

Omni Cloud Solutions

By

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the Faculty of the School of Information Technology
in Partial Fulfillment of the Requirements for
the Degree of Bachelor of Science
in Information Technology

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Acronyms and Abbreviations

AWS - Amazon Web Services

SAAS - Software as a Service

IAAS - Infrastructure as a Service

PAAS - Platform as a Service

XAAS - Anything as a Service

IT - Information Technology

CIO - Chief Information Officer

CTO - Chief Technology Officer

GM - General Manager

SMB - Small and Medium Sized Businesses

EC2 - Amazon Elastic Compute Cloud

OWASP - Open Web Application Security Project

ZAP - Zed Attack Proxy

XSS - Cross Site Scripting

Abstract

"Today, a public cloud is a top priority for many enterprises. Statistics show cloud infrastructure usage has grown from 29 percent in 2017 to 38 percent in 2018." With a wide variety of options, finding the right cloud solution can be inefficient and costly for companies. This is where Omni-Cloud Solutions helps during their digital transformation journey. Our organization aims to make finding the right solution simple with an easy to use web application-based wizard, which will help organizations choose between IaaS, SaaS, XaaS, PaaS, and different storage options from a variety of cloud service providers. The service we provide will allow the organization to provide specific details about them and receive a tailored cloud solution plan based around important metrics such as cost, storage, and availability. Reducing the amount of research previously devoted to migrating their organization to the cloud solution will save time and money allowing them to focus on their own projects.

Weins, K. (2018, February 13). Cloud Computing Trends: 2018 State of the Cloud Survey. Retrieved October 1, 2018, from <https://www.rightscale.com/blog/cloud-industry-insights/cloud-computing-trends-2018-state-cloud-survice>

1. Problem Statement

1.1 Introduction

Finding the right cloud solution can be difficult because of the vast number of companies to choose from. With the number of cloud companies growing there are a lot of options out there which can make choosing the right one very time consuming. It can be even more difficult for those who don't know all the cloud lingo and buzz words.

1.2 Project Description

Omni Cloud Solutions will allow users of varying technical backgrounds to find the right cloud solution based on their specific needs. The web app will be making filtering through the top 16 cloud providers easy through our Cloud Picker Wizard. This wizard will ask the users varying levels of questions to filter through their needs. The questions presented to the users will be based on their previous responses. This will allow us to present the top 3 solutions that fit all of the user's criteria. The users will also be able to search through all our solutions in our database if they just need information on a specific solution.

1.3 Problem

There is no website that allow people to research all the top cloud solutions at one time. Although providers like Azure have wizards to help you pick one of their solutions, there are none that help you pick between all the top cloud providers. Getting the right information from providers can also be difficult as they don't always have all the pricing information displayed. Many times, you must contact a sales rep before you can see what a solution will cost. This adds further time to your research and makes the process more of a headache. Having one site

that can show you all the information on all the top cloud providers will make the process of finding a cloud solution quick, simple and painless.

1.4 Solution

Omni Cloud Solutions will be a web-based application running on an Ubuntu 18.04 server. The server will be hosted in Amazon Web Services EC2 service and our domain will be hosted in AWS's Route 53 service. PostgreSQL will be used for our database and Bitbucket will be our code repository. The web app will be written in Java using spring boot and thymeleaf as a template resolver. Our enterprise-grade web application will have the security and compliance needed for you to build and purchase your cloud solution plan with confidence. We provide you with an easy and simple setup ran on our securely designed web application in a fully isolated, compliant, and dedicated environment via AWS (Amazon Web Services). From our service you choose from 16 dedicated and trusted providers linking you to a sales representative.

1.5 User Profile

We have determined that the End User is the only type of user that will be interacting with our web application. The potential users for the Omni Cloud Solution web application are users that are decision makers for their company's such as IT Professionals, GM's, CTO's, and CIO's who would assist in the migration to the cloud. These users will answer a series of questions to and based on previous answers will guide their path to three recommended cloud solutions. With the solutions will be provided details about the scale, cost, and reliability of the cloud solution service that we recommend.

User Profile Form

1.5.1 PROJECT:

Omni Cloud Solutions – A one stop shop for cloud solutions.

1.5.2 POTENTIAL USERS:

SMB looking for cloud solutions

CTO's, CIO's, and GM's who don't want to spend all their time researching all the cloud solution providers.

Non-IT professionals who need help deciding how the cloud can help with their needs

1.5.3 SOFTWARE, INTERFACE, AND RELATED EXPERIENCE:

This project will be aimed at SMB businesses that would like to move to the cloud and that would require help picking a solution or comparing solutions that are available. There is a large amount of cloud service providers on the market making it time consuming and expensive to research cloud solution services. The application will help the user decide on which type of solution they need that best fits their environment and needs based on.

The interface will be simple and easy to understand. In the Web Application the user will input information to narrow down the best possible solution based on a series of questions. Between the ease of use and digestible information, we will provide a tailored cloud solution to fit all the needs required for the company to make their digital transformation.

1.5.4 EXPERIENCE WITH SIMILAR APPLICATIONS:

Navigating web pages

Azure cloud solution picker

AWS cloud hosting applications

Google cloud services

1.5.5 TASK EXPERIENCE:

The user will start off at a simple home screen, possibly with some general Cloud service information. There will be a button to initiate the question gathering portion of the app. The questions will start off simple to grab a broad idea of what the user is looking for, and the questions will become more intricate as the user answers them. This will help narrow down the selection for the user. We intend to make the questionnaire and app as user friendly and understandable as possible. Once a Cloud service is decided on, we want to provide an easily digestible report for the user to review. This report will be simple enough for someone nontechnical to understand, but also provide more in-depth info for the CIO, or team in charge of the cloud implementation.

1.5.6 FREQUENCY OF USE:

Whenever users need help finding a new cloud solution and if they need help comparing different solutions.

1.5.7 KEY PROJECT DESIGN REQUIREMENTS THAT THE PROFILE SUGGESTS:

Provide information for user not familiar with Cloud technology

Quickly find Cloud solutions based on user input

Search for specific cloud solution details

Provide up to date data on all Cloud solutions
Provide easy to digest informational reports

Figure 1: User Profile Omni Cloud Solutions

1.6 Use Case Diagram

Figure 2: Use Case Diagram provides what the average interaction on both sides of the application.

