# Microsoft Azure

## Cloud computing

Delivery of computing services over the internet.
It is : economic and flexible

- Computing
- Networking
- Storage: to store data ( such as Blobs..)
- Analytics : by looking at current trend and historical data

### Types of cloud computing:
### Public,Private and Hybrid cloud models

**Public cloud:** can be accessed by public/group of users for services
**Private cloud:** can be accessed by a single organisation over a private network ( disadv.: high cost)
**Hybrid cloud:**combines both public and private clouds with the ability to sharing data between them ( for the data that is meant to be accessed publicly can be shared with the public cloud and sensitive datas in private cloud)
**Community cloud:** when the infrastructure/resources/softwares services are shared between organisations with the same business goals like universities or colleges and these community clouds are run by the organisation members or by a third-party provider . it can be a public or private cloud

## Cloud benefits

- **Economical:**
  you pay for only the services you use
  Instead of having your own IT infrastructure,hardware & third-party data centre which can be costly ( high Capital expenditure CapEX),Azure handles this and the client only handles the operating expenditures (OpEX)
  CapEx: is the fixed assets the organisation buys such as laptops,hardware..
  OpEx: is the monthly fees the organisation pays for particular services.
  For example: instead of purchasing MS licence (fixed cost;CapEX)for each user,you pay monthly fee(like a rent payment) to spread the cost throughout the year(for security ,operating systems,network)
- **Scalability & elasticity:**

Scalability: to add/eliminate a computing resource to adjust to the business demand;scaling up or scaling down.
Horizontal scaling:

For ex: during the peak periods you need to increase the servers to handle the increased traffic during this period( scaling up)
Then you can eliminate these additional servers later when the peak period is over(scaling down)

## Serverless Computing

**Serverless computing in Azure refers to a cloud computing model where you can run code without having to manage the underlying infrastructure. In this model, you only pay for the amount of compute time used, without having to worry about the infrastructure or the cost of maintaining it.**
In Azure, serverless computing is achieved through **Azure Functions and Azure Logic Apps.**

**Azure functions:** driven function to handle the IT infra whenever you run your code as you don't have to worry about the infra.
**Azure logic apps:** is a cloud based service integrated with the other cloud services (PAAS) and named as IPAAS; integration platform as a service.allows you to create your workflow.

## Data centre regions

**Data centre regions:** is distributed data centres in many areas geographically.
**A region** has one or more data centres within zones(they work as a backup for each other in case of emergencies)
**Each zone** has one DC.
**Each data centre:**

- has thousands of servers
- is independent ( in its power,cooling,IT infra..)

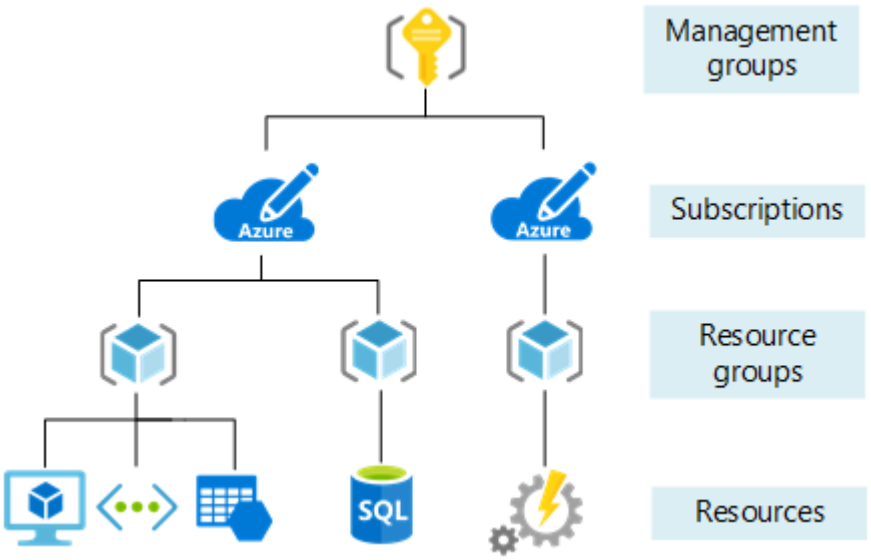
**Azure recently has its DC in 60 regions**

