CICD using GitHub Action

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Hosting and Deployment

- **Hosting** provides the infrastructure (server, cloud, domain) where your application will run.

- Deployment is the process of moving your app to that hosted server and making it work for users.

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Deployment

- SSD
- RAM
- INTERNET

Server Machine

GitHub

DB

Volumes

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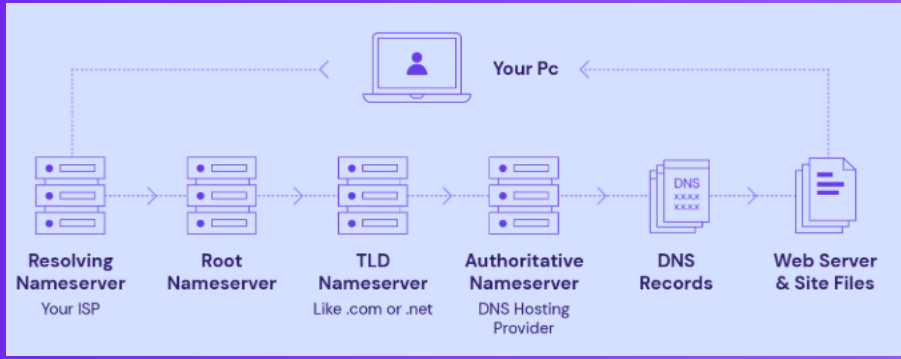
Services Required for Hosting

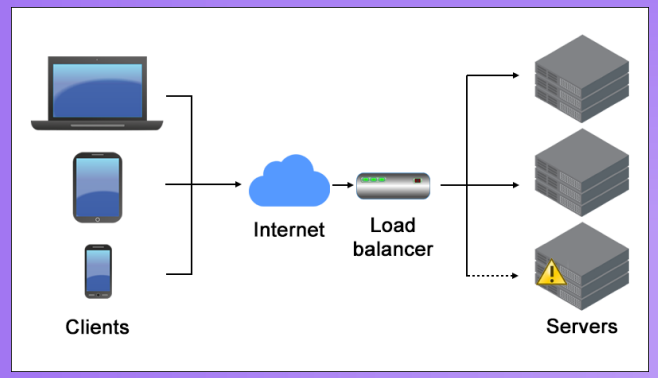
Compute: AWS EC2 for the Node.js backend.

Database: MongoDB Atlas, RDS..

Storage: AWS S3 for storing static files (like images).



DNS: Route 53 for domain management.



Load Balancer: AWS ELB for scaling the backend.

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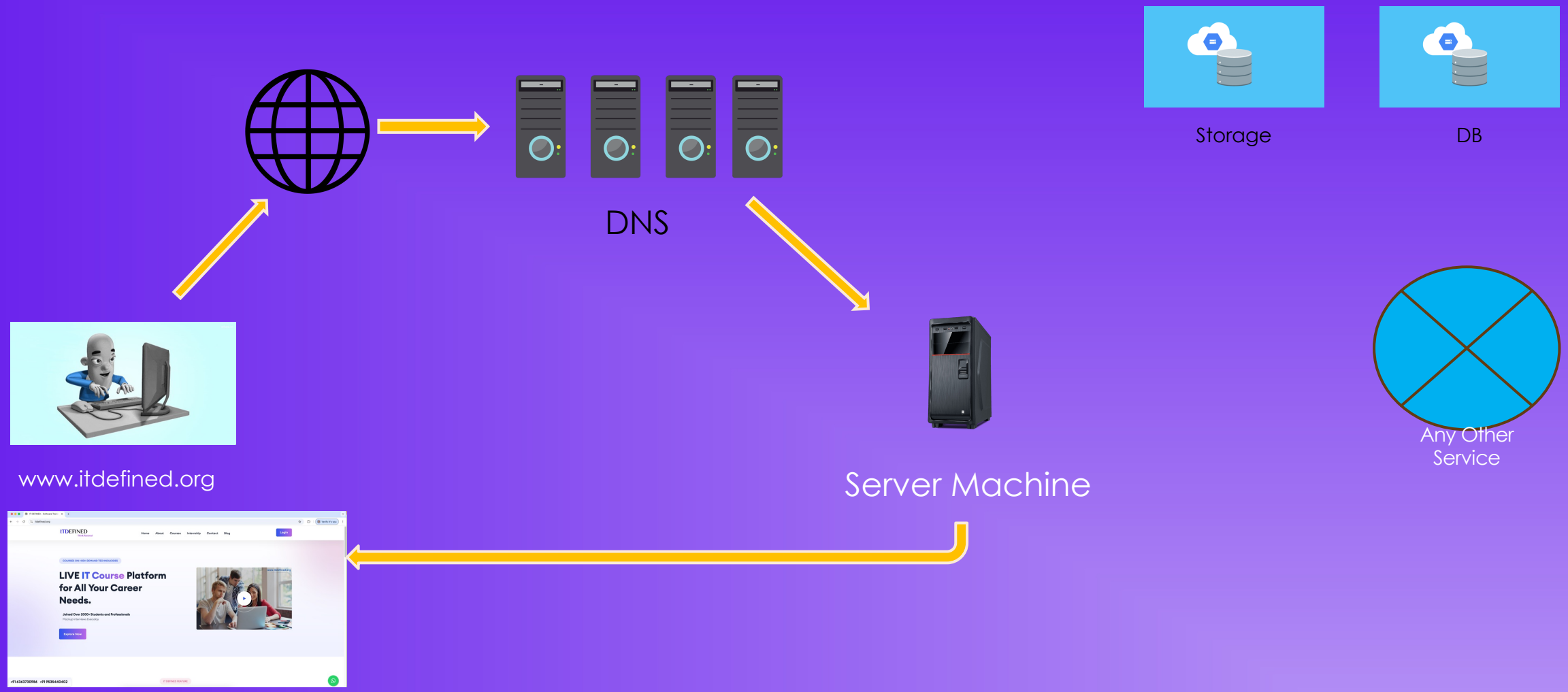