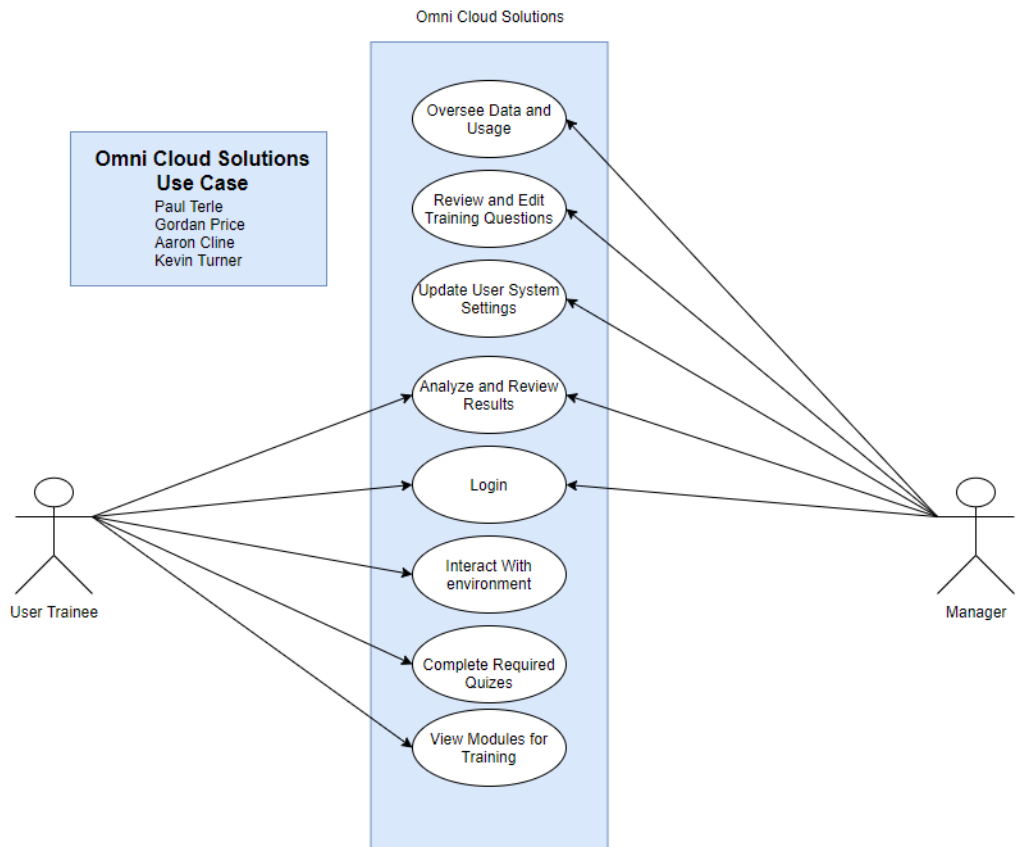


Figure 2: Omni Cloud Solutions Use Case Diagram

2. Project Management

2.1 Budget

Table #1: Project Budget Estimate provides a theoretical estimate on the cost to carry out this project. As we are doing this project for free, these are only rough estimates of what it may cost to hire employees to create this web application. The estimate comes from average hourly pay (average pay determined from the Bureau of Labor Statistics) and the length of the project (September 1, 2018 thru April 9, 2019 IT Expo.) The only actual cost we have run into has been the cost to host our test environment in AWS.

ITEM	ESTIMATED #	COST	TOTAL
Labor	8hrs x 153 days x 4 members	\$40.66 /hr	\$199,071.36
AWS Monthly Cost	8 months	\$24/month	\$192.00
TOTAL	10 months		\$199,263.36

Table 1: Project Budget Estimate

2.2 Objectives and Deliverables

Deliver an application focused on the assessment and decision process of businesses deciding on a cloud solution. The application will provide both a simple explanation at a low technical level and another for a high technical level.

The application will allow the user to answer questions and input information to narrow down and choose a solution that is tailored specifically to their needs.

Team goals:

- Meet all timelines assigned by instructor

- Build a well thought out website/application that allows people to find the right cloud solution for their needs
- Build an infrastructure that is optimized for speed and High Availability
- Make our solution as secure as possible
- Develop a product to take to market
- Sell our solution

2.3 Project Schedule

Table 2: Fall 2018 Gantt Chart, Table 3: Work Breakdown Structure provides the major events and schedule that we have stuck too throughout the project.

