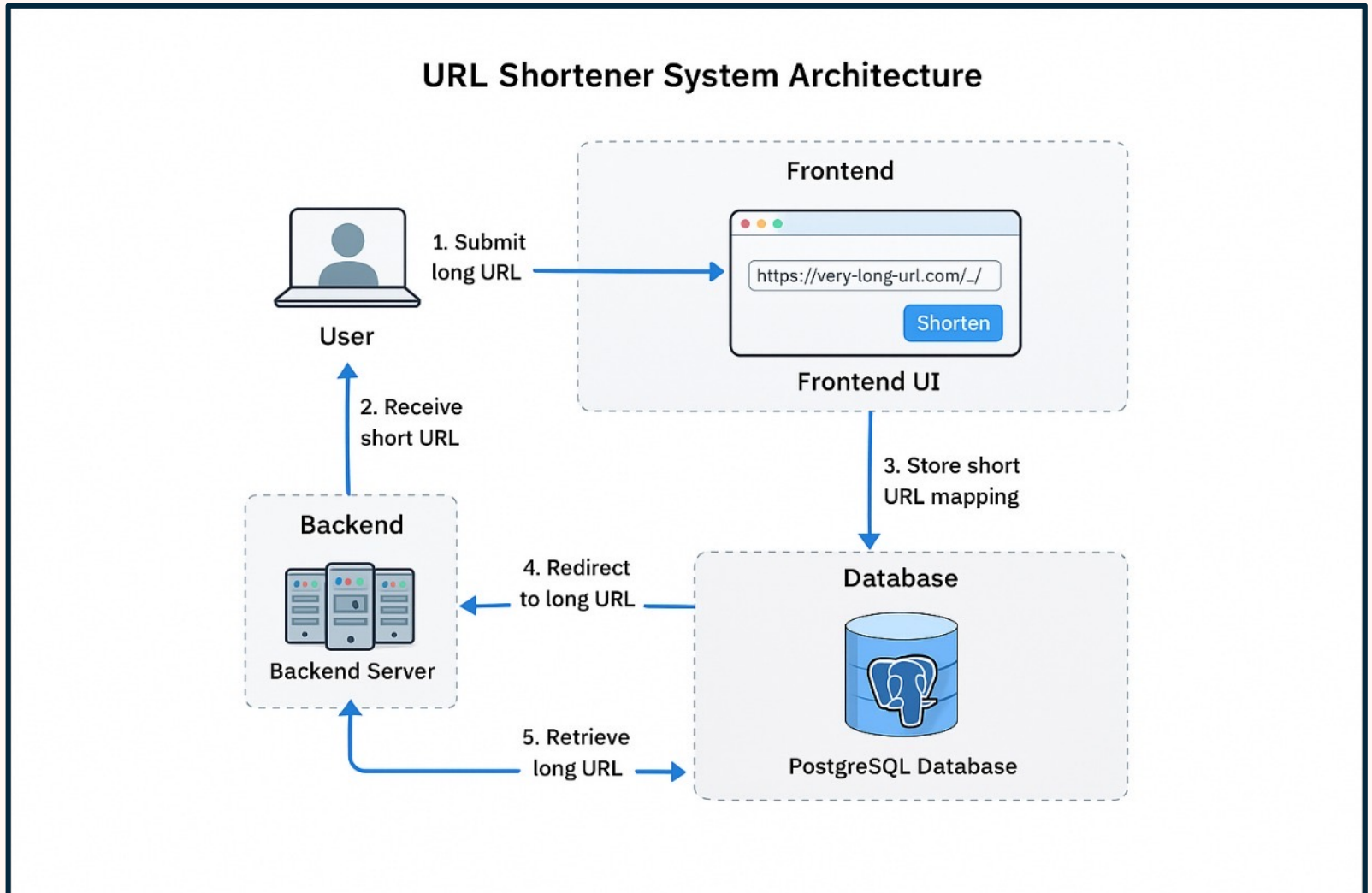
Containerize the whole system with ***Docker***

