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Infrastructure Automation in AWS utilising Terraform and GitHub Actions (CI/CD) pipeline Integration

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Abstract:

The demand of the reliable cloud-based systems has been rapidly increased, and the development and deployment of solid system architecture are becoming an essential of any business continuity and the quality of the services. This research explores the utilisation of Terraform, an Infrastructure-as-Code tool, to automate architecting the system infrastructure on the AWS cloud platform. It describes the technical process of configuring and provisioning the AWS resources including networking, computing, and storage through Terraform's highly declarative language, HashiCorp Configuration Language (HCL). It proves how infrastructure-as-code (IaC) can turn traditionally manual and time-consuming processes into an efficient, reliable, automated one in a repeatable way which helps reduce costs by optimizing the efficiency of the infrastructure. This paper also discusses the integration of Terraform with the Continuous Integration/Continuous Deployment (CI/CD) pipeline, specifically utilising the GitHub Actions to demonstrate the seamless deployment processes and reduced application downtime within DevOps Practice by emphasizing more consistent and error-free deployments with minimal manual intervention. A successful automated implementation has been achieved to build a cloud-based system architecture.

Results:

The research findings emphasize the use of terraform in AWS to automate the infrastructure by practically implementing the deployment process, reducing manual intervention and human errors, hence achieving scalability. With the integration of GitHub Actions CI/CD pipeline in Terraform infrastructure automation to enhance the software development life cycle, deployment time has been reduced, and the reliability of the system has been increased. The critical analysis of the security best practices in this study identified effective security practices such as using DynamoDB for state file locking to prevent concurrent deployments by practically implementing the security practices in the real-time system, and identifying, and mitigating the security risks involved in managing the state file. This paper demonstrated the real-world implementation of an application on AWS using Terraform with the automated pipeline integration that achieves seamless changes and rollbacks, increasing the application's agility.

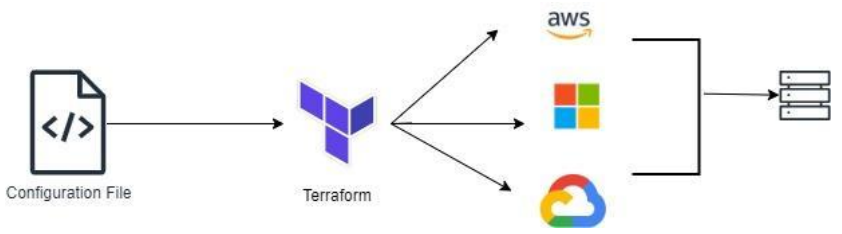

Figure 1: Terraform Architecture

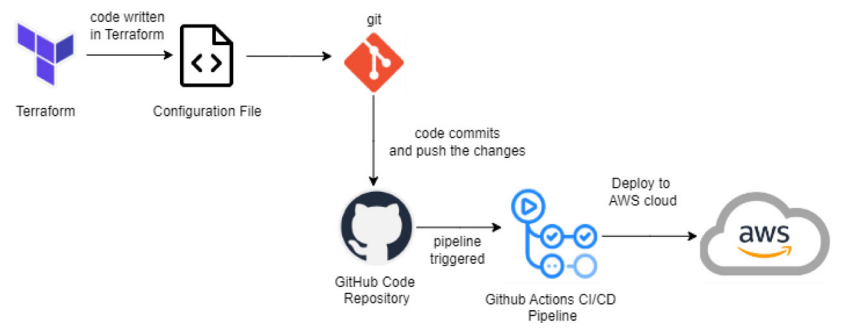

Figure 2: Workflow of CI/CD pipeline with terraform to deploy on AWS cloud

Conclusions:

The research concludes that Terraform is a powerful tool for DevOps automation as it provides simplicity and scalability of the system, HashiCorp declarative language makes complex deployments manageable and reusable of the modules. It also enhanced the software development reliability as the integration of the CI/CD pipeline reduced the deployment time, allowing the teams to focus more on development rather than operational issues. It concludes that the integration of advanced security measures is crucial for minimizing the security risks and vulnerabilities such as misconfigurations and drift in Terraform.

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