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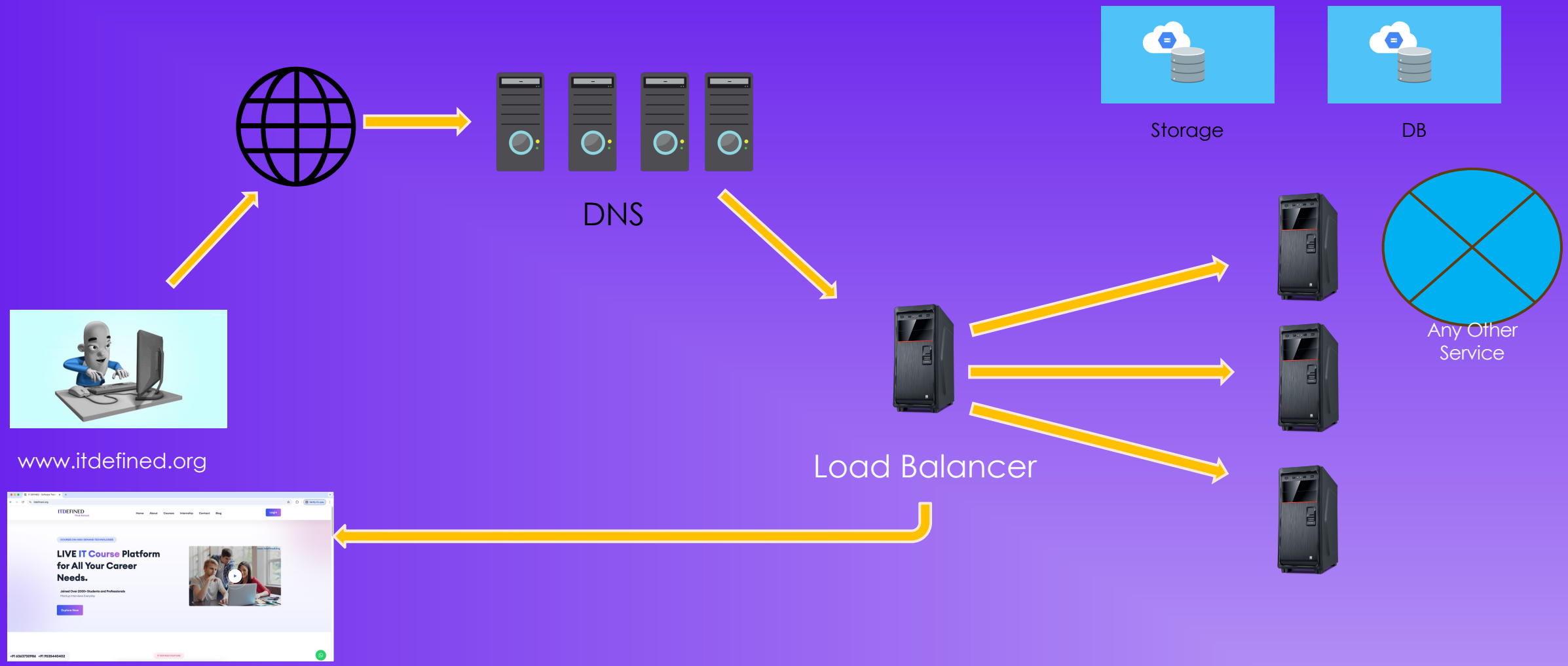

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Automating Deployments

- 1. GitHub Actions
- 2. Jenkins
- 3. GitLab CI/CD
- 4. CircleCI
- 5. Travis CI
- 6. Buddy
- 7. Semaphore
- 8. Azure DevOps
- 9. Appveyor
- 10. Octopus Deploy
- & Many More..

