UCCD2083 Cloud Computing and Services

FEB 2025

ASSIGNMENT REPORT

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1. **BACKGROUND STUDY**

The World Cuisine Encyclopedia is a website that provides a gallery of different cuisines from across the world. Examples include Asia, Africa, North and South America, etc. This website is mainly catered for, but not limited to, homemakers, chefs, teenagers, and any other interested groups or individuals.

Users will be greeted with a sliding menu with different continents to choose from. They can slide and choose their preferred continents to view the cuisine of their choice. After selecting the desired continent, users will enter the “About” interface. The interface will introduce the continent, introduce the culture of the continent, and list a few popular cuisines from the continent. From this page, users can select the desired cuisine to get to know more details about it.

In the “Details” interface, a larger image of the cuisine is displayed, along with the description of the cuisine, introducing it to the user. Is the user is interested in cooking the cuisine themselves, “show recipe” from the interface will display detailed cooking steps of the cuisine for the user.

To summarize, the website is a functioning website introducing select continents, introducing respective popular cuisines, and providing detailed steps for the cuisines. Any interested individuals or groups are encouraged and welcome to access the website to learn more about different continents of the world, as well as their popular cuisines. They can also follow, learn, and try out the cooking steps included on the website to recreate the cuisine even though they are not being in or from the originating continent.

1. **PROBLEM STATEMENT**

Although the website is complete, there are several problems that were found during the deployment and development of the website. Some require technical assistance, and some are beyond our control and thus require the help of external sources, for example, the AWS system, to assist in solving the problem and completing the website. Below are listed several problems that are being addressed about the website.

1. Scalability and Availability problems

As a website that targets and wide range of users, the website aims to be accessible and able to reach as many users as possible. With its current build, it is unable and impossible to reach a worldwide basis for any user to access the website. Thus, the problem of scalability and availability arises, therefore, hoping to deploy the website to a platform that supports it.

Amazon Simple Storage Service(AWS S3) provides a service that solves this problem. It offers Static Website Hosting, which makes it useful for deploying and allowing more people to access our website without the need for a web server. This will allow the hosting of the website to load the pages with minimal infrastructure, which will increase availability for some users with lower-end devices. AWS S3 also provides high scalability for websites, which can handle massive amounts of data smoothly.

1. Load, Traffic, and Privacy problems

As a static website, it is unable to handle high loads and traffics. If the website is accessed by too many users at the same time, the website might crash from the heavy load. Aside from those, privacy could also be an issue. As a static website, it might be vulnerable to some hackers and attackers to steal some user’s browsing privacy.

Above stated problems could be solved with several AWS services. First service to introduced is Amazon Elastic Compute Cloud (EC2). General Purpose Instances from EC2 offers balanced compute, memory, and networking to reduce the website loads. For more advanced hosts, EC2 also provides:

* Compute Optimized Instance
* Memory Optimized Instance
* Storage Optimized Instance
* Accelerated Computing Instance

All Instances provide services to accelerate the website and reduce the loads as well as the traffic of the website to solve the problem. Those Instances are optimized to utilize multiple combinations of CPU, memory, storage and networking capacity to give the flexibility to apply the appropriate combination of resources for the website.

Aside from EC2, Elastic Load Balancing (ELB) could also help in the deployment of the website. ELB automatically distributes traffic to reduce the traffic of the website, ensuring high availability and optimized performance, solving traffic problems. ELB will distribute the traffic to several targets and/or virtual applications, for example: EC2 instances, which was mentioned, containers, IP addresses and many more. There are also:

* Classic Load Balancer (CLB)
* Application Load Balancer (ALB)
* Gateway Load Balancer (GLB)
* Network Load Balancer (NLB)

Each Load Balancer provides different optimizations and is suitable in different scenarios. For example, CLB is the most used Load Balancer and is mainly used for EC2 instances. ALB is preferred for HTTP/HTTPS traffic as it supports routing based on requested content. Other Load Balancers provide other optimizations that developers can choose from.

For load and availability problems, AWS Auto Scaling is another service to solves those problems. Auto Scaling dynamically adjusts computing resources to match requirements and provide optimal performance, saving resources and costs. One of Auto Scaling, namely Multi-Service Scaling, works with the previously mentioned EC2 and other services like ECS, DynamoDB, Aurora, and many others. There are also Dynamic Scaling and Predictive Scaling, which scale resources based on real-time demand and utilize machine learning to forecast future traffic patterns to scale resources accordingly.