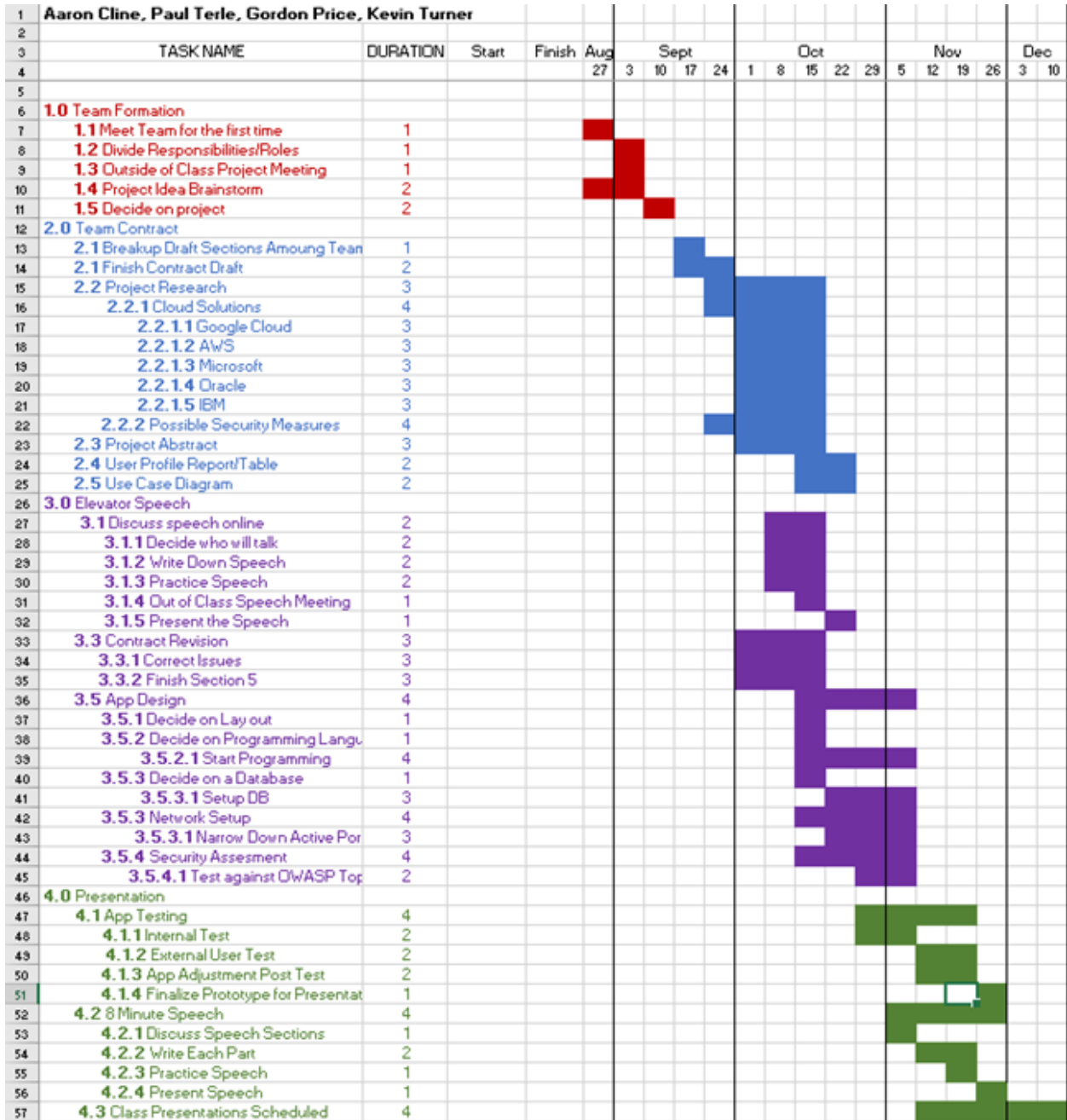


Table 2: Fall 2018 Gantt Chart

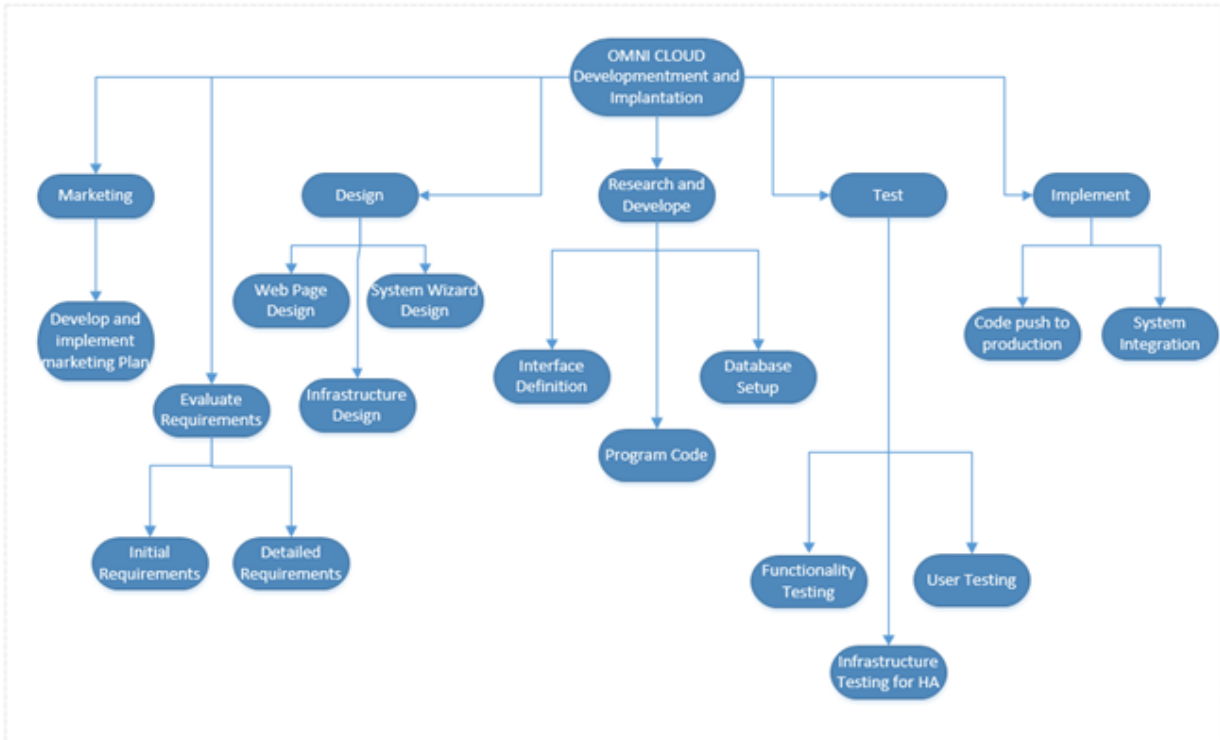


Figure 3: Work Breakdown Structure

3. Technical Elements

3.1 Network

We are hosting Omni Cloud Solutions on AWS. We have decided to go with this cloud solution because the majority of the team is familiar with the way it is set up. We have already purchased a domain for our website, aptly named <https://OmniSolutions.Cloud>. The domain is hosting using AWS’s Route 53 and the ubuntu server is hosted using a T2 medium EC2 instance.

3.2 Application

This application will serve the ultimate front-end experience for users. It will walk CEOs, CTOs, as well as anyone in a technical role through an interactive wizard that returns to them the best cloud solution. Each choice in the wizard will affect what questions will come next. This

will be done using an intricate relational database and specific algorithms. More information on the algorithm used can be found in Appendix C.

