SPE Major Project

Talent Bridge

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GitHub Repo -

1. https://github.com/ritik-rkg/Talent_Bridge_Compose
2. https://github.com/ritik-rkg/Talent_Bridge_Kubernetes

Below GitHub repo also contains the working code on which we experimented a lot: https://github.com/shouryap1/Talent_Bridge_K8s

Innovation:

1. **Trivy for Vulnerability Scanning**:
   Implemented *Trivy*, a lightweight vulnerability scanner, to ensure the Docker images used in the project are secure. This proactive approach enhances the security and reliability of the deployed services.
2. **Prometheus and Grafana for Kubernetes Monitoring**:
   Opted for Prometheus and Grafana for monitoring and logging due to their seamless integration with Kubernetes, providing real-time insights and alerts. This approach was chosen over ELK due to its complexity in Kubernetes setups, ensuring faster and more efficient deployment with minimal overhead.

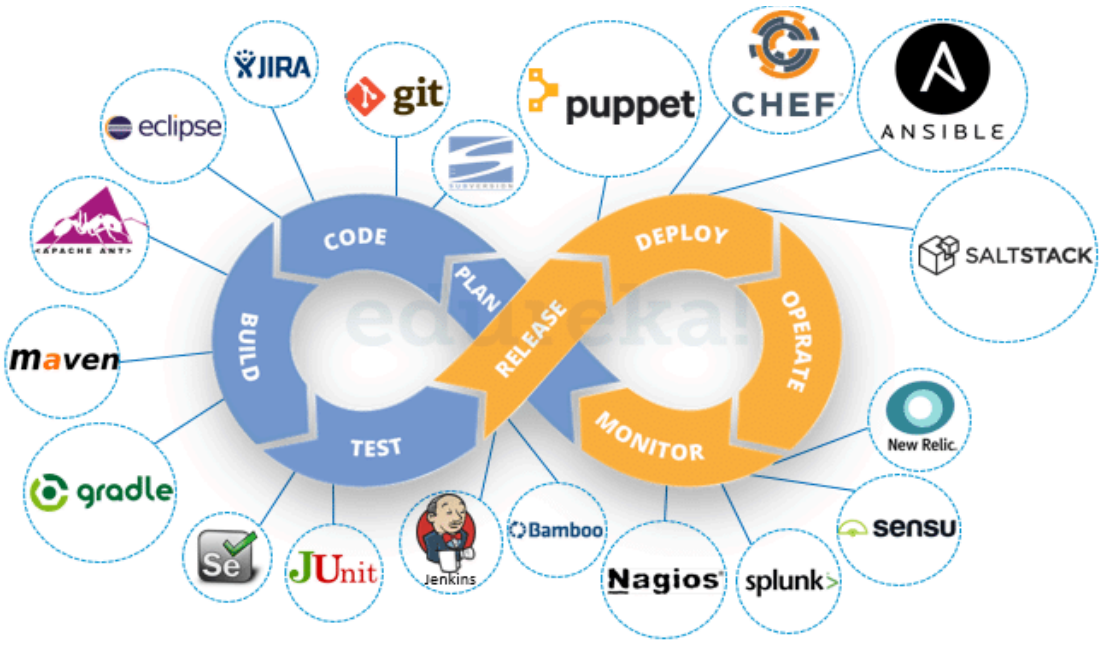
Introduction

A full-stack job portal web application developed using the MERN stack (MongoDB, Express.js, React.js, Node.js). The platform enables recruiters to post job openings, candidates to apply for positions, and administrators to manage users and job postings effectively. Candidates can upload their resumes, manage their profiles, and track their applications seamlessly. The application also features an automated CI/CD pipeline, implemented using Git, GitHub, Jenkins, Maven, Ansible, Docker, and Kubernetes, ensuring robust deployment and continuous delivery. For monitoring and observability, the ELK Stack (Elasticsearch, Logstash, Kibana), Prometheus, and Grafana are integrated to provide comprehensive logging, metrics visualization, and performance tracking.

DevOps?

What is DevOps?

- DevOps is a set of practices, tools, and a cultural philosophy that automates and integrates the processes between software development and IT teams. It emphasizes team empowerment, cross-team communication and collaboration, and technology automation.
- A DevOps team includes developers and IT operations working collaboratively throughout the product lifecycle, to increase the speed and quality of software deployment. It's a new way of working, a cultural shift, with significant implications for teams and their organizations.



DevOps Practices:

1. **Continuous Integration:** Continuous integration is the practice of automating the integration of code changes into a software project. It allows developers to frequently merge code changes into a central repository where builds and tests are executed. This helps DevOps teams address bugs quicker, improve software quality, and reduce the time it takes to validate and release new software updates.

2. **Continuous delivery:** Continuous delivery expands upon continuous integration by automatically deploying code changes to a testing/production environment. It follows a continuous delivery pipeline, where automated builds, tests, and deployments are orchestrated as one release workflow.
3. **Infrastructure as Code:** Whether your organization has an on-premise data center or is completely in the cloud, having the ability to quickly and consistently provision, configure, and manage infrastructure is key to successful DevOps adoption. Infrastructure as Code (IaC) goes beyond simply scripting infrastructure configuration to treating your infrastructure definitions as actual code: using source control, code reviews, tests, etc.
4. **Monitoring:** DevOps teams monitor the entire development lifecycle — from planning, development, integration and testing, deployment, and operations. This allows teams to respond to any degradation in the customer experience, quickly and automatically. More importantly, it allows teams to “shift left” to earlier stages in development and minimize broken production changes.

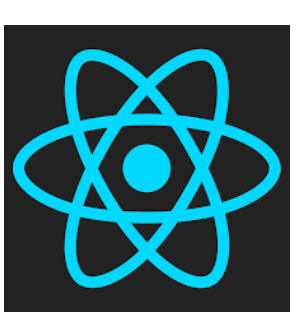
Why DevOps?

1. **Shorter Development Cycles, Faster Innovation:** When development and operations teams are in separate silos, it’s usually difficult to tell if an application is ready for operations. When development teams simply turn over an application, the operations’ cycle times are extended needlessly.
2. **Reduced Deployment Failures, Rollbacks, and Time to Recover:** Part of the reason teams experience deployment failures is due to programming defects. The shorter development cycles with DevOps promote more frequent code releases. This, in turn, makes it easier to spot code defects. Therefore, teams can reduce the number of deployment failures using agile programming principles that call for collaboration and modular programming.
3. **Increased Efficiencies:** Increased efficiency helps to speed the development process and make it less prone to error. There are ways to automate DevOps tasks. Continuous integration servers automate the process of testing code, reducing the amount of manual work required.

Technology Stack

The tools used to create the application & DevOps chain and for implementing the same are as follows:

- **Frontend:** ReactJs
- **Backend:** NodeJs and ExpressJs
- **Database:** MongoDB
- **IDE:** VSCode
- **Dependency and Package Management:** npm, pip, nvm
- **Testing:** Chai, Mocha
- **Version Control System:** Git
- **Continuous Integration:** Jenkins
- **Containerization:** Docker
- **Container Orchestration:** Kubernetes
- **Configuration Management:** Ansible
- **Monitoring:** ELK stack, Prometheus and Grafana



Express JS

docker

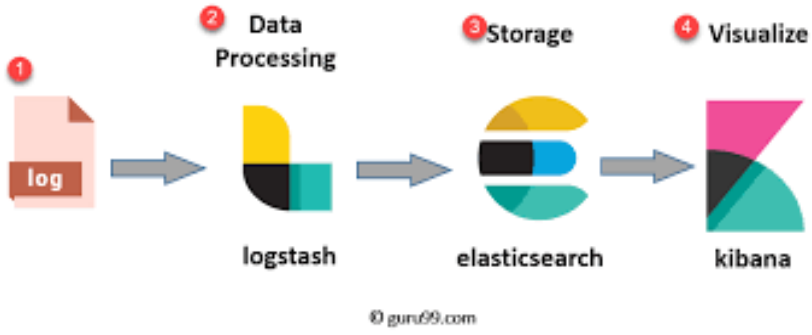
chai

git

GitHub

ANSIBLE

Jenkins



kubernetes

Prometheus Monitoring

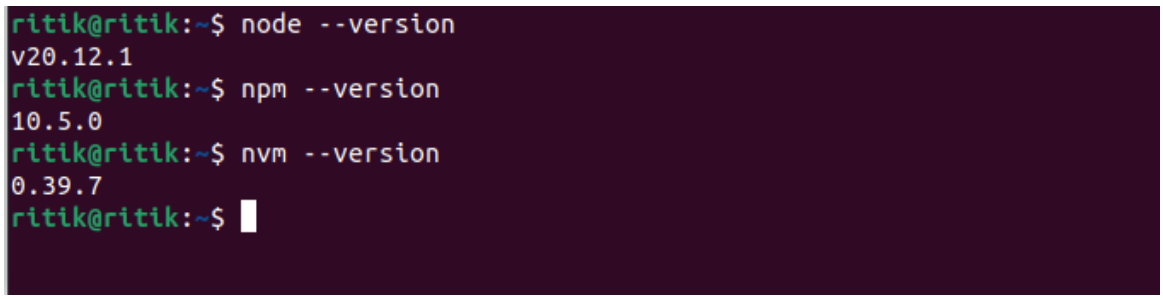
Grafana

trivy

Installation Process

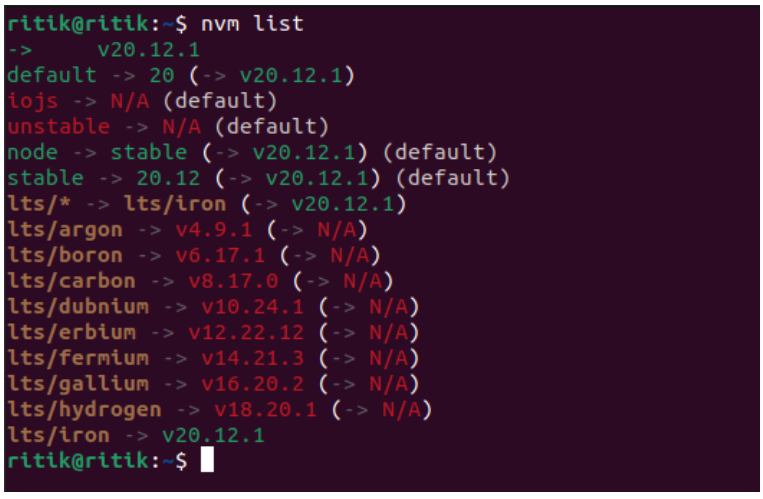
Node.js Installation

- sudo apt-get update
- curl -o- https://raw.githubusercontent.com/nvm-sh/nvm/v0.39.3/install.sh
- curl -o- https://raw.githubusercontent.com/nvm-sh/nvm/v0.39.3/install.sh | bash
- source /.bashrc
- nvm install lts/iron
- node –version



Here the long-term support version of Node.js is used as the de-facto version of the language. If some other version of Node.js has to be installed it can be changed.

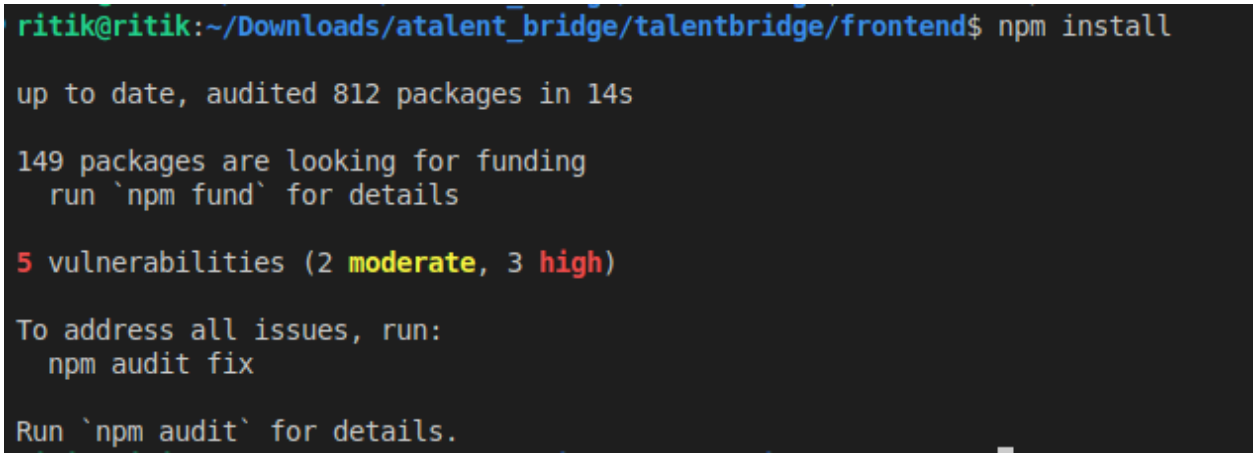
- nvm list (List all available Node.js versions)
- nvm install <version>
- nvm use <version>



React.js Installation:

Here the long-term support version of Node.js is used as the de-facto version of the language. If some other version of Node.js has to be installed it can be changed.

- npm create vite@latest TalentBridge --template react
- cd TalentBridge
- npm install
- npm run dev
- Access the app in your browser at the URL provided (typically `http://localhost:5173`)



MongoDB Atlas Setup:

Here the long-term support version of Node.js is used as the de-facto version of the language. If some other version of Node.js has to be installed it can be changed.

Sign up or log in:

- Visit MongoDB Atlas and create an account or log in.

Create a new cluster:

- In the Atlas dashboard, click "Create Cluster."
- Choose a cloud provider, region, and cluster tier.
- Click "Create Cluster."

Set up a database user:

- Go to "Database Access" and click "Add New Database User."
- Set a username and password.

Configure network access:

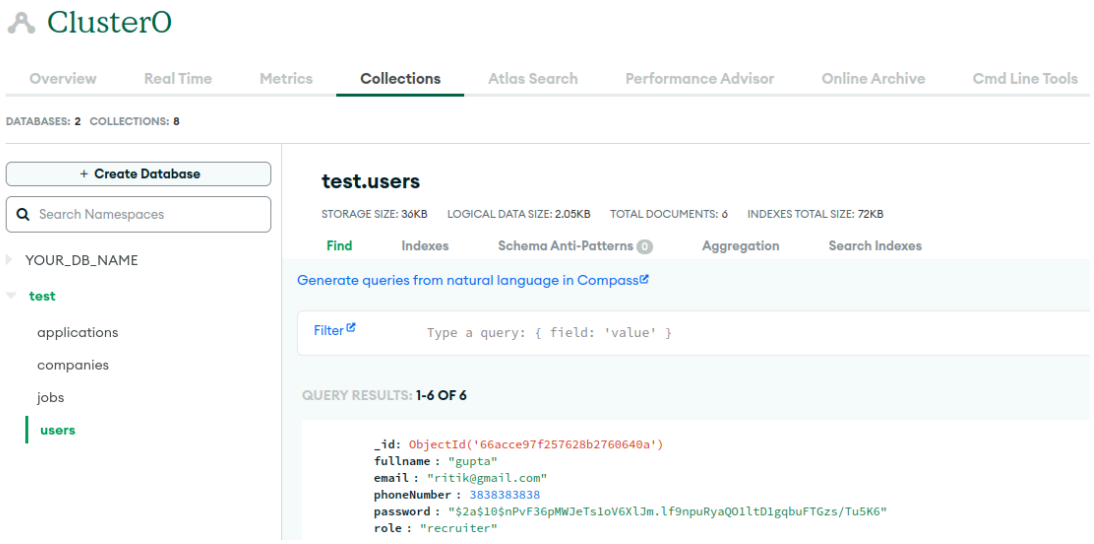
- Go to "Network Access" and click "Add IP Address."
- Allow access from your IP address (or use `0.0.0.0/0` for unrestricted access during development).

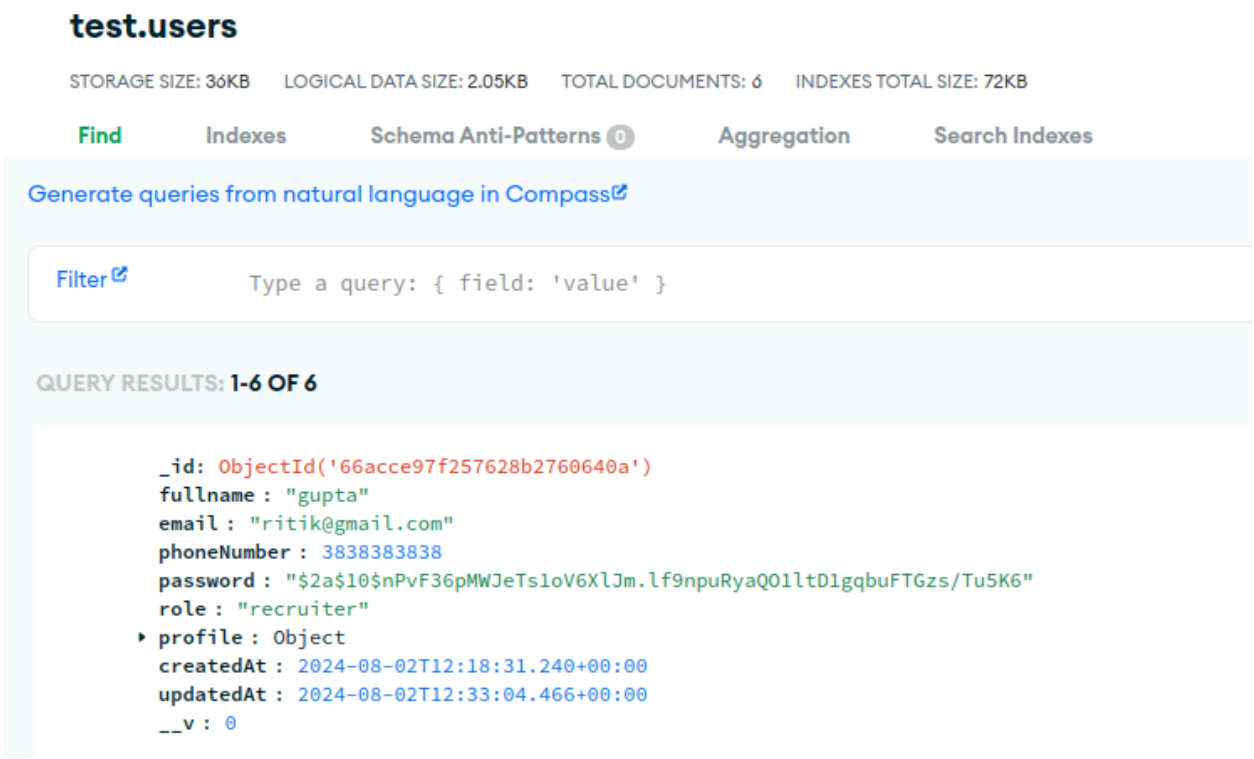
Connect to your cluster:

- Go to "Clusters" and click "Connect."
- Select "Connect Your Application."
- Copy the connection string (e.g., `mongodb+srv://<username>:<password>@cluster0.mongodb.net/myFirstDatabase?retryWrites=true&w=majority`).

Integrate with the application:

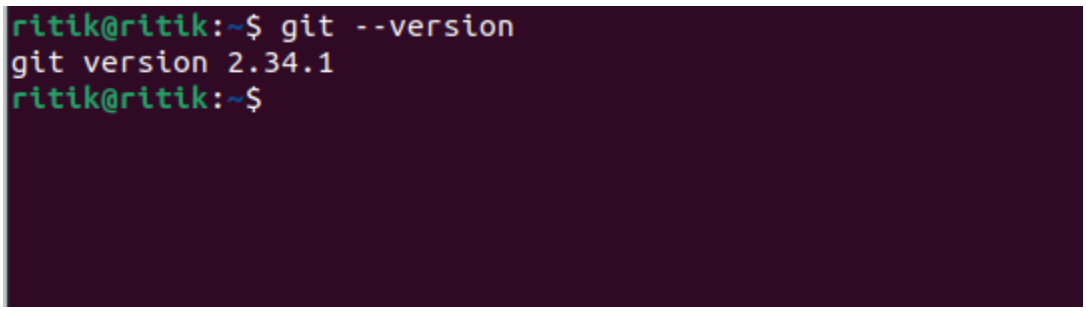
- Replace `<username>`, `<password>`, and `myFirstDatabase` in the connection string with your user credentials and database name.
- Use the string in your backend application's database connection setup (e.g., using Mongoose).