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Direct Deployment

Server Machine

scp -i /path/to/your-key.pem **/path/to/local-file** username@ec2-public-ip**:/path/to/remote-directory**

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Domain Name System (DNS) web service

- **Domain Registration**: Allows users to register new domain names.
- **DNS Service**: Translates domain names into IP addresses.
- **Scalable and Reliable**: Offers highly available and scalable DNS management.
- **Health Checks**: Monitors the health of resources and automatically routes traffic based on status.
- **DNS Failover**: Automatically reroutes traffic if a resource becomes unavailable.
- Ex:
  - **AWS Route 53**
  - **Google Cloud DNS + Load Balancer**
  - **Azure DNS + Traffic Manager**

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Generate NS for the domain by adding A records for the VMs IP

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Nginx

1. **Web server**: Serves static websites quickly.
2. **Reverse Proxy**: Forwards requests to another server, often used for load balancing.
3. **Load Balancer**: Distributes traffic across multiple servers to improve performance and reliability.
4. **Caching**: Caches content to reduce load on servers and improve speed.

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Route 53 Records

A Record

Pointing your domain to an IP address (e.g., EC2 instance).

CNAME Record:

Alias for subdomains (e.g., www to example.com).

MX Record:

Directing email traffic to mail servers.

TXT Record:

Used for email authentication, domain verification, and other settings.

NS Record:

Specifies authoritative DNS servers for a domain

SOA (Start of Authority) Record:

It is an essential DNS record that provides information about the authoritative DNS zone for a domain

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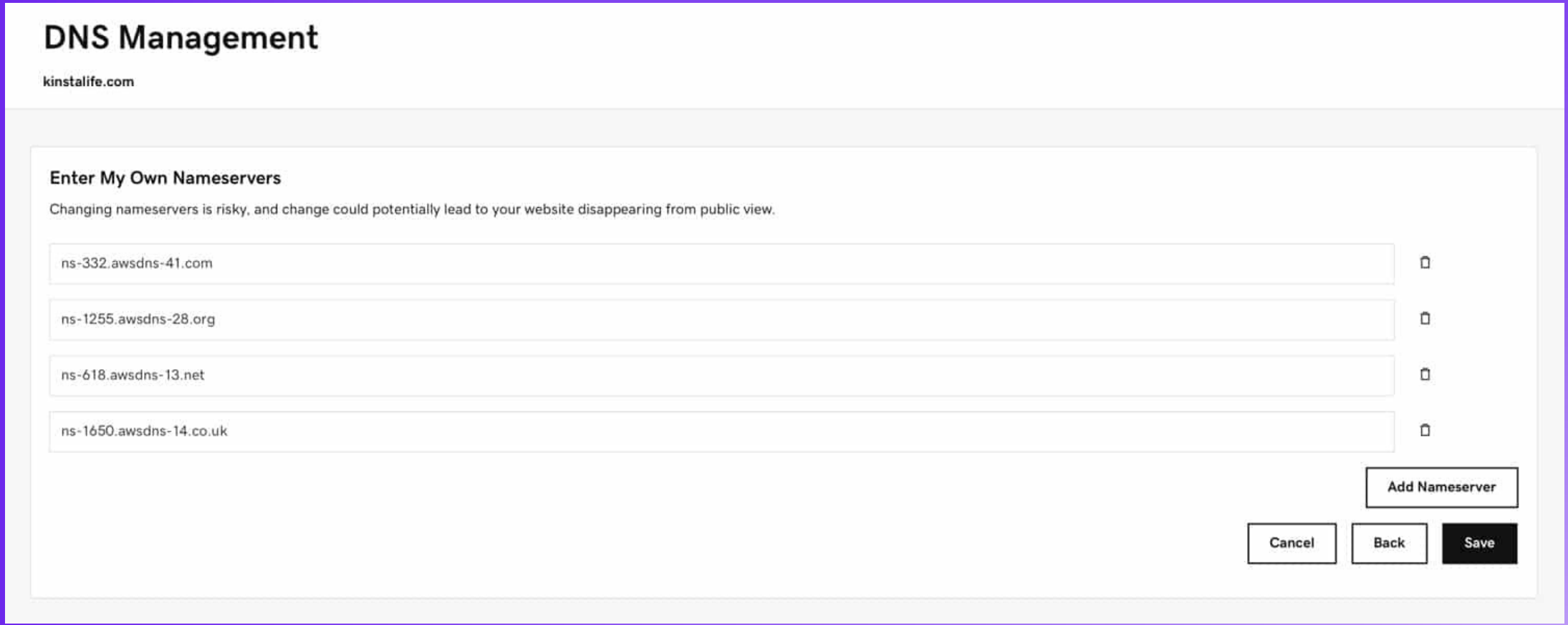
Nameservers Update