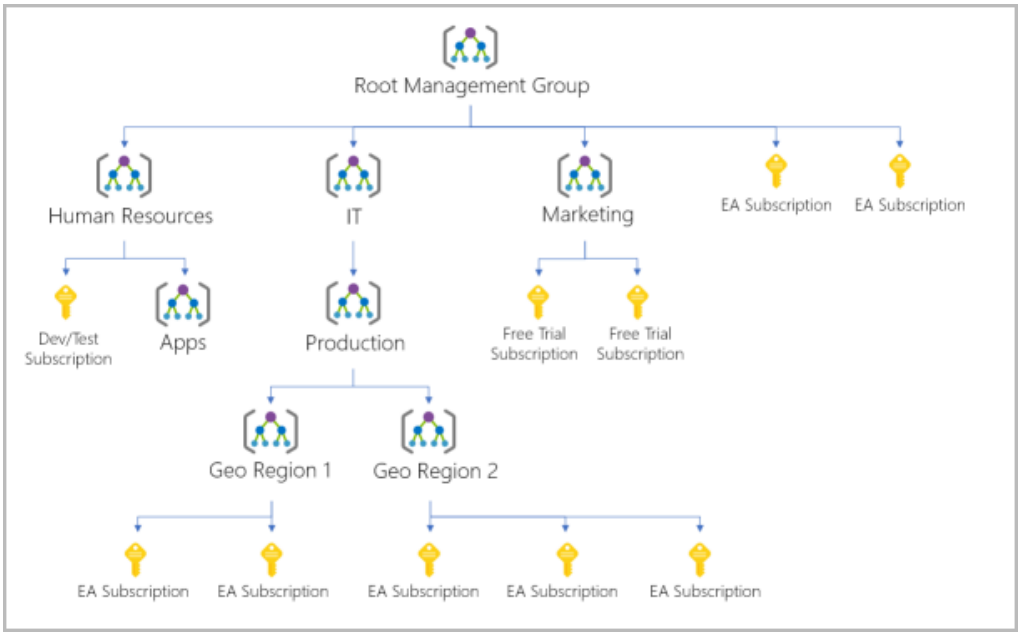
**Benefits for customers:**

- **Low latency:** by having data centres close to the users ,it improves the performance of your applications
- **High availability ( happens within one region; between zones):** to achieve it for the users ( less fault tolerance), multiple data centres in different areas are installed within one region for the backups.

- **Data sovereignty:** the user get to choose there datacenter regions
- **Disaster recovery( happens between regions; regions pairing):** as mentioned in the high availability having both the primary data centre and the back up one but between regions paired is great to improve the disaster recovery ( when one region's Data centre with all servers fails), the other region paired with it acts like a backup).

## How to organise your Azure generally




- Creating management group for specified subscriptions
- Creating resource groups for the specified management group

- Creating resources/services such as sql,VM,Storage accounts,networking,analytics..
- Creating containers to store the data in.
  Blobs: Binary Large Objects that is used to store/access large unstructured data
  **Types of blobs**:

1- Block blobs: to store large files such as images,videos..as it breaks into smaller blocks to store it in parallel
2- Append blobs: allows you to add new data to an existing file without having to rewrite the entire new blob.
3- Page blobs:allows you to read or write from fixed-size pages
Note: you can download the Microsoft Azure storage Explorer to connect all your resources created to the App.
Download link: Azure Storage Explorer – cloud storage management | Microsoft Azure
Pricing calculator Link: https://azure.microsoft.com/en-us/pricing/calculator
AWS Link:
https://aws.amazon.com/about-aws/global-infrastructure/regions_az/

