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Artificial Intelligence and Machine Learning Capabilities and Application Programming Interfaces at Amazon, Google, and Microsoft

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Abstract:
Major technology companies like Amazon, Google, and Microsoft now provide cloud computing services that include artificial intelligence and machine learning functionalities. The cloud platforms of these corporations Azure, Google Cloud Platform, and Amazon Web Services (AWS) provide advanced AI and ML capabilities. Natural language processing (NLP), computer vision (CV), speech recognition (SR), and predictive analytics are among the many tasks that their pre-trained AI models, customised machine learning frameworks, and intuitive APIs can do. Amazon SageMaker, AWS Rekognition, and AWS Comprehend exemplify Amazon's AI/ML offerings that focus on scalable cloud-based AI solutions. Google prioritises deep learning via TensorFlow, AutoML, and other advanced AI technologies such as Vertex AI and Google Vision API. Microsoft Azure provides robust AI capabilities for business applications, including Azure Machine Learning, Cognitive Services, and OpenAI interfaces. These platforms enable developers and companies to use AI for automation, data-driven decision-making, and enhanced user experiences, without necessitating extensive expertise. Amazon, Google, and Microsoft's artificial intelligence and machine learning capabilities have transformed cloud computing by providing scalable AI solutions to businesses of all sizes. They promote industry-wide innovation via their APIs and cloud-based AI services, enabling organisations to seamlessly integrate AI into their applications. The significance of AI in contemporary technological infrastructure will be reinforced as these platforms evolve, further impacting automation, efficiency, and decision-making.

Keywords: *Cloud Computing, Cloud Based AI & ML*

I. Introduction

The COVID-19 pandemic has accelerated the demand for cloud computing services, with major IT companies like Google, Amazon, and Microsoft focusing on AI and machine learning. Deep learning, an area of AI, has transformed human handling of complex issues in various disciplines, including computer vision, natural language processing, and voice recognition. Artificial neural networks (ANN) are the core concepts underpinning deep learning, which consist of nodes or artificial neurons linked in layers. Loss functions measure the gap between predictions made by a model and the reality of the situation. Informability and explainability are crucial aspects of face recognition systems, contributing to their credibility, transparency, trust, justice, and addressing issues around prejudice, discrimination, and privacy. Interpretable models enable error analysis and debugging, while explainability helps ensure compliance with legal and ethical restrictions. Strategies such as feature visualization, attention mechanisms, rule-based models, and decision trees can improve interpretability and explainability in face recognition systems. However, improving interpretability and explainability may require trade-offs with model complexity, performance, and accuracy. Striking a balance between interpretability and model performance is essential for ensuring explanations are understandable and correct without compromising system efficiency. Interpretability and explainability are essential factors in machine learning models, contributing to trust, accountability, bias mitigation, user adoption, and debugging and improvement. Cloud computing and AI hold great promise for transforming productivity tools and cutting costs in society's transition from digitization to intelligence.

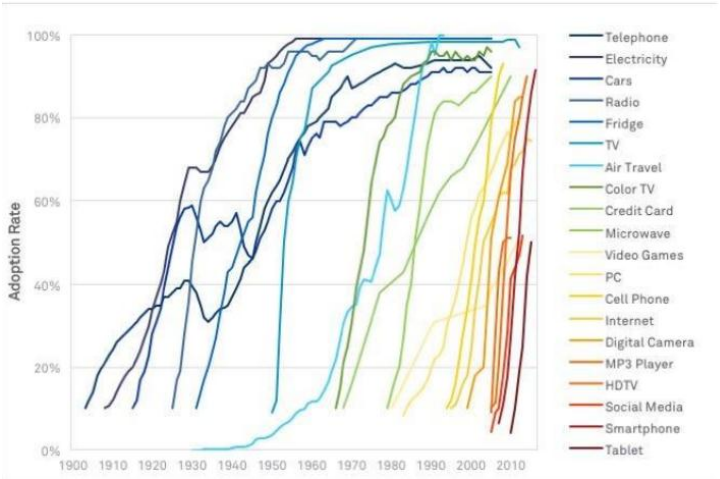

Figure 1: Adoption of Technology in the US

II. Comparative Analysis of AI and ML at Amazon, Microsoft and Google

This section explores the AI and ML practices of Google, Amazon, and Microsoft, focusing on their ecosystems and internal applications. These large platform firms have diverse business strategies and areas of specialization, making AI and ML an exciting frontier for growth. Companies looking to integrate AI and ML can benefit from the official website's introductory materials, tutorials, and documentation for APIs.