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Through Git

GitHub

Git Clone

Server Machine

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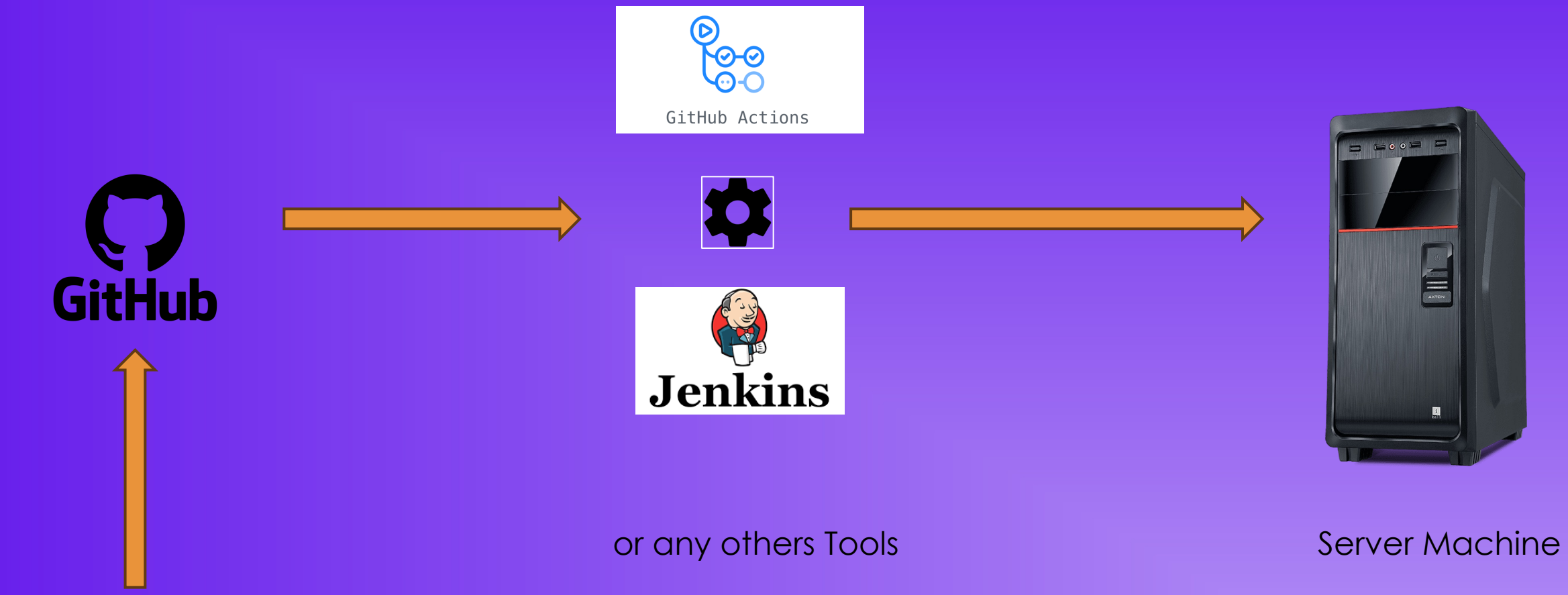
Through Git & CICD Tools



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Hosting

- Create AWS EC2 Instance (or any server)
- Assign Elastic IP (to prevent IP changes)
- Set Up Security Groups (allow SSH, HTTP, HTTPS)
- Install Docker
- Install Docker Compose
- Install Nginx (Reverse Proxy & Load Balancer)
- Create Route 53 Hosted Zone (Buy & Configure Domain)
- Set DNS Records in Route 53 (Point domain to EC2/ELB)

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Deployment

- Clone the MERN app from GitHub
- Set Up Environment Variables (.env)
- Write & Configure docker-compose.yml
- Run docker-compose up -d (Start Containers)
- Check Running Containers (docker ps)
- Configure Nginx Reverse Proxy for MERN App
- Restart Nginx (sudo systemctl restart nginx)
- Enable SSL (Let's Encrypt / AWS ACM)
- Test Application on Domain (example.com)
- Set Up GitHub Actions for CI/CD (Optional)

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Continuous Integration & Continuous Deployment

Continuous Integration (CI):

- Developers regularly merge (integrate) their code changes into a shared repository.
- Automated tests and builds are run to ensure the new code works well with the existing codebase, catching errors early

Continuous Deployment/Delivery (CD):

Delivery: Once the code passes all tests, it's ready to be manually deployed to production.