Apart from pre-mentioned services, CloudWatch is another service that could be used to solve some website problems. CloudWatch is a service that monitors applications, responds to performance changes, optimizes resource use, and provides insights into operational health. By collecting data across AWS resources, CloudWatch gives visibility into system-wide performance and allows users to set alarms, automatically react to changes, and gain a unified view of operational health. Similarly to ELB and Auto Scaling, CloudWatch optimizes the performance of the website by detecting bottlenecks and releasing unused resources to improve resource efficiency. By doing so, the performance of the website can be smoother, thus solving load and traffic problems.

Last but not least, Virtual Private Cloud (VPC) can also deal with pre-mentioned problems, as well as solving privacy problems. VPC is a virtual networking environment that allows users to control several aspects of their website, including controlling resource placement, website connectivity and security, It is an isolated platform to hold EC2 and other services for the website. Being isolated, the virtual networking environment can provide a certain level of security and protect the user’s privacy. VPC also supports customizable networking, which will allow users to define subnets, route tables, and gateways to control the traffic flow. As such, not only did VPC solve traffic problems, but it also helped in solving privacy problems, making it an essential service.

1. **LITERATURE REVIEW**

Since cloud service is being proposed, there are many types of cloud services available to meet up different business needs and technical requirements. Nowadays, there are lots of cloud platforms that offer services to help business no matter startups or enterprise that looks for expansion It is important to understand the strengths and limitations of each service in order to select the best platform for business operations. This literature review will explore three aspects by comparing AWS with its competitors such as Microsoft Azure, Google Cloud, and Alibaba Cloud in terms of flexibility, global reach and web deployment, highlighting why it is the best choice for cloud solutions.

First of all, Microsoft Azure is widely recognized for its strong enterprise integration, especially for organizations which use Windows-based infrastructure. Azure provides hybrid cloud capabilities which allow business to connect their on-premises data centers with cloud environments. Additionally, Azure offers multi-language support for development that enable applications to be developed through .NET, Java, Python, and Node.js. Besides, users can configure networking, storage, and security settings to meet specific business needs while using Azure’s Virtual Machines (VMs) as customization options are available (DataCamp, 2024). Then, Azure performs well in AI and machine learning integration. Azure provides businesses with advanced analytics and automation capabilities through offering Azure Cognitive Services and Azure Machine Learning. Although Azure offers strong enterprise integration, AWS is more flexible as it offers broader service and allows user to customize. AWS supports variety of operating systems such as Windows, Linux, and macOS which is more suitable for diverse workloads. Amazon EC2 also offers more types of instance for businesses to optimize performance and cost based on their specific needs (Microsoft, 2024). AWS Lambda allows developers to launch code without maintaining server, showing that AWS is leading in serverless computing. Thus, AWS offers greater adaptability, broader service options, and more efficient deployment solutions that is more suitable for diverse cloud workloads in terms of flexibility compared to Azrure.

Other than that, Alibaba Cloud acts as the dominant cloud provider in China through offering strong regional presence across Asia-Pacific. It has data centers in over 20 regions, with most focus on China, Hong Kong, and Southeast Asia. Alibaba Cloud’s Content Delivery Network (CDN) enables businesses which are targeting for the Chinese market to have a low-latency access (Alibaba Cloud, 2024). Apart from that, Alibaba Cloud offers affordable pricing for startups to run their businesses without pay for the capital expenses. Its Elastic Compute Service (ECS) also provides scalable virtual machines which are similar to AWS EC2, but its pricing model is more suited to businesses in China. However, while Alibaba Cloud dominates in China, AWS has a bigger global reach, with over 100 Availability Zones in 30+ geographic regions. AWS's worldwide infrastructure provides low-latency access for enterprises in North America, Europe, and emerging countries. AWS also offers multi-region replication via Amazon S3 and Amazon RDS. This offers business to maintain high availability and recover faster after disaster across continents (Alibaba Cloud, 2024). Furthermore, AWS's alliances with significant telecom providers can enhance connection, which makes AWS to be more suitable for global enterprises. Additionally, AWS also offers AWS Direct Connect, which guarantees fast and secure data transfers while facilitating network connections between on-premises settings and AWS cloud regions. Therefore, compared to Alibaba Cloud, AWS provides a wider global infrastructure, better connectivity, scalability, and reliability for companies that operate across continents.