Amazon Web Services (AWS) is a top choice for AI solutions, offering compatibility with major AI frameworks like Tensor Flow and PyTorch, as well as software linked to these units. Steelmaker's position as the ML service layer's foundational component is solidified by Studio and Marketplace. AWS provides modules for speech, text, and vision, and can be integrated into more well-established application domains.

Amazon Prime members enjoy premium services, a larger selection of products, and reduced logistics costs due to Amazon's large customer base. The flywheel effect is one of the main benefits of AWS, as it helps manage distributed processes using massive amounts of data.

AWS dominates the cloud computing sector, providing products and services to both individuals and corporations. It has a significant geographical reach, with companies like Meta, Nasdaq, Pfizer, Gilead, Best Buy, and Adidas using it for their cloud computing needs. Small and medium-sized enterprises (SMEs) also benefit from AWS's flywheel effects, as it enhances cloud computing efficiency through economies of scale.

AWS is a cloud computing platform that offers a range of services to both individuals and businesses. Its partner network spans over 150 countries, with over 100,000 partners, making it a dynamic and cost-effective platform. The AWS Marketplace functions as an online app store where customers can test, purchase, and install apps developed by third parties. This platform has several modules for speech, text, and vision, and can be integrated into well-established application domains.

Amazon Prime members have access to premium services, a wider selection of products, and lower logistics costs due to Amazon's large customer base. As Amazon's customer base grows, so does the number of third-party sellers interested in establishing a presence on the site. The flywheel effect, which allows Amazon to improve the management of distributed processes using massive amounts of data, is one of the main benefits of AWS.

AWS dominates the cloud computing sector, providing products and services to both individuals and corporations. Its geographical reach is significantly different from the ToC sector, with many big companies using it for their cloud computing needs. Small and medium-sized enterprises (SMEs) who partner with Amazon depend on flywheel effects, as AWS substantially enhances cloud computing efficiency via economies of scale. Starting their cloud operations on AWS gives SMEs a higher opportunity to enhance operational control and cut costs.

The AWS ecosystem offers two ways to make the AWS environment easier to navigate: through a coalition of trustworthy cloud service providers and the AWS Marketplace, or through its rapid expansion and market dominance. As the platform continues to grow, the flywheel effect and economies of scale will become increasingly noticeable.

Microsoft Azure offers AI infrastructure, platforms, and services, as well as evaluations of cloud and edge-based AI use cases. It also provides an open-source marketplace for customers to shop from leading vendors and get their apps up and running faster. Azure is user-friendly with many feature modules and application-oriented layers, making it a user-friendly platform.

AWS is popular among small and medium-sized businesses (SMEs) due to its strong business environment. However, it is not suitable for large corporations with strong U.S. roots. Microsoft has been a

supplier for years, helping with IT systems for large and medium-sized enterprises. Microsoft plans to incorporate customer expectations into its "hybrid cloud" approach to provide a full solution.

Microsoft Cloud offers software as a service (SaaS) products like Dynamics and Office 365, as well as a wide range of infrastructure as a service (IaaS) and platform solutions. The data structure of all three of Microsoft's cloud offerings makes them compatible with one another, reducing compatibility issues. Azure's long-term partnerships allow the company to develop more tailored solutions and simplify the product experience.

Google Cloud is an artificial intelligence (AI) whiz that combines TPU with Tensor Flow for faster and more accurate model training. Google's AI and ML platform includes features such as Auto ML, a low-code module, and a library of pre-built AI models and code modules.

The primary target audience for Google Cloud is technical engineers, but industrial deployments and product/service capabilities are where AWS and Azure excel. GCP's AI and ML platform includes analytics, machine learning, and data management, allowing data scientists to function more efficiently, globally, and intelligently.