Deployment: Goes a step further by automatically deploying the tested code to production without manual intervention.

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Continuous Integration & Continuous Deployment

- Virtual Machines (VMs)
- Networking Services
- Security Services
- Application Management Services
- Monitoring and Logging Services
- Analytics and Data Processing
- Storage Services
- Database Services

GitHub

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Steps Involved

Run Code

- Connect to Machine
- Install Docker
- Clone the repo (Delete if exists and clone)
- Run Docker Compose File

Setup Nginx

- Install NGINX on EC2
- Configure Firewall (UFW)
- Set Up NGINX as a Reverse Proxy
- Secure with SSL (Let's Encrypt)
- Test & Verify

Map domain Name

- Register a Domain
- Create a Hosted Zone
- Update Name Servers
- Create DNS Records
- Configure Load Balancer or CloudFront (Optional)

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1. **Continuous Integration (CI):**
    1. Developers push their code to a shared repository (e.g., GitHub, GitLab, Bitbucket).
    2. Jenkins automatically triggers a pipeline when code is committed.
    3. Key Steps in CI:
        1. **Code Checkout:** Jenkins fetches the latest code from the repository.
        2. **Build Process:** Jenkins compiles the code into an executable format.
        3. **Automated Testing:** Jenkins runs test cases (e.g., unit tests) to ensure the code works as expected.
        4. **Feedback Loop:** If errors occur, Jenkins notifies the developer with logs to fix issues quickly.

2. **Continuous Deployment/Delivery (CD):**
    1. Once the code passes all tests in CI, Jenkins can handle the deployment process.
    2. Two options:
        1. **Delivery:** Deploy to a staging environment for manual approval.
        2. **Deployment:** Automatically deploy to production (fully automated).
    3. Key Steps in CD:
        1. **Package Artifacts:** Jenkins packages the application (e.g., as a Docker container or WAR file).
        2. **Deploy to Server/Cloud:** Jenkins deploys the package to a production or staging environment (e.g., AWS, Azure, Kubernetes).

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GitHub Actions

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What Are GitHub Actions

- GitHub Actions is a CI/CD (Continuous Integration/Continuous Deployment) platform.
- Helps automate software workflows directly from your GitHub repository.
- Key Features:
  - Automate builds, tests, and deployments.
  - Integrate with other services.
  - Flexible YAML-based configuration.

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Why GitHub Actions

- **Automation:** Automate repetitive tasks.
- **Efficiency:** Streamline development processes.
- **Integration:** Seamless with GitHub repositories.
- **Customizable:** Define workflows that fit your project's needs.
- **Collaboration:** Improved team efficiency and communication.

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Core Concepts

1. **Workflows**

   Automated processes defined by YAML files in .github/workflows

2. **Triggers**

   Events like push, pull_request, or schedule that start workflows.

3. **Jobs**

   Steps within a workflow that run in parallel or sequentially.

4. **Steps**

   Individual tasks within a job.

5. **Actions**

   Predefined tasks to reuse in workflows.

6. **Runners**

   A runner is a server that executes the workflow. GitHub provides cloud-based runners, but you can also set up self-hosted runners for more control

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- name: CI Pipeline # Name of the workflow
- on:
  - push:
    branches: [main] # Runs on push to main branch
  - pull_request:
    branches: [main] # Runs on PRs to main
- jobs:
  - build:
    runs-on: ubuntu-latest # OS environment
    steps:
      - name: Checkout Repository
        uses: actions/checkout@v3 # Fetches code
      - name: Setup Node.js
        uses: actions/setup-node@v3
        with:
          node-version: 18 # Sets Node.js version
      - name: Install Dependencies
        run: npm install
      - name: Run Tests
        run: npm test

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Section			Description
name			Gives a name to the workflow
on			Defines triggers (push, pull_request, schedule)
jobs			Contains jobs (like build, test, deploy)
	runs-on		Specifies OS for execution (Ubuntu, Windows, macOS)
	steps		Individual tasks (checkout code, install dependencies, run tests)
		uses	Calls a pre-built GitHub Action
		with	It provides configuration options for the action
		run	Runs shell commands

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Structure of a Job:

- **name**: An optional name for the job.
- **runs-on**: Specifies the type of runner (e.g., ubuntu-latest, windows-latest).
- **steps**: A series of commands or actions that are executed in the job.
    - **needs** (optional): Specifies dependencies between jobs (i.e., one job should run after another completes).