## Connections between Python and Azure Resources

### 1- Connection between python and Azure sql database

### Pushing data to it& read it using pyodbc library

Pyodbc: python open database connectivity

**Code 1:**

Connect to azure sql to open single thread connection/one sql table

```
pip install pyodbc
# to connect the python to azure sql
import pyodbc
server='trainingtestc339.database.windows.net'
database='trainingtest'
username='c339'
password='Rovy0191654747.'
driver= '{ODBC Driver 17 for SQL Server}'  # here make sure that you have the driver version, otherwise install it from microsoft
#
https://learn.microsoft.com/en-us/sql/connect/odbc/download-odbc-driver-for-sql-server?view=sql-server-ver16
connection_string =
```

```
f"DRIVER={driver};SERVER={server};DATABASE={database};UID={username};PWD={pa
ssword}"
conn = pyodbc.connect(connection_string)
cursor = conn.cursor()
cursor.execute("SELECT * FROM student7")
rows = cursor.fetchall()
for row in rows:
    print(row)
cursor.close()
conn.close()
```

**Code 2:** connecting to multiple threads/connections :

- Defining the max connections to be opened at the same time
- Creating 'for' loop to create a connection and add it to the queue using connection string auth.
- Create get_connection() function used to open the connection between the azure sql and python
- Create release_connection() function to ensure the connection is closed/released properly

To open the connection:

- get_connection()
- Creating a cursor object; connection.cursor()
- Executing your query; cur.execute('Query')
- Using 'for' loop to go through each row of the table
- You can open another connection and many ones but based on the max queue defined earlier in step 1
- Don't forget to release the connection at the end for each connection.

```
import pyodbc
from queue import Queue
from threading import Lock
from getpass import getpass
#password = getpass()

server='trainingtestc339.database.windows.net'
database='trainingtest'
username='c339'
#password = getpass('Rovy0191654747.')
password='Rovy0191654747.'
```

```
driver= '{ODBC Driver 17 for SQL Server}'  # here make sure that you have the
driver version, otherwise install it from microsoft
#
https://learn.microsoft.com/en-us/sql/connect/odbc/download-odbc-driver-for-sq
l-server?view=sql-server-ver16
connection_string =
f"DRIVER={driver};SERVER={server};DATABASE={database};UID={username};PWD={pass
word}"
max_con=10
connection_pool=Queue(max_con)
lock=Lock()

def create_connection():# developing a function to get the connection from
queue
    with lock:
        if not connection_pool.empty():
            return connection_pool.get()
    connection = pyodbc.connect(connection_string)
    return connection

def get_connection():  # adding a new connection to the queue
    with lock:
        if not connection_pool.empty():
             return connection_pool.get()
        connection = pyodbc.connect(connection_string)
        return connection
     #       return connection_pool.put(connection)


def release_connection(connection): # closing the connection before adding it
back to the queue
    with lock:
        connection.close()
        connection_pool.put(connection)

connection=get_connection()
cursor=connection.cursor()
cursor.execute('select * from student7','select * from vehicle')
results=cursor.fetchall()  # this line is optional
for cur in results:  # or for row in cursor: print (row)
    print(cur)
```

```
release_connection(connection)
# This code should correctly create a connection pool and allow you to reuse connections to the database.
#  Note that you may need to modify the connection_string variable to match your own database credentials.
```

