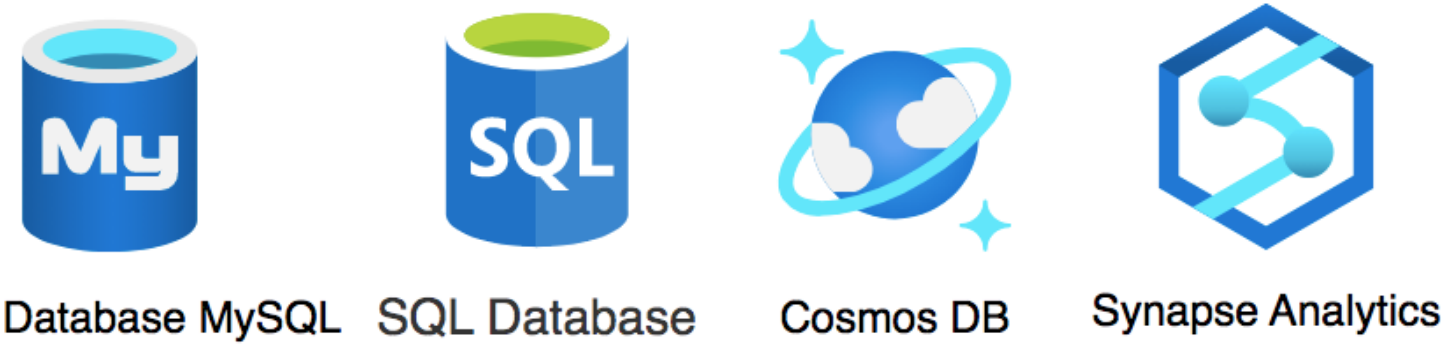
In28 Minutes

DP-900

Azure Data Fundamentals

https://links.in28minutes.com/dp-900

Getting Started



- Azure has *200+ services*. Exam expects you to understand *40+ services*.
- Exam *tests* your **decision making abilities**:
  - Which data format will you use in which situation?
  - Which Azure data store will you use in which situation?
- This course is **designed** to help you *make these choices*
- **Our Goal** : Help you get certified and start your cloud journey with Azure

How do you put your best foot forward?

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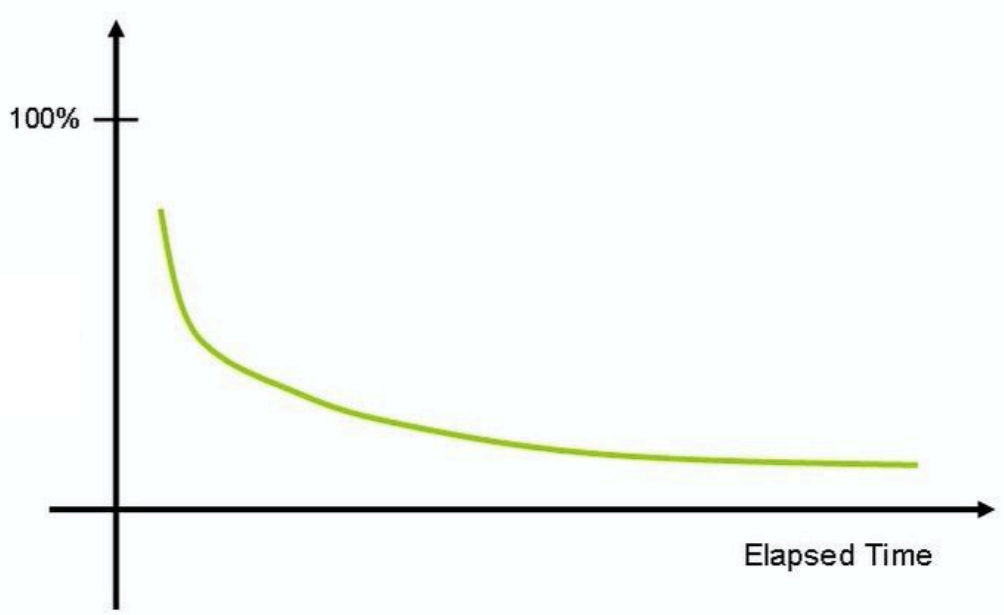
- **Challenging certification** - Expects you to understand and **REMEMBER** a number of services
- As time passes, humans forget things.
- How do you improve your chances of remembering things?
  - **Active learning** - think and take notes
  - **Review** the presentation every once in a while



Our Approach

- Three-pronged approach to reinforce concepts:
  - Presentations (Video)
  - Demos (Video)
  - **Two kinds of quizzes**:
    - Text quizzes
    - Video quizzes
- (Recommended) Take your time. Do not hesitate to replay videos!
- (Recommended) Have Fun!

FASTEST ROADMAPS

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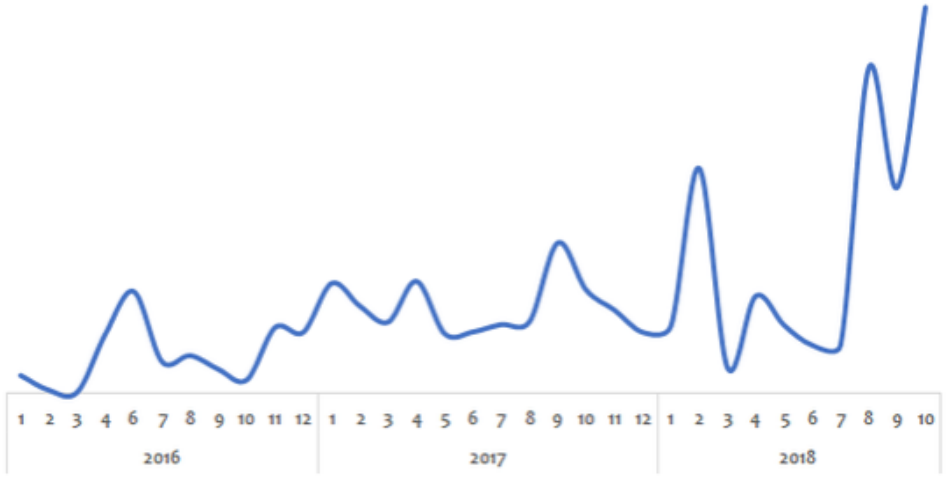
- Google Cloud Certifications
- Azure Certifications
- AWS Certifications
- DevOps
- Java Full Stack
- Java Microservices

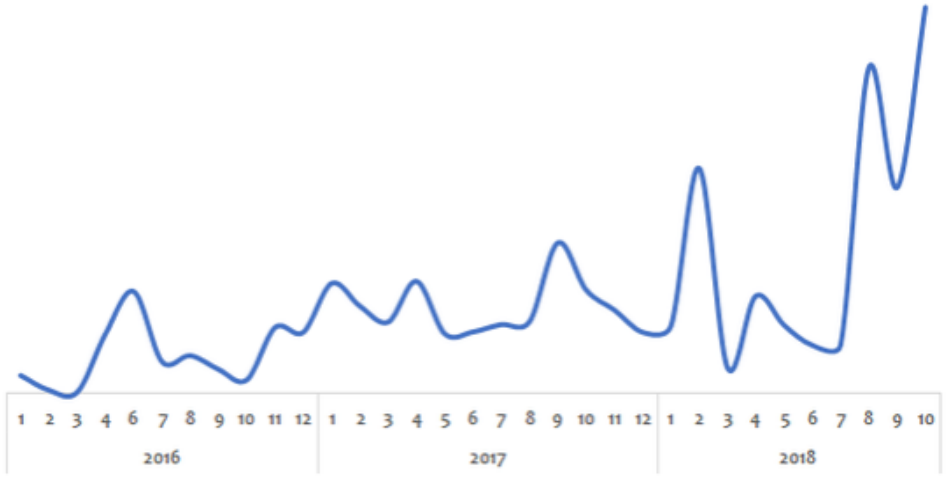
Getting Started - Azure

Before the Cloud - Example 1 - Online Shopping App



- Challenge:
  - Peak usage during holidays and weekends
  - Less load during rest of the time
- Solution (before the Cloud):
  - **Procure** (Buy) infrastructure **for peak load**
    - What would the infrastructure be doing during periods of low loads?

Before the Cloud - Example 2 - Startup



- Challenge:
  - It suddenly becomes popular.
  - How to handle the **sudden increase** in load?
- Solution (before the Cloud):
  - **Procure** (Buy) infrastructure assuming they would be successful
    - What if they are not successful?

Before the Cloud - Challenges

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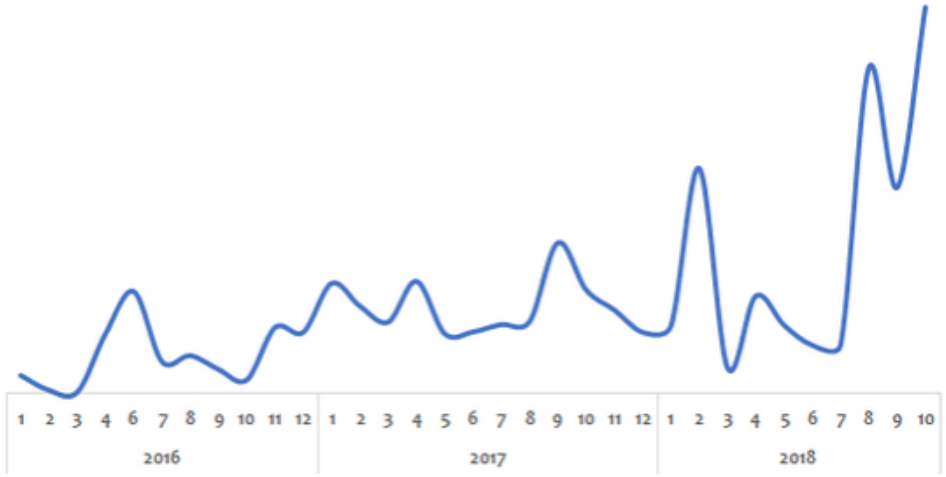

- High cost of procuring infrastructure
- Needs ahead of time planning (**Can you guess the future?**)
- Low infrastructure utilization (**PEAK LOAD** provisioning)
- Dedicated infrastructure maintenance team (**Can a startup afford it?**)

Silver Lining in the Cloud

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- How about **provisioning (renting) resources** when you want them and releasing them back when you do not need them?
  - **On-demand resource provisioning**
  - Also called **Elasticity**

Cloud - Advantages

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- Trade **"capital expense"** for **"variable expense"**
- Benefit from massive **economies of scale**
- Stop **guessing** capacity
- Stop spending money running and maintaining data centers
- **"Go global"** in minutes

Microsoft Azure

- One of the leading cloud service providers
- Provides 200+ services
- Reliable, secure and cost-effective
- The entire course is all about Azure. You will learn it as we go further.

Best path to learn Azure!

Advisor

Machine Learning

Cosmos DB

Azure DevOps

- Cloud applications make use of multiple Azure services.
- There is **no single path** to learn these services independently.
- HOWEVER, we've worked out a simple path!

Setting up Azure Account

- Create Azure Account

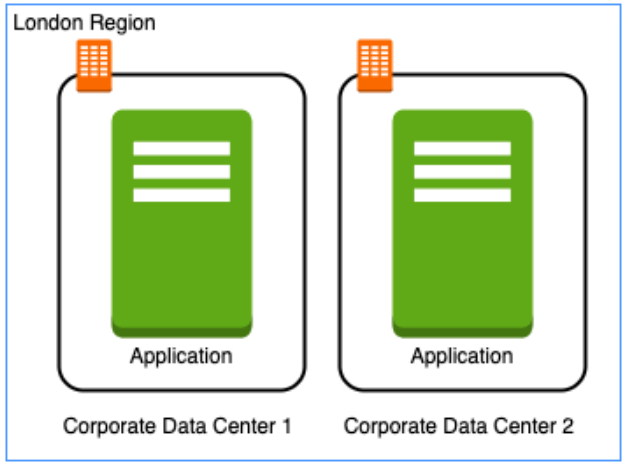
Regions and Zones

Regions and Zones

In28 Minutes

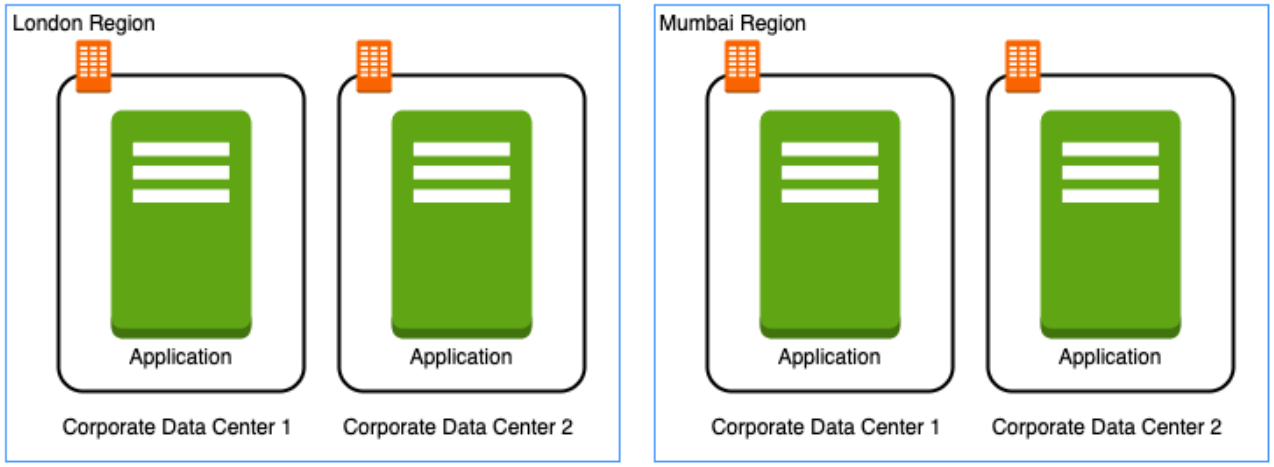
- Imagine that your application is deployed in a data center in London
- What would be the challenges?
  - Challenge 1 : Slow access for users from other parts of the world (**high latency**)
  - Challenge 2 : What if the data center crashes?
    - Your application goes down (**low availability**)

Multiple data centers



- Let's **add in one more data center** in London
- What would be the challenges?
  - Challenge 1 : Slow access for users from other parts of the world
  - Challenge 2 (**SOLVED**) : What if one data center crashes?
    - Your application is **still available** from the other data center
  - Challenge 3 : What if **entire region** of London is unavailable?
    - Your application goes down

