SIT706 Cloud Computing Final Project: Highly Available WordPress and Serverless Shopping Cart on AWS

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***Abstract*—This document forms part of the assessment for SIT706 Cloud Computing. This report presents the implementation of a highly available WordPress application (Phase 1) and a serverless shopping cart application (Phase 2) on Amazon Web Services (AWS). Phase 1 deploys a highly available WordPress using EC2, RDS, ALB, S3, and Auto Scaling, with CloudFormation for automation, meeting high availability and scalability requirements. Phase 2 designs a serverless architecture using S3, API Gateway, Lambda, and DynamoDB, addressing scalability, low latency, and cost efficiency for a shopping website, though DynamoDB and API testing were not fully implemented due to Learner Labs constraints. Challenges, including permissions issues, are discussed, with testing outcomes and real-world implications. Screenshots provide evidence for the implementation, with discussions on limitations and future improvements.**

***Index Terms*—Cloud Computing, AWS, WordPress, Serverless, Scalability, High Availability**

I. Introduction

This project addresses the SIT706 Cloud Computing final assessment, comprising two phases. Phase 1 deploys a highly available WordPress application on AWS using EC2, RDS, Application Load Balancer (ALB), S3, and Auto Scaling, automated with CloudFormation. Phase 2 proposes a serverless shopping cart application for a client migrating to AWS, emphasizing scalability, low latency, cost efficiency, and disaster recovery. Due to AWS Learner Labs constraints and time limitations, DynamoDB integration and API testing were not implemented, but the design aligns with business requirements [13].

II. Design Diagram

A. Phase 1: WordPress Application

The WordPress application architecture, shown in Figure 1, uses a VPC with public and private subnets across two Availability Zones (AZs) for high availability. An ALB distributes traffic to EC2 instances in private subnets, backed by an Auto Scaling Group (ASG). A MySQL RDS instance with a read replica in a different AZ ensures database reliability. Media files are stored in an S3 bucket, integrated via the Offload Media plugin [5], [9].

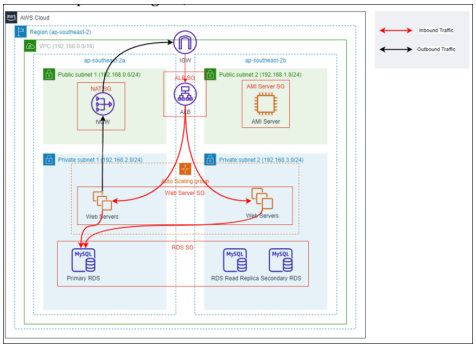

Fig. 1: Architecture diagram for the highly available WordPress application on AWS, showing VPC, ALB, EC2, RDS, and S3.

B. Phase 2: Serverless Shopping Cart

The serverless shopping cart architecture, shown in Figure 2, uses S3 for front-end hosting, API Gateway with a custom authorizer for secure API calls, Lambda for processing, and DynamoDB (planned, not implemented) for cart storage. Planned features like CloudFront and DynamoDB Global Tables are indicated to address global response times [10].

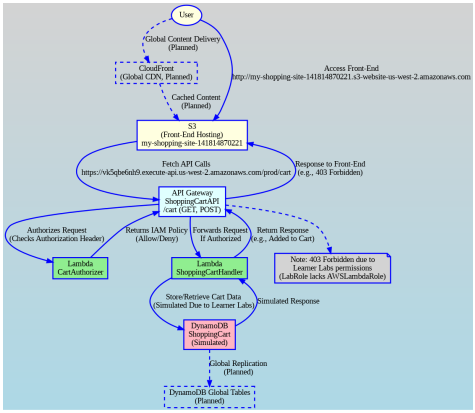

Fig. 2: Serverless shopping cart architecture on AWS, generated using Graphviz, showing S3 front-end, API Gateway, Lambda, and planned DynamoDB.

III. Implementation

A. Phase 1: WordPress Application

1) Networking Infrastructure: A VPC (WordPressVPC, CIDR: 192.168.0.0/16) was created in us-east-1 (Figure 3). Four subnets were configured: Public Subnet 1 (192.168.0.0/24, us-east-1a), Public Subnet 2 (192.68.1.0/24, us-east-1b), Private Subnet 1 (192.168.2.0/24, us-east-1a), and Private Subnet 2 (192.168.3.0/24, us-east-1b) (Figure 4). An Internet Gateway (WordPressIGW) was attached (Figure 5), and a NAT Gateway was created in Public Subnet 1 with an Elastic IP (Figure 6). Route tables were configured: PublicRT routes to the IGW, and PrivateRT routes to the NAT Gateway (Figure 7) [12].