The main difference between these two code snippets is that the second one is designed to be used in a multithreaded environment where multiple threads need to execute SQL queries concurrently. By creating a connection pool, the code can reuse existing connections rather than creating new connections each time a query is executed, which can improve performance.
The first code snippet is simpler and designed for a single-threaded environment where only one connection is needed. It creates a connection, executes a query, fetches the results, and then closes the connection.
If you only need to execute a single SQL query in a single-threaded environment, the first code snippet is probably sufficient. However, if you need to execute multiple queries concurrently in a multithreaded environment, the second code snippet with a connection pool would be a better choice.

```
#connection queue
from queue import Queue
from threading import Lock
import pyodbc
from getpass import getpass


max_con=2
connection_pool=Queue(max_con)
lock=Lock()

# create connections and add them to the queue
for i in range(max_con):
    connection_pool.put(pyodbc.connect(connection_string))


# define a function to get connection from queue
def get_Connection():
    with lock:
```

```
        if not connection_pool.empty():
            return connection_pool.get()
    # if queue is empty, raise an exception
    raise Exception("Maximum number of connections reached")

def release_connection(connection):
    with lock:
        connection_pool.put(connection)

connection=get_Connection()
cursor=connection.cursor()
cursor.execute("select * from student7")

for row in cursor:
    print(row)
connection1=get_Connection()
cursor=connection.cursor()
cursor.execute('select * from student7')
for row in cursor:
    print(row)

connection1=get_Connection()
cursor=connection.cursor()
cursor.execute('select * from student7')
for row in cursor:
    print(row)

release_connection(connection)

# output ; will give the first two connections queries and then detect the
max connection limit

(1, 'rovan', 'f', Decimal('5000.53'))
(2, 'rovan', 'f', Decimal('5000.53'))
(3, 'rovan', 'f', Decimal('5000.53'))
(4, 'rovan', 'f', Decimal('5000.53'))
(5, 'rovan', 'f', Decimal('5000.53'))
(6, 'rovan', 'f', Decimal('5000.53'))
(7, 'rovan', 'f', Decimal('5000.53'))
(1, 'rovan', 'f', Decimal('5000.53'))
(2, 'rovan', 'f', Decimal('5000.53'))
(3, 'rovan', 'f', Decimal('5000.53'))
(4, 'rovan', 'f', Decimal('5000.53'))
(5, 'rovan', 'f', Decimal('5000.53'))
(6, 'rovan', 'f', Decimal('5000.53'))
(7, 'rovan', 'f', Decimal('5000.53'))

--------------------------------------------------------------------------
```

```
Exception                                 Traceback (most recent call last)
Cell In[60], line 43
     40 for row in cursor:
     41     print(row)
---> 43 connection1=get_Connection()
     44 cursor=connection.cursor()
     45 cursor.execute('select * from student7')

Cell In[60], line 25, in get_Connection()
     23         return connection_pool.get()
     24 # if queue is empty, raise an exception
---> 25 raise Exception("Maximum number of connections reached")

Exception: Maximum number of connections reached
```

## 2- Connection between python and Azure storage/container Reading&downloading the file Using azure.storage.blob library;two classes of (BlobServiceClient,BlobClient)

To provide:

- Connection string
- Container name
- Blob name ='file path'
- BlobClient.from_connection_string('connection string','container name','blob name',)
- .download_blob()
- .content_as_text

```
from azure.storage.blob import BlobClient
import json
import io
connection_string =
'DefaultEndpointsProtocol=https;AccountName=relgendy;AccountKey=YTQ1cy1bOeU5
9C/5cp+Fjk+/DKHvr9LlimYMwuB+IU9yUtMzmvAISJy9SH4sRC9z87AyOM5ZTCyX+AStInnX4g==
;EndpointSuffix=core.windows.net'
container_name = 'historicaldata'
blob_name= 'Project/data analysis project/DE_category_id.json'

blob_client = BlobClient.from_connection_string(
    connection_string,container_name,blob_name)

with blob_client:
  blob_data = blob_client.download_blob()
  data = blob_data.content_as_text()
  categories=json.loads(data)
```

```
# Check if blob exists in container
if blob_client.exists():
    print(f"Blob '{blob_name}' exists in container '{container_name}'")

    # Get blob URL
    blob_url = blob_client.url
    print(f"Blob URL: {blob_url}")
else:
    print(f"Blob '{blob_name}' does not exist in container
'{container_name}'")
#output
Blob 'test.csv' exists in container 'historicaldata'
Blob URL: https://relgendy.blob.core.windows.net/historicaldata/test.csv
```