Multiple regions



- Let's add a new region : Mumbai
- What would be the challenges?
  - Challenge 1 (**PARTLY SOLVED**) : Slow access for users from other parts of the world
    - You can solve this by adding deployments for your applications in other regions
  - Challenge 2 (SOLVED) : What if one data center crashes?
    - Your application is still live from the other data centers
  - Challenge 3 (**SOLVED**) : What if entire region of London is unavailable?
    - Your application is served from Mumbai

Regions

- Imagine setting up data centers in different regions around the world
  - **Would that be easy?**
- (Solution) Azure provides **60+ regions** around the world
  - Expanding every year
- **Region** : Specific geographical location to host your resources
- **Advantages**:
  - High Availability
  - Low Latency
  - Global Footprint
  - Adhere to government **regulations**

Availability Zones

- How to achieve high availability in the same region (or geographic location)?
  - Enter **Availability Zones**
    - Multiple AZs (3) in a region
    - **One or more discrete data centers**
    - Each AZ has **independent** & **redundant** power, networking & connectivity
    - AZs in a region are connected through **low-latency** links
- (Advantage) **Increased availability and fault tolerance** within same region
  - Survive the failure of a complete data center
- (Remember) NOT all Azure regions have Availability Zones

Regions and Availability Zones examples

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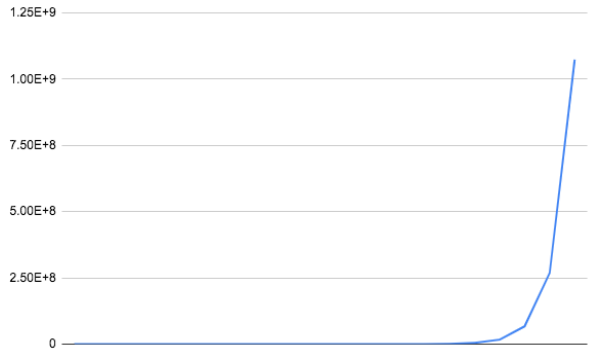
New Regions and AZs are constantly added

Region	Availability Zones
(US) East US	3
(Europe) West Europe	3
(Asia Pacific) Southeast Asia	3
(South America) Brazil South	3
(US) West Central US	0

Data

- Data is the **"oil of the 21st Century Digital Economy"**
- Amount of data generated **increasing exponentially**
  - Mobile devices, IOT devices, application metrics etc
  - **Variety of**
    - **Data formats**: Structured, Semi Structured and Unstructured
    - **Data store options**: Relational databases, NoSQL databases, Analytical databases, Object/Block/File storage ...
- Store data efficiently and gain intelligence
- **Goal of the course**: Help you choose specific data format and Azure data store for your use case
  - We will start with 10,000 feet overview of cloud:
    - Regions, Zones and IaaS/PaaS/SaaS
  - After that, play with different data formats and data storage options in Azure



IaaS vs PaaS vs SaaS

Azure Virtual Machines

- In corporate data centers, data stores are deployed on physical servers
- Where do you deploy data stores in the cloud?
  - Rent virtual servers
  - **Virtual Machines** - Virtual servers in Azure
  - **Azure Virtual Machines** - Provision & Manage Virtual Machines

VM

Problem with using VMs for Databases

In 28 Minutes

- You need to take care of:
  - OS installation & upgrades
  - Database installation & upgrades
  - Availability (create a standby database)
  - Durability (take regular backups)
  - Scaling compute & storage

VM

Managed Services

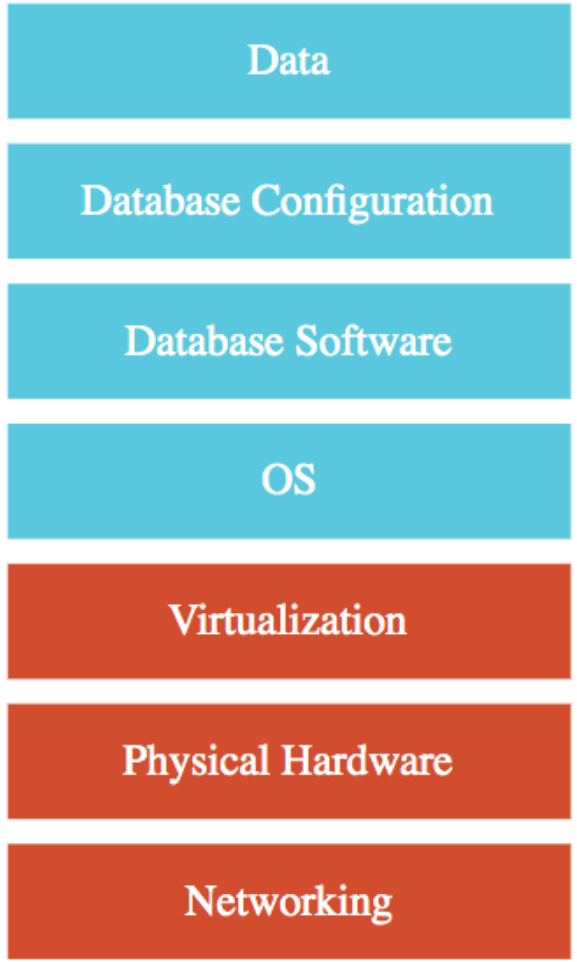
In28 Minutes

- Do you want to continue **running databases in the cloud**, the **same way you run them** in your **data center**?
- OR **are there OTHER approaches**?
- Let's **understand some terminology** used with cloud services:
  - **IaaS** (Infrastructure as a Service)
  - **PaaS** (Platform as a Service)
  - **SaaS** (Software as a Service)
- Let's get on a quick **journey** to understand these!

IaaS (Infrastructure as a Service)

In28 Minutes

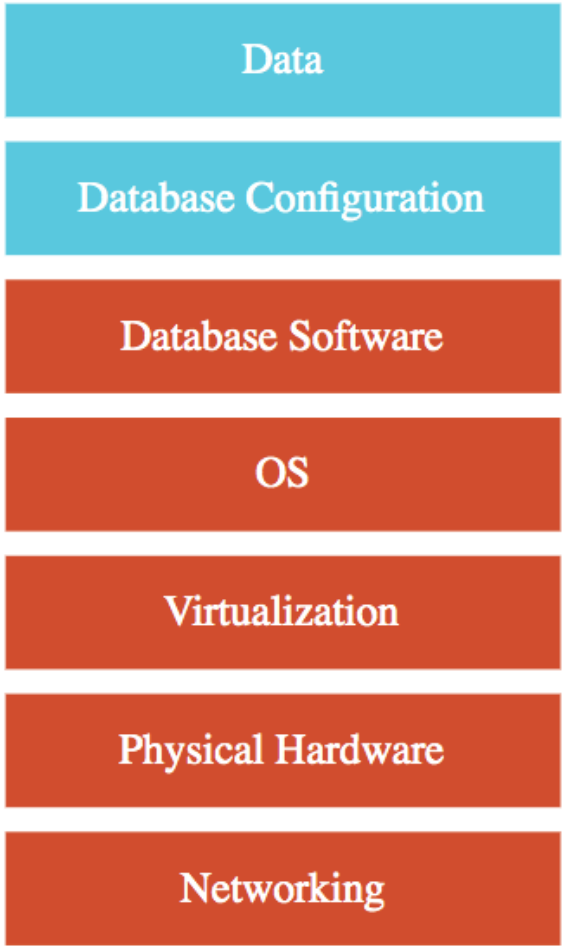
- Use **only infrastructure** from cloud provider
- **Example**: Running SQL Server on a VM
- Cloud Provider is responsible for:
  - Virtualization, Hardware and Networking
- You are responsible for:
  - OS upgrades and patches
  - Database software and upgrades
  - Database Configuration (Tables, Indexes, Views etc)
  - Data
  - Scaling of compute & storage, Availability and Durability



PaaS (Platform as a Service)

In28 Minutes

- Use a platform provided by cloud
- **Cloud provider** is responsible for:
  - Virtualization, Hardware and Networking
  - OS upgrades and patches
  - Database software and upgrades
  - Scaling, Availability, Durability etc..
- **You** are responsible for:
  - Database Configuration (Tables, Views, Indexes, ...)
  - Data
- Examples: Azure SQL Database, Azure Cosmos DB and a lot more ...
- **You** will NOT have access to OS and Database software (most of the times!)



SaaS (Software as a Service)

In 28 Minutes

- **Centrally hosted software** (mostly on the cloud)
  - Offered on a subscription basis (pay-as-you-go)
  - Examples:
    - Email, calendaring & office tools (such as Outlook 365, Microsoft Office 365, Gmail, Google Docs)
    - Customer relationship management (CRM), enterprise resource planning (ERP) and document management tools
- **Cloud provider** is responsible for:
  - OS (incl. upgrades and patches)
  - Application Runtime
  - Auto scaling, Availability & Load balancing etc..
  - Application code and/or
  - Application Configuration (How much memory? How many instances? ..)
- **Customer** is responsible for:
  - Configuring the software!

Azure Cloud Service Categories - Scenarios

In 28 Minutes

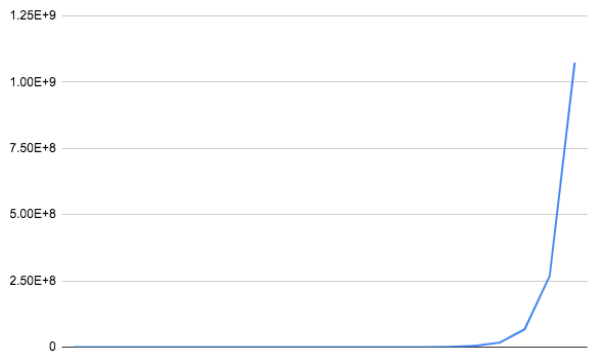
Scenario	Solution
IaaS or PaaS or SaaS: Deploy a Database in Virtual Machines	IaaS
IaaS or PaaS or SaaS: Using Gmail	SaaS
IaaS or PaaS or SaaS: Using Azure SQL Database to create a database	PaaS
True or False: Customer is responsible for OS updates when using PaaS	False
True or False: Customer is responsible for Availability when using PaaS	False
True or False: In PaaS, customer has access to VM instances	False
True or False: In PaaS, customer can customize OS and install custom software	False
True or False: In PaaS, customer can configure hardware needs (memory, cpu etc)	True

Data Formats & Data Stores
10,000 Feet Overview

Data Formats & Data Stores

In 28 Minutes

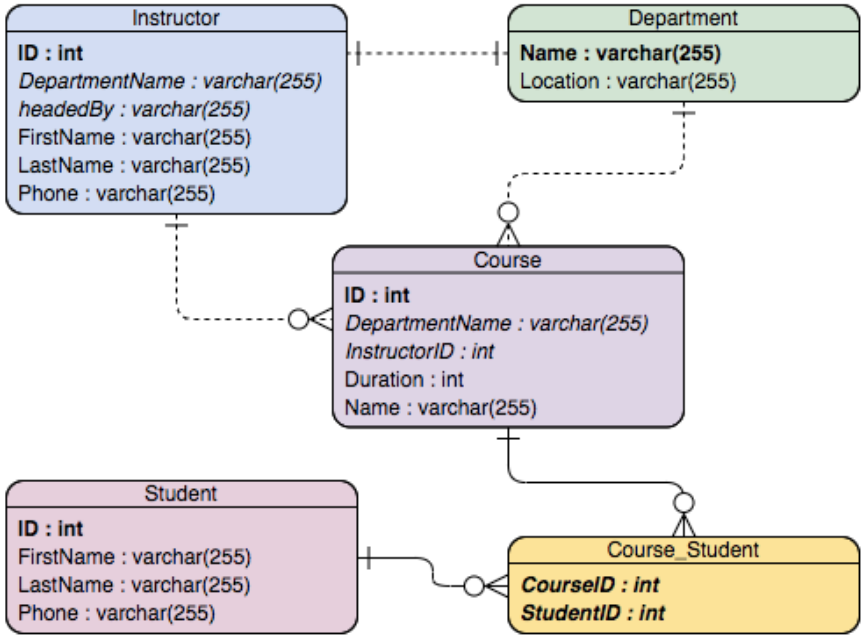
- Data is the **"oil of the 21st Century Digital Economy"**
- Amount of data generated **increasing exponentially**
- **Data formats:**
  - Structured: Tables, Rows and Columns (Relational)
  - Semi Structured: Key-Value, Document (JSON), Graph, etc
  - Unstructured: Video, Audio, Image, Text files, Binary files ...
- **Data stores:**
  - Relational databases
  - NoSQL databases
  - Analytical databases
  - Object/Block/File storage



Structured Data - Relational Databases

- **Data stored in Tables** - Rows & Columns
- **Predefined schema** - Tables, Relationships and Constraints
- **Define indexes** - Query efficiently on all columns
- Used for
  - OLTP (Online Transaction Processing) use cases and
  - OLAP (Online Analytics Processing) use cases

ID	DepartmentName	Name	Duration	InstructorID
1	Computer Science	Algorithms	8	2
2	Computer Science	Data Structures	6	4
3	Computer Science	Operating Systems	5	4
4	Computer Science	Database Management Systems	20	2



Relational Database - OLTP (Online Transaction Processing)

In 28 Minutes

- Applications where **large number of users make large number (millions) of transactions**
  - Transaction - small, discrete, unit of work
    - Example: Transfer money from your account to your friend's account
  - Heavy writes and moderate reads
  - Quick processing expected
- **Use cases**: Most traditional applications - banking, e-commerce, ..
- **Popular databases**: MySQL, Oracle, SQL Server etc
- Some **Azure Managed Services**:
  - **Azure SQL Database**: Managed Microsoft SQL Server
  - **Azure Database for MySQL**: Managed MySQL
  - **Azure Database for PostgreSQL**: Managed PostgreSQL

SQL Database

Azure Database PostgreSQL

Relational Database - OLAP (Online Analytics Processing)