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Triggers

Trigger	Runs When?
push	Code is pushed to a branch
Pull_request	A PR is opened/updated
schedule	Runs at specific times (cron)
Workflow_dispatch	Manual trigger

```
on:
  schedule:
    - cron: "0 0 * * *"
```

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YAML

```yaml
name: Deploy MERN Application

on:
  push:
    branches:
      - main

jobs:
  build-and-deploy:
    runs-on: ubuntu-latest

    services:
      mongo:
        image: mongo:latest
        ports:
          - 27017:27017

    steps:
      - name: Checkout code
        uses: actions/checkout@v3

      - name: Set up Node.js
        uses: actions/setup-node@v3
        with:
          node-version: '16'

      - name: Install backend dependencies
        run: |
          cd backend
          npm install

      - name: Install frontend dependencies
        run: |
          cd frontend
          npm install

      - name: Build frontend
        run: |
          cd frontend
          npm run build

      - name: Start backend server
        run: |
          cd backend
          npm run start &

      - name: Deploy application
        run: |
          echo "Deploy scripts or commands go here."
```

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Breakdown of the YAML File - 1

- 1. name: Name of the Workflow

```yaml
name: CI/CD Pipeline
```

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Breakdown of the YAML File - 2

- **2.** Trigger for Workflow

```yaml
on:
  push:
    branches:
      - main
```

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Breakdown of the YAML File - 1

- Define Jobs in the Workflow

```yaml
jobs:
  build:
    runs-on: ubuntu-latest
```

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Breakdown of the YAML File - 1

- Define Steps in the Job

```yaml
steps:
  - name: Checkout code
    uses: actions/checkout@v3
```

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Breakdown of the YAML File - 1

- uses and run

```yaml
- name: Set up Node.js
  uses: actions/setup-node@v3
  with:
    node-version: '16'
```

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Breakdown of the YAML File - 1

- Running Tests, Building, and Deploying

```yaml
- name: Run tests
  run: npm test
```

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Live Demo

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GitHub Actions Documentation

https://docs.github.com/en/actions

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CICD using Github Actions

- **Workflow Name**
- **Trigger**
- **Deploy Job**
  - SSH into EC2
  - Setting Environment Variables
  - Updating EC2 and Installing Dependencies
  - Stopping Old Containers
  - Cloning the GitHub Repository
  - Running Docker Compose
  - Verifying Deployment

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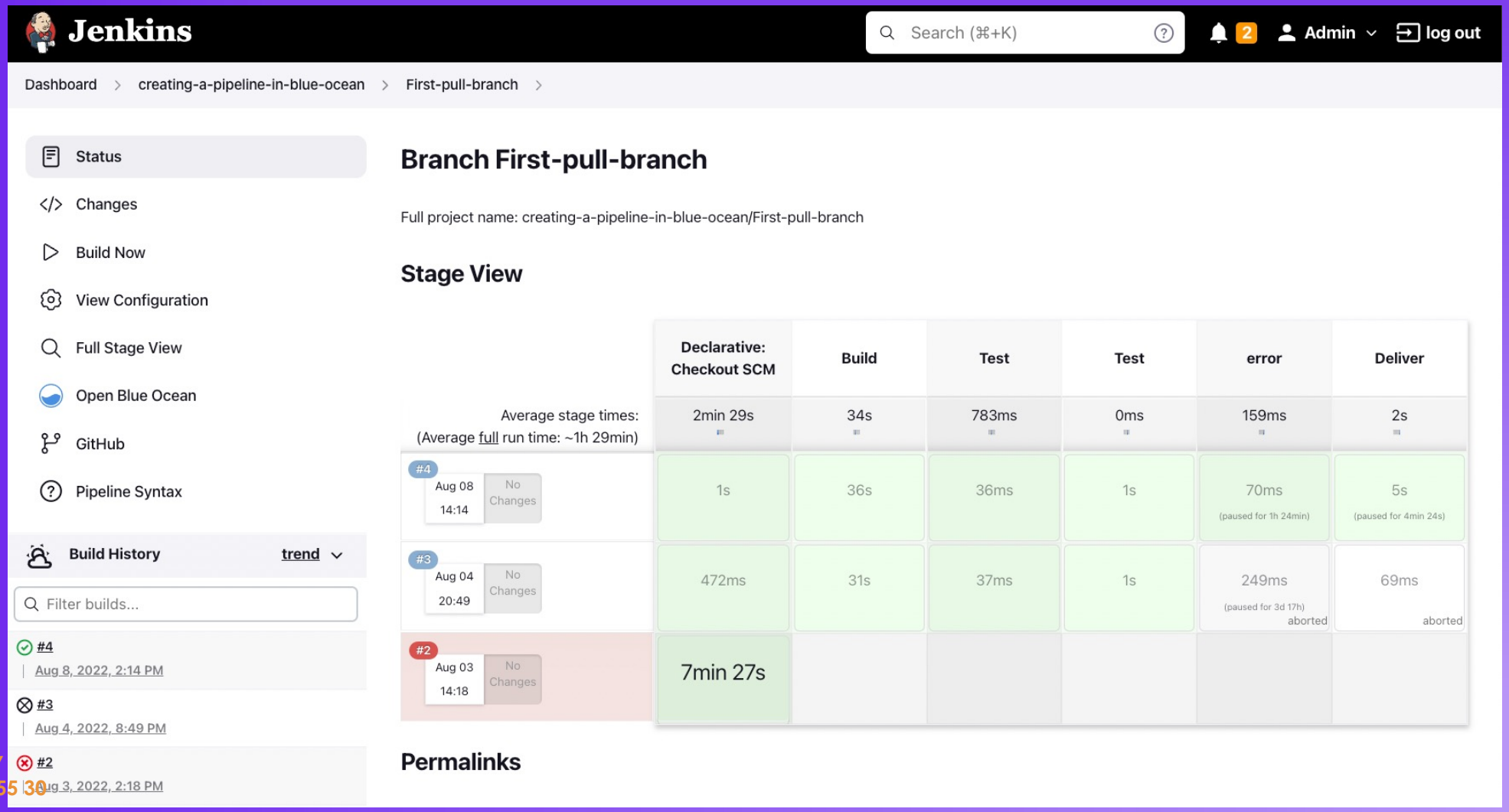
Jenkins

