Introduction to Data Science, Data Analytic and Big Data

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01 – Introduction to Data

02 – Data Science for Business

03 – Big Data Fundamentals

04 – Big Data Sources

05 – Introduction to Data Analytics

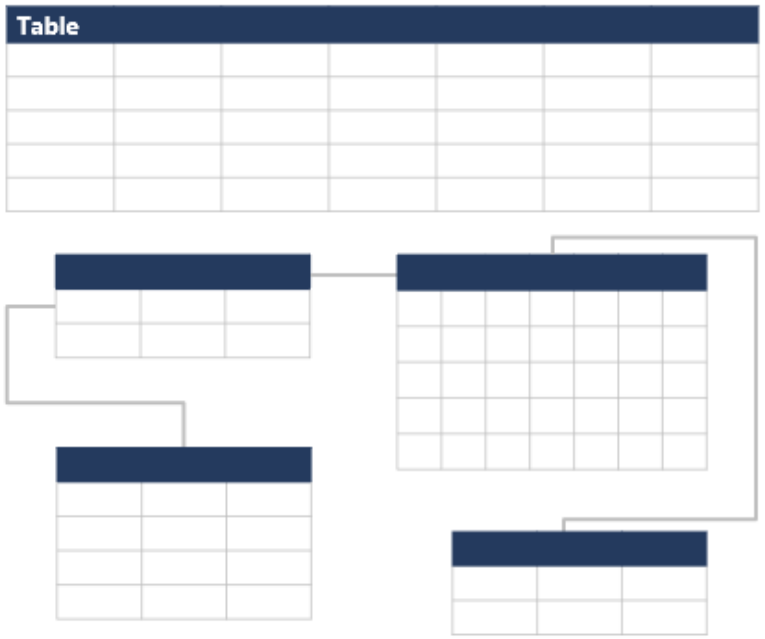
06 – Understanding Machine Learning

01 - Introduction to Data

Data is a collection of facts such as numbers, descriptions, and observations used in decision making.

What is data?

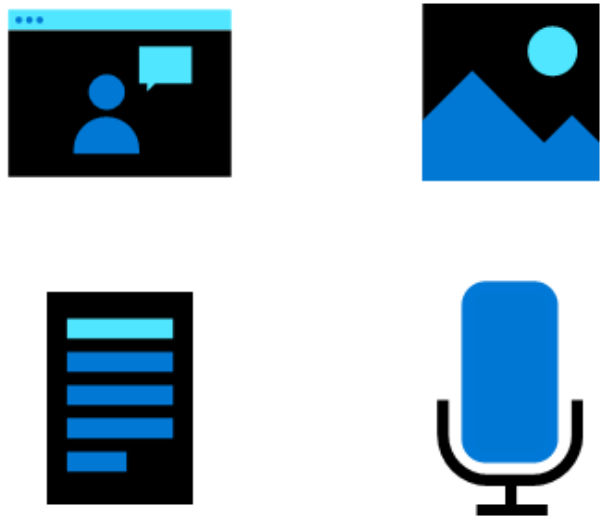
Structured



Semi-structured

```
## Document 1 ## {
"customerID": "103248",
"name": { "first": "AAA",
"last": "BBB" }, "address": {
"street": "Main Street",
"number": "101", "city":
"Acity", "state": "NY" },
"ccOnFile": "yes",
"firstOrder": "02/28/2003" }
## Document 2 ## {
"customerID": "103249",
"name": { "title": "Mr",
"forename": "AAA",
"lastname": "BBB" },
"address": { "street":
"Another Street", "number":
"202", "city": "Bcity",
"county": "Gloucestershire",
"country-region": "UK" },
"ccOnFile": "yes" }
```

Unstructured



Data Categories

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

- A transactional system is often what most people consider the primary function of business computing.
- **A transactional system records transactions.**
- A transaction could be financial, such as the movement of money between accounts in a banking system, or it might be part of a retail system, tracking payments for goods and services from customers.

What is a Transactional System?

Customer		
CustomerID	CustomerName	CustomerPhone

Account	
CustomerID	Balance
5558	1000
6023	1500

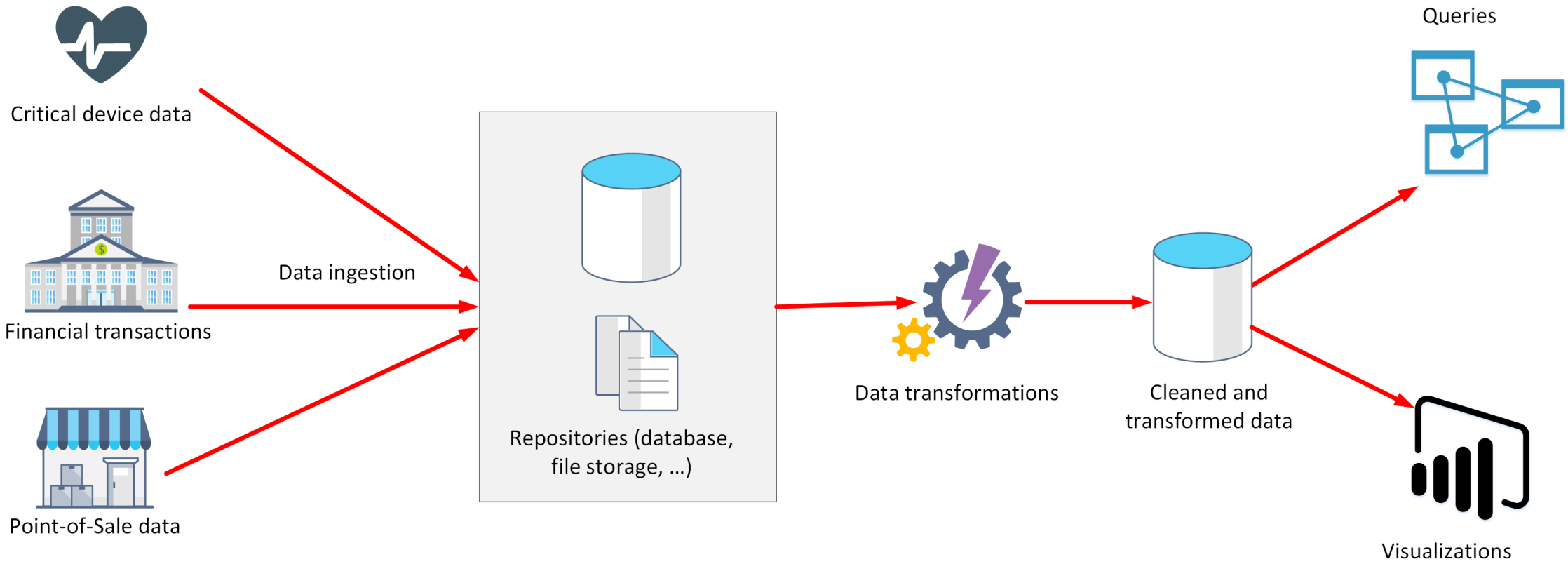
Orders		
OrderID	CustomerID	OrderDate

Transfers					
TransactionID	FromAccount	ToAccount	Transaction Amount	OrderDate	TransactionDescription
982801	6023	5558	500	DD/MM/YY	Transfer 500 from account 6023 to account

```
BEGIN TRANSACTION
UPDATE Account
SET Balance = Balance -500
WHERE CustomerID=6023;
UPDATE Account
SET Balance = Balance +500
WHERE CustomerID=5558;
INSERT INTO Transfers (Fromaccount, ToAccount, TransactionAmount,TransactionDescription)
VALUES (6023,5558,500,'Transfer 500 from account 6023 to account 5558)
COMMIT TRANSACTIONTransaction
```

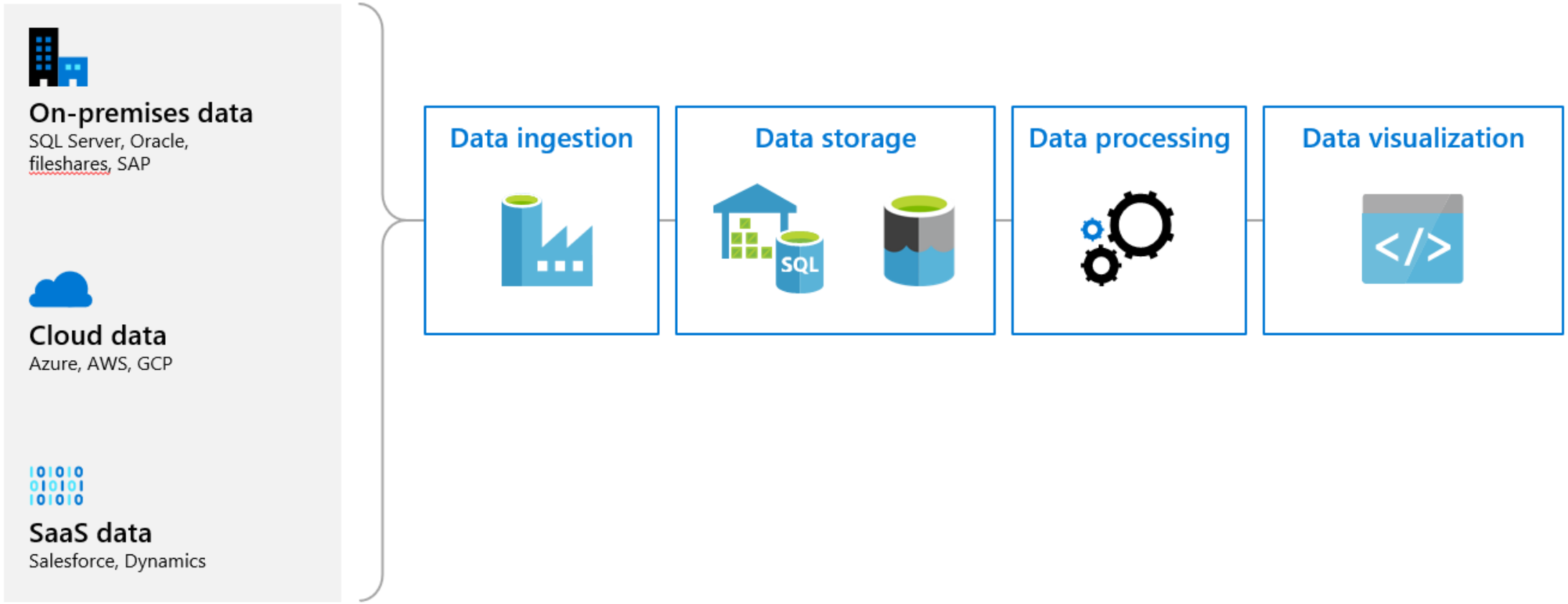
Transactional workloads

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]



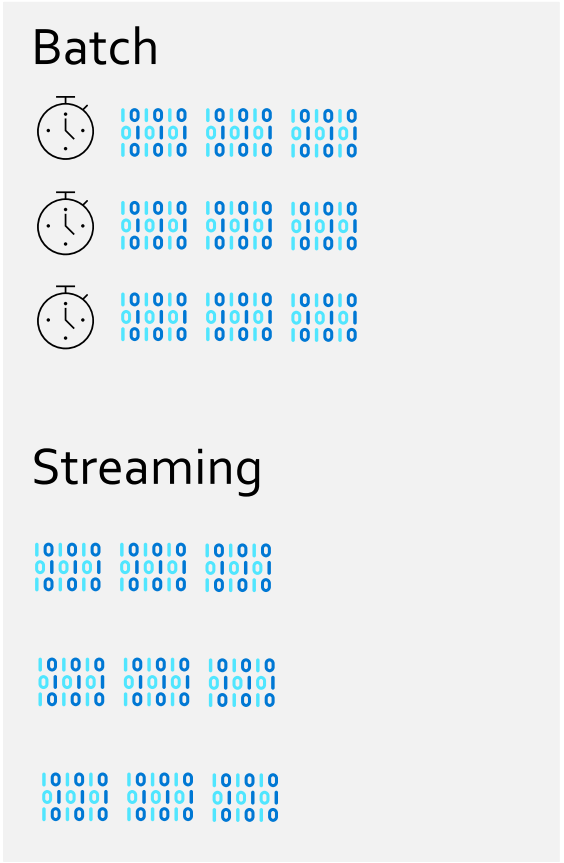
What is an Analytical System?

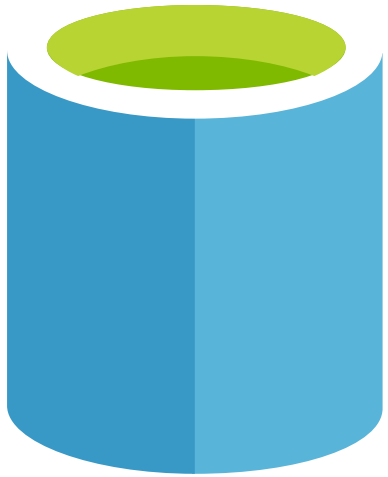
Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]



What is an Analytical System?

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]





Batch Data / Streaming Data

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

CustomerID	FirstName	LastName
1	Jay	Adams
2	Donna	Carreras
3	Linda	Burnett
4	Frances	Adams

CustomerID	AddressID
1	A
2	B
3	C
4	A

AddressID	LineNumber	Text
A	1	12
A	2	Park Street
A	3	Some City
B	1	The Big House
B	2	High Road
B	3	Another City
B	4	90210
C	1	Freepost
C	2	AAA 123

Relational Data

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

- All data is tabular. Entities are modeled as tables, each instance of an entity is a row in the table, and each property is defined as a column.
- All rows in the same table have the same set of columns.
- A table can contain any number of rows.

Characteristics of a Relational Database

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

- A primary key uniquely identifies each row in a table. No two rows can share the same primary key.

- A foreign key references rows in another, related table. For each value in the foreign key column, there should be a row with the same value in the corresponding primary key column in the other table.

Characteristics of a Relational Database

- SQL is a standard language for use with relational databases
- SQL standards are maintained by ANSI and ISO
- Proprietary RDBMS systems have their own extensions of SQL such as T-SQL, PL/SQL, pgSQL

Query - SQL

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

DML	DDL	DCL
Data Manipulation Language	Data Definition Language	Data Control Language
Used to query and manipulate data	Used to define database objects	Used to manage security permissions
SELECT, INSERT, UPDATE, DELETE	CREATE, ALTER, DROP	GRANT, REVOKE, DENY

Query - SQL

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

Statement	Description
SELECT	Select/read from a table
INSERT	Insert new rows in a table
UPDATE	Edit/Update existing rows in a table
DELETE	Delete existing rows in a table

Query - SQL

```sql
SELECT EmployeeId, YEAR(OrderDate) AS OrderYear
FROM Sales.Orders
WHERE CustomerId = 71
GROUP BY EmployeeId, YEAR(OrderDate)
HAVING COUNT(*) > 1
ORDER BY EmployeeId, OrderYear;
```

Query - SQL

Statement	Description
CREATE	Create a new object in the database, such as a table or a view
INSERT	Modify the structure of an object. For instance, altering a table to add a new column
UPDATE	Remove an object from the database
DELETE	Rename an existing object

Query - SQL

```
CREATE TABLE Mytable
(Mycolumn1 int NOT NULL PRIMARY KEY, Mycolumn2 VARCHAR(50) NOT
NULL , Mycolumn2 VARCHAR(10) NOT NULL)
```

Query - SQL

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

Customers		
CustomerID	CustomerName	CustomerPhone
100	Muisto Linna	*XXX-XXX-XXXX*
101	Noam Maoz	*XXX-XXX-XXXX*
102	Vanja Matkovic	*XXX-XXX-XXXX*
103	Qamar Mounir	*XXX-XXX-XXXX*
104	Zhenis Omar	*XXX-XXX-XXXX*
105	Claude Paulet	*XXX-XXX-XXXX*
106	Alex Pettersen	*XXX-XXX-XXXX*
107	Francis Ribeiro	*XXX-XXX-XXXX*

Tables

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

Customers		
CustomerID	CustomerName	CustomerPhone
100	Muisto Linna	*XXX-XXX-XXXX*
101	Noam Maoz	*XXX-XXX-XXXX*
102	Vanja Matkovic	*XXX-XXX-XXXX*
103	Qamar Mounir	*XXX-XXX-XXXX*
104	Zhenis Omar	*XXX-XXX-XXXX*
105	Claude Paulet	*XXX-XXX-XXXX*
106	Alex Pettersen	*XXX-XXX-XXXX*

Orders		
OrderID	CustomerName	CustomerPhone
AD100	Noa oz	*XXX-XXX-XXXX*
AD101	Noam	*XXX-XXX-XXXX*
AD102	Noam Ma	*XXX-XXX-XXXX*
AX103	Qamar M	*XXX-XXX-XXXX*
AS104	Qam unir	*XX-XXX-XXXX*
AR105	Claude Paulet	*XXX-XXX-XXXX*
MK106	Muisto Linna	*XXX-XXX-XXXX*

Data is normalized to:

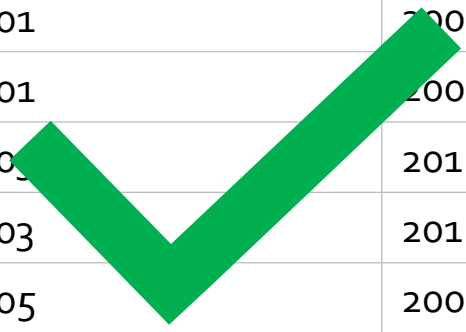
Reduce storage	Avoid data duplication	Improve data quality

Normalization

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

Customers		
CustomerID	CustomerName	CustomerPhone
100	Muisto Linna	*XXX-XXX-XXXX*
101	Noam Maoz	*XXX-XXX-XXXX*
102	Vanja Matkovic	*XXX-XXX-XXXX*
103	Qamar Mounir	*XXX-XXX-XXXX*
104	Zhenis Omar	*XXX-XXX-XXXX*
105	Claude Paulet	*XXX-XXX-XXXX*
106	Alex Pettersen	*XXX-XXX-XXXX*

Orders		
OrderID	CustomerID	SalesPersonID
AD100	101	*200*
AD101	101	200
AD102	101	200
AX103	10	201
AS104	103	201
AR105	105	200
MK106	105	201



In a normalized database schema:

- Primary Keys and Foreign keys are used to define relationships
- No data duplication exists (other than key values in 3rd Normal Form (3NF)
- Data is retrieved by joining tables together in a query

Relations

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

Customers		
CustomerID	CustomerName	CustomerPhone
100	Muisto Linna	*XXX-XXX-XXXX*
101	Noam Maoz	*XXX-XXX-XXXX*
102	Vanja Matkovic	*XXX-XXX-XXXX*
103	Qamar Mounir	*XXX-XXX-XXXX*
104	Zhenis Omar	*XXX-XXX-XXXX*
105	Claude Paulet	*XXX-XXX-XXXX*
106	Alex Pettersen	*XXX-XXX-XXXX*

IDX-CustomerRegion	
CustomerID	Region
100	France
101	Brazil
102	Croatia
103	Jordan
104	Spain
105	France
106	USA

An index:

Optimizes search queries for faster data retrieval	Reduces the amount of data pages that need to be read to retrieve the data in a SQL Statement	Data is retrieved by joining tables together in a query

Indexes

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

Customers		
CustomerID	CustomerName	CustomerPhone
100	Muisto Linna	*XXX-XXX-XXXX*
101	Noam Maoz	*XXX-XXX-XXXX*
102	Vanja Matkovic	*XXX-XXX-XXXX*
103	Qamar Mounir	*XXX-XXX-XXXX*
104	Zhenis Omar	*XXX-XXX-XXXX*
105	Claude Paulet	*XXX-XXX-XXXX*
106	Alex Pettersen	*XXX-XXX-XXXX*

Orders		
OrderID	CustomerID	SalesPersonID
AD100	101	*200*
AD101	101	200
AD102	101	200
AX103	103	201
AS104	103	201
AR105	105	200
MK106	105	201
DB205	100	205

```
Create the definition of a view:

CREATE VIEW vw_customerorders AS

SELECT Customers.CustomerID, Customers.CustomerName, Orders.OrderID FROM Customers JOIN Orders on Customers.CustomerID = Orders.CustomerID

Retrieve the orders placed by customer 102 using the view:

SELECT CustomerName, OrderID from vw_customerorders WHERE CustomerID=102
```

A view is a virtual table based on the result set of query:

Views are created to simplify the query

Combine relational data into a single pane view

View

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

Relational Database Management System - RDBMS

```
## Document for Jay Adams ##
{
  "customerID": "1",
  "name":
  {
    "firstname": "Jay",
    "lastname": "Adams"
  },
  "address":
  {
    "number": "12",
    "street": "Park Street",
    "city": "Some City",
  }
}
```

```
## Document for Frances Adams ##
{
  "customerID": "4",
  "name":
  {
    "firstname": "Francis",
    "lastname": "Adams"
  },
  "address":
  {
    "number": "12",
    "street": "Park Street",
    "city": "Some City",
  }
}
```

Non-Relational Data

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

```
## Customer 1 ID: 1
Name: Mark Hanson
Telephone: [ Home: 1-999-9999999, Business: 1-888-8888888, Cell: 1-777- 7777777 ]
Address: [ Home: 121 Main Street, Some City, NY, 10110,
           Business: 87 Big Building, Some City, NY, 10111 ]
## Customer 2 ID: 2
Title: Mr
Name: Jeff Hay
Telephone: [ Home: 0044-1999-333333, Mobile: 0044-17545-444444 ]
Address: [ UK: 86 High Street, Some Town, A County, GL8888, UK,
           US: 777 7th Street, Another City, CA, 90111 ]
```

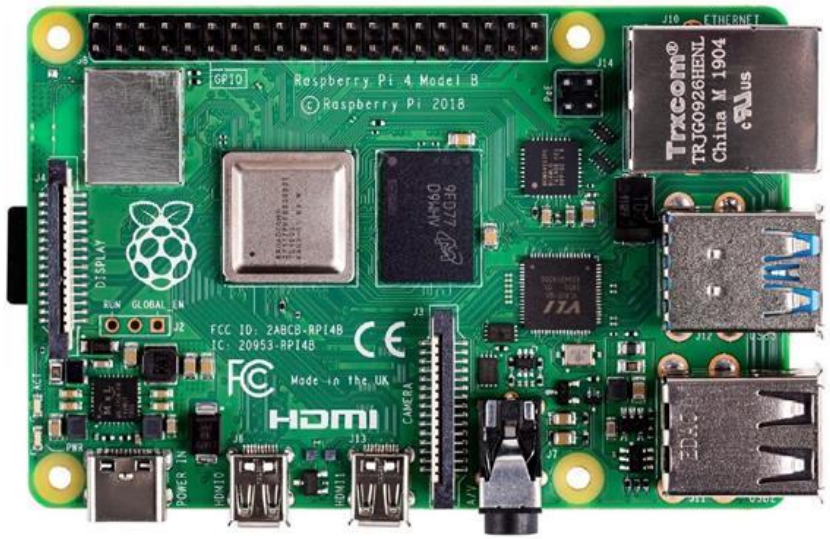
Non-relational collections can have:

Multiple entities in the same collection or container with different fields	Have a different, non-tabular schema	Are often defined by labeling each field with the name it represents

Non-Relational Data

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

- IoT and Telematics
- Retail and Marketing
- Gaming
- Web and Mobile



Identify non-relational database use cases

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

{"latitude":37.8267,"longitude":-122.4233,"timezone":"America/Los_Angeles","currently":{"time":1598191217,"summary":"Partly Cloudy","icon":"partly-cloudy-
day","nearestStormDistance":5,"nearestStormBearing":58,"precipIntensity":0,"precipProbability":0,"temperature":58.63,"apparentTemperature":58.63,"dew
Point":52.42,"humidity":0.8,"pressure":1011.8,"windSpeed":5.08,"windGust":7.73,"windBearing":210,"cloudCover":0.54,"uvIndex":0,"visibility":9.933,"oz
one":291.2},"minutely":{"summary":"Partly cloudy for the hour.","icon":"partly-cloudy-day","data":
[{"time":1598191200,"precipIntensity":0,"precipProbability":0},{"time":1598191260,"precipIntensity":0,"precipProbability":0},
{"time":1598191320,"precipIntensity":0,"precipProbability":0},{"time":1598191380,"precipIntensity":0,"precipProbability":0},
{"time":1598191440,"precipIntensity":0,"precipProbability":0},{"time":1598191500,"precipIntensity":0,"precipProbability":0},
{"time":1598191560,"precipIntensity":0,"precipProbability":0},{"time":1598191620,"precipIntensity":0,"precipProbability":0},
{"time":1598191680,"precipIntensity":0,"precipProbability":0},{"time":1598191740,"precipIntensity":0,"precipProbability":0},
{"time":1598191800,"precipIntensity":0,"precipProbability":0},{"time":1598191860,"precipIntensity":0,"precipProbability":0},
{"time":1598191920,"precipIntensity":0,"precipProbability":0},{"time":1598191980,"precipIntensity":0,"precipProbability":0},
{"time":1598192040,"precipIntensity":0,"precipProbability":0},{"time":1598192100,"precipIntensity":0,"precipProbability":0},
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{"time":1598192280,"precipIntensity":0,"precipProbability":0},{"time":1598192340,"precipIntensity":0,"precipProbability":0},
{"time":1598192400,"precipIntensity":0.0026,"precipIntensityError":0.0004,"precipProbability":0.01,"precipType":"rain"},
{"time":1598192460,"precipIntensity":0.0026,"precipIntensityError":0.0005,"precipProbability":0.01,"precipType":"rain"},
{"time":1598192520,"precipIntensity":0,"precipProbability":0},
{"time":1598192580,"precipIntensity":0.0026,"precipIntensityError":0.0005,"precipProbability":0.01,"precipType":"rain"},
{"time":1598192640,"precipIntensity":0.0026,"precipIntensityError":0.0005,"precipProbability":0.01,"precipType":"rain"},
{"time":1598192700,"precipIntensity":0.0027,"precipIntensityError":0.0005,"precipProbability":0.01,"precipType":"rain"},
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{"time":1598192820,"precipIntensity":0.0026,"precipIntensityError":0.0005,"precipProbability":0.02,"precipType":"rain"},
{"time":1598192880,"precipIntensity":0,"precipProbability":0},

Non-Relational Database use case

https://api.darksky.net/

Open API :] สำหรับนักพัฒนา

แสดงค่าประจำวัน :
//covid19.th-stat.com/api/open/today

ข้อมูลสรุปตามช่วงเวลา (เริ่มตั้งแต่วันที่ 01/01/20) :
//covid19.th-stat.com/api/open/timeline

ข้อมูลแต่ละเคส :
//covid19.th-stat.com/api/open/cases

ข้อมูลสรุปจากเคส :
//covid19.th-stat.com/api/open/cases/sum

แจ้งเตือนพื้นที่ตามคำประกาศ :
//covid19.th-stat.com/api/open/area

กรมควบคุมโรค
DEPARTMENT OF DISEASE CONTROL

Non-Relational Database use case

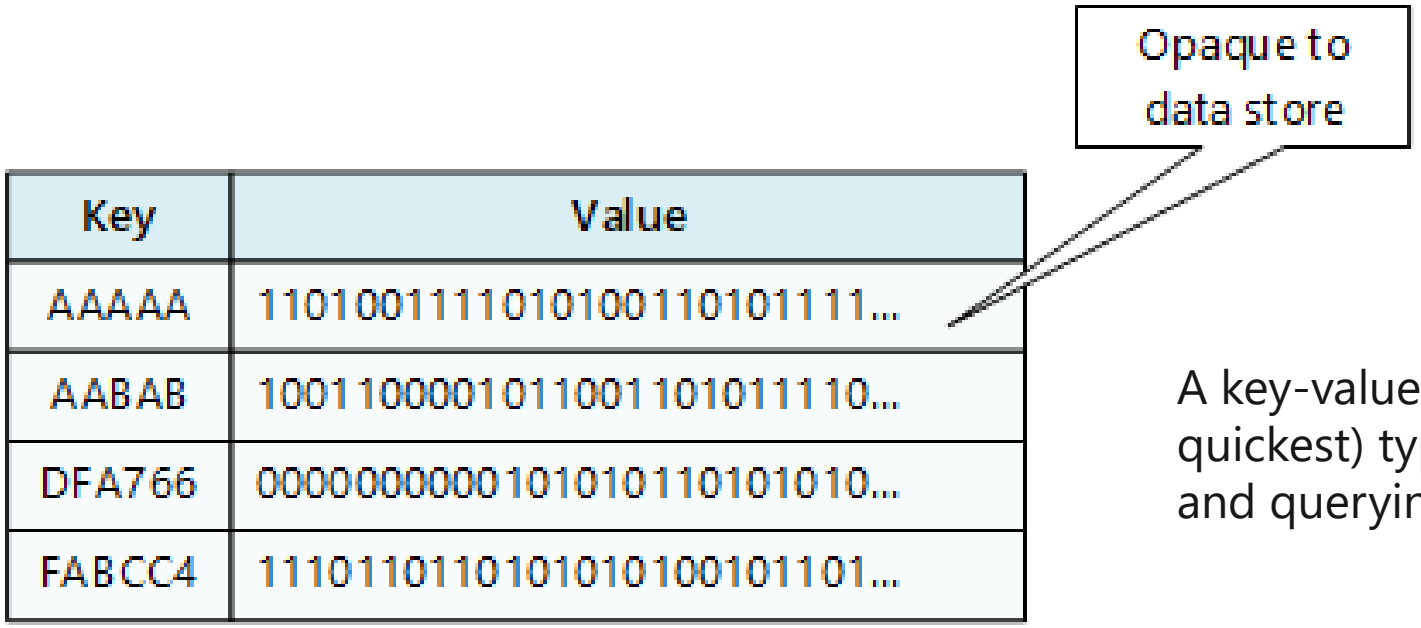
	Schema	Data relationships	Examples
Structured data	Adheres to a schema, with the same data fields or properties.	Storable in relational database tables, with rows and columns.	Sensor data and financial data.
Semi-structured data	Has an ad hoc schema with less organized fields and properties.	Non-relational or NoSQL data, not storable in tables, rows and column.	Books, blogs, JSON, HTML documents.
Unstructured data	Has no designated schema or data structure.	Non-relational or blob data, with no restrictions on the kinds of data blobs contain.	PDFs, JPGs, videos.

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

- You might see the term *NoSQL* when reading about non-relational databases.
- NoSQL is a rather loose term that simply means non-relational.
- NoSQL (non-relational) databases generally fall into four categories:

    - key-value stores
    - document databases
    - column family databases
    - graph databases.

What is NoSQL?



A key-value store is the simplest (and often quickest) type of NoSQL database for inserting and querying data.

Key-Value Stores

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

Key	Document
1001	{ "CustomerID": 99, "OrderItems": [{ "ProductID": 2010, "Quantity": 2, "Cost": 520 }, { "ProductID": 4365, "Quantity": 1, "Cost": 18 }], "OrderDate": "04/01/2017" }
1002	{ "CustomerID": 220, "OrderItems": [{ "ProductID": 1285, "Quantity": 1, "Cost": 120 }], "OrderDate": "05/08/2017" }

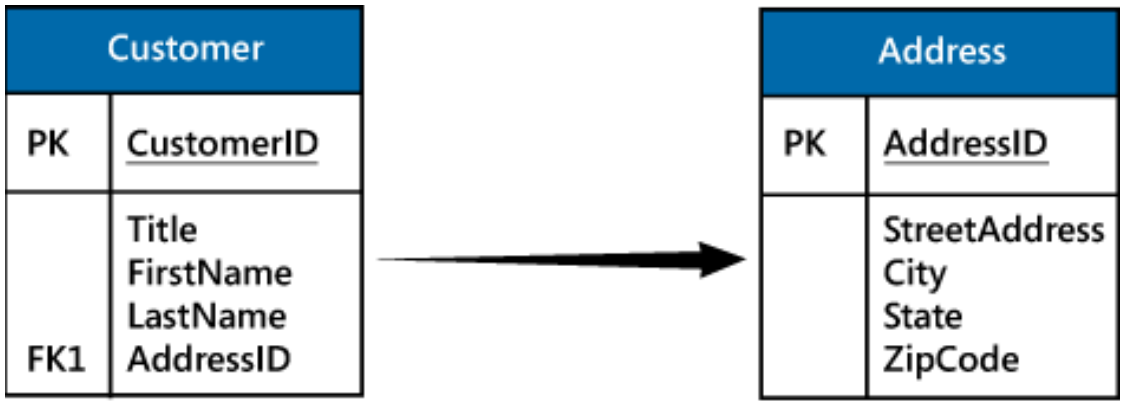
A document database represents the opposite end of the NoSQL spectrum from a key-value store. In a document database, each document has a unique ID, but the fields in the documents are transparent to the database management system. Document databases typically store data in JSON format,

Document Databases

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

RDBMS	MongoDB
Database	Database
Table	Collection
Tuple/Row	Document
column	Field
Table Join	Embedded Documents
Primary Key	Primary Key (Default key _id provided by mongodb itself)

Document Database



RDBMS is Row-based oriented

Customer Table

CustomerID	Title	FirstName	LastName	AddressID
1	Mr	Mark	Hanson	500
2	Ms	Lisa	Andrews	501
3	Mr	Walter	Harp	500

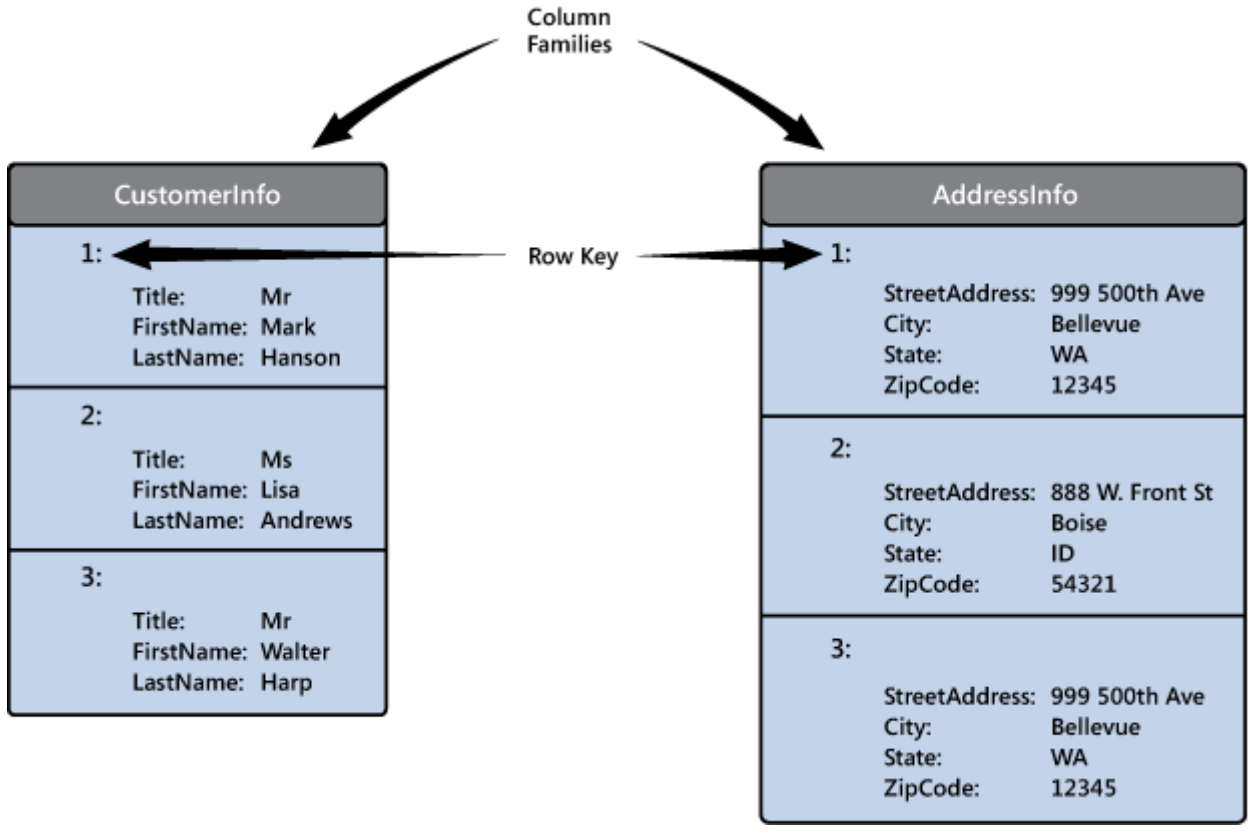
Address Table

AddressID	StreetAddress	City	State	ZipCode
500	999 500th Ave	Bellevue	WA	12345
501	888 W. Front St	Boise	ID	54321

Column Family Databases

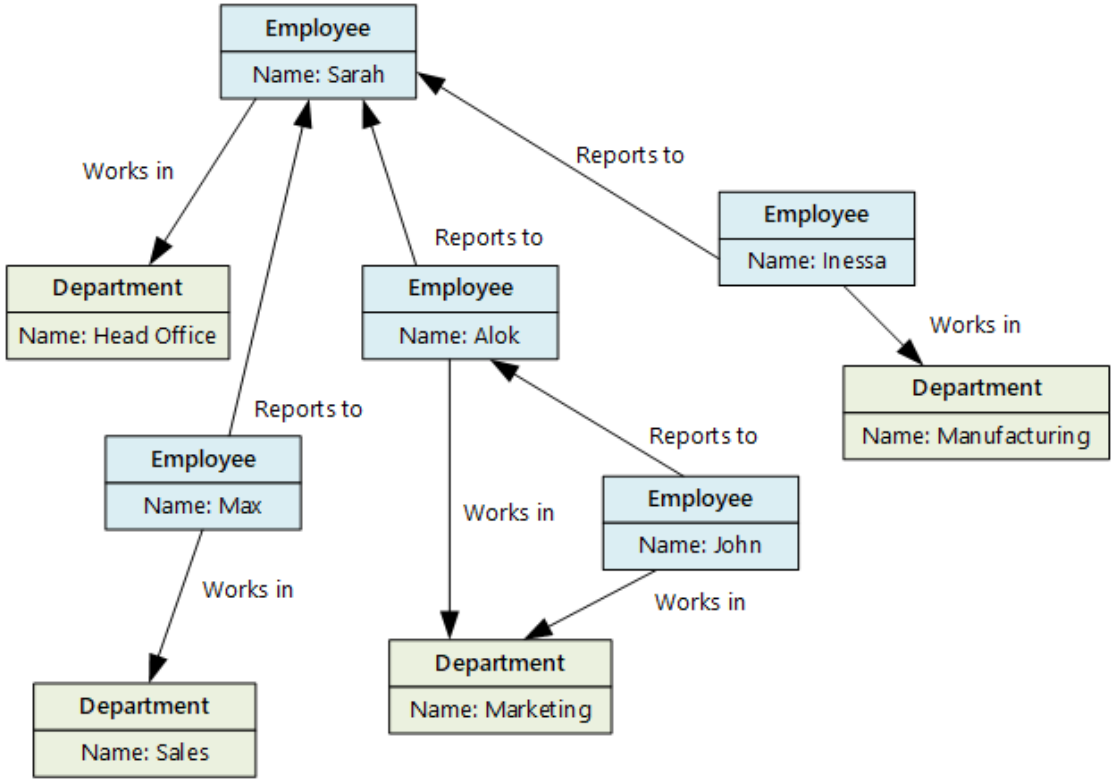
Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

Row Key	Column Families	
CustomerID	CustomerInfo	AddressInfo
1	CustomerInfo:Title Mr CustomerInfo:FirstName Mark CustomerInfo:LastName Hanson	AddressInfo:StreetAddress 999 500th Ave AddressInfo:City Bellevue AddressInfo:State WA AddressInfo:ZipCode 12345
2	CustomerInfo:Title Ms CustomerInfo:FirstName Lisa CustomerInfo:LastName Andrews	AddressInfo:StreetAddress 888 W. Front St AddressInfo:City Boise AddressInfo:State ID AddressInfo:ZipCode 54321
3	CustomerInfo:Title Mr CustomerInfo:FirstName Walter CustomerInfo:LastName Harp	AddressInfo:StreetAddress 999 500th Ave AddressInfo:City Bellevue AddressInfo:State WA AddressInfo:ZipCode 12345



Column Family Databases

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

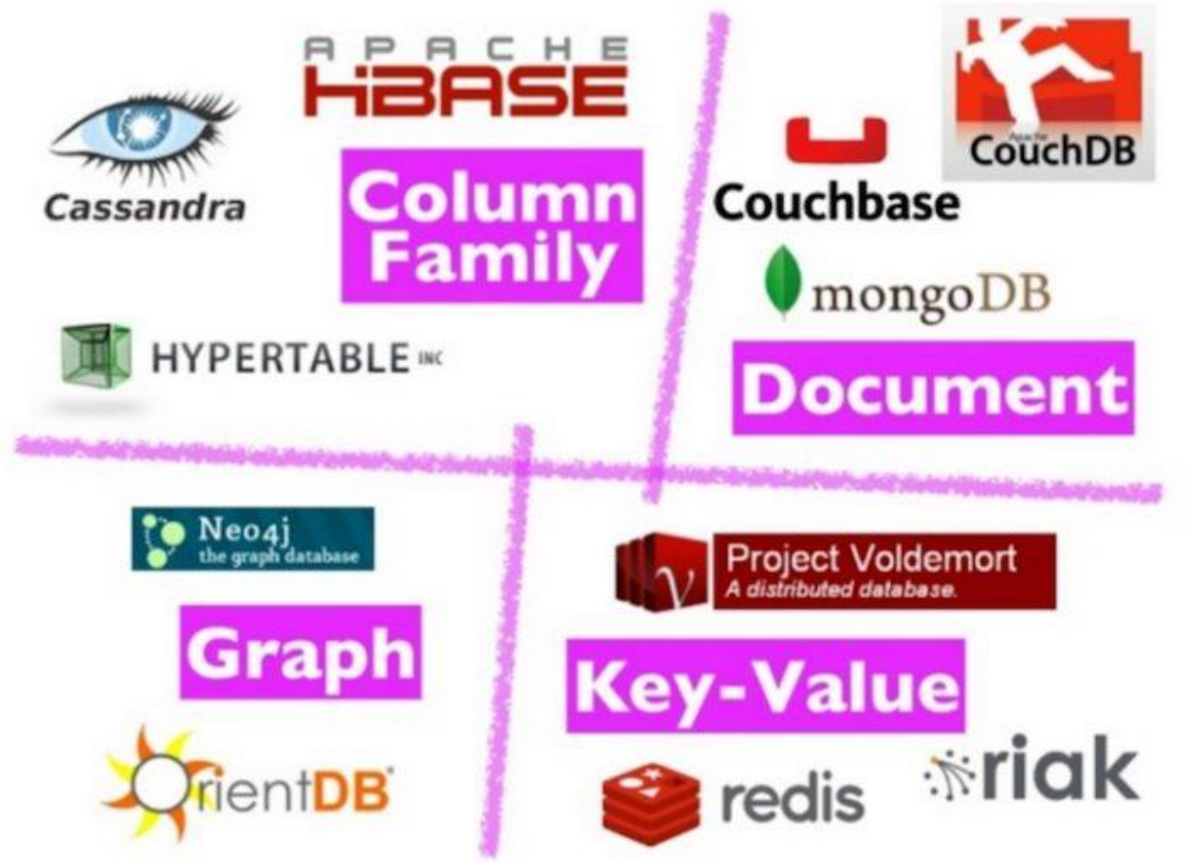


Graph databases enable you to store entities, but the main focus is on the relationships that these entities have with each other.