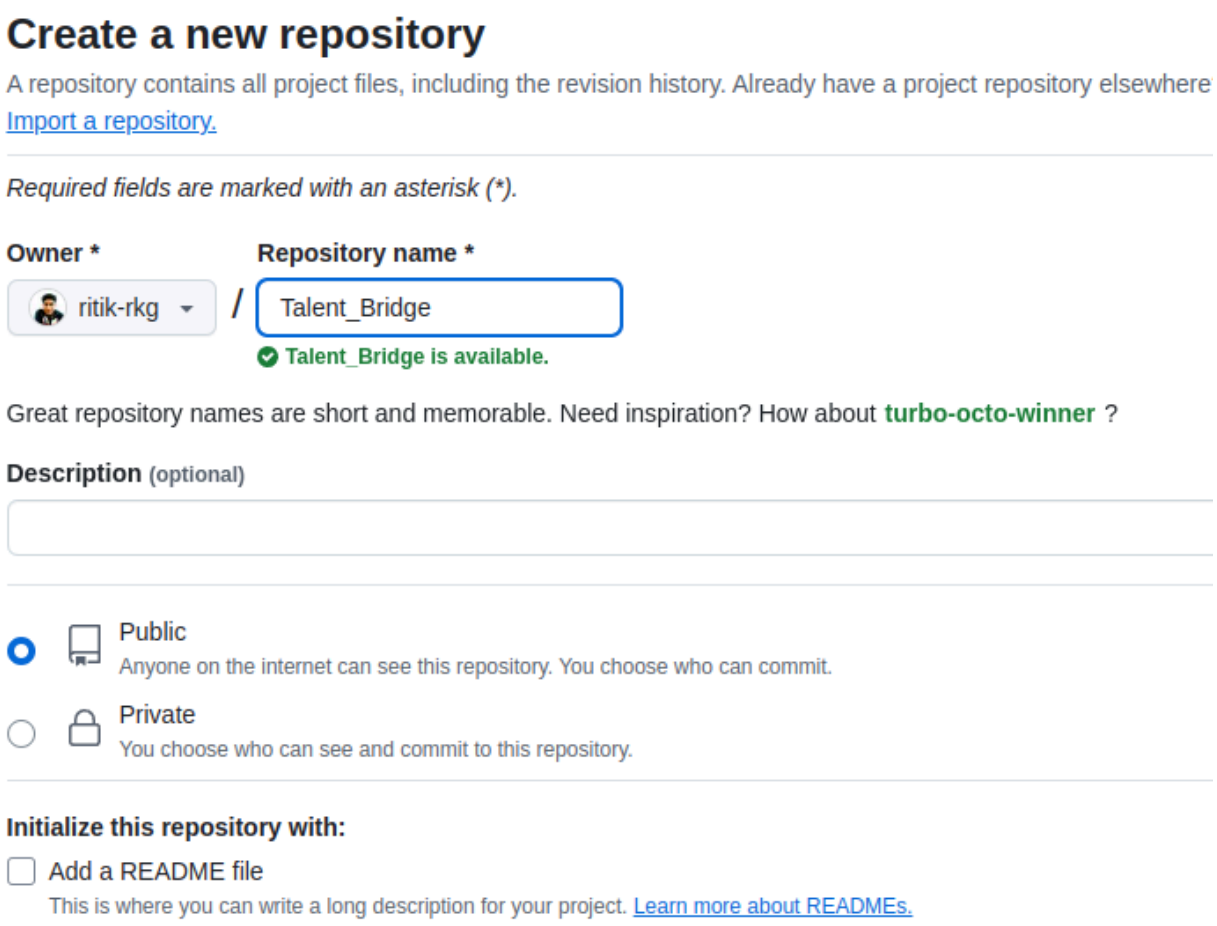




Git Installation:

- sudo apt-get update
- sudo apt-get install git
- git --version





Jenkins Installation:

- wget -q -O - https://pkg.jenkins.io/debian/jenkins.io.key | sudo apt-key add -
- sudo sh -c 'echo deb https://pkg.jenkins.io/debian binary/etc/apt/sources.list.d/jenkins.list'
- sudo apt install ca-certificates
- sudo apt-get update
- sudo apt-get install jenkins
- sudo service jenkins status
- jenkins --version

```
ritik@ritik:~$ jenkins --version
2.479.2
ritik@ritik:~$
```

Docker Installation:

- sudo apt-get update
- sudo apt-get install docker.io
- sudo dockerd (To start the docker service)
- docker --version
- sudo docker images (To list all local docker images)

```
ritik@ritik:~$ sudo systemctl status docker
● docker.service - Docker Application Container Engine
     Loaded: loaded (/lib/systemd/system/docker.service; enabled; vendor preset>
     Active: active (running) since Mon 2024-12-09 19:30:48 IST; 20min ago
TriggeredBy: ● docker.socket
       Docs: https://docs.docker.com
   Main PID: 1611 (dockerd)
      Tasks: 14
     Memory: 51.5M
        CPU: 2.609s
     CGroup: /system.slice/docker.service
             └─1611 /usr/bin/dockerd -H fd:// --containerd=/run/containerd/cont>
```

```
ritik@ritik:~$ docker --version
Docker version 27.3.1, build ce12230
```

Ansible Installation:

- sudo apt-get install openssh-server
- sudo apt-get update
- sudo apt-get install ansible

- pip install docker
- ansible --version

```
ritik@ritik:~$ ansible --version
ansible [core 2.17.7]
  config file = /etc/ansible/ansible.cfg
  configured module search path = ['/home/ritik/.ansible/plugins/modules', '/usr
/share/ansible/plugins/modules']
  ansible python module location = /usr/lib/python3/dist-packages/ansible
  ansible collection location = /home/ritik/.ansible/collections:/usr/share/ansi
ble/collections
  executable location = /usr/bin/ansible
  python version = 3.10.12 (main, Nov  6 2024, 20:22:13) [GCC 11.4.0] (/usr/bin/
python3)
  jinja version = 3.1.3
  libyaml = True
ritik@ritik:~$
```

Prometheus Installation:

- helm repo add prometheus-community https://prometheus-community.github.io/helm-charts
- helm repo update
- helm install prometheus prometheus-community/prometheus
- curl https://raw.githubusercontent.com/helm/helm/main/scripts/get-helm-3 | bash
- helm repo add grafana https://grafana.github.io/helm-charts

```
ritik@ritik:~$ helm search repo prometheus-community
NAME                                            CHART VERSION   APP VERSION     DESCRIPTION
prometheus-community/alertmanager               1.13.1          v0.27.0         The Alertmanage
r handles alerts sent by client ...
prometheus-community/alertmanager-snmp-notifier 0.4.0           v1.6.0          The SNMP Notifi
er handles alerts coming from Pr...
prometheus-community/jiralert                   1.7.1           v1.3.0          A Helm chart fo
r Kubernetes to install jiralert
prometheus-community/kube-prometheus-stack      66.3.1          v0.78.2         kube-prometheus
-stack collects Kubernetes manif...
prometheus-community/kube-state-metrics         5.27.0          2.14.0          Install kube-st
ate-metrics to generate and expo...
prometheus-community/prom-label-proxy           0.10.0          v0.11.0         A proxy that en
forces a given label in a given ...
prometheus-community/prometheus                 26.0.0          v3.0.0          Prometheus is a
 monitoring system and time seri...
prometheus-community/prometheus-adapter         4.11.0          v0.12.0         A Helm chart fo
r k8s prometheus adapter
prometheus-community/prometheus-blackbox-exporter 9.1.0         v0.25.0         Prometheus Blac
```

Grafana Installation:

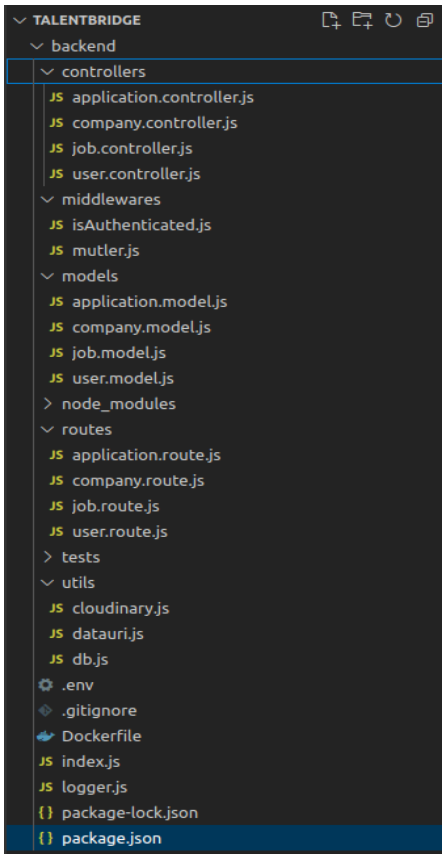
- sudo apt-get install -y adduser libfontconfig1 musl

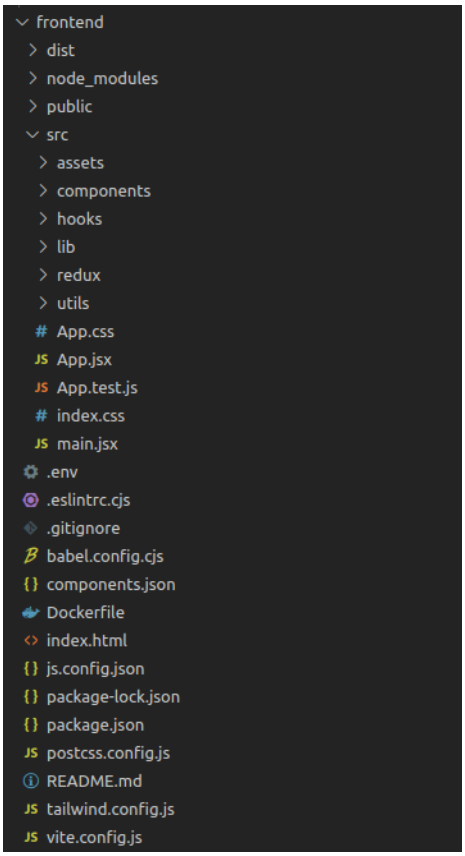
- wget https://dl.grafana.com/enterprise/release/grafana-enterprise_11.4.0_amd64.deb
- sudo dpkg -i grafana-enterprise_11.4.0_amd64.deb

```
ritik@ritik:~$ sudo systemctl status grafana-server
● grafana-server.service - Grafana instance
     Loaded: loaded (/lib/systemd/system/grafana-server.service; enabled; vendor preset: enabled)
     Active: active (running) since Mon 2024-12-09 19:30:45 IST; 31min ago
       Docs: http://docs.grafana.org
   Main PID: 1612 (grafana)
      Tasks: 24 (limit: 6946)
     Memory: 86.0M
        CPU: 6.900s
     CGroup: /system.slice/grafana-server.service
             └─1612 /usr/share/grafana/bin/grafana server --config=/etc/grafana/grafana.ini --pidfile=>

Dec 09 19:30:47 ritik grafana[1612]: logger=grafana-apiserver t=2024-12-09T19:30:47.44889713+05:30 lev>
Dec 09 19:30:47 ritik grafana[1612]: logger=grafana-apiserver t=2024-12-09T19:30:47.451705238+05:30 le>
Dec 09 19:32:02 ritik grafana[1612]: logger=infra.usagestats t=2024-12-09T19:32:02.630170116+05:30 lev>
Dec 09 19:40:47 ritik grafana[1612]: logger=cleanup t=2024-12-09T19:40:47.680098489+05:30 level=info m>
```

Web Application

Directory Structure



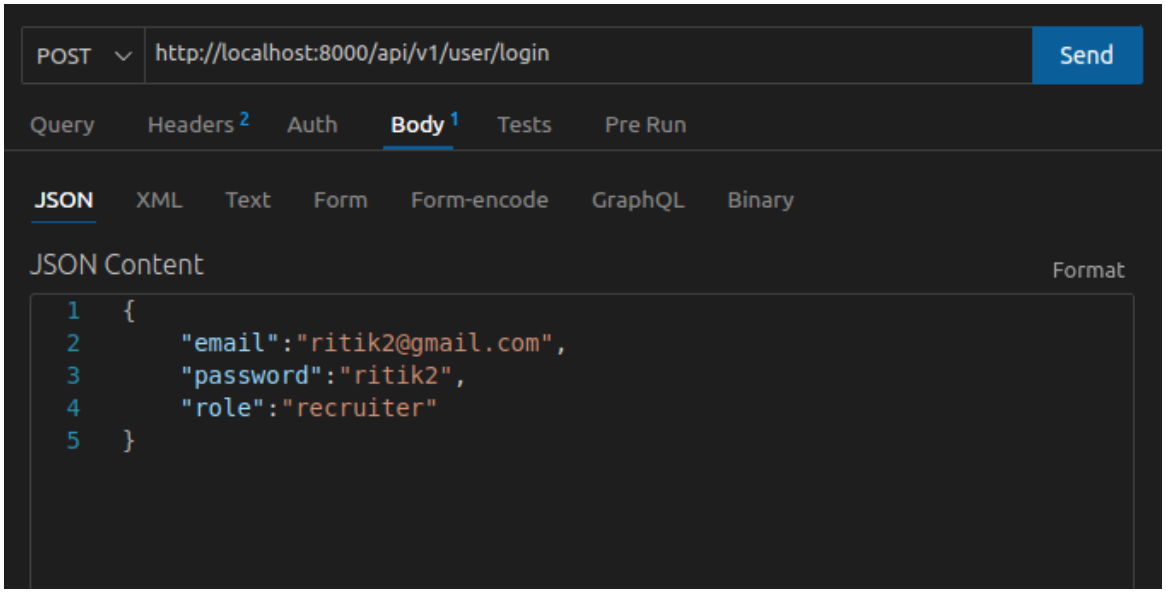


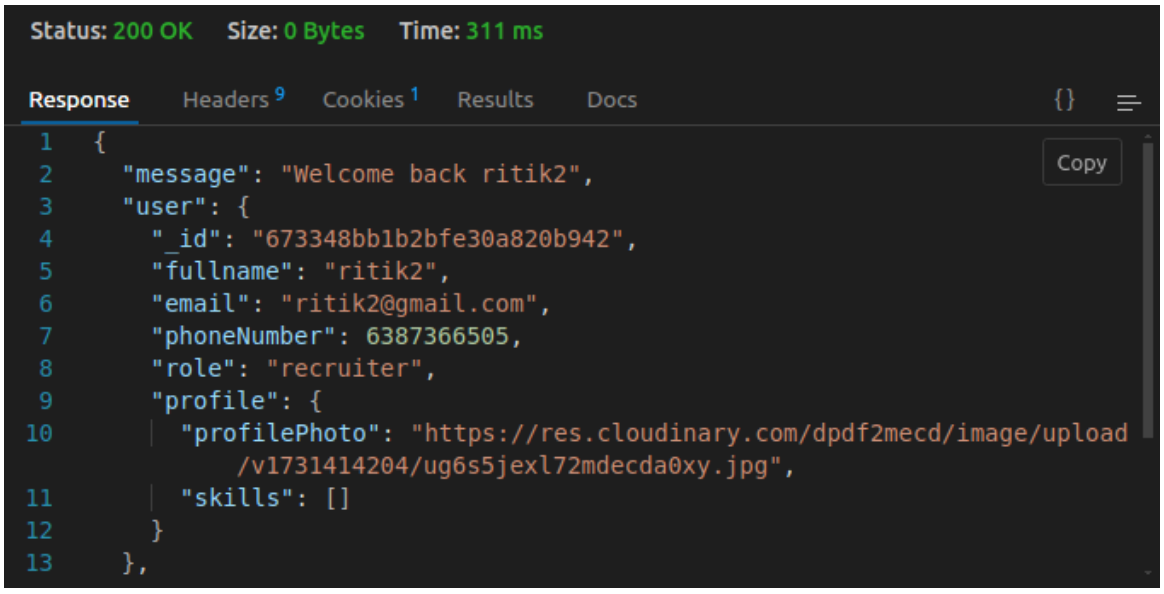
API Endpoints:

Base URL: We have made 4 base urls, user, company, job and application.

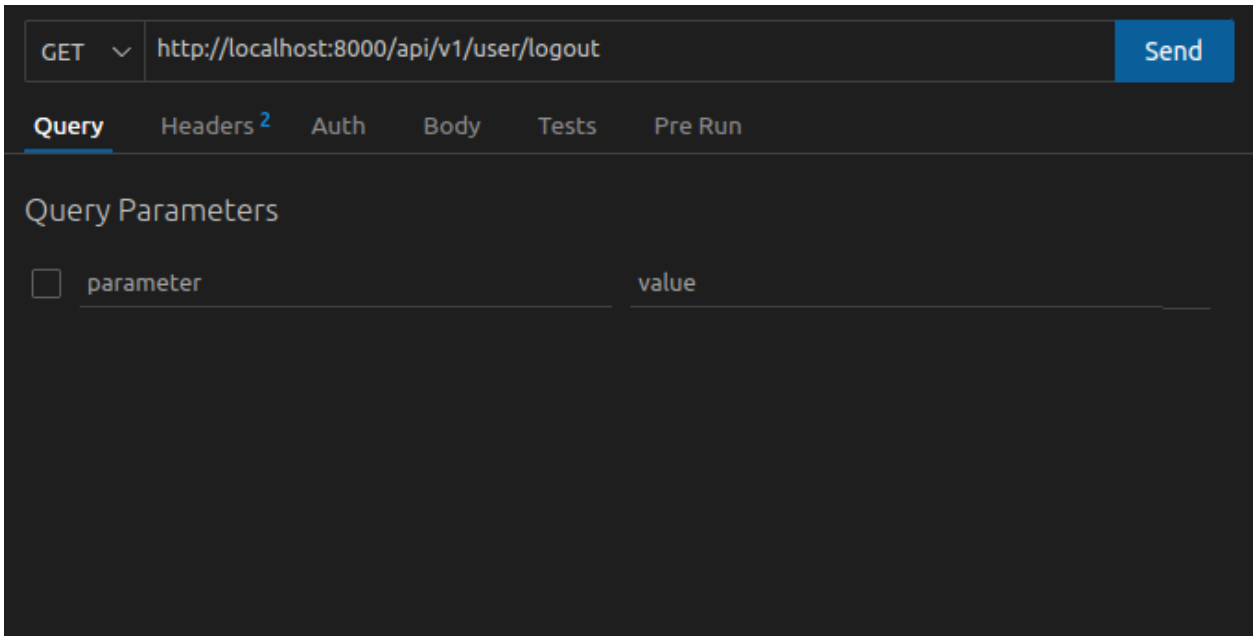
```
// api's
app.use("/api/v1/user", userRoute);
app.use("/api/v1/company", companyRoute);
app.use("/api/v1/job", jobRoute);
app.use("/api/v1/application", applicationRoute);
```