Google, a service provider with billions of users, has been focusing on AI and ML capabilities to grow its user base and attract advertisers. The company's cloud computing platform, Google Cloud Platform (GCP), has maintained its third-largest market share position, with the Vertex AI Workbench enabling machine learning model development. GCP faces pressure to compete with AWS and Azure, but Deep Mind has been a significant player in the AI sector, with their Alpha Go AI and Alpha Go Zero AI reaching unprecedented levels of accuracy.

Google Cloud Platform offers AI and ML tools such as the Tensor Flow deep learning framework, Auto ML neural architecture search engine, and BERT pre-training model for natural language processing. The platform also offers an AI Hub platform that simplifies the management and administration of complex machine learning environments at the PaaS level. Google's Cloud API foundation includes Auto ML configurable models and other APIs for vision, language, chat, structured data, and more.

Despite Amazon's vast SME network and Microsoft's B2B relationships with large corporations, Google has managed to win over customers in the global market through partnerships with HSBC, USAA, and eBay. GCP can handle market volume while having fewer external users, and being the first to incorporate new technologies into GCP's AI and ML platform will benefit Google as the industry leader in artificial intelligence and machine learning.

III. Competitive Analysis and Trends with Potential

The demand for artificial intelligence and machine learning solutions is increasing as more companies shift their operations online. These technologies are as commonplace as electricity, and a platform can provide all the functionality consumers require with effective integration. Users' submitted use cases can improve the platform's industry module capabilities, benefiting everyone involved. However, commercialization faces several challenges, such as high running costs, insufficient data collection, and difficulties in guaranteeing implementation impact. Implementation is difficult due to various reasons, including data privacy and security concerns, customers' understanding and use of AI and ML, and stringent legislative restrictions. Small and medium-sized enterprises (SMEs) often struggle to commercialize on a grand scale. The S2b2c route is one option that could help bridge the gap between the industry, the platform, and linked businesses. Due to limited resources, even with a huge platform, a high degree of strategic attention is necessary. When looking at the rate of AI adoption in a market from a vertical viewpoint, two angles should be considered: intrinsic demand (use case value, AI adoption readiness, etc.) and the needs for analytical transparency and resistance. The met averse represents the future of internet use in the eyes of many, and advancements in AI and ML will cause research to move at a fast pace. AI can speed up the process of creating digital products, with three main types of deep learning-based AI: automatic speech recognition (ASR), computer vision (CV), and natural language processing (NLP). These skills allow for almost anything in the met averse. The next generation will be shaped by a tremendous technology explosion that scientists predict will occur between 2019 and 2030 at a CAGR of 43.3%. Work has been done to prepare the software and hardware for the rapid expansion of the met averse, using innovative methods like Advanced Speech Recognition (ASR), GPT3, NeRF (Neural Radiance Fields), and virtual and augmented reality technology. If the met averse is the future, artificial intelligence general purpose computing will be the method of choice for building most virtual worlds. Digital businesses' adoption of AI and ML platforms will provide a perfect setting for the AIGC ecosystem to flourish. Prioritizing large-scale industrial commercialization, adhering to the three criteria, and focusing on current AIGC-related applications may speed up the development of AI and ML platforms in the met averse.

IV. Experiments and Results

This case study focuses on a proof-of-concept experiment to evaluate the performance of a proposed framework in plant categorization. The study analyzes a leaf dataset, chooses the best model, trains it on a test dataset, and evaluates the classification results. The dataset contains three distinct types of leaf images, each with

vital information about the plant type. ML models are constructed using 120 images, with 40 from each class. The performance of these models is assessed using 99 photos, with 33 for each class. The models are then used to classify the dataset after removing all labels from a tagged testing dataset. The models' real accuracy is computed and shown using both known and newly found labels.

1. Approaches

This study focuses on the use of feature extraction and machine learning techniques to extract data properties from images. The experiment uses various techniques, including color and basic characteristics (such as edge and corner), and generates two distinct shape-based signatures (Ordered-Signature and Sorted Signature) for every object in the image.