3.3 Database

The database will be running on PostgreSQL which is installed on our Ubuntu 18.04 server. We chose this database because there is a lot of support articles if we need to look up how to do anything and some of us had previous experience with it. Detailed information on the database research and architecture can be found in Appendix B.

3.4 Security

Security for the application will be focused around the Open Web Application Security Project (OWASP.) “OWASP is in a unique position to provide impartial, practical information about AppSec to individuals, corporations, universities, government agencies and other organizations worldwide. Operating as a community of like-minded professionals, OWASP issues software tools and knowledge-based documentation on application security” https://www.owasp.org/index.php/Main_Page The decision to focus our application security on OWASP was because it is readily available, the information that OWASP provides is easy to understand and implement, and the fact that it is all free information didn't hurt the decision either.

3.5 Technical Architecture

This diagram shows how our machine learning interacts with our server and the client

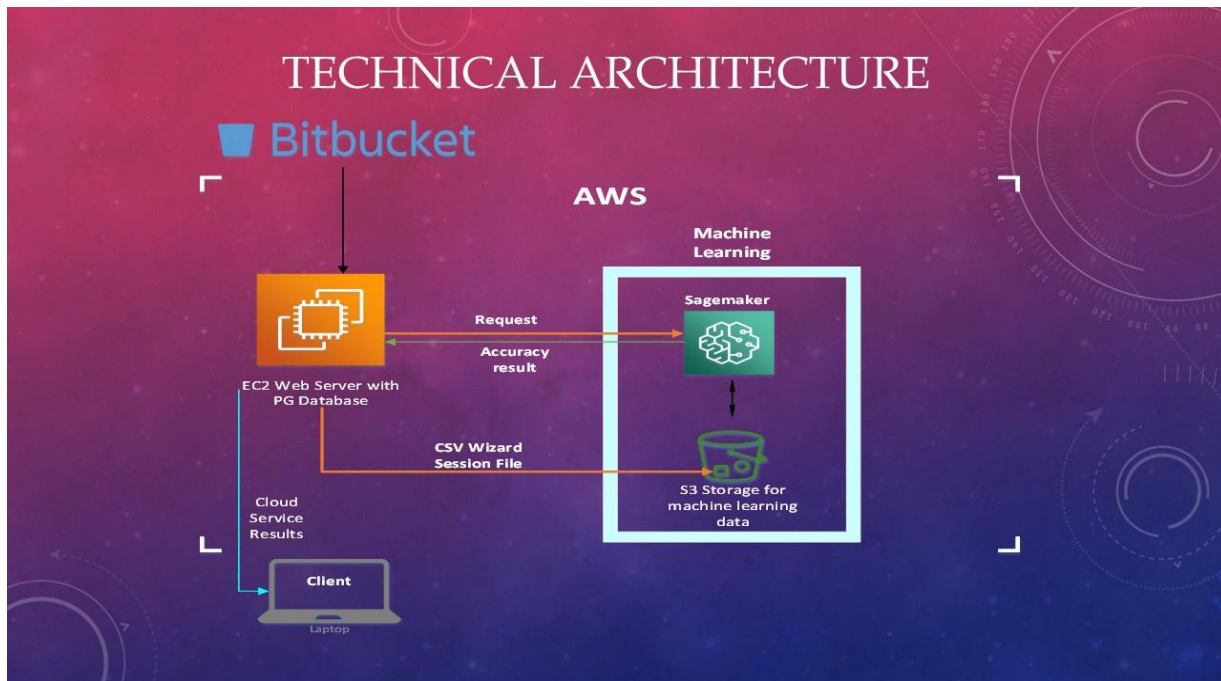


Figure 4: Technical Architecture Diagram

4. Application

4.1 Application Architecture

The web application will be packaged using maven. This will allow us to have proper dependency management. We will be using MVC as the plan of attack for designing our application. Utilizing java's core libraries and spring boot allows for scalability. Thymeleaf will be the template resolver of choice. Bootstrap and jQuery will be pulled in through maven and allow us to enhance the user's experience.