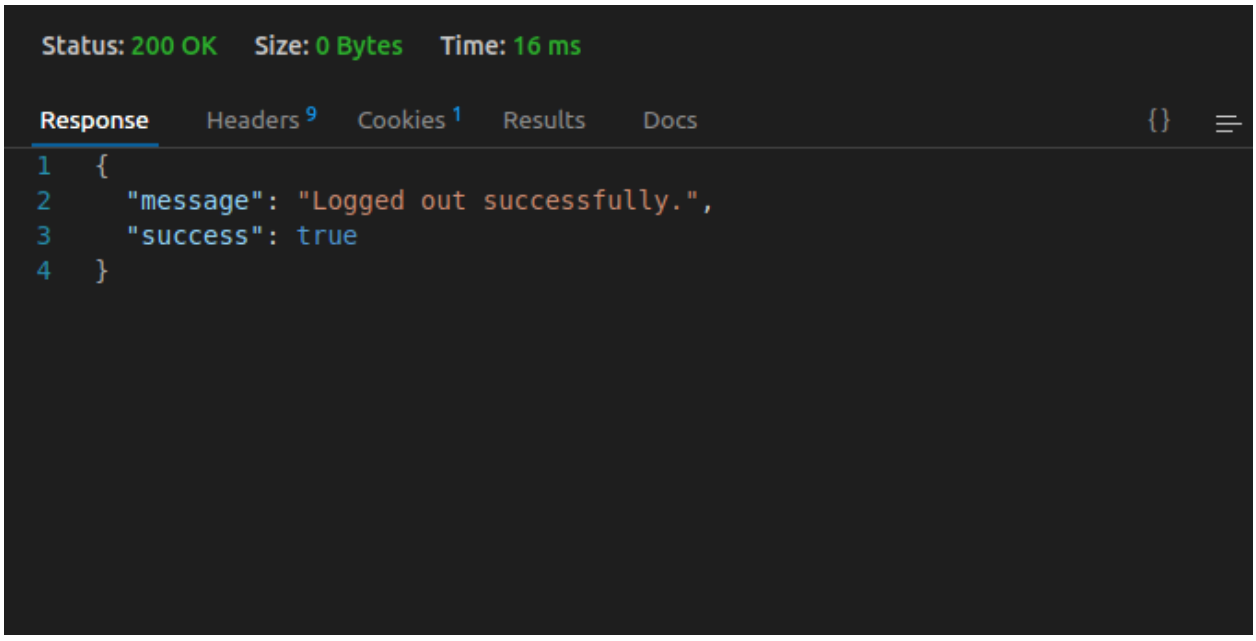
1. POST /user/login





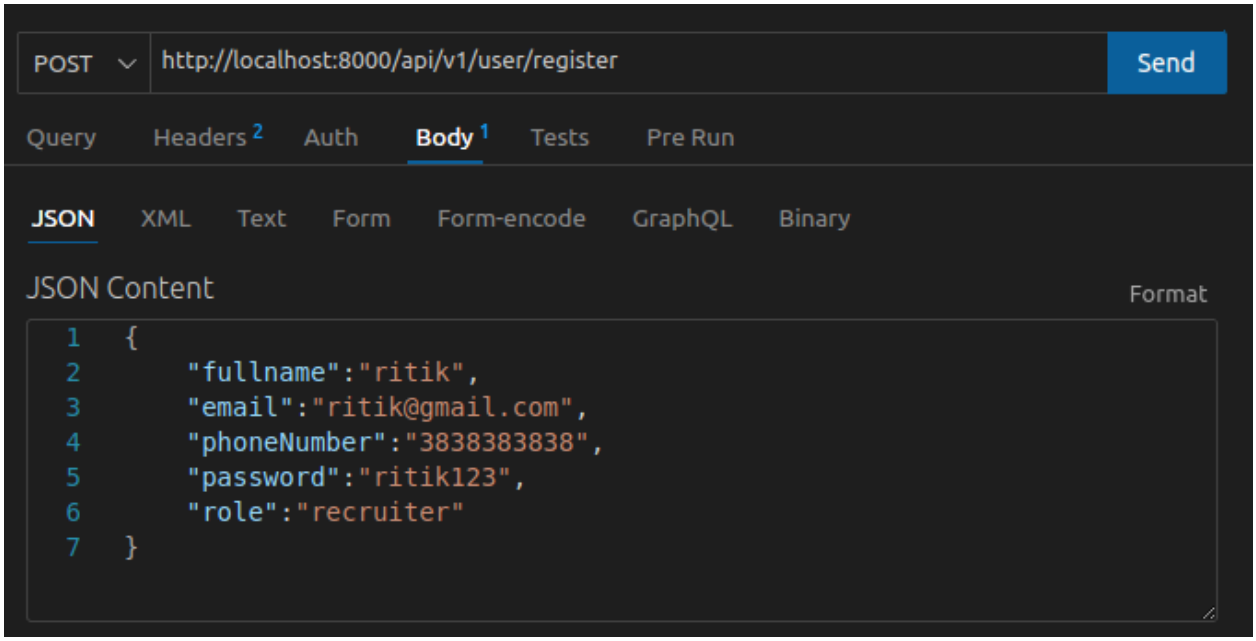
2. GET /user/logout



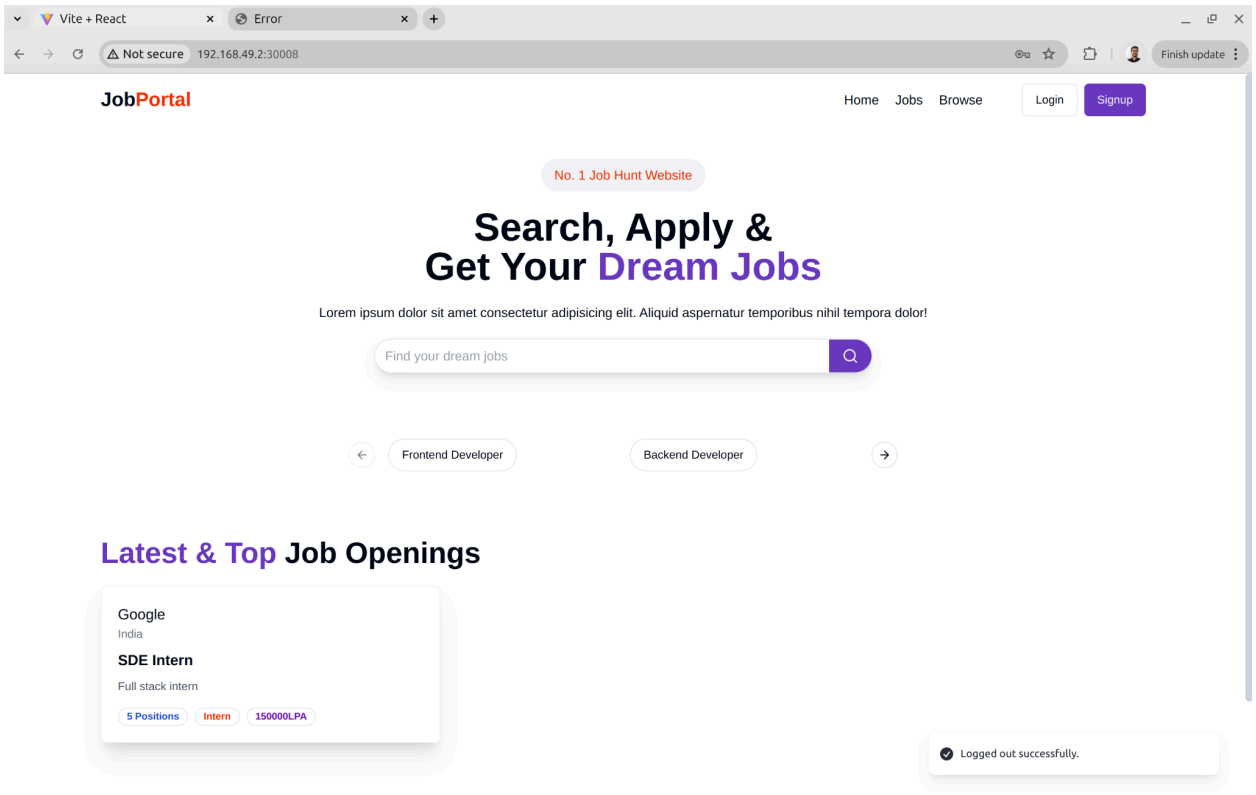


3. POST /user/profile/update

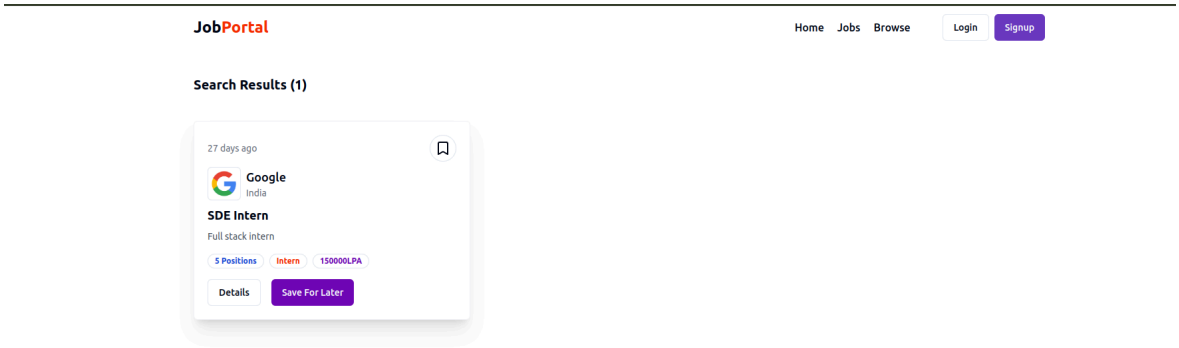
4. POST /user/register



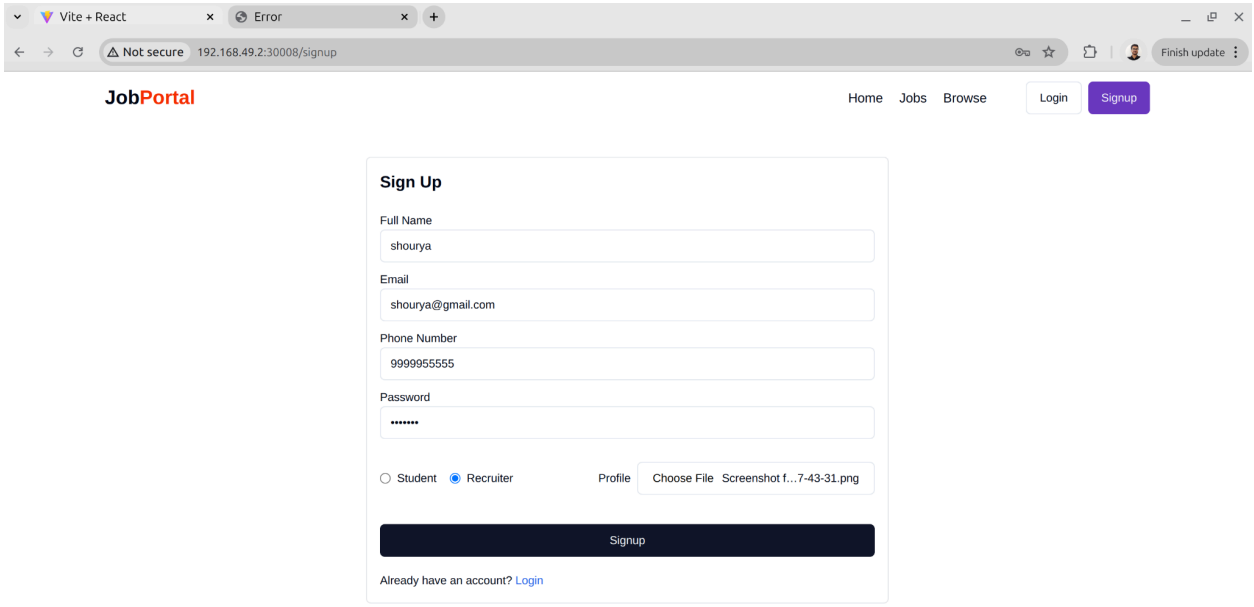
User Interface



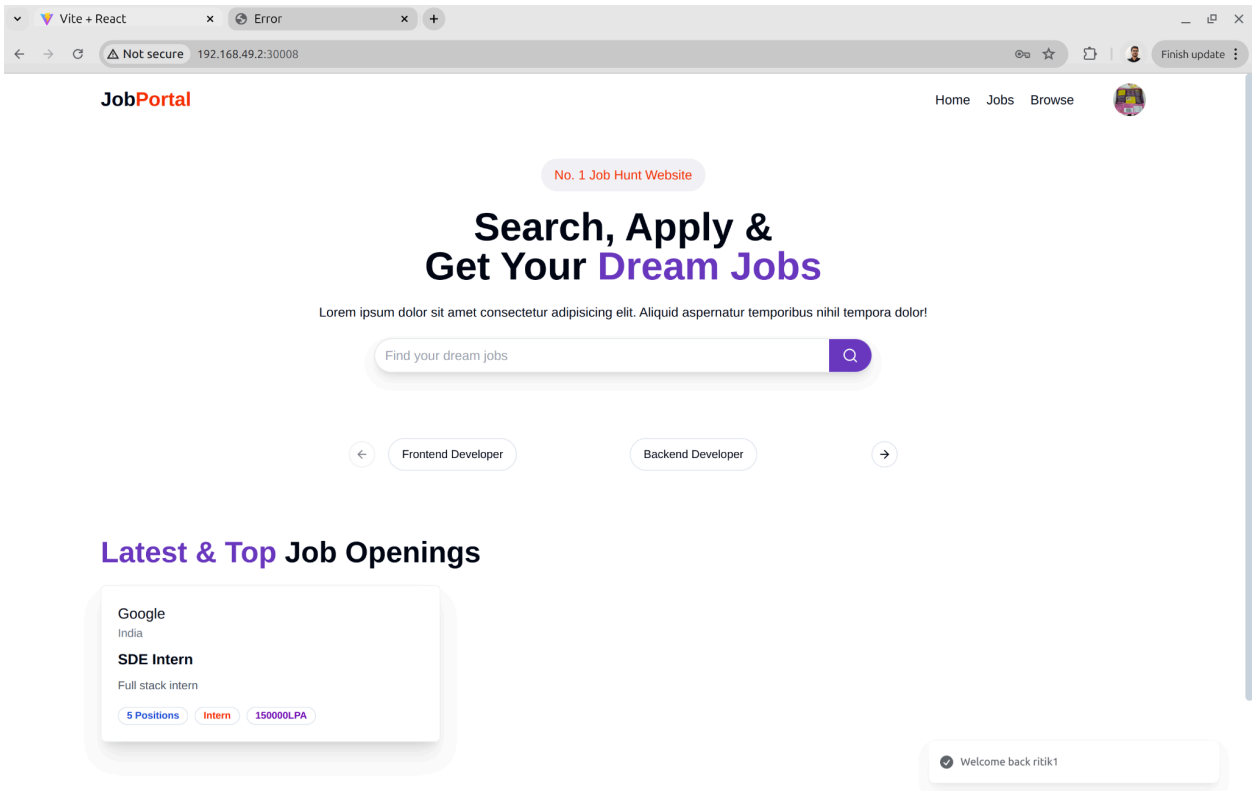
Home Page



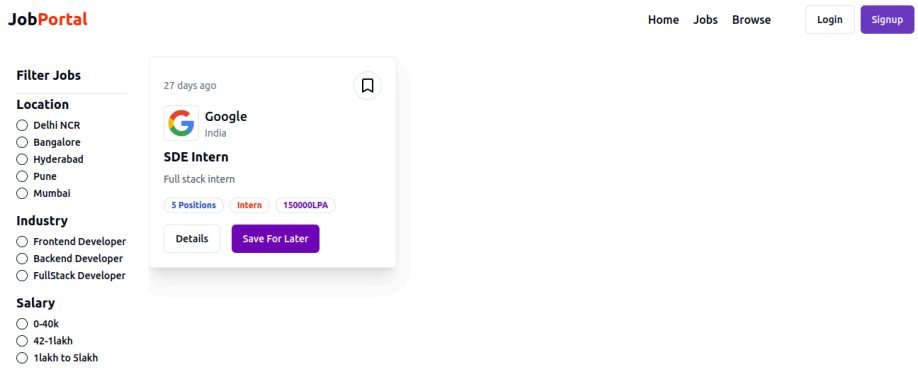
Can Browse Different Jobs



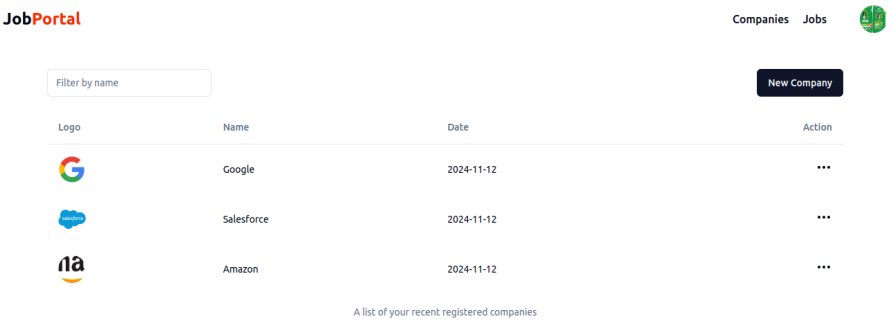
Login Page



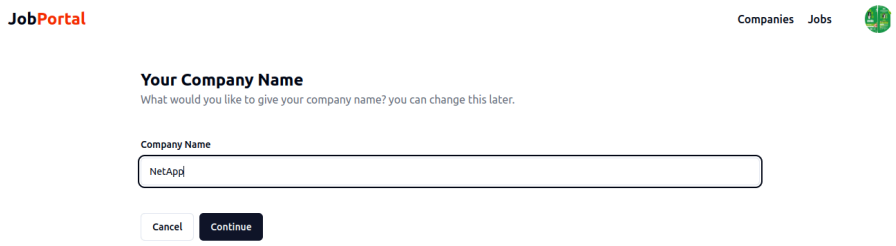
After User Logged in to



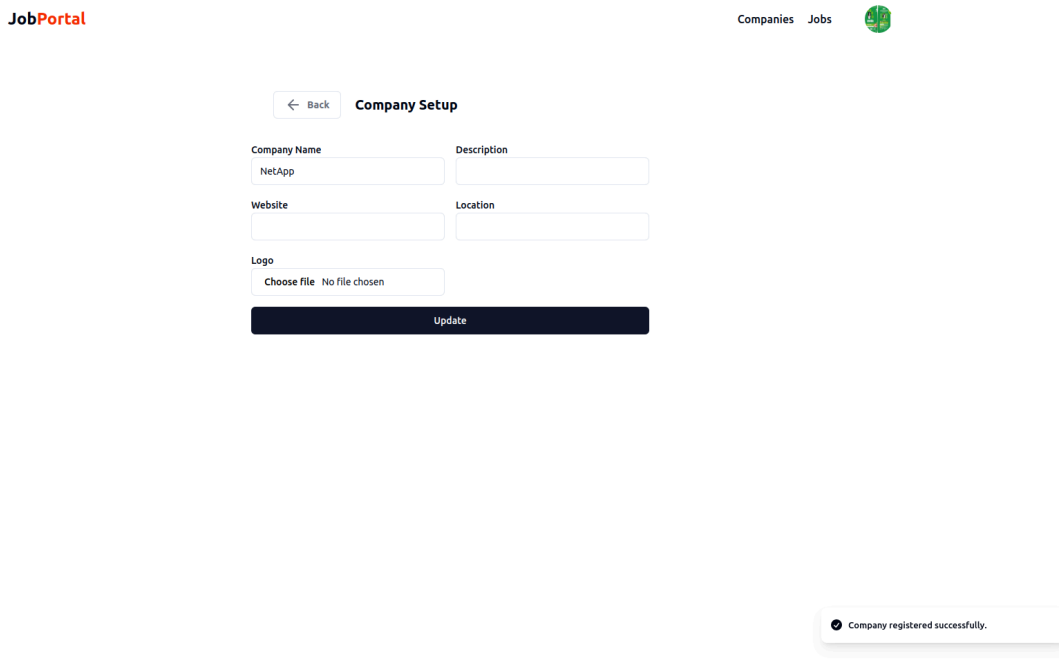
Jobs Search Page



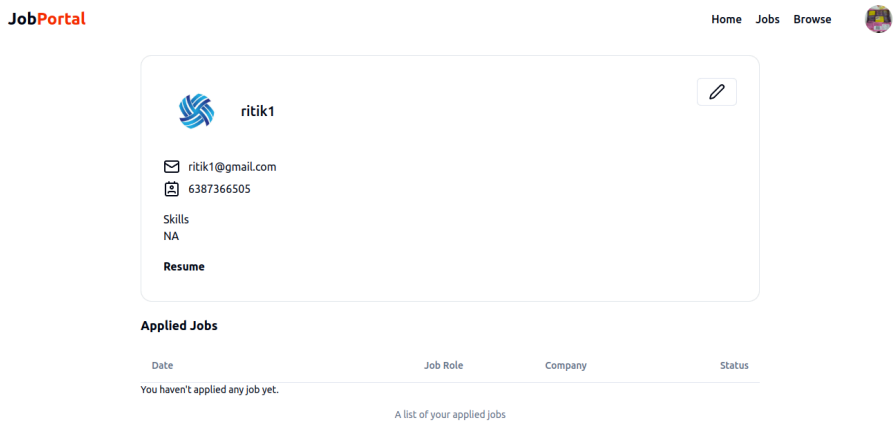
Recruiter Page Showcasing Different Companies



Adding another company on the platform



Filling further details related to the company.



User Profile page

Project Design and Framework

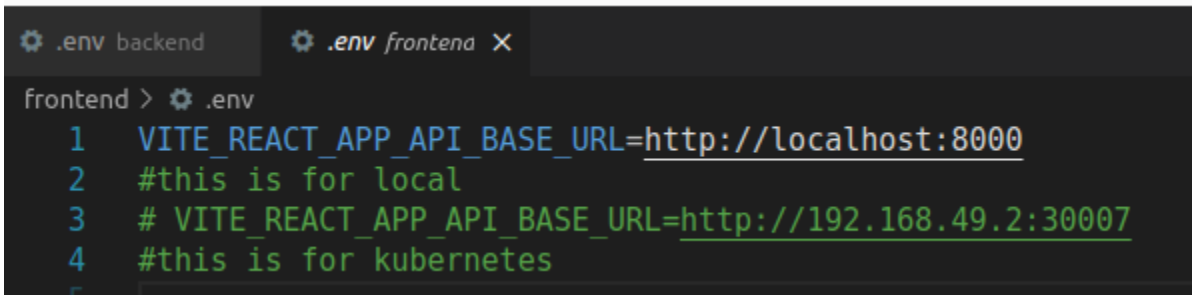
Version Control and Project Setup

1. Create an account and a new repository at https://github.com/. Click on Code and copy the repository URL.
2. Clone the Repository:
    a. git clone <repository url>
    b. cd <project-directory>
3. Open the project in your IDE (VSCode, IntelliJ IDEA, etc)
4. Install Dependencies:
    a. For Backend -
        i. cd backend
        ii. npm install
    b. For Frontend -
        i. cd frontend
        ii. npm install
5. Setup Environment Variables:

a. Create an `.env` file in both the backend and frontend directories if not already present.
    i. For Backend:

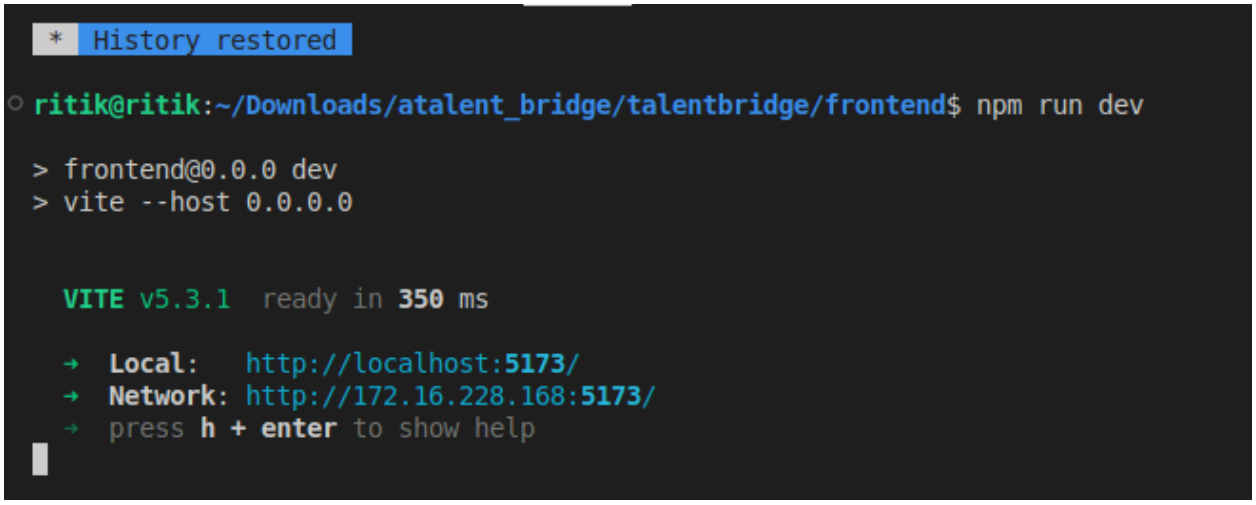
```
MONGO_URI=
PORT=
SECRET_KEY=
CLOUD_NAME=
API_KEY=
API_SECRET=
CLIENT_ORIGIN_URL=http://localhost:5173   # this is for local
# CLIENT_ORIGIN_URL="http://192.168.49.2:30008"   #this is for kubernetes
```

    ii. For Frontend:



6. Run the application:
    a. Start the Backend server:
        i. npm run dev

    b. Start the frontend server:
        i. npm run dev



For committing the change to the application, Run the following commands in your terminal:

1. git init
2. git add .
3. git commit -m " initial commit "
4. git remote add origin < REPOSITORY_URL >
5. git remote add upstream < REPOSITORY_URL >
6. git push origin main

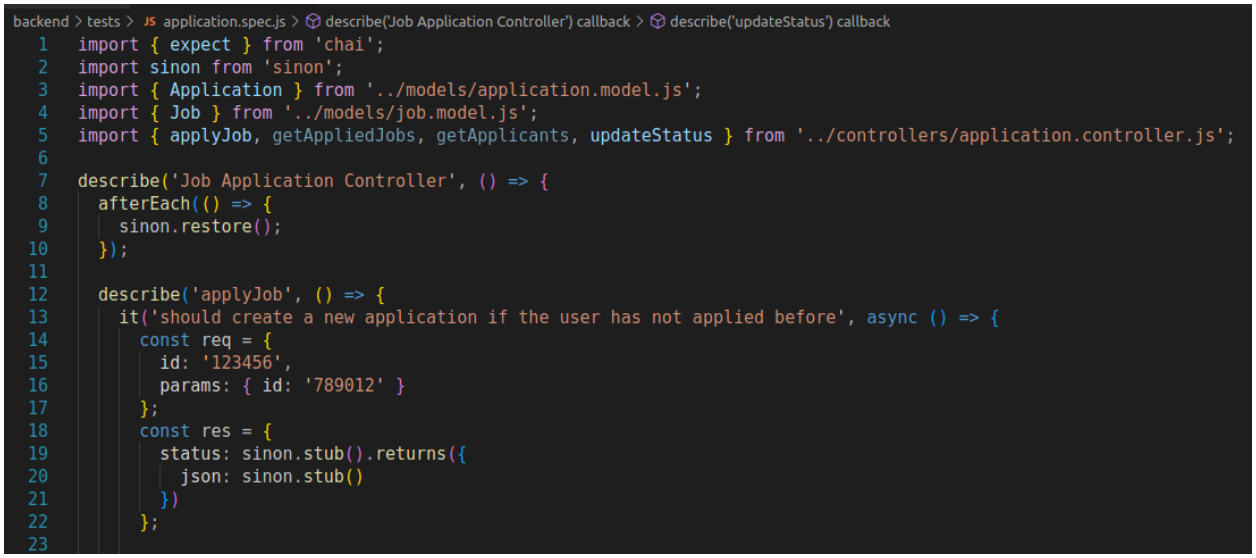
Testing:

To run Test:

1. cd backend
2. npm run test

Key Scenarios:

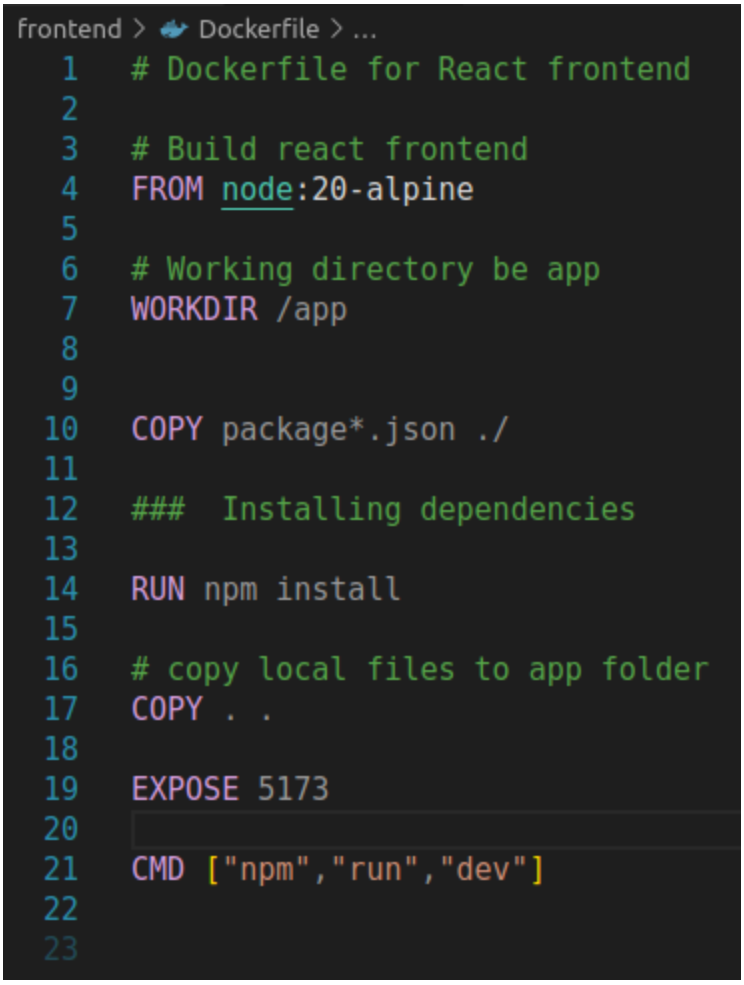
1. **applyJob API**
    - Success: Creates a new application.
    - Errors: Handles duplicate applications and non-existent jobs.
2. **updateStatus API**
    - Success: Updates application status.
    - Errors: Handles missing status and invalid application ID.