In 28 Minutes

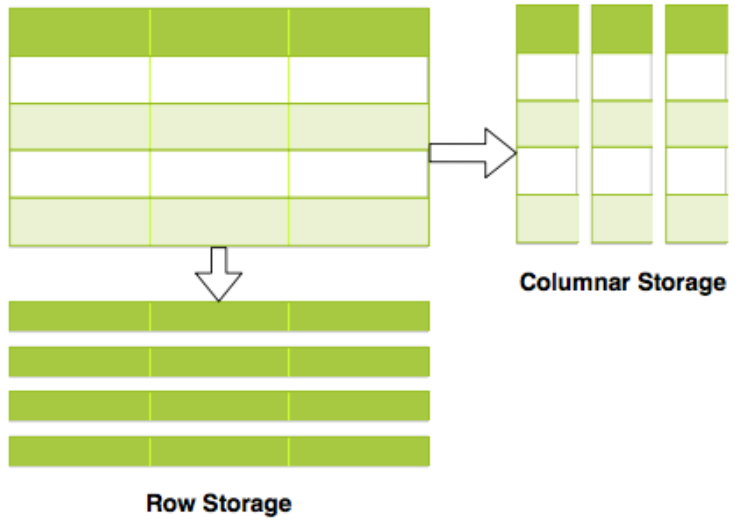
- Applications allowing users to **analyze petabytes of data**
  - **Examples**: Reporting applications, Data warehouses, Business intelligence applications, Analytics systems
  - Data is consolidated from multiple (typically transactional) databases
  - **Sample application** : Decide insurance premiums analyzing data from last hundred years
- Azure Managed Service: **Azure Synapse Analytics**
  - **Petabyte-scale** distributed data ware house
  - Unified experience for developing end-to-end analytics solutions
    - Data integration + Data warehouse + Data analytics
  - Run complex queries across petabytes of data
  - Earlier called Azure SQL Data Warehouse

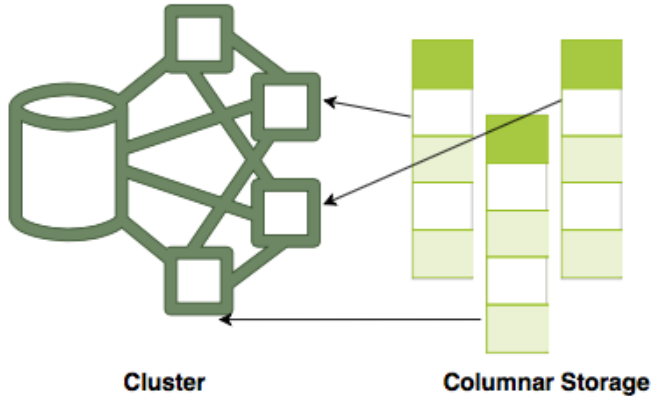
Synapse Analytics

Relational Databases - OLAP vs OLTP

In28 Minutes

- OLAP and OLTP use **similar data structures**
- BUT **very different approach in how data is stored**
- **OLTP databases** use row storage
  - Each table row is stored together
  - Efficient for processing small transactions
- **OLAP databases** use columnar storage
  - Each table column is stored together
  - **High compression** - store petabytes of data efficiently
  - **Distribute data** - one table in multiple cluster nodes
  - **Execute single query across multiple nodes** - Complex queries can be executed efficiently





Semi Structured Data

In28 Minutes

- Data has **some structure BUT not very strict**
- Semi Structured Data is stored in NoSQL databases
  - NoSQL = not only SQL
  - Flexible schema
    - Structure data **the way your application needs it**
    - Let the structure evolve with time
  - Horizontally scale to petabytes of data with millions of TPS
- **Managed Service**: Azure Cosmos DB
- **Types of Semi Structured Data**:
  - Document
  - Key Value
  - Graph
  - Column Family

```
{
  "customerId": "99999999",
  "firstName": "Ranga",
  "lastName": "Ranga",
  "address": {
    "number": "505",
    "street": "Main Street",
    "city": "Hyderabad",
    "state": "Telangana"
  },
  "socialProfiles": [
    {
      "name": "twitter",
      "username": "@in28minutes"
    },
    {
      "name": "linkedin",
      "username": "rangaraokaranam"
    }
  ]
}
```

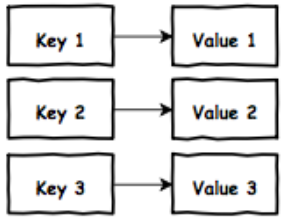
Semi Structured Data - 1 - Document

In28 Minutes

- Data stored as **collection of documents**
  - Typically **JSON** (Javascript Object Notation)
    - Be careful with formatting (name/value pairs, commas etc)
    - address - Child Object - {}
    - socialProfiles - Array - []
  - Documents are retrieved by unique id (called the key)
    - Typically, you can define additional indexes
  - Documents don't need to have the same structure
    - No strict schema defined on database
    - Apps should handle variations (application defined schema)
  - Typically, information in one document would be stored in multiple tables, if you were using a relational database
- **Use cases**: Product Catalog, Profile, Shopping Cart etc
- **Managed Service**: Azure Cosmos DB SQL API & MongoDB API

```
{
  "customerId": "99999999",
  "firstName": "Ranga",
  "lastName": "Ranga",
  "address": {
    "number": "505",
    "street": "Main Street",
    "city": "Hyderabad",
    "state": "Telangana"
  },
  "socialProfiles": [
    {
      "name": "twitter",
      "username": "@in28minutes"
    },
    {
      "name": "linkedin",
      "username": "rangaraokaranam"
    }
  ]
}
```

Semi Structured Data - 2 - Key-Value



Key Value Database

userId	session
user1	{ "name": "Jane", "previousAction" : "someAction1" }
user2	{ "name": "Doe", "previousAction" : "someAction2" }
user3	{ "name": "Doe", "previousAction" : "someAction3" }

- Similar to a **HashMap**
  - **Key** - Unique identifier to retrieve a specific value
  - **Value** - Number or a String or a complex object, like a JSON file
  - Supports simple lookups - query by keys
    - NOT optimized for query by values
    - Typically, no other indexes allowed
- **Use cases**: Session Store, Caching Data
- **Managed Services**: Azure Cosmos DB Table API, Azure Table Storage

Semi Structured Data - 3 - Graph

- Social media applications have data with complex relationships
- How do you store such data?
  - As a graph in **Graph** Databases
  - Used to store data with **complex relationships**
- Contains nodes and edges (relationships)
- **Use cases**: People and relationships, Organizational charts, Fraud Detection
- **Managed Service**: Azure Cosmos DB Gremlin API

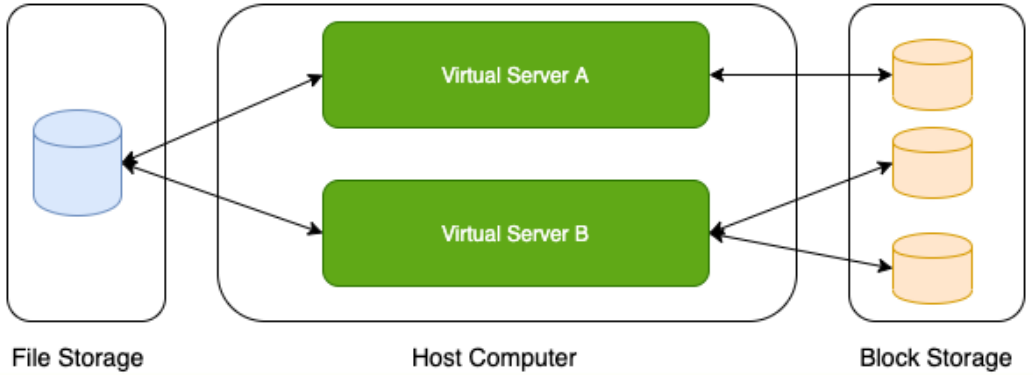
Semi Structured Data - 4 - Column Family

In28 Minutes

Rowid	Column Family 1			Column Family 2			Column Family 3		
	col1	col2	col3	col1	col2	col3	col1	col2	col3
1									
2									
3									

- Data organized into **rows and columns**
- Can appear similar to a relational database
- **IMPORTANT FEATURE**: Columns are divided into groups called column-family
  - Rows can be sparse (does NOT need to have value for every column)
- **Use cases**: IOT streams and real time analytics, financial data - transaction histories, stock prices etc
- **Managed Service**: Azure Cosmos DB Cassandra API

Unstructured Data



- Data which does not have any structure (Audio files, Video files, Binary files)
  - What is the type of storage of your hard disk?
    - **Block Storage** (Azure Managed Service: Azure Disks)
  - You've created a file share to share a set of files with your colleagues in a enterprise. What type of storage are you using?
    - **File Storage** (Azure Managed Service: Azure Files)
  - You want to be able to upload/download objects using a REST API without mounting them onto your VM. What type of storage are you using?
    - **Object Storage** (Azure Managed Service: Azure Blob Storage)

Relational vs Non Relational Data - Quick Overview

In 28 Minutes

- **Relational Data** (Structured Data)
  - **OLTP**: SQL Server on Azure VMs, Azure SQL Database (or Azure SQL Managed Instance), Azure Database for PostgreSQL, MariaDB, MySQL
  - **OLAP**: Azure Synapse Analytics
- **Non Relational Data** (Semi Structured/Unstructured Data)
  - Semi Structured - Document (JSON)
    - Azure Cosmos DB SQL API and Cosmos DB MongoDB API
  - Semi Structured - Key-Value
    - Azure Cosmos DB Table API, Azure Table Storage
  - Semi Structured - Column-Family
    - Azure Cosmos DB Cassandra API
  - Semi Structured - Graph
    - Azure Cosmos DB Gremlin API
  - Unstructured Data
    - Block Storage (Azure Disks), File Storage (Azure Files), Object Storage (Azure Blob Storage)

Cosmos DB

SQL Database

Azure Database MySQL

Azure Storage

Databases - Scenarios

In 28 Minutes

Scenario	Solution
A start up with quickly evolving schema for storing documents	Azure Cosmos DB SQL API and Cosmos DB MongoDB API
Transactional local database processing thousands of transactions per second	Azure SQL Database and other relational databases..
Store complex relationships between transactions to identify fraud	Azure Cosmos DB Gremlin API
Database for analytics processing of petabytes of structured data	Azure Synapse Analytics
File share between multiple VMs	Azure Files
Storing profile images uploaded by your users	Azure Blob Storage

Relational Databases

Relational Databases

- **Structured Data** - Tables, Rows and Columns
- **Structured Query Language (SQL)** for retrieving and managing data
- Recommended when **strong transactional consistency guarantees** are needed
- Database **schema is mandatory**
- **Azure Managed Services**:
  - Azure SQL Database
  - Azure SQL Managed Instance
  - Azure Database for PostgreSQL
  - Azure Database for MySQL
  - Azure Database for MariaDB

SQL Database

Azure Database MySQL

Azure Database PostgreSQL

Azure SQL Database

In28 Minutes

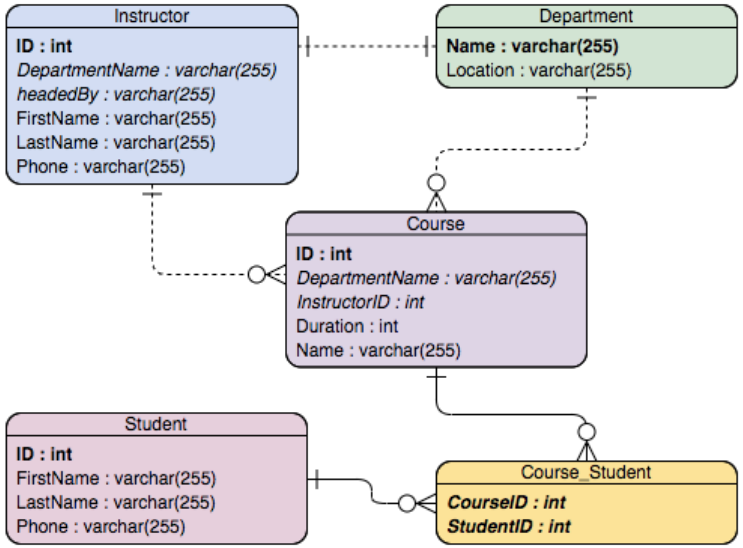
- **Fully Managed Service** for Microsoft SQL Server
- 99.99% availability
- **Built-in** high availability, automatic updates and backups
- Flexible and responsive serverless compute
- Hyperscale (up to 100 TB) storage
- **Transparent data encryption(TDE)** - Data is automatically encrypted at rest
- **Authentication**: SQL Server authentication or Active Directory (and MFA)

SQL Database

Relational Databases - Tables and Relationships

In28 Minutes

- Relational Databases are **modeled using Tables and Relationships**
  - A Course has an Instructor
  - A Course belongs to a Department
- **Table**: Table contains columns and rows
  - All rows in a table have same set of columns
  - Relationship between tables is established using Primary Key and Foreign Key
    - **Primary Key**: Uniquely identifies a row in a table
    - **Foreign Key**: Provides a link between data in two tables



Structured Query Language

In28 Minutes

- **SQL**: Language used to perform operations on relational databases
  - **Data Definition Language (DDL)**: Create and modify structure of database objects
    - Create: Create a database or its constituent objects (Table, View, Index etc)
    - Drop: Delete objects (Table, View, Index) from database
    - Alter: Alter structure of the database
  - **Data Query Language (DQL)**: Perform queries on the data
    - Example: `SELECT * from Course`, `SELECT Count(*) from Course`
  - **Data Manipulation Language (DML)**: Insert, update or delete data
    - Example: `insert into Course values (1, 'AZ-900', 1);`
    - Example: `Update Course Set title='AZ-900 Azure Fundamentals' where id=1`
    - Example: `Delete from Course where id=1`
  - **Data Control Language (DCL)**: Manage permissions and other controls
    - Example: Grant and revoke user access - `GRANT SELECT ON course TO user1`
  - **Transaction Control Language(TCL)**: Control transactions within a database
    - `Commit` - commits a transaction
    - `Rollback` - rollbacks a transaction (used in case of an error)

SQL Database

Index

In 28 Minutes

```
CREATE CLUSTERED INDEX INDEX_NAME on TABLE (COLUMN_NAME);

CREATE NONCLUSTERED INDEX INDEX_NAME on TABLE (COLUMN_NAME);
```

- Allows **efficient data retrieval** from a database
- **Combination** of one or more columns
- **Remember**: An index is automatically created with the primary key
- **Remember**: A table can have more than one index
- **Two Types** of Indexes:
  - **Clustered**: Data in table is stored in the order of the index key values
    - Remember: Only one clustered index per table (Why? - data rows can only be sorted in one way)
  - **Non-clustered** indexes: Index stored separately with pointers to the data rows

View

In28 Minutes

```
create view all_courses_with_students
as
    select course_id, student_id, first_name, last_name, title
    from Course_Student, Student, Course
    where Course_Student.student_id = Student.id and
        Course_Student.course_id=Course.id;
```

- **View**: Virtual table mapped to a query
- Can be used just like a table in SQL queries
- **Use cases**: Add calculated columns, join multiple tables, filter unnecessary columns

Normalization

In28 Minutes

- **Goals** in designing relational databases:
  - High Data Integrity
  - Minimum Data Redundancy (or Duplication)

Database

- How do achieve these goals?
  - **Database Normalization**: "Process of restructuring a relational database to reduce data redundancy and improve data integrity"
    - **First Normal Form (1NF)**: Single(atomic) valued columns
      - Violation Example: A column named address
    - **Second Normal Form (2NF)**: Eliminate redundant data
    - **Third Normal Form (3NF)**: Move columns not directly dependent on primary key
      - (REMEMBER) There are other normal forms (4NF, 5NF, ...) but 3NF is considered good enough for most relational data
- **Advantages** of Normalization
  - Avoid same data being duplicated in multiple tables
  - Reduce disk space wastage
  - Avoid data inconsistencies

Normalization example

In28 Minutes

Unnormalized - Enrollment Details

	student_first_name	student_last_name	title	instructor_first_name	instructor_last_name
1	Ranga	K	AZ-900	in28minutes	cloud
2	Ranga	K	DP-900	in28minutes	cloud
3	Sathish	M	AZ-900	in28minutes	cloud
4	Sathish	M	DP-900	in28minutes	cloud
5	Ramesh	S	AZ-900	in28minutes	cloud
6	Ramesh	S	Google Cloud	in28minutes	cloud

Normalized - Student

id	first_name	last_name
1	Ranga	K
2	Sathish	M
3	Ramesh	S

Normalized - Instructor

id	first_name	last_name
1	in28minutes	cloud

Normalization example - 2

In28 Minutes

Normalized - Course

id	title	instructor_id
1	AZ-900	1
2	DP-900	1
3	Google Cloud	1

Normalized - Course_Student

id	course_id	student_id
1	1	1
2	2	1
3	1	2
4	2	2
5	1	3
6	3	3

Transactions

In 28 Minutes

- **Transaction**: Sequence of operations that need to be atomic
  - All operations are successful (commit) OR NONE are successful (rollback)
  - **Example**: Transfer $10 from Account A to B
    - Operation 1: Reduce $10 from Account A
    - Operation 2: Add $10 to Account B
    - If Operation 1 is successful and Operation 2 fails - Inconsistent state
      - You don't want that!