4.2 Application Screenshots and Examples

Omni Cloud Solutions home page

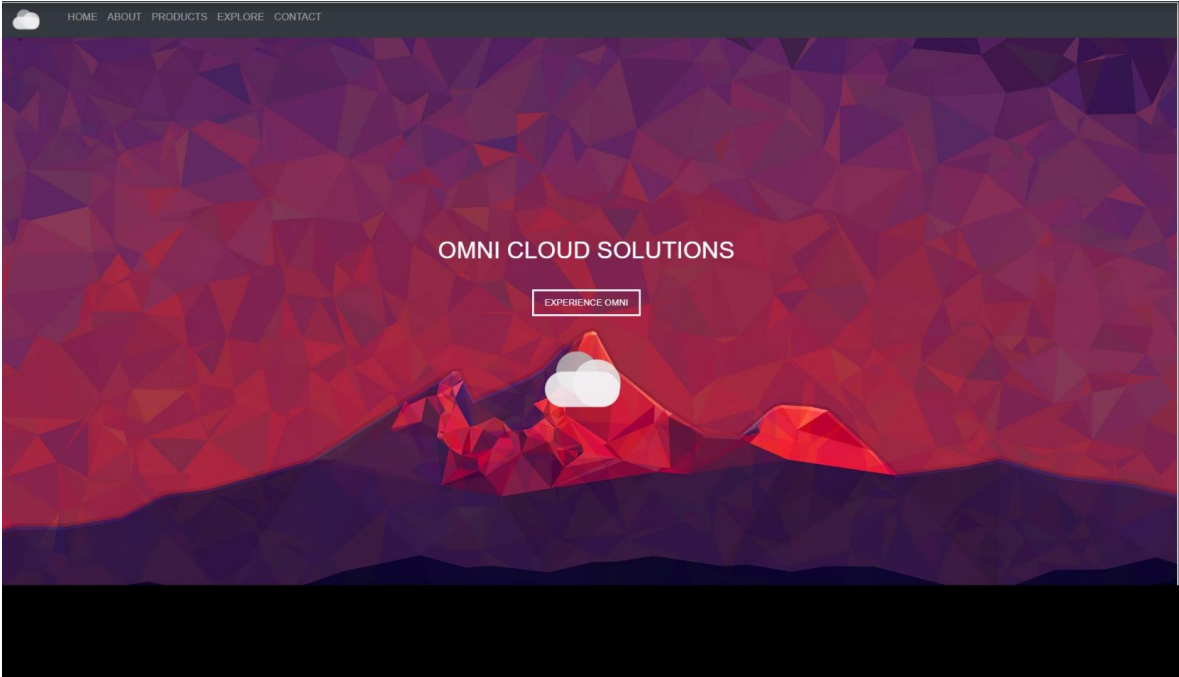


Figure 5: Website Head

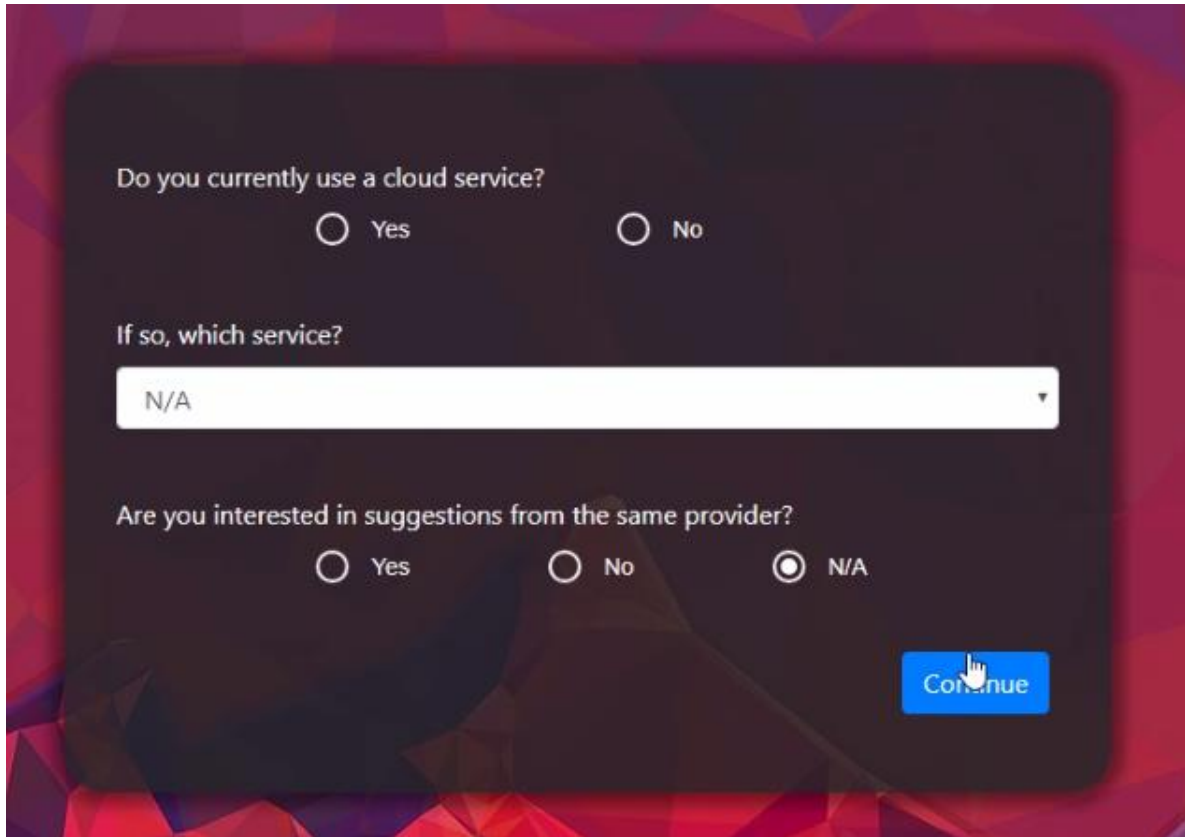


Figure 6: Website Material

5. Test Plan

5.1 Overview

Our biggest focus when it comes to testing is making the application easy to use. We would like to start off with internal testing to make sure that the application is working the way it is intended, making sure all the buttons correspond with the correct link, and the results make sense. After the initial internal testing we will be inquiring for outside testing and input, possibly from other classmates, faculty, and any other people we may be able to get to test it. The external testing will focus more on observing how the users interact with the application and making sure that they do not have any issues understanding or navigating the application.

With the outside external testing we will modify the interface until we feel that anyone can use it regardless if they are from the Security team or HR. The application guide can be viewed in Appendix A-1.

5.2 Objective

- Create a web app that helps users find the right cloud solution to fit their needs
- Centralized source of information on all cloud solutions from top 3 providers
- Create wizard that helps find tailored cloud solutions
- Eliminate middle man and allow users of any background to use our wizard

6. Testing

6.1 Overview

This section will explain the testing that we carried out on Omni Cloud Solutions. Testing will be carried out by the team of developers, network administrators, and security analyst.

6.2 Scope

The scope of the testing is to test the reliability and functionality of the wizard, as well as test against the database to protect data being sent and received from a security point of view.

6.3 Objective

The objective of this test plan is to verify that our application functions correctly and to check for security vulnerabilities. These tests are designed to verify that the wizard and machine learning will give the users the best solution. The Systems Administrator and Security Analyst will run tests on the security of the application throughout the development process. The

developers will test components of the wizard as they are developed. There will also be thorough testing done by all group members when the application is completed.

6.4 Entry and Exit Criteria

Entry Criteria:

- Verify data is being sent, and called, from the database
- Wizard can complete a full run through

Exit Criteria:

- Harden database in case any XSS issues, or any other issues are discovered
- Wizard runs with no issues
- Information is being stored in database and called correctly

6.5 Loggings Test and Reporting

During testing we will log which question path we take in case an error occurs and the route needs to be testing again. Any errors or issues will be logged and tracked on an issues page, that will be reviewed by the team.

6.6 Testing Procedure

Wizard Testing: The user (a member of the team) will run through the wizard several times, in as many, if not all, possible paths.

Database Testing: The database will be monitored as the wizard is submitting the information to confirm the data is being stored correctly.