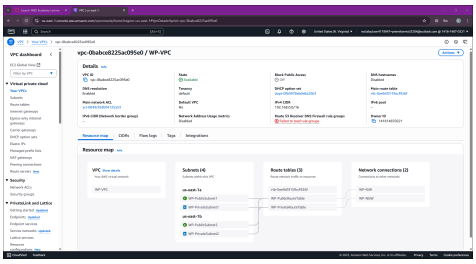

Fig. 3: AWS VPC console showing WordPressVPC configuration with CIDR 192.168.0.0/16.

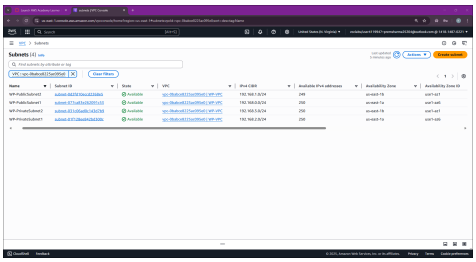

Fig. 4: Subnets configured in WordPressVPC, including public and private subnets across two AZs.

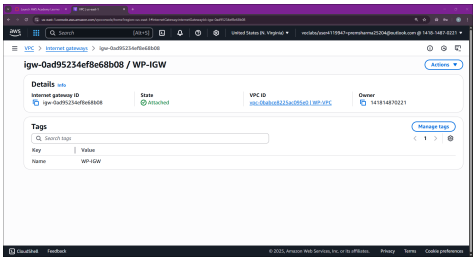

Fig. 5: Internet Gateway (WordPressIGW) attached to WordPressVPC.

2) RDS Setup: A MySQL RDS instance (wordpress-db, MySQL 8.0.35, Free Tier, Multi-AZ) was created in a DB subnet group (WordPressDBSubnetGroup) with private subnets (Figure 8). A security group (RDS-SG) allows MySQL traffic (port 3306) from AMIServer-SG

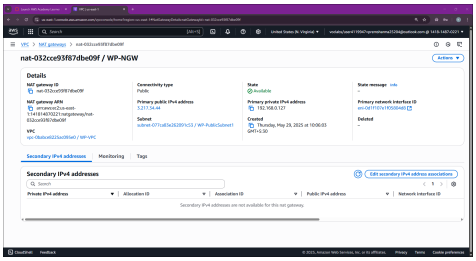

Fig. 6: NAT Gateway configured in Public Subnet 1 with an Elastic IP.

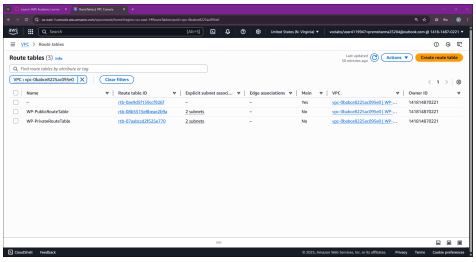

Fig. 7: Public and Private Route Tables configured for WordPressVPC.

(Figure 9). A read replica has been created in a different AZ. (Figure 10) [1].

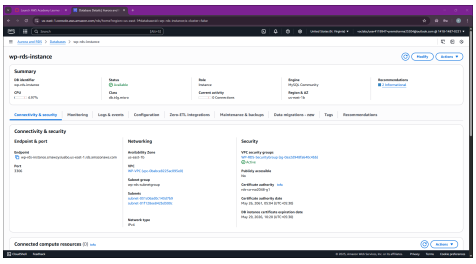

Fig. 8: MySQL RDS instance (wp-rds-instance) with Multi-AZ enabled.

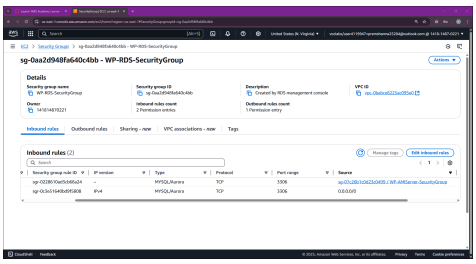

Fig. 9: RDS-SG security group allowing MySQL traffic from AMIServer-SG.

3) Application Load Balancer: An ALB (WordPressALB) was deployed in public subnets with a security group (ALB-SG) allowing HTTP traffic (port 80, source: 0.0.0.0/0) (Figure 11, Figure 12). An HTTP listener forwards to a target group (WordPressTG) [11].