A graph database stores two types of information: nodes that you can think of as instances of entities, and edges, which specify the relationships between nodes.

Graph Databases

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]



No-SQL Tools

Content Reference : www.somkiat.cc

Roles in Data

Database Administrator	Data Engineer	Data Analyst
Database Management	Data Pipelines and processes	Provides insights into the data
Implements Data Security	Data Ingestion storage	Visual Reporting
Backups	Prepare data for Analytics	Modeling Data for Analysis
User Access	Prepare data for analytical processing	Combines data for visualization and analysis
Monitors performance		

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

Roles in Data

Content Reference : http://insidebigdata.com/

- Installing and upgrading the database server and application tools.
- Allocating system storage and planning storage requirements for the database system.
- Modifying the database structure, as necessary, from information given by application developers.
- Enrolling users and maintaining system security.

Database Administrator tasks and responsibilities

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

- Ensuring compliance with database vendor license agreement.
- Controlling and monitoring user access to the database.
- Monitoring and optimizing the performance of the database.
- Planning for backup and recovery of database information.
- Maintaining archived data.

Database Administrator tasks and responsibilities

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

- Backing up and restoring databases.
- Contacting database vendor for technical support.
- Generating various reports by querying from database as per need.
- Managing and monitoring data replication.
- Acting as liaison with users.

Database Administrator tasks and responsibilities

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

- Developing, constructing, testing, and maintaining databases and data structures.
- Aligning the data architecture with business requirements.
- Data acquisition.
- Developing processes for creating and retrieving information from data sets.
- Using programming languages and tools to examine the data.

Data Engineer tasks and responsibilities

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

- Identifying ways to improve data reliability, efficiency, and quality.
- Conducting research for industry and business questions.
- Deploying sophisticated analytics programs, machine learning, and statistical methods.
- Preparing data for predictive and prescriptive modeling.
- Using data to discover tasks that can be automated.

Data Engineer tasks and responsibilities

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

- Making large or complex data more accessible, understandable, and usable.
- Creating charts and graphs, histograms, geographical maps, and other visual models that help to explain the meaning of large volumes of data, and isolate areas of interest.
- Transforming, improving, and integrating data from many sources, depending on the business requirements.

Data Analyst tasks and responsibilities

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

- Combining the data result sets across multiple sources. For example, combining sales data and weather data provides a useful insight into how weather influenced sales of certain products such as ice creams.

- Finding hidden patterns using data.

- Delivering information in a useful and appealing way to users by creating rich graphical dashboards and reports.

Data Analyst tasks and responsibilities

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

Retail Analysis Sample

Ask a question about your data

Total Stores
NEW & EXISTING STORES

104

This Year's Sales
NEW & EXISTING STORES

$22M

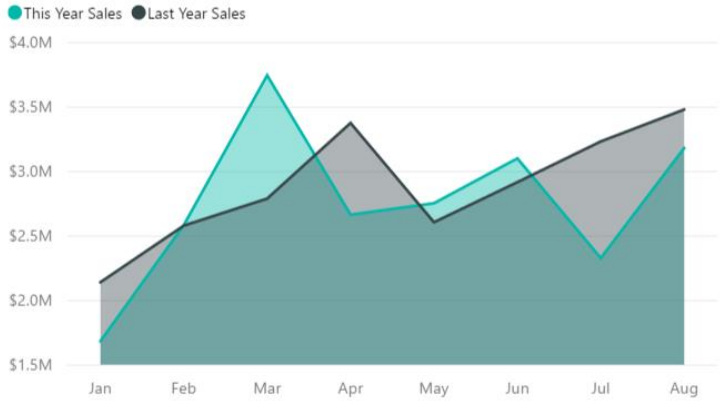
This Year's Sales
BY CHAIN

New Stores, New Stores Target
YEAR TO DATE

This Year's Sales
NEW STORES ONLY

$2M

This Year's Sales, Last Year's Sales
BY FISCAL MONTH



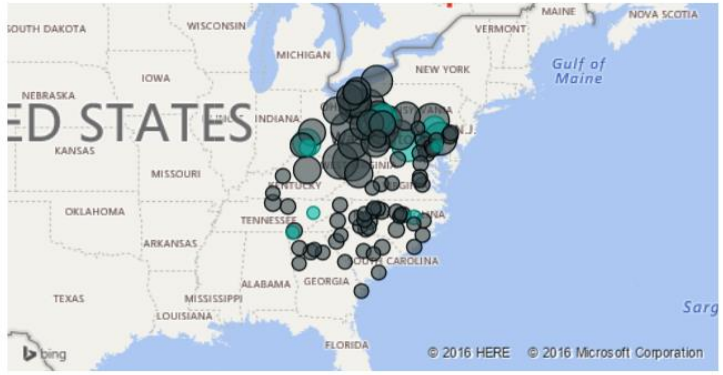
Total Sales Variance %, Sales Per Sq Ft, This Year's Sales
BY DISTRICT

New Stores
NEW STORES ONLY

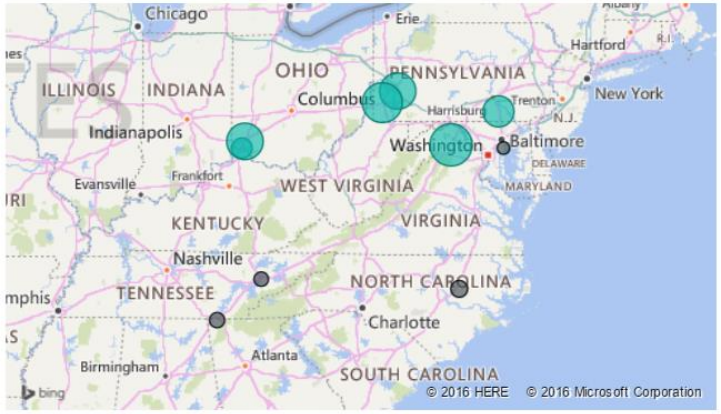
10

Stores Opened This Year
BY OPEN MONTH, CHAIN

This Year's Sales
BY POSTAL CODE, STORE TYPE



This Year's Sales
BY CITY, CHAIN

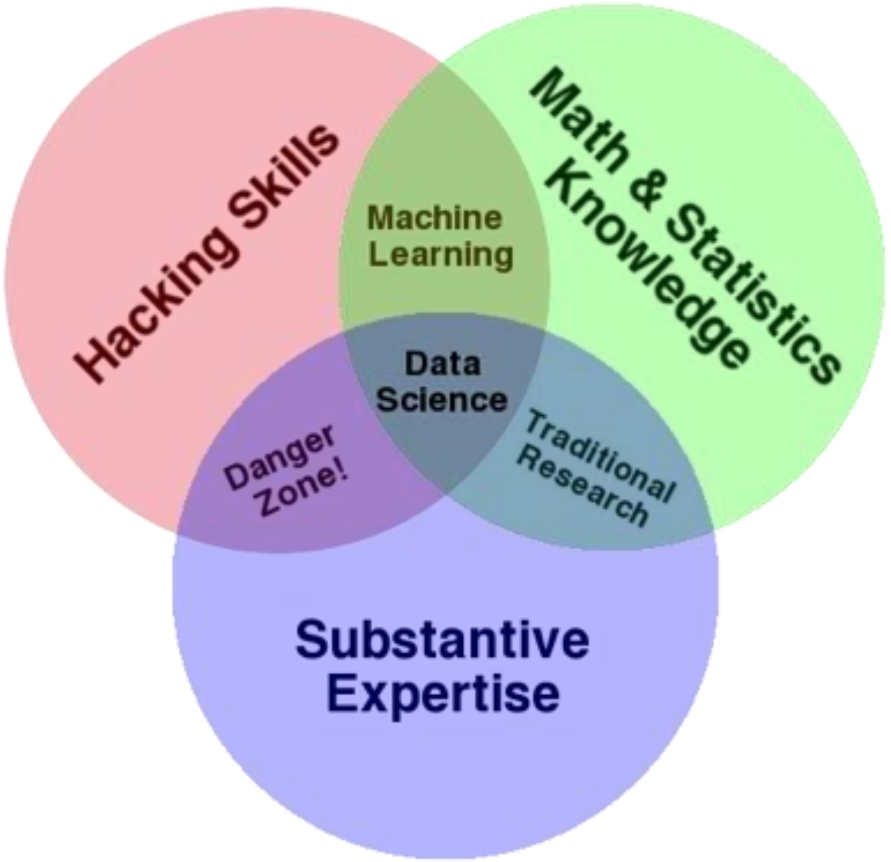


Sales Per Sq Ft
BY NAME

02 - Data Science for Business

- Data Science aims to derive **knowledge** from **big data, efficiently** and **intelligently.**
- Data Science encompasses the **set of activity, tools, and methods** that enable **data-driven activities** in science, business, medicine, and government.
- Data science is a multidisciplinary blend of **data inference, algorithm development, and technology** in order to solve analytically complex problems.

What is Data Science?



Data Science Venn Diagram (Drew Conway)

Content Reference : http://drewconway.com/zia/2013/3/26/the-data-science-venn-diagram

Element	Databases	Data Science
Data Value	Precious	Cheap
Data Volume	Modest	Massive
Example	Bank records, Census Information, Medical records, ...	Online clicks, GPS logs, Social Media (Facebook, Tweets), ...
Priorities	Consistency, Error Recovery, Auditability	Speed, Availability, Query richness
Structured	Strongly (Schema)	Weakly or None (Text)

Data Science vs. Database

Content Reference : Veerasak Kritsanapraphan [Software Park Thailand]

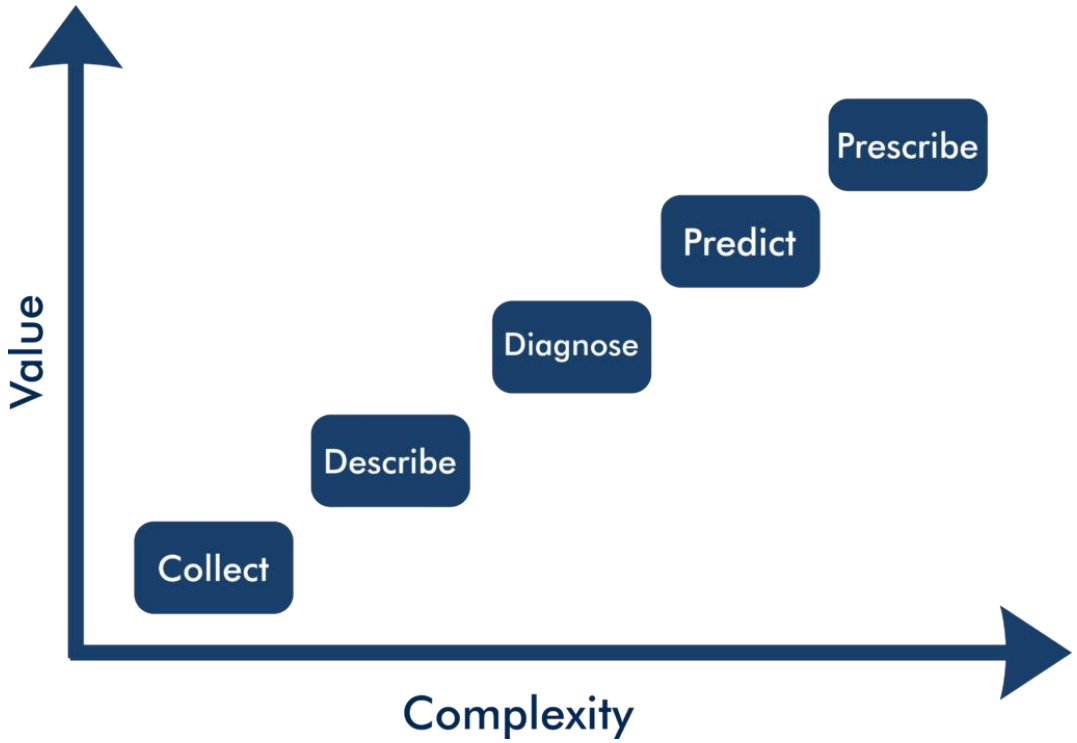
Element	Databases	Data Science
Properties	Transactions, Atomicity, Consistency, Isolation, Durability	Consistency, Availability, Partition Tolerance, theorem (2/3), eventual consistency
Realizations	SQL (Oracle, SQL Server, MariaDB, …)	NoSQL (MongoDB, Apache Hbase, …)
Query	Querying the past	Querying the future

Data Science vs. Database

Content Reference : Veerasak Kritsanapraphan [Software Park Thailand]

- Cloud Computing
- Big Data
- Machine Learning
- Statistics and Probability
- Programming Language (R, Python)

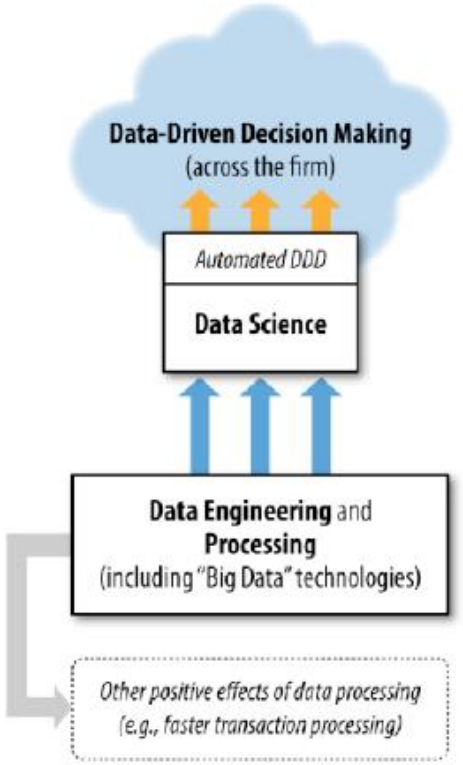
Basic Components of Data Science

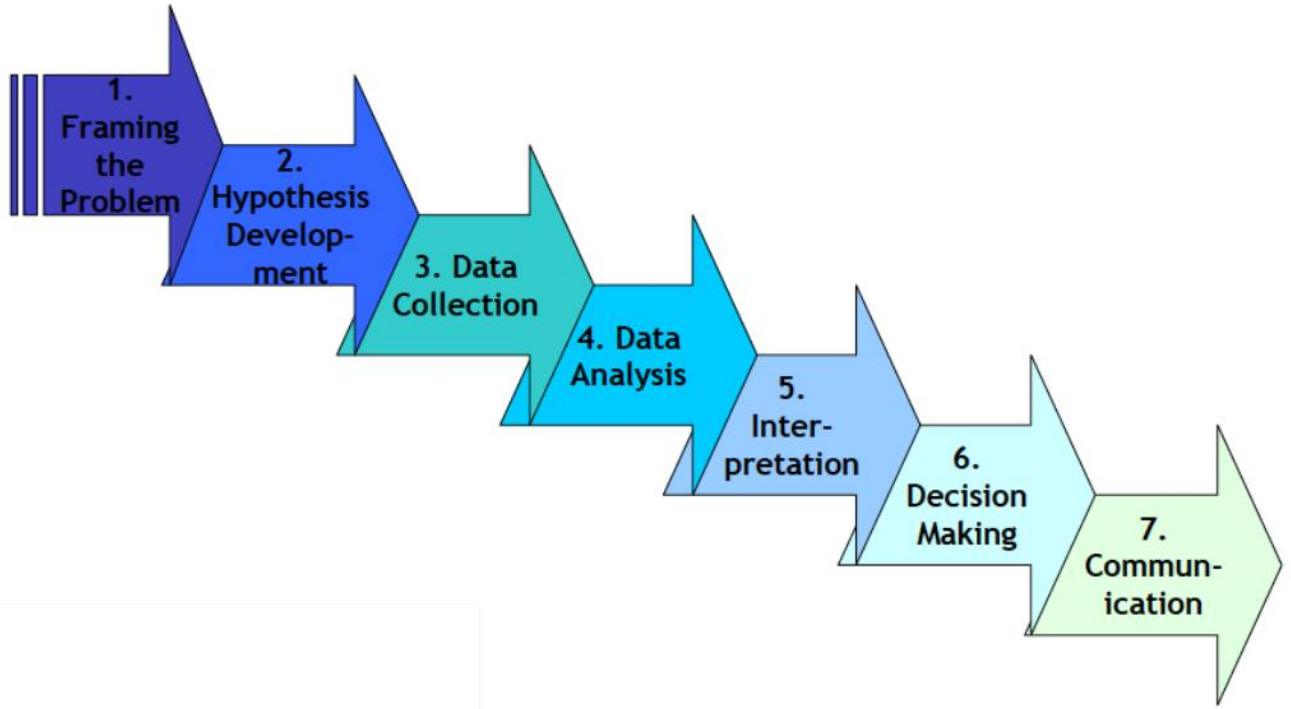


- Describing the data is the first step in extracting value.
- Descriptive statistics are the core of most business reporting and are an essential first step in analysing the data.
- Diagnostics or analysis is the core activity of most professions.
- Predictive analysis seems to be the holy grail for many managers.
- Prescriptive analysis uses the knowledge created in the previous phases to automatically run a business process and even decide on future courses of action.

Strategic Data Science

Content Reference : https://lucidmanager.org/data-science/strategic-data-science/ [Peter Prevos]





Data-Driven Decision Making Process

Content Reference : Veerasak Kritsanapraphan [Software Park Thailand]

- Guard against your biases
- Define objectives
- Gather data now
- Find the unresolved questions
- Find the data needed to solve these questions

Data-Driven Decision Making Guide

Content Reference : data cafe

- Analyze and understand
- Don’t be afraid to revisit and reevaluate
- Present the data in a meaningful way
- Set measurable goals for decision making
- Continue to evolve your data driven business decisions

data cafe
Company Limited

Data-Driven Decision Making Guide

Content Reference : data cafe

- Curiosity
- Creativity
- Focus
- Attention to Detail

Characteristics of Data Scientist

- Finding rich data sources.
- Working with large volumes of data despite hardware, software, and bandwidth constraints.
- Cleaning the data and making sure that data is consistent.
- Melding multiple datasets together.
- Visualizing that data.

Data Scientist

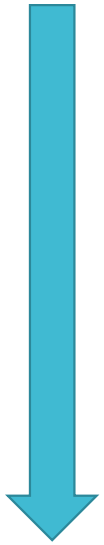
Content Reference : Veerasak Kritsanapraphan [Software Park Thailand]

- Business User
- Project Sponsor
- Project Manager
- BI Analyst
- Database Administrator
- Data Engineer
- Data Scientist

Data Science Team

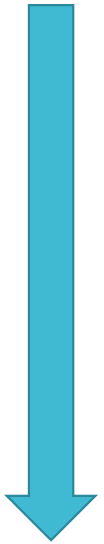
- Transforming
- Creating
- As a Service
- Crowdsourcing

Approaches to Developing Data Science Capabilities



- Problem Identification
- Business Understanding
- Data Acquisition - ETL
- Data Understanding - EDA

- Feature Engineering
- Model Training/Validation
- Model Deployment
- Model Monitoring



Data Science Life Cycles

- Frame the Business Problem
- Previous know outcome from reliable and different source and industry experts
- Figure out whether cost of Failure does create reputation damage
- Facilitate Experimentation with Automation
- Decide where you need to scale

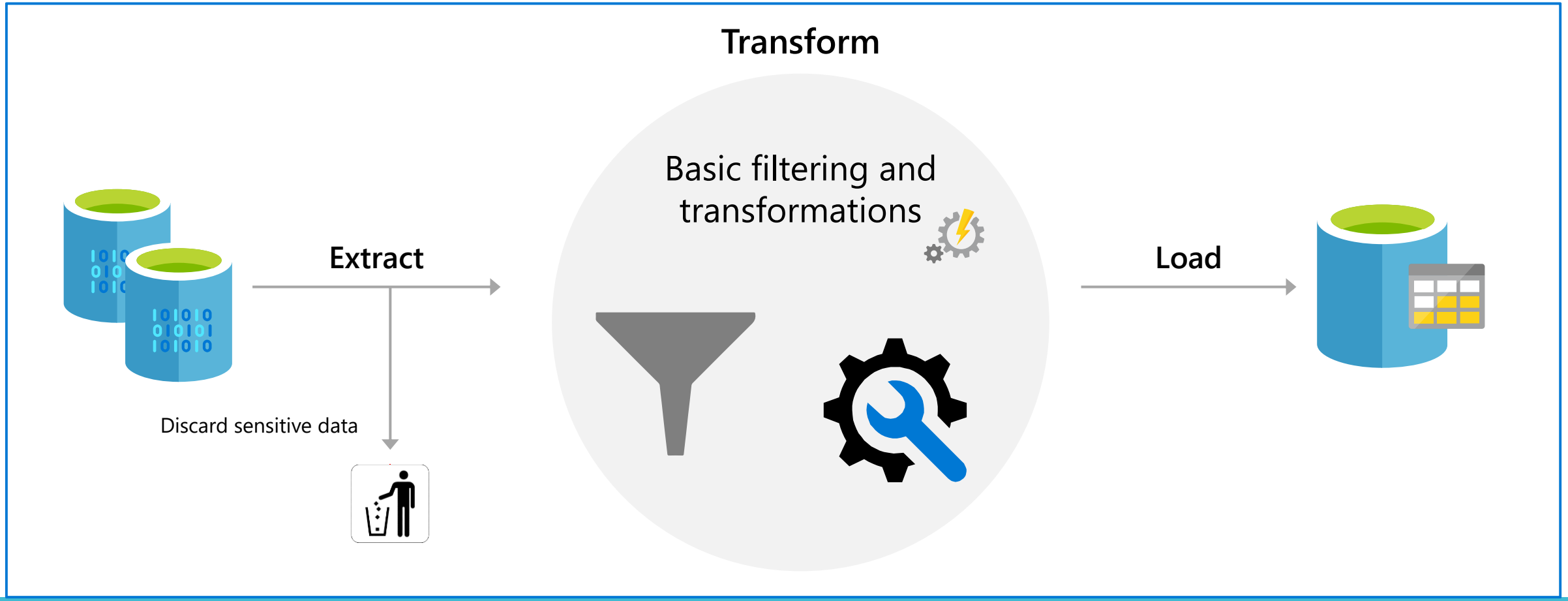
Problem Identification

Content Reference : https://towardsdatascience.com [Sivakar Siva]

- Understand the Business Objective
- Understand scalability need
- Defining your success Criteria and success measuring Metrics KPI & SLA
- Identify the key business variables that the model needs to predict
- Discuss Integration of model with business process

Business Understanding

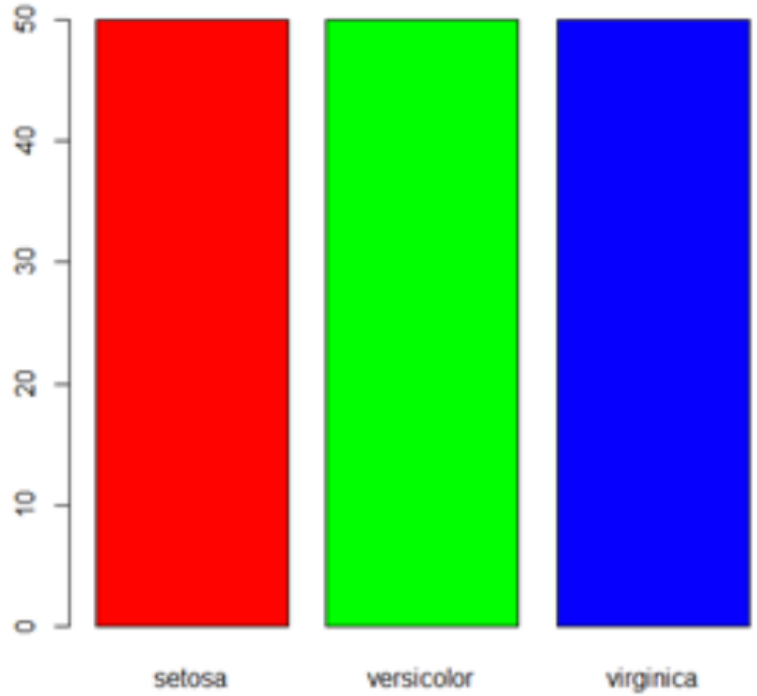
Content Reference : https://towardsdatascience.com [Sivakar Siva]



Data Acquisition - ETL

Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

- Descriptive Statistics
  - Measures of Frequency
  - Measures of Central Tendency
  - Measures of Dispersion or Variation
  - Measures of Position
- Inferential Statistics
  - The estimation of the parameter(s)
  - Testing of statistical hypotheses.



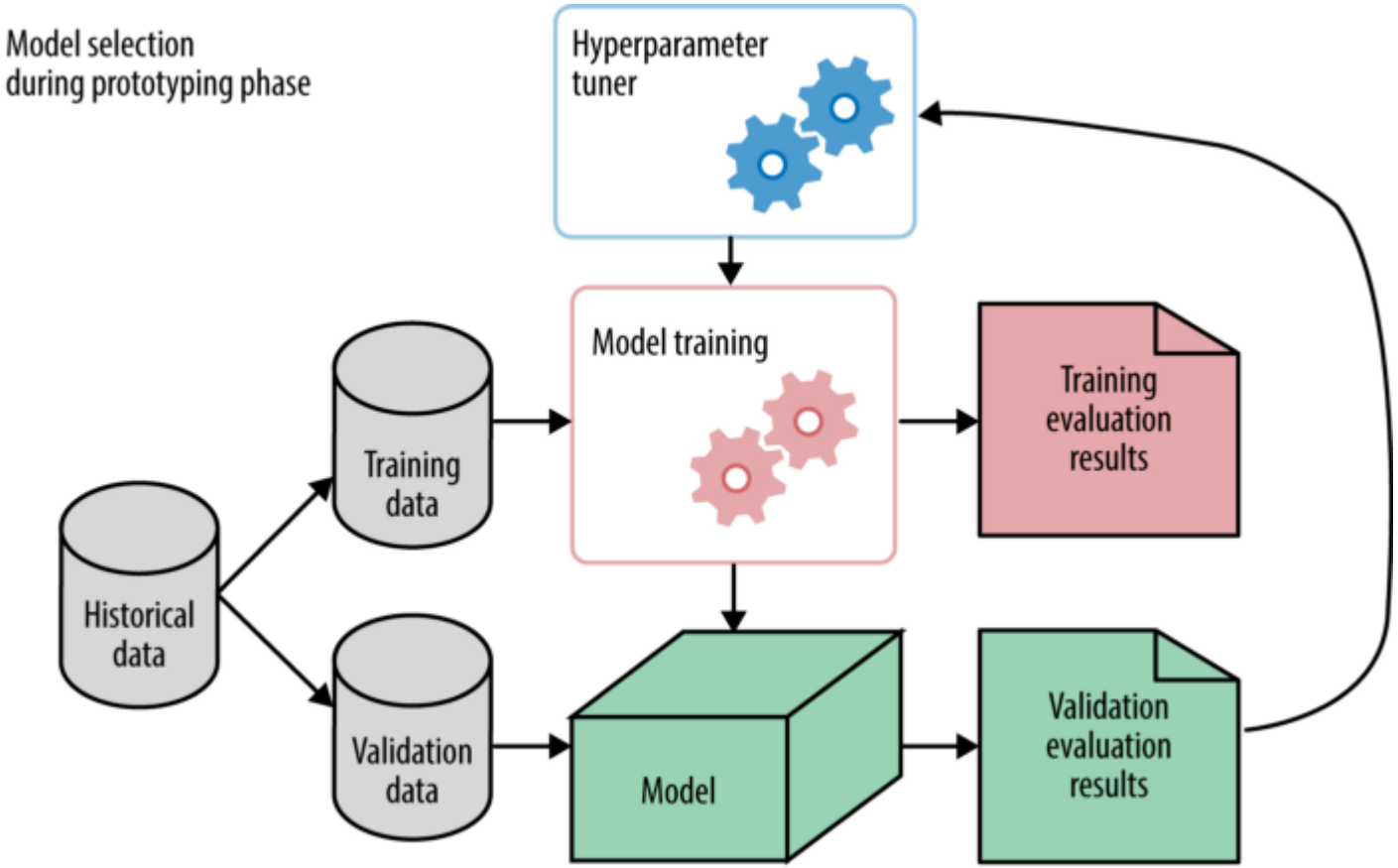
Data Understanding - EDA

Content Reference : https://towardsdatascience.com [Sivakar Siva]

- Feature engineering is the process of using domain knowledge to extract features from raw data via data mining techniques.
- These **features** can be used to strengthen the performance of machine learning models.
- Feature engineering can be considered as applied machine learning itself.

Feature Engineering

Content Reference : https://towardsdatascience.com [Sivakar Siva]



Model Training/Validation

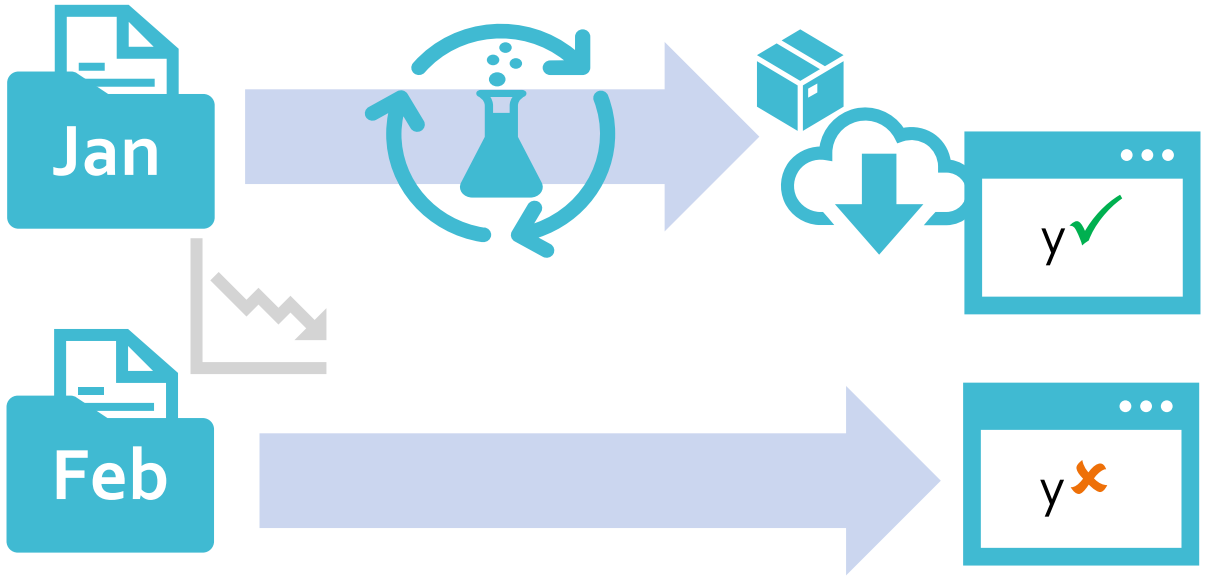
Content Reference : Oreilly by Alice Zheng

Deploy a Real-Time Pipeline

Publish a Batch Pipeline

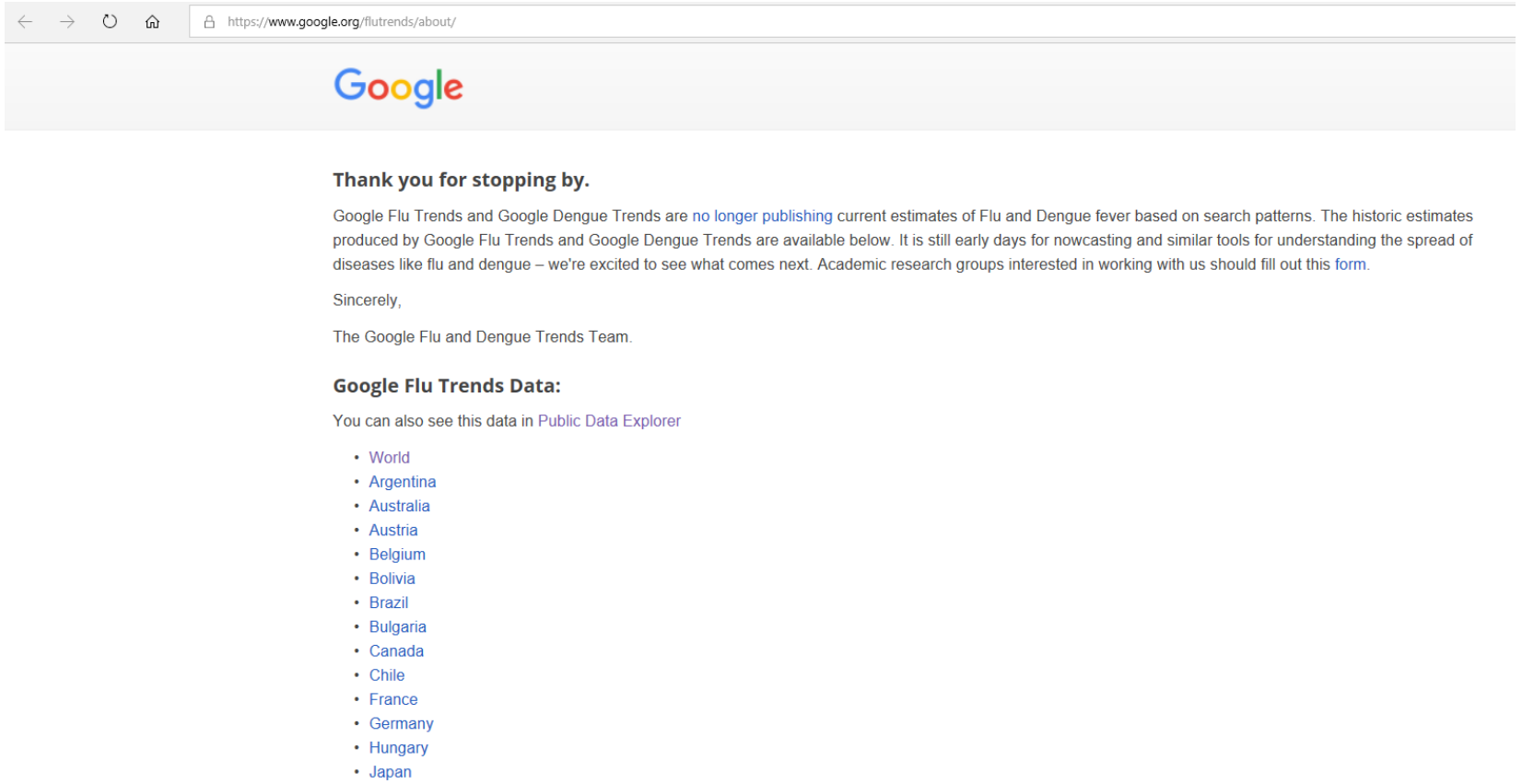
Model Deployment

Content Reference : Microsoft Corporation



Model Monitoring

Content Reference : Microsoft Corporation



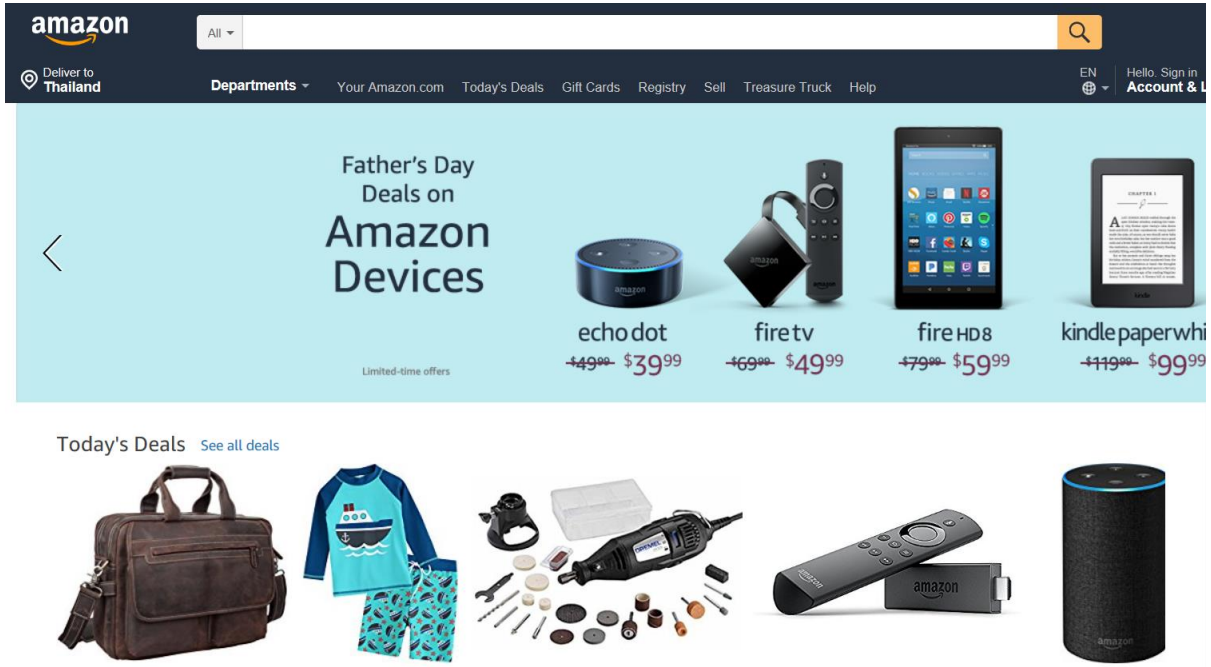
- **Google Flu Treads (Nowcasting Example)**
- https://www.google.org/flutrends/about/

Nowcasting vs Forecasting

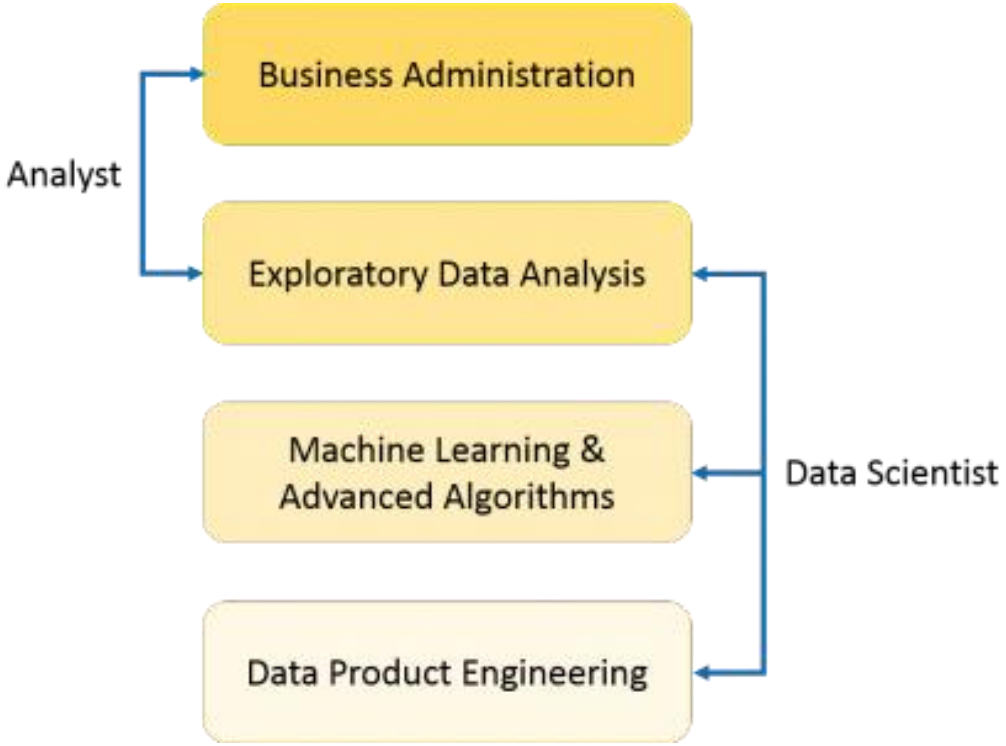
elections2012
(Forecasting Example)

Nowcasting vs Forecasting

- **Transform Data Into …**
  - Valuable Insights
  - Data Productions
  - Interesting Stories



Summary of Data Science



- Predictive causal analytics
- Prescriptive analytics
- Machine learning for making predictions
- Machine learning for pattern discover

Summary of Data Science

Content Reference : https://www.edureka.co/blog/what-is-data-science/

03 - Big Data Fundamentals

- Big data is a term that describes the large volume of data – both structured and unstructured – that inundates a business on a day-to-day basis. But it's not the amount of data that's important. It's what organizations do with the data that matters.