Containerization:

Containerization allows your application to run consistently across different environments by encapsulating the application and its dependencies into a container.

1. **Docker File for Frontend:**



Build the Docker Image: From the root of the frontend directory, build the Docker image using the following command:

a. docker build -t ritikgupta0114/frontend .
b. docker run -p 5173:5173 frontend
c. docker ps

```
ritik@ritik:~/Downloads/atalent_bridge/talentbridge/frontend$ docker build -t ritikgupta0114/frontend .
[+] Building 20.9s (8/10)
 => [internal] load build definition from Dockerfile
 => => transferring dockerfile: 309B
 => [internal] load metadata for docker.io/library/node:20-alpine
 => [auth] library/node:pull token for registry-1.docker.io
 => [internal] load .dockerignore
 => => transferring context: 2B
 => [internal] load build context
 => => transferring context: 1.74MB
 => [1/5] FROM docker.io/library/node:20-alpine@sha256:426f843809ae05f324883afceebaa2b9cab9cb697097dbb1a2a7a41c5701de72
 => => resolve docker.io/library/node:20-alpine@sha256:426f843809ae05f324883afceebaa2b9cab9cb697097dbb1a2a7a41c5701de72
 => => sha256:426f843809ae05f324883afceebaa2b9cab9cb697097dbb1a2a7a41c5701de72 7.67kB / 7.67kB
 => => sha256:effc1ee6b93c4db0aab5729f3bc25d9df841e9b88ec3c4683d5a948a37553244 1.72kB / 1.72kB
 => => sha256:2215267afb33d93392d8d16b41c461a569bf52a442e5af4c4add1371b73f26e3 6.18kB / 6.18kB
 => => sha256:38a8310d387e375e0ec6fabe047a9149e8eb214073db9f461fee6251fd936a75 3.64MB / 3.64MB
 => => sha256:65052e355180ad17acd4b61613338090c587b931124cd2946b9dcf0e945b76cb 42.54MB / 42.54MB
 => => sha256:9cf3157062e6e87bb84921361434e0c930e8f73584eb06114cf7563178355253 1.26MB / 1.26MB
 => => sha256:dcfb660a4e70b11e73b64689666db5db05706d6d6a9bb950d9fea8593712af3c 446B / 446B
 => => extracting sha256:38a8310d387e375e0ec6fabe047a9149e8eb214073db9f461fee6251fd936a75
 => => extracting sha256:65052e355180ad17acd4b61613338090c587b931124cd2946b9dcf0e945b76cb
 => => extracting sha256:9cf3157062e6e87bb84921361434e0c930e8f73584eb06114cf7563178355253
 => => extracting sha256:dcfb660a4e70b11e73b64689666db5db05706d6d6a9bb950d9fea8593712af3c
 => [2/5] WORKDIR /app
 => [3/5] COPY package*.json ./
 => [4/5] RUN npm install
```

```
ritik@ritik:~/Downloads/atalent_bridge/talentbridge/frontend$ docker run -p 5173:5173 ritikgupta0114/frontend

> frontend@0.0.0 dev
> vite --host 0.0.0.0

Re-optimizing dependencies because vite config has changed

  VITE v5.3.1  ready in 438 ms

  ➜  Local:   http://localhost:5173/
  ➜  Network: http://172.17.0.2:5173/
```

This will expose the app on port 5173. You can now access the React app at `http://localhost:5173` in your browser.

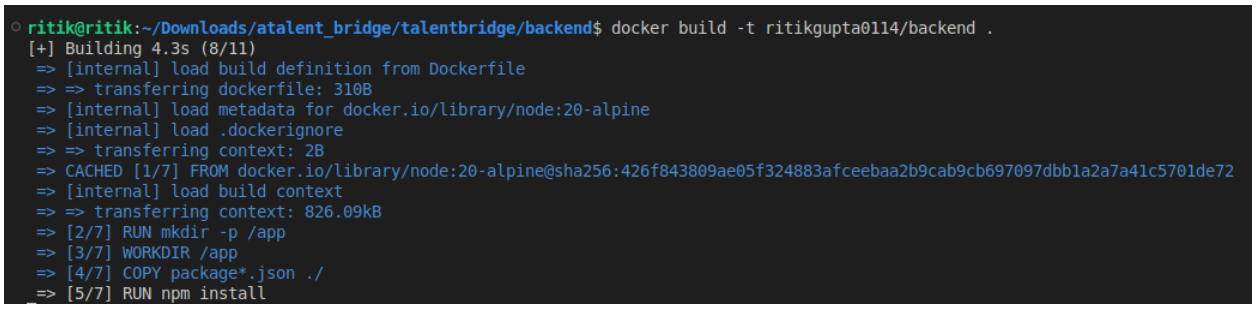
2. **Docker File for Backend:**

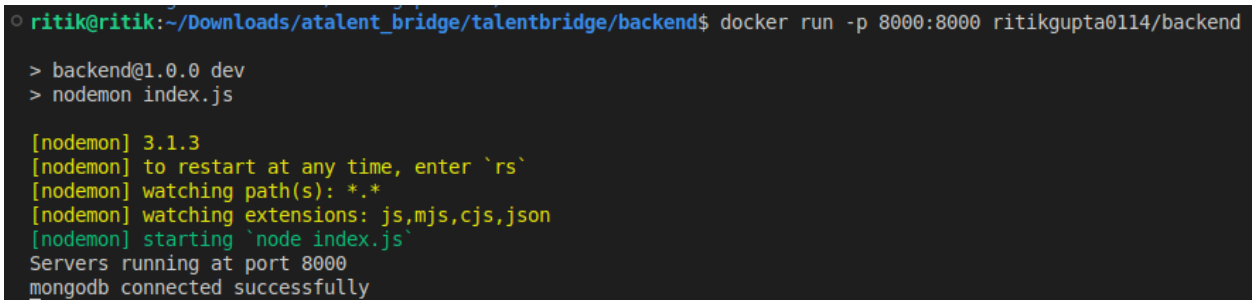
backend > Dockerfile > ...

```dockerfile
#  Dockerfile for  Backend

FROM node:20-alpine

# Create App Directory
RUN mkdir -p /app
WORKDIR /app

# Install Dependencies
COPY package*.json ./

RUN npm install

RUN npm install morgan

# Copy app source code
COPY . .

# Exports
EXPOSE 8000

CMD ["npm","run","dev"]
```

Build the Docker Image: From the root of the frontend directory, build the Docker image using the following command:

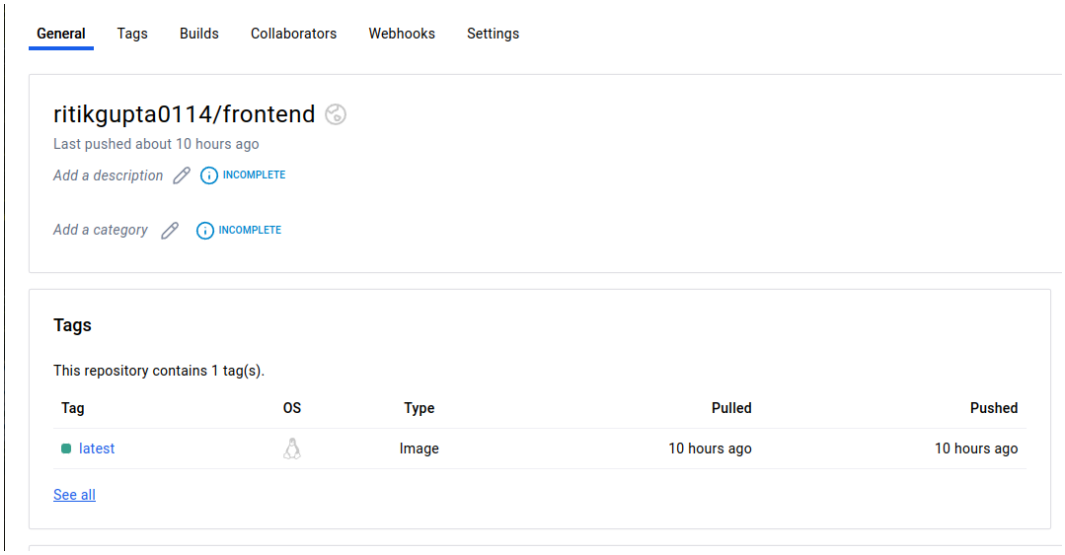
a. `docker build -t ritikgupta0114/backend .`
b. `docker run -p 8000:8000 frontend`
c. `docker ps`

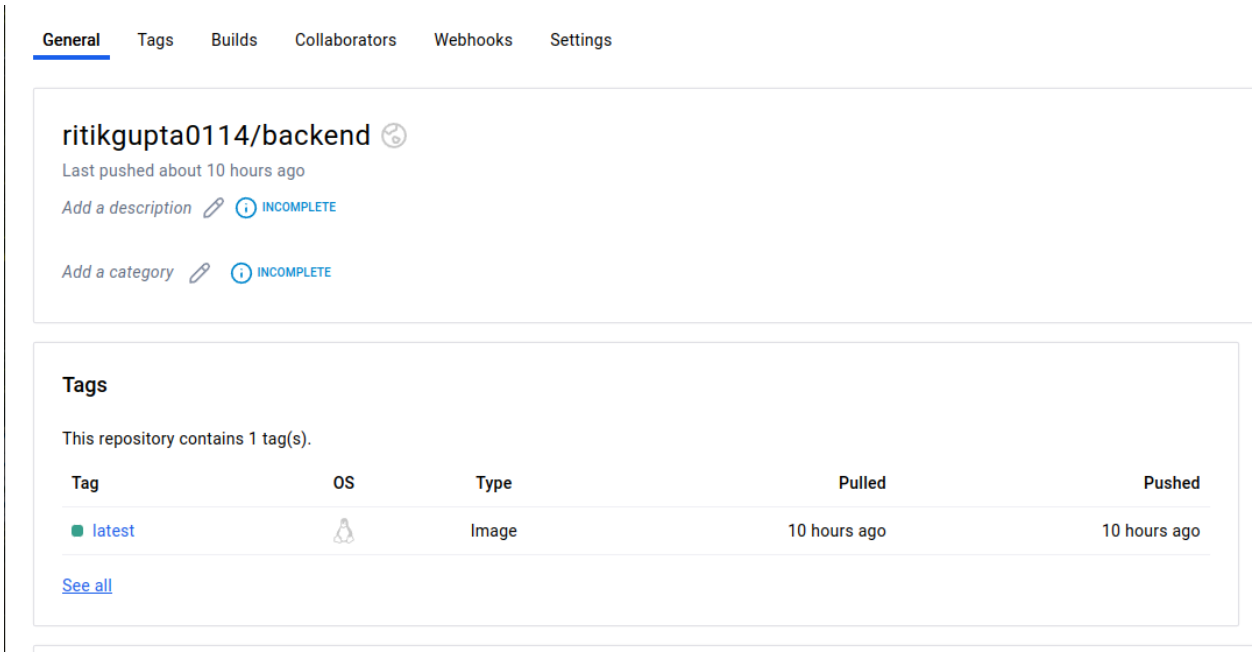




This will expose the app on port 5173. You can now access the React app at `http://localhost:8000` in your browser.

Pushing to DokcerHub:





Docker Compose:

Docker Compose is used to define and manage multi-container Docker applications. Below is the configuration for your application, which includes services for the backend, frontend, Elasticsearch, Logstash, and Kibana.

.env backend | docker-compose.yml | .env ./

docker-compose.yml

```yaml
services:
  server:
    image: ritikgupta0114/backend:latest
    container_name: myapp-node-server
    ports:
      - "8000:8000"
    environment:
      - NODE_ENV=development
      - MONGO_URI
      - LOGSTASH_HOST=logstash:5044
    networks:
      - app-network
    depends_on:
      - client
      - logstash
    volumes:
      - /app/node_modules
      - /home/ritik/Downloads/atalent_bridge/talentbridge/app.log:/app/app.log
    dns:
      - 8.8.8.8

  client:
    image: ritikgupta0114/frontend:latest
    container_name: myapp-react-client
    ports:
      - "5173:5173"
    environment:
      - NODE_ENV=development
    networks:
      - app-network
    volumes:
      - /app/node_modules

```

```yaml
  elasticsearch:
    image: docker.elastic.co/elasticsearch/elasticsearch:7.17.10
    container_name: elasticsearch
    environment:
      - discovery.type=single-node
      - ES_JAVA_OPTS=-Xms512m -Xmx512m
    networks:
      - app-network
    volumes:
      - elasticsearch-data:/usr/share/elasticsearch/data
    ports:
      - "9200:9200"

  logstash:
    image: docker.elastic.co/logstash/logstash:7.17.10
    container_name: logstash
    volumes:
      - /home/ritik/Downloads/atalent_bridge/talentbridge/app.log:/app/app.log
      - /home/ritik/Downloads/atalent_bridge/talentbridge/logstash.conf:/usr/share/logstash/pipeline/logstash.conf:ro
    environment:
      - xpack.monitoring.enabled=false
    networks:
      - app-network
    depends_on:
      - elasticsearch
    ports:
      - "5044:5044"

  kibana:
    image: docker.elastic.co/kibana/kibana:7.17.10
    container_name: kibana
    environment:
      - ELASTICSEARCH_HOSTS=http://elasticsearch:9200
    networks:
      - app-network
    depends_on:
      - elasticsearch
    ports:
      - "5601:5601"

networks:
  app-network:
    driver: bridge

volumes:
  node_modules:
  elasticsearch-data:
    driver: local
```

Explanation of the Configuration

1. `server` **(Backend)**:
    - The backend service uses the `ritikgupta0114/backend:latest` Docker image.
    - The server runs on port `8000` and communicates with Logstash for log shipping.
    - Dependencies such as MongoDB and Logstash are also included as `depends_on`.
2. `client` **(Frontend)**:
    - The frontend service uses the `ritikgupta0114/frontend:latest` Docker image.

    - The frontend runs on port `5173` and uses shared network configurations.
3. **`elasticsearch`**:
    - Elasticsearch is configured to run as a single-node instance, exposed on port `9200`.
4. **`logstash`**:
    - Logstash is configured to process logs, with a configuration file `logstash.conf`.
    - It runs on port `5044` to receive logs from the backend.
5. **`kibana`**:
    - Kibana connects to Elasticsearch for visualizing and managing logs.
    - It is exposed on port `5601`.
6. **Networks and Volumes**:
    - The services are connected through a bridge network named `app-network`.
    - Volumes are used for persistent storage (`node_modules` and `elasticsearch-data`).

Explanation of Volumes

In Docker Compose, volumes are used to persist data across container restarts and to share data between containers. Volumes can also help in mapping files from your host machine to containers for easy access and modification.

Here's how volumes are used in your configuration:

1. **Backend Volume (`/app/node_modules`)**: This volume ensures that the `node_modules` directory in the backend container is persisted and is shared between the host machine and the container, preventing the need to re-install dependencies every time the container starts.
2. **Log Volume (`/app/app.log`)**: The log file from your backend application is shared with the `logstash` service to ship logs to Elasticsearch for analysis. This volume maps the log file from your local system

(`/home/ritik/Downloads/atalent_bridge/talentbridge/app.log`) to the container's log file path.

3. **Elasticsearch Data Volume (`elasticsearch-data`)**: This volume ensures that Elasticsearch's data is persistent, meaning data won't be lost when the container is stopped or restarted. The volume is mapped to Elasticsearch's data directory inside the container.
4. **Logstash Configuration Volume (`logstash.conf`)**: This volume maps the local `logstash.conf` file (configuration for Logstash) to the Logstash container. The file is used to configure how Logstash processes the logs from the backend.

Note: The `:ro` suffix ensures that the file is mounted as read-only, meaning the container cannot modify the host file.

Steps to Use Docker Compose:

1. **Create the `.env` File:** In the root directory of your project, create a file named `.env`. This file will store environment variables that will be used in the Docker Compose setup.

2. **Start All Services**: From the project directory where the `docker-compose.yml` file is located, run:
    a. docker-compose up
3. **Verify Running Containers**: Check the status of the containers:
    a. docker ps
4. **Stop All Services**: To stop all services, use:
    a. docker-compose down

```
ritik@ritik:~/Downloads/atalent_bridge/talentbridge$ docker compose up
[+] Running 5/0
 ✔ Container elasticsearch       Created                                                                                    0.0s
 ✔ Container myapp-react-client  Created                                                                                    0.0s
 ✔ Container kibana              Created                                                                                    0.0s
 ✔ Container logstash            Created                                                                                    0.0s
 ✔ Container myapp-node-server   Created                                                                                    0.0s
Attaching to elasticsearch, kibana, logstash, myapp-node-server, myapp-react-client
logstash            | 2024/12/10 04:40:57 Setting 'xpack.monitoring.enabled' from environment.
logstash            | Using bundled JDK: /usr/share/logstash/jdk
myapp-react-client  |
myapp-react-client  | > frontend@0.0.0 dev
myapp-react-client  | > vite --host 0.0.0.0
myapp-react-client  |
logstash            | OpenJDK 64-Bit Server VM warning: Option UseConcMarkSweepGC was deprecated in version 9.0 and will likely be removed in a future r
elease.
myapp-node-server   |
myapp-node-server   | > backend@1.0.0 dev
myapp-node-server   | > nodemon index.js
myapp-node-server   |
myapp-react-client  |
myapp-react-client  |   VITE v5.3.1  ready in 867 ms
myapp-react-client  |
myapp-react-client  |   ➜  Local:   http://localhost:5173/
myapp-react-client  |   ➜  Network: http://172.23.0.2:5173/
myapp-node-server   | [nodemon] 3.1.3
myapp-node-server   | [nodemon] to restart at any time, enter `rs`
myapp-node-server   | [nodemon] watching path(s): *.*
myapp-node-server   | [nodemon] watching extensions: js,mjs,cjs,json
myapp-node-server   | [nodemon] starting `node index.js`
myapp-node-server   | Servers running at port 8000
myapp-node-server   | mongodb connected successfully
```

Configuration Management:

Configuration management is the process of automating the management of system configurations to ensure that they are consistent, reliable, and up-to-date. It involves managing infrastructure as code, which means that configurations are defined in code and can be version-controlled, tested, and automated.

Running Multi-Container setup - Docker-Compose:

inventory

```
1  [ansible_nodes]
2  localhost ansible_user=ritik ansible_password=@my_vault.yml ansible_python_interpreter=/usr/bin/python3
3
4  [ansible_nodes:vars]
5  ansible_connection=local
6
```

playbook-new.yaml

```
1  - name: Deploying with Docker-Compose
2    hosts: all
3    become: true
4    roles:
5      - git_clone
6      - deploy_docker_compose
7
```

Playbook Explanation:

1. **Purpose**:
   The playbook delegates tasks such as cloning the repository and deploying services to predefined Ansible roles for better organization and reusability.
2. **Hosts**:
   The playbook runs on all specified hosts in the Ansible inventory.
3. **Tasks**:
   - **Git Clone Role**: Handles cloning the repository containing the Docker Compose configuration.
   - **Docker Compose Deployment Role**: Executes the deployment using Docker Compose.
4. **Privilege Escalation**:
   The `become: true` directive ensures that tasks requiring elevated privileges (e.g., Docker commands) are executed with sudo.
1.

Run the Playbook:

Execute the playbook using the `ansible-playbook` command:

`ansible-playbook -i inventory playbook-new.yaml`

Running Container Orchestration- Kubernetes:

inventory-k8

```
[ansible_nodes]
localhost ansible_user=ritik ansible_password=@my_vault.yml ansible_python_interpreter=/usr/bin/python3

[ansible_nodes:vars]
ansible_connection=local
```

playbook-k8-new.yaml

```
- name: Deploy Frontend and Backend with Kubernetes
  hosts: all
  tasks:
    - name: Show ansible_user
      debug:
        msg: "The ansible_user is {{ ansible_user }}"

    - name: Clone Repository
      include_role:
        name: clone_repo

    - name: Deploy Frontend Resources
      include_role:
        name: deploy_frontend

    - name: Deploy Backend Resources
      include_role:
        name: deploy_backend
```

Playbook Explanation

1. **Purpose**:
   Automates the deployment of frontend and backend Kubernetes resources, separating tasks into modular roles.
2. **Hosts**:
   The playbook is executed on all specified hosts in the Ansible inventory.
3. **Tasks**:
   - **Show Ansible User**: Verifies and displays the Ansible user running the playbook.
   - **Clone Repository**: Uses the clone_repo role to fetch the codebase from a specified repository.
   - **Deploy Frontend Resources**: Uses the deploy_frontend role to apply the necessary Kubernetes manifests for the frontend application.
   - **Deploy Backend Resources**: Uses the deploy_backend role to apply the Kubernetes manifests for the backend application.

Run the Playbook:
Execute the playbook using the `ansible-playbook` command:
```
ansible-playbook -i inventory-k8 playbook-k8-new.yaml
```

Ngrok and Github Webhooks

Whenever the developer builds the code commits it and push that to Github, webhooks automatically builds the code in Jenkins. To perform a webhook, the private IP address of the local machine needs to be converted to a public IP address. Automated messages known as "webhooks" are triggered when changes occur. Specifically, in our situation, updates made to the GitHub repository will activate the Jenkins pipeline through the webhook.