Database

- Properties: **ACID (Atomicity, Consistency, Isolation, Durability)**
  - **Atomicity**: Each transaction is atomic (either succeeds completely, or fails completely)
  - **Consistency**: Database must be consistent before and after the transaction
  - **Isolation**: Multiple Transactions occur independently
  - **Durability**: Once a transaction is committed, it remains committed even if there are system failures (a power outage, for example)
- Remember: Supported in all Relational Databases

Azure SQL Database - Purchase Models

In28 Minutes

- **vCore-based**: Choose between provisioned or serverless compute
  - OPTIONAL: Hyperscale (Autoscale storage)
  - Higher compute, memory, I/O, and storage limits
  - Supports BYOL
  - **Serverless Compute**: Database is paused during inactive periods
    - You are only billed for storage during inactive periods
    - If there is any activity, database is automatically resumed
- **DTU-based**: Bundled compute and storage packages
  - Balanced allocation of CPU, memory and IO
  - Assign DTUs (relative - Double DTU => Double resources)
  - Recommended when you want to keep things simple
    - You CANNOT scale CPU, memory and IO independently
  - Use DTUs for **small and medium databases** (< few hundred DTUs)

SQL Database

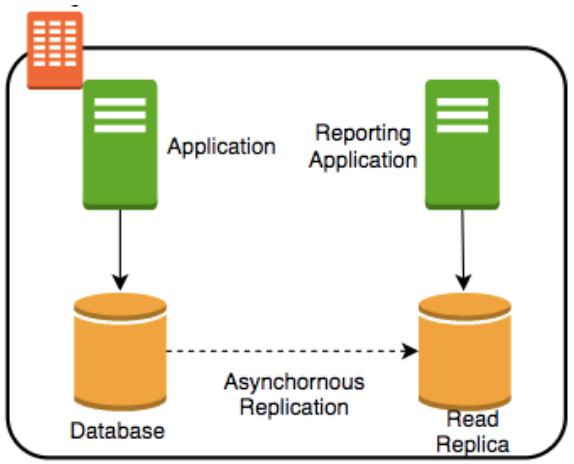
Azure SQL Database - Important Features

In28 Minutes

Feature	Description
Single database	Great fit for modern, cloud-born applications Fully managed database with predictable performance Hyperscale storage (up to 100TB) Serverless compute
Elastic pool	Cost-effective solution for multiple databases with variable usage patterns Manage multiple databases within a fixed budget
Database server	Database servers are used to manage groups of single databases and elastic pools. Things configured at Database server level: Access management, Backup management

Azure SQL Database - Remember

- **Prerequisites** to connect and query from Azure SQL database:
  - **1:** Connection Security: Database should allow connection from your IP address
  - **2:** User should be created in the database
  - **3:** User should have grants (permissions) to perform queries - Select, Insert etc.
- Use **BYOL** to reduce license costs
- Use read-only replicas (Read scale-out) for offloading read-only query workloads



Azure SQL managed instance

In 28 Minutes

- Another **Fully Managed Service** for Microsoft SQL Server
- What's New: **Near 100% SQL Server feature compatibility**
- Recommended when migrating on premise SQL Servers to Azure
- **Azure SQL managed instance features** NOT in Azure SQL Database
  - Cross-database queries (and transactions) within a single SQL Server instance
  - Database Mail
  - Built in SQL Server Agent
    - Service to execute scheduled administrative tasks - jobs in SQL Server
  - Native virtual network support
- Supports **only vCore-based** purchasing model
- (Remember) SQL Server Analysis Services (SSAS), SQL Server Reporting Services (SSRS), Polybase: NOT supported by both Azure SQL Database and SQL Managed Instance

SQL Server in Azure - Summary

In28 Minutes

Service	Description
SQL Server on Azure Virtual Machines	Provides full administrative control over the SQL Server instance and underlying OS for migration to Azure
Azure SQL Database	Fully Managed Service for Microsoft SQL Server. Recommended for cloud-born applications
Azure SQL managed instance	Full (Near 100%) SQL Server access and feature compatibility Recommended for migrating on-premise SQL Server databases Azure SQL managed instance ONLY features: Cross-database queries, Database Mail Support, SQL Server Agent etc.

Azure database for MySQL

In28 Minutes

- Fully managed, scalable **MySQL database**
- Supports 5.6, 5.7 and 8.0 community editions of MySQL
- 99.99% availability
  - Choose single zone or zone redundant high availability
- Automatic updates and backups
- **Alternative**: Azure Database for MariaDB
  - MariaDB: community-developed, commercially supported fork of MySQL

Azure Database MySQL

Azure Database for PostgreSQL

- Fully managed, intelligent and scalable **PostgreSQL**
- 99.99% availability
  - Choose single zone or zone redundant high availability
- Automatic updates and backups
- **Single Server and Hyperscale Options**
  - Hyperscale: Scale to hundreds of nodes and execute queries across multiple nodes

Azure Database PostgreSQL

Relational Data - Scenarios

Scenario	Solution
You are migrating a Microsoft SQL Server database to cloud. You want full access to OS and Microsoft SQL Server installation.	SQL Server on VM
You are migrating a Microsoft SQL Server database to cloud. You do NOT need full access to OS and Microsoft SQL Server installation. However, you need access to Database Mail and SQL Server Agent.	Azure SQL Managed Instance
You want create a new managed Microsoft SQL Server database in cloud	Azure SQL Database, Azure SQL Managed Instance
Which category of SQL is this? `GRANT SELECT ON course TO user1`	Data Control Language (DCL)

Relational Data - Scenarios - 2

In 28 Minutes

Scenario	Solution
Which category of SQL is this? `create table course (...)`	Data Definition Language (DDL)
Your queries on a relational databases are slow. What is the first thing that you would consider doing?	Check if there is an index
Your colleague asked you to normalize your tables. What should be your goals?	High Data Integrity & Minimum Data Redundancy (or Duplication)
How can you offload read-only workloads from Azure SQL database?	Read-only replicas (Read scale-out)

Azure Cosmos DB

Relational vs Non Relational Data - Quick Overview

In28 Minutes

- **Relational Data** (Structured Data)
  - **OLTP**: Azure SQL Database, Azure SQL Managed Instance, SQL Server on Azure VMs, Azure Database for PostgreSQL, MariaDB, MySQL
  - **OLAP**: Azure Synapse Analytics
- **Non Relational Data** (Semi Structured/Unstructured Data)
  - Semi Structured - Document (JSON)
    - Azure Cosmos DB SQL API and Cosmos DB MongoDB API
  - Semi Structured - Key-Value
    - Azure Cosmos DB Table API, Azure Table Storage
  - Semi Structured - Column-Family
    - Azure Cosmos DB Cassandra API
  - Semi Structured - Graph
    - Azure Cosmos DB Gremlin API
  - Unstructured Data
    - Block Storage (Azure Disks), File Storage (Azure Files), Object Storage (Azure Blob Storage)

Cosmos DB

SQL Database

Azure Database MySQL

Azure Storage

Azure Cosmos DB

In 28 Minutes

- **Fully managed NoSQL database service**
- **Global database**: Automatically replicates data across multiple Azure regions
  - Single-digit millisecond response times
  - 99.999% availability
  - Automatic scaling (serverless) - Storage and Compute
  - Multi-region writes
  - Data distribution to any Azure region with the click of a button
    - Your app doesn't need to be paused or redeployed to add or remove a region
- **Structure**: Azure Cosmos account(s) > database(s) > container(s) > item(s)

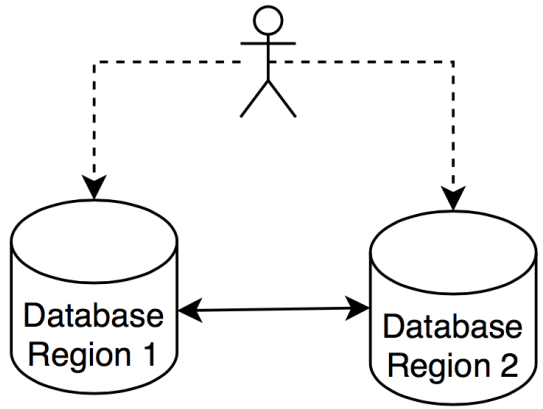
Azure Cosmos DB APIs

- **Core(SQL)**: SQL based API for working with documents
- **MongoDB**: Document with MongoDB API
  - Move existing MongoDB workloads
- **Table**: Key Value
  - Ideal for moving existing Azure Table storage workloads
- **Gremlin**: Graph
  - Store complex relationships between data
- **Cassandra**: Column Family
- REMEMBER: You need a separate Cosmos DB account for each type of API

Azure Cosmos DB - What is Different?

In28 Minutes

- Single-digit millisecond response times even if you scale to petabytes of data with millions of TPS
  - Horizontal scalability
- One thing I love about Azure Cosmos DB: **Flexibility**
  - Structure data **the way your application needs it**
    - Let the structure evolve with time
  - Provides a variety of consistency levels
    - Strong, Bounded staleness, Session, Consistent prefix, Eventual
  - If you are familiar with SQL but want to still use document database use SQL API
  - Options for key-value, column-family and graph databases



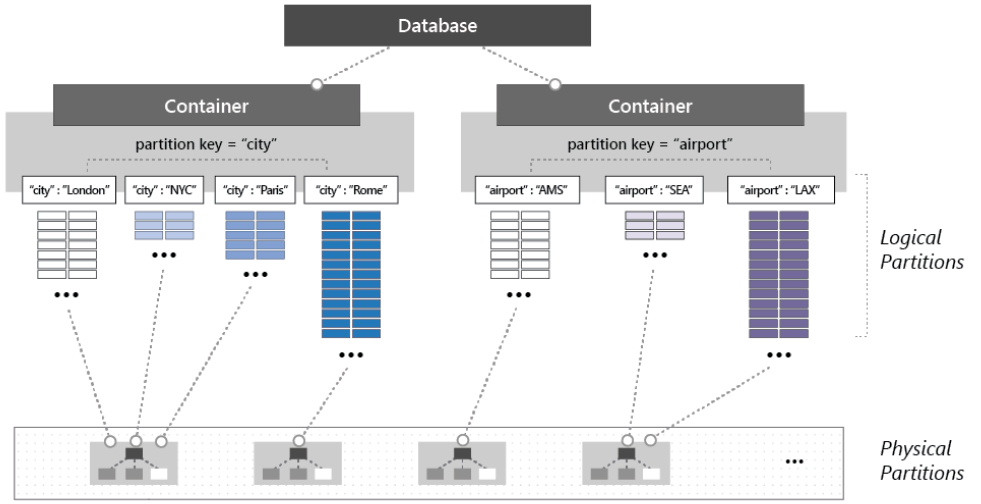
Cosmos DB - Structure

In 28 Minutes

Entity	SQL	Cassandra	MongoDB	Gremlin	Table
Database	Database	Keyspace	Database	Database	NA
Container	Container	Table	Collection	Graph	Table
Item	Item	Row	Document	Node or edge	Item

Cosmos DB - Logical and Physical Partitions

- Each container is **horizontally partitioned** in an Azure region
  - ALSO distributed to all Azure regions associated with the Cosmos DB account
- Items in a container **divided into logical partitions** based on the partition key
- Cosmos DB take care of categorizing logical partitions into physical partitions
- Ensures high availability and durability



(*https://docs.microsoft.com*)

Cosmos DB - Provisioned throughput vs Serverless

In28 Minutes

Factor	Provisioned throughput	Serverless
Description	Provision throughput in Request Units per second	No need to provision capacity. Auto scales to meet request load.
What are you billed for?	RUs provisioned per hour (usage does NOT matter) + Storage	per-hour RUs consumed + Storage
When to use?	Continuous predictable traffic	Intermittent, unpredictable traffic
Multi Regions	Yes	No - only in 1 Azure region
Max storage per container	No limit	50 GB
Performance	< 10 ms latency for point-reads and writes	< 10 ms latency for point-reads and < 30 ms for writes

Azure Cosmos DB - Scenarios

Scenario	Solution
How can you increase storage associated with Azure Cosmos DB?	Automatic scaling (serverless)
What is the high level structure of storing data in Azure Cosmos DB?	Azure Cosmos account(s) > database(s) > container(s) > item(s)
How are items in a container divided into logical partitions?	Using partition key
You want to store data for a social networking app with complex relationships	Gremlin API
You want SQL based API for working with documents	Core(SQL) API
You want to move existing MongoDB workloads to Azure	MongoDB API