6.7 Security Testing

OWASP provides a useful tool name OWASP Zed Attack Proxy (ZAP) which helps to scan for security vulnerabilities in web applications. Using ZAP, we were able to double check our efforts on strengthen the security of the web application. Though we had believed that we had did an adamant job, ZAP picked up a few vulnerabilities that had been over looked, which included Cross Site Script (XSS) vulnerabilities and ClickJacking vulnerabilities. Below is a picture of the ZAP tool after running it against the web application.

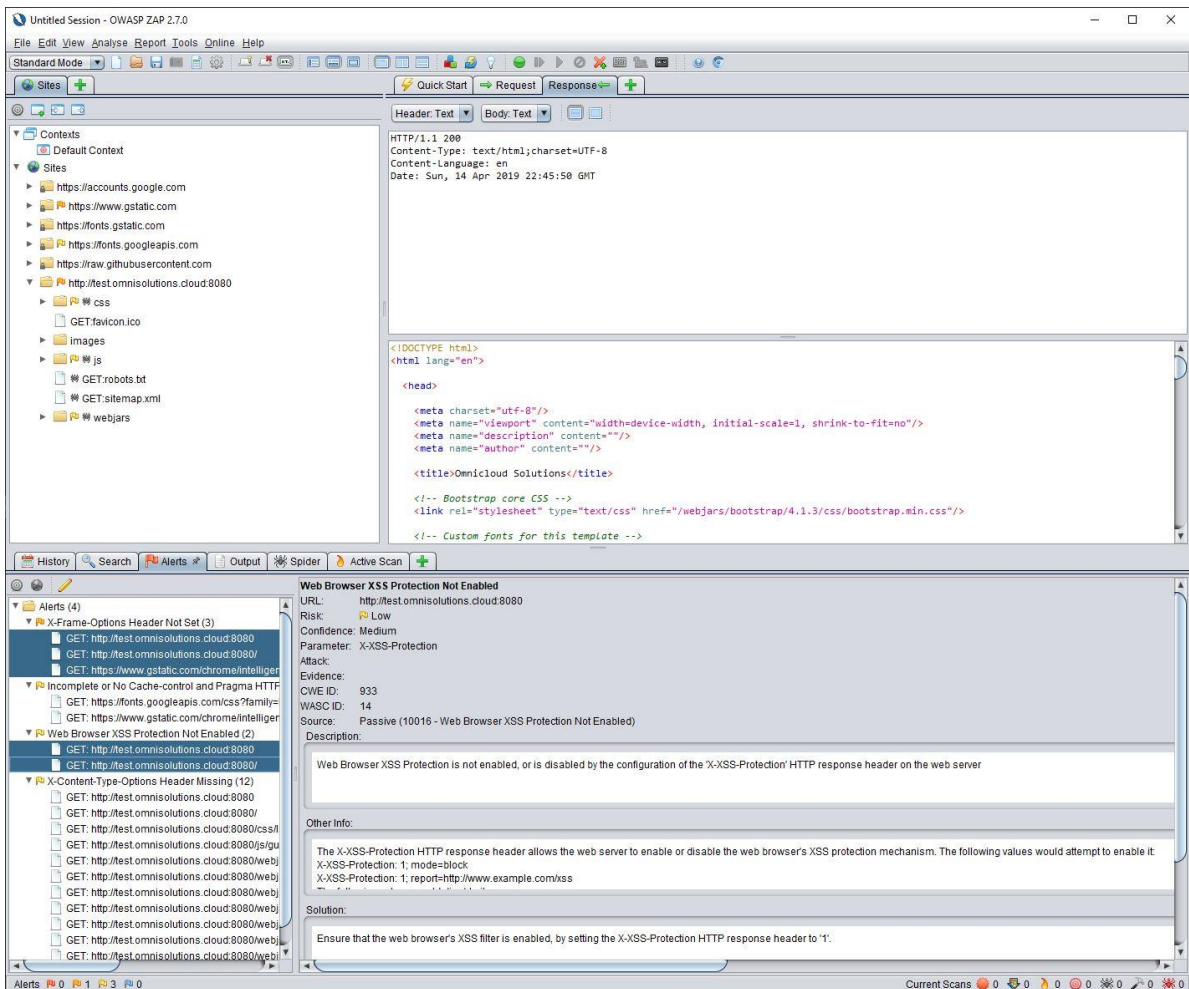


Figure 7: ZAP Application

6.8 Pass/Fail Conditions

It will be expected that the OmniCloud WebApp must pass all tests in every category to be successful. This includes database and server security along with functionality of the website and wizard. If it does not pass, the tester will document the issue.

6.9 Schedule of Team Member Testing

The schedule of the team member testing is done on a biweekly interval, primarily done during in person and Discord meetings.

Name	Testing Schedule	How Often?
Systems Administrator	01/14/2018 to 04/08/2018	Bi weekly
Backend Developer	01/14/2018 to 04/08/2018	Bi weekly
Front End Developer	01/14/2018 to 04/08/2018	Sparse
Security Analyst	01/14/2018 to 04/08/2018	Bi weekly

Table 3: Testing Schedule

6.10 Risks

The following factors will impact our testing:

- New features added that have not been pushed to master branch yet
- Schedule of the testing rounds
- Delays in bug fixes
- Issues with Machine Learning csv data test and training

6.11 Test Items

Test Item	Test Plan	Expected Results
Wizard functionality	Run through countless trials to test the functionality of the wizard to ensure that it does not have any errors when a user is navigating through it.	Each iteration of runs through the wizard will be a successful with no errors.

Wizard flow	The flow of the questions should reflect the previous answers.	When going through the wizard, based on your answers, you should be presented with more questions to narrow down the results.
SQL Database	During the testing of the wizard, ensure that data is being sent to the database at the end of each iteration, and data is being recovered for recommendations.	Data is sent and received with no issues.
SQL Database Machine Learning	At the end of each session data is sent to and from the SQL database. The information received should reflect past sessions, and the information sent should alter future recommendations.	Each session will be stored in the database. This data is referenced by the machine learning algorithm to help users find results faster.
Security Testing	Attempt to access the database and grab information using XSS.	Data will be unable to be grabbed using XSS.
User Interface	Users inside and outside of the group will test and provide feedback on how they felt about using the application.	Users will find it easy to navigate through the wizard, understanding the buttons, sliders, and questions given to them.
Browser testing	We will test our application on all the widely used browsers like Chrome, Firefox, Safari, Edge and IE.	Our application will function without any errors within all major browsers.