- Big data can be analyzed for insights that lead to better decisions and strategic business moves.

Overview - Big Data

- **It's all happening online**
  - Click
  - Ad impression
  - Billing event
  - Fast Forward, pause,…
  - Server request
  - Transaction
  - Network message
  - Fault

- **User Generate Content on Web & Mobile**



Where Dose Big Data Come From?

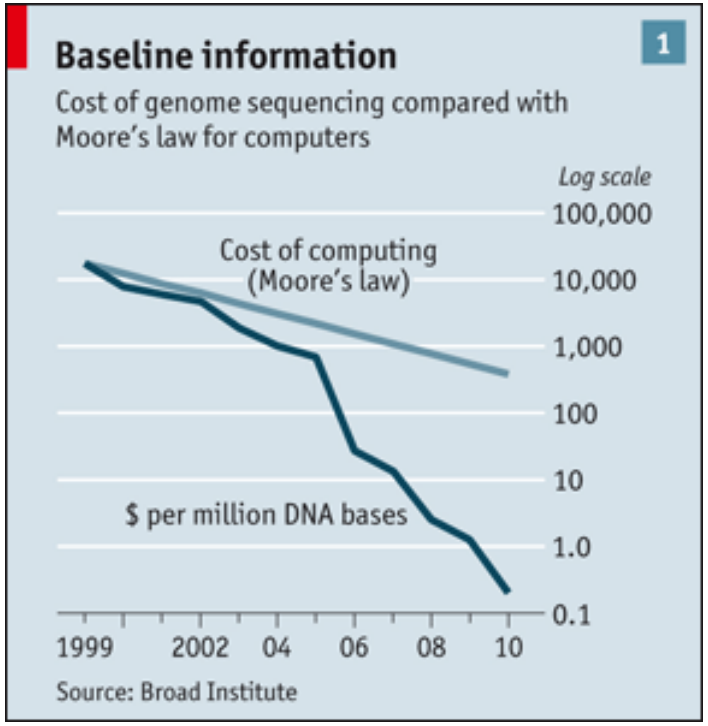
- Health and Scientific Computing

Biology 2.0

A decade after the human-genome project, writes Geoffrey Carr (interviewed here), biological science is poised on the edge of something wonderful

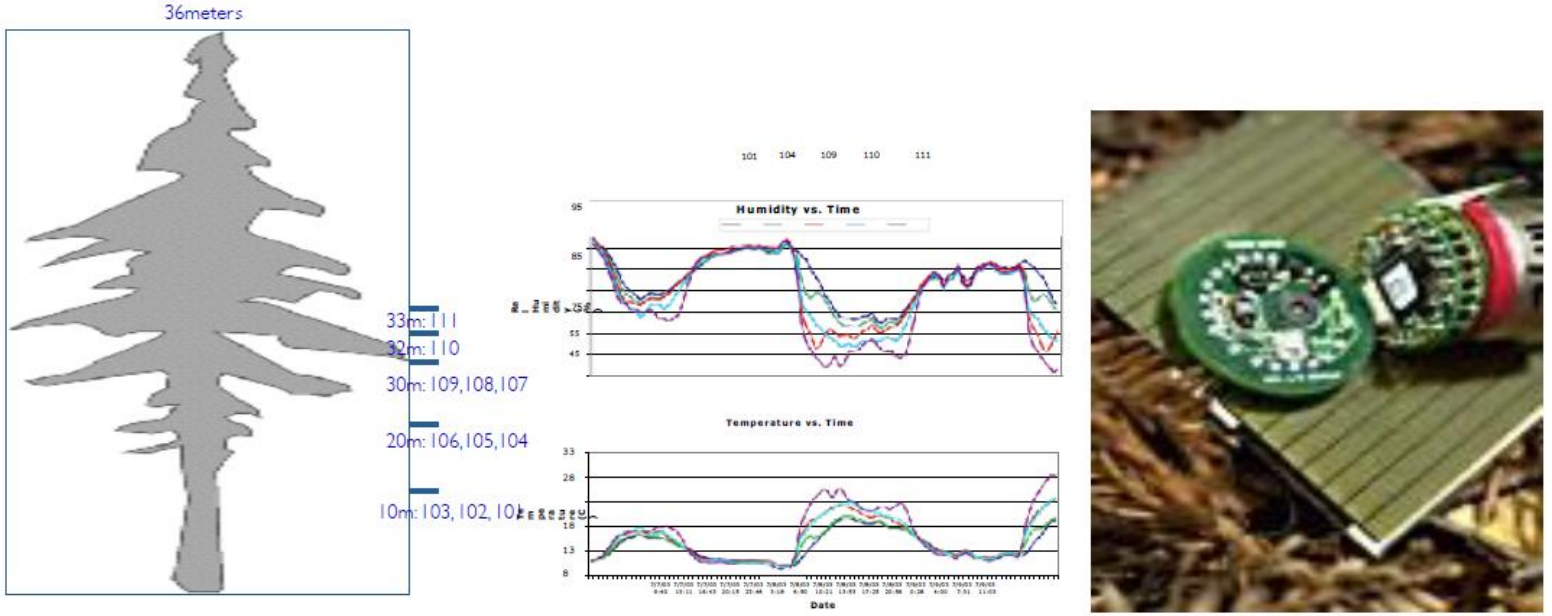
Jun 17th 2010 Timekeeper Like 391 Tweet

TEN years ago, on June 26th 2000, a race ended. The result was declared a dead heat and both runners won the prize of shaking the hand of America's then president, Bill

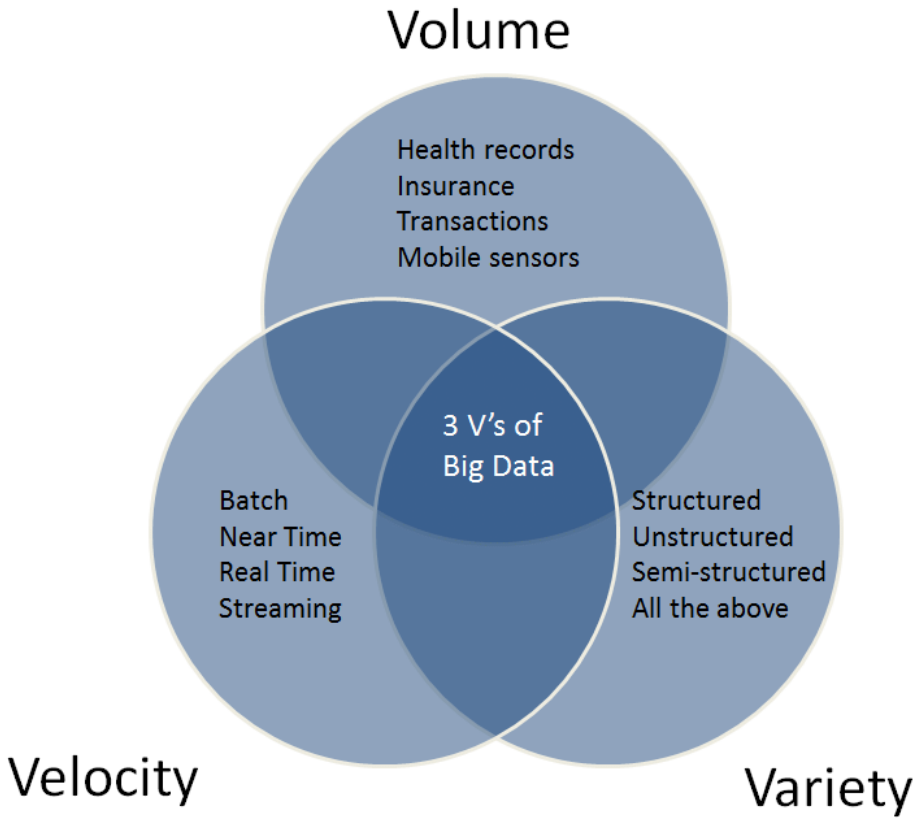


Where Dose Big Data Come From?

- **Internet of Thing (IoT)**

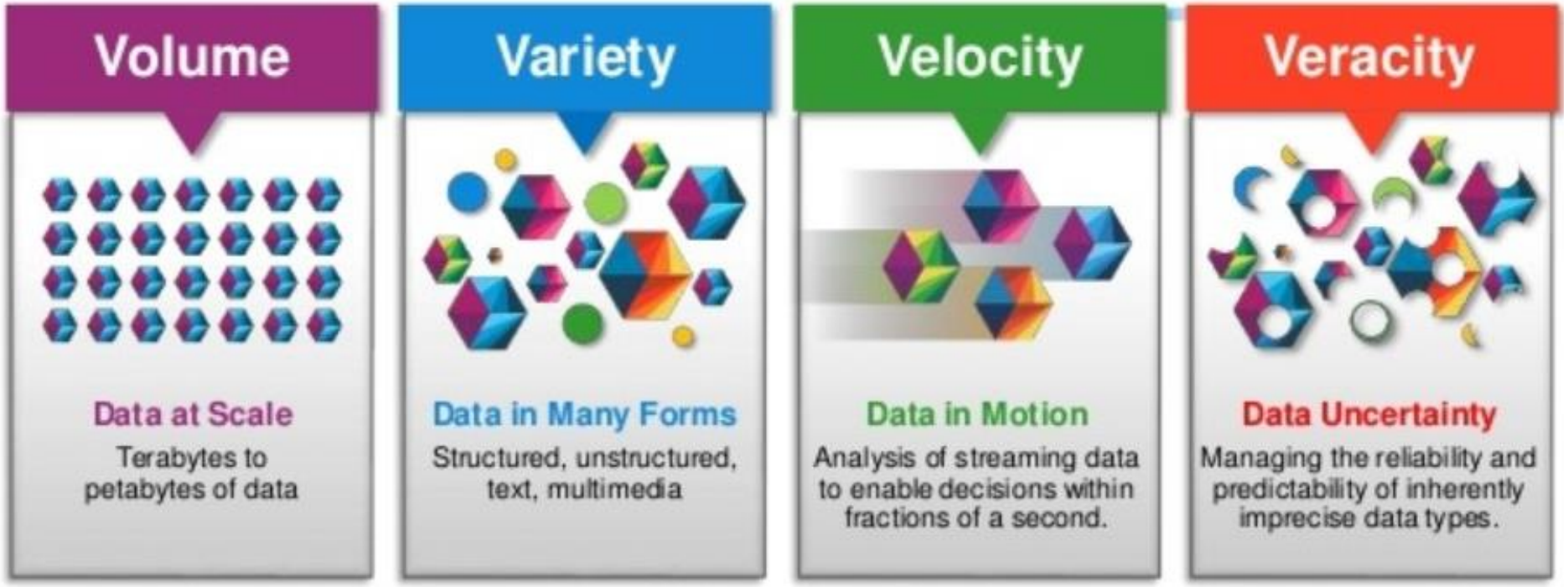


Where Dose Big Data Come From?



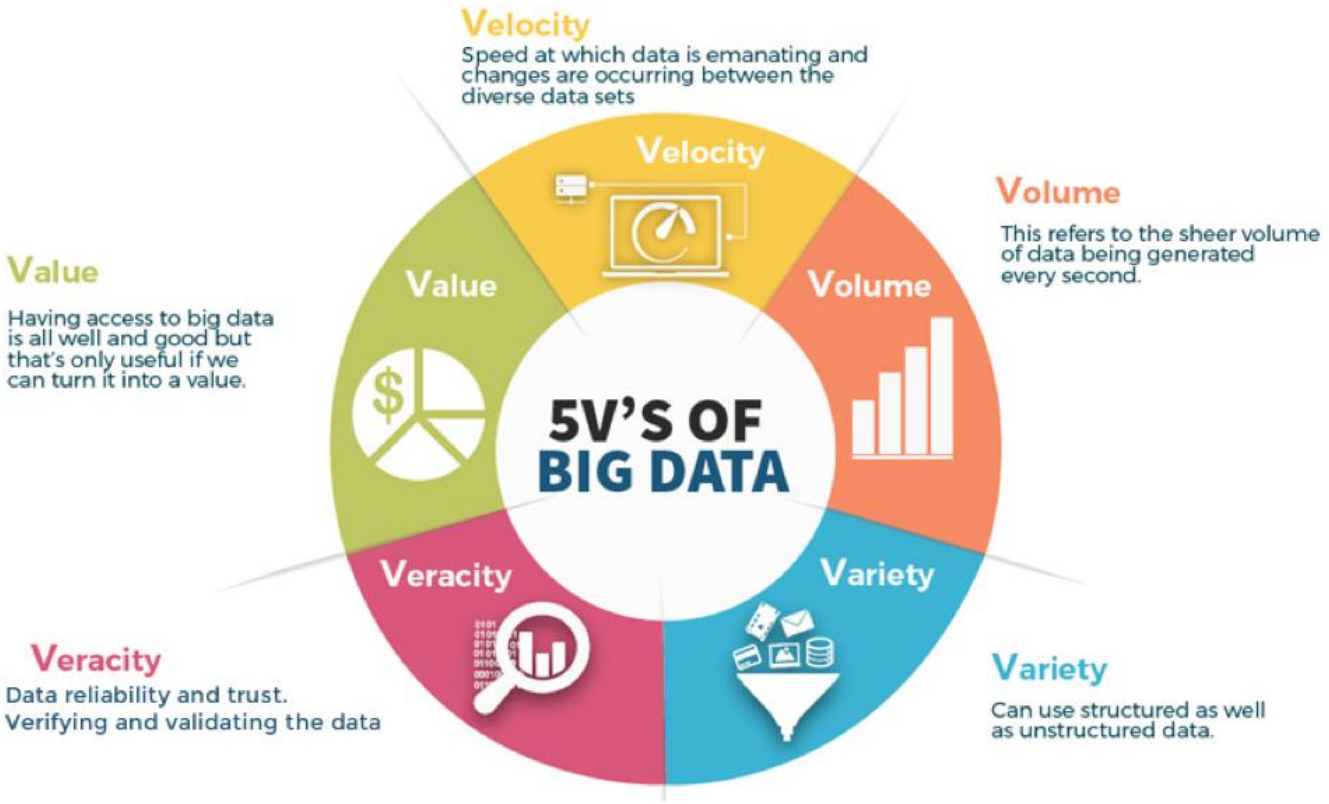
The 3 V's of Big Data Characteristics

Content Reference : Christopher O. Austin



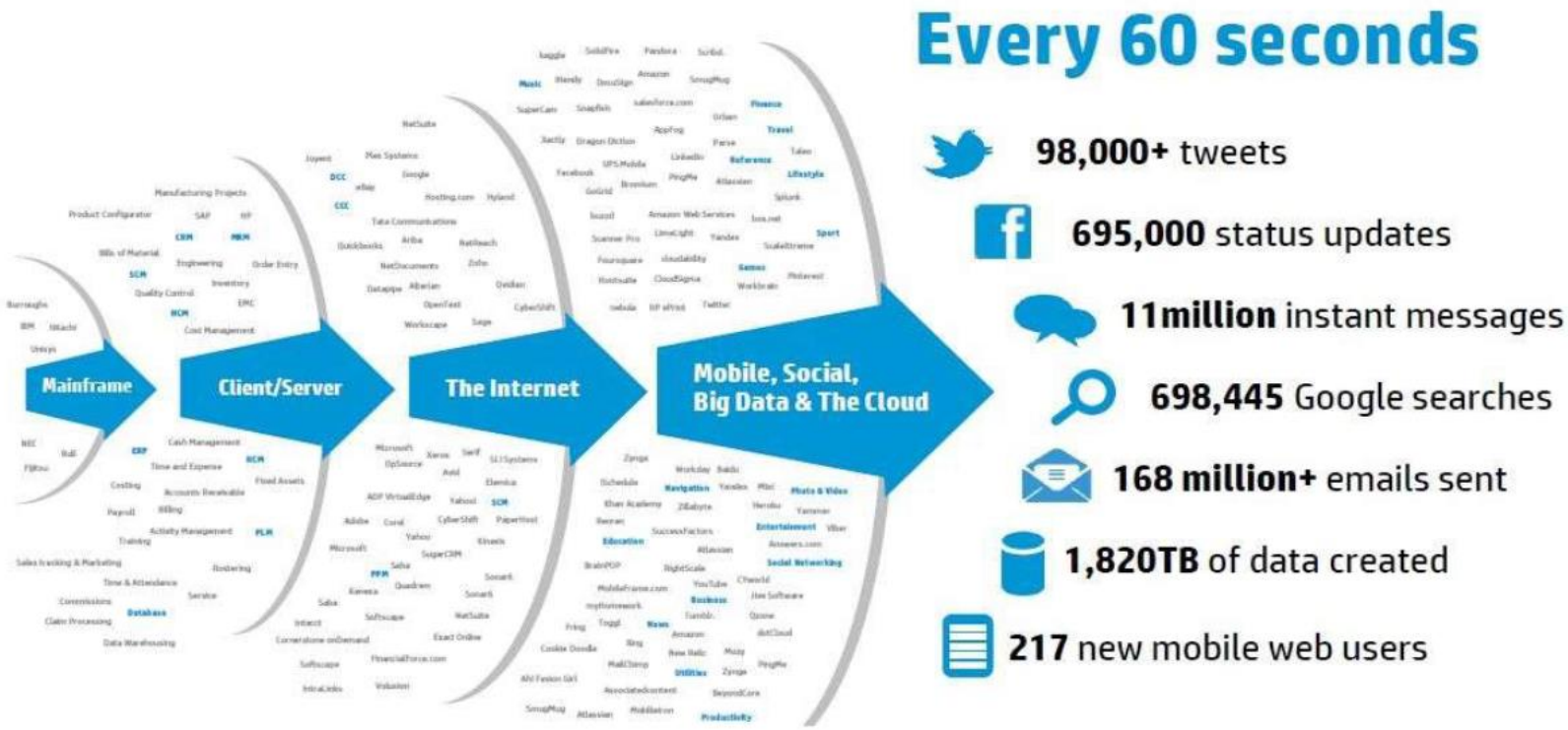
The 4V's of Big Data Characteristics (IBM)

Content Reference : https://www.sliceofbi.com/



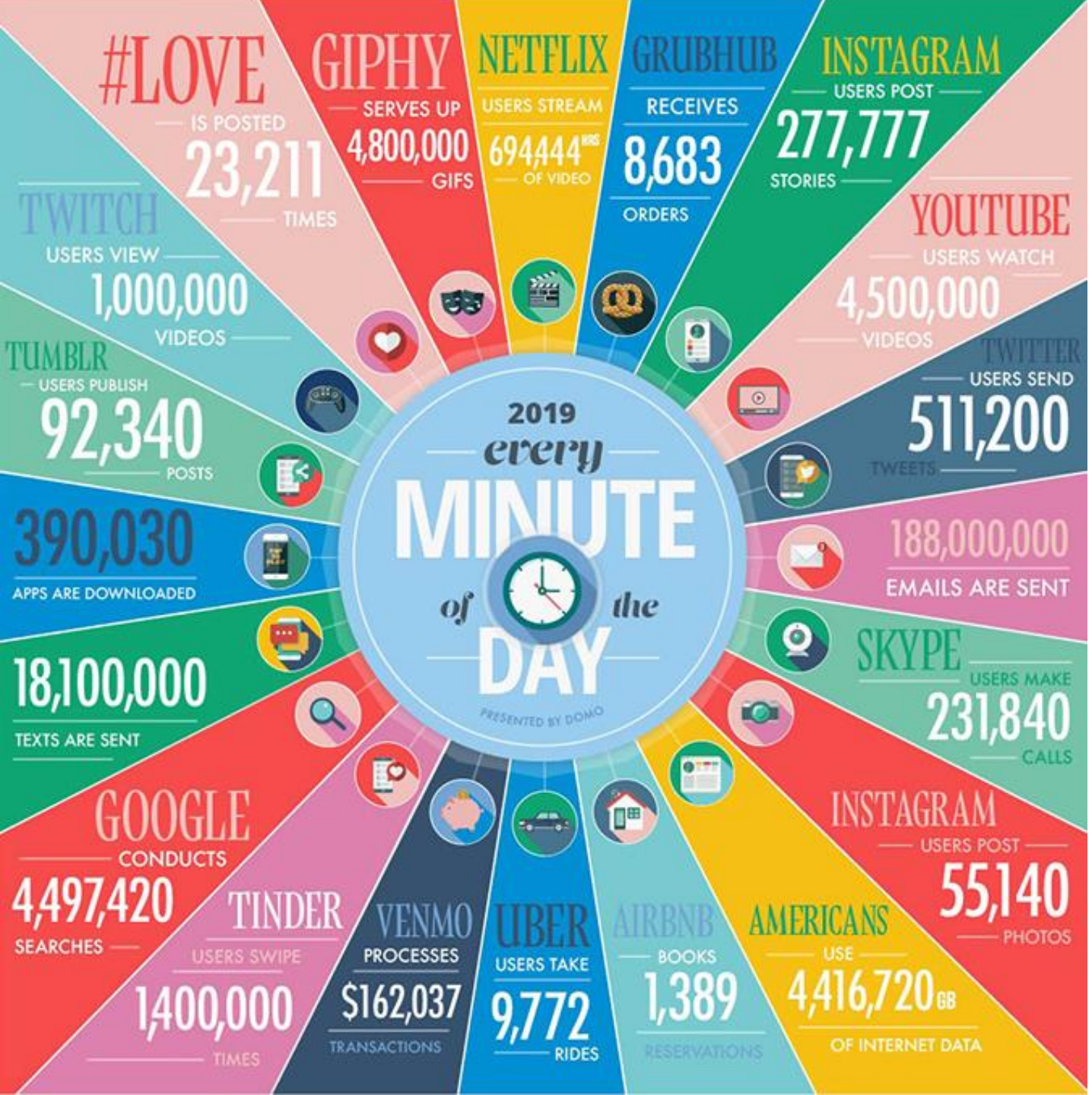
The 5V's of Big Data

Content Reference : https://www.techentice.com/the-data-veracity-big-data/



Big Data Characteristics

Content Reference : Bernard Marr's



Data Never Sleeps

Content Reference :
https://web-assets.domo.com/blog/wp-content/uploads/2019/07/data-never-sleeps-7-896kb.jpg

https://www.youtube.com/watch?v=ZQPZ-_k_2Hg

- Hadoop – Big Data Platform
- MongoDB – Document Database [No-SQL]
- Cloud Computing

Big Data Technologies Overview

- Hadoop is an Apache open source framework written in java that allows **distributed processing of large datasets across clusters of computers** using simple programming models.

- A Hadoop framework application works in an environment that provides distributed storage and computation across clusters of computers.

- Hadoop is designed to scale up from single server to thousands of machines, each offering local computation and storage.

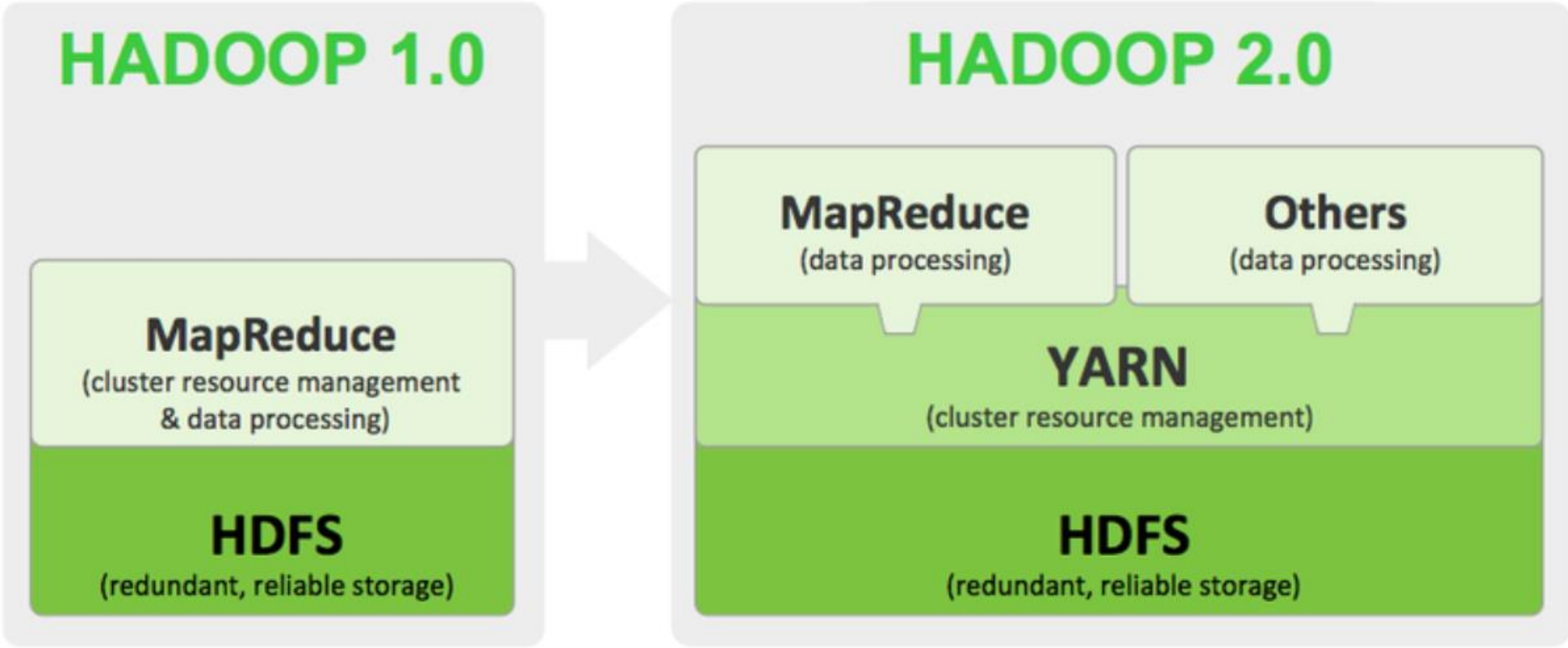
Introduction to Hadoop

When (not) to use Hadoop

- When to use Hadoop
  - For processing really big data
  - For storing a diverse set of data
  - For parallel data processing

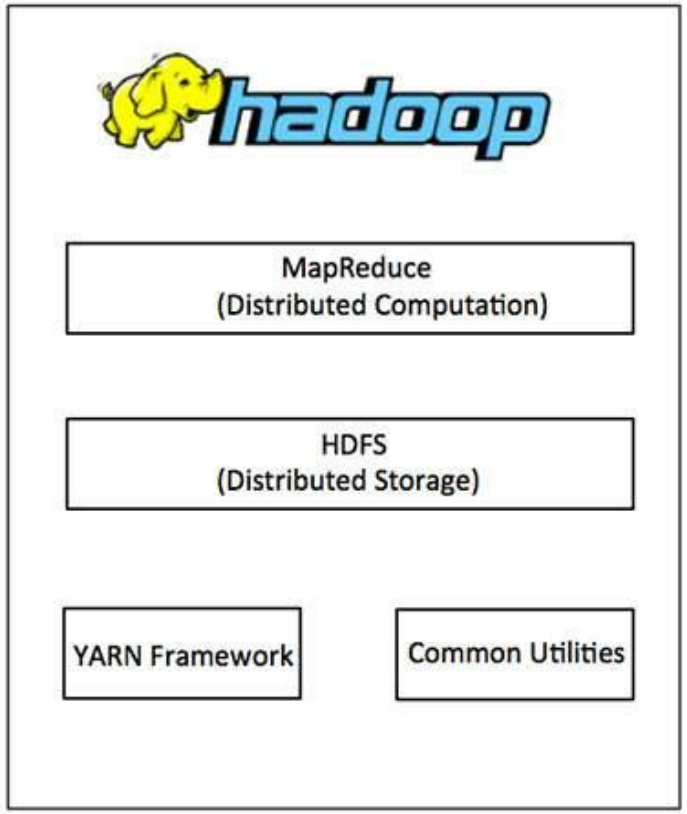
- When NOT to use Hadoop
  - For real-time data analysis
  - For a relational database system
  - For a general network file system
  - For non-parallel data processing

Content Reference : DigiTech [Business Insights Analytics Course]



Hadoop History

Content Reference : DigiTech [Business Insights Analytics Course]



- **Hadoop Common**

These are Java libraries and utilities required by other Hadoop modules. These libraries provides filesystem and OS level abstractions and contains the necessary Java files and scripts required to start Hadoop.

- **Hadoop YARN**

This is a framework for job scheduling and cluster resource management.

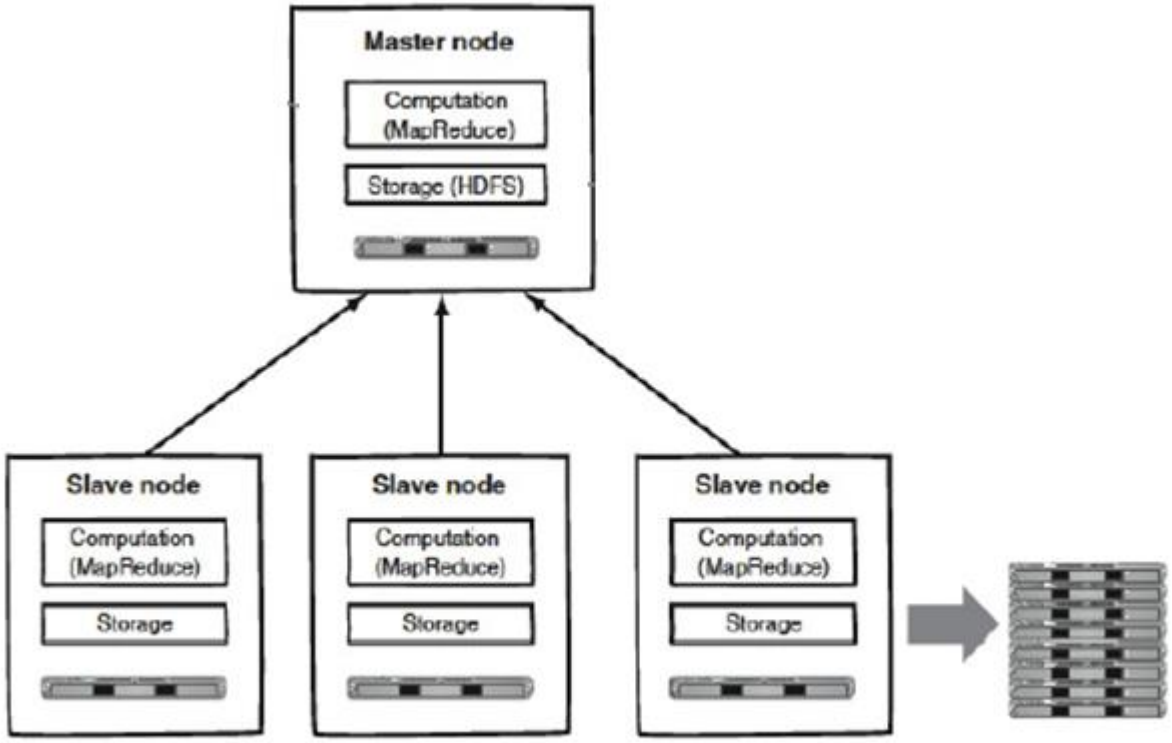
- **Hadoop Distributed File System (HDFS)**

A distributed file system that provides high-throughput access to application data.

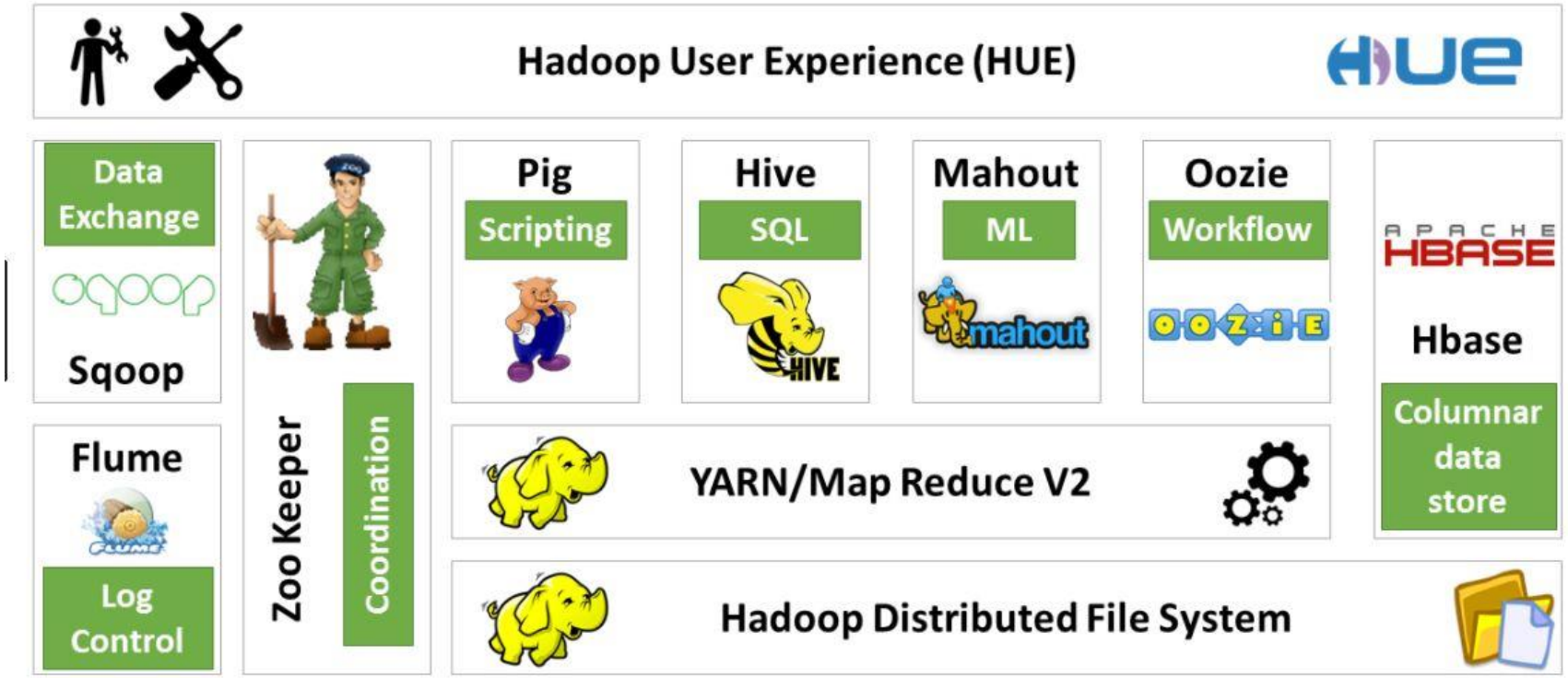
- **Hadoop MapReduce :**
  This is YARN-based system for parallel processing of large data sets.

