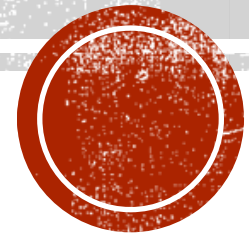


AWS, GCP & AZURE

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OVERVIEW OF AWS

- AWS is particularly dominant in the market of cloud computing. In a Q3 2017 report, Amazon remained bigger than its next five largest competitors combined.
- AWS has massive scope of operations and services.
- But it seems like difficult to control the cost(Even if what I used this semester is mainly free-tier service, I was charged for half of the credits) What if use the commercial tier service to satisfy the work loads?



OVERVIEW OF GCP

- GCP specializes in high compute offerings like Big Data, analytics and machine learning. It also offers considerable scale and load balancing – Google knows data centers and fast response time.
- It provides limited services and features comparing to AWS and Azure, and neither has as many global data centers as AWS or Azure.



OVER VIEW OF AZURE

- It's easy for beginners to use. I spent less than half an hour from registering a student account to deploying a web app using the Azure plugin for Eclipse in the course of csye6220.
- Like many Microsoft productions, for instance, Office, Windows Server, .Net etc, Azure is friendly to kick-starters, but doesn't offers as much support for DevOps approaches as some of the other cloud platforms. For example, it doesn't have as much integrated automation, requiring staff to perform many management tasks by hand.



COMPUTE *AWS*

- **Elastic Compute Cloud:** Amazon's flagship compute service is Elastic Compute Cloud, viz EC2. EC2 offers a wide variety of options, including a huge assortment of instances, support for both Windows and Linux, bare metal instances (currently a preview), GPU instances, high-performance computing, auto scaling and more.
- **Container services:** Within the compute category, Amazon's various container services are increasing in popularity, and it has options that support Docker, Kubernetes, and its own Fargate service that automates server and cluster management when using containers. It also offers a VPC option known as Lightsail, Batch for batch computing jobs, Elastic Beanstalk for running and scaling Web applications, etc.



COMPUTE *GCP*

- **Compute Engine:** By comparison, Google's catalog of compute services is somewhat shorter than its competitors'. Its primary service is called Compute Engine, which boasts both custom and predefined machine types, per-second billing, Linux and Windows support, automatic discounts and carbon-neutral infrastructure that uses half the energy of typical data centers. It offers a free tier that includes one f1-micro instance per month for up to 12 months.
- **Focus on Kubernetes:** Google also offers a Kubernetes Engine for organizations interested in deploying containers. And it's worth noting that Google has been heavily involved in the Kubernetes project, giving it extra expertise in this area.



COMPUTE *Azure*

- **Virtual Machines:** Microsoft's primary compute service is known simply as Virtual Machines. It boasts support for Linux, Windows Server, SQL Server, Oracle, IBM, and SAP, as well as enhanced security, hybrid cloud capabilities and integrated support for Microsoft software. Like AWS, it has an extremely large catalog of available instances, including GPU and high-performance computing options, as well as instances optimized for artificial intelligence and machine learning. It also has a free tier with 750 hours per month of Windows or Linux B1S virtual machines for a year.
- **Additional Services:** Azure's version of Auto Scaling is known as Virtual Machine Scale Sets. And it has two container services: Azure Container Service is based on Kubernetes, and Container Services uses Docker Hub and Azure Container Registry for management. It has a Batch service, and Cloud Services for scalable Web applications is similar to AWS Elastic Beanstalk. It also has a unique offering called Service Fabric that is specifically designed for applications with microservices architecture.



STORAGE *AWS*

- **S3 to EFS:** AWS offers a long list of storage services that includes its Simple Storage Service (S3) for object storage, Elastic Block Storage (EBS) for persistent block storage for use with EC2, and Elastic File System (EFS) for file storage. Some of its more innovative storage products include the Storage Gateway, which enables a hybrid storage environment, and Snowball, which is a physical hardware device that organizations can use to transfer petabytes of data in situations where Internet transfer isn't practical.
- **Database and archiving** On the database side, Amazon has a SQL-compatible database called Aurora, Relational Database Service (RDS), DynamoDB NoSQL database, ElastiCache in-memory data store, Redshift data warehouse, Neptune graph database and a Database Migration Service. Amazon doesn't offer a backup service, per say, however, it does have Glacier, which is designed for long-term archival storage at very low rates. In addition, its Storage Gateway can be used to easily set up backup and archive processes .



STORAGE *GCP*

- **Unified Storage and more:** As with compute, GCP has a smaller menu of storage services available. Cloud Storage is its unified object storage service, and it also has a Persistent Disk option. It offers a Transfer Appliance similar to AWS Snowball, as well as online transfer services.
- **SQL and NoSQL** When it comes to databases, GCP has the SQL-based Cloud SQL and a relational database called Cloud Spanner that is designed for mission-critical workloads. It also has two NoSQL options: Cloud Bigtable and Cloud Datastore. It does not have backup and archive services .



STORAGE *Azure*

- **Storage Services:** Microsoft Azure's basic storage services include Blob Storage for REST-based object storage of unstructured data, Queue Storage for large-volume workloads, File Storage and Disk Storage. It also has a Data Lake Store, which is useful for big data applications.
- **Extensive Database:** Azure's database options are particularly extensive. It has three SQL-based options: SQL Database, Database for MySQL and Database for PostgreSQL. It also has a Data Warehouse service, as well as Cosmos DB and Table Storage for NoSQL. Redis Cache is its in-memory service and the Server Stretch Database is its hybrid storage service designed specifically for organizations that use Microsoft SQL Server in their own data centers. Unlike AWS, Microsoft does offer an actual Backup service, as well as Site Recovery service and Archive Storage .