Table 4: Test Items

6.12 Test Cases

Tester	Date	Test	Pass/Fail	Notes
Paul	1/25/19	Click Site links to confirm links are valid	Pass	
Gordon	2/12/19	Click Wizard Experience and try to go back a page to test for errors	Pass	Went to previous page with no issues
Gordon	2/19/19	Test First Page Cloud, each service selected, with each radial button combination	Pass	
Gordon	2/19/19	Second page option combination test	Pass	

Gordon	2/19/19	Third page option combination test	Pass	
Aaron	3/2/19	Forth Page option combination test	Pass	
Aaron	3/19/19	Observer data change in the database	Pass	
Kevin	3/25/19	Results page present more than one suggestion, and presents different suggestions during different runs	Pass	
Paul	3/30/19	Verify Data is being sent to SageMaker	Pass	
Kevin	3/20/19	Run ZAP for security vulnerabilities	Fail	XSS Vulnerabilities and Clickjacking Vulnerabilities found

Table 5: Test Case Results

7. Future Recommendations

- For the future we would like to implement machine learning into more of our application. This would allow us to dynamically update the weights of questions allowing us to always give the users the best suggestions as we collect more data from users.
- We also would like to add additional providers and solutions to our database. We would like to include some of the smaller providers into our solution to help show users there might be a cheaper option from other providers.
- Another future plan would be to make the site mobile friendly so anyone with a smartphone could use our service.
- A recommendation we had was to allow users to create profiles on the site so they can save their cloud choices to view at a later time.

- Another recommendation is that we might have providers give us a small percentage of sales if our solution helps sell theirs.
- We have not decided if we wanted to continue to build the application after this semester is over, but we are considering it.

8. Conclusion

8.1 Fall Semester 2018

In conclusion Omni Cloud Solutions group has finalized all details for the project; which include and are not limited to cloud provider research data, an application architecture plan, and a scrum delivery plan before Expo and Technical presentations to assure project readiness. The project defines a clear solution for users and addresses the questions and concerns of industry professionals looking to purchase a cloud solution. With the application architecture planned the team of developers will have UX a top priority and focus for product success. The focus of being an easy, simple to use, and clearly defined question web application that provides a recommendation, is what the project plans to achieve by mid spring semester. While the development plan is a great start, the backend infrastructure is still incomplete awaiting compiling and input of data to the database, which should be completed within the next upcoming semester.


8.2 Spring Semester 2019

With Omni Cloud Solutions Web Application up and readily available, the project is prepared to solve consumers problems by using the application to learn and suggest a detailed cloud solution. While the web application is a good start, expanding the cloud solution providers and question set data is a portion that is still incomplete. In addition, our stretch goal of having a fully self-learning machine learning algorithm is partially in-complete as well. This feature should be available shortly after we update the training data imported to the project to test and train a larger pool while will provide more accurate recommendation and percentage result, creating an overall better user experience.


9. Poster

Senior Design
Aaron Cline, Gordon Price
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Omni Cloud Solutions



University of
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Technology


Problem

- Finding the right cloud solution can be difficult because of the vast number of companies to choose from.
- With the number of cloud companies growing there are a lot of options out there which can make choosing the right one very time consuming.


Solution

- Our enterprise-grade web application has the security and compliance needed for you to build and purchase your cloud solution plan with confidence. We provide a simple to use website that will make finding the right cloud solution quick and easy


Technology Used




Amazon
Machine
Learning




Azure




spring
boot




HTML CSS JS



aws



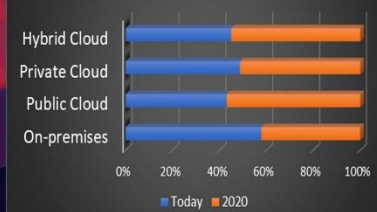
Bootstrap



Google Cloud Platform

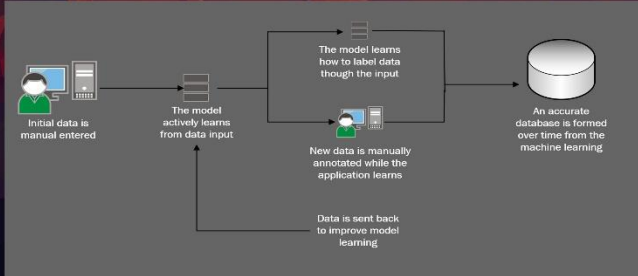
Marketing Statistics

Where will workloads run (Today vs. 2020)



Category	Today (%)	2020 (%)
Hybrid Cloud	~45	~55
Private Cloud	~40	~50
Public Cloud	~35	~45
On-premises	~30	~40

Machine Learning



```

graph LR
    A[Initial data is manual entered] --> B[The model actively learns from data input]
    B --> C[The model learns how to label data through the input]
    C --> D[An accurate database is formed over time from the machine learning]
    D --> E[Data is sent back to improve model learning]
    E --> B
    F[Now data is manually annotated while the application learns] --> B
    
```