Edge detection is a fundamental technique in image processing for identifying and extracting features, such as finding abrupt brightness shifts or discontinuities. The canny edge detector technology is used, as it outperforms the competition. Corner detection is an often-used computer vision method, and the Harris corner detection method is well-known for its effectiveness.

Colors are used to numerically express color information, with various color spaces being used by various computer vision, image processing, and computer graphics applications. The choice of suitable color spaces depends on the method and applications for object identification. The image's pixel resolution is checked, and a mean of all pixels across R, G, and B is taken for every available slot. A histogram is created to calculate statistical moments like standard deviation, bias, and mean.

Shapes are described and depicted using region-based or contour-based techniques. In this case study, contour-based processes are used, as individuals often distinguish shapes based on their contour aspects. The contour-based approach is proposed, utilizing shape boundary information as a fundamental property for detecting an object's edges.

Ordered-Signature and Sorted-Signature are two ways the functionality can be implemented. The top three models are M1 (Basic), M7 (Sorted-Signature and Basic features), and M9 (Sorted-Signature and Color features). The findings show that ML models are not always better when using a combination of feature categories, even when using only one. Comparing the results of different feature combinations with the Color feature, the Basic and Color feature model (M5) achieves a lower degree of accuracy (43%) than M1, while the Color feature model (M2) achieves a lower degree of accuracy (31%). When combined with the Ordered-Signature model, the Color feature further enhances accuracy, going up to 78% from 72% in M2 and M3.

Looking at various datasets yields different findings, indicating that there is no silver bullet when it comes to training ML models using features. Based on the findings, the feature-category model optimization component suggests the Sorted-Signature and Color features (M9) model, which achieves the highest accuracy of 93%. The very precise M7 and M1 models are ranked second and third, respectively, for this dataset.

