A BRIEF CLOUD SURVEY : COMPARING MACHINE LEARNING PLATFORMS OF AMAZON WEB SERVICES, MICROSOFT AZURE & GOOGLE CLOUD

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1. **INTRODUCTION**

As machine learning becomes increasingly pivotal for businesses, cloud computing has emerged as a popular tool to help serve these needs effectively. A key aspect of cloud computing is PaaS (Platform as a Service) which uses virtualization to provide developers and engineers with a complete development and deployment environment. This survey,done as part of Assignment-1 of *Cloud & Machine Learning* course, deep dives into this tool.The aim of this survey is to conduct a comprehensive and in depth survey of machine learning platforms of three popular cloud computing providers: *AWS SageMaker, Microsoft Azure Machine Learning and Google Cloud AI Platform.*

2. **BACKGROUND & PURPOSE**

PaaS accelerates software development and deployment by managing underlying infrastructure and operating system requirements. These platforms help boost agility and also provide increased flexibility to businesses. AWS SageMaker, Azure AI and GCP AI are all examples of a Platform as a Service.The purpose of this study is to analyze the features, capabilities and strengths of these platforms to understand which platform is best suited for a particular use case.

3. **STUDYING THE THREE PLATFORMS**

3.1 AWS SAGEMAKER

AWS SageMaker released by Amazon Web Services in 2017 is a comprehensive platform which allows users to create, train and deploy models on the cloud. SageMaker provides a wide range of tools to enable more and more people to innovate with Machine Learning.
- Business Analysts can generate accurate predictions without coding by making use of pre-trained and ready to use models in the SageMaker Canvas. SageMaker Autopilot can do data processing,model selection,hyperparameter tuning and model training with limited human guidance which makes it very handy for people with limited knowledge of machine learning.
- Data Scientists can clean,build,train and deploy models with the SageMaker Studio which supports the most popular machine learning frameworks like TensorFlow, Pytorch, embedded Jupyter Notebooks, Apache MXNET etc.
- ML Engineers can use SageMaker MLOps for deploying models at scale. SageMaker MLOps provides engineers with the ability to reproduce models for troubleshooting,track versions, automate model retraining etc.

AWS SageMaker allows easy collaborations between business analysts, data scientists and ML engineers which enables the entire development and production to be centralized using one service. It has flexible pricing from a free tier, to pay on the go to saving plans which can be enabled for certain workloads.

3.2 MICROSOFT AZURE AI

Azure AI provides a suite of AI services where you can access speech,vision and text AI models through API calls or build your own models in IDE's like Jupyter Notebooks, a VS Code extension using frameworks like Pytorch and TensorFlow.
- Azure AI focuses on using AI responsibly by providing built in tools to protect and control data.Azure has strategic partnerships which ensures that users get the best services. Azure AI's supercomputing uses state of the art NVIDIA GPU and GPT-4 can be used via Azure OpenAI Service.
- Using Conversational AI with Azure AI Bot, users can design and deploy AI Bots using minimal code. Businesses can also harness generative AI by using Azure OpenAI which protects against undesirable prompts and outputs.
- Azure MLOps helps in model deployment, version control, reproducibility and continuous model monitoring.
- Easy integration with other Azure services like Azure Databricks.

3.3 GOOGLE CLOUD AI PLATFORM

Google Cloud AI platform provides tools and services for building and deploying machine learning models mainly in TensorFlow, Google's open source machine learning framework. Soon this platform will be integrated into Google Vertex AI Workbench.
- GCP AI Platforms offers limited built in models in Beta mode(currently only available to some users).
- GCP is also experimenting with offering human dataset labeling which is also only available in Beta.
- Provides JupyterLabs instances using the Vertex AI Workbench.
- You can also easily monitor and manage your models, using the command line interfaces.
- AI Hub: A repository for sharing and deploying AI pipelines and components.

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4. COMPARISON

Here is a tabular comparison of the three platforms across some of the most widely used and needed features including the platforms main focus, access to built-in models, supported frameworks, pricing structure, managed notebook ability, AutoML and specialized features.

Features	AWS SageMaker	Azure AI	Google Cloud AI Platform
Main Focus	Enable more people to innovate with ML	Using and building AI responsibly	Strong coupling with Google Cloud for development & deployment.
Built-in models	Wide range with options of GUI and minimal coding	Variety of built in models across speech,vision & text	Built in models are available only to Beta users.
Supported Frameworks	Pytorch, TensorFlow , R, Python	Pytorch, TensorFlow , R, Python	TensorFlow ,Sci-kit learn , Python
Pricing	Flexible, on-demand & cost effective plans available	Flexible, on-demand & cost effective plans available	Flexible, on-demand & cost effective plans available
Notebooks	Jupyter Notebook	Jupyter & Azure Notebook	Jupyter Notebooks
AutoML	✔	✔	✔
Human Dataset Labeling	✘	✘	✔ (Beta)
Specialized Features	Ease of use for people with limited ML knowledge	GPT-4 integration, Conversational AI	AI Hub for sharing AI components

5. CONCLUSION

Each of these services bring their own strengths to the table.AWS SageMaker stands out for its ease of use and collaboration between various diverse roles. Azure AI focuses on conversational and generative AI while promoting responsible and ethical use of AI while Google Cloud AI Platform is strongly coupled with the Google cloud environment and gives a seamless experience for development using TensorFlow. Choosing a PaaS depends on your use case. If a business wants to leverage GPT-4, Azure AI is more suited while Google's AI Platform is great for development using TensorFlow. Each platform offers flexible pricing plans, and gives a comprehensive environment for training,testing and deploying models. As research in machine learning grows these platforms continue to grow and add new features and tools.
In conclusion, each of these platforms offer unique advantages.This survey aimed to provide a brief insight into these platforms which are helping developers,analysts and businesses to use data to create solutions.

6. REFERENCES

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