Deploy to ***Kubernetes***

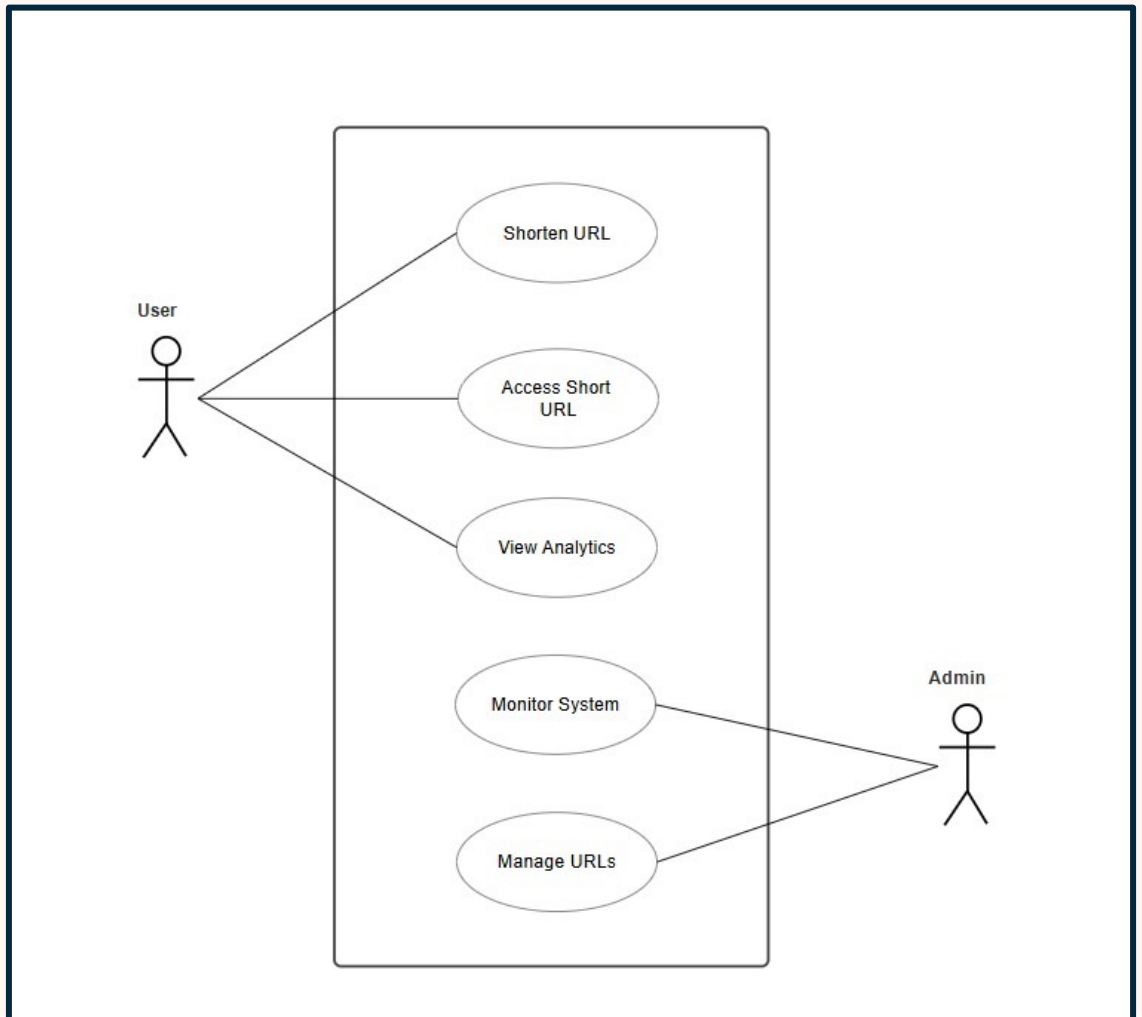
Add ***Prometheus + Grafana***

Automate deployment with ***GitHub Actions***

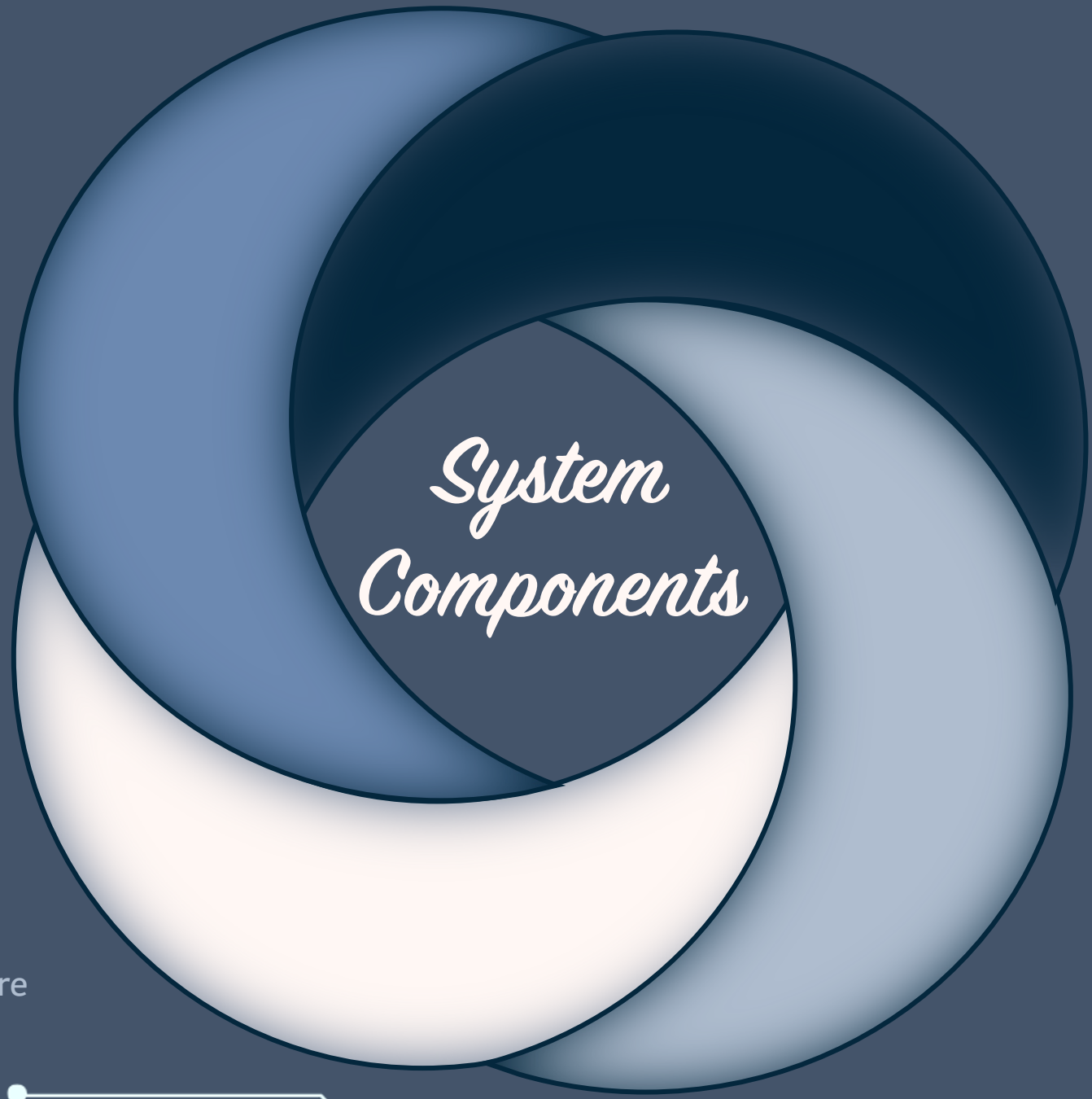
System Architecture



Use Case Diagram



System Components



Fronted (React)

- Built with React
- Clean UI for short link creation
- Shows analytics (visits count)

Backend (Node.js)

- URL creation
- URL redirection
- URL analytics
- RESTful API architecture

Monitoring

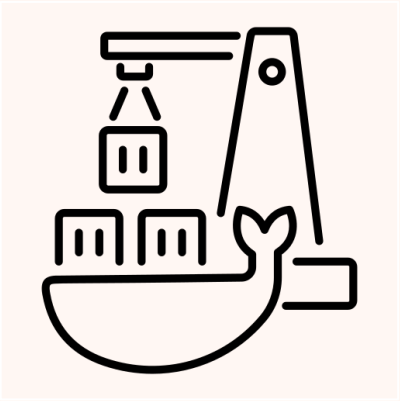
- Prometheus: Metrics exporter
- Grafana: Dashboard for system health