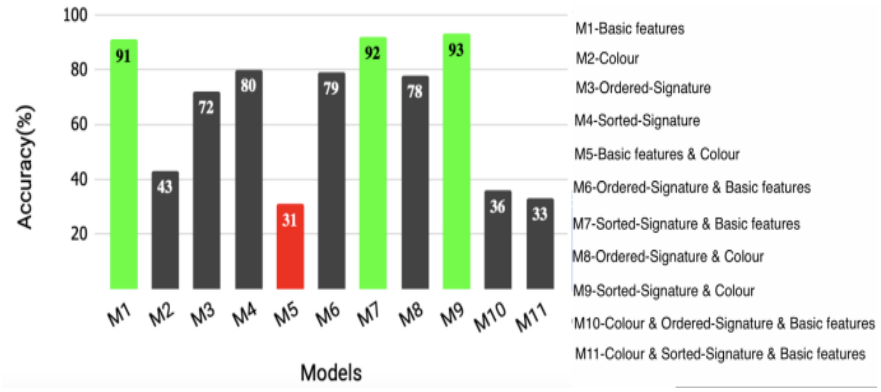

Figure 2: The actual correctness of the built model in the Training Mode

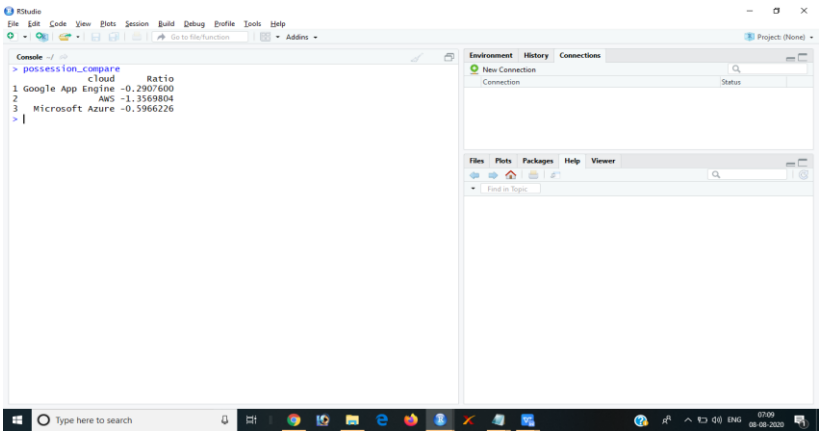

Figure 3: Performance comparison between the drives

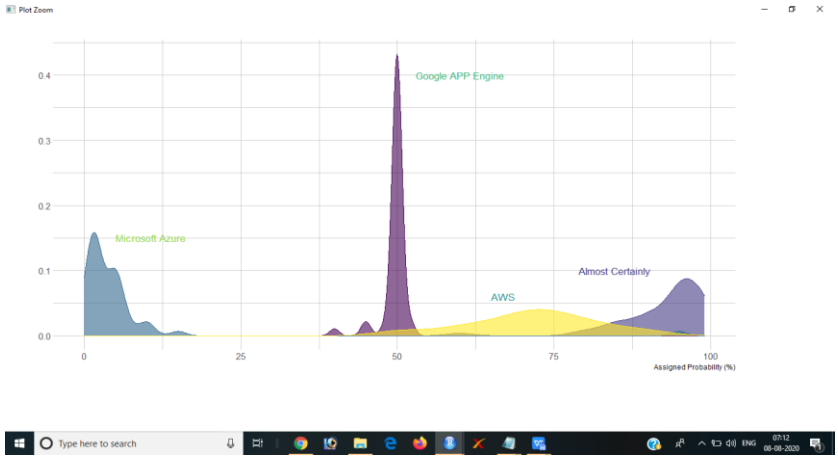

Figure 4: Comparison of the different cloud services used in the models

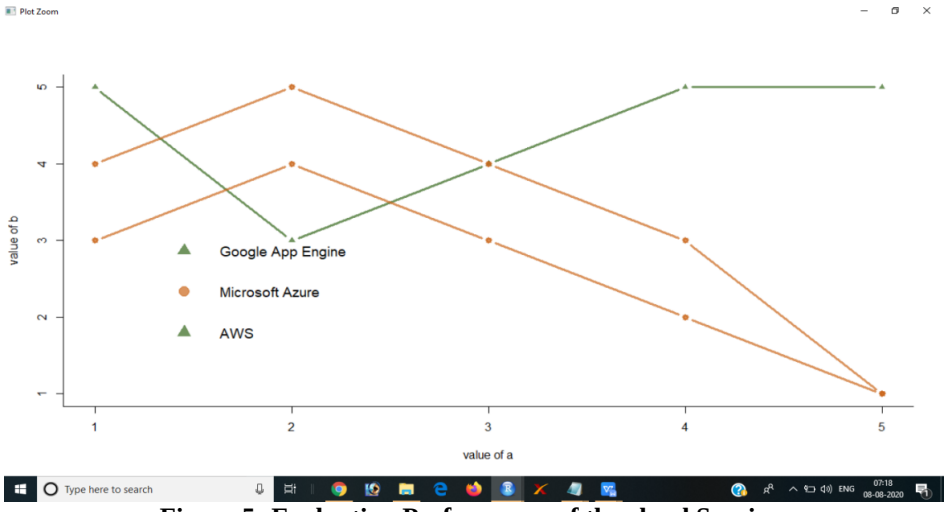

Figure 5: Evaluation Performance of the cloud Services

When tested in Testing Mode, the optimized model, M9, is in the top three most accurate models. Another two types are the M1 and the M7. From the training dataset, M9 stood out as the top model with an accuracy rate of 93%. When applied to the training and testing datasets, the models often provide the expected results (Figure 3.13). However, there are cases when this isn't true since the two datasets aren't always identical. For instance, model M9 outperforms model M7 in Training Mode (93% vs. 92%), but it fails to live up to expectations in Testing Mode (86% vs. 89%).