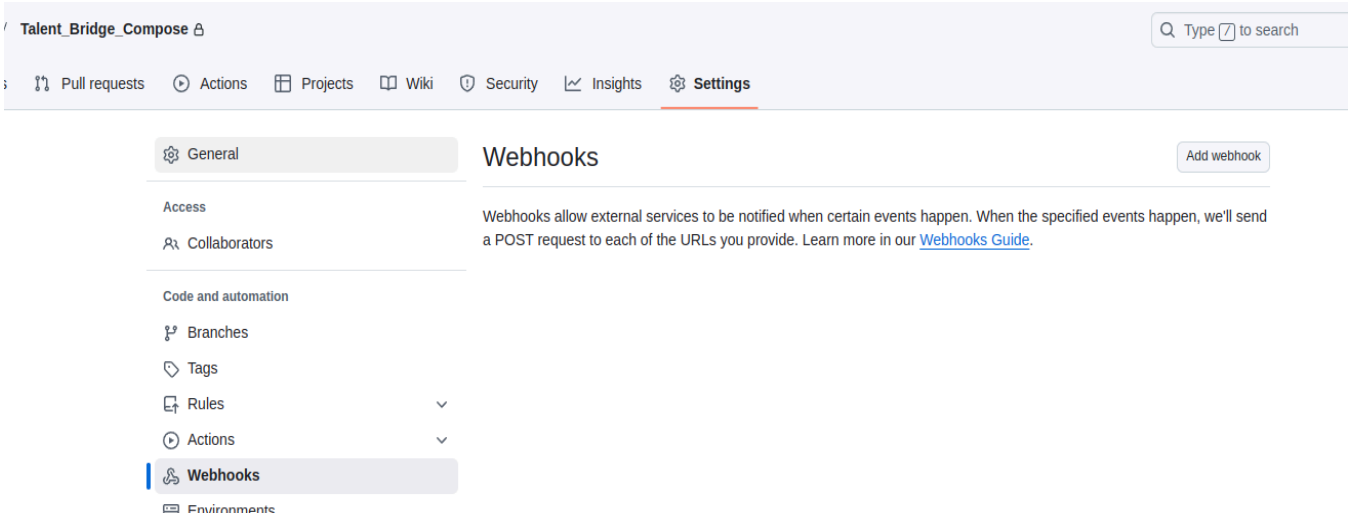
Jenkins can use webhooks for triggering builds. A webhook (or web callback) is a way for an app to provide other applications with real-time information. This can ensure that GitHub will send a webhook to our Jenkins server and our Jenkins application will build and test the changes and send the build status for the commit that was made. However the IP address must be a public one, hence we use ngrok to create a public address and use that to configure the webhook. Once the webhook is set up, all commits to the remote repository, send a POST

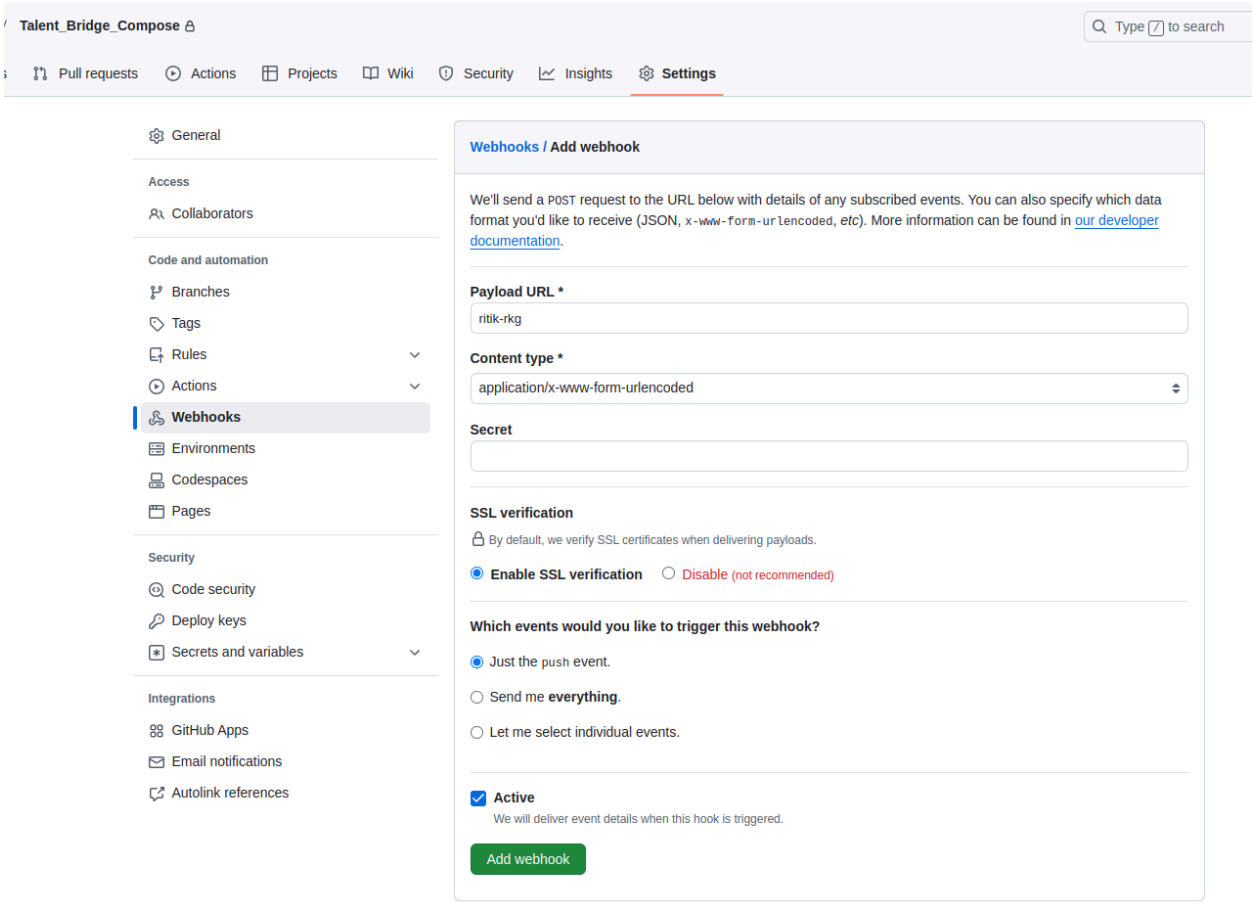
request to the payload ngrok URL, which in turn tells the Jenkins server to trigger the build.

To start ngrok: `ngrok http 8080`

Setting Up WebHooks :

Navigate to the settings section of the Github repository, then proceed to the Webhooks tab and select Add webhook. Add the ngrok address in payload URL and the personal access token in secret.





If Webhook is already set up then just edit it and copy and paste the new ngrok public IP address.

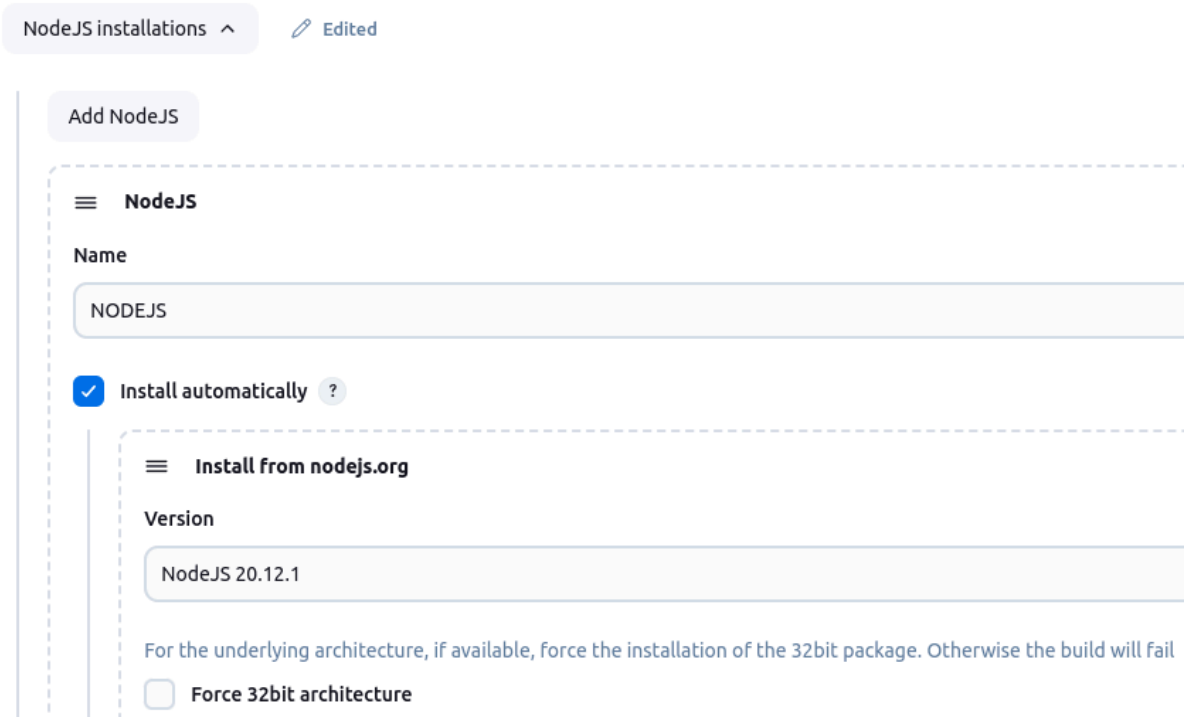
Continuous Integration Pipeline for Docker-Compose Setup:

This Jenkins pipeline automates the build, test, and deployment process for a project using Docker Compose. Below is a detailed breakdown of the steps required to set up Jenkins, an explanation of each stage in the Jenkinsfile, and instructions to execute the pipeline.

Steps to Set Up Jenkins

1. **Configure Node.js**:
    - Go to `Manage Jenkins > Global Tool Configuration`.
    - Under `NodeJS`, add a Node.js version and name it (e.g., "NODEJS").

NodeJS installations



2. **Set Up Credentials**:
    - Navigate to `Manage Jenkins > Credentials`.
    - Add the following credentials:
        - **Docker Hub Credentials** (ID: `Docker_Credentials_ritik`).
        - **MongoDB URI** (ID: `mongo-uri`).
        - **Cloudinary Credentials** (`cloud_secret_key`, `cloud_name`, `cloud_api_key`, `cloud_api_secret`).
        - **Ansible Vault Password** (ID: `ansible_vault_pass`).

	System	(global)	githubcredential	ritik-rkg/******
	System	(global)	cloud_api_key	cloud_api_key
	System	(global)	cloud_name	cloud_name
	System	(global)	mongo-uri	mongo-uri
	System	(global)	cloud_secret_key	cloud_secret_key
	System	(global)	cloud_api_secret	cloud_api_secret
	System	(global)	Docker_Credentials_ritik	ritikgupta0114/******
	System	(global)	ansible_vault_pass	ansible_vault_pass

Jenkinsfile Explanation

Pipeline Configuration

- **Environment Variables**:
  - Securely fetch credentials like Docker Hub credentials, MongoDB URI, and Cloudinary keys from Jenkins.
  - Set custom environment variables (e.g., `PORT`, `MINIKUBE_HOME`).
- **Tools**:
  - Specify the Node.js version configured in Jenkins

.

```
Jenkinsfile
pipeline {
    environment {
        DOCKERHUB_CRED = credentials("Docker_Credentials_ritik")
        MONGO_URI = credentials("mongo-uri")
        SECRET_KEY = credentials("cloud_secret_key")
        CLOUD_NAME = credentials("cloud_name")
        API_KEY = credentials("cloud_api_key")
        API_SECRET = credentials("cloud_api_secret")
        PORT = "8000"
        MINIKUBE_HOME = '/home/jenkins/.minikube'
        VAULT_PASS = credentials("ansible_vault_pass")
        BECOME_PASS = credentials("ansible_vault_pass")
    }
    agent any
    tools {nodejs "NODEJS"}
```

Stages

1. **Stage 1: Git Clone**
   - Deletes any existing project directory and clones the repository.
   - Ensures a clean workspace.

```
    stages {
        stage("Stage 1: Git Clone") {
            steps {
                sh '''
                [ -d Talent_Bridge_Compose ] && rm -rf Talent_Bridge_Compose
                git clone https://github.com/ritik-rkg/Talent_Bridge_Compose.git
                '''
            }
        }
```

2. **Stage 2: Backend Testing**

- Installs backend dependencies and testing tools (e.g., Mocha, Chai).
- Runs backend test scripts to validate functionality.

```
stage("Stage 2: Backend Testing") {
    steps {
        sh '''
        cd backend
        npm i
        cd tests
        npm install mocha chai sinon prom-client
        npm test
        '''
    }
}
```

3. **Stage 3: Build Frontend**
    - Installs frontend dependencies and builds the project.
    - Generates production-ready static files.

```
stage("Stage 3: Build frontend") {
    steps {
        sh '''
        cd Talent_Bridge_Compose/frontend
        npm install
        npm run build
        '''
    }
}
```

4. **Stage 4: Remove Docker Images and Containers**
    - Cleans up unused Docker images and containers to free space.

```
stage("Stage 4: Remove docker images and container") {
    steps {
        sh "docker container prune -f"
        sh "docker image prune -a -f"
    }
}
```

5. **Stage 5: Create Docker Image for Frontend**
    - Builds a Docker image for the frontend application using its Dockerfile.

```
stage("Stage 5: Creating Docker Image for frontend") {
    steps {
        sh '''
        cd Talent_Bridge_Compose/frontend
        docker build -t ritikgupta0114/frontend:latest .
        '''
    }
}
```

6. **Stage 6: Scan Docker Image for Frontend**
    - Uses Trivy to scan the Docker image for vulnerabilities.

```
stage("Stage 6: Scan Docker Image for frontend") {
    steps {
        sh '''
        trivy image ritikgupta0114/frontend:latest
        '''
    }
}
```

7. **Stage 7: Push Frontend Docker Image**
    - Logs into Docker Hub and pushes the frontend image to the repository.

```
stage("Stage 7: Push Frontend Docker Image") {
    steps {
        sh '''
        docker login -u ${DOCKERHUB_CRED_USR} -p ${DOCKERHUB_CRED_PSW}
        docker push ritikgupta0114/frontend:latest
        '''
    }
}
```

8. **Stage 8: Create Docker Image for Backend**
    - Builds a Docker image for the backend application using its Dockerfile.

```
stage("Stage 8: Creating Docker Image for backend") {
    steps {
        sh '''
        cd Talent_Bridge_Compose/backend
        docker build -t ritikgupta0114/backend:latest .
        '''
    }
}
```

9. **Stage 9: Scan Docker Image for Backend**
    - Scans the backend Docker image for vulnerabilities using Trivy.

```
stage("Stage 9: Scan Docker Image for backend") {
    steps {
        sh '''
        trivy image ritikgupta0114/backend:latest
        '''
    }
}
```

10. **Stage 10: Push Backend Docker Image**
    - Pushes the backend Docker image to Docker Hub.

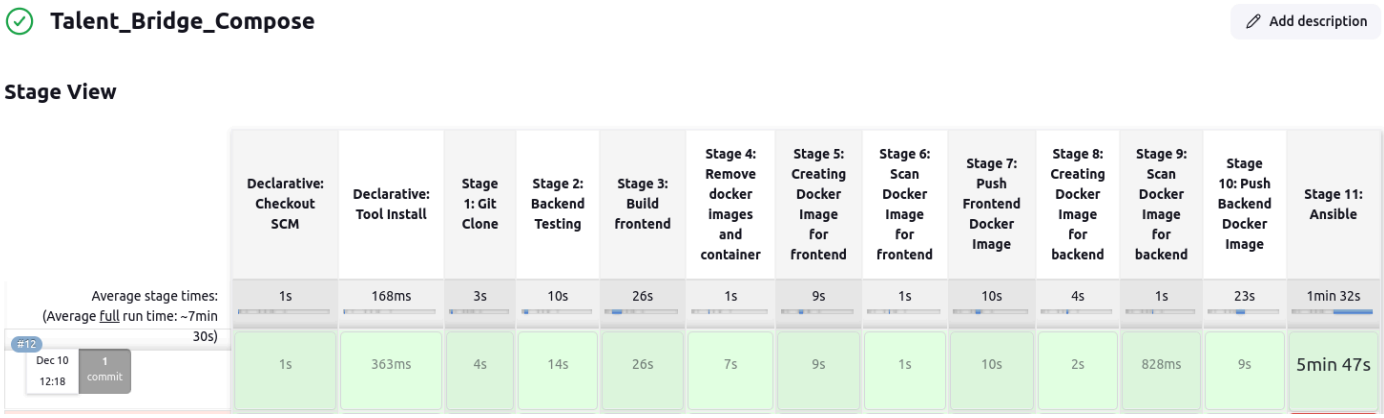
```
stage("Stage 10: Push Backend Docker Image") {
    steps {
        sh '''
        docker login -u ${DOCKERHUB_CRED_USR} -p ${DOCKERHUB_CRED_PSW}
        docker push ritikgupta0114/backend:latest
        '''
    }
}
```

11. **Stage 11: Ansible Deployment**
    - Executes an Ansible playbook to deploy the application using Docker Compose.
    - Handles sensitive credentials securely and cleans them after use.

```
        stage("Stage 11: Ansible") {
            steps {
                sh '''
                cd Talent_Bridge_Compose
                echo "$VAULT_PASS" > /tmp/vault_pass.txt
                chmod 600 /tmp/vault_pass.txt

                # Export become password if needed
                echo "$BECOME_PASS" > /tmp/become_pass.txt
                chmod 600 /tmp/become_pass.txt

                # Run the Ansible playbook with sudo privilege
                ansible-playbook -i inventory --vault-password-file /tmp/vault_pass.txt --extra-vars "ansible_become_pass=$(cat /
                tmp/become_pass.txt)" playbook-new.yaml

                # Clean up sensitive files
                rm -f /tmp/vault_pass.txt /tmp/become_pass.txt
                '''
            }
        }
    }
}
```

Steps to Run the Pipeline

1. **Create a New Pipeline Job**:
    - Go to `Jenkins Dashboard > New Item`.
    - Choose "Pipeline" and provide a name for the job.
2. **Configure the Pipeline**:
    - Under the "Pipeline" section, choose "Pipeline script" and paste the Jenkinsfile.
3. **Trigger the Build**:
    - Save the job configuration and click "Build Now" to execute the pipeline.



```
Run `npm audit` for details.
+ npm test

> backend@1.0.0 test
> mocha ./tests/*.spec.js



  Job Application Controller
    applyJob
      ✔ should create a new application if the user has not applied before
      ✔ should return an error if the user has already applied for the job
      ✔ should return an error if the job is not found
    updateStatus
      ✔ should update the status of an application
      ✔ should return an error if the status is not provided
      ✔ should return an error if the application is not found


  6 passing (33ms)

[Pipeline] }
[Pipeline] // withEnv
```

```
+ cd Talent_Bridge_Compose
+ echo ****
+ chmod 600 /tmp/vault_pass.txt
+ echo ****
+ chmod 600 /tmp/become_pass.txt
+ cat /tmp/become_pass.txt
+ ansible-playbook -i inventory --vault-password-file /tmp/vault_pass.txt --extra-vars ansible_become_pass=**** playbook-new.yaml

PLAY [Deploying with Docker-Compose] ***************************************

TASK [Gathering Facts] *****************************************************
ok: [localhost]

TASK [git_clone : Clone the repository for Docker Compose] *****************
changed: [localhost]

TASK [deploy_docker_compose : Set COMPOSE_HTTP_TIMEOUT to 300] *************
changed: [localhost]

TASK [deploy_docker_compose : Deploy the application using Docker Compose] *****
changed: [localhost]

PLAY RECAP *****************************************************************
localhost                  : ok=4    changed=3    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0

+ rm -f /tmp/vault_pass.txt /tmp/become_pass.txt
```

```
[Pipeline] }
[Pipeline] // withEnv
[Pipeline] }
[Pipeline] // stage
[Pipeline] }
[Pipeline] // withEnv
[Pipeline] }
[Pipeline] // withEnv
[Pipeline] }
[Pipeline] // withCredentials
[Pipeline] }
[Pipeline] // withEnv
[Pipeline] }
[Pipeline] // node
[Pipeline] End of Pipeline
Finished: SUCCESS
```

Continuous Integration Pipeline for Kubernetes Setup:

This Jenkins pipeline automates the build, test, and deployment process for a project using Kubernetes. The stages from **1 to 10** are the same as in the Docker Compose setup, focusing on code cloning, building, testing, and pushing Docker images. In **Stage 11**, the application is deployed to a Kubernetes cluster using `kubectl` commands and manifests.

Stage 11: Ansible Deployment

- Executes an Ansible playbook to deploy the application using Docker Compose.
- Handles sensitive credentials securely and cleans them after use.

```
stage("Stage 11: Ansible"){
    steps {
        sh '''
        cd Talent_Bridge_K8s
        echo "$VAULT_PASS" > /tmp/vault_pass.txt
        chmod 600 /tmp/vault_pass.txt
        ansible-playbook -i inventory-k8 --vault-password-file /tmp/vault_pass.txt playbook-k8-new.yaml
        rm -f /tmp/vault_pass.txt
        '''
    }

}
```

Talent_Bridge_Kubernetes

Add description

Stage View

	Declarative: Checkout SCM	Declarative: Tool Install	Stage 1: Git Clone	Stage 2: Backend Testing	Stage 3: Build frontend	Stage 4: Remove docker images and container	Stage 5: Creating Docker Image for frontend	Stage 6: Scan Docker Image for frontend	Stage 7: Push Frontend Docker Image	Stage 8: Creating Docker Image for backend	Stage 9: Scan Docker Image for backend	Stage 10: Push Backend Docker Image	Stage 11: Ansible
Average stage times: (Average full run time: ~5min 36s)	1s	492ms	2s	15s	32s	22s	25s	27s	1min 16s	25s	12s	1min 6s	13s
#1 Dec 10 16:13 No Changes	1s	492ms	2s	15s	32s	22s	25s	27s	1min 16s	25s	12s	1min 6s	13s

```
PLAY [Deploying with Kubernetes] ***********************************************

TASK [Gathering Facts] *********************************************************
ok: [localhost]

TASK [Show ansible_user] *******************************************************
ok: [localhost] => {
    "msg": "The ansible_user is ritik"
}

TASK [Clone the repository] ****************************************************
changed: [localhost]

TASK [Apply Kubernetes manifests] **********************************************
changed: [localhost]

PLAY RECAP *********************************************************************
localhost                  : ok=4    changed=2    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0

+ rm -f /tmp/vault_pass.txt
```

```
+ rm -f /tmp/vault_pass.txt
[Pipeline] }
[Pipeline] // withEnv
[Pipeline] }
[Pipeline] // stage
[Pipeline] }
[Pipeline] // withEnv
[Pipeline] }
[Pipeline] // withEnv
[Pipeline] }
[Pipeline] // withCredentials
[Pipeline] }
[Pipeline] // withEnv
[Pipeline] }
[Pipeline] // node
[Pipeline] End of Pipeline
Finished: SUCCESS
```

Monitoring and Logging

Once deployed Monitoring is critical for maintaining the health and security of the deployment as well as the deployment infrastructure, as it allows us to quickly detect and respond to potential problems before they become critical.

Docker Compose: ELK Stack for Monitoring and Logging:

Backend Logging Code

The backend application utilizes **Morgan**, **Winston**, and **elasticsearch-winston** for structured logging. Here's how the logging is implemented:

`index.js`

```
app.use(cors(corsOptions));
app.use(
    morgan(morganFormat, {
      stream: {
        write: (message) => {
          const logObject = {
            method: message.split(" ")[0],
            url: message.split(" ")[1],
            status: message.split(" ")[2],
            responseTime: message.split(" ")[3],
          };
          logger.info(JSON.stringify(logObject));
        },
      },
    })
  );
```

Explanation of the Code

1. **Morgan**:
    - Used to log HTTP requests in a structured format.
    - Outputs method, URL, status, and response time.
    - Logs are passed to Winston via a custom `stream`.
2. **Winston**:
    - A powerful logging library that supports multiple transports.

    - Logs are sent to the console and Elasticsearch for centralized logging.
3. **elasticsearch-winston**:
    - Sends logs to Elasticsearch for storage and analysis.
    - Configured with the Elasticsearch URL.
4. **Log Object**:
    - Contains `method`, `url`, `status`, and `responseTime`.
    - JSON format ensures compatibility with Elasticsearch.