CI/CD

- Automated build and test
- Auto-deploy to cluster

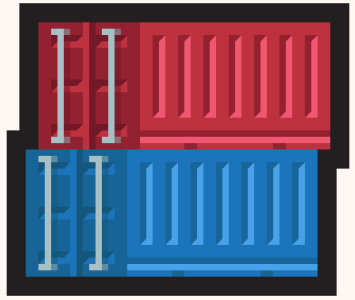
Containerization Strategy

Docker



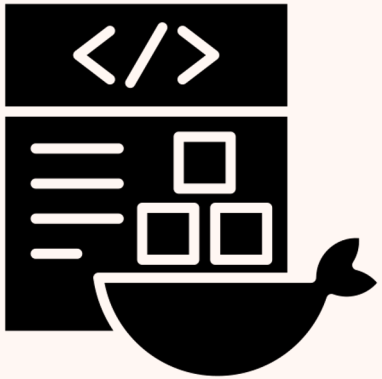
Build Stage

- Compile TypeScript
- Install dependencies
- Build React App



Remote Area Residents

- Copy Artifacts only
- Alpine Linux base
- 90% smaller images



Result

80MB fronted, 200MB backend

Docker Compose

Network Isolation

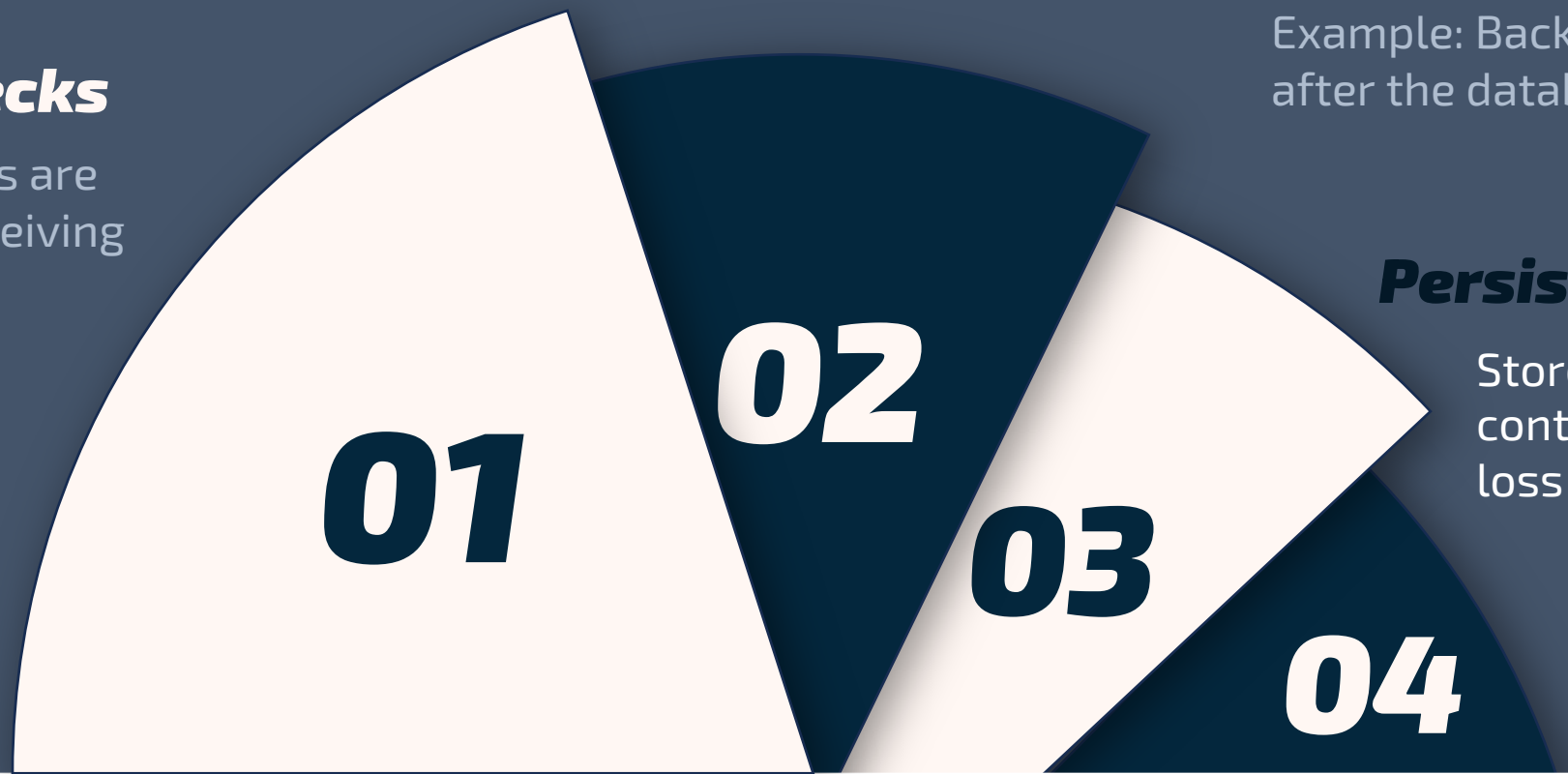
Each service runs inside its own isolated network for better security.

Service Dependencies

Example: Backend starts only after the database is ready.

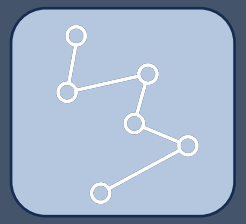
Health Checks

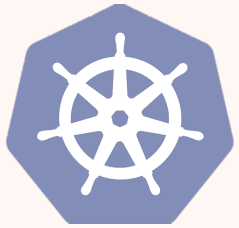
Ensures containers are healthy before receiving traffic.



Persistent Volumes

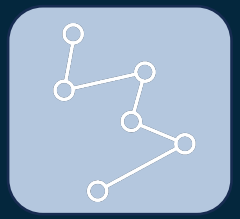
Stores data outside containers → Zero data loss on restart.





Kubernetes Deployment

The application is deployed on a fully container-orchestrated environment using Kubernetes to ensure scalability, reliability, and seamless updates.

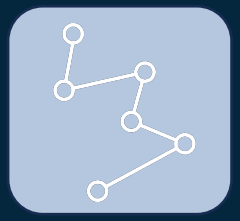


Multi Component Deployment

Frontend, backend, PostgreSQL, and monitoring each run as separate Deployments.

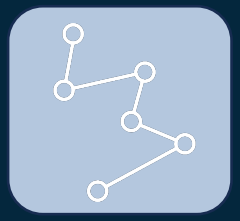
Service Discovery

ClusterIP for internal communication –
NodePort/Ingress for external access.



Persistent Storage

PostgreSQL uses PV + PVC to ensure durable data across restarts.



Self Healing & Rolling Updates

Automatic pod restarts and zero-downtime updates through Kubernetes controllers.

Monitoring & Observability

01

Prometheus

Collects metrics:

- CPU usage
- Memory
- API response time
- Requests per second
- Errors per second

02

Grafana

Visualizes dashboards for:

- API performance
- Redirect success rate
- Error percentages (404, 500)
- Total shortened URLs
- Request latency (95th percentile)

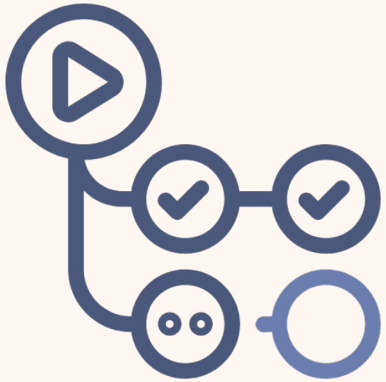
GitHub Actions Automations:

- Install dependencies
- Run tests
- Build Docker images
- Push images to registry
- Deploy automatically