Azure Storage

Relational vs Non Relational Data - Quick Overview

In28 Minutes

- **Relational Data** (Structured Data)
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  - Unstructured Data
    - Block Storage (Azure Disks), File Storage (Azure Files), Object Storage (Azure Blob Storage)

Cosmos DB

SQL Database

Azure Database MySQL

Azure Storage

Azure Storage

In28 Minutes

- Managed Cloud Storage Solution
  - Highly available, durable and massively scalable (upto few PetaBytes)
- Core Storage Services:
  - **Azure Disks**: Block storage (hard disks) for Azure VMs
  - **Azure Files**: File shares for cloud and on-premises
  - **Azure Blobs**: Object store for text and binary data
  - **Azure Queues**: Decouple applications using messaging
  - **Azure Tables**: NoSQL store (Very Basic)
    - Prefer Azure Cosmos DB for NoSQL
- (PRE-REQUISITE) Storage Account is needed for Azure Files, Azure Blobs, Azure Queues and Azure Tables

Azure Storage

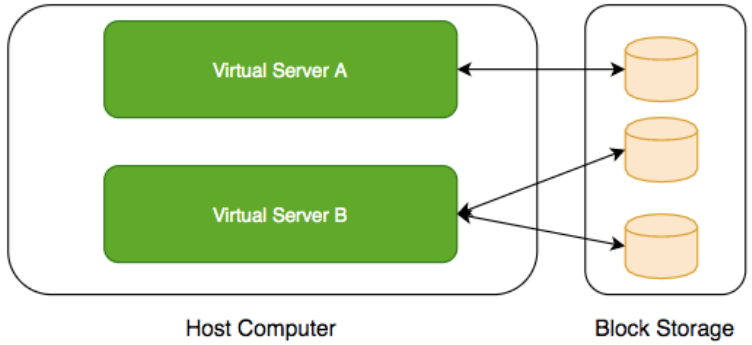
Azure Storage - Data Redundancy

In28 Minutes

Option	Redundancy	Discussion
Locally redundant storage (LRS)	Three synchronous copies in same data center	Least expensive and least availability
Zone-redundant storage (ZRS)	Three synchronous copies in three AZs in the primary region	
Geo-redundant storage (GRS)	LRS + Asynchronous copy to secondary region (three more copies using LRS)	
Geo-zone-redundant storage (GZRS)	ZRS + Asynchronous copy to secondary region (three more copies using LRS)	Most expensive and highest availability

Block Storage

- Use case: Hard-disks attached to your computers
- Typically, ONE Block Storage device can be connected to ONE virtual server
- HOWEVER, you can connect multiple different block storage devices to one virtual server



Azure Disks Storage

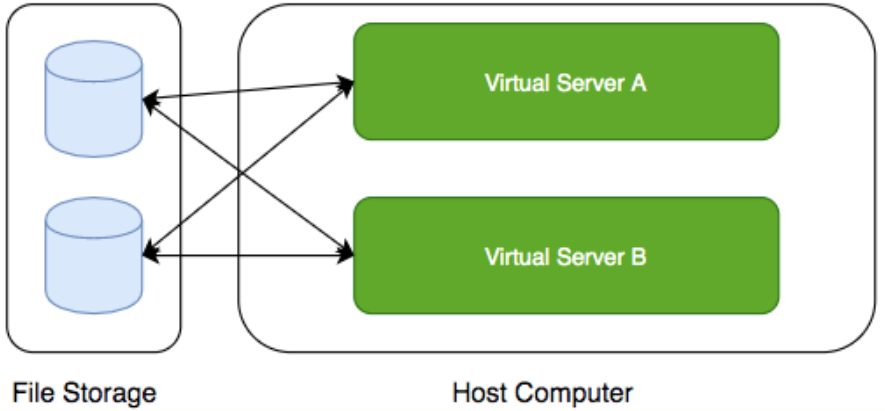
In28 Minutes

- **Disk storage**: Disks for Azure VMs
  - **Types**:
    - **Standard HDD**: Recommended for Backup, non-critical, infrequent access
    - **Standard SSD**: Recommended for Web servers, lightly used enterprise applications and dev/test environments
    - **Premium SSD disks**: Recommended for production and performance sensitive workloads
    - **Ultra disks (SSD)**: Recommended for IO-intensive workloads such as SAP HANA, top tier databases (for example, SQL, Oracle), and other transaction-heavy workloads
  - Premium and Ultra provide very high availability
- **Managed vs Unmanaged Disks**:
  - Managed Disks are easy to use:
    - Azure handles storage
    - High fault tolerance and availability
  - Unmanaged Disks are old and tricky (Avoid them if you can)
    - You need to manage storage and storage account
    - Disks stored in Containers (NOT Docker containers. Completely unrelated.)

Azure Storage

Azure Files

- Media workflows need huge shared storage for things like video editing
- Enterprise users need a quick way to share files in a secure & organized way
- **Azure Files**:
  - Managed File Shares
  - Connect from multiple devices concurrently:
    - From cloud or on-premises
    - From different OS: Windows, Linux, and macOS
  - Supports Server Message Block (SMB) and Network File System (NFS) protocols
  - Usecase: Shared files between multiple VMs (example: configuration files)



Azure Blob Storage

In28 Minutes

- **Azure Blob Storage**: Object storage in Azure
- **Structure**: Storage Account > Container(s) > Blob(s)
- Store massive volumes of unstructured data
  - **Store all file types** - text, binary, backup & archives:
    - Media files and archives, Application packages and logs
    - Backups of your databases or storage devices
- **Three Types of Blobs**
  - Block Blobs: Store text or binary files (videos, archives etc)
  - Append Blobs: Store log files (Ideal for append operations)
  - Page Blobs: Foundation for Azure IaaS Disks (512-byte pages up to 8 TB)
- **Azure Data Lake Storage Gen2**: Azure Blob Storage Enhanced
  - Designed for enterprise big data analytics (exabytes, hierarchical)
  - Low-cost, tiered storage, with high availability/disaster recovery

Azure Storage

Azure Blob Storage - Access Tiers

In 28 Minutes

- **Different kinds of data** can be stored in Blob Storage
  - Media files, website static content
  - Backups of your databases or storage devices
  - Long term archives
- Huge variations in **access patterns**
- Can I pay a cheaper price for objects I access less frequently?
  - **Access tiers**
    - **Hot**: Store frequently accessed data
    - **Cool**: Infrequently accessed data stored for min. 30 days
    - **Archive**: Rarely accessed data stored for min. 180 days
      - Lowest storage cost BUT Highest access cost
      - Access latency: In hours
      - To access: **Rehydrate** (Change access tier to hot or cool) OR
        - Copy to another blob with access tier hot or cool
    - You can **change access tiers** of an object **at any point in time**

Azure Storage

Azure Storage - Remember

In28 Minutes

- **Azure Queues**: Decouple applications using messaging
- **Azure Tables**: NoSQL store (Very Basic)
  - A key/value store
  - Store and retrieve values by key
  - Supports simple query, insert, and delete operations
  - Cosmos DB Table API is recommended as key/value store for newer usecases (supports multi-master in multiple regions)
  - Azure Tables only supports read replicas in other regions
    - **GRS or GZRS**: Data in secondary region is generally NOT available for read or write access
      - Available for read or write only in case of failover to the secondary region
    - To enable round the clock read access:
      - Use read-access geo-redundant storage (RA-GRS) or read-access geo-zone-redundant storage (RA-GZRS)

Azure Storage

Azure Storage - Scenarios

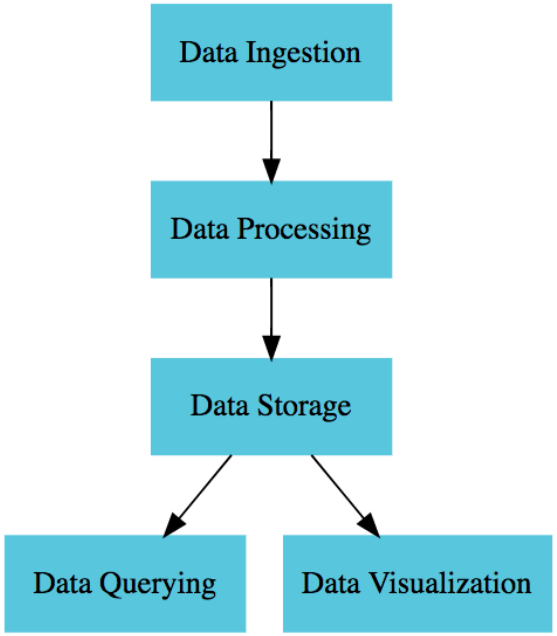
Scenario	Solution
What is needed before storing data to Azure Files, Azure Blobs, Azure Queues and Azure Tables?	Storage Account
You have a Storage Account and you are making use of Azure Blob Storage. You want to create a new file share. Is it mandatory to create a new Storage Account?	No
You want highest availability for data in your Storage Account	Geo-zone-redundant storage (GZRS)
Which service supports Server Message Block (SMB) and Network File System (NFS) protocols?	Azure Files
You are not planning to access your data in Azure Blob storage for a few years. You can wait for a few hours when you need to access the data. How can you reduce your costs?	Move data to Archive tier

Data Analytics

Data Analytics

In28 Minutes

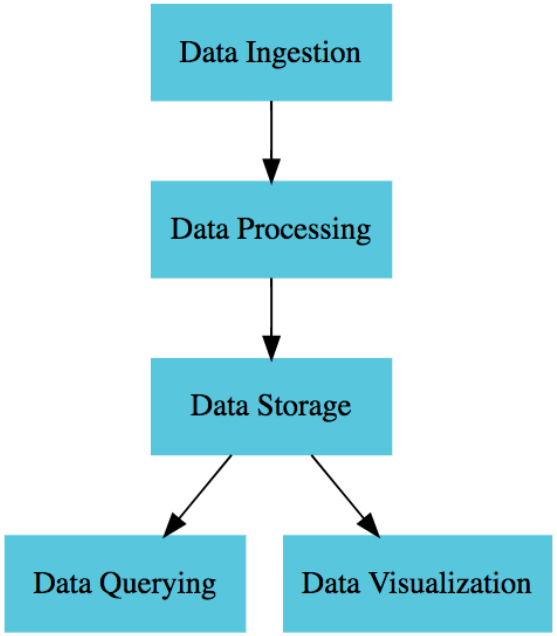
- **Goal**: Convert raw data to intelligence
  - Uncover trends and discover meaningful information
  - Find new opportunities and identify weaknesses
  - Increase efficiency and improve customer satisfaction
  - Make appropriate business decisions
- Raw data can be from different sources:
  - Customer purchases, bank transactions, stock prices, weather data, monitoring devices etc
- **Approach**: Ingest => Process => Store (data warehouse or a data lake) => Analyze
- Ex: Decide future sales using past customer behavior
- Ex: Faster diagnosis & treatment using patient history



Data Analytics Work Flow

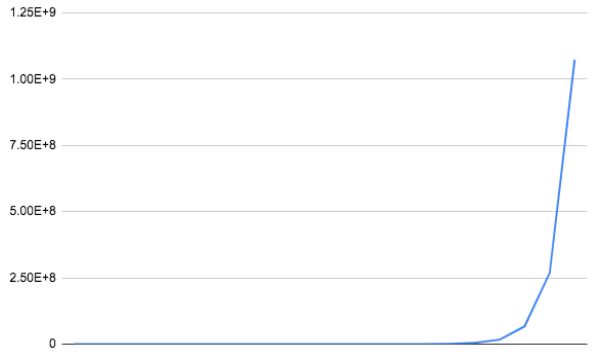
In28 Minutes

- **Data Ingestion**: Capture raw data
  - From various sources (stream or batch)
    - Example: Weather data, sales records, user actions - websites ..
- **Data Processing**: Process data
  - Raw data is not suitable for querying
    - Clean (remove duplicates), filter (remove anomalies) and/or aggregate data
    - Transform data to required format (Transformation)
- **Data Storage**: Store to data warehouse or data lake
- **Data Querying**: Run queries to analyze data
- **Data Visualization**: Create visualizations to make it easier to understand data and make better decisions
  - Create dashboards, charts and reports (capture trends)
  - Help business spot trends, outliers, and hidden patterns in data



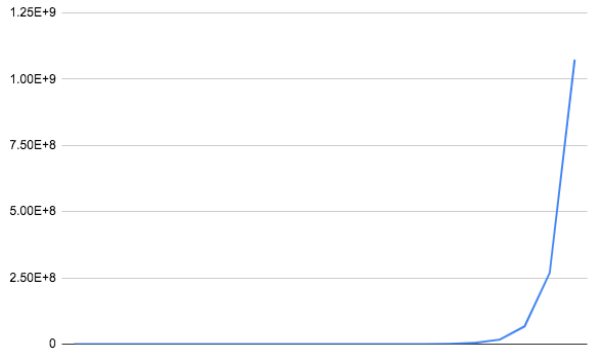
Data Analysis Categories

- **Descriptive analytics**: What's happening?
  - Based on historical/current data
  - Monitor status (of KPIs) and generate alerts
  - Example: Generating reports (current vs planned)
- **Diagnostic analytics**: Why is something happening?
  - Take findings from descriptive analytics and dig deeper
  - Example: Why did sales increase last month?
  - Example: Why are sales low in Netherlands?
- **Predictive analytics**: What will happen?
  - Predict probability based on historical data
  - Mitigate risk and identify opportunities
  - Example: What will be the future demand?
  - Example: Calculate probability of something happening in future



Data Analysis Categories - 2

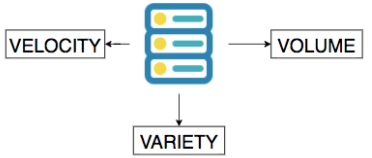
- **Prescriptive analytics**: What actions should we take?
  - Use insights from predictive analytics and make data-driven informed decisions
  - Still in early stages
  - Example: What can I do to increase probability of this course being successful in future?
- **Cognitive analytics**: Make analytic tools to think like humans
  - Combine traditional analytics techniques with AI and ML features
  - Examples: Speech to text (transcription or subtitles), text to speech, Video Analysis, Image Analysis, Semantic Analysis of Text (Analyze reviews)