Explanation of `logger.js`

The `logger.js` file uses the **Winston** library to configure and manage application logging. It provides a flexible and customizable logging mechanism for the application.

1. Importing Modules
    - **`createLogger`**: Creates a logger instance.
    - **`format`**: Provides formatting utilities to structure log output.
    - **`transports`**: Defines where the logs are written (e.g., console, file).
    - Deconstruct specific formatting methods: `combine`, `timestamp`, `json`, `colorize`.
2. Custom Console Log Format
    - **`format.colorize()`**:
        - Adds color to log levels for better readability in the console.
    - **`format.printf()`**:
        - Customizes the log message format.
        - Outputs logs in the format: `level: message`
3. Creating the Logger

- **`level: "info"`**:
    - Sets the minimum log level to `info`. Lower levels like `debug` won't be logged.
- **`format: combine()`**:
    - Combines multiple formats:
        - **`colorize()`**: Adds color for console logs.
        - **`timestamp()`**: Adds timestamps to logs.
        - **`json()`**: Converts log messages to JSON format for structured logging.
- **`transports`**:

- Specifies where the logs are written:
  - **Console**: Logs with a custom colorful format for debugging during development.
  - **File**: Logs are also written to `app.log` in the default JSON format for persistent storage.

Job Portal > backend > JS logger.js > ...

```
1  import { createLogger, format, transports } from "winston";
2  const { combine, timestamp, json, colorize } = format;
3
4  // Custom format for console logging with colors
5  const consoleLogFormat = format.combine(
6    format.colorize(),
7    format.printf(({ level, message, timestamp }) => {
8      return `${level}: ${message}`;
9    })
10 );
11
12 // Create a Winston logger
13 const logger = createLogger({
14   level: "info",
15   format: combine(colorize(), timestamp(), json()),
16   transports: [
17     new transports.Console({
18       format: consoleLogFormat,
19     }),
20     new transports.File({ filename: "app.log" }),
21   ],
22 });
23
24 export default logger;
```

Setting up ElasticSearch, Logstash, and Kibana (ELK Stack) with Docker Compose:

```yaml
  elasticsearch:
    image: docker.elastic.co/elasticsearch/elasticsearch:7.17.10
    container_name: elasticsearch
    environment:
      - discovery.type=single-node
      - ES_JAVA_OPTS=-Xms512m -Xmx512m
    networks:
      - app-network
    volumes:
      - elasticsearch-data:/usr/share/elasticsearch/data
    ports:
      - "9200:9200"

  logstash:
    image: docker.elastic.co/logstash/logstash:7.17.10
    container_name: logstash
    volumes:
      - /home/ritik/Downloads/atalent_bridge/talentbridge/app.log:/app/app.log
      - /home/ritik/Downloads/atalent_bridge/talentbridge/logstash.conf:/usr/share/logstash/pipeline/logstash.conf:ro
    environment:
      - xpack.monitoring.enabled=false
    networks:
      - app-network
    depends_on:
      - elasticsearch
    ports:
      - "5044:5044"

  kibana:
    image: docker.elastic.co/kibana/kibana:7.17.10
    container_name: kibana
    environment:
      - ELASTICSEARCH_HOSTS=http://elasticsearch:9200
    networks:
      - app-network
    depends_on:
      - elasticsearch
    ports:
      - "5601:5601"
```

Steps to Run the ELK Stack:

1. **Create Necessary Files: Place your application logs (`app.log`) in the specified directory.**
2. **Create a `logstash.conf` file for Logstash pipeline configuration**

Explanation of logstash.conf:

This `logstash.conf` file defines how Logstash ingests, processes, and outputs log data. It reads log files from the specified path (`/app/app.log`), processes the log content using the **Grok filter** to parse structured information (like method, URL, status, and response time), and converts certain fields to appropriate data types (e.g., `response_time` to float, `status` to integer). The processed logs are sent to an Elasticsearch instance under the index `logstash_indexing` for storage and analysis. Additionally, debug logs are output to the console in a human-readable format using the `rubydebug` codec.

The **Grok filter** in the `logstash.conf` file is used to extract and structure log data based on a specific pattern. The pattern matches the log message's format, breaking it into meaningful fields such as `method`, `url`, `status`, `response_time`, and `timestamp`.

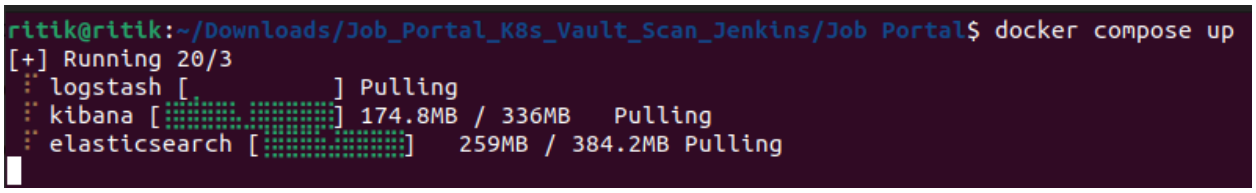
In your configuration, the Grok pattern decodes ANSI color codes and JSON-like content to extract structured data. For example:

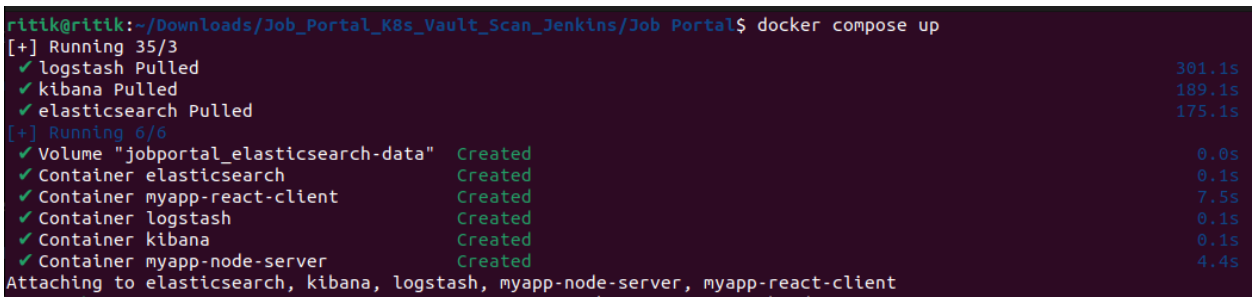
- **`method`** captures the HTTP method (e.g., GET, POST).

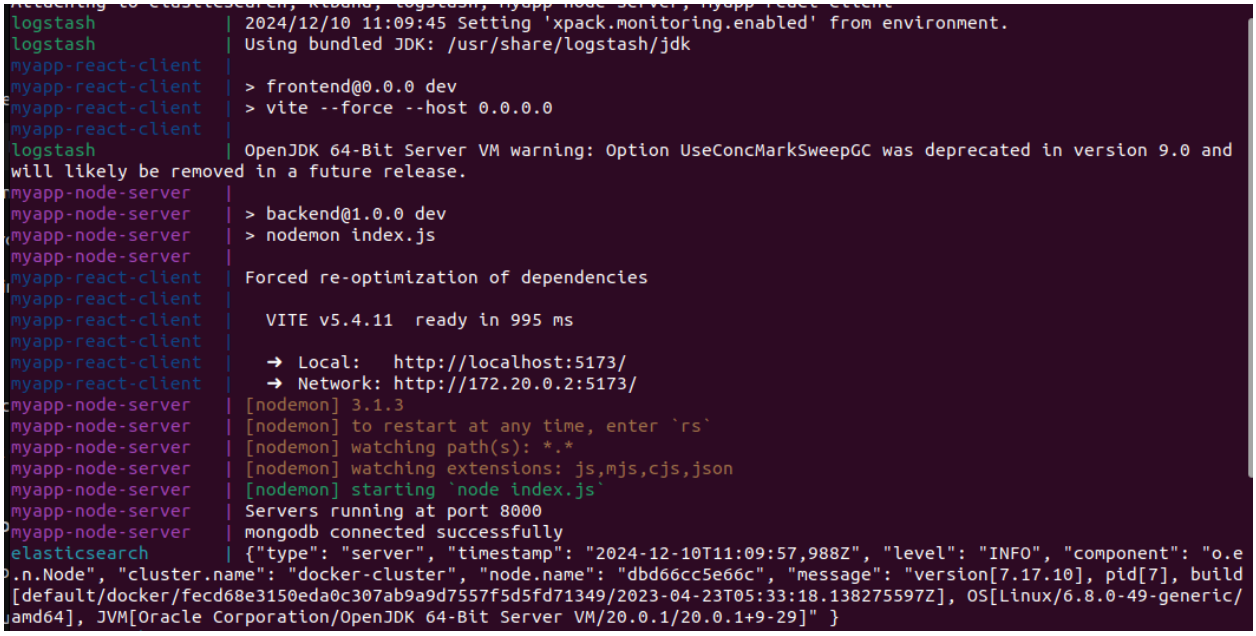
- `url` captures the endpoint being accessed.
- `status` captures the HTTP response status code.
- `response_time` captures the response time of the request.
- `timestamp` captures when the log entry was recorded.

This structured data is then processed and stored for easier querying and analysis in Elasticsearch.

3. **Start the Containers**:
    - Run the following command in the directory containing `docker-compose.yaml`:
        - docker-compose up

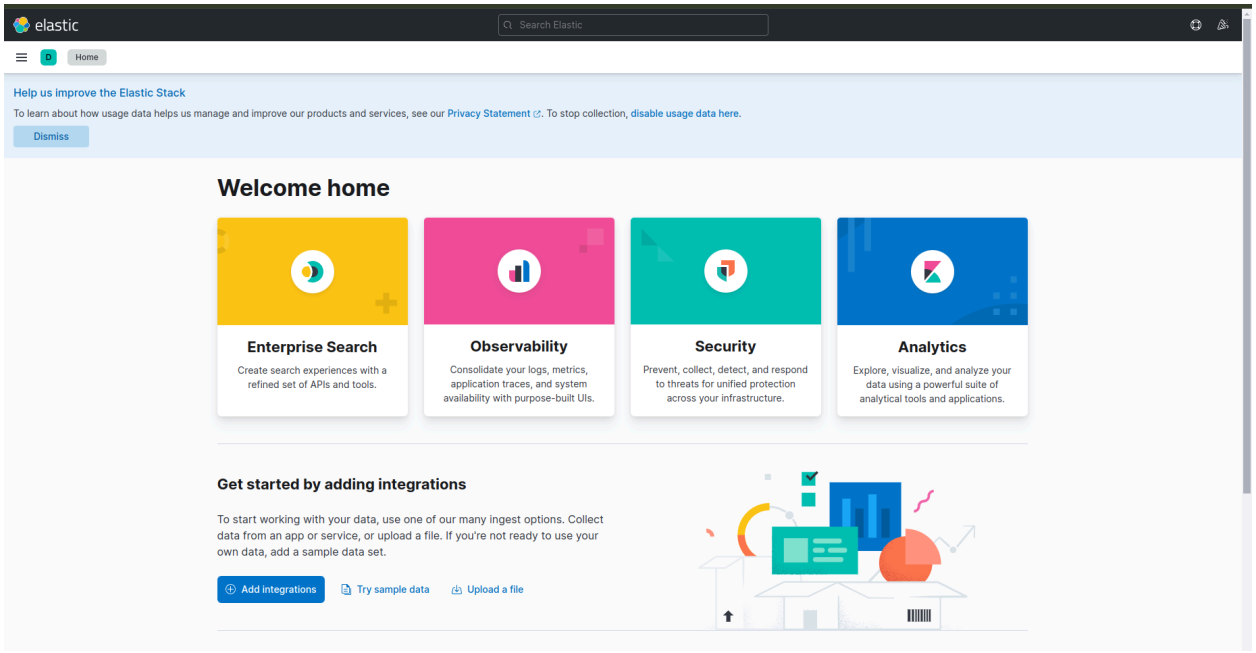




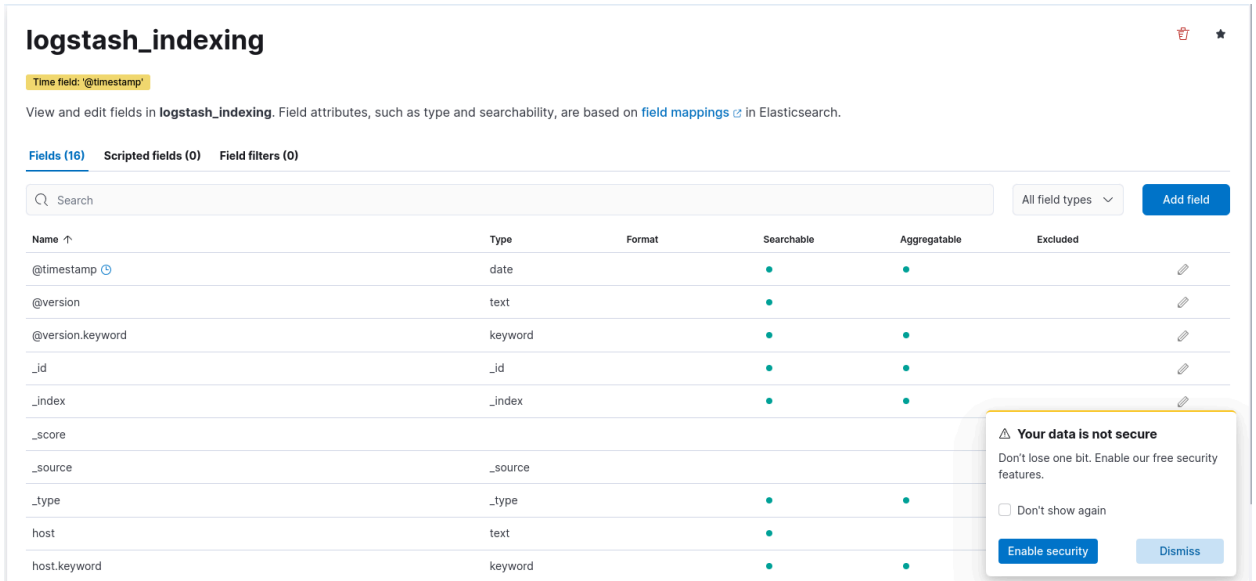


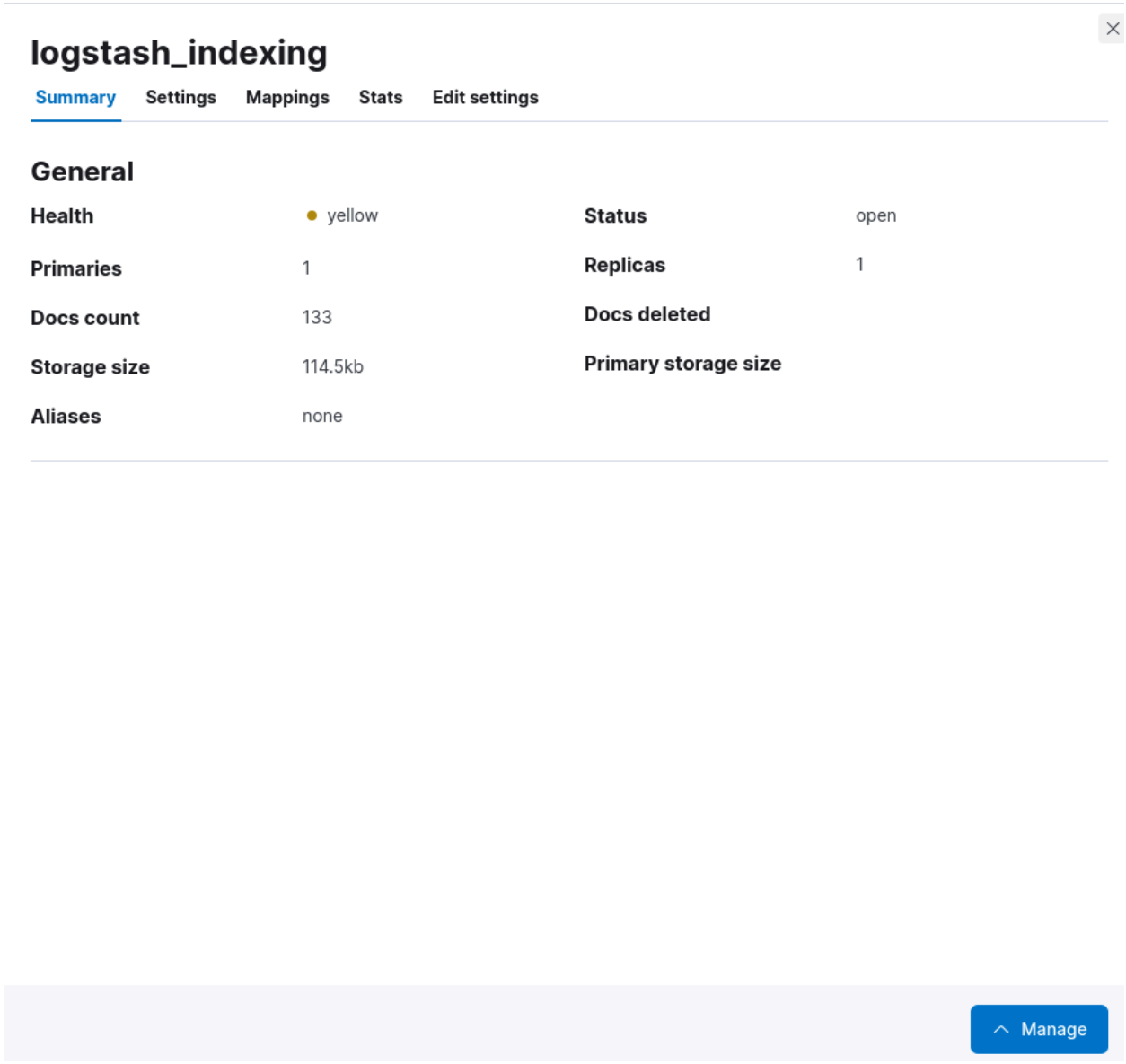
4. **Access the Services**:

- **Elasticsearch**: Access at `http://localhost:9200`.
- **Kibana**: Access at `http://localhost:5601`.

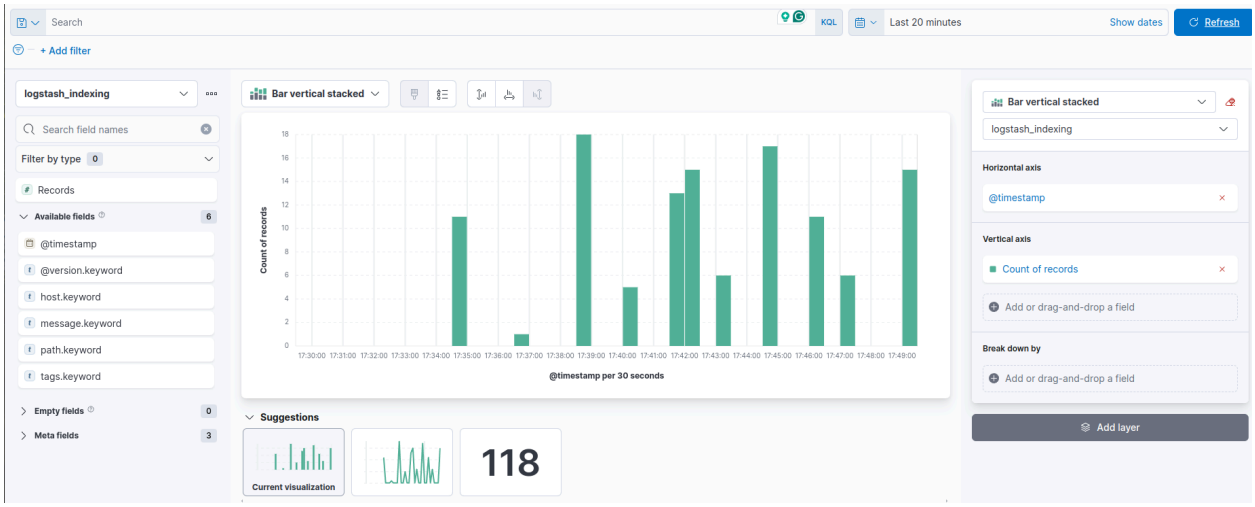


5. **Verify Logs in Kibana**:
   - Open Kibana and navigate to the **Discover** section.
   - Configure an index pattern matching Elasticsearch indices (e.g., `logstash-*`).
   - View logs from your application in Kibana.