Last but not least, Google Cloud is popular for its developer-friendly environment with the integration of open source technology. Google Kubernetes Engine (GKE) provides automated scaling and management of containerized applications which is ideal for microservices architectures. Developers can deploy apps using Google Cloud's Cloud Build and Cloud Run, which ease continuous integration and deployment (CI/CD) (Google Cloud, 2024).. Google Cloud also has powerful AI and machine learning capabilities, which can help organizations integrate advanced analytics into their web apps. Although Google Cloud excels in containerization, AWS provides a more comprehensive suite of web deployment tools. AWS offers Elastic Beanstalk that simplifies application deployment by automatically handling scaling, monitoring, and load balancing. AWS’s CloudFront CDN ensures fast content delivery across global which helps to improve website performance (Google Cloud, 2024). AWS also provides AWS Amplify, a full-stack development framework that enhances frontend and backend deployment for web applications. Hence, AWS offers a more scalable and cost-effective solution for businesses to efficiently manage their applications with minimal operational in terms of web deployment, making AWS the best choice for businesses requiring scalable, high-performance web applications.

In conclusion, Microsoft Azure, Alibaba Cloud, and Google Cloud have their own advantages in enterprise integration, regional dominance, and developer-friendly tools respectively. However, AWS still remains the first choice for cloud services due to its flexibility, global reach, and web deployment solutions. Azure excels at hybrid cloud and enterprise integration, whereas AWS offers more customized and serverless computing. Alibaba Cloud is the market leader in China, but AWS is better suited for international operations due to its worldwide infrastructure and multi-regional capabilities especially for those businesses whose want to expand. Google Cloud is strong in Kubernetes and AI, but AWS offers a more comprehensive set of deployment tools that guarantee scalability and performance. Thus, AWS is the best options in considering cloud services

**4.0 METHODOLOGY**

For the deployment and development of this website, we are going to use several AWS services that have been mentioned above. They are Amazon S3, Amazon EC2, Amazon VPC, AWS Auto Scaling, and CloudWatch and would be coming with some features, such as storage bucket for the website deployment, instances, load balancer, and auto scaling of the website and Internet traffic, security protection for the website, dashboards and alarms for monitoring the performance and current situations of the feature running and related metrics, and the list goes on.

**Amazon Simple Storage Service (S3)**

Amazon Simple Storage Service, also known as Amazon S3, is the service that has the primary deployment of the website with the bucket that lets users of the service or developers upload their website resources. The uploaded resources can be used and made public by having some setup on public access to the resources. After finishing the setup and configuration, the developers are able to share and publish their website by just having the link of the main page or the index of the website, which is the webpage that has been set up as the main page or the index of the website, by just using the link with the public access. The following step would be shown with the screenshots of the setup and configuration of the S3 service.

Step 1: Create a bucket and upload the website resources

A screen shot of a computer

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Based on the image above, we are able to know that there is the bucket created with the name, hecticdevelopers. We are able to create the bucket by clicking the button with the phrase “Create bucket”, that located at the right upper side. After click on it, we are able to look at the interface for creating the bucket. We just have to write the name of the bucket and just click on the “Create Bucket” button for creating the bucket. For the name of the bucket, we have to give a name that is different and unique across the whole AWS in the world.

A screenshot of a chat

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After we have created the bucket, we are going to upload the website resources. We are able to upload the website resources by clicking the upload button, and we will choose either upload files or a folder, depending on the location of the website resources. We will be able to look at our website resources after we have finished uploading the resources.

Step 2: Configure and Setup for Public Access

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We have to configure and set up for public access before we publish the website to the public. We will have the setting on three features, static website hosting, public access blockage and object ownership. First, we have to select the static website hosting and enable the ACL of the website. We have to select the “Host a static website” and set for the website with its main page or index. After that, we have to uncheck the block public access and check the object ownership with the enabling of ACL. After that, we have the last action, which is to make the resources public which as shown in the image below. Then we are able to copy the link of the website and make it as a publicly accessible website. And here is the link of our website: <https://hecticdevelopers.s3.ap-southeast-1.amazonaws.com/UCCD2323_P4P5G60/1_mainpage.html>

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**Amazon Virtual Private Cloud (VPC)**

Amazon Virtual Private Cloud, also known as the Amazon VPC, is an isolated cloud resource that enables developers to setup a reasonably isolated section in the AWS cloud for the deployment of the website with a virtual environment. The VPC includes the setting of the availability zones, public subnets and private subnets, NAT and Internet gateway, security group and the list go on. The following step would focus on the setup of the VPC.