Hadoop Architecture

Content Reference : https://www.tutorialspoint.com/

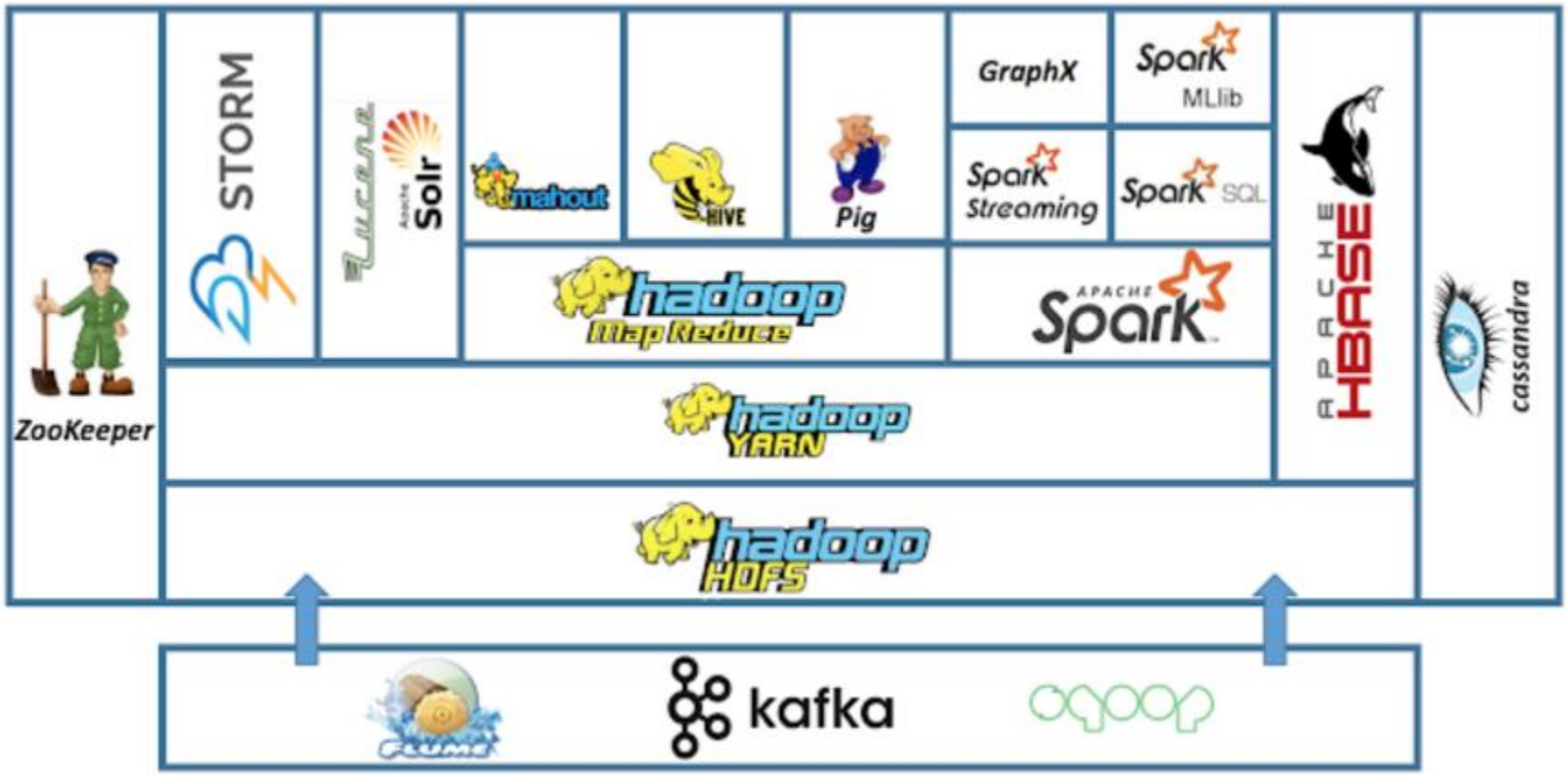


Hadoop Architecture



Hadoop Ecosystem (Version 2)

Content Reference : https://www.ktexperts.com/hadoop-ecosystem [Neeraj Sharma]



Hadoop Ecosystem - Update

- Apache Hive is a data warehouse software project built on top of Apache Hadoop for providing data summarization, query and analysis.
- Hive gives an SQL-like interface to query data stored in various databases and file systems that integrate with Hadoop.
- SQL-like queries (HiveQL)

Hadoop Technology - Apache Hive

- HiveQL Sample

```
1 DROP TABLE IF EXISTS docs;
2 CREATE TABLE docs (line STRING);
3 LOAD DATA INPATH 'input_file' OVERWRITE INTO TABLE docs;
4 CREATE TABLE word_counts AS
5 SELECT word, count(1) AS count FROM
6  (SELECT explode(split(line, '\s')) AS word FROM docs) temp
7 GROUP BY word
8 ORDER BY word;
```

Hadoop Technology - Apache Hive

- Apache Pig is a high-level platform for creating programs that run on Apache Hadoop.

- The language for this platform is called Pig Latin

```
1 input_lines = LOAD '/tmp/word.txt' AS (line:chararray);
2 words = FOREACH input_lines GENERATE FLATTEN(TOKENIZE(line)) AS word;
3 filtered_words = FILTER words BY word MATCHES '\\w+';
4 word_groups = GROUP filtered_words BY word;
5 word_count = FOREACH word_groups GENERATE COUNT(filtered_words) AS count, group AS word;
6 ordered_word_count = ORDER word_count BY count DESC;
7 STORE ordered_word_count INTO '/tmp/results.txt';
```

Hadoop Technology - Apache Pig

- HBase is an open-source, non-relational, distributed database modeled after Google's big table and is written in Java.

- **HBase is not a direct replacement for a classic SQL database**

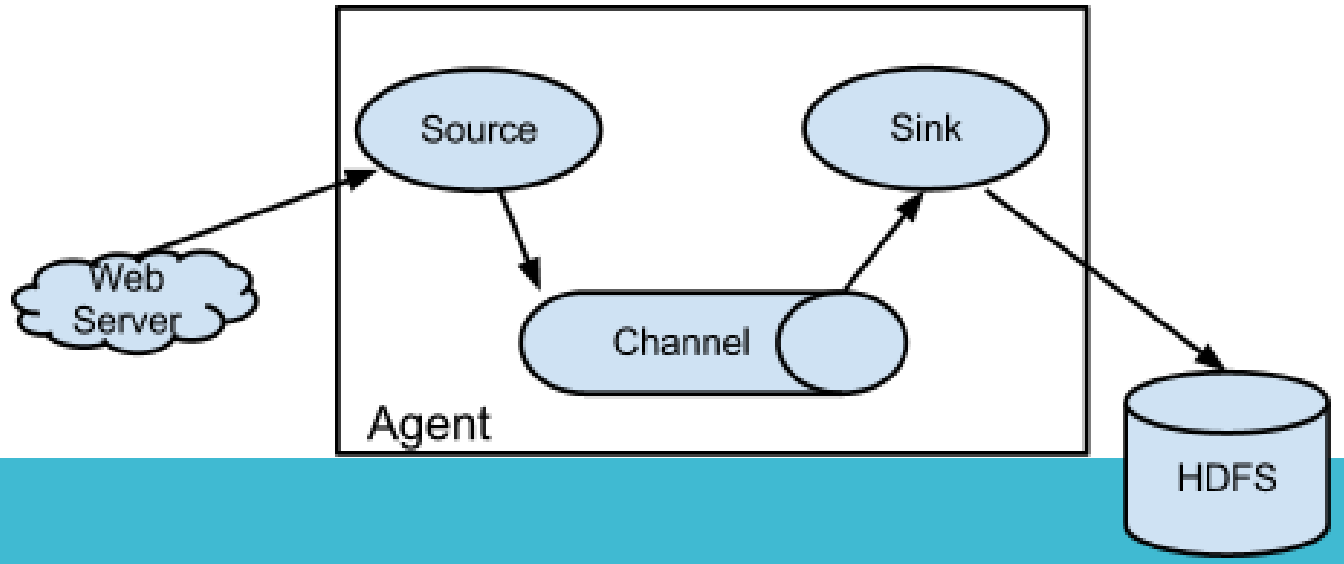
Hadoop Technology - Apache HBase

- Sqoop is a command-line interface application for transferring data between relational databases and Hadoop

Hadoop Technology - Apache Sqoop

- Flume is a distributed, reliable, and available service for efficiently collecting, aggregating, and moving large amounts of log data.

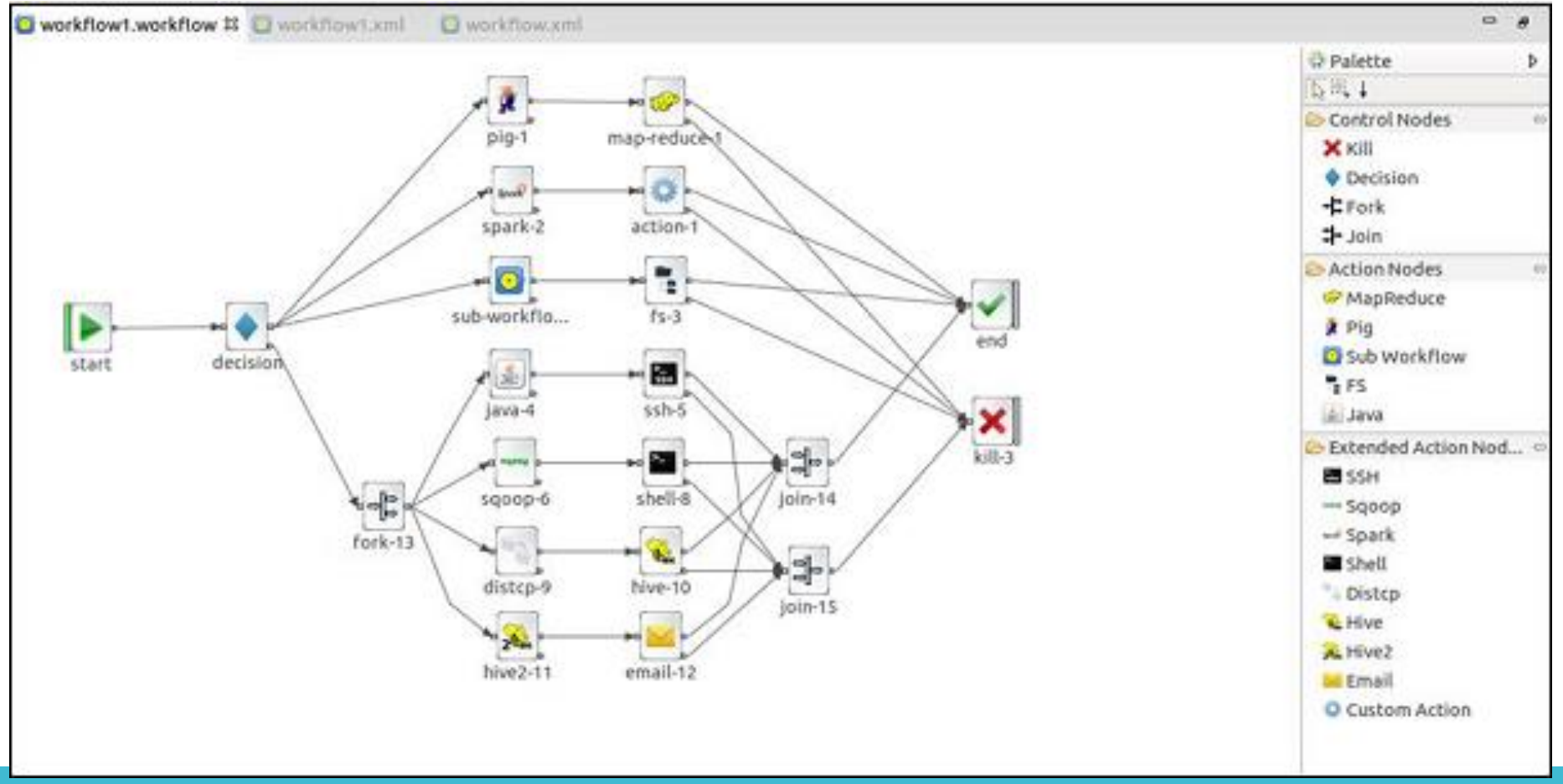
- It has a simple and flexible architecture based on streaming data flows.



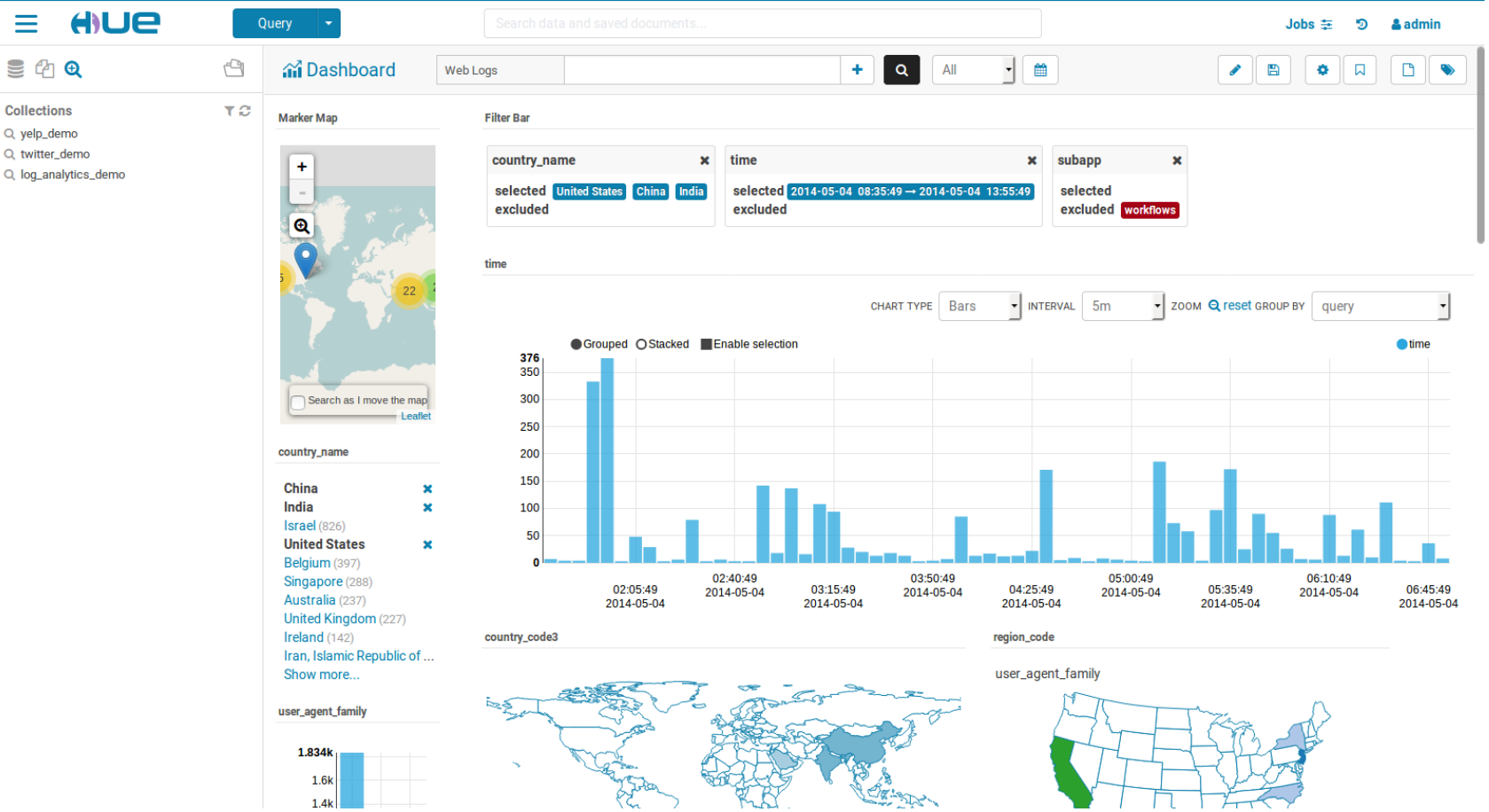
Hadoop Technology - Apache Flume

- Apache Oozie is a server-based workflow scheduling system to manage Hadoop jobs.
- Workflows in Oozie are defined as a collection of control flow and action nodes in a directed acyclic graph.
- Control flow nodes define the beginning and the end of a workflow (start, end, and failure nodes) as well as a mechanism to control the workflow execution path (decision, fork, and join nodes).

Hadoop Technology - Apache Oozie



Hadoop Technology - Apache Oozie



- Hue is an open source Analytics Workbench for browsing, querying and visualizing data.

Hadoop Technology - Apache Hue

- Apache Mahout is a project of the Apache Software Foundation to produce free implementations of distributed or otherwise scalable machine learning algorithms focused primarily in the areas of collaborative filtering, clustering and classification.

- Mahout also provides Java libraries for common maths operations (focused on linear algebra and statistics) and primitive Java collections.

Hadoop Technology - Apache Mahout

MongoDB is a database using document-oriented storage. Under this model, data is stored in documents and documents are combined into collections.

- Database
- Collection
- Document

Big Data Technology - MongoDB

RDBMS	MongoDB
Database	Database
Table	Collection
Tuple/Row	Document
column	Field
Table Join	Embedded Documents
Primary Key	Primary Key (Default key _id provided by mongodb itself)

Big Data Technology - MongoDB

- Schema less
- Structure of a single object is clear
- No complex joins
- Deep query-ability (document-based query language)
- Tuning
- Ease of scale-out

Advantages of MongoDB over RDBM

- Big Data
- Content Management and Delivery
- Mobile and Social Infrastructure
- User Data Management
- Data Hub

Where to Use MongoDB?

```
var MongoClient = require('mongodb').MongoClient;

//Create a database named "myDatabase":
var url = "mongodb://localhost:27017/myDatabase";

MongoClient.connect(url, function(err, db) {
  if (err) throw err;
  console.log("Database created!");
  db.close();
});
```

Create Database using NodeJS

```
var MongoClient = require('mongodb').MongoClient;
var url = "mongodb://localhost:27017/";

MongoClient.connect(url, function(err, db) {
  if (err) throw err;
  var dbo = db.db("myDatabase");

  //Create a collection name "customers":
  dbo.createCollection("customers",
   function(err, res) {
    if (err) throw err;
    console.log("Collection created!");
    db.close();
  });
});
```

Create Collection using NodeJS

```
var MongoClient = require('mongodb').MongoClient;
var url = "mongodb://localhost:27017/";

MongoClient.connect(url, function(err, db) {
  if (err) throw err;
  var dbo = db.db("myDatabase");

  var myobj = {
    name: "Bank of Thailand", address: "Tewet" };
  dbo.collection("customers").insertOne(myobj, function(err, res) {
    if (err) throw err;
    console.log("1 document inserted");
    db.close();
  });
});
```

Create Document using NodeJS

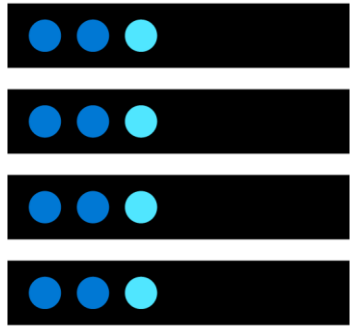
```
var MongoClient = require('mongodb').MongoClient;
var url = "mongodb://localhost:27017/";

MongoClient.connect(url, function(err, db) {
  if (err) throw err;
  var dbo = db.db("myDatabase");

    var myquery = { address: 'Bangkok' };
  dbo.collection("customers").deleteOne(myquery, function(err, obj)
  {
    if (err) throw err;
    console.log("1 document deleted");
    db.close();
  });
});
```

Delete Document using NodeJS

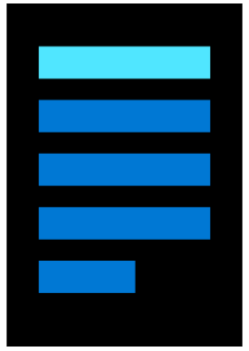
```
var MongoClient = require('mongodb').MongoClient;
var url = "mongodb://localhost:27017/";

MongoClient.connect(url, function(err, db) {
  if (err) throw err;
  var dbo = db.db("myDatabase");
  dbo.collection("customers")
  .drop(function(err, delOK) {
    if (err) throw err;
    if (delOK) console.log("Collection deleted");
    db.close();
  });
});
```

Drop Collection using NodeJS

Cloud Computing

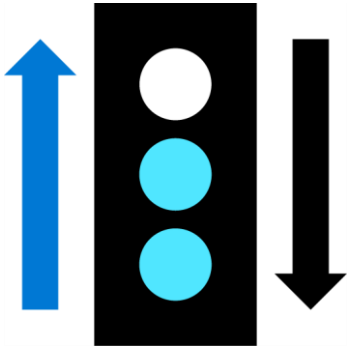


Compute



Storage

Cloud providers include Microsoft, Amazon, and Google



Networking

Analytics

Microsoft

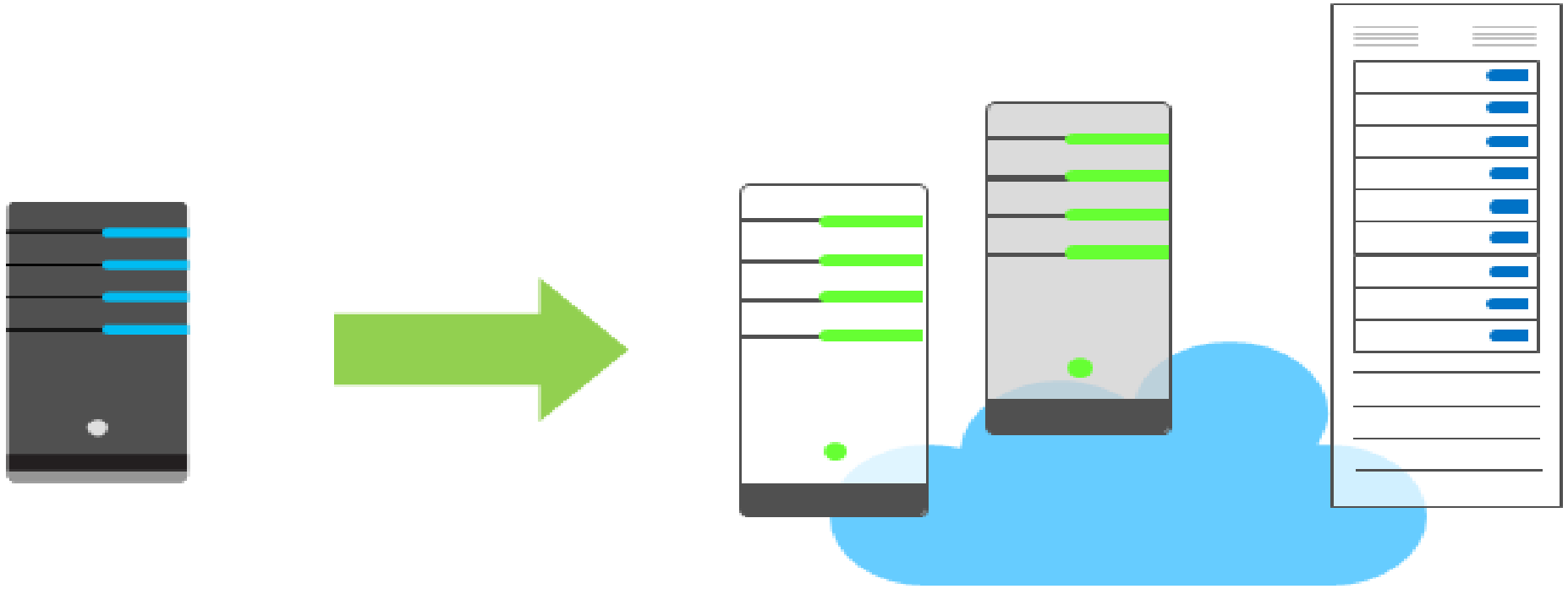
Explore key cloud concepts

- High availability
- Fault tolerance
- Scalability
- Elasticity
- Global reach
- Customer latency capabilities
- Agility
- Predictive cost considerations
- Disaster recovery
- Security

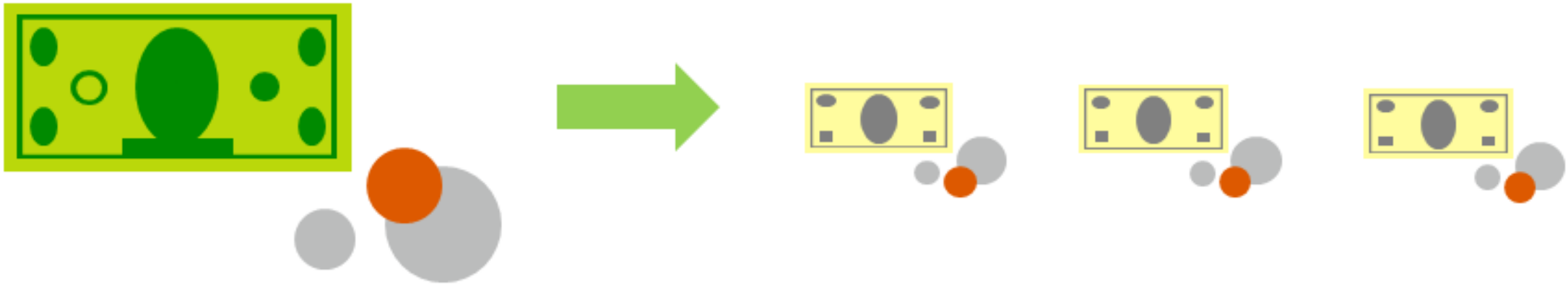
Microsoft

Discuss economies of scale

E*conomies of scale* – Cloud providers can reduce costs and gain efficiency when operating at a large scale.



Compare CapEx vs. OpEx



Capital Expenditure (CapEx)

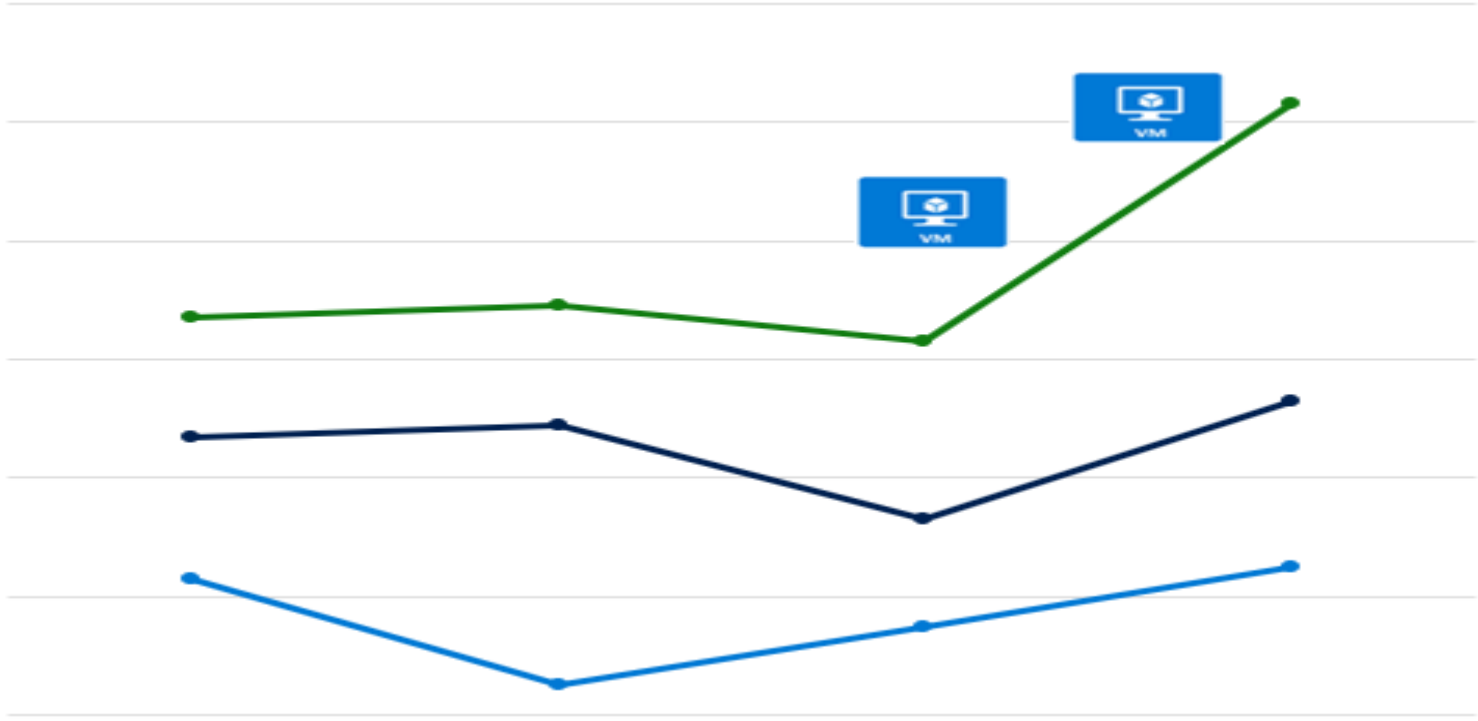
- High upfront cost, value of investment reduces over time.

Operational Expenditure (OpEx)

- Spend on services or products as needed.
- No upfront cost, pay-as-you use.

Microsoft

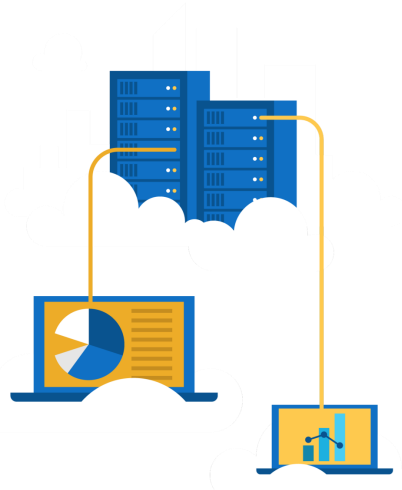
Define consumption-based model



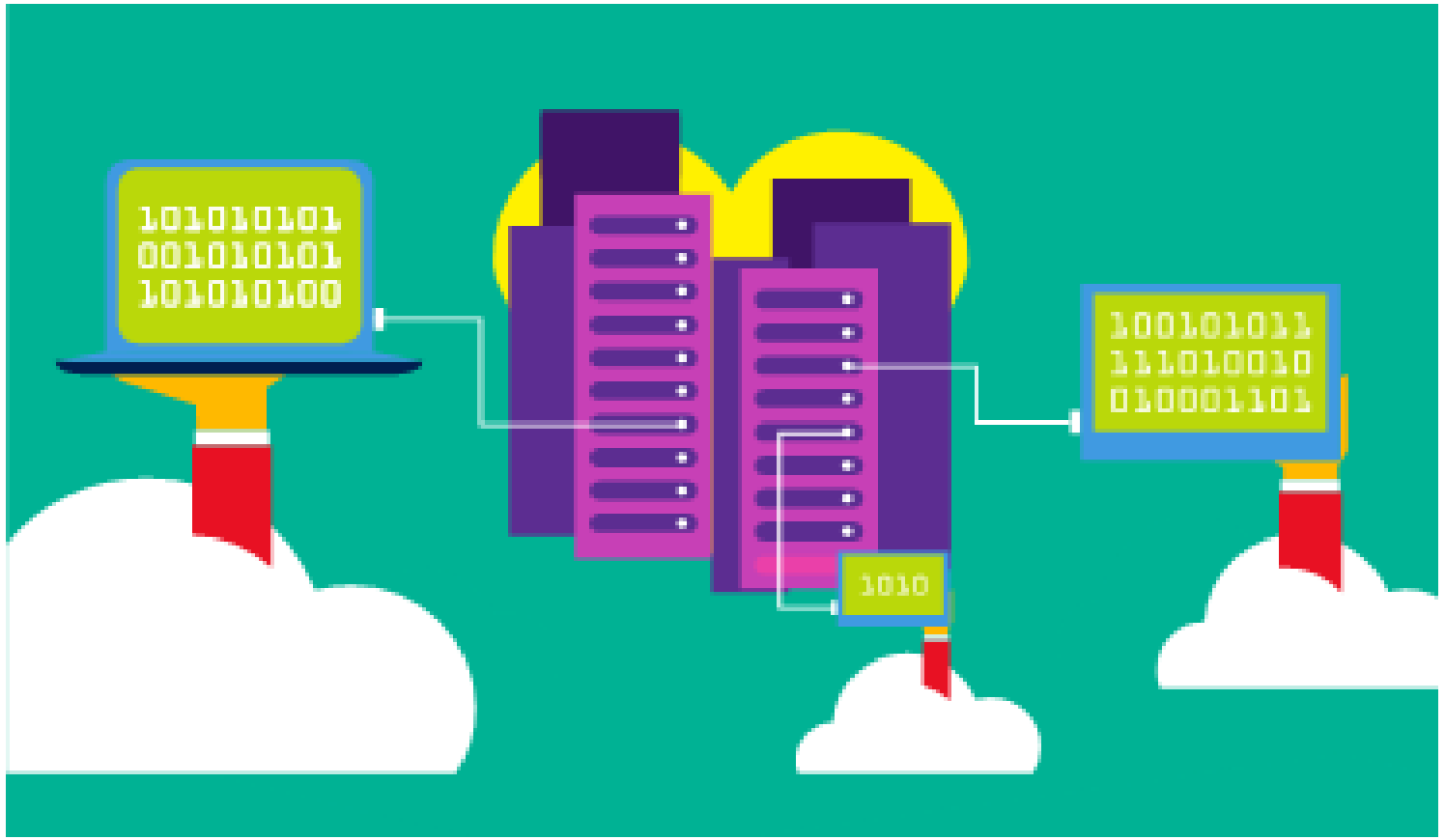
Consumption-based model = Pay only for the resources you use

Microsoft

Distinguish types of cloud models



public cloud

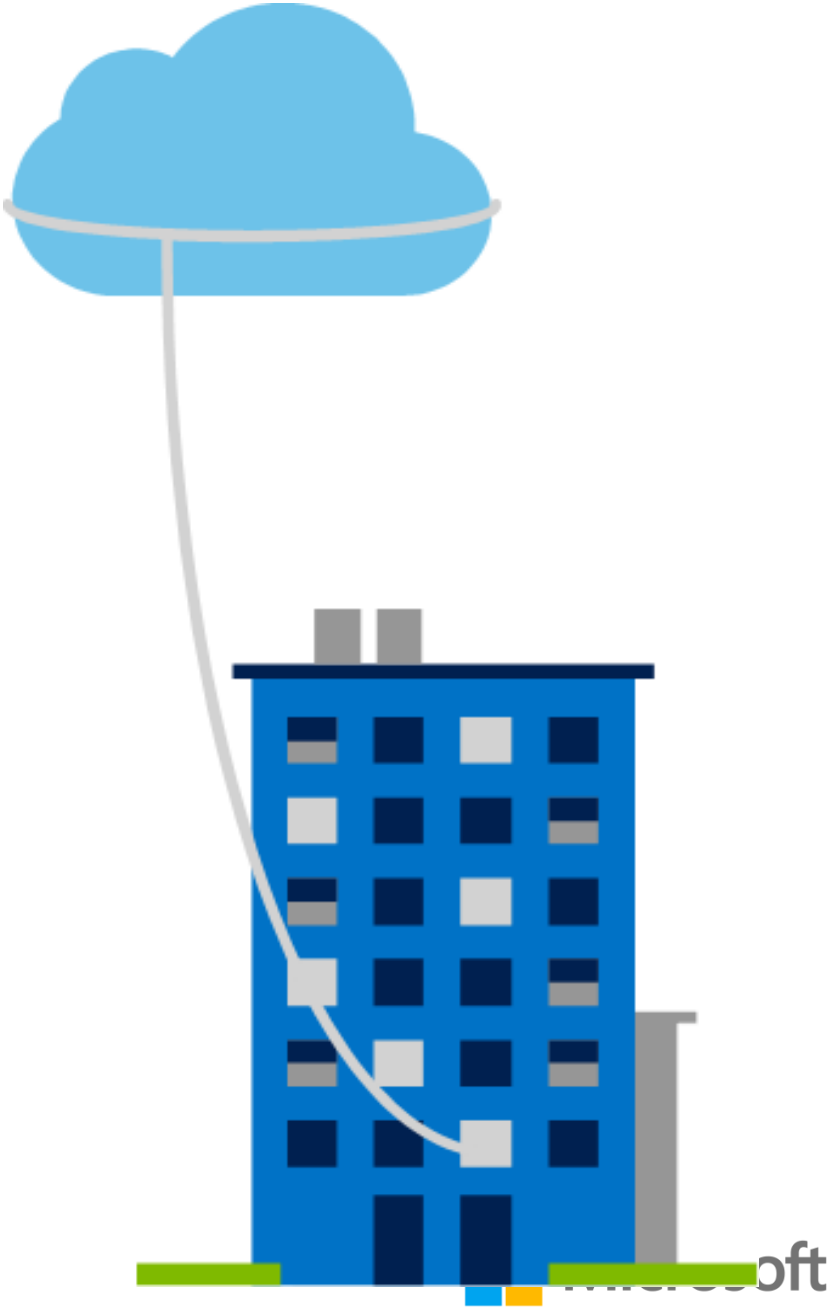


- Owned by cloud services or *hosting* provider.
- Provides resources and services to multiple organizations and users.
- Accessed via secure network connection (typically over the internet).

Microsoft

private cloud

- Organizations create a cloud environment in their datacenter.
- Organizations responsible for operating the services they provide.



hybrid cloud

Combines *Public* and *Private* clouds to allow applications to run in the most appropriate location.

Microsoft

Compare cloud models

Public cloud:

- No capital expenditures to scale up.
- Applications can be quickly provisioned and deprovisioned.
- Organizations pay only for what they use.

Private cloud:

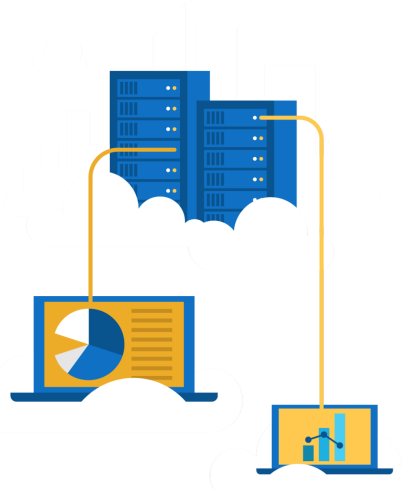
- Organizations have complete control over resources.
- Organizations have complete control over security.