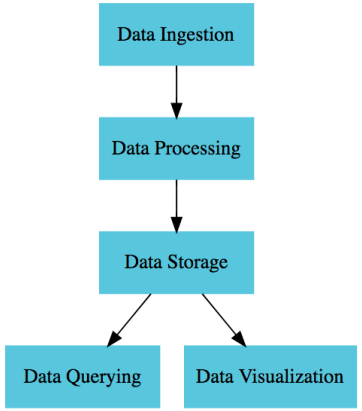


Big Data - Terminology and Evolution

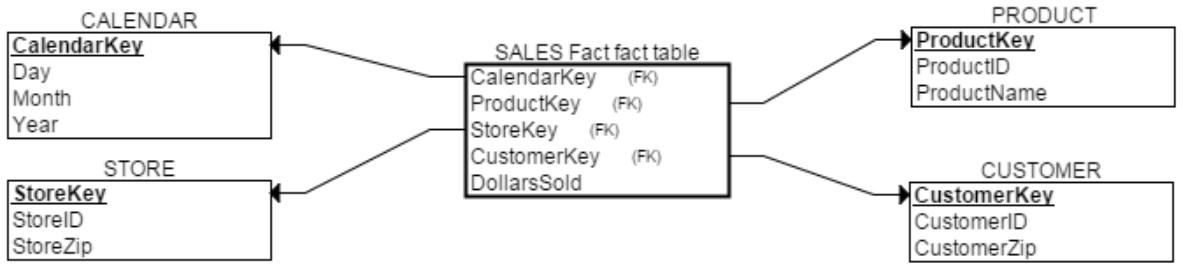
In28 Minutes

- **3Vs** of Big Data
  - **Volume**: Terabytes to Petabytes to Exabytes
  - **Variety**: Structured, Semi structured, Unstructured
  - **Velocity**: Batch, Streaming ..
- **Terminology**: Data warehouse vs Data lake
  - **Data warehouse**: PBs of Storage + Compute (Typically)
    - Data stored in a format ready for specific analysis! (processed data)
      - Examples: Teradata, BigQuery(GCP), Redshift(AWS), Azure Synapse Analytics
    - Typically uses specialized hardware
  - **Data lake**: Typically retains all raw data (compressed)
    - Typically object storage is used as data lake
      - Amazon S3, Google Cloud Storage, Azure Data Lake Storage Gen2 etc..
    - Flexibility while saving cost
    - Perform ad-hoc analysis on demand
    - Analytics & intelligence services (even data warehouses) can directly read from data lake
      - Azure Synapse Analytics, BigQuery(GCP) etc..





Data warehouse Best Practice - De-normalized Star Schema



- How do you structure data for quick analysis in a data warehouse?
  - Option: **Star Schema**
  - Modeling approach most widely used by relational data warehouses
- **Each Table classified as "Dimension" or "Fact":**
  - **Fact** tables: Quantitative data - Data generated in a transactional system (typically)
    - Contains observations or events (sales orders, stock balances, temperatures ...)
  - **Dimension** tables: Contain descriptive attributes related to fact data
    - Example: Product, Customer, Store, Calendar
- **Advantage**: Star schemas are de-normalized and are easier to query

Data Analytics: 3 Azure Specific Services

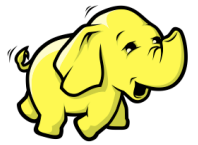
In28 Minutes

- **Azure Synapse Analytics**: End-to-end analytics solutions
  - Data integration + Enterprise data warehouse + Data analytics
  - Create SQL and Spark pools to analyze data
- **Azure Data Factory**: **Fully managed serverless** service to build complex data pipelines
  - Extract-transform-load (ETL), extract-load-transform (ELT) and data integration
- **Power BI**: Create visualization around data
  - Unify data and create BI reports & dashboards

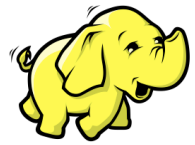
Big Data - Hadoop, Spark and Databricks

In 28 Minutes

- Hadoop based approaches:
  - **Apache Hadoop**: Create datasets with variety of data. Get intelligence.
    - Runs on commodity servers with attached storage (Large clusters - thousands of nodes)
    - **Hadoop Distributed File System (HDFS)**: Primary data storage
    - **MapReduce**: Write Java, Python, .. apps to process data
      - Enables massive parallelization
    - **HIVE**: Query using SQL
    - **Apache Spark**: How about processing in-memory?
      - Really fast: Can be up to 100 times faster than MapReduce (if you make sufficient memory available)
      - Supports Java, Python, R, SQL and Scala programming languages
      - Run data analytics, data processing and machine learning workloads
      - Has become very popular and is offered as a separate service in most cloud platforms!
  - **Databricks**: Web-based platform for working with Spark
    - Centralized platform for machine learning, streaming analytics and business intelligence workloads
    - Founded by the creators of Apache Spark
    - **Automated cluster management**



Hadoop and Spark in Azure

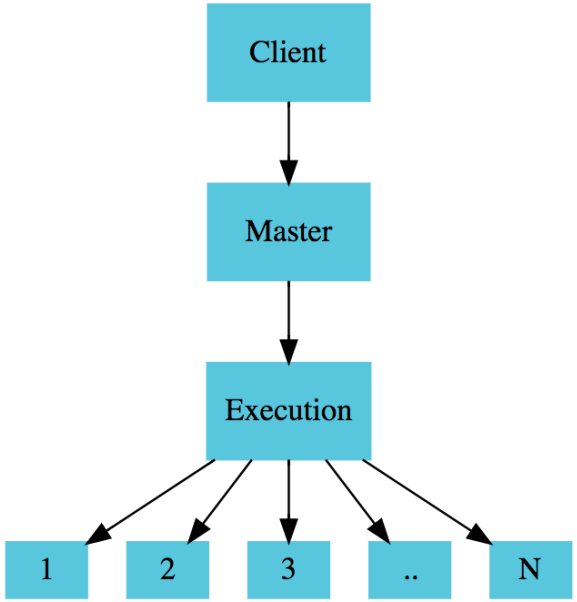


- **Azure HDInsight**: Managed Apache Hadoop Azure service
  - Process big data with Hadoop, Spark
- **Azure Databricks**: Managed Apache Spark service
  - Premium Spark offering
  - Focused only on running Apache Spark workloads
  - Can consume data from Azure SQL Database, Event hubs, Cosmos DB
- **Other Azure Spark Integrations**:
  - **Azure Synapse Analytics**: Can run Spark jobs using "Apache Spark for Azure Synapse"
  - **Azure Data Factory**: Run pipelines involving Azure services like Azure HDInsight, Azure Databricks

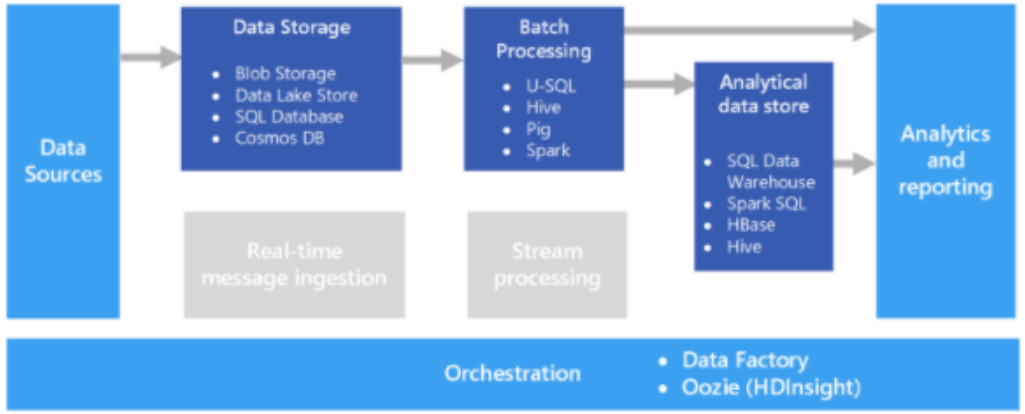
Massive Parallel Processing (MPP)

In28 Minutes

- Split processing across multiple compute nodes
- Typically separate storage and compute
  - Use Data lake as storage (for example)
  - Scale compute on demand
- Examples: Spark, Azure Synapse Analytics
  - Some services run Spark in serverless mode!



Batch Pipelines

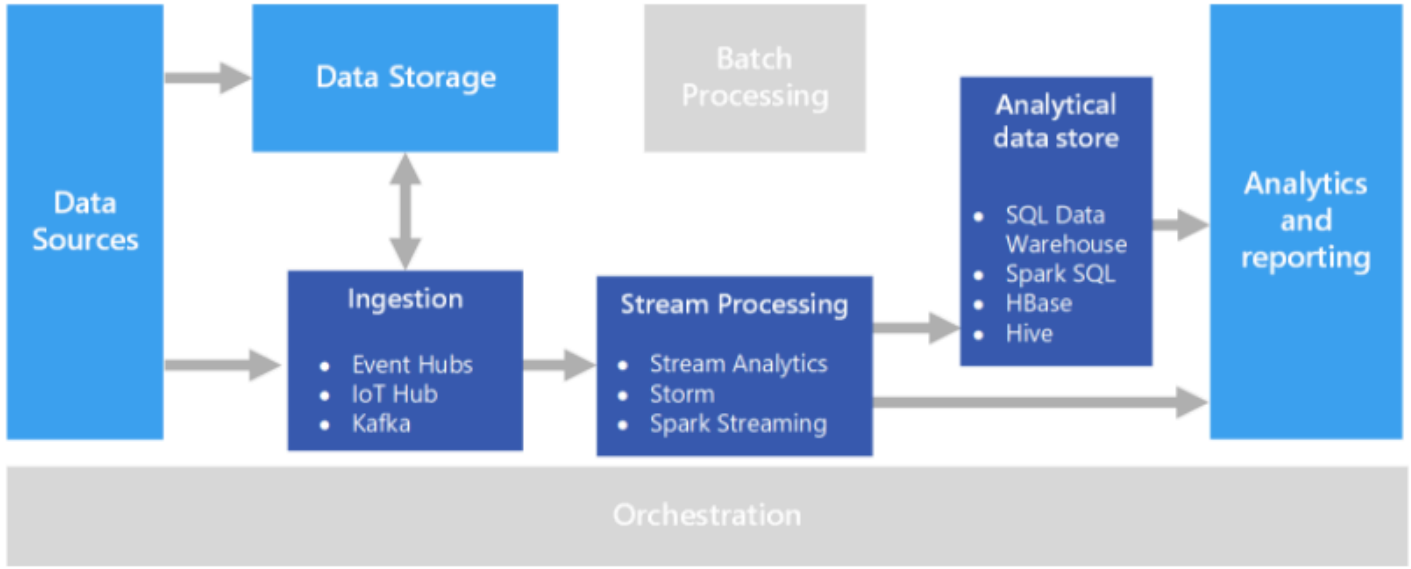


(*https://docs.microsoft.com*)

- **Batch Processing**: Buffering and processing data in groups
  - Define condition - how often to run? (every 6 hours or after 10K records)
  - **Advantages**: Process huge volumes of data during off-peak hours (overnight, for example)
    - Typically takes longer to run (minutes to hours to days)
  - **Example**: Read from storage (Azure Data Lake Store), process, and write to Relational Database or NoSQL Database or Data warehouse

Streaming Pipelines

In28 Minutes



(*https://docs.microsoft.com*)

- **Streaming Processing**: Real-time data processing
  - Processing data as it arrives (in seconds or milliseconds)
  - Examples: Stock Market Data, Telemetry from IOT Devices, User action metrics from websites

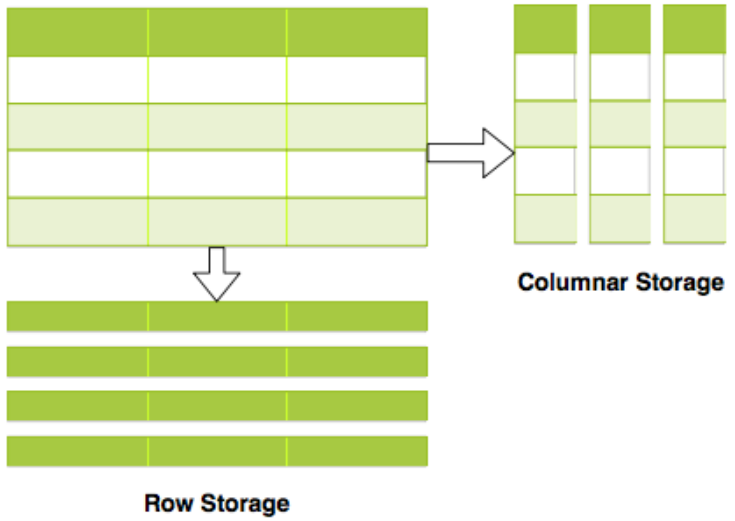
Stream vs Batch Processing

In28 Minutes

Feature	Batch	Streaming
Time Period	Process data in batches - all data from few hours to few days to few months	Process most recent data (last 30 seconds, for example).
Data Size	Process large datasets efficiently	Process individual records or micro batches containing a few records
Latency	High - Typically few hours	Low - Typically few seconds or milliseconds
Usecase	Use for performing complex storage or analysis	Used for storing individual records, simple aggregation or rolling average calculations

Apache Parquet

- Open source **columnar storage format**
- **High compression** because of columnar storage
- **Efficient storage** for big data workloads
- Introduced by the Apache Hadoop ecosystem
- **Supported by most big data platforms**:
  - Azure Data Factory supports Parquet for both read and write (Source and Sink)
  - Azure Data Lake Storage / Azure Blob Storage - Store data in Parquet format
  - Azure Synapse Analytics can be used to store tabular representation of data in Parquet format