Step 1: Create VPA close-up of a computer screen

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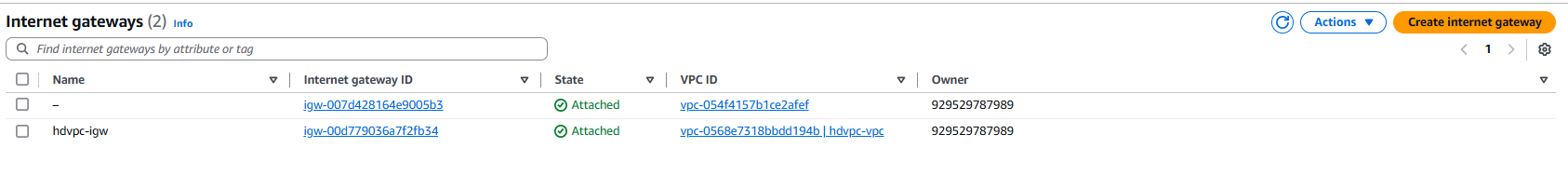
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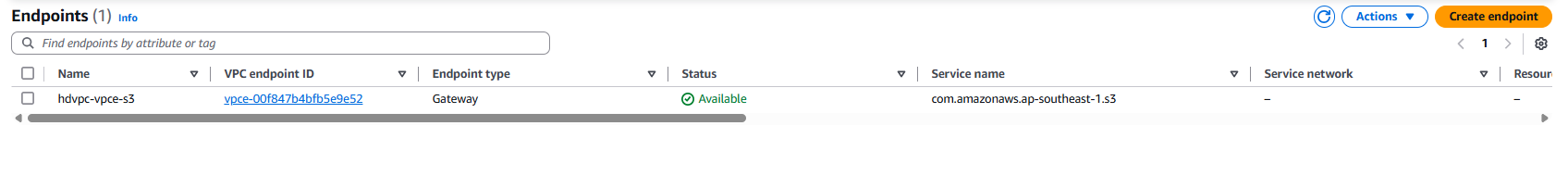
After we have clicked the create button, we have to choose “VPC and more so that we are able to create all of the features except the security group of the web server. Same as the previous, we have to name the VPC and set up the IPv4 CIDR block. The developers can select the IPv6 CIDR block if it is necessary for the website, and keep the default for the tenancy. After that, developers have to choose the number of availability zones, public subnets, and private subnets for the VPC. Developers can have customization for the subnets if they would like to have it. Lastly, we have to choose the NAT gateway for each of the availability zones and the VPC endpoints with the S3 gateway, and check the DNS options. And we will be able to look at the features for the VPC with the images shown below.

A screenshot of a computer screen

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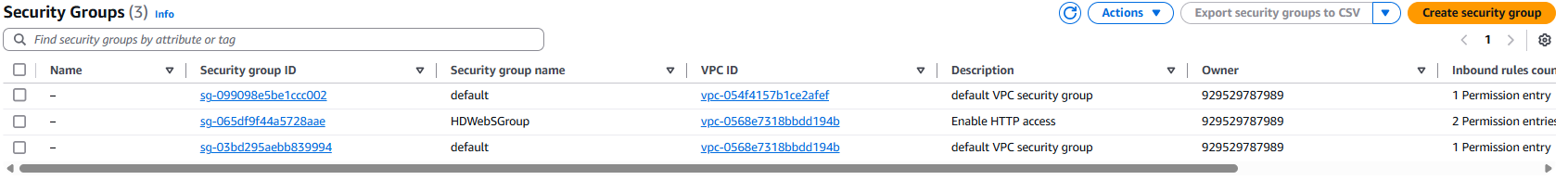
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AI-generated content may be incorrect.A close-up of a computer screen

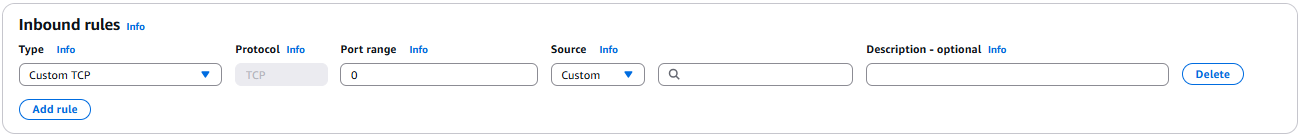
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All of these are the features and the resources map of the VPC, and we do not need to create anything for the VPC structure. Now, we can create the security group with the created VPC.

Step 2: Create Security Group

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Generally, security group would be use for the inbound and outbound rules of the Internet access. For this deployment and development, we are going to create a security group for two protocols, which are SSH for telnet, and most importantly for the Internet access, HTTP. We have to use the VPC that we have created and set the inbound rules for SSH and HTTP. For the source and destination IP for both inbound and outbound rules, we have to choose the All IPv4 address so that there would not be any blockage for any traffic. Then, we just create it after finish the configuration.