Hybrid cloud:

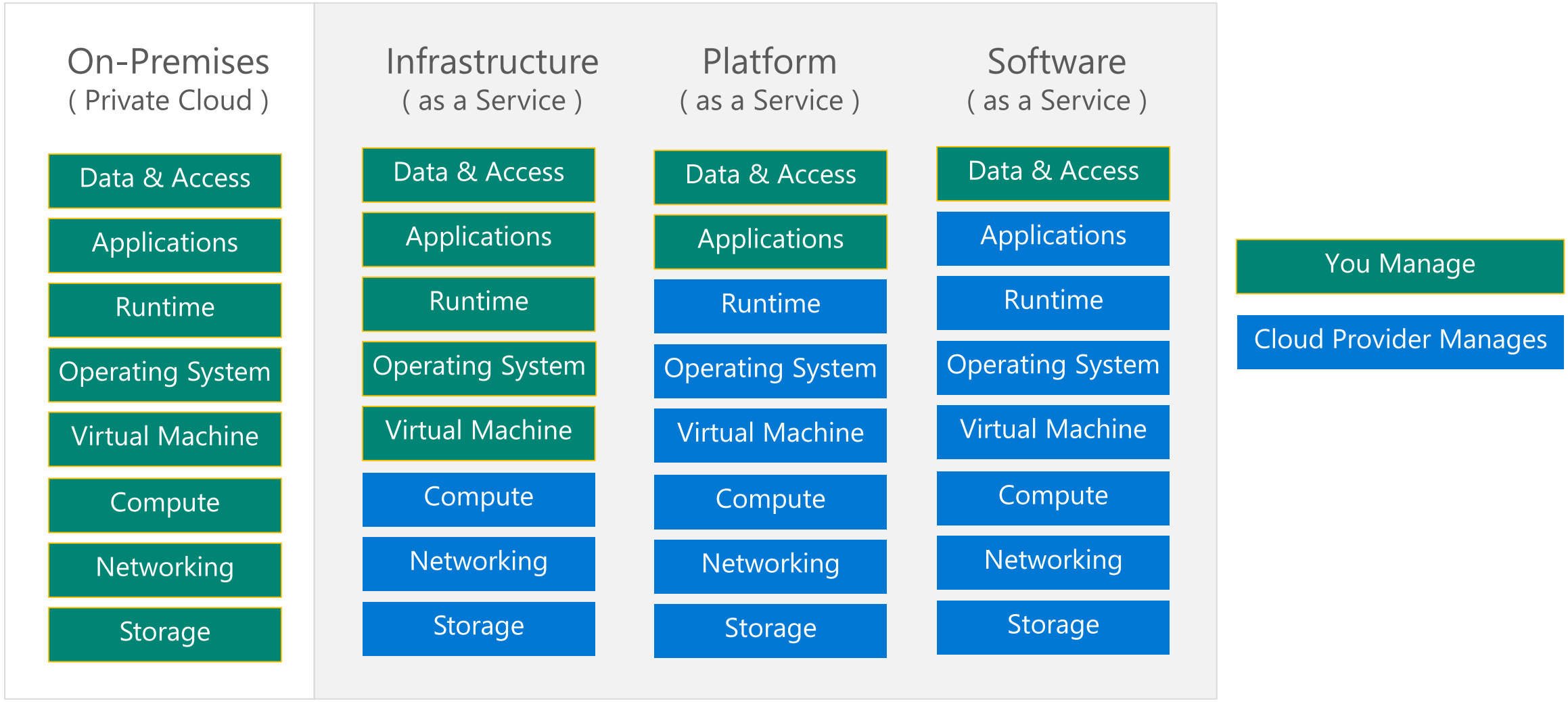
- Most flexibility.
- Organizations determine where to run their applications.
- Organizations control security, compliance, or legal requirements.

Microsoft

Explore types of cloud services



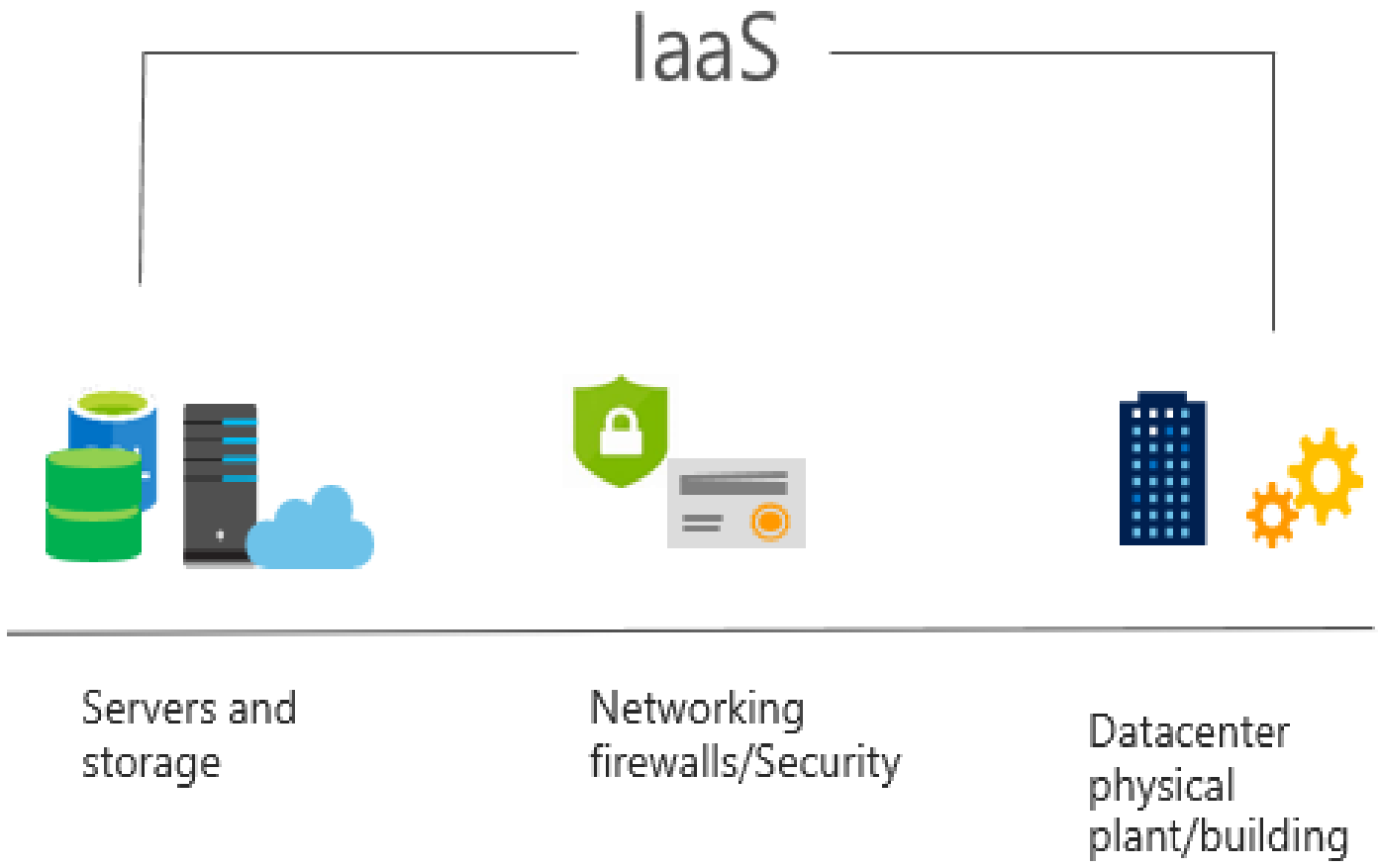
Discuss shared responsibility model



Microsoft

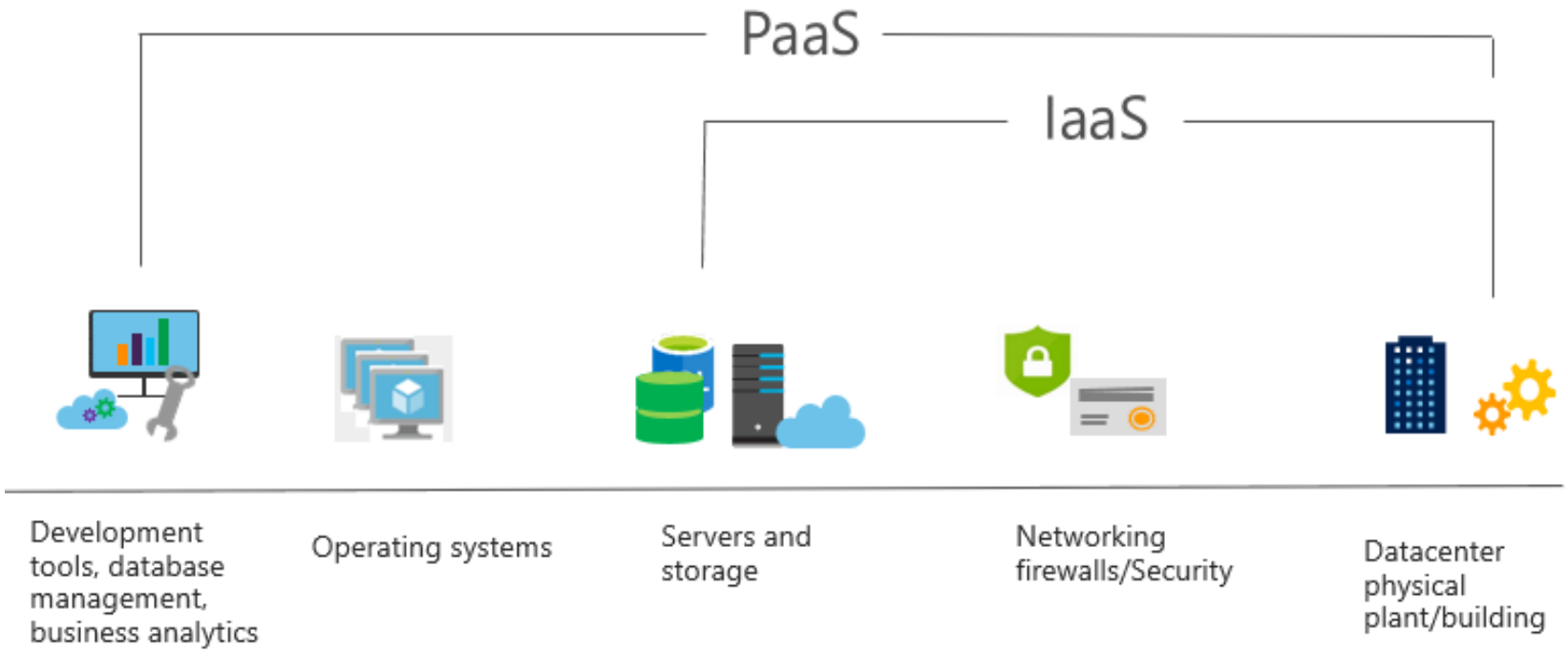
Define Infrastructure as a Service (IaaS)

Build pay-as-you-go IT infrastructure by renting servers, virtual machines, storage, networks, and operating systems from a cloud provider.



Microsoft

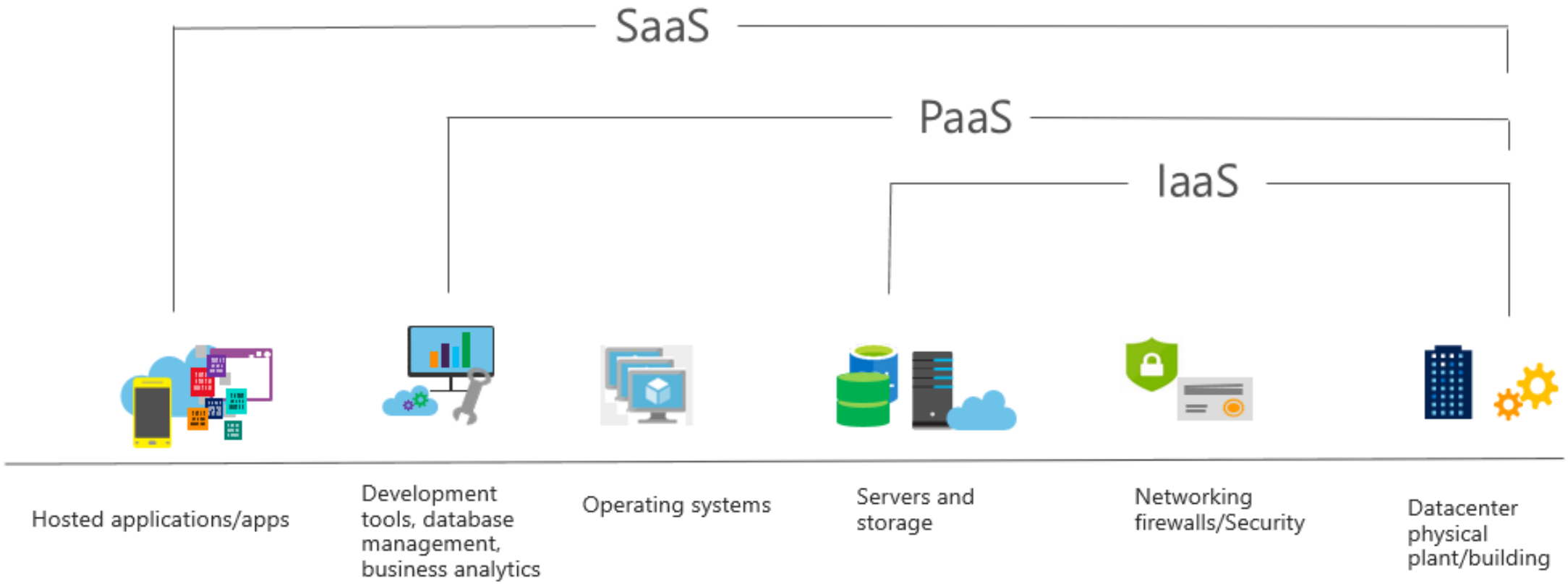
Define Platform as a Service (PaaS)



Provides environment for building, testing, and deploying software applications; without focusing on managing underlying infrastructure.

Microsoft

Define Software as a Service (SaaS)



Users connect to and use cloud-based apps over the internet: for example, Microsoft Office 365, email, and calendars.

Microsoft

Compare cloud services

IaaS

- The most flexible cloud service.
- You configure and manage the hardware for your application.

PaaS

- Focus on application development.
- Platform management is handled by the cloud provider.

SaaS

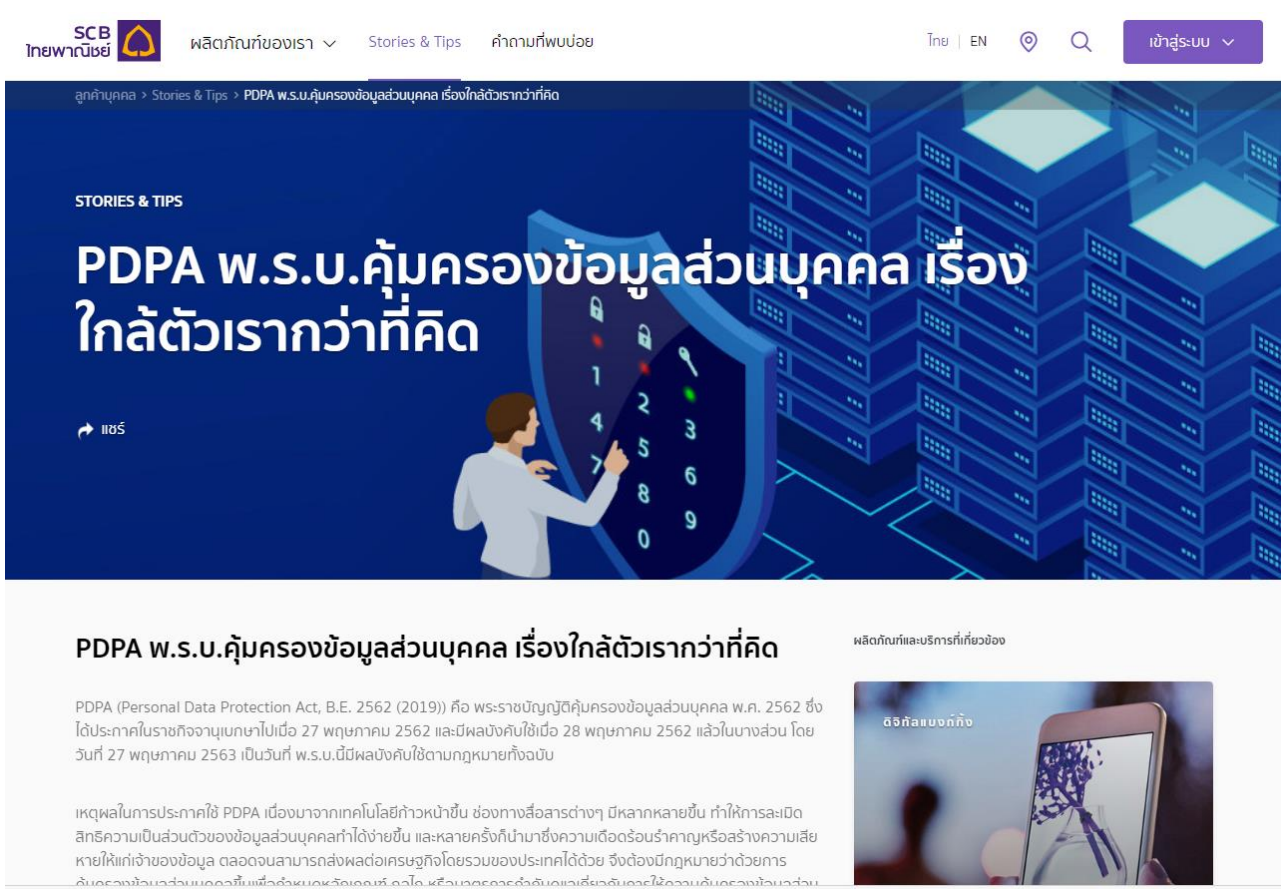
- Pay-as-you-go pricing model.
- Users pay for the software they use on a subscription model.

Microsoft

- Finance and Banking
- Telecommunication
- Retail
- Healthcare
- Agriculture
- Entertainment
- Real Estate

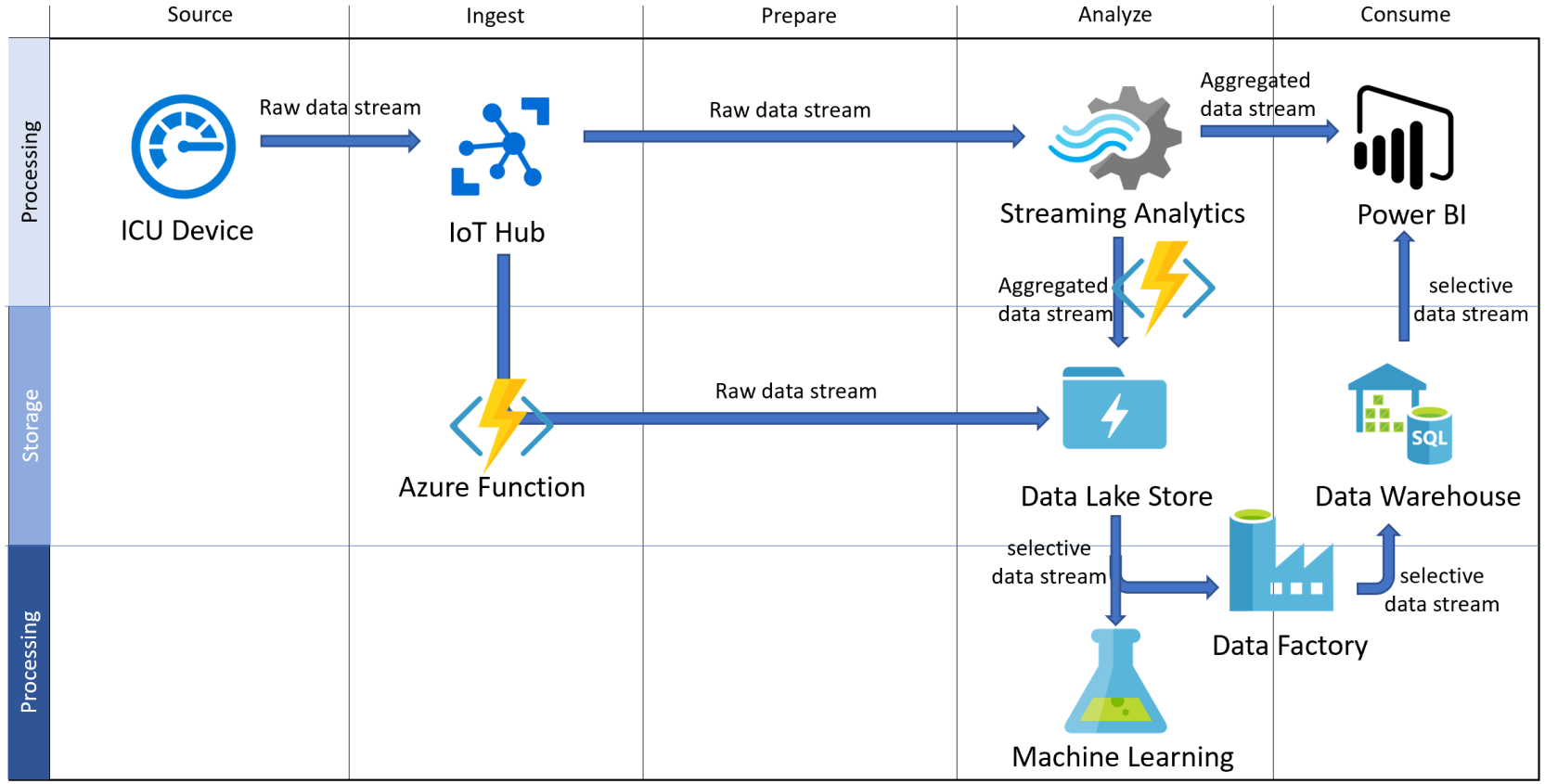
Big Data Use Case & Success Stories

- Data privacy is responsibly collecting, using and storing data about people, in line with the expectations of those people, your customers, regulations and laws.
- Data ethics is doing the right thing with data, considering the human impact from all sides, and making decisions based on your brand values.



Privacy and Ethics of Big Data

Content Reference : https://looker.com/blog/big-data-ethics-privacy



Big Data Project – Case Example (Azure)

Content Reference : Microsoft Corporation

What to use for Data

Storage Account

- When you need a **low cost, high throughput** data store.
- When you need to store **No-SQL** data.
- When you **do not need to query** the data directly. **No ad hoc query** support.
- Suits the storage of archive or **relatively static data.**
- Suits acting as a **HDInsight Hadoop** data store.

Data Lake Store

- When you need a **low cost, high throughput** data store.
- **Unlimited storage** for **No-SQL** data
- When you **do not need to query** the data directly. **No ad hoc query** support.
- Suits the storage of archive or **relatively static data.**
- Suits acting as a **Databricks** , **HDInsight** and **IoT** data store.

Azure Databricks

- **Eases the deployment** of a Spark based cluster.
- Enables the **fastest processing** of Machine Learning solutions.
- **Enables collaboration** between data engineers and data scientists.
- Provides **tight enterprise security integration** with Azure Active Directory
- **Integration with other Azure Services** and **Power BI.**

Azure CosmosDB

- Provides **global distribution** for both structured and unstructured data stores.
- **Millisecond query response** time.
- **99.999% availability** of data.
- **Worldwide elastic scale** of both the storage and throughput
- **Multiple consistency levels** to control data integrity with concurrency

Azure SQL Database

- When you require a **relational** data store.
- When you need to manage **transactional workloads**
- When you need to manage a **high volume on inserts and reads**
- When you need a service that **requires high concurrency**
- When you require a solution that can scale **elastically**

What to use for Data

Azure Synapse Analytics

- When you require an integrated **relational** and **big data** store.
- When you need to manage **data warehouse** and **analytical workloads**
- When you need **low cost storage**.
- When you require the ability to **pause and restart the compute**.
- When you require a solution that can scale **elastically**

Azure Stream Analytics

- When you require a **fully managed event processing** engine.
- When you require **temporal analysis of streaming** data.
- Support for analyzing **IoT streaming** data.
- Support for analyzing application data through **Event Hubs.**
- Ease of use with a **Stream Analytics Query Language**.

Azure Data Factory

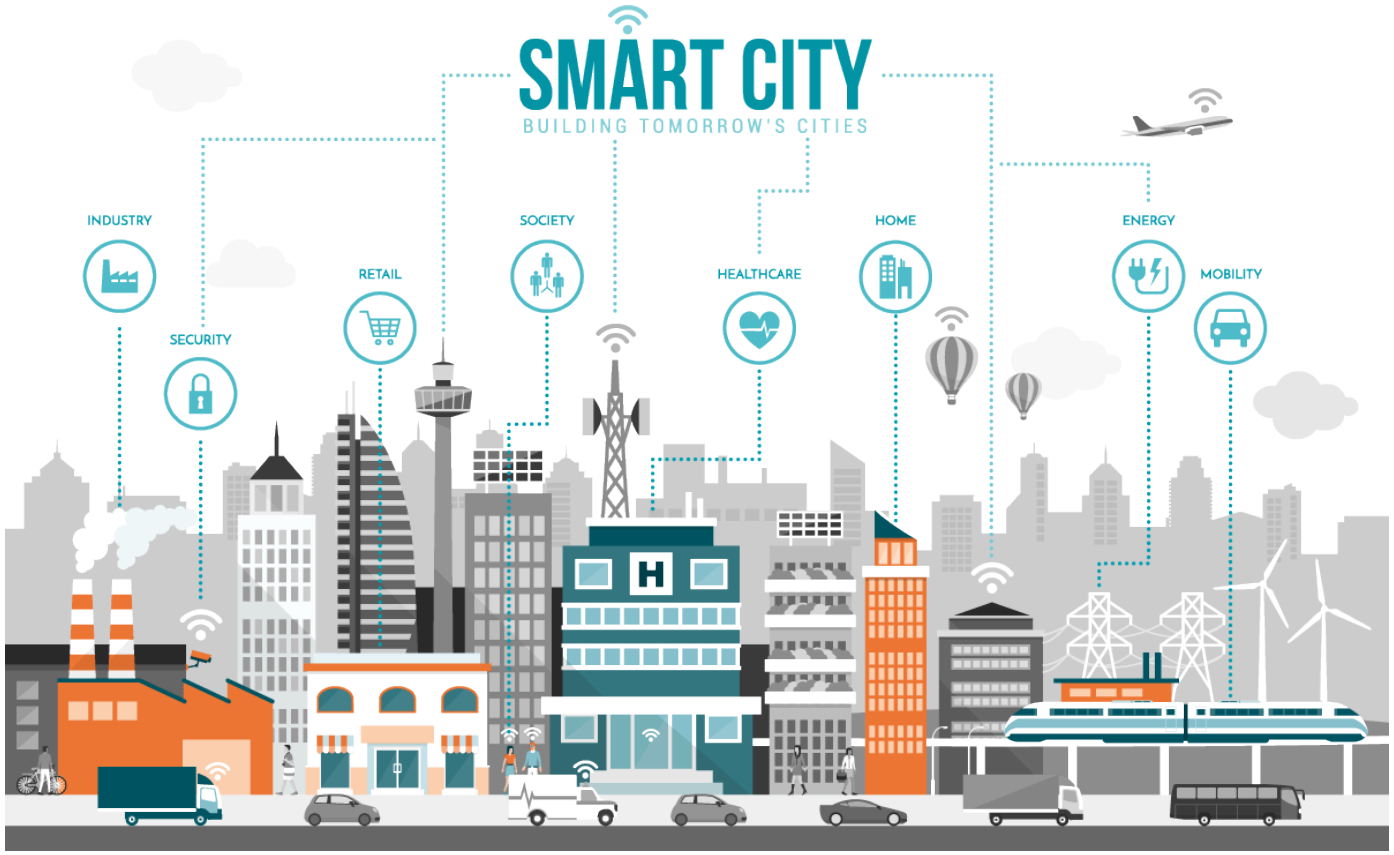
- When you want to **orchestrate the batch movement** of data.
- When you want to connect to **wide range of data platforms**.
- When you want to **transform or enrich** the data in movement.
- When you want to **integrate with SSIS packages**.
- Enables **verbose logging** of data processing activities.

Azure HDInsight

- When you need a **low cost, high throughput** data store.
- When you need to store **No-SQL** data.
- Provides a Hadoop **Platform as a Service** approach
- Suits acting as a **Hadoop, Hbase, Storm or Kafka** data store.
- **Eases the deployment and management** of clusters.

Azure Data Catalog

- When you require **documentation** of your data stores.
- When you require a **multi user** approach to documentation.
- When you need to **annotate data sources** with descriptive metadata.
- A **fully managed cloud service** whose users can discover the data sources.
- When you require **a solution that can help business users** understand their data.



Smart City

Content Reference : https://www.arcweb.com/industries/smart-cities

Smart Farm

Content Reference : https://www.luda.farm/

04 - Big Data Sources

- Enterprise Data are functionally different application supporting the business operations in various departments.

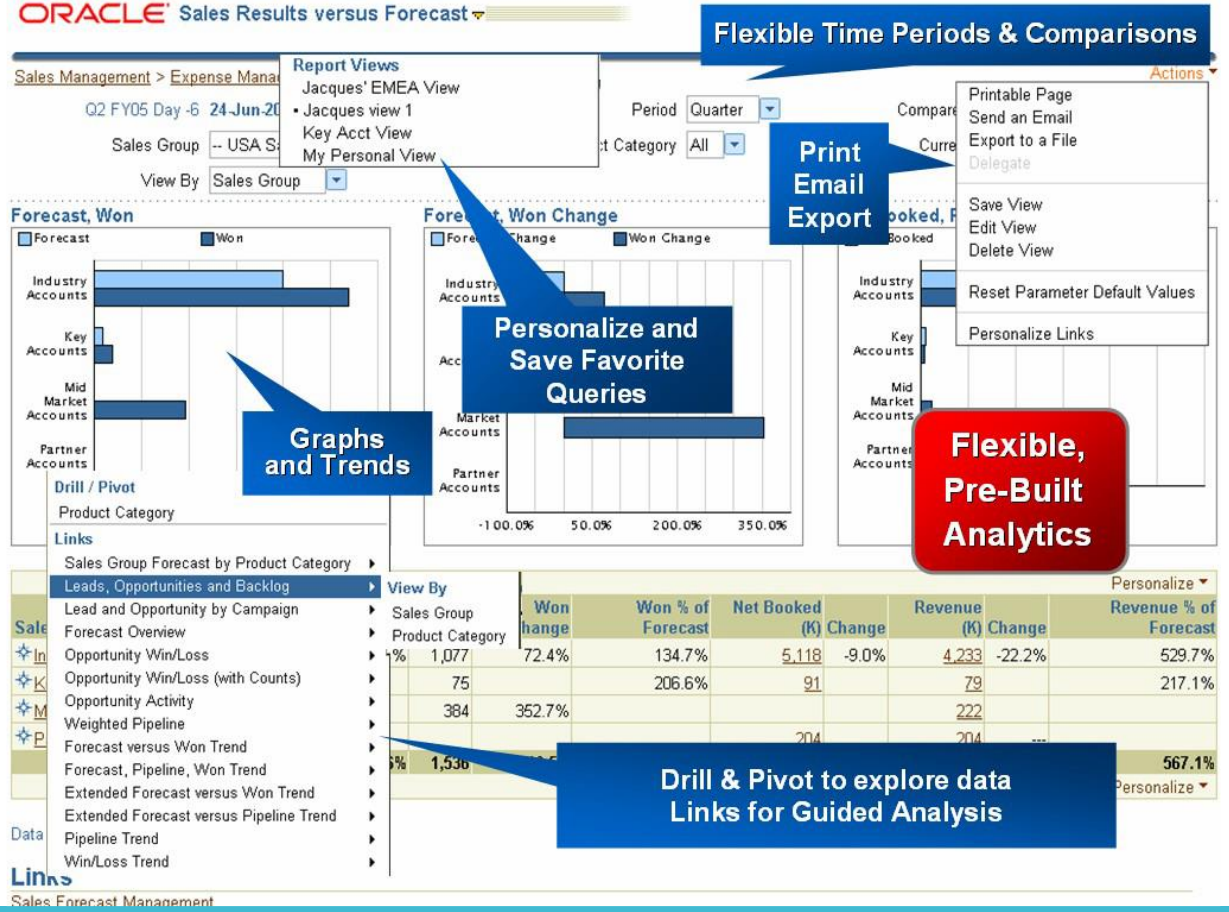
- Enterprise Data Sources within an organization integrate and retrieve data for both internal applications and external communication.

- Enterprise Data Sources ensure trust and confidence in data assets.

Introduction to Enterprise Data Source

Enterprise System

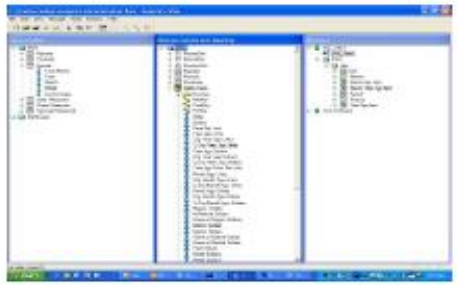
- The vast majority of contemporary Enterprise Systems are based on relational database technology and, consequently, provide well-structured datasets that can be easily accessed.
- Enterprise Systems are Oracle, SQL Server, DB2, SAP, ….
- Use ODBC, JDBC, OLEDE, … For access to dataset.



- Oracle provides a range of "Enterprise Application" including HR/Payroll, Finance, Customer Relationship Management (CRM).
- Oracle suite of application is Oracle E-Business Suite, PeopleSoft and JD Edwards.

Enterprise System - Oracle

Define



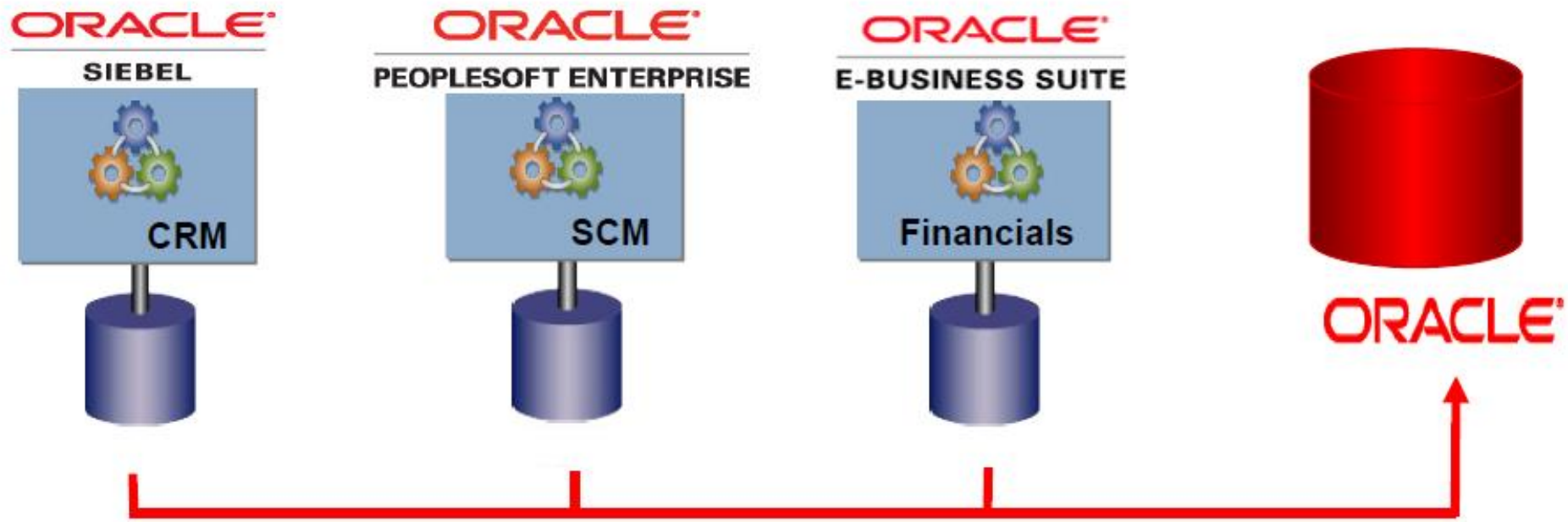
Analyze

Report

Consistent Multi-Source Intelligence

BI EE Analytic Server

- **Enterprise Semantic Model**
- **Multi-Source Data Warehouse Model**
- **Pre-Packaged Dashboards**
- **Pre-Packaged ETL Maps**



Enterprise System - SAP

- SAP providers enterprise application that include modules such as HR/Payroll, Finance, and SAP Suite of offering also includes a number of vertical application.

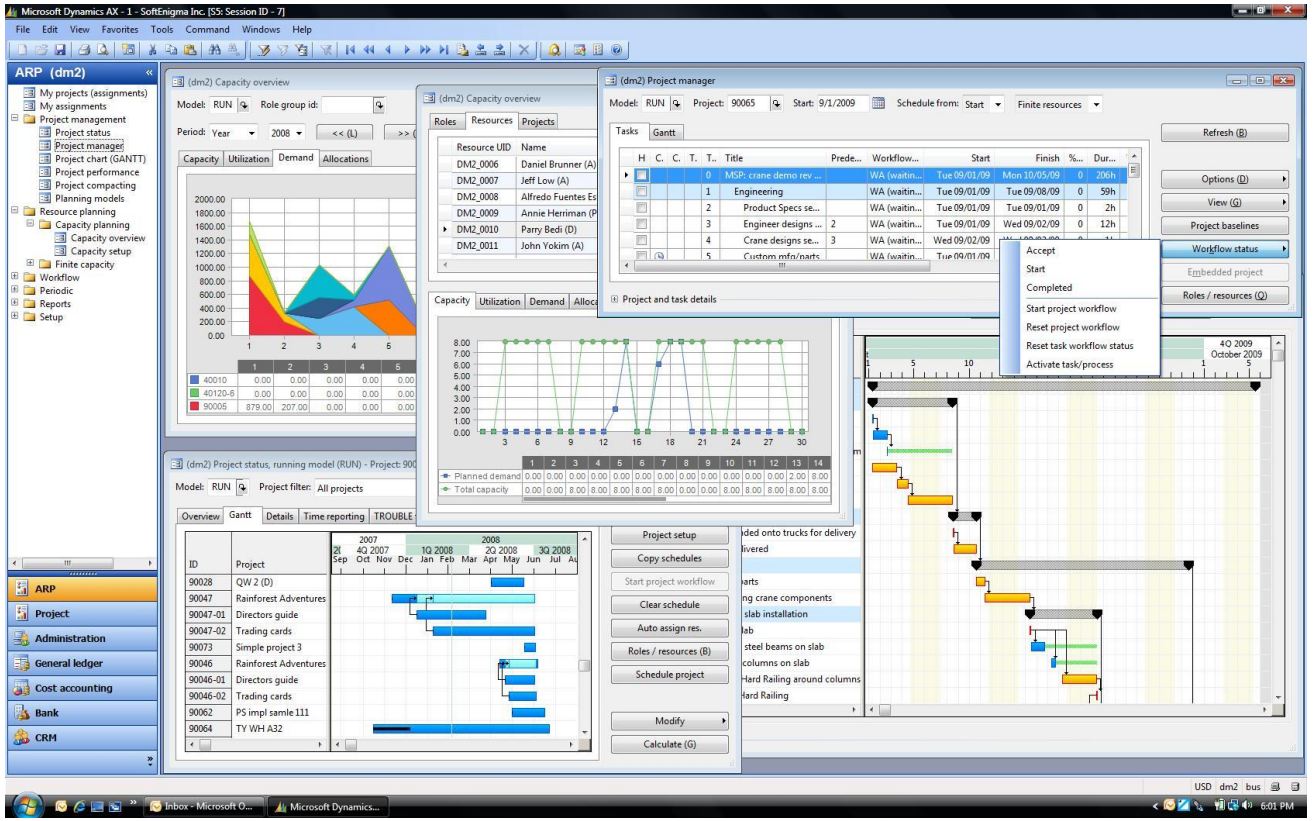
- Extracting data from SAP is more difficult than other enterprise system since SAP users a proprietary language, ABAP, for data manipulation. Additionally, SAP database use tables which are different from standard database.