ETL

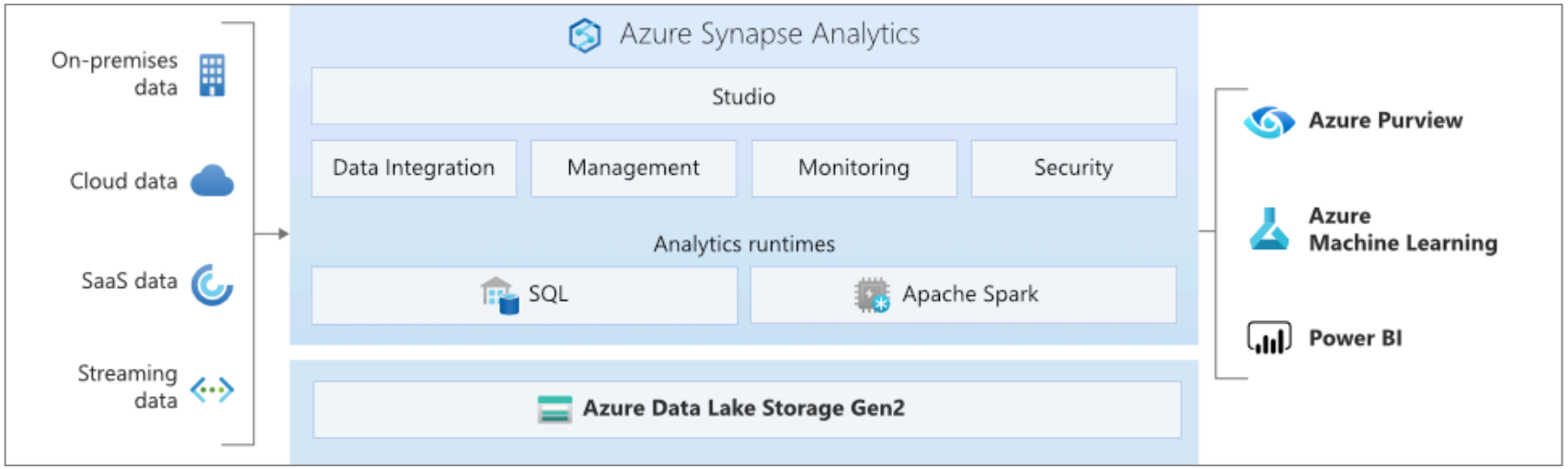
- **ETL (Extract, Transform, and Load)**: Retrieve data, process and store it
- Data can be from multiple sources
- Recommended for simple processing:
  - Basic data cleaning tasks, de-duplicating data, formatting data
  - Example: Ensure data privacy and compliance
    - Removing sensitive data before it reaches analytical data models
- Can run each of the phases in parallel
  - While extract is going on, you can transform data which is already loaded

ELT

- **ELT (Extract, Load, and Transform)**: Data is stored before it is transformed
- Uses an iterative approach (multiple steps) to process data in target system
- Needs a powerful target datastore:
  - Target datastore should be able to perform transformations
- Advantage: Does NOT use a separate transformation engine
- Typical target data stores: Hadoop cluster (using Hive or Spark), Azure Synapse Analytics
  - Enables use of massively parallel processing (MPP) capabilities of data stores

Azure Synapse Analytics

In28 Minutes

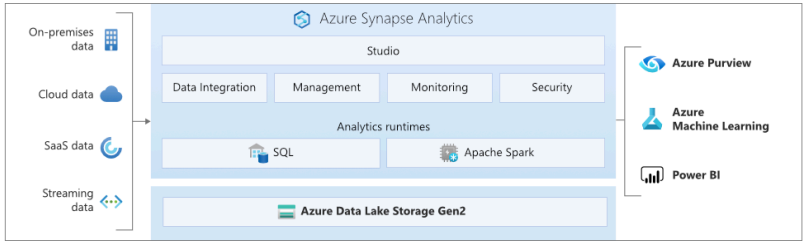


(*https://docs.microsoft.com*)

- Develop **end-to-end analytics** solutions
  - Data integration + Enterprise data warehouse + Data analytics
  - SQL technologies + Spark technologies + Pipelines
  - Full integration with Power BI, Cosmos DB, and Azure ML

Azure Synapse Analytics - Workflow

- In a workspace, create pipelines for:
  - **Data Ingestion**:
    - **Ingest data** from 90+ data sources (Cosmos DB,AWS, GCP..)
    - **Stream data** into SQL tables
  - **Data Storage**: Datasets - Azure Storage, Azure Data Lake Storage
    - Formats: Parquet, CSV, JSON ..
  - **Data Processing**: Mix & match SQL and Spark
    - **SQL pool**: SQL Database supporting distributed T-SQL queries
      - Two consumption models: dedicated and serverless
      - Recommended for complex reporting & data ingestion using Polybase
      - SQL Pool can be paused to reduce compute costs
    - **Apache Spark pools**: Run Spark based workloads
      - 1: Create Spark data analysis notebooks OR
      - 2: Run batch Spark jobs (jar files)
      - Recommended for data preparation and ML



(*https://docs.microsoft.com*)

Azure Data Factory

- **Fully managed serverless** service to build complex data pipelines:
  - Extract-transform-load (ETL), extract-load-transform (ELT) and data integration
    - **90 built-in** connectors
    - Ingest data from:
      - **Big Data sources** like Amazon Redshift, Google BigQuery
      - **Enterprise data warehouses** like Oracle Exadata, Teradata
      - All Azure data services
  - **Build data flows** to transform data
    - Integrate with services like Azure HDInsight, Azure Databricks, Azure Synapse Analytics for data processing
  - Move SQL Server Integration Services (SSIS) packages to cloud
- CI/CD support with Azure Devops

Demo - Azure Data Factory and Synapse Analytics

In28 Minutes

- Create a Data Lake Storage Account Gen2
- Create a SQL Server Database
- Task: Extract data from SQL Server to CSV file

Azure Data Lake Storage (Gen2)

In28 Minutes

- Blob storage + Hierarchical directory structure
- Configure permissions(RBAC) at file and directory level
- Fully compatible with Hadoop Distributed File System (HDFS)
  - Apache Hadoop workloads can directly access data in Azure Data Lake Storage
- **Three main elements**:
  - **Data Lake Store**: Azure Data Factory, Azure Databricks, Azure HDInsight, Azure Data Lake Analytics, and Azure Stream Analytics can read directly
  - **Data Lake Analytics**: Run analytics jobs using U-SQL
  - **HDInsight**: Run Hadoop jobs

Data Lake Storage

Azure Data Factory - Components

- **Pipeline**: Logical group of activities that can be scheduled
  - You can chain activities in a pipeline
  - You can run activities sequentially or in parallel
  - A pipeline can execute other pipelines
- **Activity**: Represents a step in a pipeline (an action to be performed)
  - **Copy Activity**: Copy data from one store to another store
    - Example: Copy CSV from Blob Storage to a Table in SQL Database
  - **Three types** of activities: Data movement, Data transformation, Control activities
- **Data Flow**: Create and manage data transformation logic
  - Build reusable library of data transformation routines
  - Executes logic on a Spark cluster:
    - You don't need to manage the cluster (it is spun up and down automatically as needed)
- **Control flow**: Orchestrate pipeline activity based on output of another pipeline activity

Azure Data Factory - Components - 2

In28 Minutes

- **Linked Service**: Used to connect to an external source
  - Connect to different sources like Azure Storage Blob, SQL Databases etc
- **Dataset**: Representation of data structures within data stores
- **Integration Runtime**: Compute infrastructure used by Azure Data Factory allowing you to perform
- **Triggers**: Trigger pipeline at a specific times

Power BI

In 28 Minutes

- **Power BI**: Unify data and create BI reports & dashboards
  - Integrates with all Azure analytics services
    - Azure Synapse Analytics to Azure Data Lake Storage
  - **Power BI Components**
    - **Power BI Service**: Online SaaS (Software as a Service) service
      - Power BI online - app.powerbi.com
      - Create/share reports and dashboards
    - **Power BI Desktop**: Windows desktop application to create and share reports
      - More data sources, Complex modeling and transformations
    - **Power BI Report Builder**: Standalone tool to author paginated reports
    - **Power BI Mobile Apps**: Apps for Windows, iOS, and Android devices
  - **Typical Power BI Workflow**:
    - **1**: Create a report with Power BI Service/Desktop (or paginated report with Power BI Report Builder)
    - **2**: Share it to the Power BI service
    - **3**: View and interact with report (and create dashboards) using Power BI service
      - Reports can also be accessed from Power BI mobile

Power BI

Power BI Dashboard

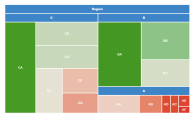
In 28 Minutes

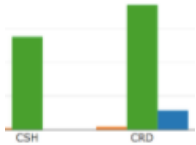
- **Workspace**: Container for dashboards, reports, workbooks & datasets
  - **Dataset**: Collection of data
    - Can be a file(Excel, CSV etc) or a database
      - Azure SQL Database, Azure Synapse Analytics, Azure HDInsight, ..
    - Each dataset can be used in multiple reports
  - **Report**: One or more pages of visualizations
    - Highly interactive and highly customizable
    - All data for a report comes from a single dataset
    - A report can be used in multiple dashboards
  - **Paginated Reports**: Create pixel perfect multi page reports for printing & archiving (PDF/Word)
    - Create in "Power BI Report Builder" and publish to use in Power BI service
  - **Dashboard**: Single page - visualizations from one or more reports
    - Technically a canvas with multiple tiles
    - Monitor the most important information at one glance and dig deeper, if needed
      - You can select a tile and go to a report page to dig deeper

Power BI

Visualization Options

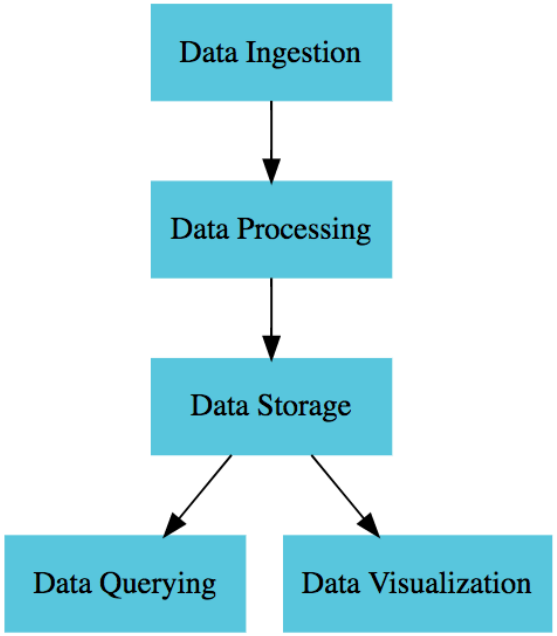
- **Bar and column charts**: Most basic of charts
- **Line Charts**: Emphasize shape of a series of values over time
- **Pie Charts**: Displays division of total into different categories
- **Matrix**: Summarize data in a tabular structure
- **Treemap**: Charts of colored rectangles
- **Scatter**: Shows relationship between two numerical values
  - **Bubble chart**: Replace data points with bubbles
    - Bubble size represents a 3rd dimension
- **Filled map**: Show on a Map
- **Cards**: Single number
- *Link: Reference for all visualization options in Power BI*





Data Analytics Work Flow - Data Ingestion

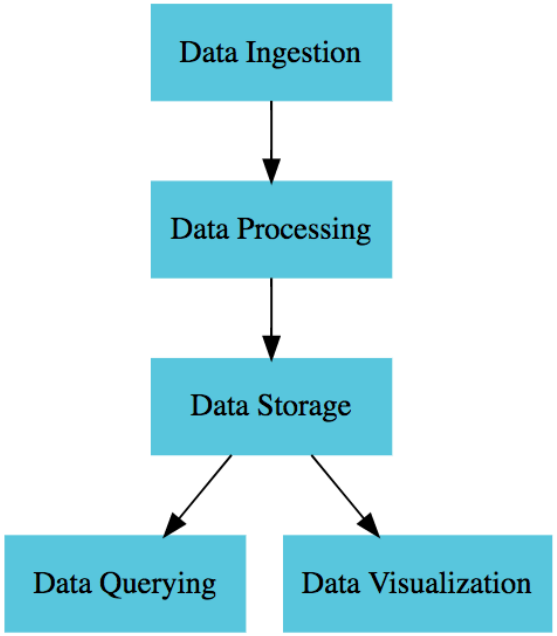
- **Data Ingestion**: Capture raw data
  - **Azure Data Factory**: data ingestion and transformation service
    - Ingest streaming and batch data
    - Data from on-premises and cloud
    - PolyBase: Run T-SQL queries on external data sources
      - PolyBase makes external data sources appear like tables
    - SQL Server Integration Services (SSIS): on-premises tool data integration and data transformation solution that is part of Microsoft SQL Server
      - Run existing SSIS packages as part of Azure Data Factory pipeline
  - **Spark**: Ingest streaming data
  - **IOT Hub**: Managed message hub for IoT devices
  - **Event Hub**: Big data streaming platform and event ingestion service



Data Analytics Work Flow - Data Processing and Storage

In 28 Minutes

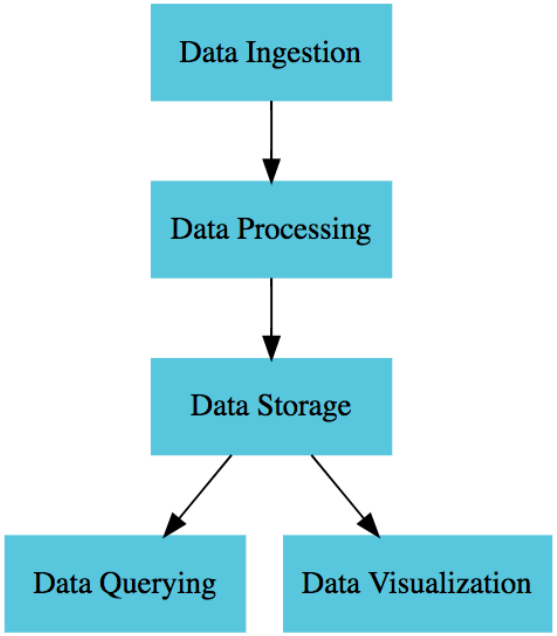
- **Data Processing and Storage:**
  - **Azure Data Lake Storage Gen2**: Data lake storage
  - **Azure Synapse Analytics**: Data processing can be done using:
    - 1: T-SQL - Query using SQL from databases, files, and Azure Data Lake storage
    - 2: Spark - Write and run Spark jobs using C#, Scala, Python, SQL etc
  - **Azure Databricks**: Process data from Azure Blob storage, Azure Data Lake Store, Hadoop storage, flat files, databases, and data warehouses
    - Handle streaming data
  - **Azure HDInsight**: Storage - Azure Data Lake storage
    - Analyze data using Hadoop Map/Reduce, Apache Spark, Apache Hive (SQL)
  - **Azure Data Factory**: Build pipelines and data-driven workflows
    - Ingest data from relational and non-relational systems



Data Analytics Work Flow - Querying and Visualization

In28 Minutes

- **Data Querying**: Run queries to analyze data
  - **Recommended Services**: Azure Synapse Analytics, Hive (SQL)
- **Data Visualization**: Create dashboards, charts and reports
  - **Recommended Services**: Power BI



Data Analytics - Scenarios

In28 Minutes

Scenario	Solution
Decide Data Analysis Category: You have generated a report showing current status vs planned	Descriptive analytics
Decide Data Analysis Category: Why did sales increase last month?	Diagnostic analytics
Decide Data Analysis Category: Semantic Analysis of Text (Analyze reviews)	Cognitive analytics
You want to move your Hadoop workloads to the cloud	Azure HDInsight
Stream or Batch: Processing after you received 10K records	Batch
You want to move SQL Server Integration Services (SSIS) packages to cloud	Use Azure Data Factory
Categorize activity: Copy data from one store to another store	Data movement