**Amazon Elastic Compute Cloud (EC2)**

Amazon Elastic Compute Cloud, also known as Amazon EC2, is a service for offering secure and resizable compute capacity. Its purpose is to enable easy access to the website and also the usability of website. For this service, we will create the instance for every availability zones, load balancer and auto scaling group. For the load balancer, since we cannot found the Elastic Load Balancer (ELB), we will just use the load balancer created in EC2, and the auto scaling group would be used to connect with the AWS Auto Scaling service.

Step 1: Create Instances for the Availability Zones

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After click the “Launch Instance” button, we are able to create the instance. Keep all of the default selections except the key pair and the network setting. We have to create the key pairs if there is not provided for the encryption and decryption of the data transfers. Then, we have to choose the VPC and the public subnet that used for create the instances, and the security group for the access of the Internet connection and SSH. We can just click on “Launch Instances” and we are able to create three instances for three availability zones by repeating this step.

Step 2: Create Load Balancer

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We create the load balancer by choosing the application load balancer (ALB) since we are going to use the load balancer for the website running. In the setup of the load balancer, we just need to choose the VPC that we have created and all of the public subnet for the load balancer. Also, we have to choose the security group and also add the listener with the port 80 for HTTP with the created target group. For the creation of the target group, we need to choose the instances type and also the VPC and security group that we have created before. Also, we have to set the protocol and the health check for the target group before we create the target group. A screenshot of a computer

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Step 3: Create Auto Scaling Group

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For the creation of the auto scaling group, we have to create the AMI and templates before create auto scaling group with the instance, VPC and the target group. We have to use the template, VPC, security group, load balancer and the availability zones that would be used for the auto scaling and there would be subnets chosen for the auto scaling group if the website need all of the subnets including public and private subnets to have the auto scaling. Then we will configure the group size and scaling of the auto scaling group before we create it.

**AWS Auto Scaling**

AWS Auto Scaling is for us to have the scaling of the website or applications, with monitoring to ensure the scalability of the website or applications. AWS Auto scaling would be used for ensuring the website sustains steady and to have a predictable performance at the lowest possible price. We will use the Auto Scaling Group that we have created in the Amazon EC2 for connecting with AWS Auto Scaling to have the scaling plan with just one step.

Step 1: Create Scaling Plan

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Based on these images, we will select the Auto Scaling Group that we have created just now and just have some configurations on the scaling plan, such as scaling strategies, checking for predictive and dynamic scaling, and other advanced settings. We will just create the scaling plan directly after we have done for previewing the scaling plan.

Amazon CloudWatch

Amazon CloudWatch is the service that lets us monitor the performance and status of the services based on the metrics and logs with the creation of dashboards and alarms. For the images below, we are able to look at the sample dashboard would show up the performance of the metrics and the traffic of logs with the graph and record methods. For the alarms, the alarms would basically be created for auto scaling and instances to monitor the status of the services. The status with “OK” then would be in the true condition, while the false condition would comes with the “In Alarm” status.

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**5.0 AWS SOLUTION ARCHITECTURE DIAGRAM**

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1. **CONCLUSION & FUTURE WORK**

The World Cuisine Encyclopedia website aims to provide a globally accessible platform for users to explore and learn about international cuisines. The site aims to educate and inspire a diverse audience to explore and recreate global cuisines no matter where they are. The above information describes the website's background, problem statement, literature review and methodology.

The site is fully functional but its current static setup faces challenges in terms of scalability, usability, traffic and privacy. To address these issues several options are proposed for this website which can enable high scalability, global availability, optimized performance and enhanced security by leveraging AWS services such as S3, EC2, ELB, Auto Scaling, CloudWatch and VPC.

The literature review confirms that AWS is the superior cloud platform with its flexibility, extensive global infrastructure, and powerful web deployment tools, making it the best choice for deploying and scaling the World Cuisine Encyclopedia website to meet the needs of a diverse global audience.

Although the website is very well done, there are still some weaknesses on the website. So, the world Cuisine Encyclopedia website has a lot of room for improvement in the future. The first future work on the World Cuisine Encyclopedia site is to use RDS and aurora to make Frequently asked question and feedback. This will help users to get information more quickly and allow the site to accept more suggestions from users. This will help users to get information more quickly and allow the site to receive more suggestions from users so that there is room for improvement.

The second future work is to add domain names using AWS Routing 53. This is because domain names make websites easier to find and increase the probability that they will be searched for. Besides, in the future we can use Amazon Cognito for user authentication, authorization, and management in the world Cuisine Encyclopedia website. It simplifies the process of user registration, login and access control. Finally, use IAM to develop and deploy specified rules for website. IAM rules can define which users can perform specific actions on AWS resources, ensuring security, compliance, and efficient operations.

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