- In order to extract data from SAP we need to use additional tools.

  - SAP Connector from Oracle
  - SAP Business Connector
  - SAP Java Connector
  - SAP .NET Connector from SAP

- Microsoft provides a set of enterprise application through its Dynamic suite. The suite includes CRM and ERP modules and is targeted at small and medium enterprises.

- The Microsoft Dynamics Suite is based on relational database technology (SQL Server)



Enterprise System - Microsoft

- Defined in many different ways, but not rigorously.
  - A decision support database that is maintained separately from the organization's operational database
  - Support information processing by providing a solid platform of consolidated, historical data for analysis.
- "A data warehouse is a subject-oriented, integrated, time-variant, and nonvolatile collection of data in support of management's decision-making process."—W. H. Inmon
- Data warehousing: The process of constructing and using data warehouses

Data Warehouse

Content Reference : Jiawei Han, Micheline Kamber, and Jian Pei University of Illinois at Urbana-Champaign & Simon Fraser University

- Organized around major subjects, such as customer, product, sales
- Focusing on the modeling and analysis of data for decision makers, not on daily operations or transaction processing
- Provide a simple and concise view around particular subject issues by excluding data that are not useful in the decision support process

Data Warehouse : Subject-Oriented

Content Reference : Jiawei Han, Micheline Kamber, and Jian Pei University of Illinois at Urbana-Champaign & Simon Fraser University

- Constructed by integrating multiple, heterogeneous data sources

  - relational databases, flat files, on-line transaction records

- Data cleaning and data integration techniques are applied.

  - Ensure consistency in naming conventions, encoding structures, attribute measures, etc. among different data sources E.g., Hotel price: currency, tax, breakfast covered, etc.

  - When data is moved to the warehouse, it is converted.

Data Warehouse : Integrated

Content Reference : Jiawei Han, Micheline Kamber, and Jian Pei University of Illinois at Urbana-Champaign & Simon Fraser University

- The time horizon for the data warehouse is significantly longer than that of operational systems
  - Operational database: current value data
  - Data warehouse data: provide information from a historical perspective (e.g., past 5-10 years)

- Every key structure in the data warehouse
  - Contains an element of time, explicitly or implicitly
  - But the key of operational data may or may not contain "time element"

Data Warehouse : Time Variant

Content Reference : Jiawei Han, Micheline Kamber, and Jian Pei University of Illinois at Urbana-Champaign & Simon Fraser University

- A physically separate store of data transformed from the operational environment
- Operational update of data does not occur in the data warehouse environment
  - Does not require transaction processing, recovery, and concurrency control mechanisms
  - Requires only two operations in data accessing: initial loading of data and access of data

Data Warehouse : Nonvolatile

Content Reference : Jiawei Han, Micheline Kamber, and Jian Pei University of Illinois at Urbana-Champaign & Simon Fraser University

	OLTP	OLAP
users	clerk, IT professional	knowledge worker
function	day to day operations	decision support
DB design	application-oriented	subject-oriented
data	current, up-to-date detailed, flat relational isolated	historical, summarized, multidimensional integrated, consolidated
usage	repetitive	ad-hoc
access	read/write index/hash on prim. key	lots of scans
unit of work	short, simple transaction	complex query
# records accessed	tens	millions
#users	thousands	hundreds
DB size	100MB-GB	100GB-TB
metric	transaction throughput	query throughput, response

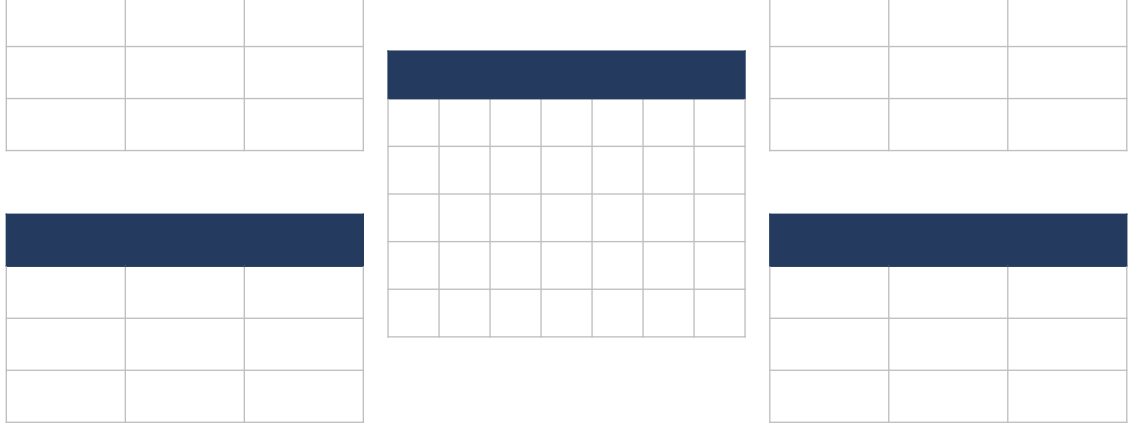
Content Reference : Jiawei Han, Micheline Kamber, and Jian Pei University of Illinois at Urbana-Champaign & Simon Fraser University

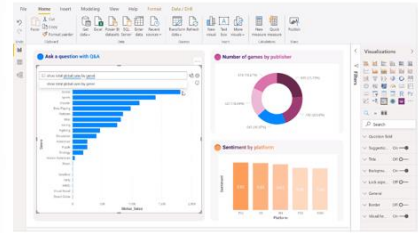
Online Transactional Processing (OLTP)

Customer		
CustomerID	CustomerName	CustomerPhone

Orders		
OrderID	CustomerID	OrderDate

Online Analytical Processing (OLAP)





Transactional vs analytical data stores

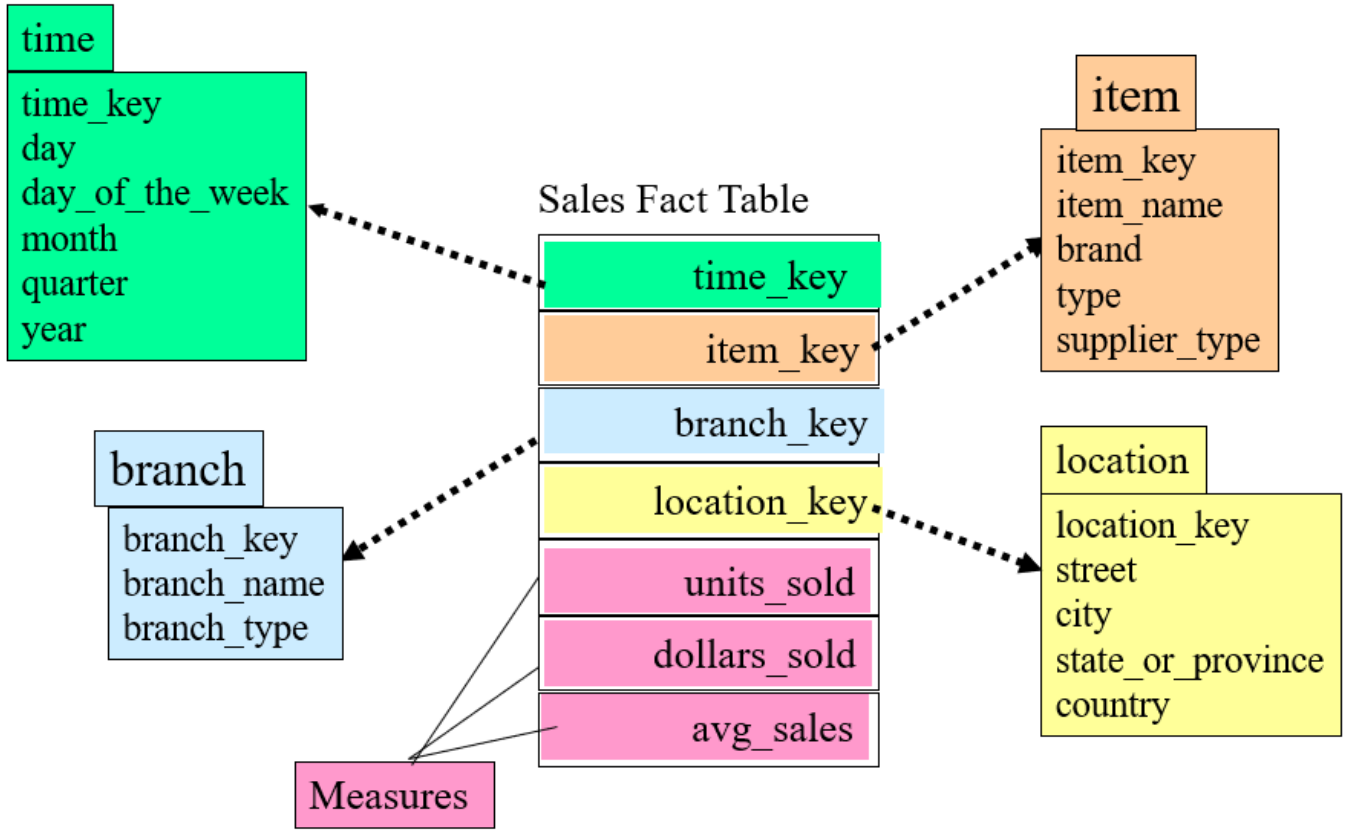
Content Reference : Microsoft Corporation [DP-900 : Microsoft Azure Data Fundamentals]

Modeling data warehouses: dimensions & measures

- **Star schema**: A fact table in the middle connected to a set of dimension tables
- **Snowflake schema**: A refinement of star schema where some dimensional hierarchy is normalized into a set of smaller dimension tables, forming a shape similar to snowflake
- **Fact constellations**: Multiple fact tables share dimension tables, viewed as a collection of stars, therefore called galaxy schema or fact constellation

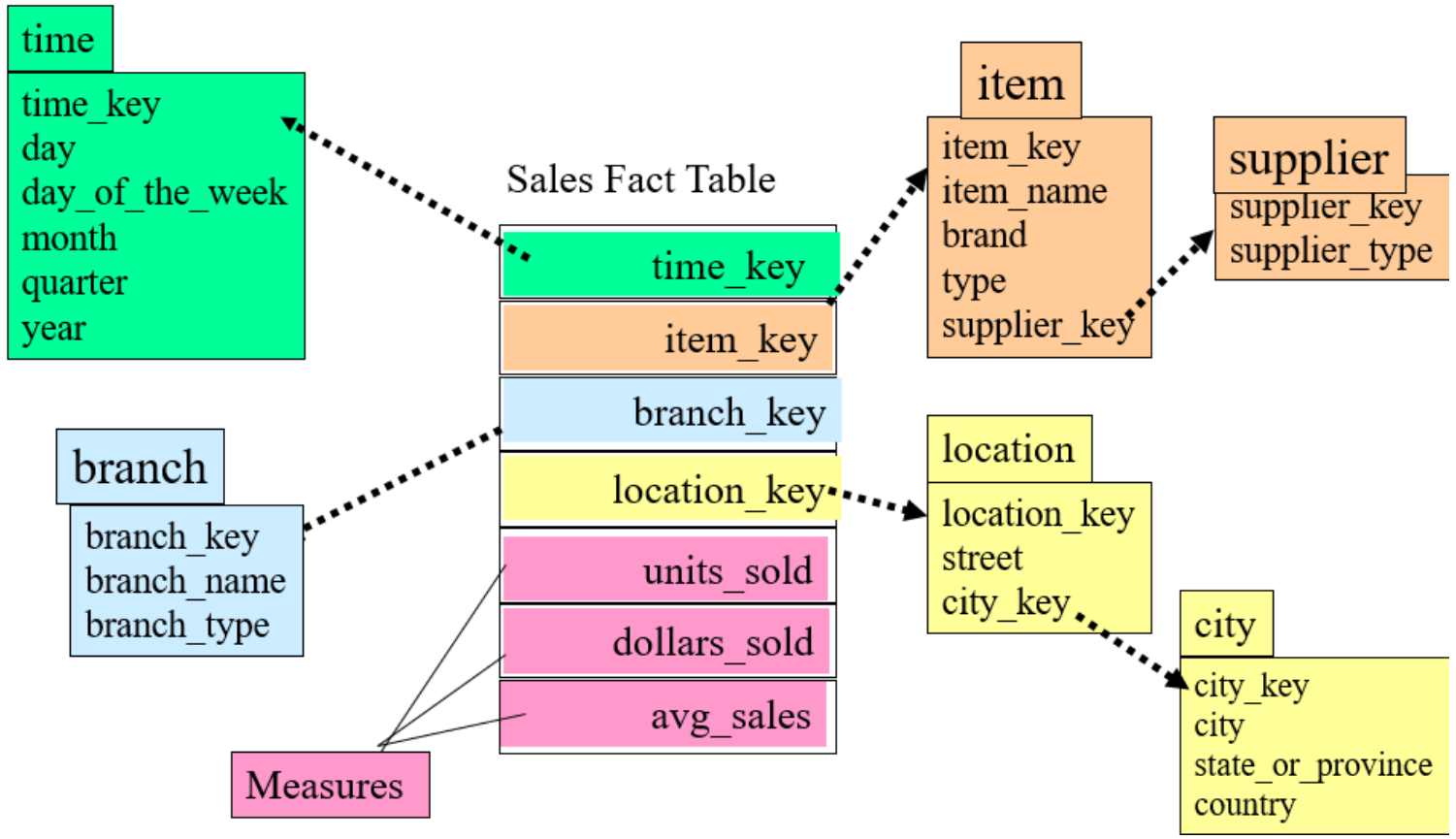
Conceptual Modeling of Data Warehouses

Content Reference : Jiawei Han, Micheline Kamber, and Jian Pei University of Illinois at Urbana-Champaign & Simon Fraser University



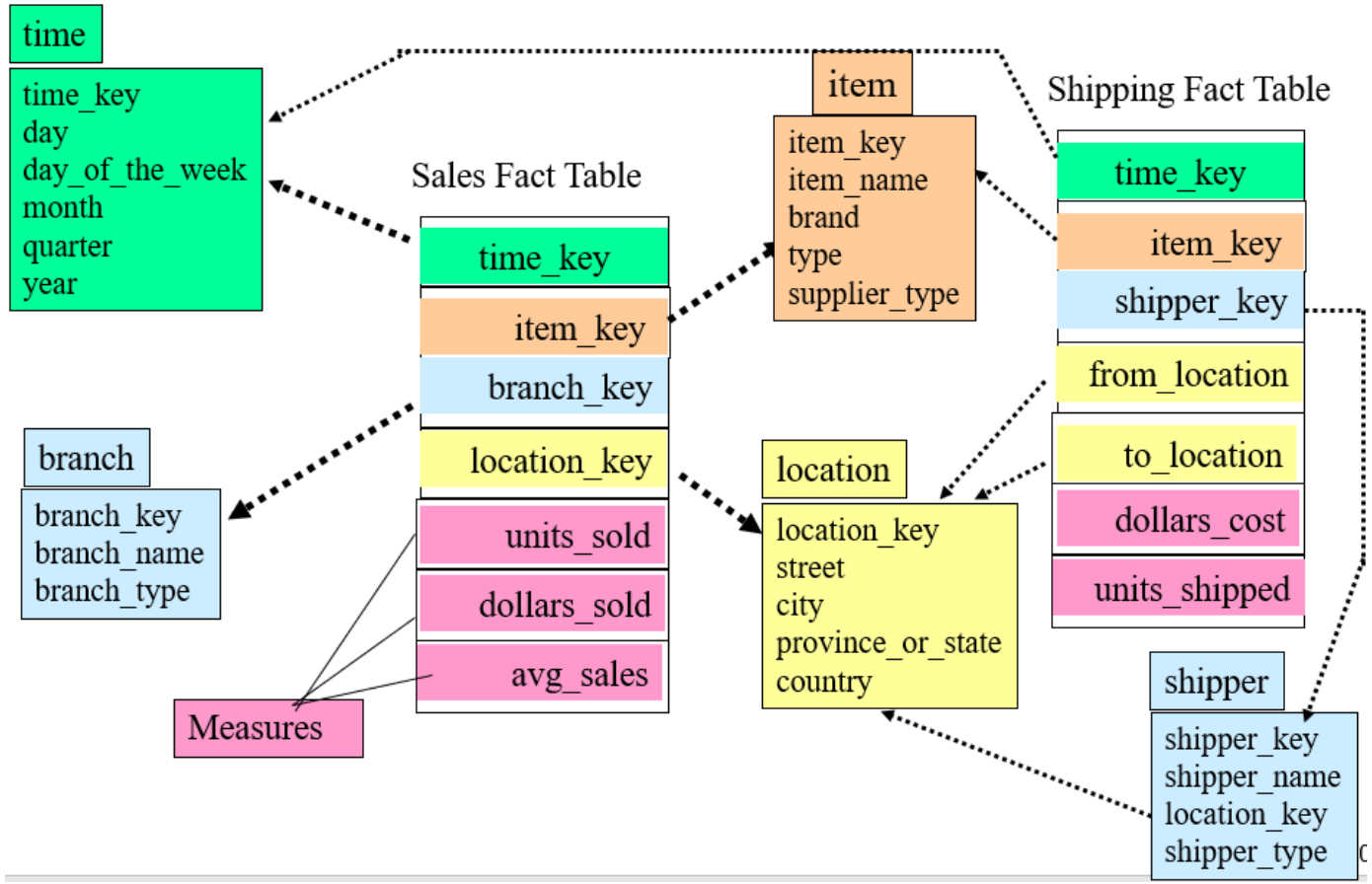
Example of Star Schema

Content Reference : Jiawei Han, Micheline Kamber, and Jian Pei University of Illinois at Urbana-Champaign & Simon Fraser University



Example of Snowflake Schema

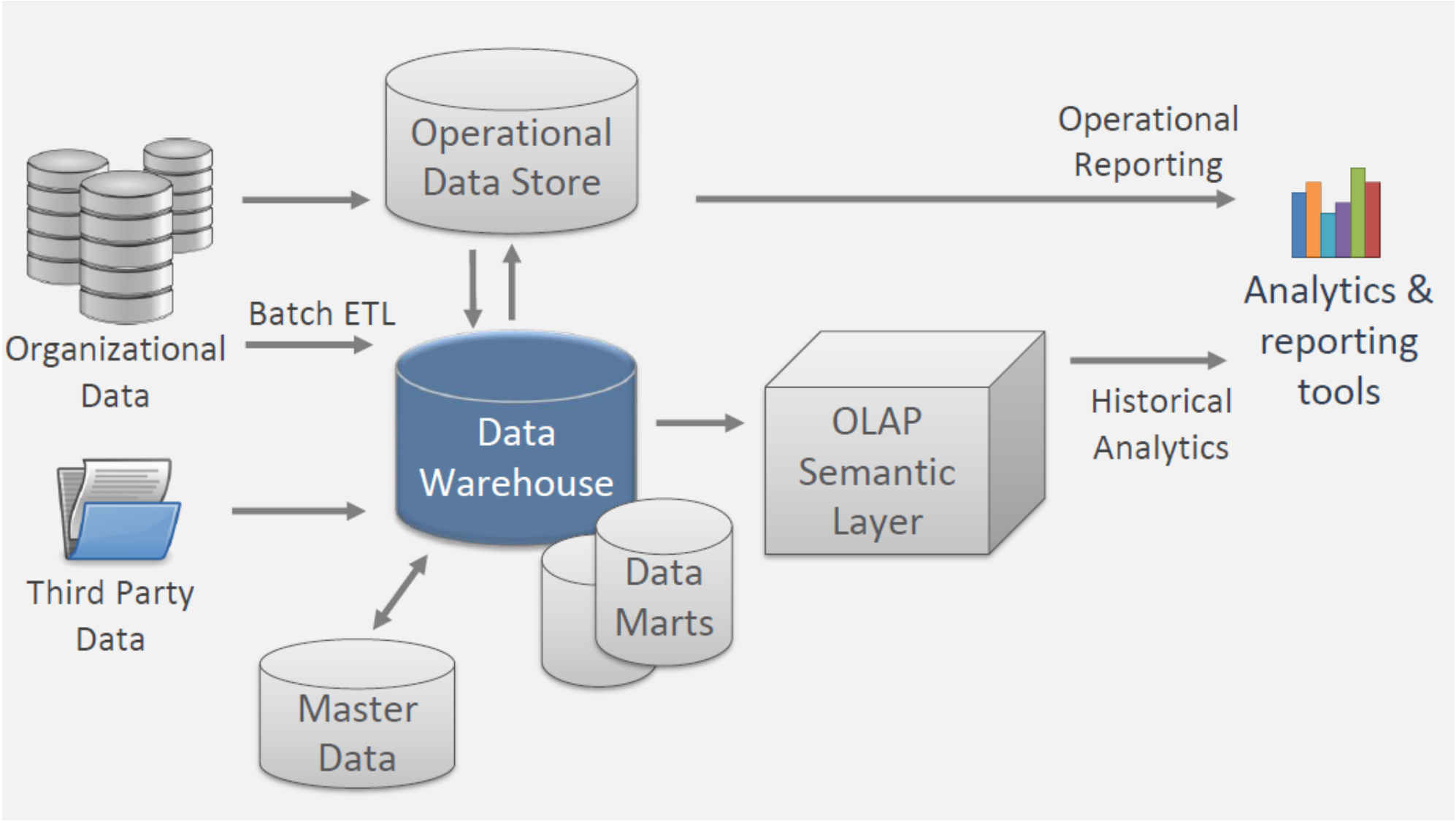
Content Reference : Jiawei Han, Micheline Kamber, and Jian Pei University of Illinois at Urbana-Champaign & Simon Fraser University



Example of Fact Constellation

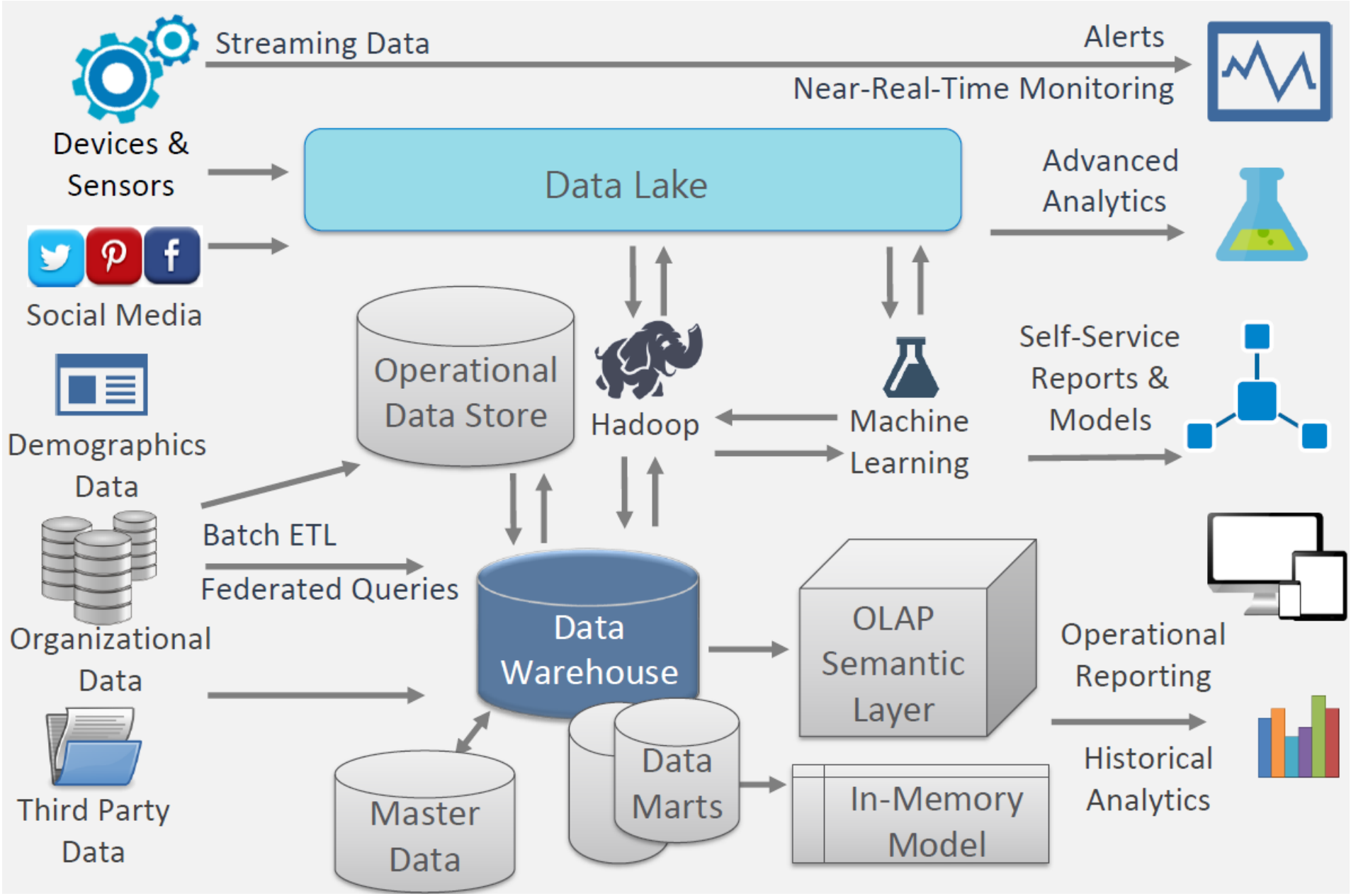
Content Reference : Jiawei Han, Micheline Kamber, and Jian Pei University of Illinois at Urbana-Champaign & Simon Fraser University

Traditional Data Warehousing



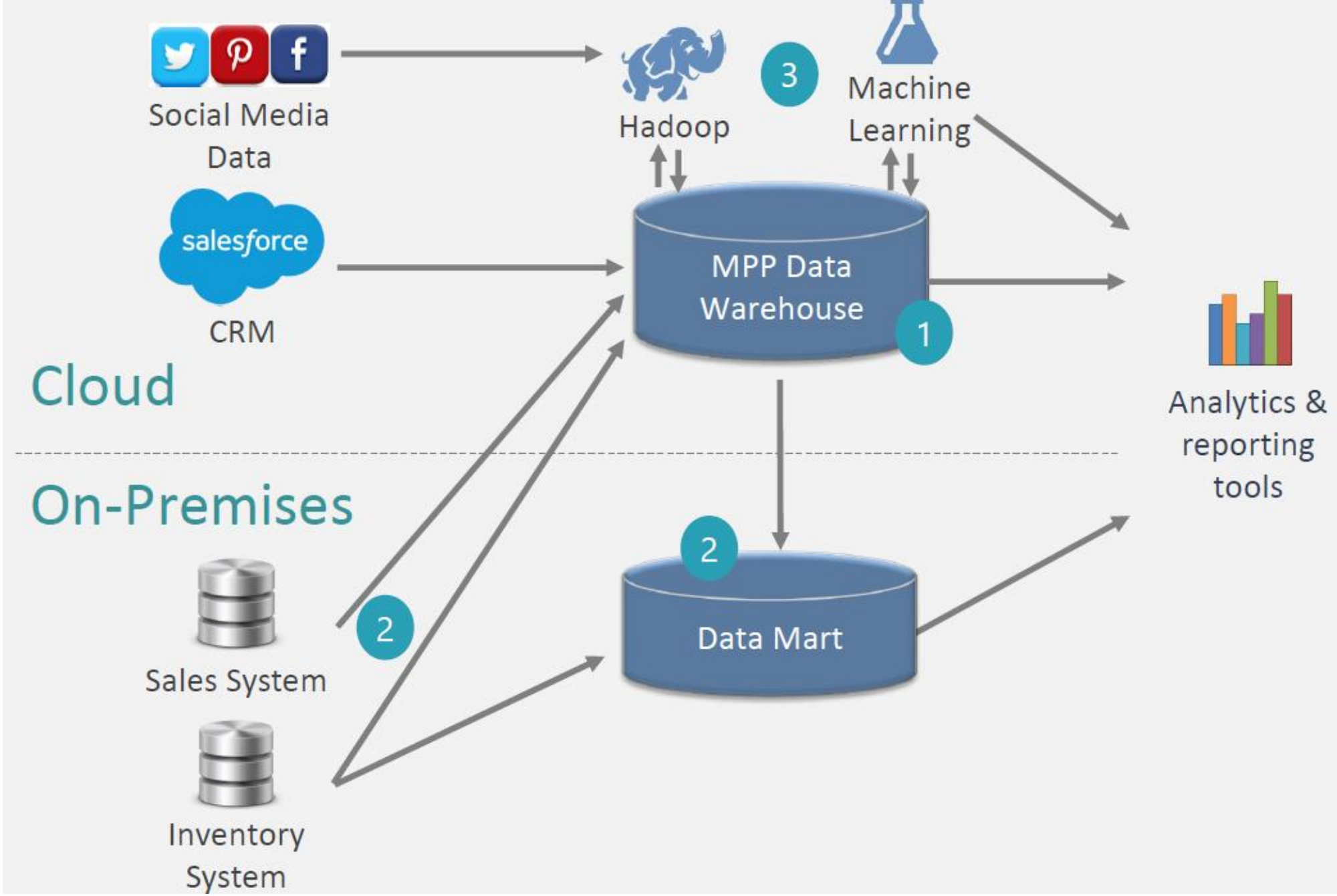
Content Reference : Melissa Coates [Blog: sqlchick.com/Twitter: @sqlchick]

Modern Data Warehouses



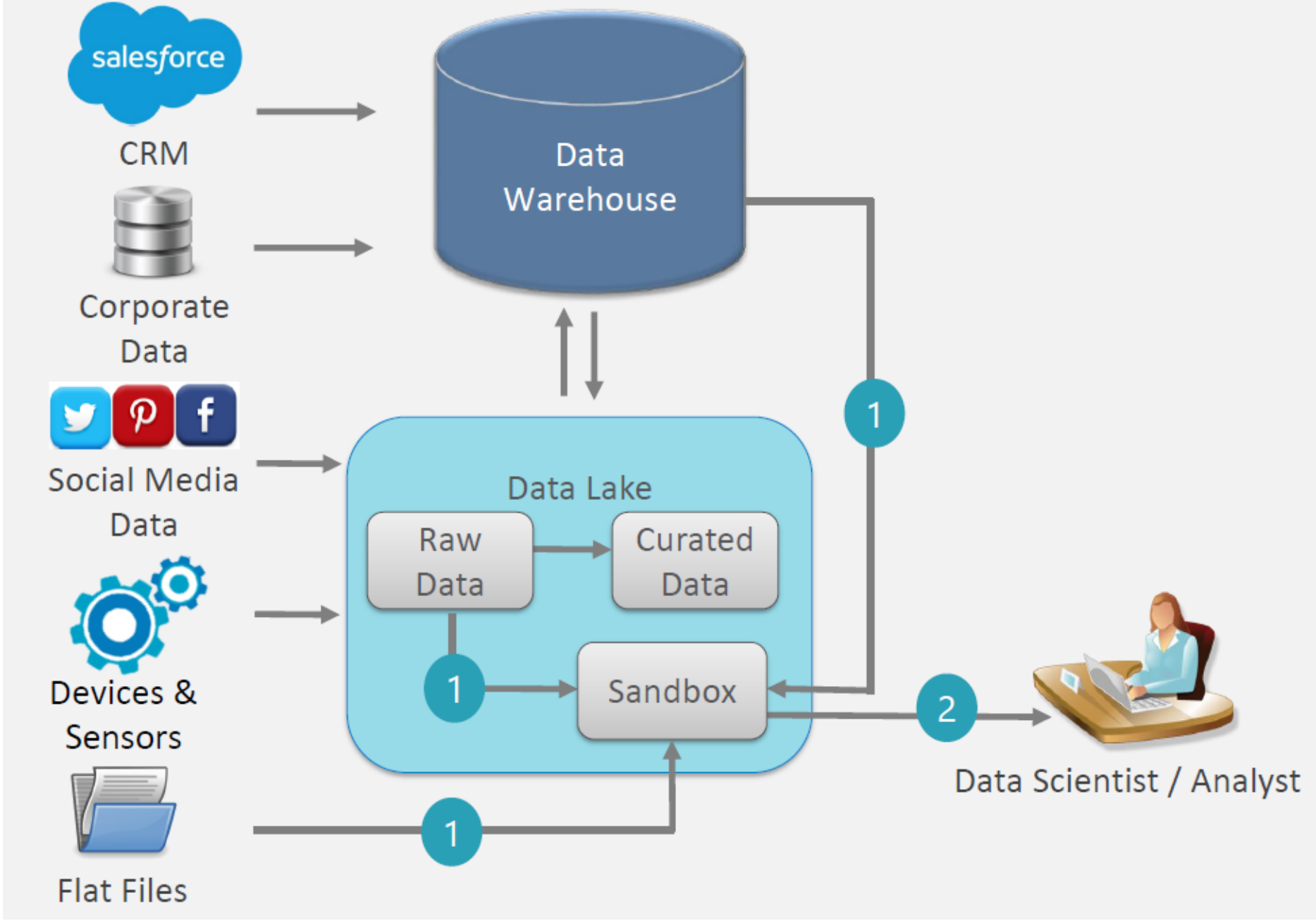
Content Reference : Melissa Coates [Blog: sqlchick.com/Twitter: @sqlchick]

Hybrid Architecture



Content Reference : Melissa Coates [Blog: sqlchick.com/Twitter: @sqlchick]

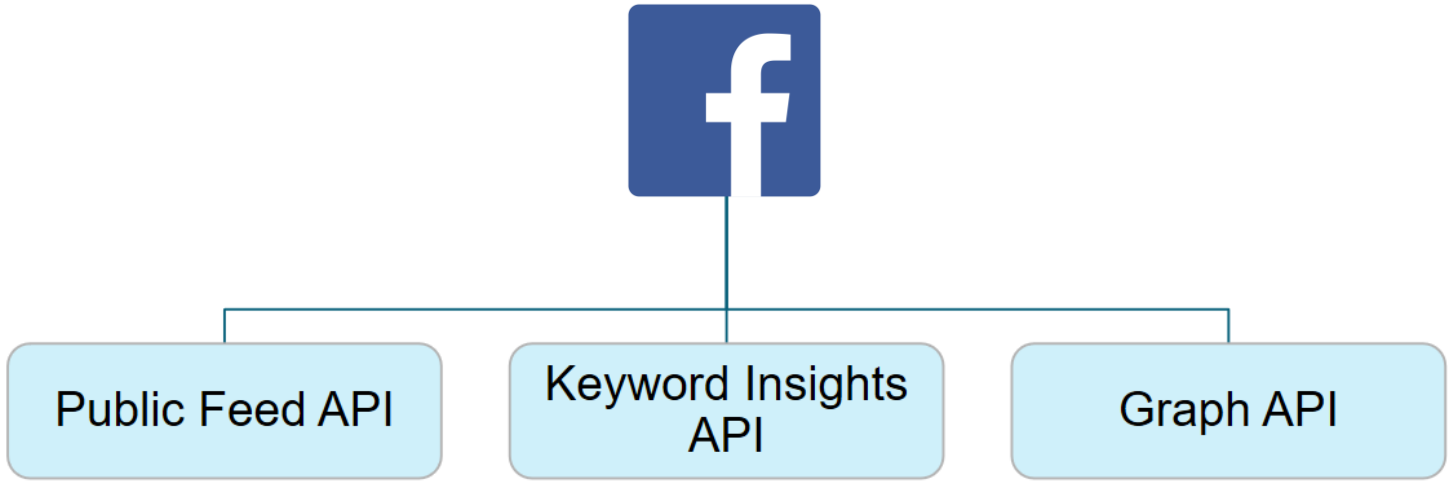
Sandbox Solutions

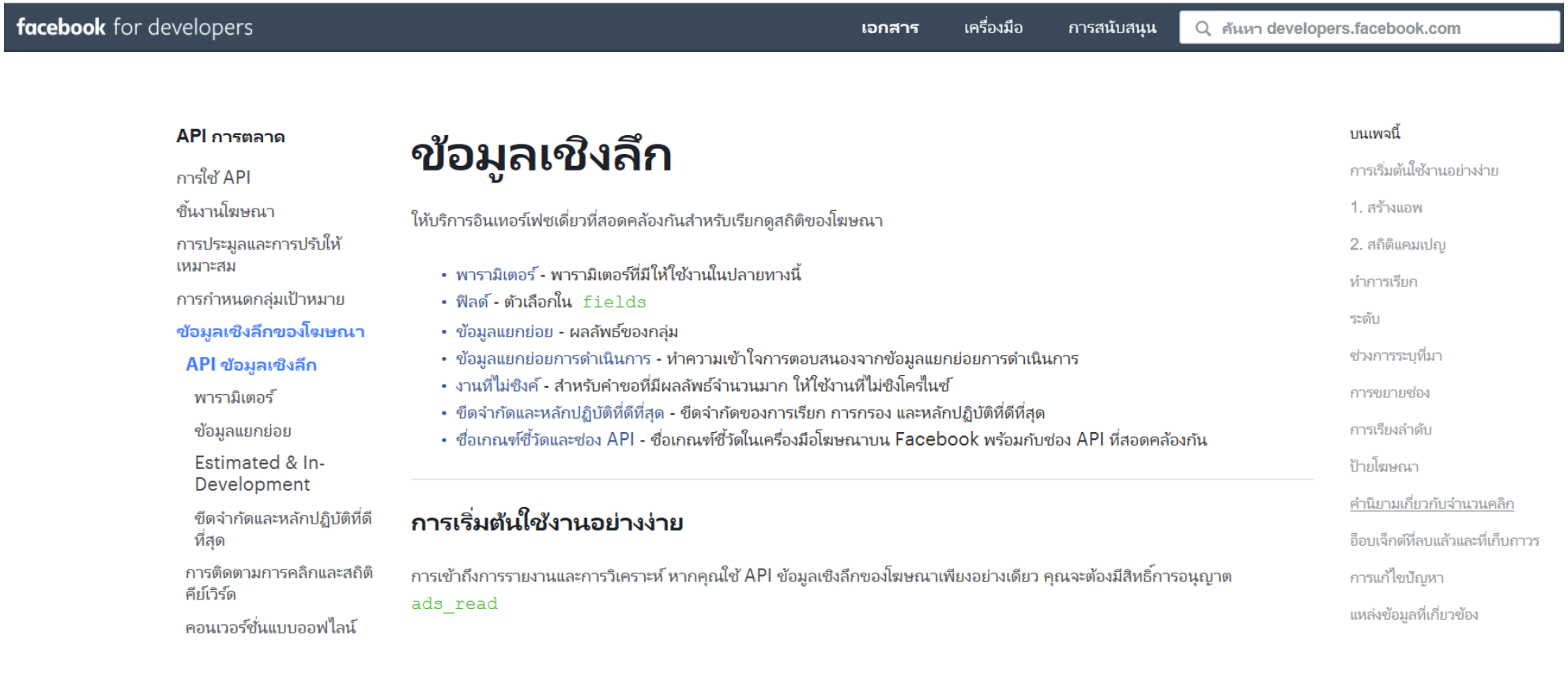


Content Reference : Melissa Coates [Blog: sqlchick.com/Twitter: @sqlchick]

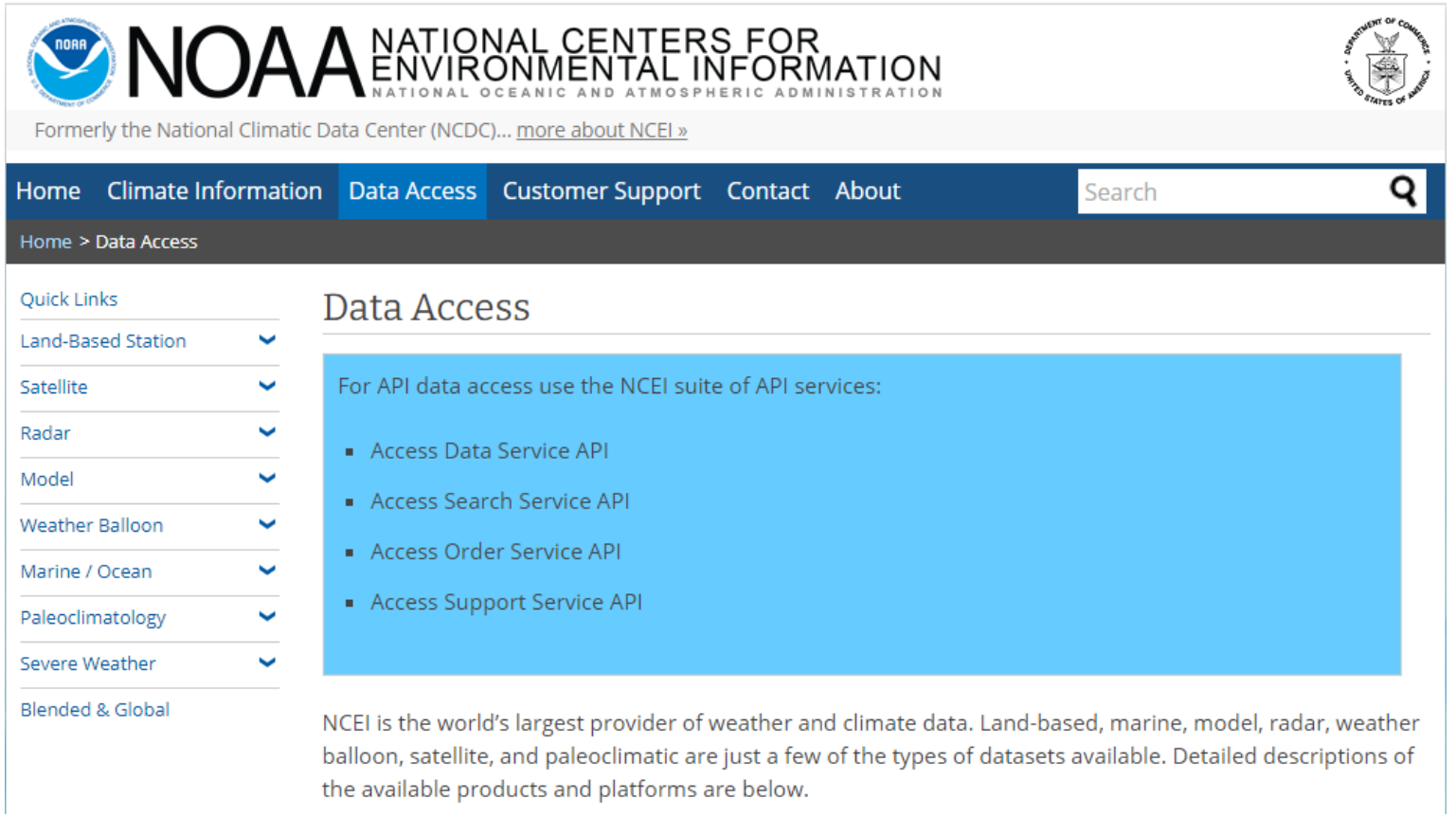
Social Media Data Sources - Facebook

- Facebook provides several ways to access its data streams. The access is done through separate Application Programming Interface (APIs)
- Some APIs are available only to certain organizations and currently cannot be accessed by the general public.



