Cloud Computing in the Era of COVID

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1 Introduction

The ongoing COVID-19 pandemic has brought undeniable effects on every industry, from pharmacy to sports and everything in between. Due to disease mitigation strategies such as social distancing and other measures, a common theme has emerged out of necessity for most businesses - the maximized adoption of virtual operations. Even with mass vaccinations and a push to "return to normal," it is clear that digitization has become a hallmark for modern and durable businesses looking to succeed. Existing and novel digital platforms require services including storage, computing power, data analytics, and more. As has been the trend for the last decade, this is being done not on personal server setups, but the web of cloud computing infrastructure.

2 Relevant Cloud Computing Topics

Due to the broad nature of this matter, there is no sole cloud computing service to discuss. This section will explore some of the most relevant topics or services.

2.1 Databases

An increase in internet usage has brought a boom of additional data to be collected from customers. This includes purchase history, watched movie titles, liked pictures, and countless other items. All of this information can be leveraged to make systems (ex; AI models) function better, create target marketing efforts, or be sold. To store this plethora of data, companies turn to appropriate database models offered by cloud computing companies. The main models are:

- **Relational:** Traditional tables with rows and columns, usually utilizing SQL
- **OLAP:** Similar to relational databases, but systems can integrate multiple databases at once
- **Column-Family:** Keys/values where families include rows, and each row (key) can have columns (values). More Information

- **Graph:** Nodes are entities, edges are directional relationships which can have keys/values
- **Document:** Documents/bodies which have attributes (key/values), ex; for storing user comments
- **Key-Value:** Basic, keys have certain values or information, similar to JSON file

Various other data storage methods (ex; AWS Buckets and Google Drive) have seen more adoption as well.

2.2 Web Servers

The most primitive aspect of a digitized presence is...a website! To sustain them and all related platforms, most businesses and individuals opt to rent web servers from a cloud provider to keep their front end and logic continually running. Think of a web server as a stripped down PC, which sits somewhere in a data center and has a web application running. During the pandemic, increased web traffic has brought a demand for more web servers - especially ones which can scale quickly and handle more load.

2.3 Assorted Cloud Services

Beyond basic website and storage, modern cloud computing offers countless other services. Let's take a look at several of these which have flourished during the pandemic.

- **Automated Machine Learning**: Insert data, best model is generated, model can be easily deployed and called
- **Serverless Computing**: You "give" the code to cloud provider, code can be called or used at any time, they manage everything with servers
- **Live Video**: You stream from your camera or video capture to cloud provider, then customers or other devices can access the feed from there
- **Big Data Analytics**: Seamlessly analyze, make sense of, and visualize vast amounts of data
- **Blockchain**: Storing centralized blockchain ledgers or maintaining nodes

3 Cloud Provider Options

During just the first quarter of 2020, cloud spending grew by 37 percent. Recognizing this momentum, cloud providers have expanded their offerings, and consequently, most high demand services can be found on any of the "big 3" platforms - Google Cloud, Amazon Web Services (AWS), and Microsoft Azure.

Cheaper alternatives can be found in many cases as well, on platforms such as Digital Ocean, Vultr, Linode, and IBM Watson. All in all, there are many options for businesses to choose from during their digitization process.

4 Discussion

As aforementioned, cloud computing has powered the rapid emergence of online entertainment, work, and commerce. Now, the reasons for this during the pandemic are clear, but what about post-COVID? During the pandemic, many companies have actually discovered the efficiencies and benefits afforded by online presences. For example, a mom-and-pop retail store which entered ecommerce during the pandemic may have been able to extract useful insights about their customers derived from collected data. Businesses utilizing cloud infrastructure for online work may have seen increases in productivity. Also, it is important to recognize that cloud services often save money in the long term. Think about have a fully remote developer team rather than renting an office - video conferencing costs are certainly going to be lower than rent in a dense urban setting. Paired with an expected 30 billion Internet of Things (IoT) devices globally expected by 2025, it is clear that cloud computing is here to stay.

- What other cloud services have become popularized during the pandemic?
- Are there any potential negative impacts of a cloud surge? (Ex; environmental)
- If you were to start a business today, would you locally maintain infrastructure like web servers, or use a cloud provider?
- Is there more room to grow for cloud computing? If so, where?
- What other impacts has cloud computing had on us during the pandemic?

5 Demo

5.1 Case Study

Let's look at a specific example of cloud computing helping during the pandemic - virtual learning. From managing content management platforms to hosting large video calls, cloud infrastructure has been crucial. Zooming in, pretend that you are a system administrator working for a school, tasked with creating an online learning platform. You are given a list of classes that must be transitioned online. Now what? A possible solution: Use the Google Classroom API to create online classrooms. Now teachers can join, add students, and collaboratively harness the power of Google products including Docs, Slides, Sheets, etc.

5.2 Qwiklabs

As you might expect, there is no single Qwiklabs demo to encompass all aspects of cloud computing during the era of COVID. However, here are several options which each cover a crucial aspect.

- Cloud-based Blockchain
- NoSQL Cloud Database - 1 credit
- AI Deployed on the Cloud - 1 credit