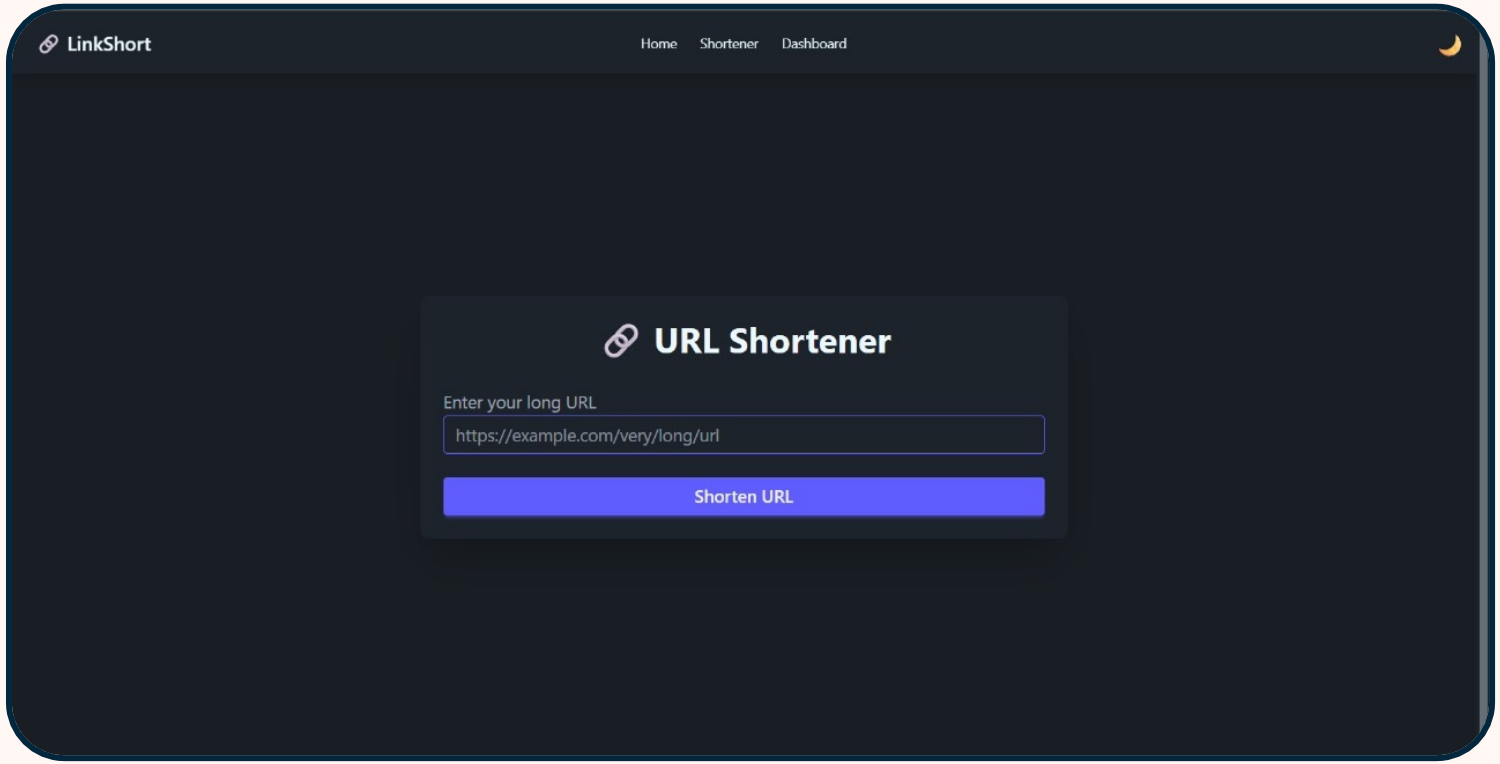
Ensures:

- Fast deployments
- Zero-downtime updates
- Reliable release cycles

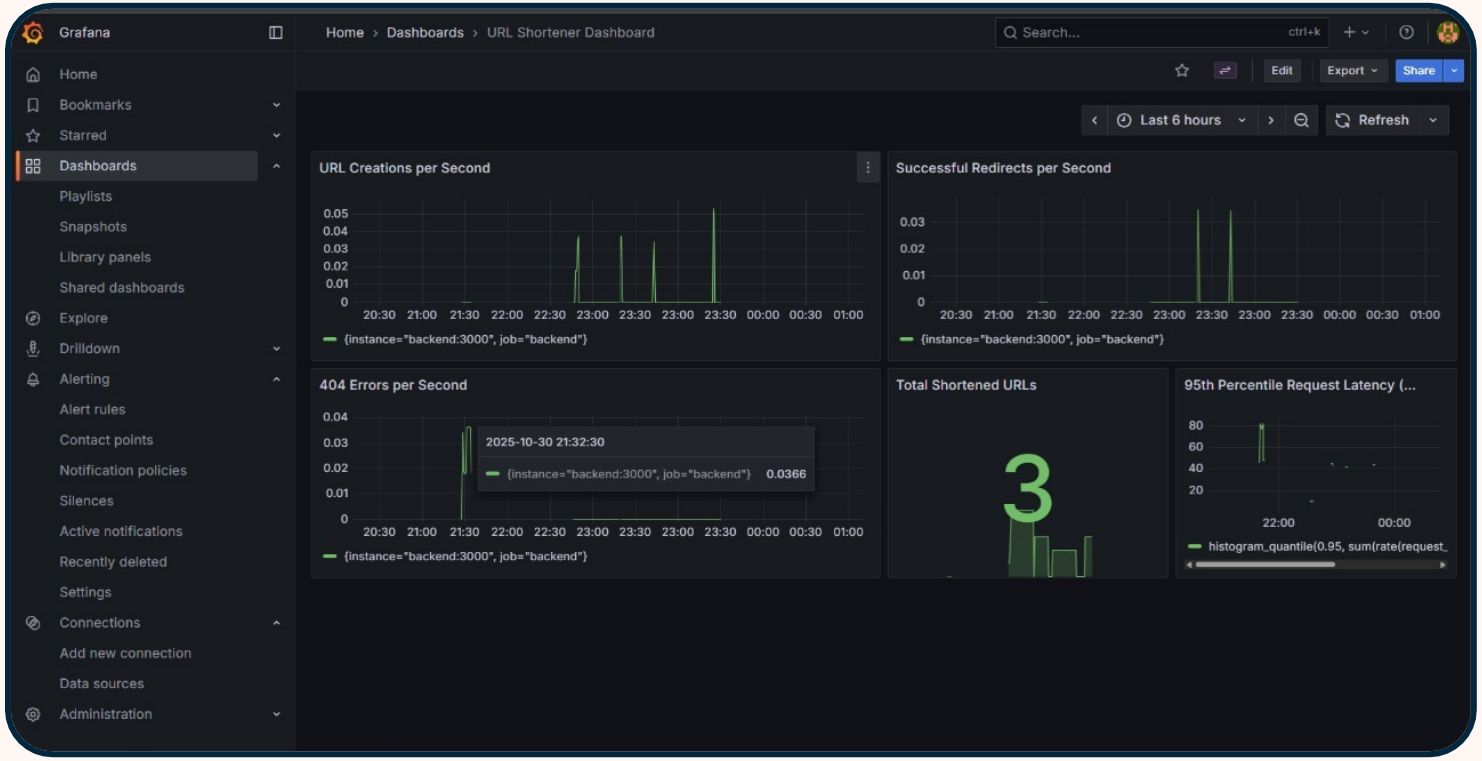
CI/CD Pipeline



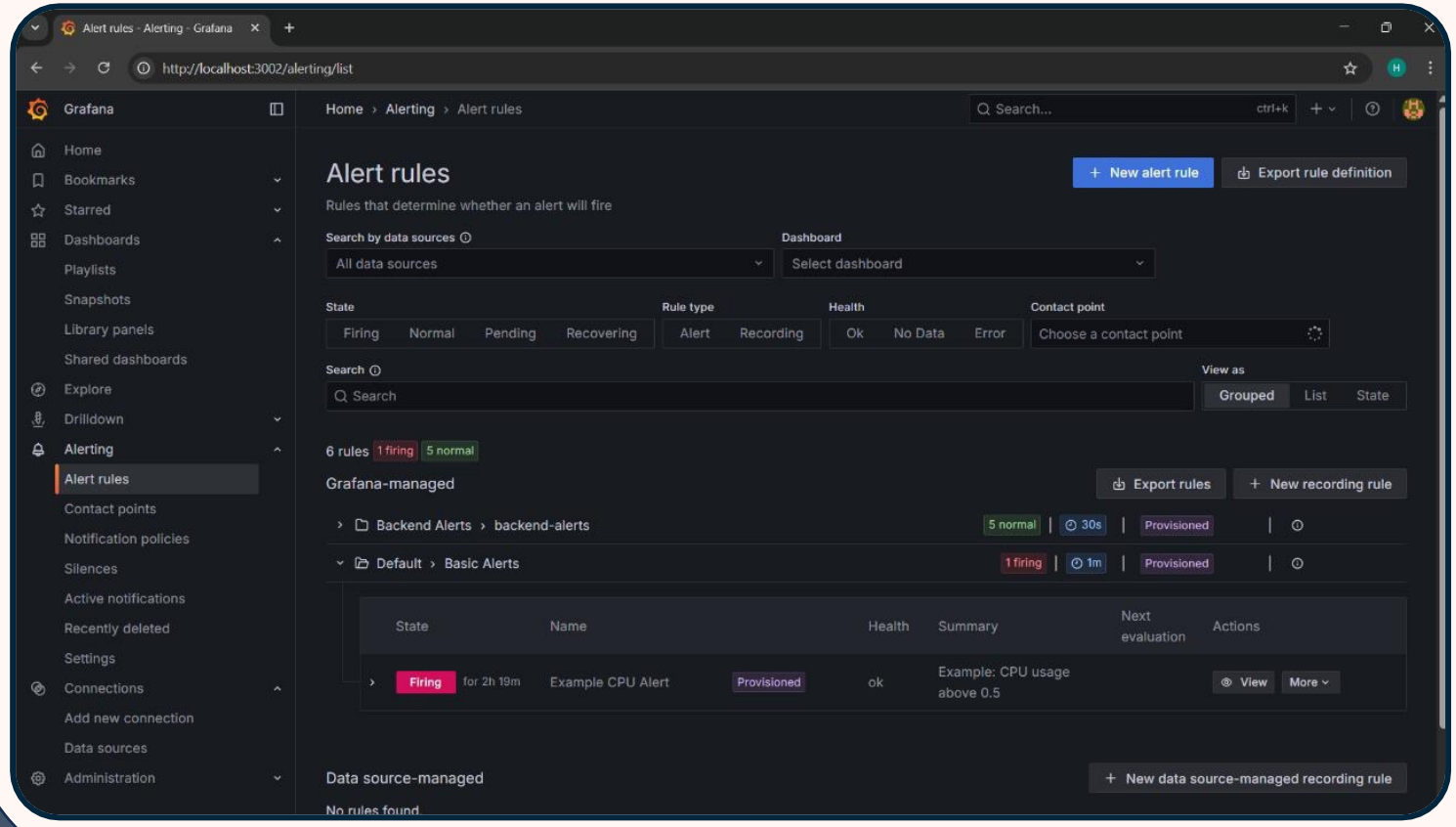
Url Shortener



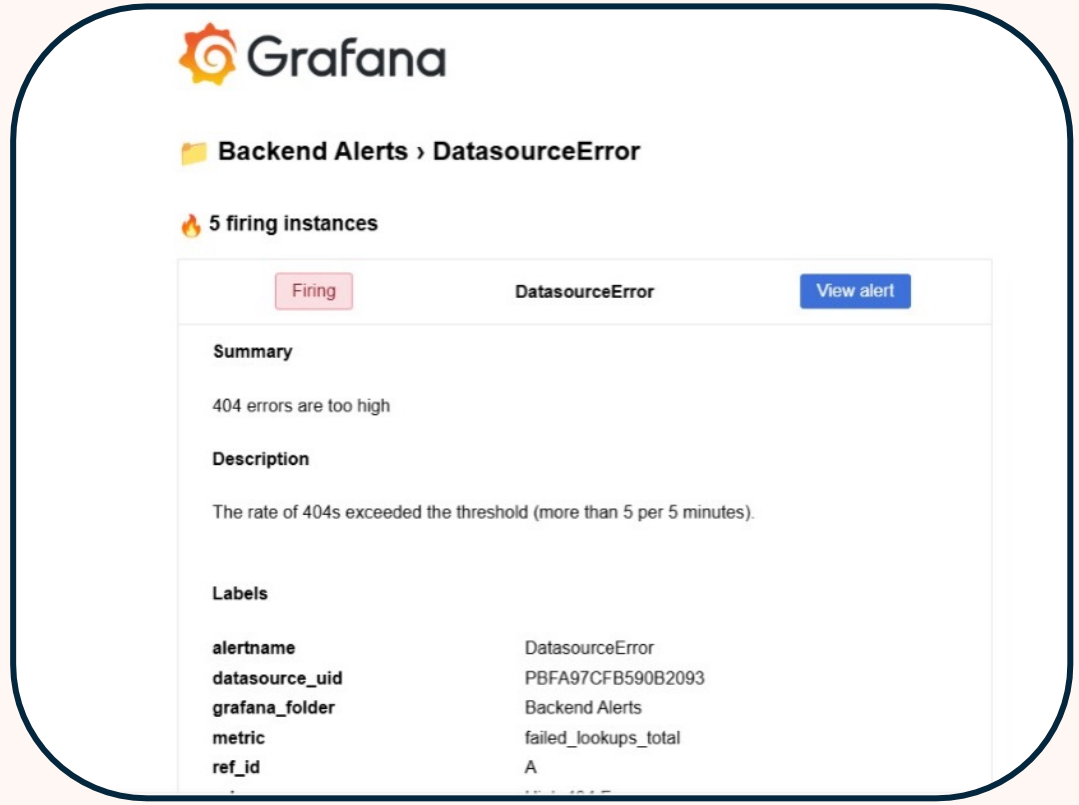
Url Shortener


Grafana
Home
Bookmarks
Starred
Dashboards
Playlists
Snapshots
Library panels
Shared dashboards
Explore
Drilldown
Alerting
Alert rules
Contact points
Notification policies
Silences
Active notifications
Recently deleted
Settings
Connections
Add new connection
Data sources
Administration
Home › Dashboards › URL Shortener Dashboard
Search...
ctrl+k
Edit
Export
Share
Last 6 hours
Refresh
URL Creations per Second
0.05
0.04
0.03
0.02
0.01
0
20:30 21:00 21:30 22:00 22:30 23:00 23:30 23:00 23:30 00:00 00:30 01:00
{instance="backend:3000", job="backend"}
Successful Redirects per Second
0.03
0.02
0.01
0
20:30 21:00 21:30 22:00 22:30 23:00 23:30 23:00 23:30 00:00 00:30 01:00
{instance="backend:3000", job="backend"}
404 Errors per Second
0.04
0.03
0.02
0.01
0
2025-10-30 21:32:30
{instance="backend:3000", job="backend"} 0.0366
20:30 21:00 21:30 22:00 22:30 23:00 23:30 23:00 23:30 00:00 00:30 01:00
{instance="backend:3000", job="backend"}
Total Shortened URLs
3
95th Percentile Request Latency (...
80
60
40
20
22:00
00:00
histogram_quantile(0.95, sum(rate(request_