Figure 8: Senior Design Poster

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Appendix

Appendix A-1 - Omni Cloud Quick Reference Guide

About Omni Cloud Solutions

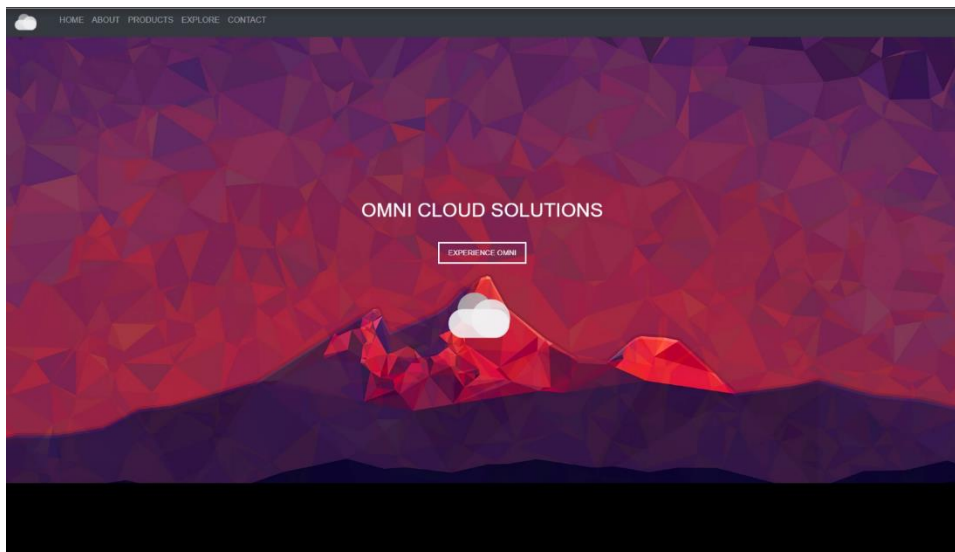
Omni Cloud Solutions Web Application is a service created to provide an easy to use and simple experience for individuals of all technical levels to pick a cloud provider. This application asks you a series of questions and given a certain path will recommend a cloud solution provider and give you a path to get there.

Quick Reference Guide

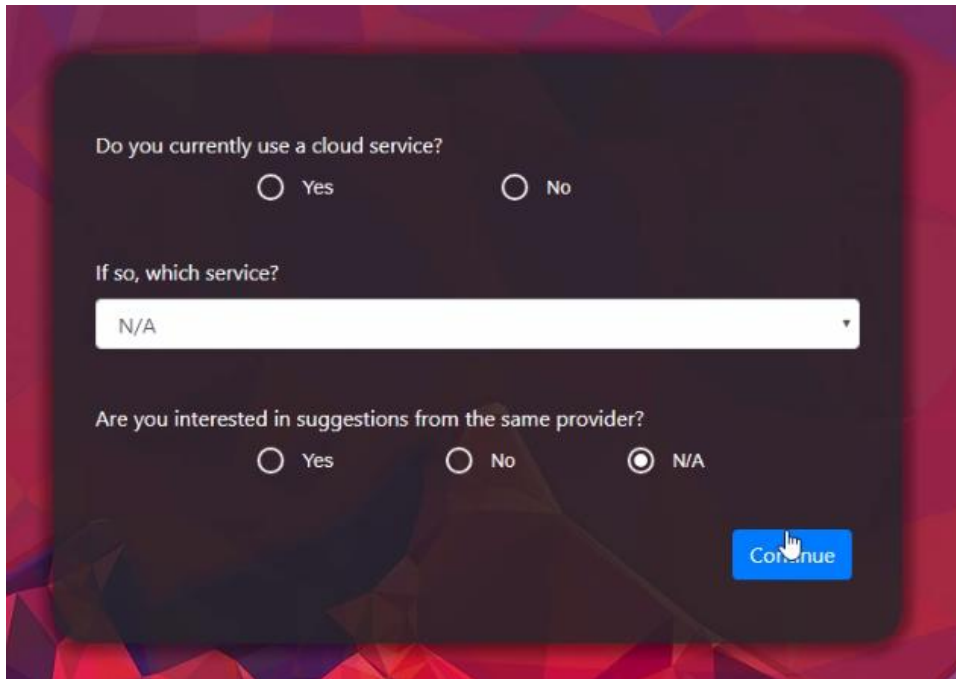
Accessing Omni Cloud's Web App

Go to the URL OmniCloudSolutions.com

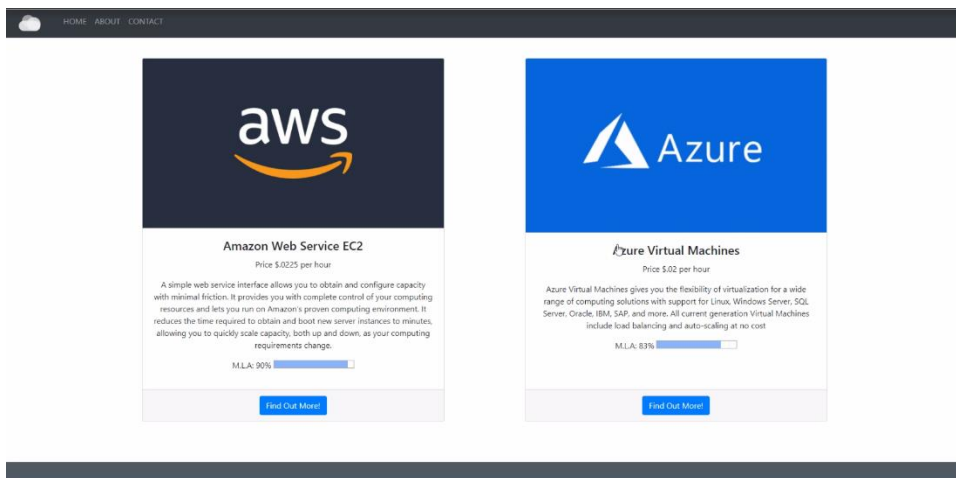
Click "Experience Omni"



Answer application questions based on your organizations needs



Navigate to Cloud Solution Providers website to make purchase



Appendix B-1 - Omni Cloud Database and Research

Omni Cloud Solution's project was a heavily researched focused project that covered multiple technical areas such as products ranging from Amazon SageMaker Machine Learning to product knowledge and information about Azure Disaster Recovery. With a wide of products our team's skillset and knowledge was spread across many different discipline areas making our

project very unique, requiring a well-designed database and project backend architecture which is why we chose PostgreSQL as our object-relational management system.

PostgreSQL has many advanced features, some of which we used within our project.

User-defined types

Table inheritance

Sophisticated locking mechanism

Foreign key referential integrity

Views, rules, subquery

Appendix C-1 - Omni Cloud Machine Learning Algorithm Quick Overview

Within Omni Cloud Solutions Web Application, we chose Amazon SageMaker to quickly and easily build, train, and deploy a machine learning model to help enhance our application and overall user experience. By implementing this specific machine learning service, the group was able to run a singular real time model and test data from a csv file. With the data the application was able to recommend a solution given a certain sequence of user inputs of various objects and user interactions. The specific model was trained on GPU instances and used GPU instances for instance inference.