Parameters	IBM	Azure	Google Cloud	Amazon Cloud
Accuracy	82	84	88	92
Timely Response	12.5	11	8.2	6.5
Execution Time	180	156	120	92
Error Correction	12	10	8	4

Table 1: Comparison analysis of the cloud services

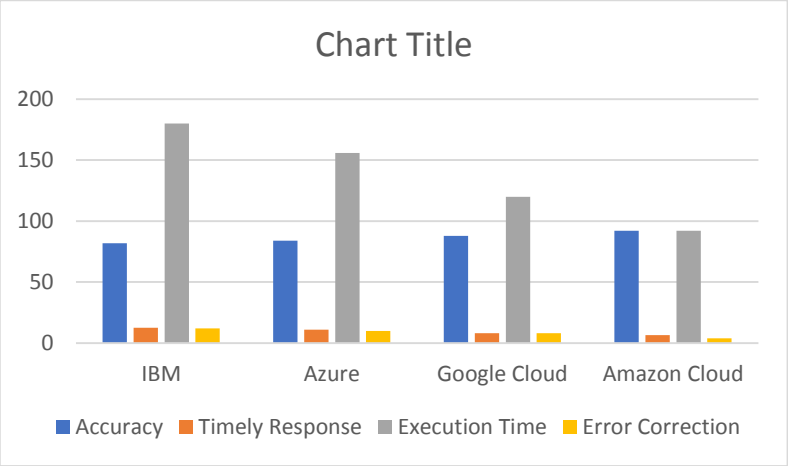

Figure 6: Cloud services based on the parameters

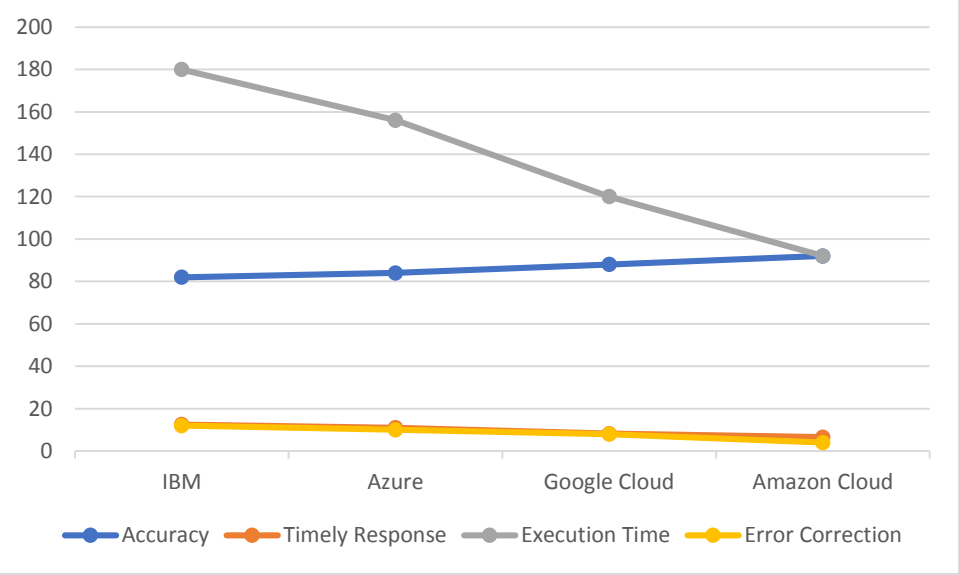

Figure 7: AWS compared to other cloud services

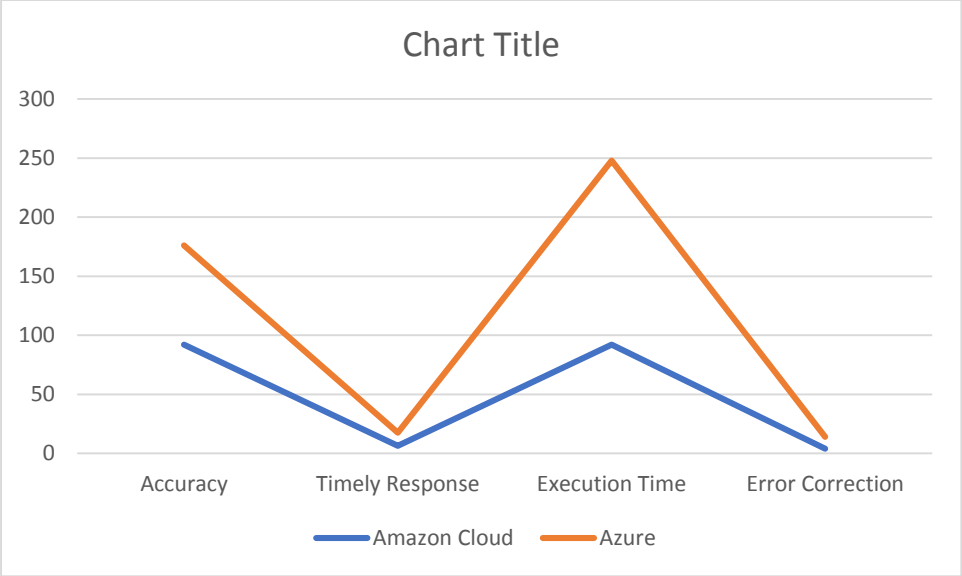

Figure 8: AWS compared to Azure for best service provider

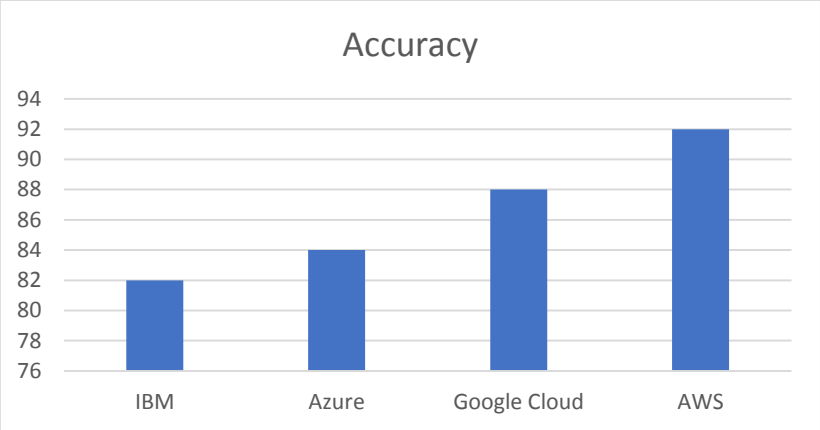

Figure 9: Performance of the cloud services

AWS, a leading cloud computing service, is known for its innovative data protection features. These include monitoring and protecting networks, developing dashboards for real-time data display, and using AWS for disaster recovery. AWS logs provide scalable security, while data encryption and backup procedures ensure customer trust.

To compare and evaluate performance, various parameters have been used, including application load balancing on Windows Azure, control of information, networking access to datacenters, managing identities and access permissions, and multiple-factor authentication with Active Directory. Windows Azure offers various solutions for managing identities and access permissions based on user data.

Multiple-factor authentication with Active Directory allows for sharing information and combining interactions between different types of code. Azure provides various solutions to address common issues, such as simple queued messages or complex relationships. There is overlap between discussions of storage queues, service bus relays, service buses, and service buses.

In summary, AWS's cloud computing services are known for their robust data protection features, robust application load balancing, and efficient communication. By focusing on security and enhancing user experience, AWS continues to be a trusted choice for cloud computing.

V. Discussion & Conclusion

This analysis will explore the impact of data exporting and importing on big data and AWS's cloud data centre services. We used SLA and QoS methods to assess the cloud's effectiveness. Upon assessing the attributes of the three cloud platforms, we determined that AWS has the most superior data processing capabilities. In this experiment, several models were developed from a labelled training dataset, each possessing a distinct set of data properties. We conducted accuracy assessments on each model to determine the most effective one. We used the

existing knowledge of the data labels to evaluate each constructed model on an unlabelled testing dataset. The suggested optimisation component identified which machine learning models exhibited superior performance in Training Mode relative to Testing Mode for a certain dataset. This enables us to effectively categorise unlabelled datasets, similar to Training Mode. Identifying an item only based on its characteristics may be challenging. Models trained using the most relevant feature category of a certain ML classifier often exhibit superior performance across most datasets. The proposed feature-category model optimisation, which involves first categorising an unlabelled dataset followed by selecting a labelled dataset, proved to be a robust and efficient approach for identifying the best model with the highest accuracy.

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