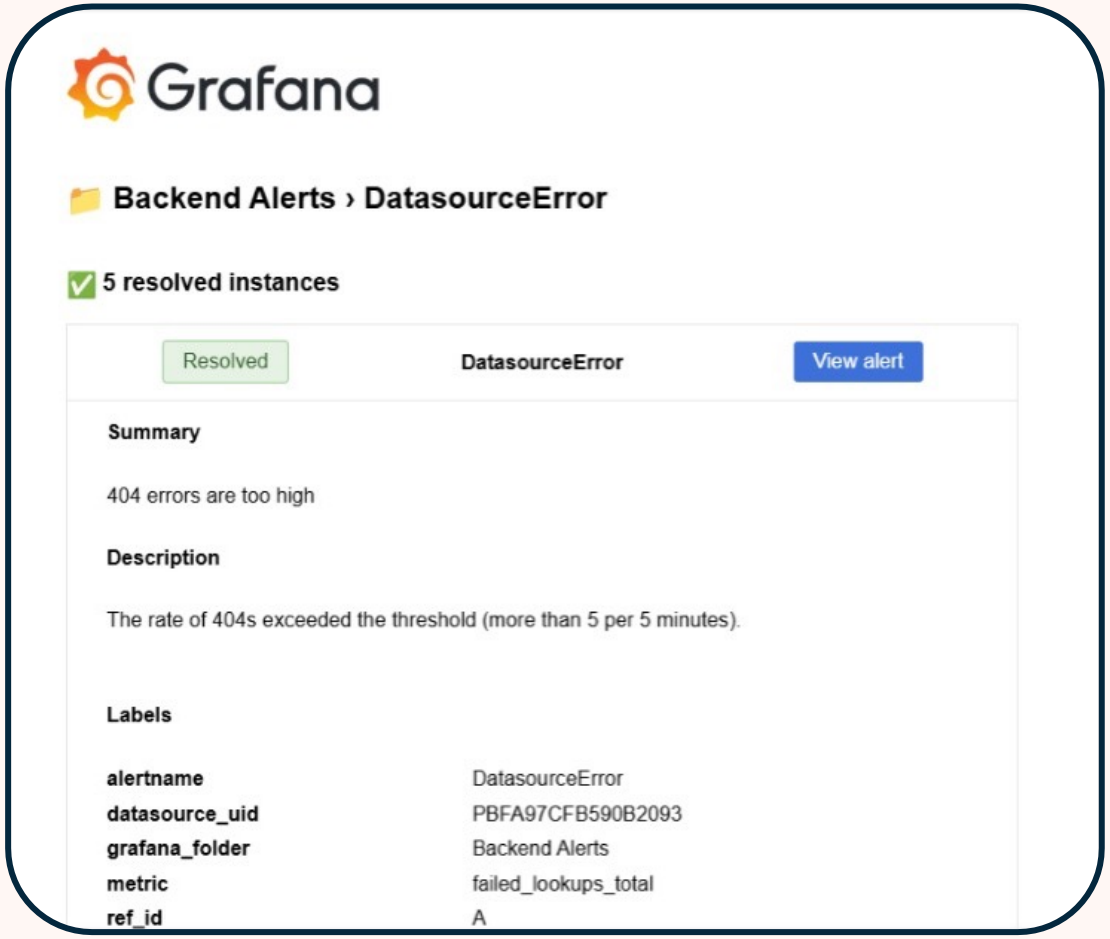
Dashboard


Alert rules - Alerting - Grafana
http://localhost:3002/alerting/list
Grafana
Home
Bookmarks
Starred
Dashboards
Playlists
Snapshots
Library panels
Shared dashboards
Explore
Drilldown
Alerting
Alert rules
Contact points
Notification policies
Silences
Active notifications
Recently deleted
Settings
Connections
Add new connection
Data sources
Administration
Home › Alerting › Alert rules
Search... ctrl+k
Alert rules
Rules that determine whether an alert will fire
+ New alert rule
Export rule definition
Search by data sources
All data sources
Dashboard
Select dashboard
State
Firing Normal Pending Recovering
Rule type
Alert Recording
Health
Ok No Data Error
Contact point
Choose a contact point
Search
Search
View as
Grouped List State
6 rules 1 firing 5 normal
Grafana-managed
Export rules
+ New recording rule
Backend Alerts › backend-alerts
5 normal | 30s | Provisioned
Default › Basic Alerts
1 firing | 1m | Provisioned
State
Name
Health
Summary
Next evaluation
Actions
Firing for 2h 19m
Example CPU Alert
Provisioned
ok
Example: CPU usage above 0.5
View
More
Data source-managed
+ New data source-managed recording rule
No rules found

Alert


Grafana
Backend Alerts › DatasourceError
5 firing instances
Firing
DatasourceError
View alert
Summary
404 errors are too high
Description
The rate of 404s exceeded the threshold (more than 5 per 5 minutes).
Labels
alertname DatasourceError
datasource_uid PBFA97CFB590B2093
grafana_folder Backend Alerts
metric failed_lookups_total
ref_id A

Alert


Grafana
Backend Alerts › DatasourceError
5 resolved instances
Resolved
DatasourceError
View alert
Summary
404 errors are too high
Description
The rate of 404s exceeded the threshold (more than 5 per 5 minutes).
Labels
alertname DatasourceError
datasource_uid PBFA97CFB590B2093
grafana_folder Backend Alerts
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ref_id A

Alert

Thank You