## Pushing data/file to azure storage

```
from azure.storage.blob import BlobServiceClient, BlobClient,
ContainerClient
import os

# Set the connection string for your Azure Blob Storage account
connect_str
='DefaultEndpointsProtocol=https;AccountName=relgendy;AccountKey=YTQ1cy1bOeU
59C/5cp+Fjk+/DKHvr9LlimYMwuB+IU9yUtMzmvAISJy9SH4sRC9z87AyOM5ZTCyX+AStInnX4g=
=;EndpointSuffix=core.windows.net'


# Create a BlobServiceClient object
blob_service_client = BlobServiceClient.from_connection_string(connect_str)

# Set the name of the container where you want to upload the file
container_name ='historicaldata'
# Create a ContainerClient object for the container
container_client = blob_service_client.get_container_client(container_name)

# Set the path of the file you want to upload
local_path = "from Jinesh\movies.csv"

# Set the name of the blob that will be created in the container
blob_name = "movies.csv"

# Get the BlobClient object for the blob
blob_client = container_client.get_blob_client(blob_name)

# Upload the file to the blob
with open(local_path, "rb") as data:
```

```
    blob_client.upload_blob(data)
```

## Azure Storage Blob library's classes

BlobServiceClient and BlobClient are both classes in the azure.storage.blob module of the Azure Storage SDK for Python.

BlobServiceClient represents a client to interact with the Blob service at the account level, allowing you to perform operations on containers and blobs at the account level, like creating or deleting containers, getting properties of the account or container, or listing the blobs in a container.

On the other hand, BlobClient represents a client to interact with a specific blob within a container, allowing you to perform operations on a specific blob, like uploading, downloading, deleting, or getting properties of the blob.

In summary, BlobServiceClient is used for account-level operations and BlobClient is used for blob-level operations.

## 3- Connection between Azure Storage and Azure sql Using Pandas library and azure.storage.blob lib;BlobServiceClient,BlobClient,ContainerClient classes

## Azure Data Factory (ADF)

ADF:
Azure Data Factory can be used to move and transform data between Azure Storage and Azure SQL, and many other data sources and destinations. In fact, Azure Data Factory supports a wide range of data sources and destinations including on-premises and cloud-based data stores, such as Blob storage, Azure Data Lake Storage, Azure SQL Database, Azure Synapse Analytics, and many others.
In order to transfer data between these sources and destinations, you can create data pipelines in Azure Data Factory.
. A data pipeline consists of one or more activities that define the data movement and transformation operations that need to be performed on the

data.
To create a data pipeline in Azure Data Factory, you will need to define the source and destination data stores
So in short, Azure Data Factory acts as a connector that allows you to transfer and transform data between various data sources and destinations, including Azure Storage and Azure SQL.

Definitions:

**Data Flows**
Activities within Azure Data Factory pipelines that use scaled-out Apache Spark clusters.

**Dataset**
Represent data structures within your data stores.

**Pipelines**
A logical grouping of activities that perform a specific unit of work. These activities together perform a task.

**Integration Runtimes**
Provides the bridge between the activity and linked services.

**Linked Services**
Define the required connection information needed for Azure Data Factory to connect to external resources, such as a data source.

**Activities**
Azure Data Factory supports three types of ____: data movement, data transformation, and control.

## To create a data factory

**- create data factory:**
name: DatafactoryTrainingtestc339
- go to this link
https://portal.azure.com/#view/AzureTfsExtension/OrganizationsTemplateBlad

e
https://aex.dev.azure.com/me?mkt=en-US
- add organisation , sign in and create new project
- add the project link to the create data factory
- to add repo name , go to the project page and in the left bar you will find repos , add new repository
- in azure the repository type is: Azure DevOps repo or GitHub repo.
- public endpoint
- enable creating virtual machine every time i run a task

- to manage repositories in azure DevOPS. repo .. manage repositories .. security

- go to your datafactory and then launch studio
- go to manage icon and then click on  Git configuration

- to configure a repository using Github and connect it to my data factory
- create repo in github and then go with the steps in the DF
- after creating , you will be able to see many files in the github repo
- go to home icon + ingest + next

**Copy Data tool steps/creating data pipeline from the source to the destination**
- source type : azure blob storage name: azurestorageblobsource1
- adding new connection (name: azurestorageblobsource1 and  copy the key of the azure storage account and paste it in the account key after selecting the storage account name)
- proceed with the steps and for the destination enter the name azureblobstoragedestination1
- once done. browse through your source and get the file you want to move
- then go to pipelines and copy it to the destination ( you can edit the file directory and the name of the file in the destination)
- click save and debug.
- status will be queued then succeeded . Once successful, check your destination for the file to make sure the process is a success.
- you can find all these updates in the JSON file in the Github pipeline folder in the repository.
- for other files you can press on copy again and start specifying the directories of the file source and destination(Sink).