STORAGE SUMMARY

Vendor	Storage Services	Database Services	Backup Services
AWS	<ul style="list-style-type: none">• Simple Storage Service (S3)• Elastic Block Storage (EBS)• Elastic File System (EFS)• Storage Gateway• Snowball• Snowball Edge• Snowmobile	<ul style="list-style-type: none">• Aurora• RDS• DynamoDB• ElastiCache• Redshift• Neptune• Database migration service	<ul style="list-style-type: none">• Glacier
Azure	<ul style="list-style-type: none">• Blob Storage• Queue Storage• File Storage• Disk Storage• Data Lake Store	<ul style="list-style-type: none">• SQL Database• Database for MySQL• Database for PostgreSQL• Data Warehouse• Server Stretch Database• Cosmos DB• Table Storage• Redis Cache• Data Factory	<ul style="list-style-type: none">• Archive Storage• Backup• Site Recovery
GCP	<ul style="list-style-type: none">• Cloud Storage• Persistent Disk• Transfer Appliance• Transfer Service	<ul style="list-style-type: none">• Cloud SQL• Cloud Bigtable• Cloud Spanner• Cloud Datastore	<ul style="list-style-type: none">• None



AWS VS. AZURE VS. GOOGLE: PRICING

- **AWS Pricing:** Amazon's pricing is particularly inscrutable. While it does offer a cost calculator, the many number of variables involved make it difficult to get accurate estimates. Amazon's granular pricing structure is complex; use of third-party cost management tools is highly recommended.
- **Azure Pricing:** Microsoft Azure doesn't make things any simpler. Because of Microsoft's complicated software licensing options and use of secretive discounts, its pricing structure can be even more difficult to understand without outside help.
- **Google Pricing:** By contrast, Google uses its pricing as a point of differentiation. It aims to offer “customer-friendly” prices that beats the list prices of the other providers.



SERVICE LIST 1

	Amazon Web Services	Microsoft Azure	Google Cloud Platform
Regions	<u>Global Infrastructure</u>	<u>Regions</u>	<u>Regions and Zones</u>
Pricing	<u>Complex Pricing</u>	Difficult to Understand	customer-friendly
Basic Compute	<u>EC2</u>	<u>Virtual Machines</u>	<u>Compute Engine</u>
Containers	<u>ECS</u> <u>EKS</u>	<u>AKS</u> <u>Container Instances</u>	<u>Kubernetes Engine</u>
Serverless	<u>Lambda</u>	<u>Functions</u>	<u>Cloud Functions</u>
App Hosting	<u>Elastic Beanstalk</u>	<u>App Service</u> <u>Service Fabric</u> <u>Cloud Services</u>	<u>App Engine</u>



SERVICE LIST 2

	Amazon Web Service	Microsoft Azure	Google Cloud Platform
Object Storage	<u>S3</u>	<u>Blob Storage</u>	<u>Cloud Storage</u>
Block Storage	<u>EBS</u>	N/A	<u>Persistent Disk</u>
File Storage	<u>EFS</u>	<u>File Storage</u>	N/A
Relational/SQL Database	<u>RDS</u> <u>Aurora</u>	<u>SQL Database</u> <u>Database for MySQL</u> <u>Database for PostgreSQL</u>	<u>Cloud SQL</u> <u>Cloud Spanner</u>
NoSQL Database	<u>DynamoDB</u>	<u>Cosmos DB</u> <u>Table Storage</u>	<u>Cloud Bigtable</u> <u>Cloud Datastore</u>
Authentication and Access Management	<u>IAM</u> <u>Directory Service</u> <u>Organizations</u> <u>Single Sign-On</u>	<u>Active Directory</u> <u>Multi-Factor</u> <u>Authentication</u>	<u>Cloud IAM</u> <u>Cloud IAP</u>



SERVICE LIST 3

	Amazon Web Services	Microsoft Azure	Google Cloud Platform
Cloud Monitoring	<u>CloudWatch</u> <u>CloudTrail</u>	<u>Monitor</u> <u>Log Analytics</u>	<u>Stackdriver</u>
Cloud Management	<u>Systems Manager</u> <u>Management Console</u>	<u>Portal</u> <u>Policy</u> <u>Cost Management</u>	<u>Stackdriver</u>



SUMMARY

Vendor	Strengths	Weaknesses
AWS	<ul style="list-style-type: none">• Dominant market position• Extensive, mature offerings• Support for large organizations• Extensive training• Global reach	<ul style="list-style-type: none">• Difficult to use• Cost management• Overwhelming options
Microsoft Azure	<ul style="list-style-type: none">• Second largest provider• Integration with Microsoft tools and software• Broad feature set• Hybrid cloud• Support for open source	<ul style="list-style-type: none">• Less "enterprise-ready"• Incomplete management tooling
Google	<ul style="list-style-type: none">• Designed for cloud-native businesses• Commitment to open source and portability• Deep discounts and flexible contracts• DevOps expertise	<ul style="list-style-type: none">• Late entrant to IaaS market• Fewer features and services• Fewer worldwide data centers