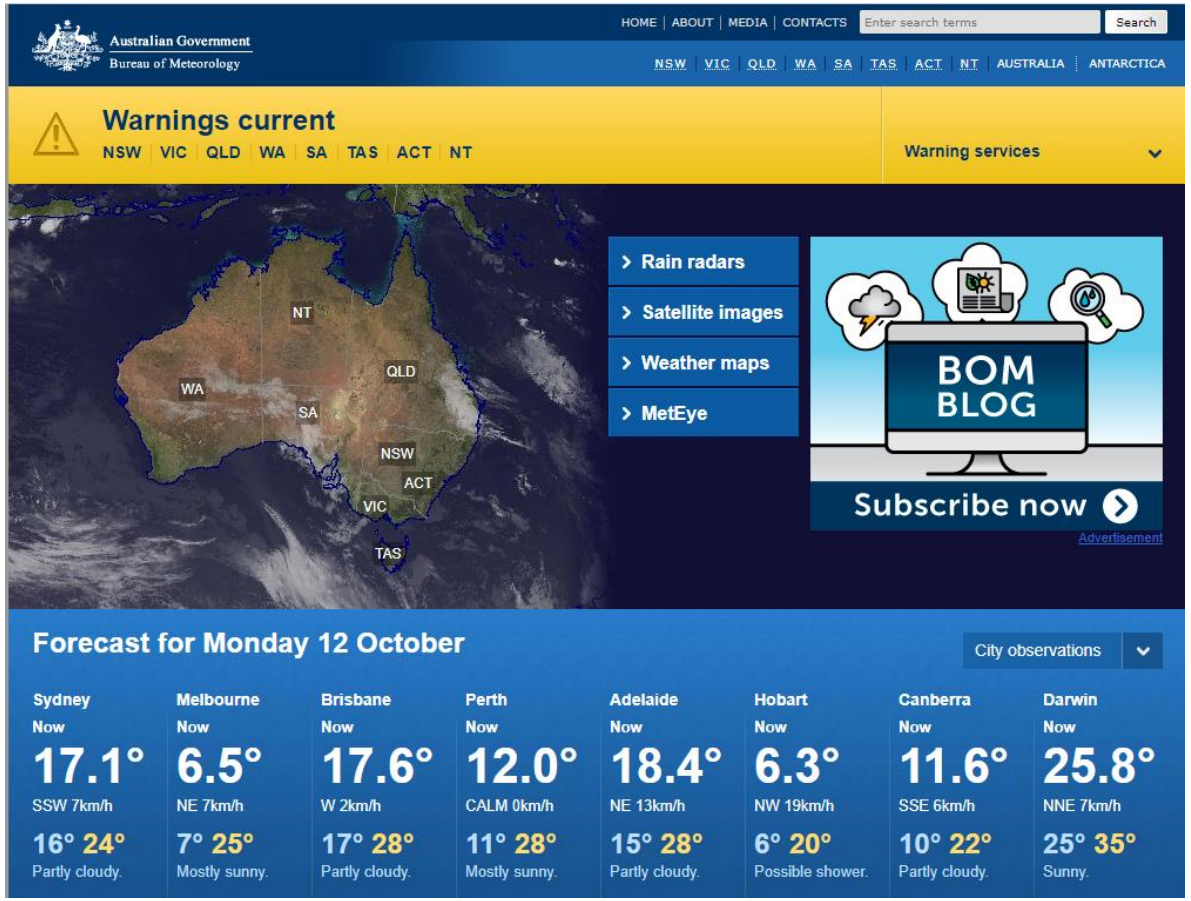


Social Media Data Sources - Facebook



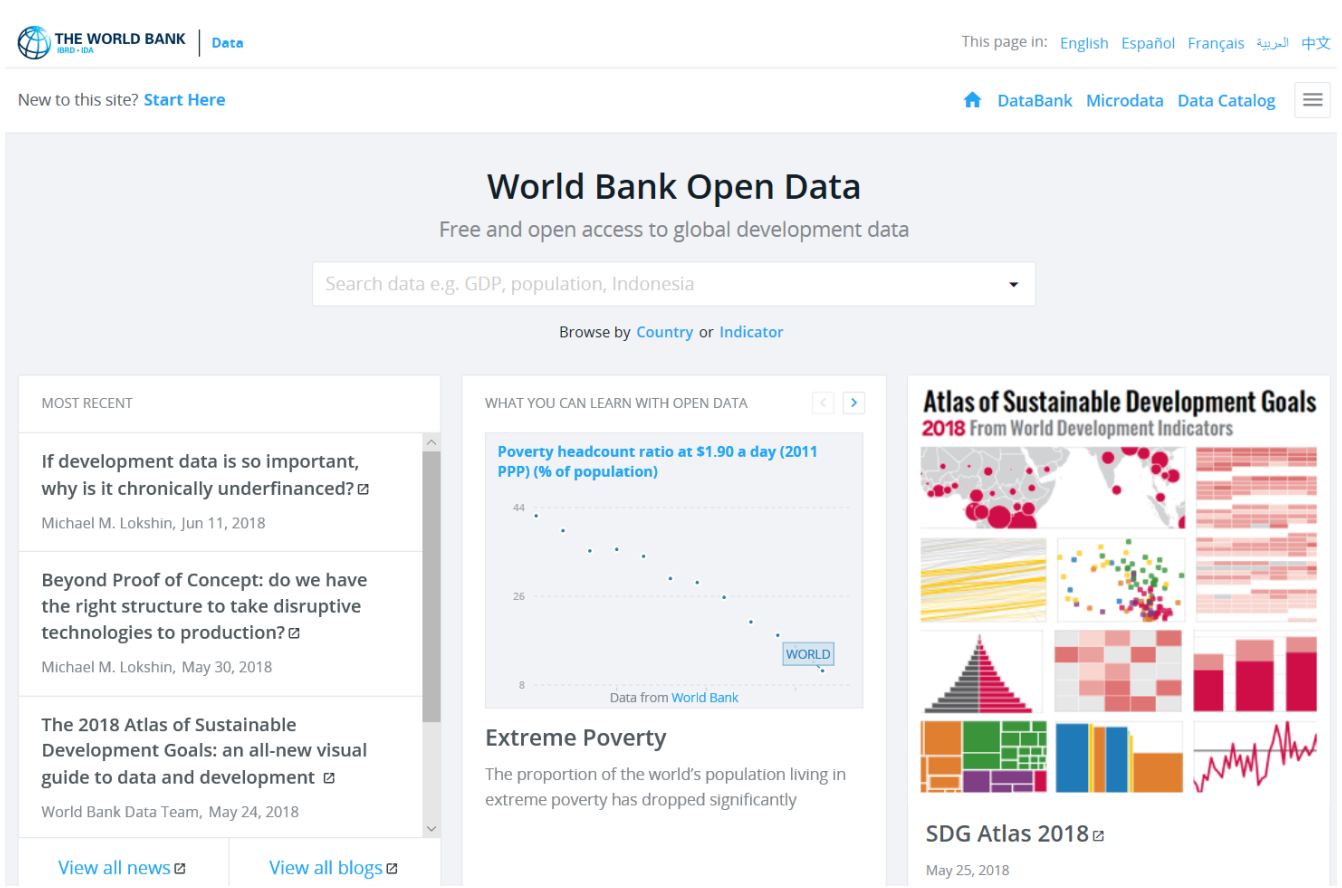
Public Data Sources - Weather

Content Reference : https://www.ncdc.noaa.gov/data-access



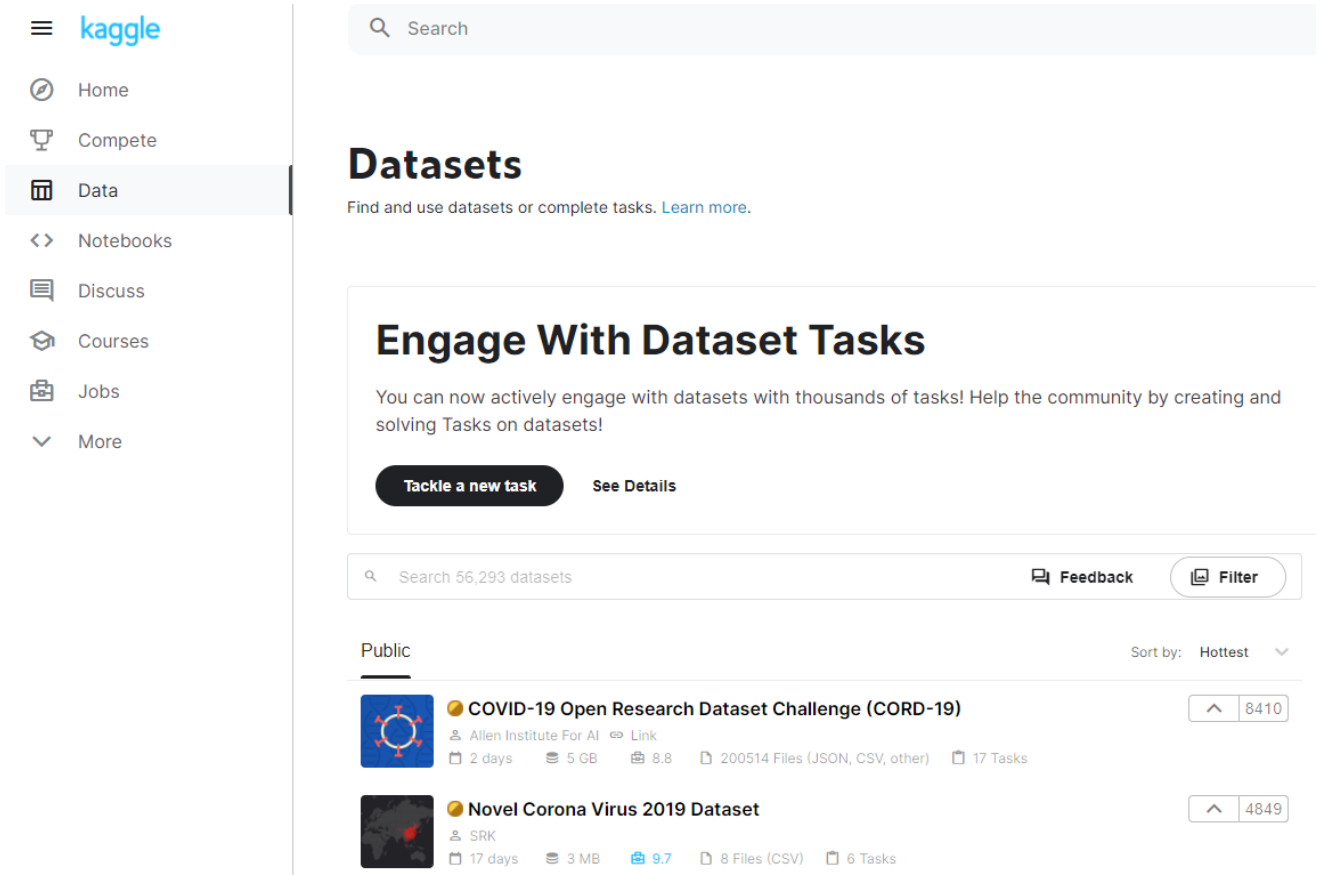
Public Data Sources - Weather

Content Reference : http://www.bom.gov.au/



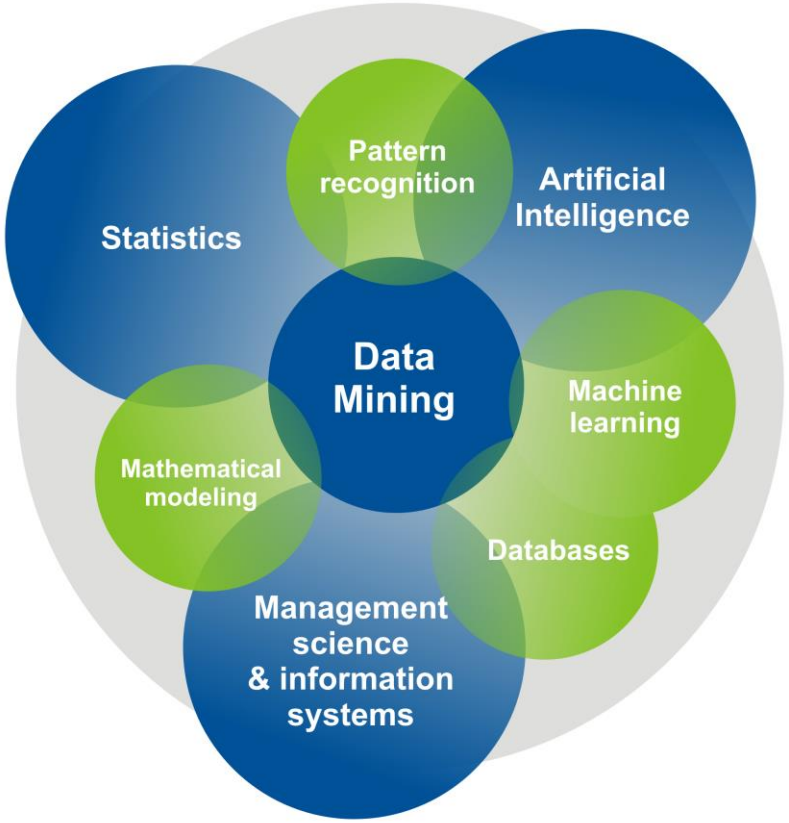
Public Data Sources – Economics & Finance

Content Reference : https://data.worldbank.org/



kaggle

Content Reference : https://www.kaggle.com/datasets



- Data mining is the process of discovering patterns in large data sets involving methods at the intersection of machine learning, statistics, and database systems.

Introduction to Data Mining

Content Reference : https://olucampbellcom.wordpress.com/

Why Data Mining?

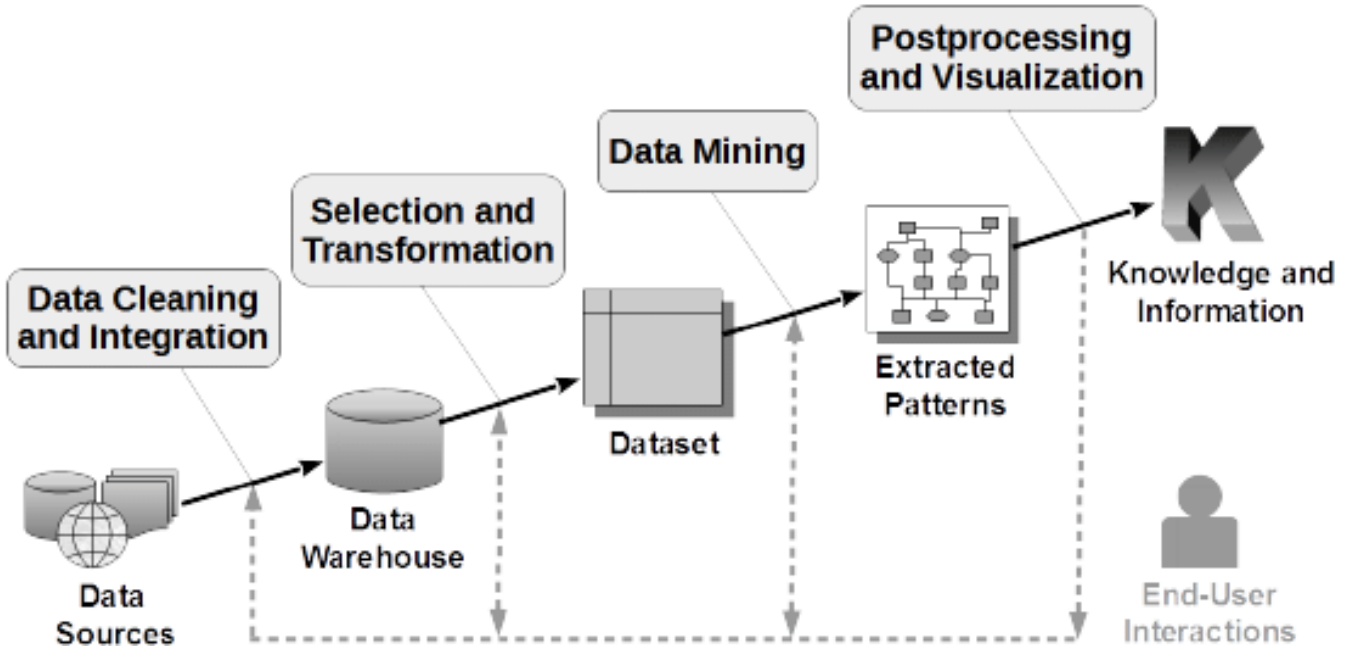
- The explosive growth in data collection
  - The storing of data in data warehouses.
  - The availability of increased access to data from Web navigation and intranet.

  *** **We have to find a more effective way to use these data in decision support process than just using traditional query languages** ***

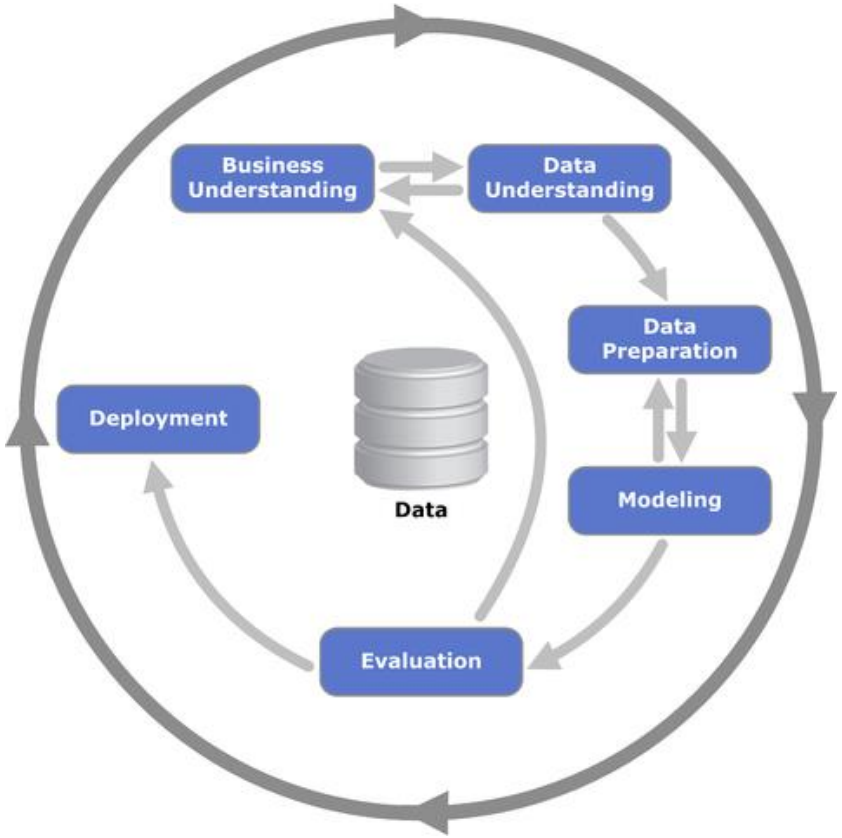
- Knowledge discovery in databases
- Knowledge extraction
- Data archeology
- Data exploration
- Data pattern processing
- Data dredging

Data Mining - Objectives

- Data Cleaning
- Data Integration
- Data Selection
- Data Transformation
- Data Mining
- Pattern Evaluation
- Knowledge Representation



Data Mining Process



Cross-Industry process for data mining

Data Mining Process - CRISP-DM

Content Reference : https://www.stitchdata.com/resources/what-is-data-mining/

- Prediction
  - how certain attributes within the data will behave in the future.
- Identification
  - identify the existence of an item, an event, an activity.
- Classification
  - partition the data into categories.
- Optimization
  - optimize the use of limited resources.

Data Mining - Goals

Basic Types of Data Mining

- **Association**

  - Providing the rules correlate the presence of a set of items with another set of item.

- **Classification**

  - Classification is the process of learning a model that describes different classes of data, the classes are predetermined.

  - The model that is produced is usually in the form of a decision tree or a set of rules.

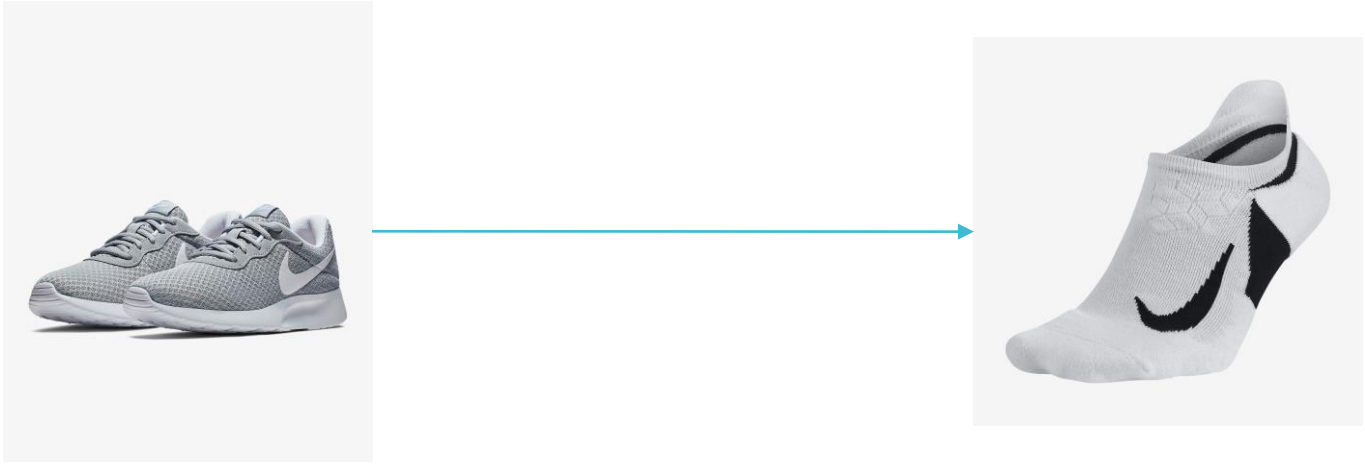
- **Clustering**

  - The previous data mining task of classification deals with partitioning data based on a pre-classified training sample.

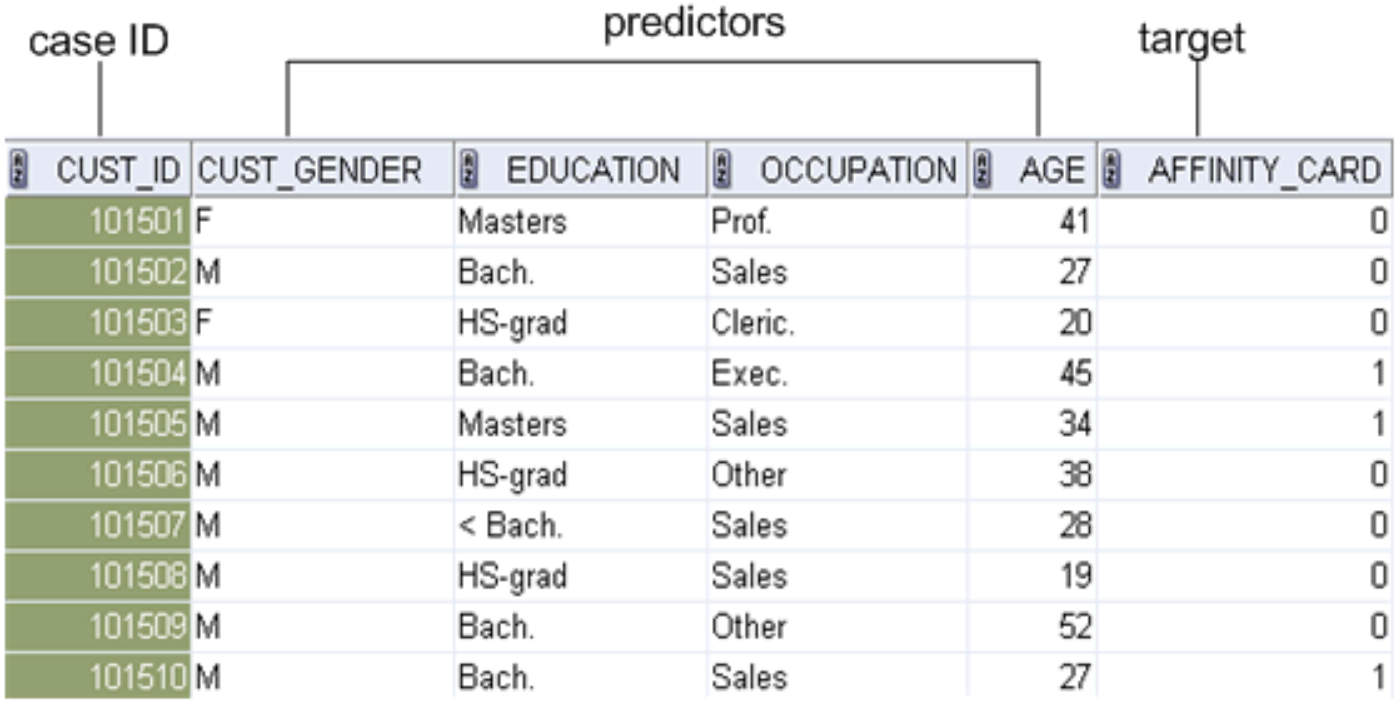
Market-basket model.

- Look for combinations of products.
- Put the SHOES near the SOCKS so that if a customer buys one they will buy the other.

Transactions: is the fact the person buys some items in the itemset at supermarket.

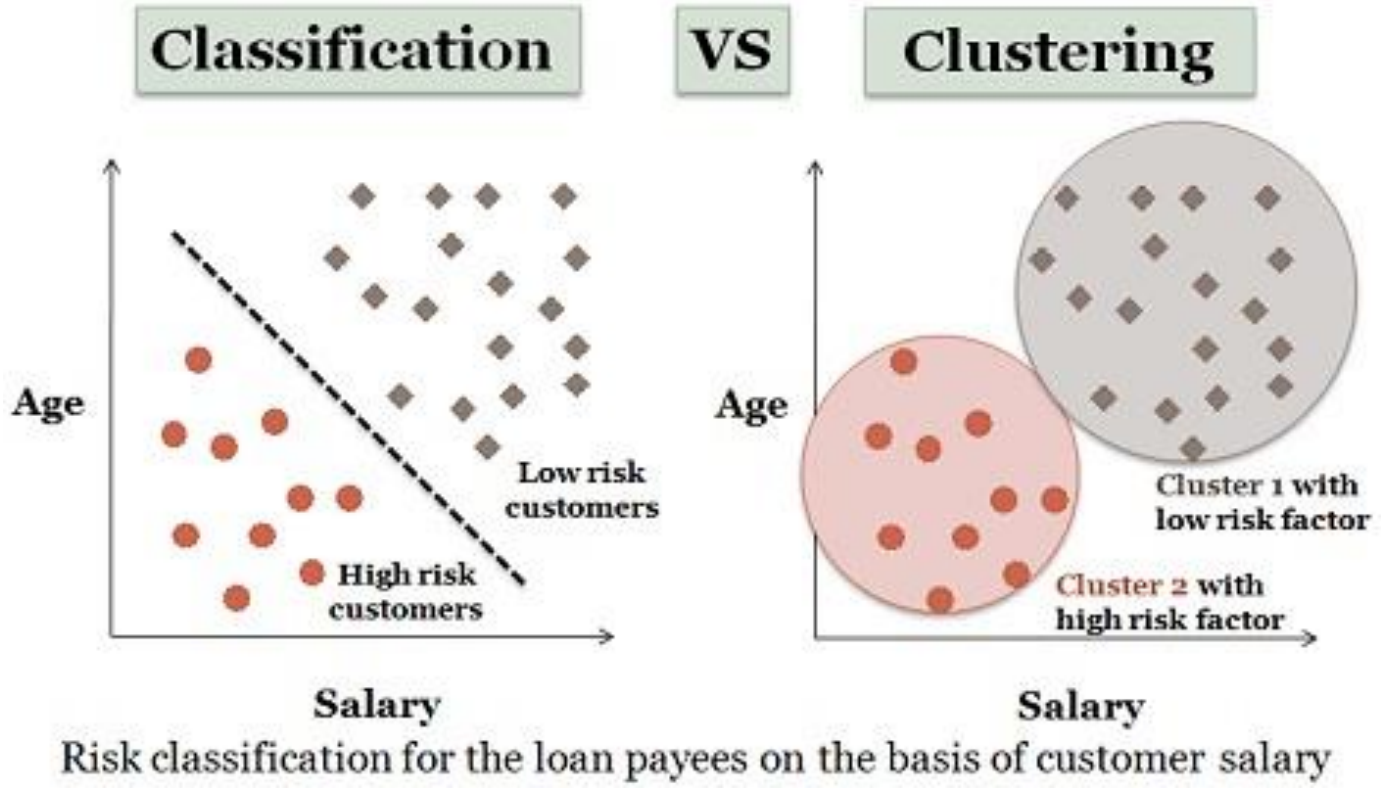


Association



CUST_ID	CUST_GENDER	EDUCATION	OCCUPATION	AGE	AFFINITY_CARD
101501	F	Masters	Prof.	41	0
101502	M	Bach.	Sales	27	0
101503	F	HS-grad	Cleric.	20	0
101504	M	Bach.	Exec.	45	1
101505	M	Masters	Sales	34	1
101506	M	HS-grad	Other	38	0
101507	M	< Bach.	Sales	28	0
101508	M	HS-grad	Sales	19	0
101509	M	Bach.	Other	52	0
101510	M	Bach.	Sales	27	1

Classification



Risk classification for the loan payees on the basis of customer salary

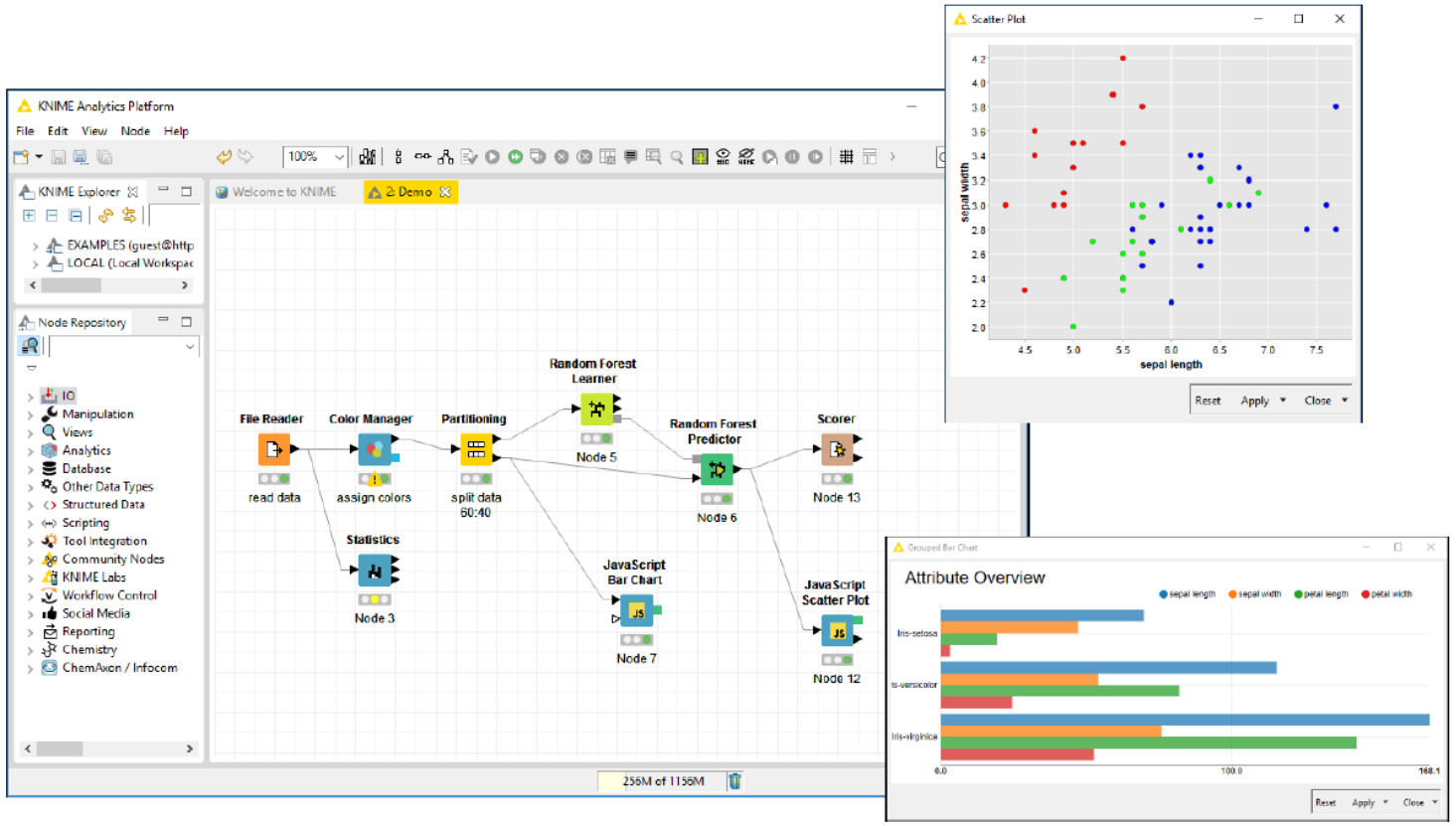
Classification vs Clustering

Content Reference : https://www.educba.com/data-mining-methods/

- Weka is data mining software that uses a collection of machine learning algorithms.
- These algorithms can be applied directly to the data or called from the Java code.
- Weka is a collection of tools for:
    - Regression
    - Clustering
    - Association
    - Data pre-processing
    - Classification
    - Visualization

Data Mining Tools - Weka

Content Reference : https://www.cs.waikato.ac.nz/ml/weka/



- KNIME is a free and open-source data analytics, reporting and integration platform.
- KNIME integrates various components for machine learning and data mining through its modular data pipelining concept.