- **Jenkins** is an open-source automation server used to build, test, and deploy software projects automatically.
- It supports integrating code changes, running tests, and deploying applications efficiently.



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Creating DNS Records

Inside the Hosted Zone, click "**Create Record**"

- • A Record (IPv4 Address)
  - • Type: A
  - • Value: Your EC2 Public IP
  - • TTL: 300 (default)
- • CNAME Record (for subdomains)
  - • Type: CNAME
  - • Name: www
  - • Value: yourdomain.com
- • MX Record (for Email Hosting)
  - • Required if setting up custom emails (e.g., Google Workspace, Zoho).
- • TXT Record (for Verification & SSL)
  - • Used for email verification, SPF, DKIM, etc.

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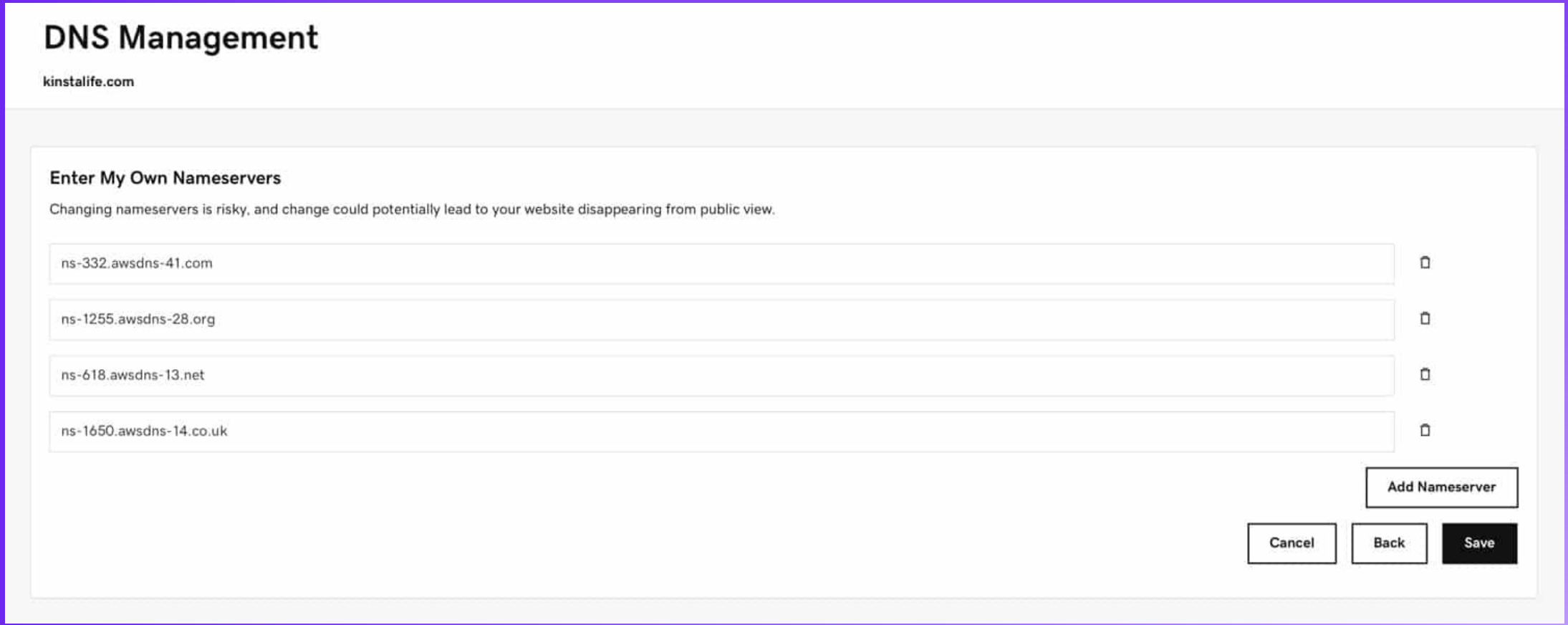
Nameservers Update