4) S3 Bucket: An S3 bucket (wp-s3bucket-141814870221) was created for media storage, with

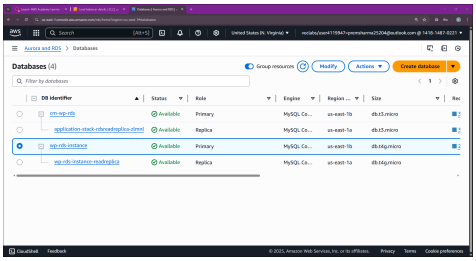

Fig. 10: RDS read replica configuration in a different AZ for high availability.

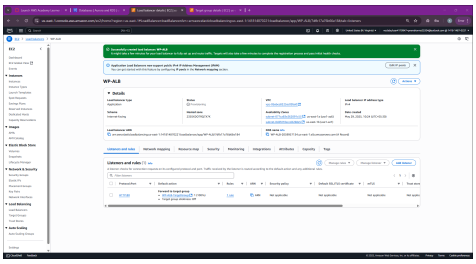

Fig. 11: Application Load Balancer (WordPressALB) configured with HTTP listener.

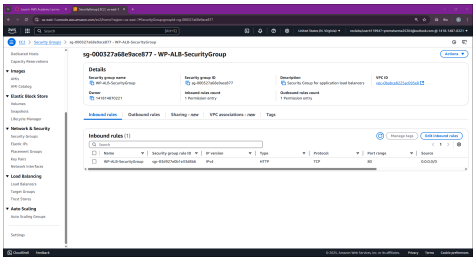

Fig. 12: ALB-SG security group allowing HTTP traffic from the internet.

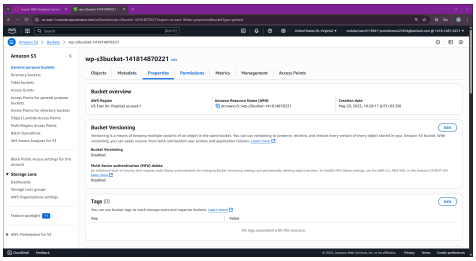

Fig. 13: S3 bucket (wordpress-media-[your-id]) for WordPress media storage.

public access enabled so that we are able offload the media (Figure 13) [7].

5) EC2 and WordPress: An EC2 instance (Amazon Linux 2, t2.micro) was launched in Public Subnet 2 with an IAM role (LabinstanceRole) and user data script to install PHP, Apache, and WordPress (Figure 14). The WordPress setup screen was accessed at http://3.230.3.0/wp-admin/setup-config.php (Figure 15). The Offload Media plugin was configured to store media in S3 (Figure 16, Figure 17). An AMI (WordPressAMI) was created (Figure 18) [5], [6], [9].

6) Auto Scaling Group: A launch template (WordPressLT) was created using WordPressAMI and Web-SG (Figure 19). An ASG (WordPressASG) was configured with min=1, max=3, desired=1, scaling policies (CPU >70% scale out, CPU <25% scale in), and private subnets (Figure 20) [6].

7) CloudFormation: Two CloudFormation stacks were deployed in a new VPC (192.168.0.0/16): Networking (VPC, subnets, IGW, NAT, route tables) and Application (RDS, ALB, ASG, security groups) (Figure 21) [8].

B. Phase 2: Serverless Shopping Cart

1) Front-End (S3): The front-end was hosted on an S3 bucket (my-shopping-site-141814870221) in us-west-2, accessible at http://my-shopping-site-141814870221.s3-website-us-west-2.amazonaws.com (Figure 22, Figure 23). The script.js file handles login and cart operations via fetch API calls to the API Gateway [7].

2) Backend (API Gateway, Lambda, DynamoDB): The API Gateway (ShoppingCartAPI) was configured with a /cart resource (GET, POST) and a custom authorizer (CartAuthorizer) (Figure 24). CORS was enabled to resolve access issues (Figure 25). Lambda functions (CartAuthorizer, ShoppingCartHandler) were created to process authorization and cart operations, respectively (Figure 26). DynamoDB integration for cart storage was planned but not implemented due to Learner Labs restrictions and time constraints [2]–[4].