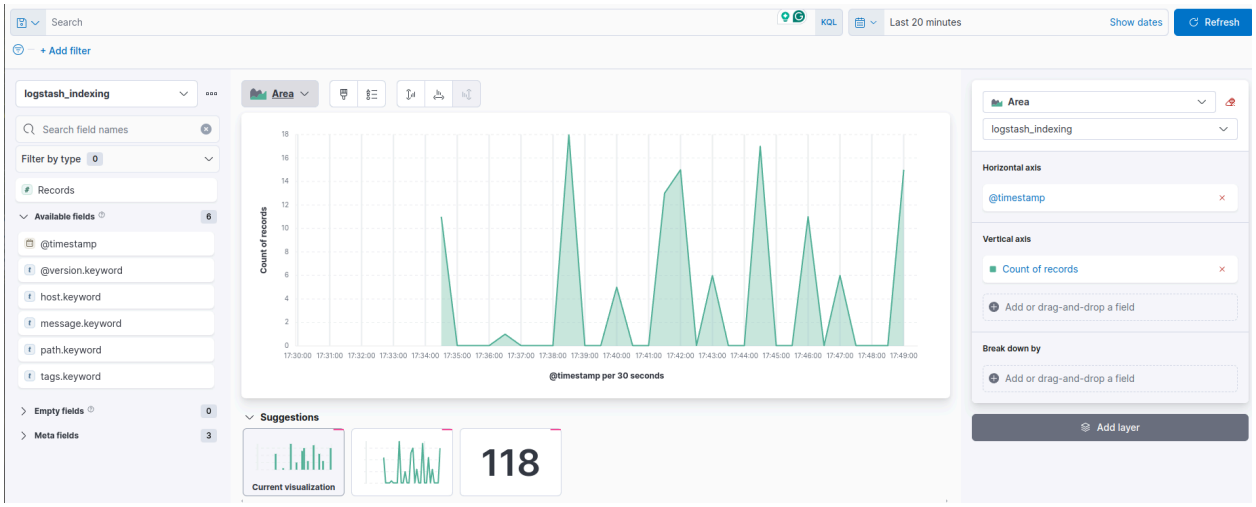




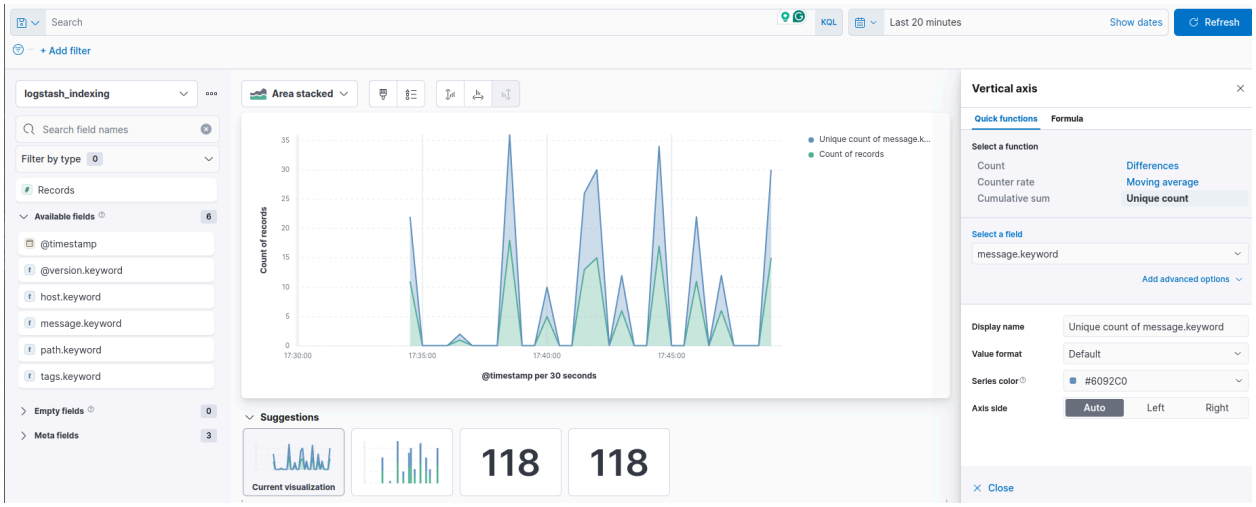
Visualization - 1: Bar Vertical Stacked



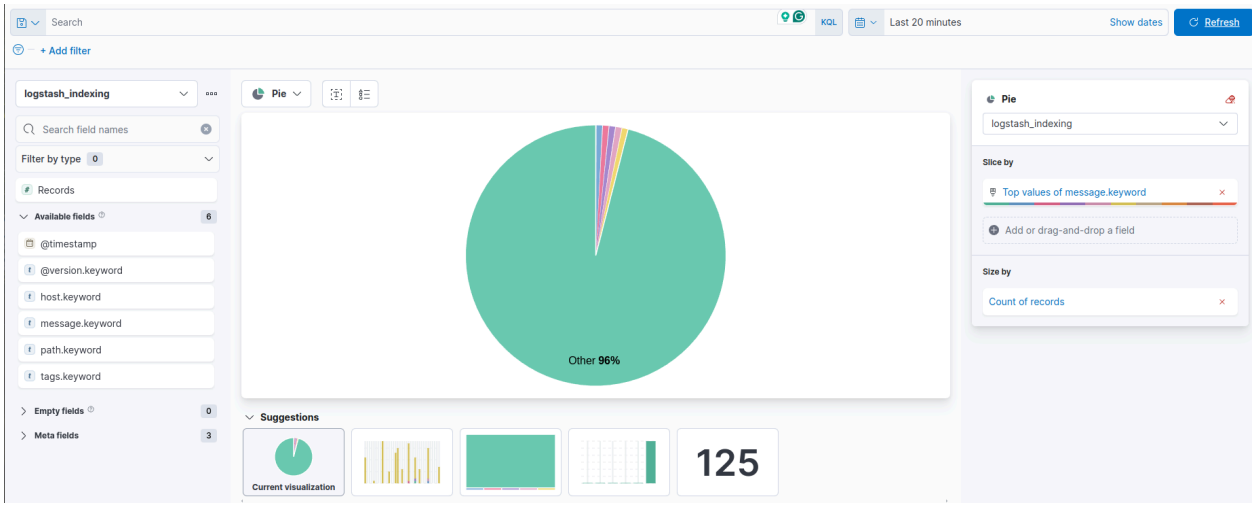
Visualization - 2: Area Plot



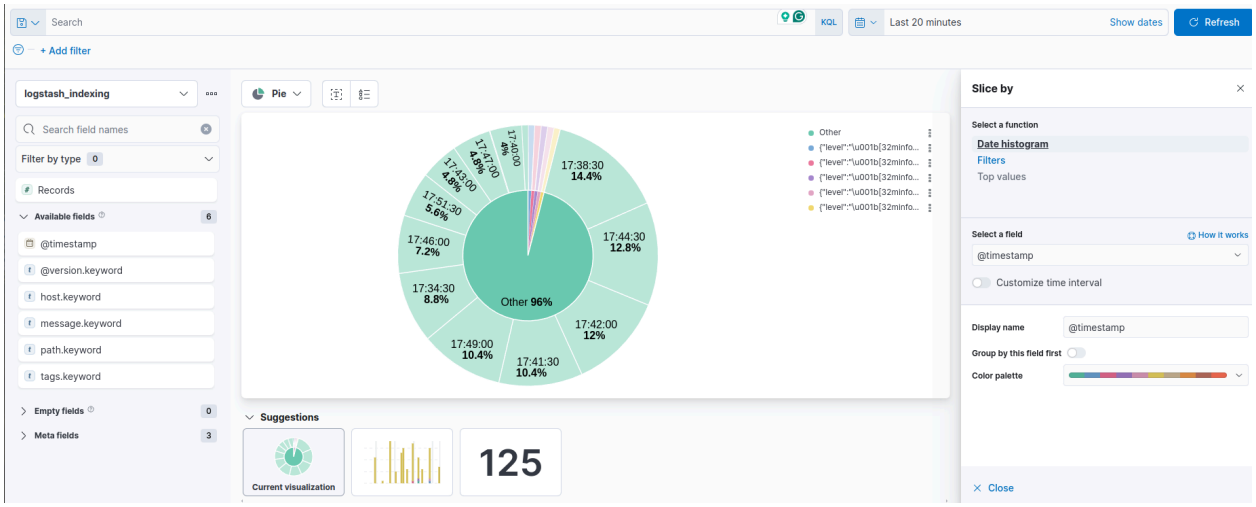
Visualization - 3: Area Stacked Plot



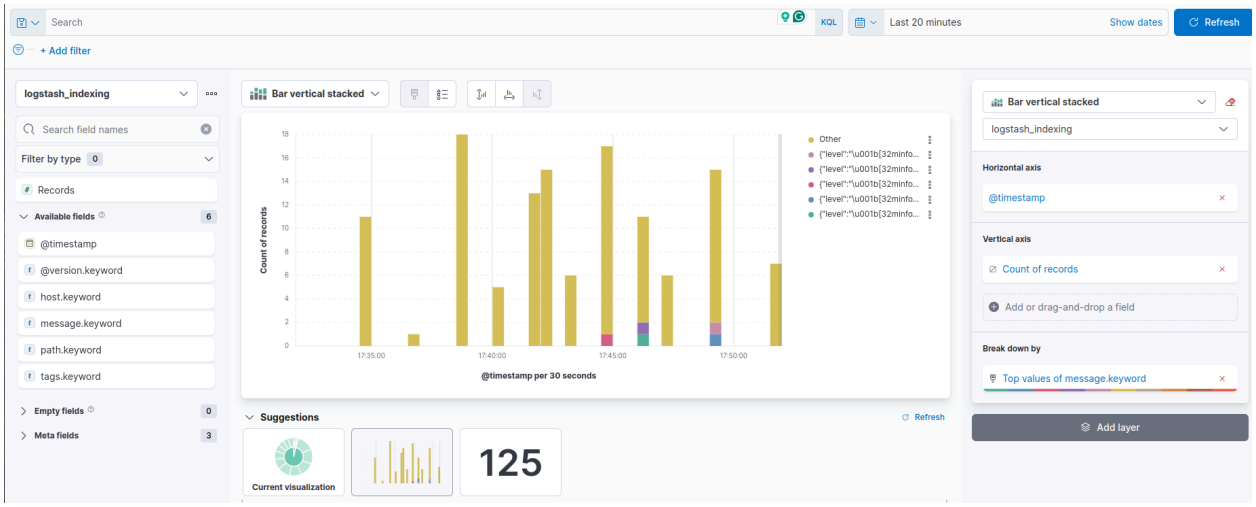
Visualization - 4: Pie Chart

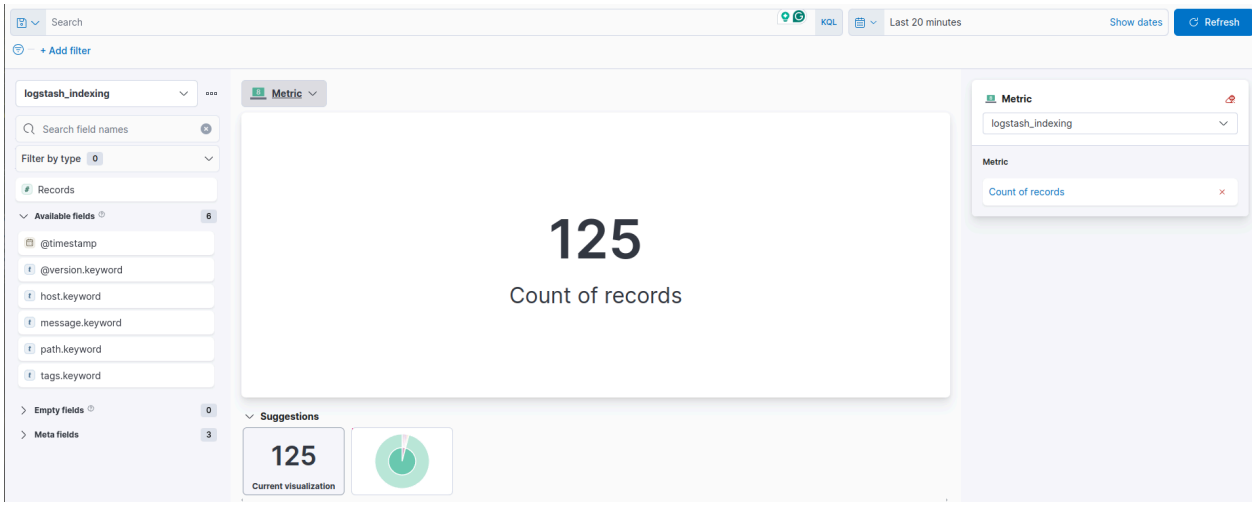


Visualization - 5: Pie Chart - 2

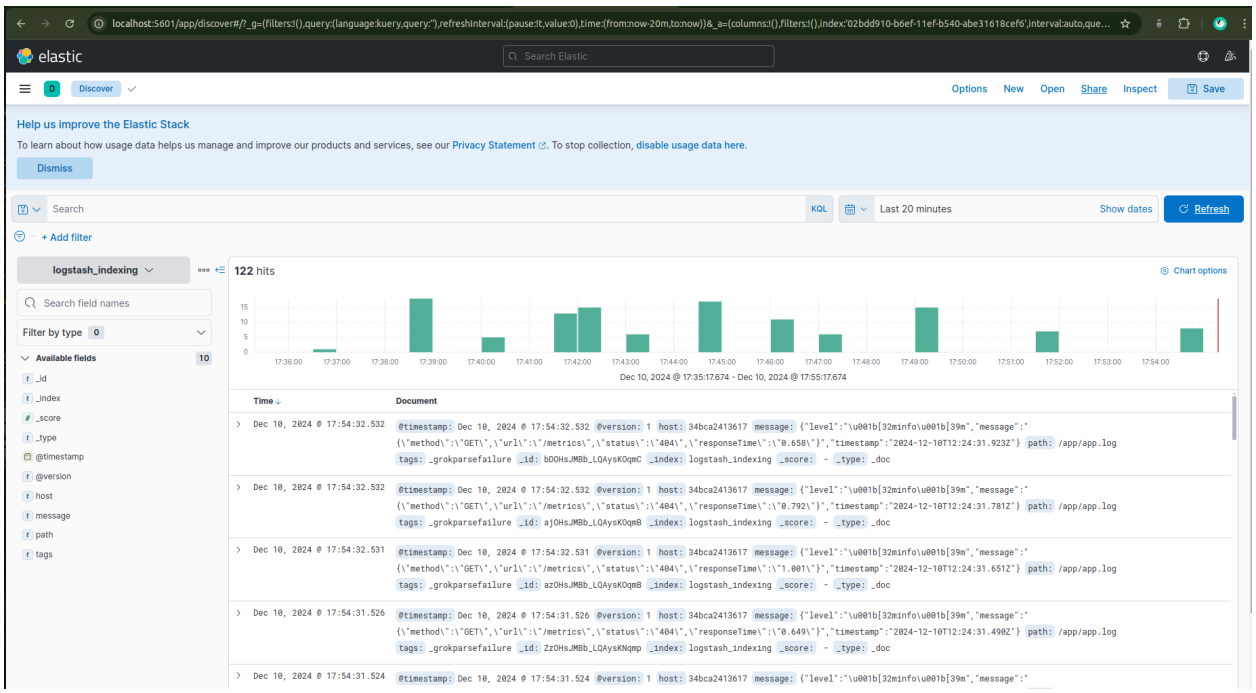


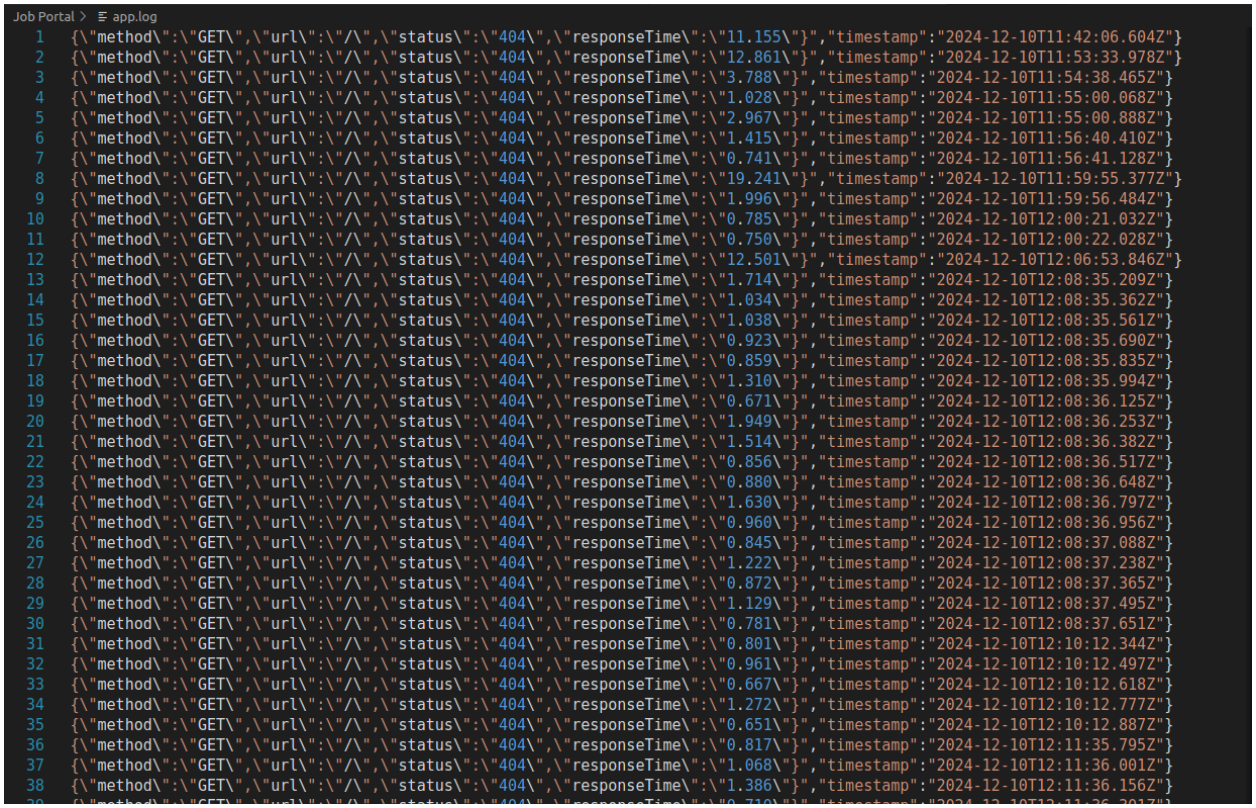
Visualization - 6: Bar Vertical Stacked





Kibana Dashboard





Kubernetes: Prometheus and Grafana for Monitoring and Logging

Prometheus and Grafana are commonly used together for robust monitoring and visualization in Kubernetes environments.

Setup Steps:

1. **Install Helm**: Helm is a package manager for Kubernetes. Install Helm using the following command:
    a. `curl https://raw.githubusercontent.com/helm/helm/main/scripts/get-helm-3 | bash`
2. **Pull Loki Docker Image**: Loki is a log aggregation tool that integrates seamlessly with Grafana. Pull the Loki image:
    a. `docker pull grafana/loki:2.9.3`
3. **Pull Promtail Docker Image**: Promtail is an agent used to collect logs and forward them to Loki. Pull the Promtail image:
    a. `docker pull grafana/promtail:2.9.3`

4. **Pull Grafana Docker Image**: Grafana provides visualizations and dashboards. Pull the latest Grafana image:
    a. `docker pull grafana/grafana:latest`
5. **Add Grafana Helm Repository**:
    a. helm repo add grafana https://grafana.github.io/helm-charts
6. **Install Loki Stack Using Helm**: Deploy Loki, Promtail, Prometheus, and Grafana together in the `monitoring` namespace. Customize the configuration using the Helm command:
    a. helm install loki grafana/loki-stack \ --namespace monitoring \ --create-namespace \ --set loki.image.tag=2.9.3 \ --set promtail.enabled=true \ --set promtail.config.server.http_listen_port=3101 \ --set promtail.config.clients[0].url=http://loki:3100/loki/api/v1/push \ --set promtail.config.positions.filename=/run/promtail/positions.yaml \ --set promtail.config.scrape_configs[0].job_name="kubernetes-pods" \ --set promtail.config.scrape_configs[0].kubernetes_sd_configs[0].role="pod" \ --set promtail.config.scrape_configs[0].relabel_configs[0].action="keep" \ --set promtail.config.scrape_configs[0].relabel_configs[0].source_labels="[_meta_kubernetes_namespace]" \ --set promtail.config.scrape_configs[0].relabel_configs[0].regex=".*" \ --set promtail.config.scrape_configs[0].relabel_configs[1].source_labels="[meta_kubernetes_pod_name]" \ --set promtail.config.scrape_configs[0].relabel_configs[1].target_label="job" \ --set promtail.config.scrape_configs[0].relabel_configs[2].source_labels="[meta_kubernetes_namespace]" \ --set promtail.config.scrape_configs[0].relabel_configs[2].target_label="namespace" \ --set promtail.config.scrape_configs[0].relabel_configs[3].source_labels="[_meta_kubernetes_pod_name]" \ --set promtail.config.scrape_configs[0].relabel_configs[3].target_label="pod" \ --set grafana.enabled=true \ --set prometheus.enabled=true
7. **Port-Forward Prometheus, Grafana, and Loki:**
    a. kubectl port-forward --namespace monitoring svc/loki-prometheus-server 9090:80

b. kubectl port-forward --namespace monitoring service/loki-grafana 3000:80
c. kubectl port-forward svc/loki -n monitoring 3100:3100

8. **Retrieve Grafana Admin Password:**
    a. kubectl get secret loki-grafana -n monitoring -o jsonpath="{.data.admin-password}" | base64 --decode

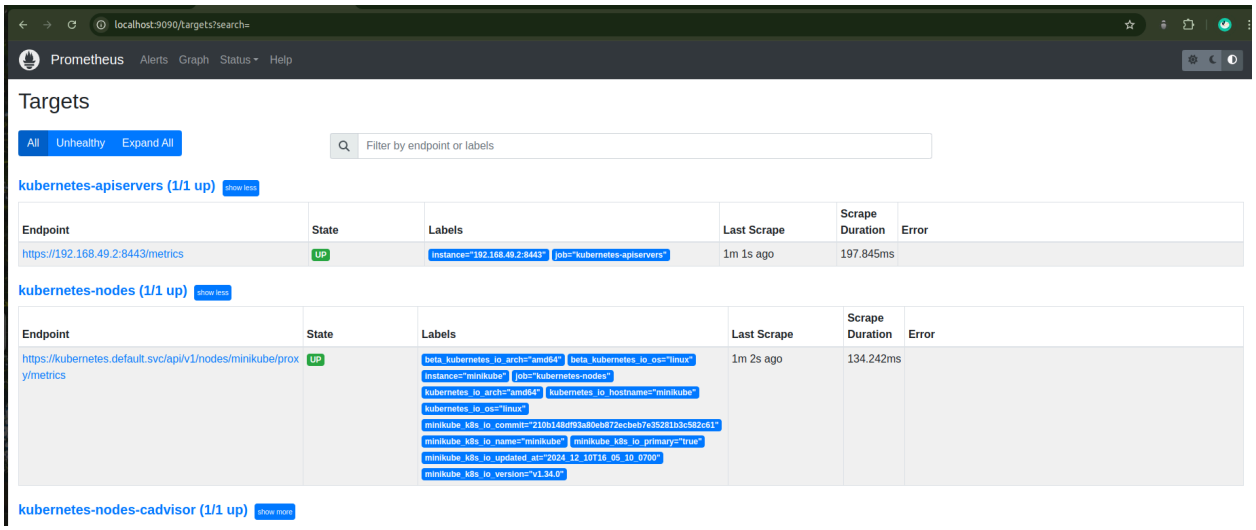
```
ritik@ritik:~/Downloads/Talent_Bridge_Kubernetes$ kubectl get all -n monitoring
NAME                                            READY   STATUS    RESTARTS   AGE
pod/loki-0                                      1/1     Running   0          4m10s
pod/loki-alertmanager-0                         1/1     Running   0          4m10s
pod/loki-grafana-847987dcd7-h8qp2               2/2     Running   0          4m11s
pod/loki-kube-state-metrics-85d4bdcbc5-5qkl2    1/1     Running   0          4m11s
pod/loki-prometheus-node-exporter-5wvvd         1/1     Running   0          4m11s
pod/loki-prometheus-pushgateway-7999888c99-dn69m   1/1     Running   0          4m11s
pod/loki-prometheus-server-598f8bc7d5-bgnpm     2/2     Running   0          4m11s
pod/loki-promtail-5gl2k                         1/1     Running   0          4m11s

NAME                                    TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)    AGE
service/loki                            ClusterIP   10.99.136.107    <none>        3100/TCP   4m11s
service/loki-alertmanager               ClusterIP   10.99.109.79     <none>        9093/TCP   4m11s
service/loki-alertmanager-headless      ClusterIP   None             <none>        9093/TCP   4m11s
service/loki-grafana                    ClusterIP   10.100.210.95    <none>        80/TCP     4m11s
service/loki-headless                   ClusterIP   None             <none>        3100/TCP   4m11s
service/loki-kube-state-metrics         ClusterIP   10.103.144.25    <none>        8080/TCP   4m11s
service/loki-memberlist                 ClusterIP   None             <none>        7946/TCP   4m11s
service/loki-prometheus-node-exporter   ClusterIP   10.98.140.106    <none>        9100/TCP   4m11s
service/loki-prometheus-pushgateway     ClusterIP   10.109.100.71    <none>        9091/TCP   4m11s
service/loki-prometheus-server          ClusterIP   10.100.128.143   <none>        80/TCP     4m11s
```