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Generate NS for the domain by adding A records for the VMs IP

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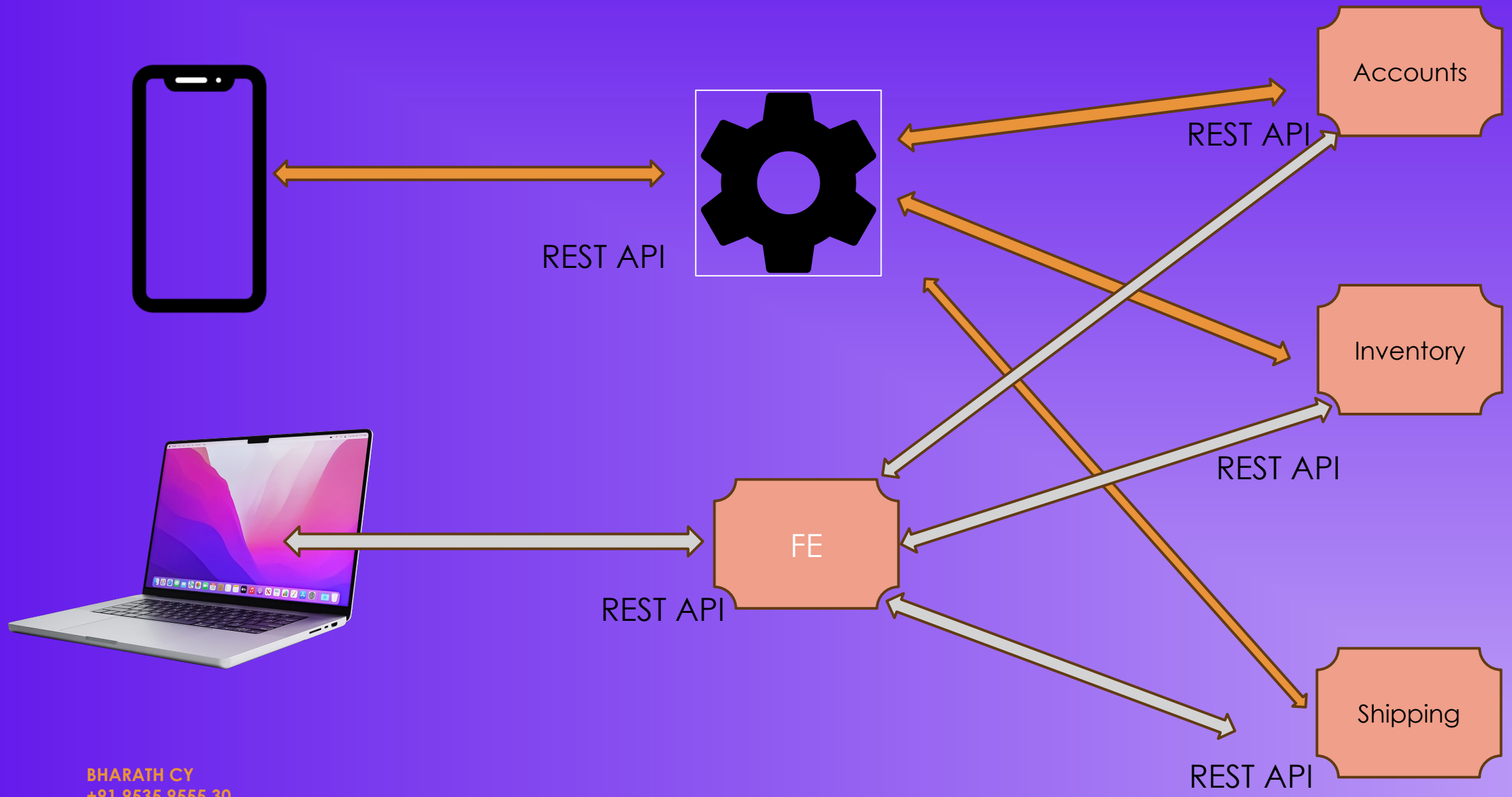
Micro Services



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