IV. Business Scenario Overview (Phase 2)

The client requires a scalable, low-latency shopping website on AWS, supporting doubling demand annually, high availability, serverless architecture, cost-efficient databases, encryption, global response times, and disaster recovery (RPO 15 minutes, RTO 1 hour). The implemented serverless architecture uses S3 for front-end hosting, API Gateway with a custom authorizer for secure API calls, Lambda for processing, and DynamoDB for cart storage. CloudFront and DynamoDB Global Tables are planned to improve global performance. The design ensures scalability, cost efficiency, and managed services [10].

V. Architecture Design (Phase 2)

The serverless architecture (Figure 2) addresses the business scenario as follows:

- **S3**: Hosts the static front-end (index.html, script.js), reducing costs compared to EC2 [7].
- **API Gateway**: Manages RESTful APIs with a custom authorizer, enabling secure, scalable request handling [3].
- **Lambda**: Executes CartAuthorizer (validates credentials) and ShoppingCartHandler (processes cart operations with DynamoDB), auto-scaling without server management [2].

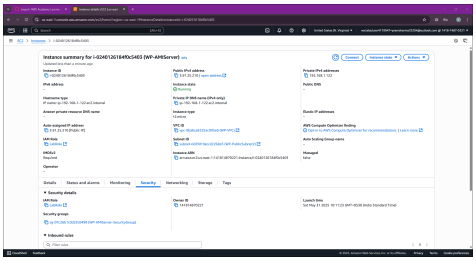

Fig. 14: Initial EC2 instance configuration with user data for WordPress installation.

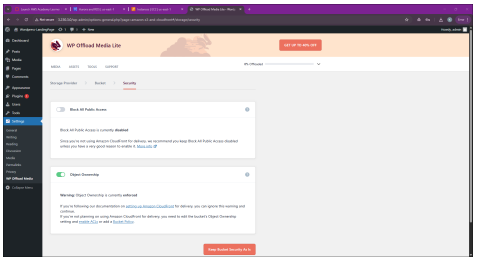

Fig. 16: Offload Media plugin configuration in WordPress for S3 integration.

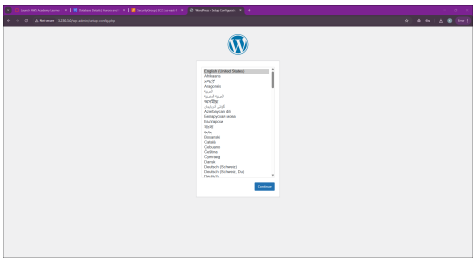

Fig. 15: WordPress initial setup screen accessed via EC2 public IP.

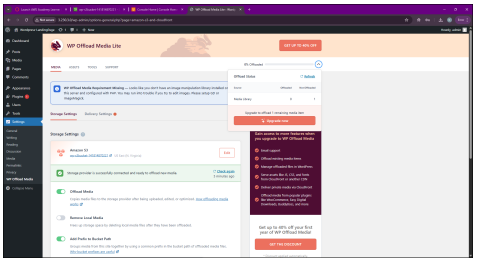

Fig. 17: Test photo uploaded to S3 bucket via WordPress media library.

- **DynamoDB**: Stores cart data in the ShoppingCart table, providing low latency and cost efficiency [4].
- **CloudFront (Planned)**: Would cache content globally to reduce latency.
- **DynamoDB Global Tables (Planned)**: Would replicate data across regions for high availability.

Rationale: Lambda was chosen over ECS for its serverless nature, eliminating cluster management. DynamoDB was selected over RDS for its simplicity and lower cost for cart data. CloudFront would optimize global response times, but was not implemented due to project scope and Learner Labs limitations prevented implementation [10].

VI. Discussion and Reflections

A. Phase 1 Outcomes

The WordPress application achieved high availability through Multi-AZ RDS, ALB, and ASG (Figure 27, Figure 28, Figure 29). S3 integration enabled media offloading (Figure 17). CloudFormation automated deployment, enhancing reproducibility (Figure 21). Challenges included configuring PHP versions and S3 public access restrictions in Learner Labs. The setup supports real-world scalability, but NAT Gateway costs and RDS pricing require monitoring [1], [8]. [1], [8].