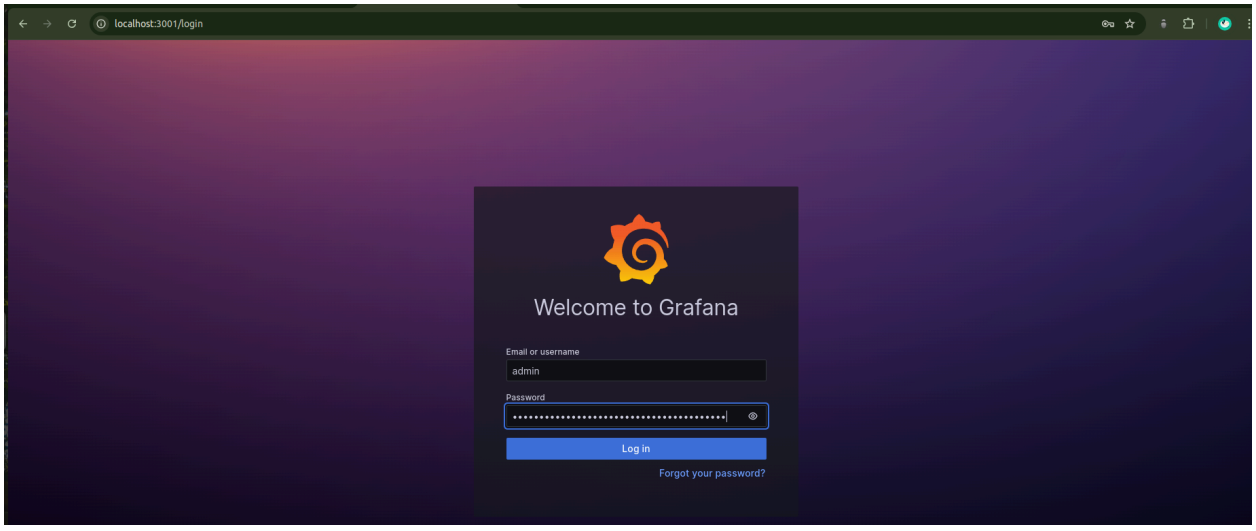
```
ritik@ritik:~/Downloads/Talent_Bridge_Kubernetes$ kubectl port-forward --namespace
 monitoring svc/loki-prometheus-server 9090:80
Forwarding from 127.0.0.1:9090 -> 9090
Forwarding from [::1]:9090 -> 9090
```

```
ritik@ritik:~/Downloads/Talent_Bridge_Kubernetes$ kubectl port-forward --namespace
 monitoring service/loki-grafana 3001:80
Forwarding from 127.0.0.1:3001 -> 3000
Forwarding from [::1]:3001 -> 3000
```

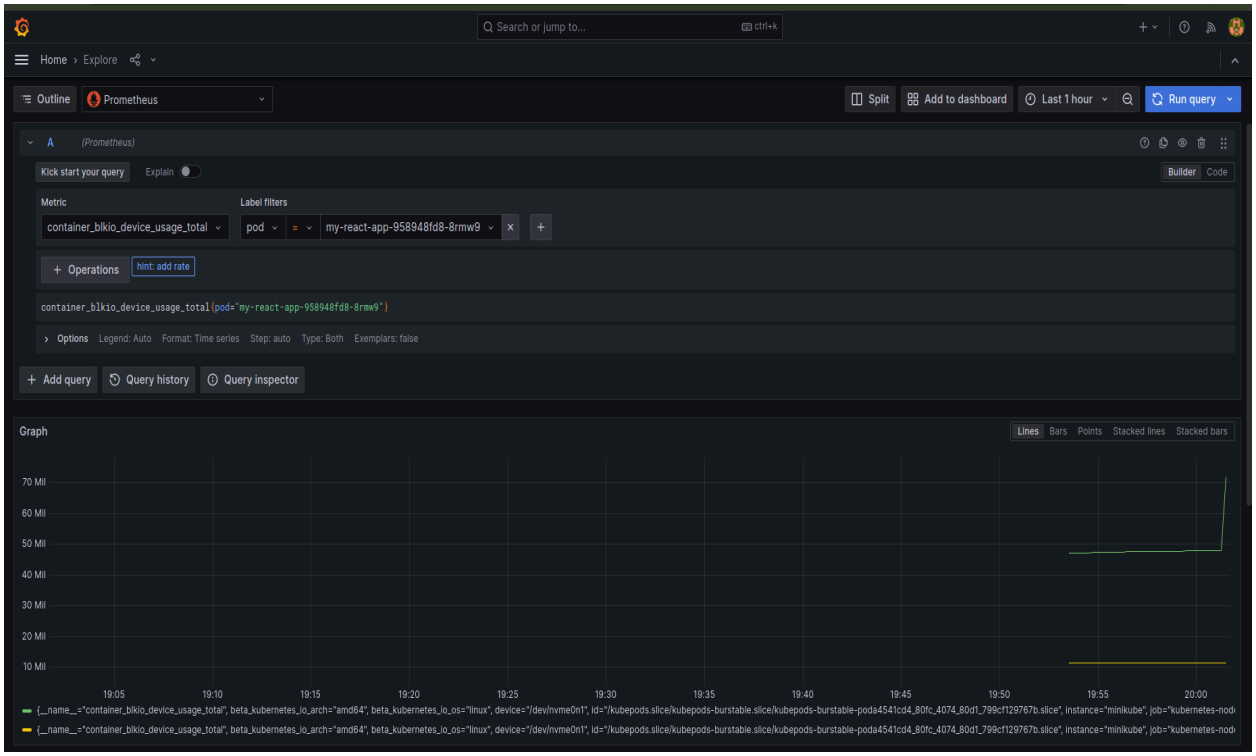
```
ritik@ritik:~/Downloads/Talent_Bridge_Kubernetes$ kubectl port-forward svc/loki -n
 monitoring 3100:3100
Forwarding from 127.0.0.1:3100 -> 3100
Forwarding from [::1]:3100 -> 3100
```

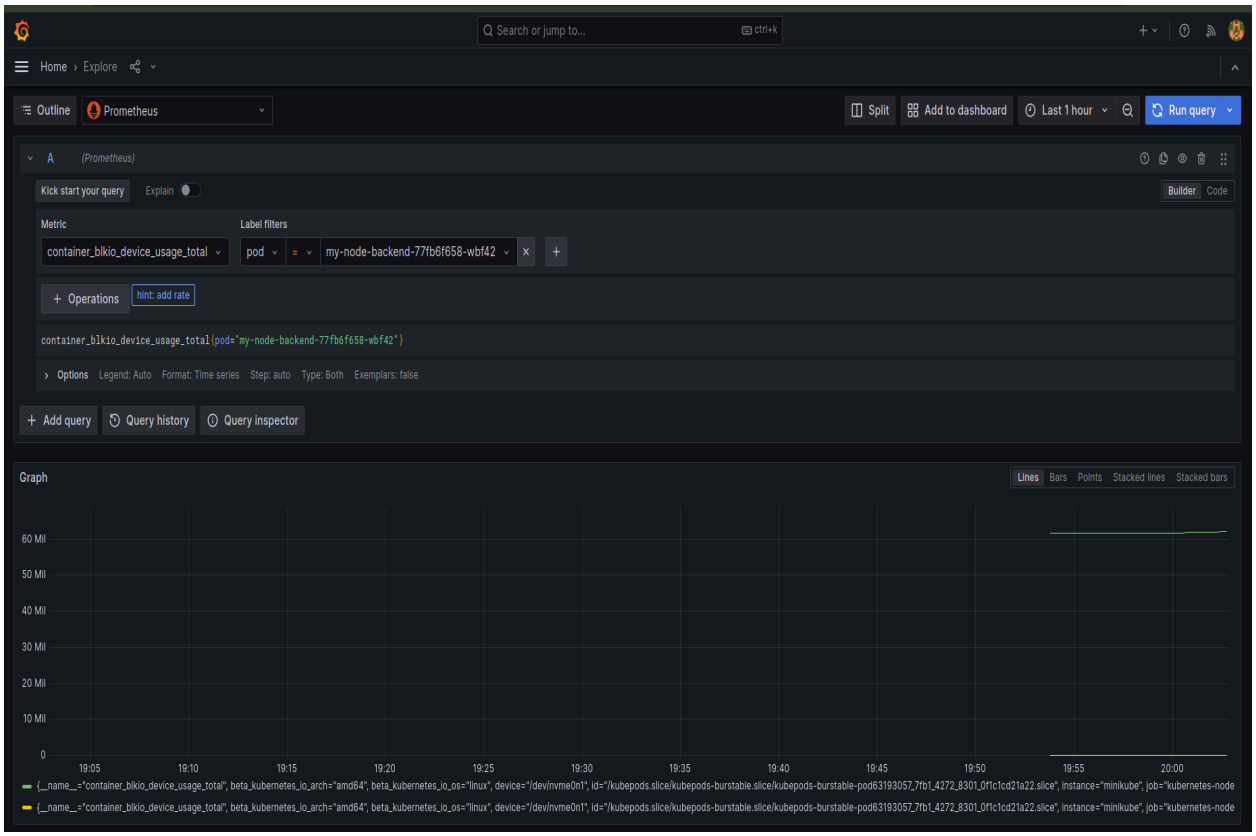
```
ritik@ritik:~/Downloads/Talent_Bridge_Kubernetes$ kubectl get secret loki-grafana
-n monitoring -o jsonpath="{.data.admin-password}" | base64 --decode
xfOFagYJIaJ6gZqC7yzbrfjgzhrLm22IO28EGs2dritik@ritik:~/Downloads/Talent_Bridge_Kube
rnetes$
```

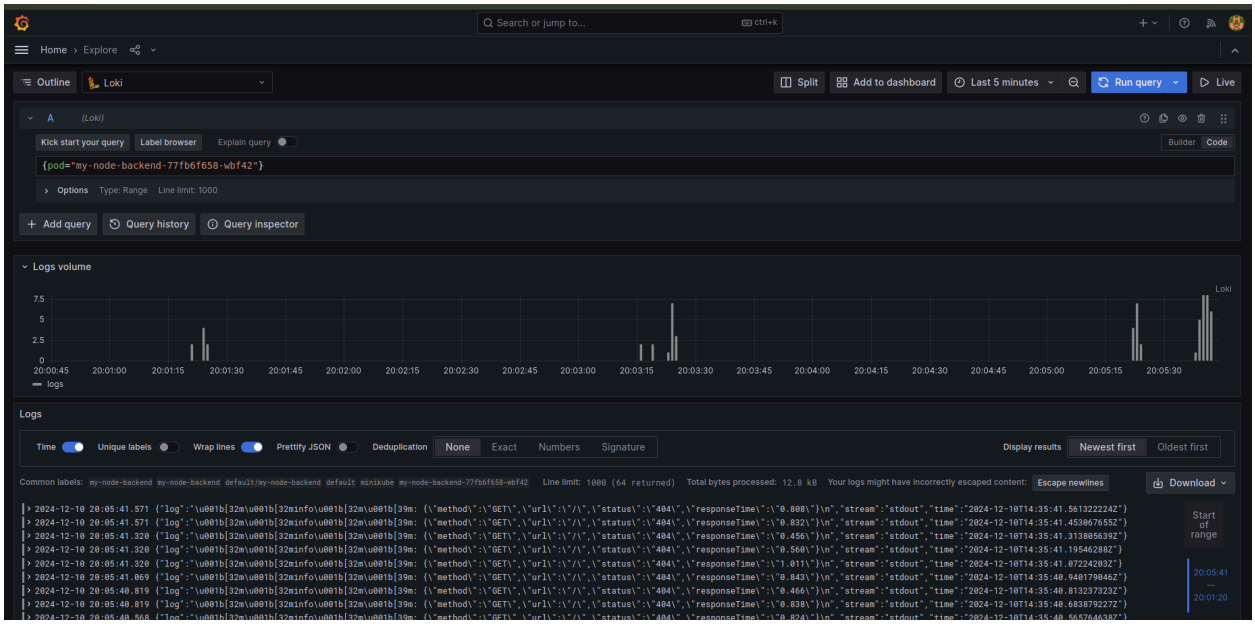





```
ritik@ritik:~/Downloads/Talent_Bridge_Kubernetes$ kubectl get pods
NAME                                READY   STATUS    RESTARTS   AGE
my-node-backend-77fb6f658-wbf42     1/1     Running   0          14m
my-react-app-958948fd8-8rmw9        1/1     Running   0          14m
```


Search or jump to... ctrl+k
Home › Explore
Outline
Prometheus
Split
Add to dashboard
Last 1 hour
Run query
A (Prometheus)
Kick start your query
Explain
Builder Code
Metric
Label filters
container_blkio_device_usage_total
pod = my-react-app-958948fd8-8rmw9
Operations
hint: add rate
container_blkio_device_usage_total{pod="my-react-app-958948fd8-8rmw9"}
Options Legend: Auto Format: Time series Step: auto Type: Both Exemplars: false
Add query
Query history
Query inspector
Graph
Lines Bars Points Stacked lines Stacked bars
70 Mil
60 Mil
50 Mil
40 Mil
30 Mil
20 Mil
10 Mil
19:05 19:10 19:15 19:20 19:25 19:30 19:35 19:40 19:45 19:50 19:55 20:00
{__name__="container_blkio_device_usage_total", beta_kubernetes_io_arch="amd64", beta_kubernetes_io_os="linux", device="/dev/nvme0n1", id="/kubepods.slice/kubepods-burstable.slice/kubepods-burstable-poda4541cd4_80fc_4074_80d1_799cf129767b.slice", instance="minikube", job="kubernetes-node
{__name__="container_blkio_device_usage_total", beta_kubernetes_io_arch="amd64", beta_kubernetes_io_os="linux", device="/dev/nvme0n1", id="/kubepods.slice/kubepods-burstable.slice/kubepods-burstable-poda4541cd4_80fc_4074_80d1_799cf129767b.slice", instance="minikube", job="kubernetes-node


Search or jump to... ctrl+k
Home › Explore
Outline
Prometheus
Split
Add to dashboard
Last 1 hour
Run query
A (Prometheus)
Kick start your query
Explain
Builder Code
Metric
Label filters
container_blkio_device_usage_total
pod = my-node-backend-77fb6f658-wbf42
Operations
hint: add rate
container_blkio_device_usage_total{pod="my-node-backend-77fb6f658-wbf42"}
Options Legend: Auto Format: Time series Step: auto Type: Both Exemplars: false
Add query
Query history
Query inspector
Graph
Lines Bars Points Stacked lines Stacked bars
60 Mil
50 Mil
40 Mil
30 Mil
20 Mil
10 Mil
0
19:05 19:10 19:15 19:20 19:25 19:30 19:35 19:40 19:45 19:50 19:55 20:00
{__name__="container_blkio_device_usage_total", beta_kubernetes_io_arch="amd64", beta_kubernetes_io_os="linux", device="/dev/nvme0n1", id="/kubepods.slice/kubepods-burstable.slice/kubepods-burstable-pod63193057_7fb1_4272_8301_0f1c1cd21a22.slice", instance="minikube", job="kubernetes-node
{__name__="container_blkio_device_usage_total", beta_kubernetes_io_arch="amd64", beta_kubernetes_io_os="linux", device="/dev/nvme0n1", id="/kubepods.slice/kubepods-burstable.slice/kubepods-burstable-pod63193057_7fb1_4272_8301_0f1c1cd21a22.slice", instance="minikube", job="kubernetes-node


Search or jump to... ctrl+k
Home › Explore
Outline
Loki
Split
Add to dashboard
Last 5 minutes
Run query
Live
A (Loki)
Kick start your query
Label browser
Explain query
Builder
Code
{pod="my-node-backend-77fb6f658-wbf42"}
Options Type: Range Line limit: 1000
Add query
Query history
Query inspector
Logs volume
Loki
7.5
5
2.5
0
20:00:45 20:01:00 20:01:15 20:01:30 20:01:45 20:02:00 20:02:15 20:02:30 20:02:45 20:03:00 20:03:15 20:03:30 20:03:45 20:04:00 20:04:15 20:04:30 20:04:45 20:05:00 20:05:15 20:05:30
logs
Logs
Time
Unique labels
Wrap lines
Prettify JSON
Deduplication
None
Exact
Numbers
Signature
Display results
Newest first
Oldest first
Common labels: my-node-backend my-node-backend default/my-node-backend default minikube my-node-backend-77fb6f658-wbf42
Line limit: 1000 (64 returned)
Total bytes processed: 12.8 kB
Your logs might have incorrectly escaped content:
Escape newlines
Download
2024-12-10 20:05:41.571 {"log":"\u001b[32m\u001b[32minfo\u001b[32m\u001b[39m: {\"method\":\"GET\",\"url\":\"/\",\"status\":\"404\",\"responseTime\":\"0.808\"}\n","stream":"stdout","time":"2024-12-10T14:35:41.561322224Z"}
2024-12-10 20:05:41.571 {"log":"\u001b[32m\u001b[32minfo\u001b[32m\u001b[39m: {\"method\":\"GET\",\"url\":\"/\",\"status\":\"404\",\"responseTime\":\"0.832\"}\n","stream":"stdout","time":"2024-12-10T14:35:41.453067655Z"}
2024-12-10 20:05:41.320 {"log":"\u001b[32m\u001b[32minfo\u001b[32m\u001b[39m: {\"method\":\"GET\",\"url\":\"/\",\"status\":\"404\",\"responseTime\":\"0.456\"}\n","stream":"stdout","time":"2024-12-10T14:35:41.313805639Z"}
2024-12-10 20:05:41.320 {"log":"\u001b[32m\u001b[32minfo\u001b[32m\u001b[39m: {\"method\":\"GET\",\"url\":\"/\",\"status\":\"404\",\"responseTime\":\"0.560\"}\n","stream":"stdout","time":"2024-12-10T14:35:41.195462882"}
2024-12-10 20:05:41.320 {"log":"\u001b[32m\u001b[32minfo\u001b[32m\u001b[39m: {\"method\":\"GET\",\"url\":\"/\",\"status\":\"404\",\"responseTime\":\"1.011\"}\n","stream":"stdout","time":"2024-12-10T14:35:41.072242032"}
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2024-12-10 20:05:40.819 {"log":"\u001b[32m\u001b[32minfo\u001b[32m\u001b[39m: {\"method\":\"GET\",\"url\":\"/\",\"status\":\"404\",\"responseTime\":\"0.466\"}\n","stream":"stdout","time":"2024-12-10T14:35:40.813237323Z"}
2024-12-10 20:05:40.819 {"log":"\u001b[32m\u001b[32minfo\u001b[32m\u001b[39m: {\"method\":\"GET\",\"url\":\"/\",\"status\":\"404\",\"responseTime\":\"0.838\"}\n","stream":"stdout","time":"2024-12-10T14:35:40.683879227Z"}
Start of range
20:05:41
—
20:01:20

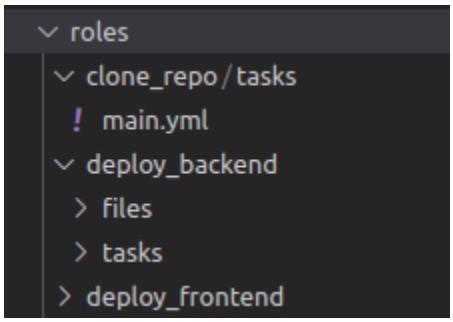
Advanced Features:

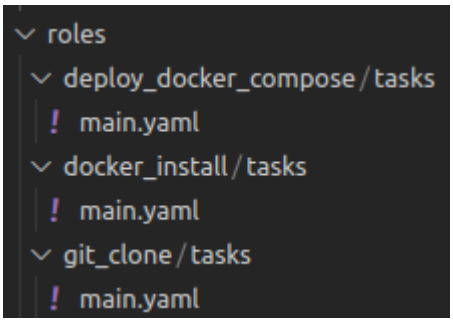
1. *Ansible Vault -*

my_vault.yml

```
$ANSIBLE_VAULT;1.1;AES256
62623064653532313362323235343066623461383633313632613331363165336466373064396639
63656639396461316561316636656432363539613133656 10a373239396634636563353132326435
39393432626662386162346635613166396163666643037666537383563353135326239346230 63
66616435356533626 60a336265353132313663633066336231656161306665376166313233383930
6335
```

2. *Modularity: Roles in Ansible -*





3. *HPA -*

backend-hpa.yaml

```yaml
apiVersion: autoscaling/v2
kind: HorizontalPodAutoscaler
metadata:
  name: my-node-backend-hpa
spec:
  scaleTargetRef:
    apiVersion: apps/v1
    kind: Deployment
    name: my-node-backend
  minReplicas: 1
  maxReplicas: 5
  metrics:
    - type: Resource
      resource:
        name: cpu
        target:
          type: Utilization
          averageUtilization: 1
```

frontend-hpa.yaml

```yaml
apiVersion: autoscaling/v2
kind: HorizontalPodAutoscaler
metadata:
  name: my-react-app-hpa
spec:
  scaleTargetRef:
    apiVersion: apps/v1
    kind: Deployment
    name: my-react-app
  minReplicas: 1
  maxReplicas: 5
  metrics:
    - type: Resource
      resource:
        name: cpu
        target:
          type: Utilization
          averageUtilization: 1
```

Challenges Faced

1. **Setting Up Kubernetes on Jenkins**
   Integrating Kubernetes with Jenkins was challenging due to the complexity of managing Kubernetes configurations within the Jenkins pipeline. Configuring Kubernetes credentials, ensuring compatibility between Jenkins agents and Kubernetes clusters, and setting up Minikube as the local Kubernetes environment required extensive troubleshooting. Additionally, automating the deployment of Kubernetes resources via Helm charts and maintaining proper security for sensitive data, like Kubernetes secrets, was intricate and time-consuming.
2. **ELK Stack Setup on Kubernetes**
   Deploying the ELK (Elasticsearch, Logstash, Kibana) stack on Kubernetes proved to be difficult due to resource constraints and the intricate nature of its configuration. Elasticsearch's memory requirements and Logstash's dependency on pipeline files made the setup prone to errors. Furthermore, ensuring smooth intercommunication between ELK components within a Kubernetes cluster was tedious. This challenge led us to shift to **Prometheus and Grafana**, which offered a more lightweight and Kubernetes-friendly monitoring and logging solution. Their native support for Kubernetes metrics and easier setup proved to be a practical alternative.
3. **Setting Up the SSH Server for Testing Ansible**
   Establishing an SSH server to test Ansible configurations was complex due to networking and authentication issues. Configuring SSH keys for secure, password-less authentication and ensuring compatibility across multiple environments required meticulous attention. Managing the server environment, ensuring it mimicked production systems, and dealing with connectivity issues while testing playbooks made this task especially challenging.

Future Scope

In the future, the Job Portal application can incorporate machine learning models to enhance user experience and platform reliability. ML algorithms can be used to **identify fake job postings** by analyzing patterns and anomalies in job descriptions, recruiter profiles, and posting behavior. Additionally, **personalized job recommendations** can be provided to users by leveraging their profiles, skills, and past interactions, improving job search efficiency and satisfaction.

References:

1. https://kubernetes.io/docs/home/
2. https://docs.docker.com/
3. https://github.com/prometheus-community/helm-charts
4. https://prometheus.io/docs/prometheus/latest/installation/
5. https://trivy.dev/v0.18.3/installation/