**Quiz notes & engage materials:**

**Azure Resource Manager** provides a management layer that enables you to create, update, and delete resources in your Azure account. You use management features like access control, locks, and tags to secure and organise your resources after deployment.also manage your infrastructure through declarative templates rather than scripts.

**Azure Resource Manager templates (ARM templates)**/ Azure Resource Manager supports the use of declarative templates to define resources for deployment, enabling you to create a template based on existing resources.

**The template** is a JavaScript Object Notation (JSON) file that defines the infrastructure and configuration for your project . In the template, you specify the resources to deploy and the properties for those resources as an Infra-code for your project. (like your application code for the project to work).

**Infra-code**: use the practice of infrastructure as code. In code, you define the infrastructure that needs to be deployed. The infrastructure code becomes part of your project. Just like application code, you store the infrastructure code in a source repository and version it. Anyone on your team can run the code and deploy similar environments.

**Resource groups** are a way to organise and manage resources in Azure.

Although an **Azure geography** often aligns to a specific country, a geography can also align to a market, such as Europe or Asia. You can host resources in any region, so geographies by themselves do not determine where you can place resources. Geographies also do not correspond to physical data centers, but instead contain regions in which data centers reside.(Geographies typically contain two or more regions. )

**Region pair**: A region pair consists of two regions within the same geography.

**Availability zones:** An availability zone encompasses separate power, networking, and cooling, and it is intended to guard against data loss or outages caused by failures in any of those three categories.
Although a single data centre generally fits those criteria, a data centre is not

an availability zone, and vice versa. Conceptually, however, they are much the same. Deploying services across availability zones enables you to achieve higher SLAs for those services.

**Tags:** You can apply tags to a resource group. For example, you might use tags to differentiate production from development or user acceptance testing (UAT) resources.
The tag applies only to the resource group and not to the resources inside the group.
Think of the tag as a label you add to the box, not to the contents of the box. However, the resources in the resource group can have their own tags. Applying a tag to a resource group applies the tag only at the container level.

**Azure Tenants** is a group of users.

**Azure subscriptions**:Using Azure requires an Azure subscription. A subscription provides you with authenticated and authorised access to Azure products and services
is an identity in Azure Active Directory (Azure AD)
**Create additional Azure subscriptions:**
- Environments: When managing your resources, you can choose to create subscriptions to set up separate environments for development and testing, security, or to isolate data for compliance reasons
-Organizational structures: For example, you could limit a team to lower-cost resources, while allowing the IT department a full range.
-Billing:you might want to create subscriptions to manage and track costs based on your needs. For instance, you might want to create one subscription for your production workloads and another subscription for your development and testing workloads.