Data Analytics - Scenarios - 2

In28 Minutes

Scenario	Solution
Categorize activity: Orchestrate pipeline activity based on output of another pipeline activity	Control flow
You want to connect to an external source from Data Factory	Linked Service
Compute infrastructure used by Azure Data Factory	Integration Runtime
Standalone tool to author paginated reports	Power BI Report Builder
What is Online SaaS Power BI called?	Power BI Service
Which of these represents "One or more pages of visualizations in Power BI"?	Report
Which of these represents "Single page visualizations from one or more reports"?	Dashboard

Other Important Azure Concepts

Database Tools

In28 Minutes

Tool	Description
Azure Data Studio	Cross-platform (Windows, Mac, linux) db tool with Intellisense, code snippets and source control Run SQL queries. Save results in different formats - text, JSON, Excel Supports SQL Server, Azure SQL Database, Azure Synapse Analytics.. Notebooks: Create and share documents with text, images and SQL query results Support to create and restore backup from SQL Database
SQL Server Management Studio (SSMS)	Graphical tool for managing SQL Server and Azure Databases Query, design, and manage your databases and data warehouses Supports configuration, management and administration tasks Suitable for SQL Server, SQL Database, Azure Synapse Analytics
SQL Server Data Tools (SSDT)	Build SQL Server and Azure SQL relational databases, Analysis Services (AS) data models, Integration Services (IS) packages, and Reporting Services (RS) reports
sqlcmd	Run SQL scripts and procedures from command line Supports SQL Server, Azure SQL Database, Azure SQL MI, Azure Synapse Analytics

Roles

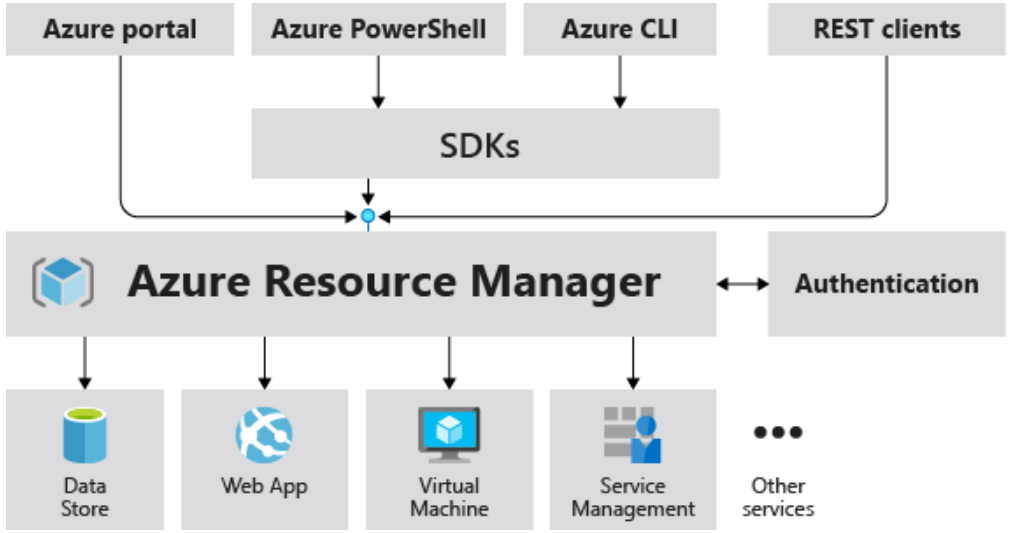
Role	Description
Database Administrator	**Role**: Install, upgrade, control (authorization, availability, durability, performance optimization, backups, disaster recovery, compliance with licensing) of data servers **Tools**: Azure Data Studio, SQL Server Management Studio (SSMS)
Data Engineers	**Responsible for** data architecture, data acquisition, data ingestion, data processing (transformation, cleansing and pipelines) and data storage (design, build and test) for analytical workloads Responsible for build, test, monitoring, performance optimization of data pipelines Responsible for improving data reliability, efficiency, and quality **Tools**: Azure Data Studio, Azure HDInsight, Azure Databricks, Azure Data Factory, Azure Cosmos DB, Azure Storage ... Programming Languages - HiveQL, R, or Python
Data Analyst	**Responsible for** getting intelligence from data through integration of data(from multiple sources), dashboards, reports, visualizations (charts, graphs, ..) and pattern identification (from huge volumes of data) **Tools**: Microsoft Excel, Power BI...

Pricing calculator

- **Estimate the costs for Azure services**
- Example Services that you can estimate costs for:
  - Virtual Machines
  - Storage Accounts
  - Azure SQL Database
  - Azure Cosmos DB
  - ...
- Ideal place to explore and learn important factors about different Azure services

Azure Resource Manager

In28 Minutes



(*https://docs.microsoft.com/*)

- Deployment and management service for Azure
- All actions to any resource in Azure **go through ARM**
  - Irrespective of where you are performing it from
    - Azure portal OR Powershell OR CLI or ARM template or ...

Azure Resource Manager (ARM) templates

In28 Minutes

- **Lets consider an example**:
  - I would want to create an Azure SQL Database
  - I would want to create an Azure Data Lake Storage Gen2
  - I would want to create an Azure Data Factory Workspace
- AND I would want to create 4 environments
  - Dev, QA, Stage and Production!
- **Azure Resource Manager (ARM) templates** can help you do all these with a simple (actually NOT so simple) script!

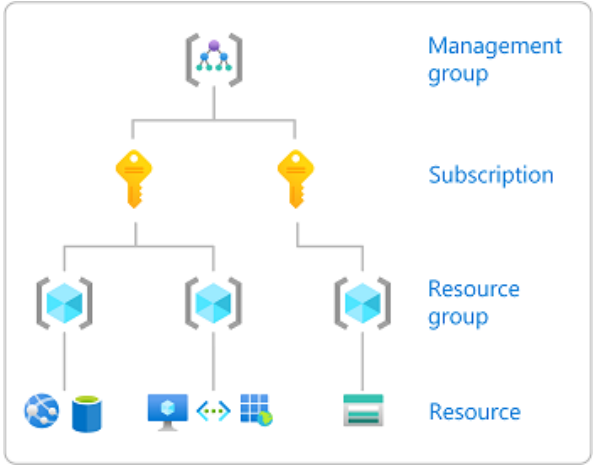
Azure Portal, PowerShell, CLI, Cloud Shell

In28 Minutes

Tool	Details
Azure Portal	Web-based user interface. Great to get started BUT NO automation possible. Runs in all modern desktop and tablet browsers
Azure PowerShell	Execute cmdlets (sequence of commands) and create scripts (PowerShell script) Recommended for teams familiar with Windows administration Cross-platform (Windows, Linux, and macOS)
Azure CLI	Similar to Azure PowerShell BUT uses a different syntax (Bash Scripts) Recommended for teams familiar with Linux administration (and Bash Scripts) Cross-platform (Windows, Linux, and macOS)
Azure Cloud Shell	Free Browser based interactive shell (Access from Azure Portal) Common Azure tools pre-installed and configured to use with your account Supports both PowerShell and CLI (bash) Runs in all modern desktop and tablet browsers

Azure Resource Hierarchy

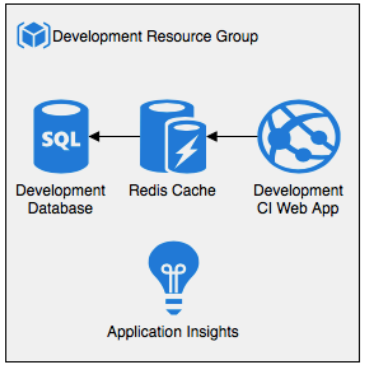
- **Hierarchy**: Management Group(s) > Subscription (s) > Resource Group (s) > Resources
  - **Resources**: VMs, Storage, Databases
  - **Resource groups**: Organize resources by grouping them into Resource groups
  - **Subscriptions**: Manage costs for resources provisioned for different teams or different projects or different business units
  - **Management groups**: Centralized management for access, policy, and compliance across multiple subscriptions
- **Remember**:
  - No hierarchy in resource groups BUT management groups can have a hierarchy

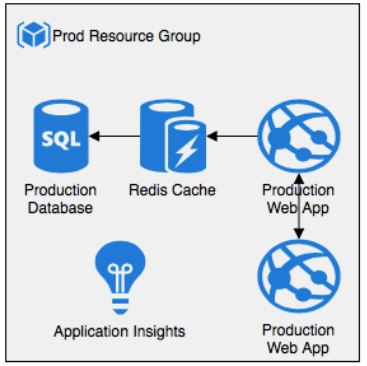


(*https://docs.microsoft.com/*)

Resource Groups

- **Resource Group**: Logical container for resources
  - Associated with a single subscription
  - Can have multiple resources
    - (REMEMBER) A resource can be associated with one and only one resource group
  - Can have resources from multiple regions
  - Deleting it deletes all resources under it
- Tags assigned to resource group are not automatically applied to resources
  - HOWEVER, Permissions/Roles assigned to user at the resource group level are inherited by all resources in the group
- Resource Groups (like Management Groups) are free





Subscriptions

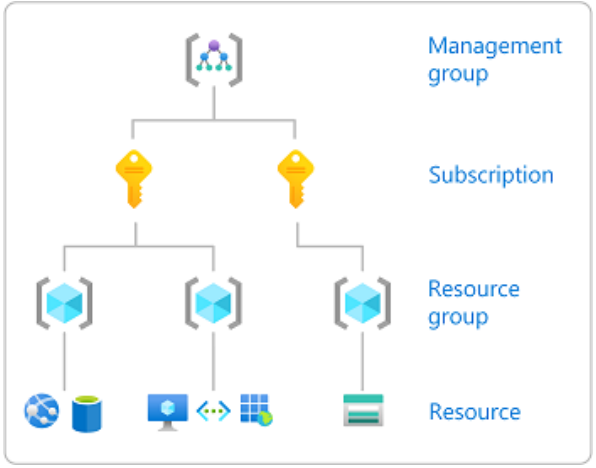
In28 Minutes

- You need a Subscription to create resources in Azure
  - Subscription links Azure Account to its resources
- An Azure Account can have multiple subscriptions and multiple account administrators
- **When do you create a new subscription?**
  - I want to manage different access-management policies for different environments:
    - Create different subscriptions for different environments
    - Manage distinct Azure subscription policies for each environment
  - I want to manage costs across different departments of an organization:
    - Create different subscriptions for different departments
    - Create separate billing reports and invoices for each subscription (or department) and manage costs
  - I'm exceeding the limits available per subscription
    - Example: VMs per subscription - 25,000 per region

Subscriptions

Management Groups

- Allows you to manage access, policies, and compliance across multiple subscriptions
  - Group subscriptions into **Management Groups**
  - All subscriptions & resources under a Management Group inherit all constraints applied to it
- (REMEMBER) You can create a hierarchy of management groups
- (REMEMBER) All subscriptions in a management group should be associated with the same Azure AD tenant



(*https://docs.microsoft.com/*)

Quick Review

Azure Storage - Quick Review

In28 Minutes

Service	Description
Azure Disk storage	Store disks attached to VMs.
Azure Blob storage	Store unstructured data - video files, database archives etc.
Azure File storage	Create file shares or file servers in the cloud
Azure Queue storage	Decouple applications using a queue (asynchronous communication)
Azure Table storage	Store structure data using NoSQL approach (NON-relational). Schemaless. Key/attribute store.

Azure Databases - Quick Review

In28 Minutes

Service	Description
SQL Server on Azure Virtual Machines	Provides full administrative control over the SQL Server instance and underlying OS for migration to Azure
Azure SQL Database	Fully Managed Service for Microsoft SQL Server. Recommended for cloud-born applications
Azure SQL managed instance	Full (Near 100%) SQL Server access and feature compatibility Recommended for migrating on-premise SQL Server databases Azure SQL managed instance ONLY features: Cross-database queries, Database Mail Support, SQL Server Agent etc.
Azure Database for MySQL	Fully managed MySQL database
Azure Database for PostgreSQL	Fully managed PostgreSQL database

Azure Databases - Quick Review - 2

In28 Minutes

Service	Description
Azure Cosmos DB	NoSQL database. Globally distributed. Core(SQL), MongoDB, Table, Gremlin and Cassandra APIs
Azure Cache for Redis	Managed service for Redis (high-throughput, low-latency data caching)
Azure Database Migration Service	Migrate databases to the cloud

Azure Analytics Services - Quick Review

In28 Minutes

Service	Description
Azure Data Lake Storage	Data lake built on Azure Blob Storage
Azure Databricks	Managed Apache Spark
Azure HDInsight	Managed Apache Hadoop
Azure Synapse Analytics	End-to-end analytics solutions Data integration + Enterprise data warehouse + Data analytics
Azure Data Factory	Data Integration. Fully managed serverless service to build complex data pipelines.
Power BI	Create visualization around data - reports & dashboards
Event Hubs	Receive telemetry from millions of devices

Get Ready

Certification Exam

- Certification **Home Page**
  - *https://docs.microsoft.com/en-gb/learn/certifications/exams/dp-900*
- Different Types of Multiple Choice Questions
  - **Type 1** : Single Answer - 2/3/4 options and 1 right answer
  - **Type 2** : Multiple Answer - 5 options and 2 right answers
- **No penalty** for wrong answers
  - Feel free to guess if you do not know the answer
- **40-60** questions and **65** minutes
- Result immediately shown after exam completion
- Email with detailed scores (a couple of days later)

Certification Exam - My Recommendations

In 28 Minutes

- Read the **entire question**
  - Identify the key parts of the question
- Read all answers at least once
- If you do NOT know the answer, **eliminate** wrong answers first
- **Mark questions for future consideration** and review them before final submission

You are all set!

Let's clap for you!

- You have a lot of patience! Congratulations
- You have put your **best foot forward** to get Microsoft Certification - DP-900: Microsoft Azure Data Fundamentals
- Make sure you prepare well and
- **Good Luck!**

Do Not Forget!

In 28 Minutes

- **Recommend** the course to your friends!
  - **Do not forget** to review!
- **Your Success = My Success**
  - Share your success story with me on LinkedIn (Ranga Karanam)
  - Share your success story and lessons learnt in Q&A with other learners!

Google Cloud

aws

What Next?

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DevOps

Java Full Stack

Java Microservices