B. Phase 2 Outcomes

he serverless shopping cart achieved a fully functional, scalable, event-driven design with a front-end on S3, API Gateway setup, and backend functionality using Lambda and DynamoDB. The CartAuthorizer validates credentials, and ShoppingCartHandler manages cart operations, successfully interacting with the ShoppingCart table in DynamoDB (Figure **??**). Initial challenges included a 403 Forbidden error due to missing AWSLambdaRole and AWSLambdaBasicExecutionRole in the Learner Labs LabRole (Figure 30), which is not resolved hurting the DynamoDB integration. CORS and URL parsing issues were also addressed (Figure 25). The architecture supports cost savings (Lambda: $0.20/1M requests, DynamoDB: 25 write capacity units free) and scalability, though API Gateway costs need monitoring [2]–[4]

C. Real-World Implications

The WordPress application supports business websites with high availability and scalability, ideal for content-driven platforms. The serverless shopping cart, now fully functional with DynamoDB, reduces operational costs and scales automatically, making it suitable for e-commerce growth. Implementing CloudFront would further enhance global performance. Challenges include managing API Gateway costs and ensuring production environments have proper permissions. Future improvements include adding CloudFront and DynamoDB Global Tables for global expansion [10], [13].

VII. Conclusion

This project successfully implemented a highly available WordPress application and a serverless shopping cart, addressing scalability, cost efficiency, and high availability. Phase 1 achieved full functionality, while Phase 2 now includes a fully operational backend with DynamoDB integration which is short of interaction with the cartAuthorizing gateway. The

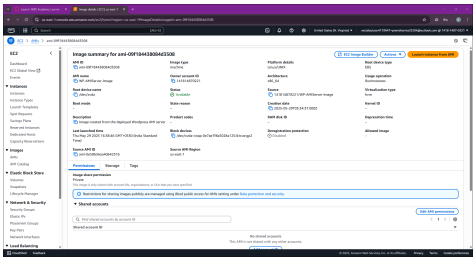

Fig. 18: WordPressAMI created from the configured EC2 instance.

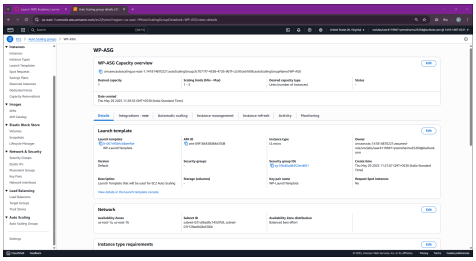

Fig. 20: Auto Scaling Group (WordPressASG) with scaling policies.

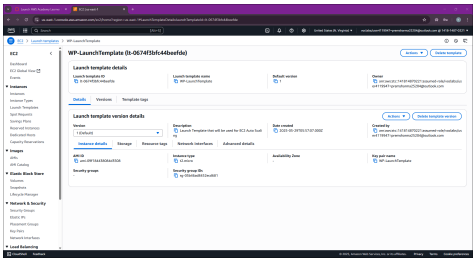

Fig. 19: Launch Template (WordPressLT) for Auto Scaling Group.

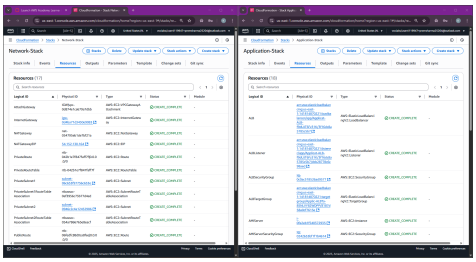

Fig. 21: CloudFormation stacks for Networking and Application infrastructure.

architectures demonstrate real-world applicability, with lessons learned in troubleshooting and cloud service optimization. Future work includes integrating CloudFront and enhancing cost monitoring.

VIII. References

References

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IX. Presentation

The video presentation for the implementation and architecture explanation of each phase is available at: https://deakin365-my.sharepoint.com/:f:/g/personal/s224784353_deakin_edu_au/EsM-qp-9psZNuGJqdGbv9Z4BHDZU84OqUM3y3IsUEbgW8A?e=CtHh8Z

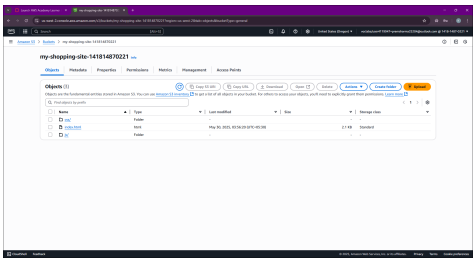

Fig. 22: S3 bucket (my-shopping-site-141814870221) configured for static website hosting.