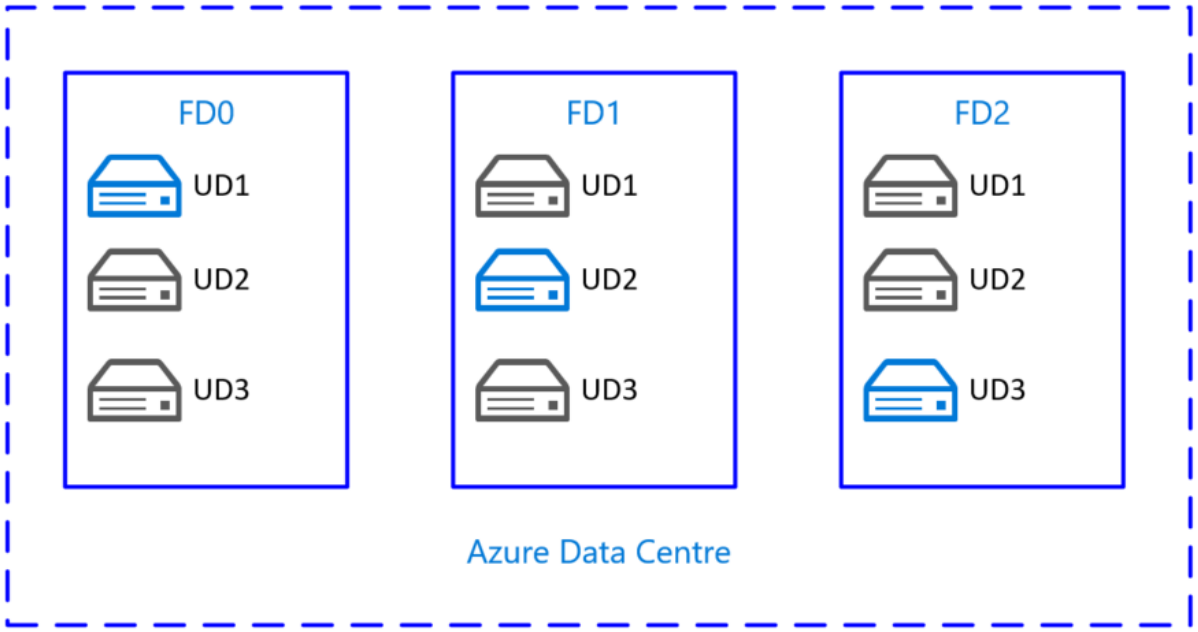
## Availability Sets

Availability sets are another feature of Azure that help you avoid potential outages caused by hardware issues, updates, or other events. Two elements that enable availability sets are update domains and fault domains.

**A fault domain** is a logical grouping of hardware that shares a power source and network switch, similar to a physical rack in a data center containing VMs.(if the physical hardware fails, all the VMs will fail in this rack)

**An update domain** is a logical group of VMs that undergoes maintenance activities or reboot events at the same time.

Benefits:An availability set distributes VMs across multiple fault domains and update domains (see below ). Distributing the VMs in this way helps guard against outages caused by a power or networking event in a fault domain and also enables the VMs to be updated or otherwise maintained within their respective update domains without causing the set as a whole to be unavailable




Here for ex: if UD1 in FD0 is being updated/rebooted. UD2 in FD1 and UD3 in FD2 are still available. So, the load balancer will manage the traffic to UD2. And if FD0 fails because of power outage,network failure.FD1 & FD2 are still available.


load balancer: manages the traffic.

An Azure Load Balancer is a **Layer-4 (TCP, UDP)** load balancer that **distributes incoming traffic among healthy instances of services defined in a backend pool**. The load balancer can be used to improve the availability and scalability of applications or services

that run in the cloud. It can **distribute incoming traffic based on rules and algorithms you define**, such as round-robin, least connections, or source IP hash, and can automatically scale your applications or services up or down based on demand.

Azure Load Balancer supports both inbound and outbound scenarios and **can be used with both public and private IP addresses.** It also provides health probes to monitor the health of the backend instances and can detect and remove unhealthy instances from the pool.

In addition to the basic Load Balancer, Azure also provides **an Application Gateway, which is a Layer-7 (HTTP, HTTPS) load balancer that provides additional features** such as SSL termination, URL-based routing, session affinity, and web application firewall (WAF) capabilities.

## Azure Database Migration Service

Azure Database Migration Service supports a variety of database migration scenarios for both one-time (offline) and continuous synchronisation (online) migrations. In an offline migration, the source is offline while the migration takes place, making the application(s) supported by that data unavailable. In an online migration, the data is synchronised from the live source to the target and then the application is cut over to the new instance of the database.

## what is the difference between azure lake storage gen 1 and gen 2?

ADLS Gen1 is built on top of Hadoop Distributed File System (HDFS), whereas ADLS Gen2 is built on top of Azure Blob Storage. This means that ADLS Gen2 leverages the scalability, durability, and security features of Azure Blob Storage, such as geo-redundancy and hierarchical namespace.