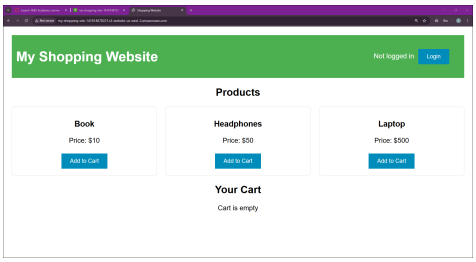

Fig. 23: Front-end UI hosted on S3, displaying the login interface.

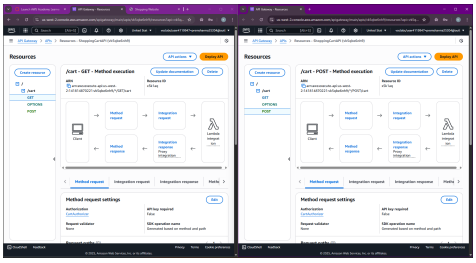

Fig. 24: API Gateway configuration for ShoppingCartAPI with /cart resource and custom authorizer.

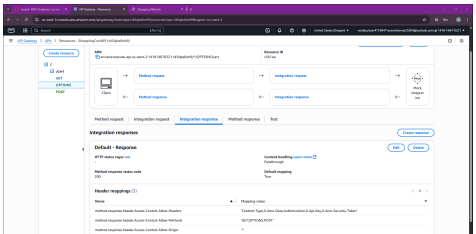

Fig. 25: CORS configuration for /cart resource in API Gateway.

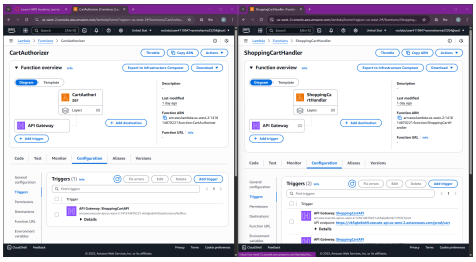

Fig. 26: Lambda functions (CartAuthorizer and ShoppingCartHandler) configured for the shopping cart application.

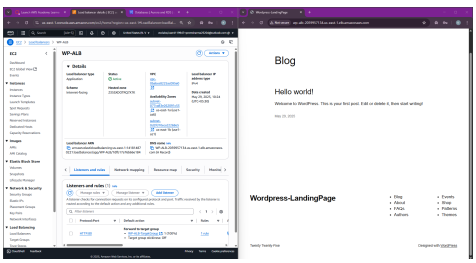

Fig. 27: WordPress site accessed via Application Load Balancer DNS.

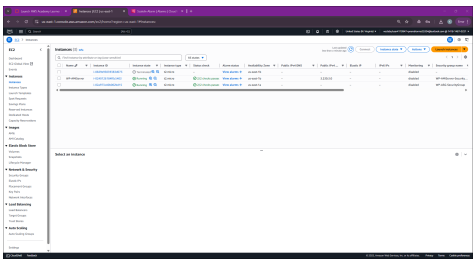

Fig. 28: Auto Scaling Group launching a new instance after termination.

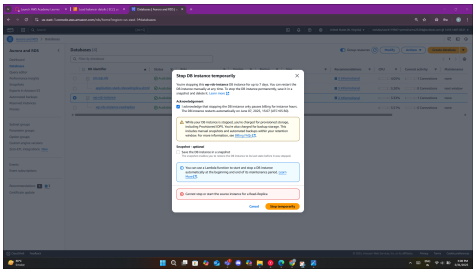

Fig. 29: RDS Multi-AZ failover after stopping the primary instance.

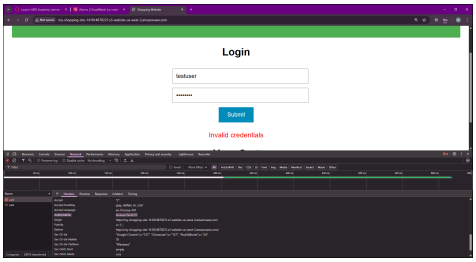

Fig. 30: Browser Network tab showing 403 Forbidden error for API request due to Learner Labs permissions.

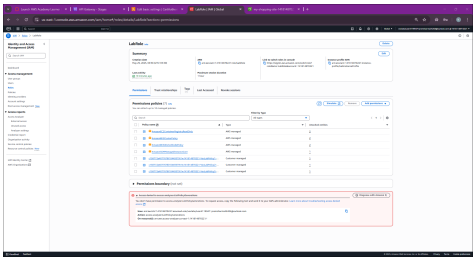

Fig. 31: CloudWatch logs showing no invocation records for CartAuthorizer due to missing permissions.