Data Mining Tools - KNIME

Content Reference : https://www.knime.com

Business Applications

- Predict behavior
- Deliver personalized services
- Measure profitability

Challenges

- Noisy data
- Scalability
- Incomplete data

Data Mining Summary

Content Reference : https://www.stitchdata.com/resources/what-is-data-mining/

Best Practices

- Preserve data
- Have a good idea of the insights you seek
- Strive for data quality
- Recognize outliers

Data Mining Summary

Content Reference : https://www.stitchdata.com/resources/what-is-data-mining/

05 - Introduction to Data Analytics

Data Science - Analytic Type

- Analysis
- Business Analytics

Data Science - Build Model

- Build
- AI & Machine Learning

Two Type of Data Science

Content Reference : Dr. Thanachart Ritbumroong [NIDA]

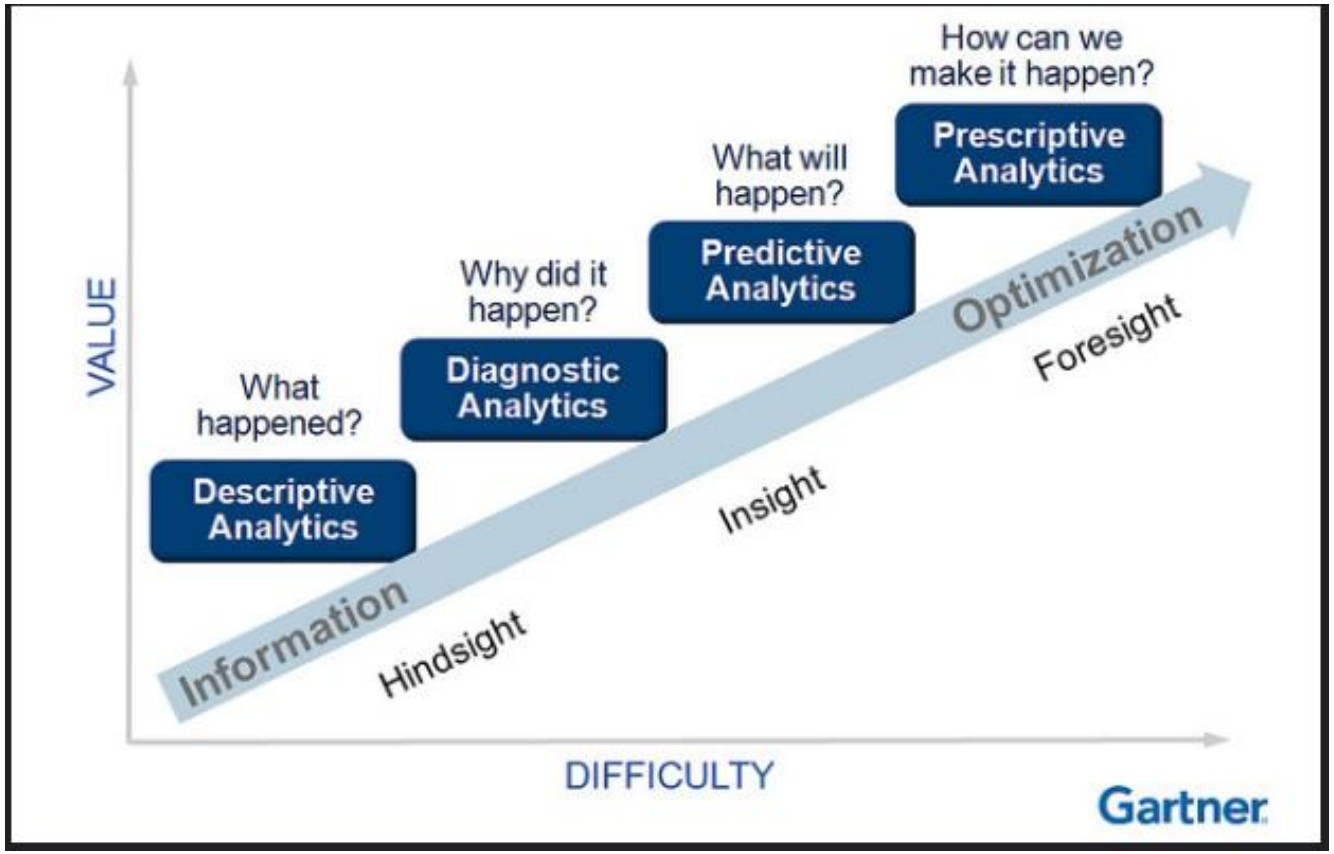
Microsoft Power Platform

Overview of Data Analysis

Data Analysis is telling a story with data.

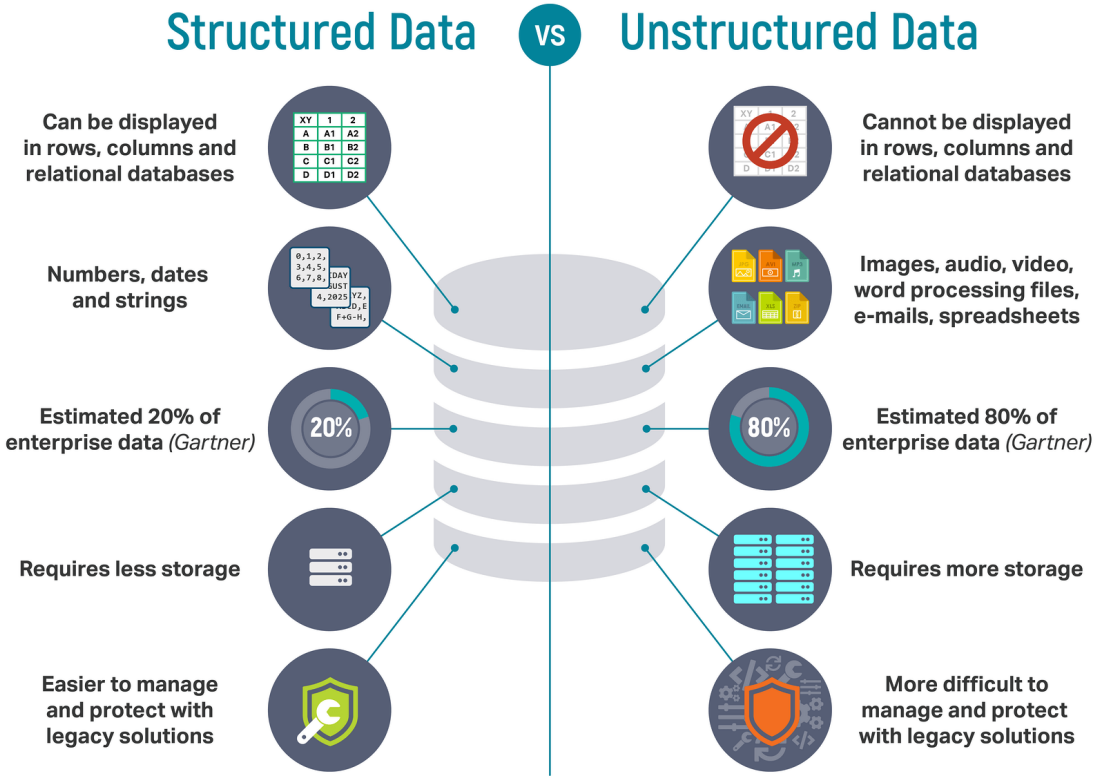
Five categories of analytics:

- Descriptive
- Diagnostic
- Predictive
- Prescriptive
- Cognitive



Data Analytics Maturity

Content Reference : Gartner



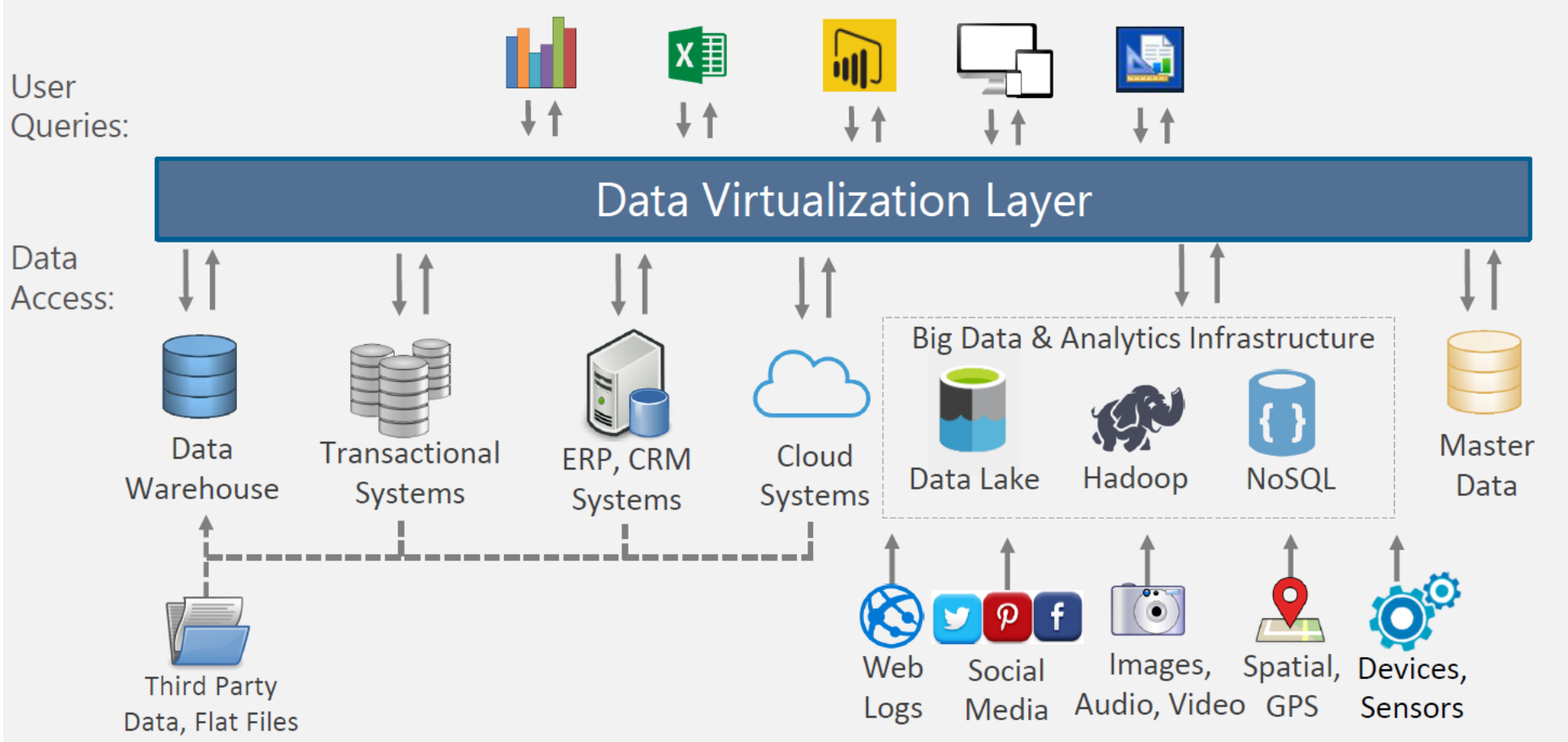
Understanding the Nature of the Data and The Data Analysis Process

Content Reference : https://www.igneous.io/blog/structured-data-vs-unstructured-data

- Customer Lifetime Value
- Customer Segmentation
- Up and Cross Selling
- Next Best Action
- Propensity to buy
- Chun Prevention
- Fraud Detection
- Risk Management
- Demand Forecast
- Price Optimization
- Quality Assurance
- Predictive Maintenance

Data Analytics in Business

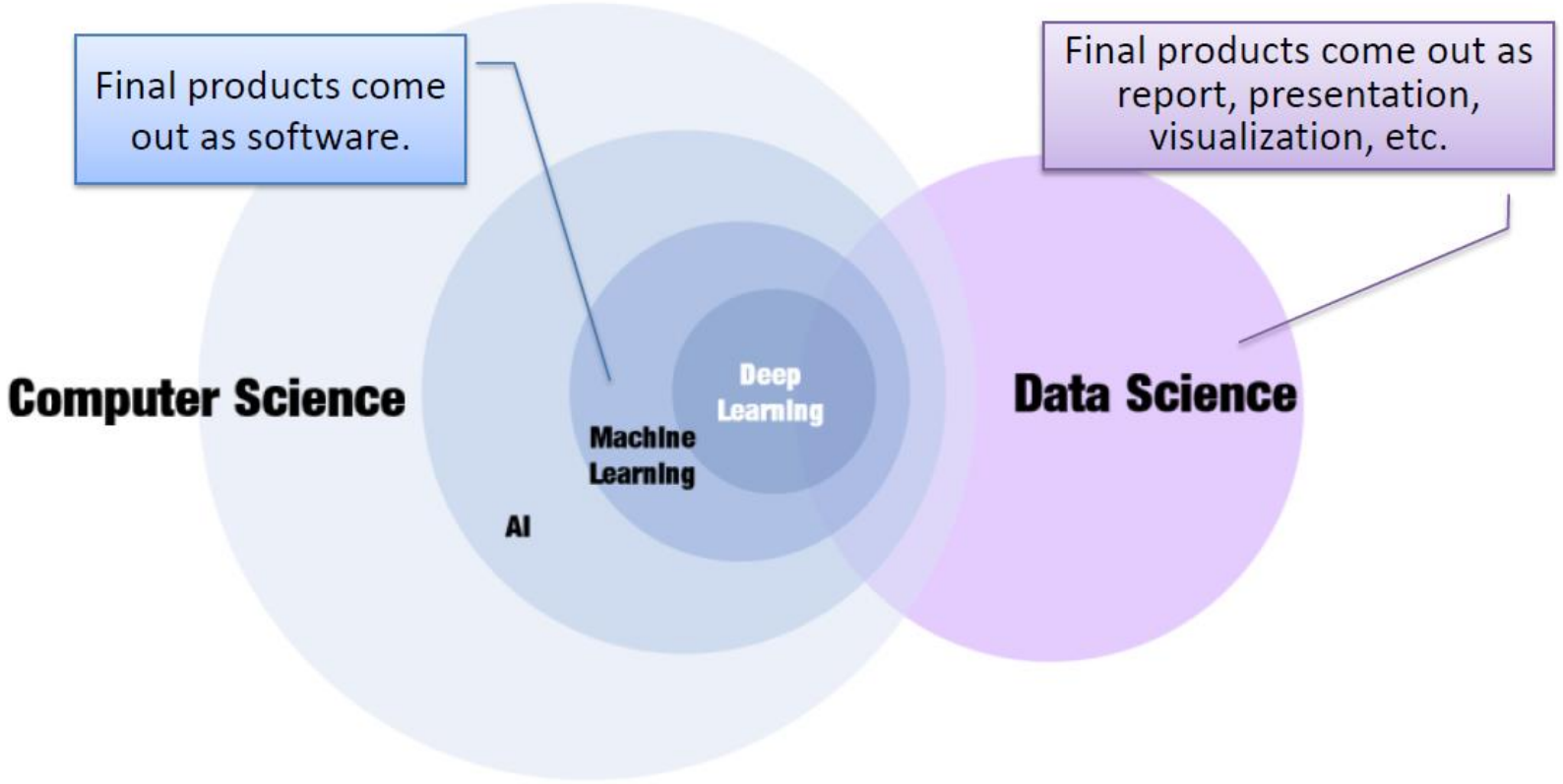
Content Reference : https://www.stitchdata.com/resources/what-is-data-mining/



Data Virtualization

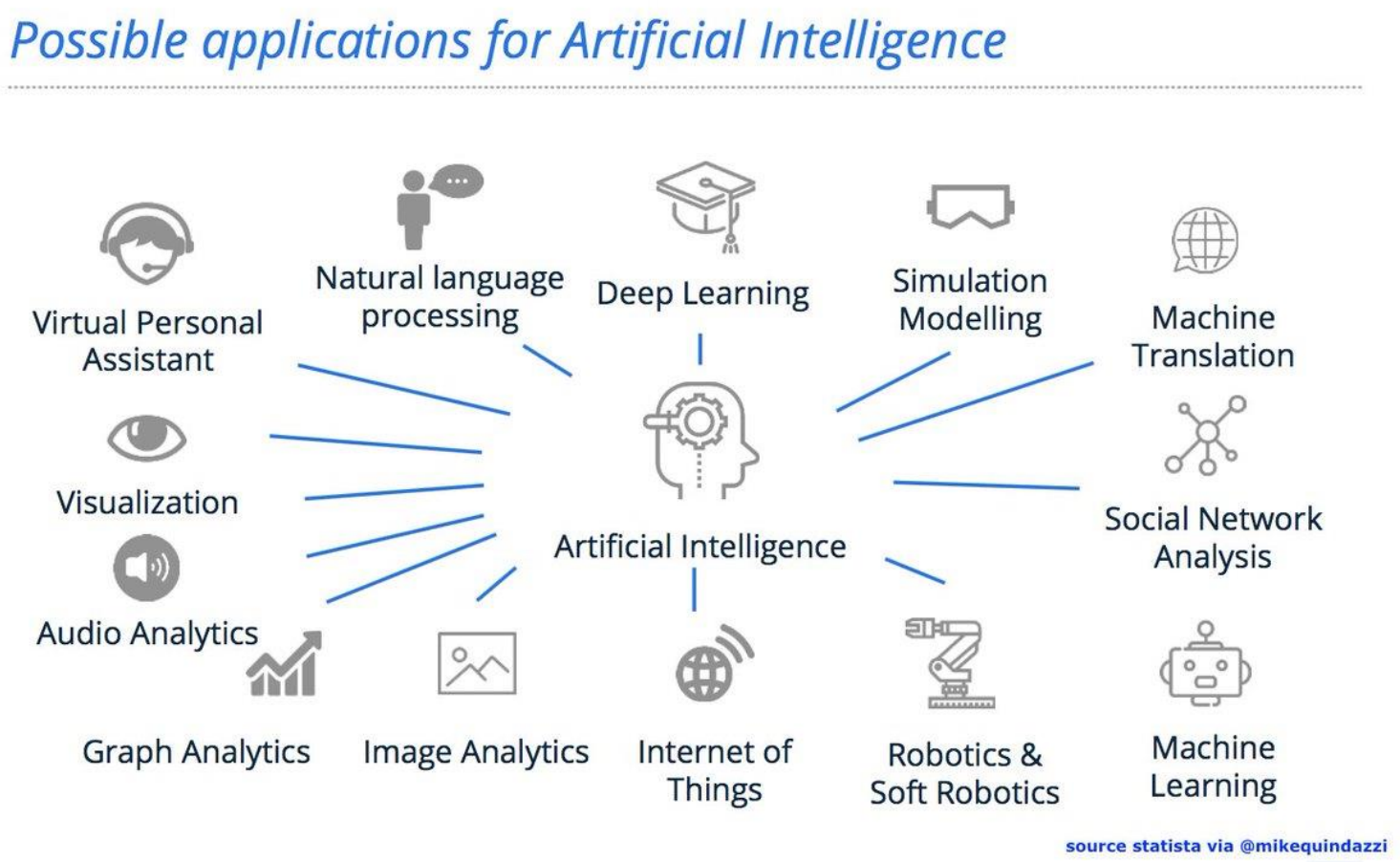
Content Reference : Melissa Coates [Blog: sqlchick.com/Twitter: @sqlchick]

06 - Understanding Machine Learning



Terminology

Content Reference : https://www.coursera.org/learn/ai-for-everyone



Artificial Intelligence (AI)

Content Reference : statista via @mikequindazzi

Software that imitates human capabilities

- Making decisions based on data and past experience
- Recognizing abnormal events
- Interpreting visual input
- Understanding written and spoken language
- Engaging in dialogs and conversations

What is Artificial Intelligence?

Content Reference : Microsoft Corporation

	Machine Learning	Predictive models based on data and statistics – the foundation for AI
	Anomaly Detection	Systems that detect unusual patterns or events, enabling pre-emptive action
	Computer Vision	Applications that interpret visual input from cameras, images, or videos
	Natural Language Processing	Applications that can interpret written or spoken language
	Conversational AI	AI agents, (or *bots*), that can engage in dialogs with human users

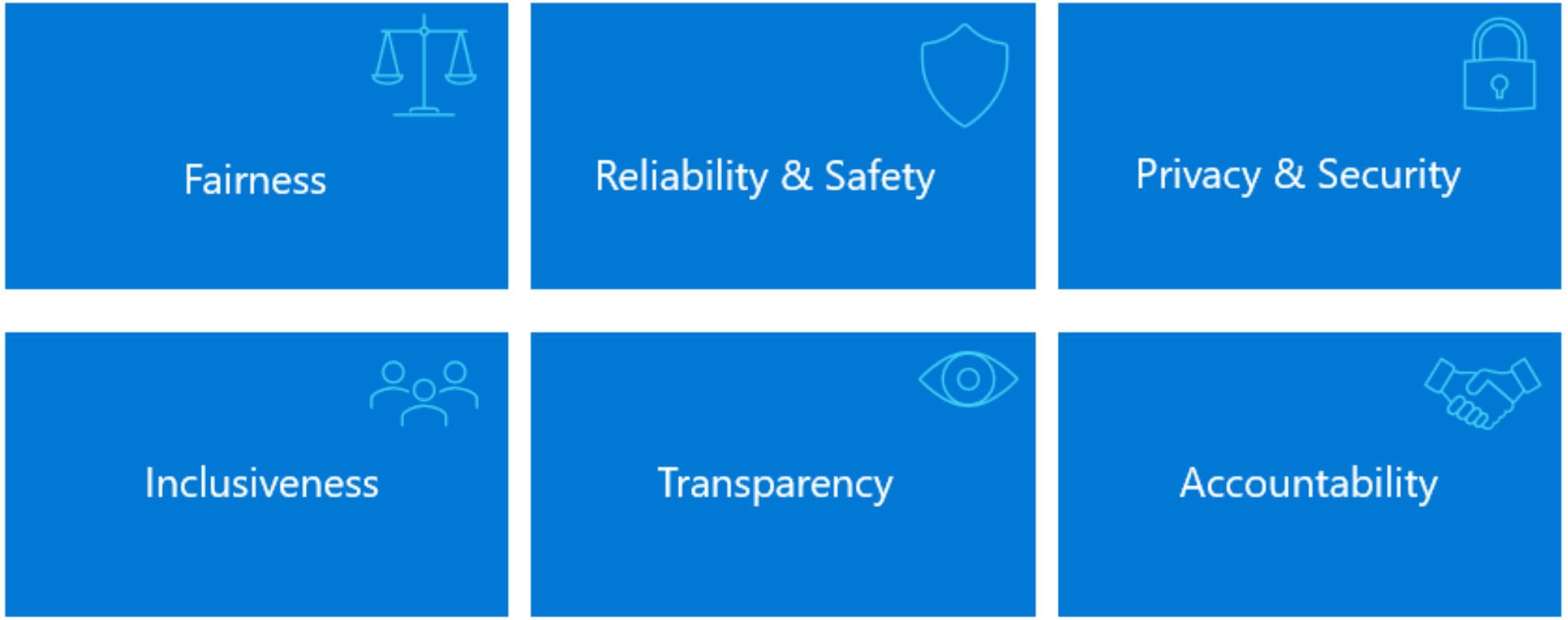
Common Artificial Intelligence Workloads

Content Reference : Microsoft Corporation

Challenge or Risk	Example
Bias can affect results	A loan-approval model discriminates by gender due to bias in the data with which it was trained
Errors may cause harm	An autonomous vehicle experiences a system failure and causes a collision
Data could be exposed	A medical diagnostic bot is trained using sensitive patient data, which is stored insecurely
Solutions may not work for everyone	A predictive app provides no audio output for visually impaired users
Users must trust a complex system	An AI-based financial tool makes investment recommendations - what are they based on?
Who's liable for AI-driven decisions?	An innocent person is convicted of a crime based on evidence from facial recognition – who's responsible?

Challenges and Risks with AI

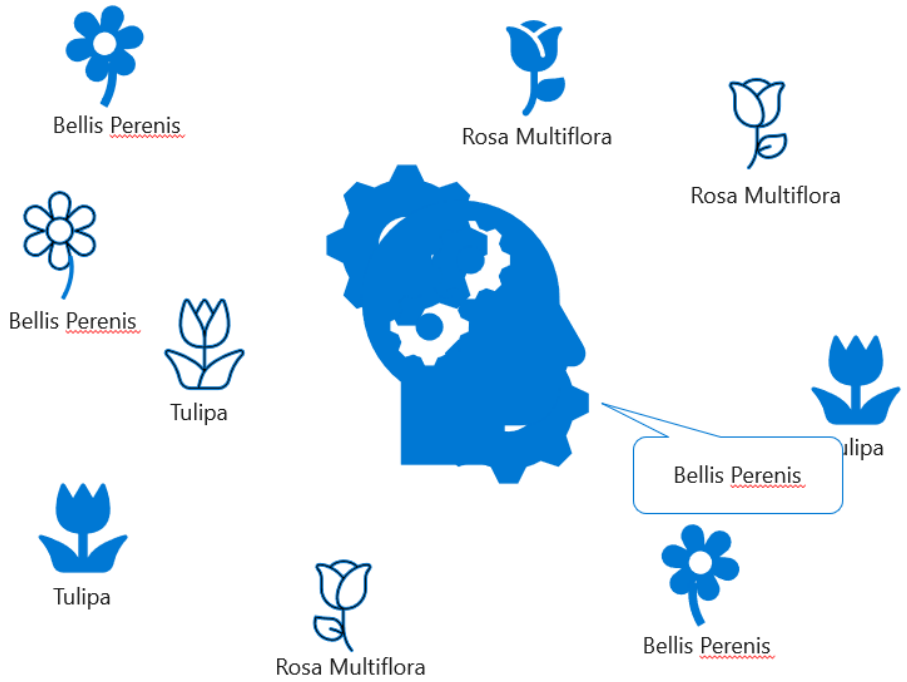
Content Reference : Microsoft Corporation



Principles of Responsible AI

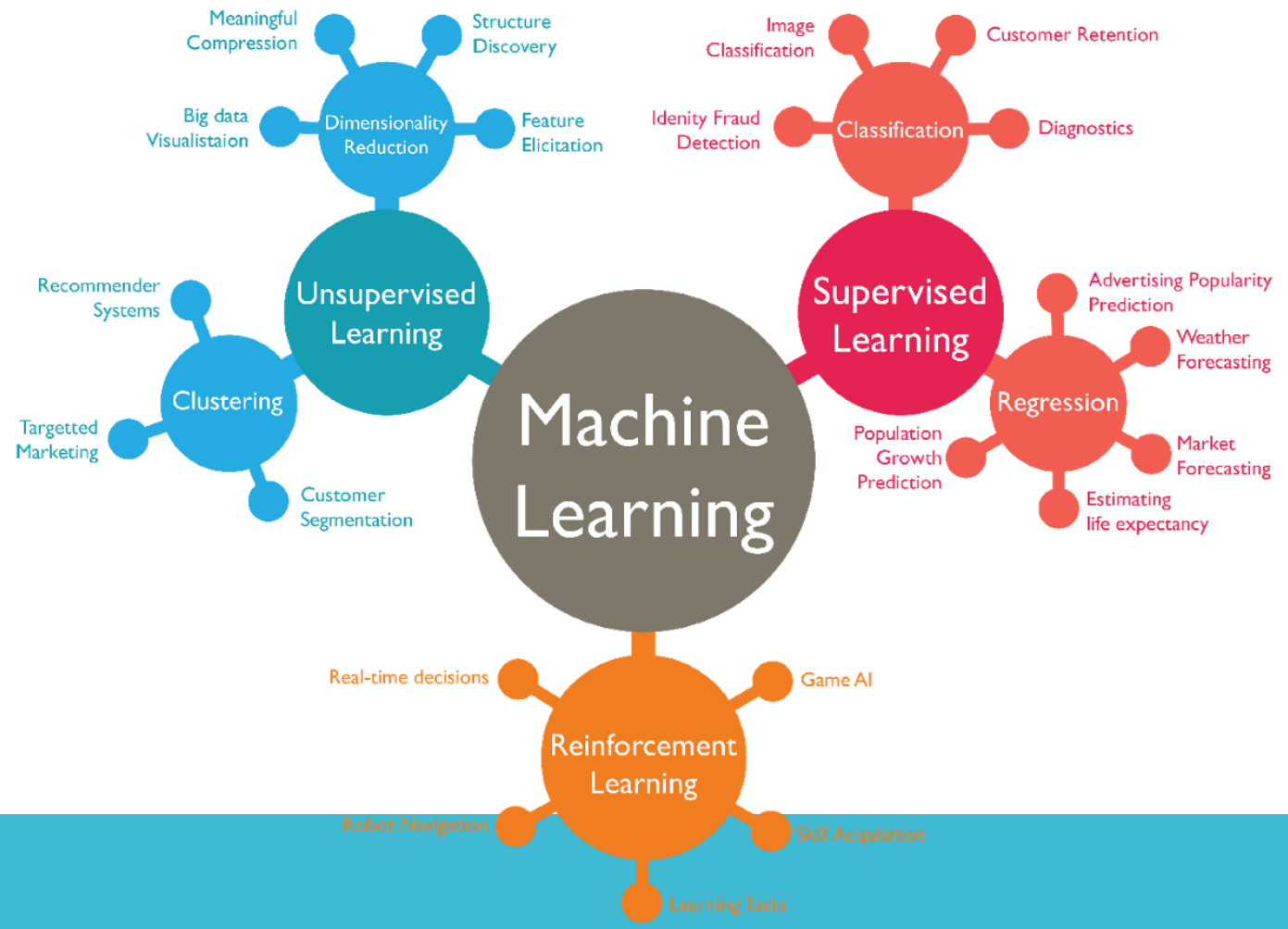
Content Reference : Microsoft Corporation

Creating predictive models by finding relationships in data



What is Machine Learning

Content Reference : Microsoft Corporation

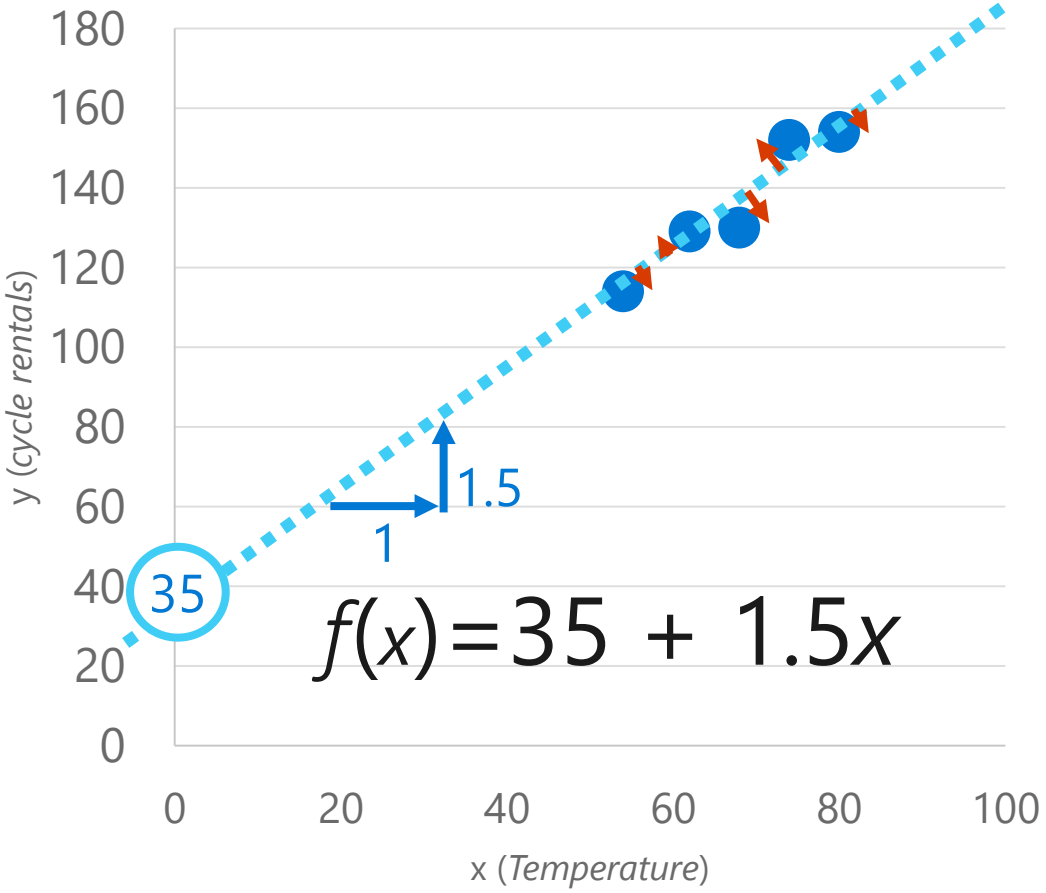


Type of Machine Learning

Content Reference : https://www.7wdata.be/visualization/types-of-machine-learning-algorithms-2/

Regression

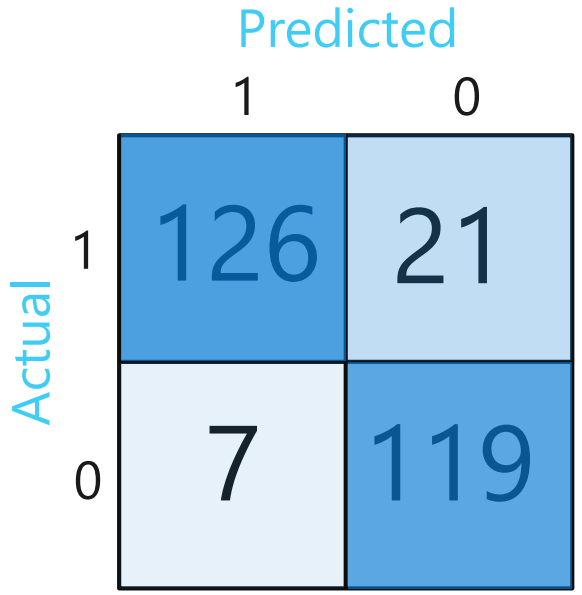
	x	y	f(x) ŷ
Training	56	115	
	61	126	
	67	137	
	72	140	
	76	152	
	82	156	
Validation	54	114	116
	62	129	128
	68	130	137
	74	152	146
	80	154	155



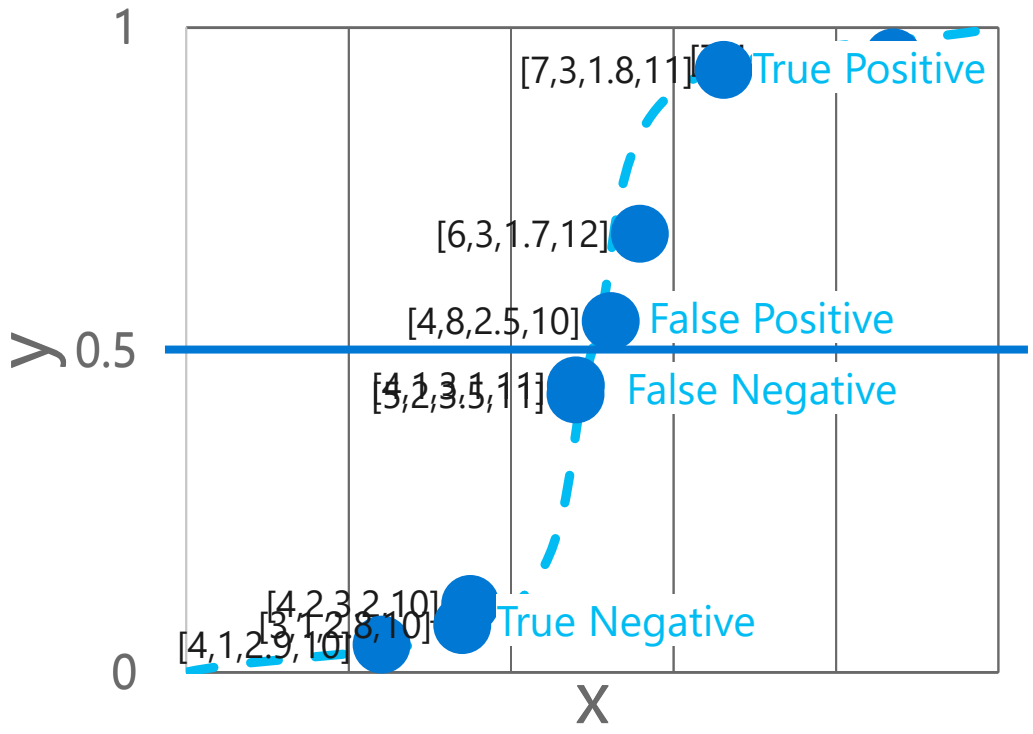
Content Reference : Microsoft Corporation

Classification

	x	y
Training	[4,2,3.2,10]	0
	[6,3,1.7,12]	1
	[5,2,3.5,11]	0
	[4,1,2.9,10]	0
	[7,4,2.1,11]	1
Validation	[3,1,2.8,10]	0
	[7,3,1.8,11]	1
	[4,8,2.5,10]	0
	[4,1,3,1,11]	1



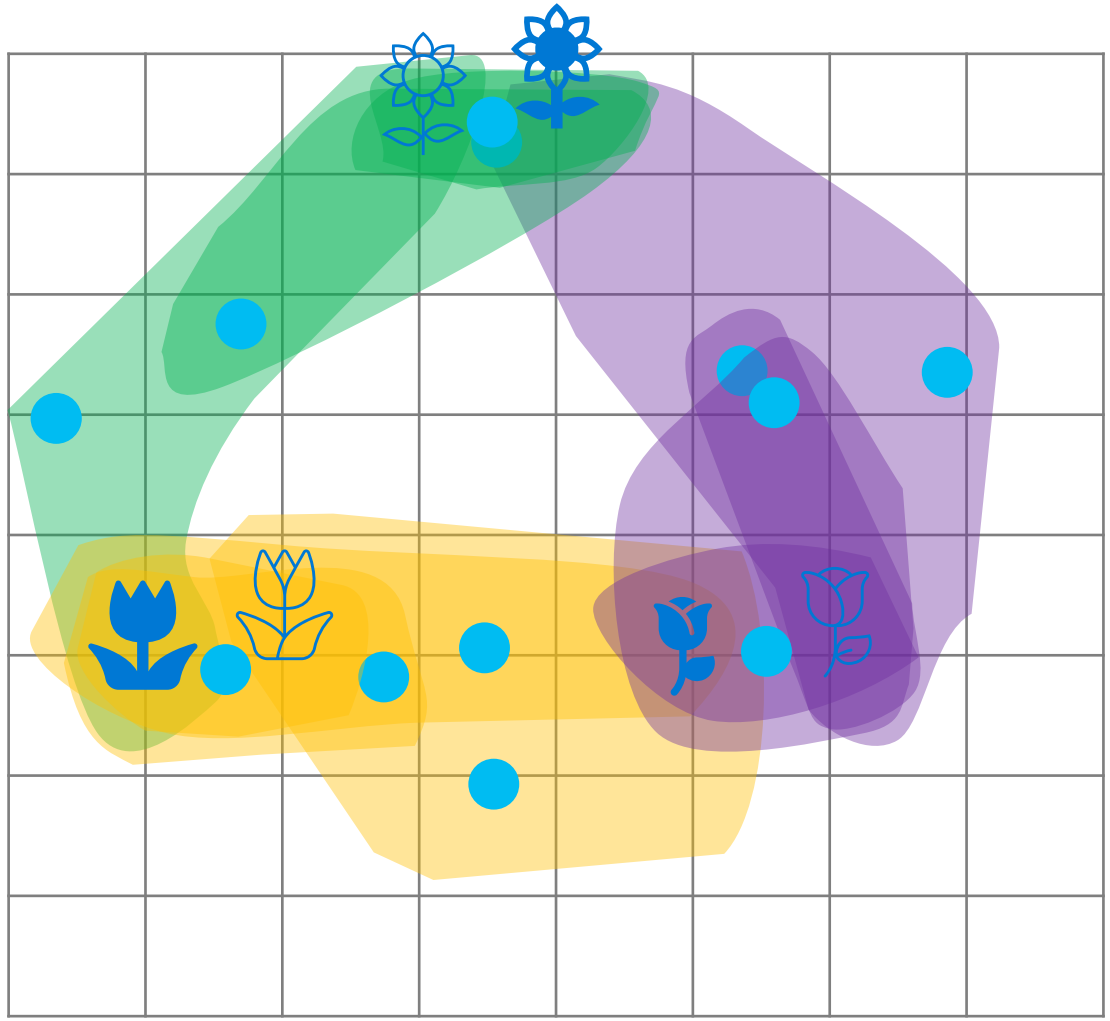
P(1)	P(0)	ŷ	
0.2	0.8	0	✓
0.9	0.1	1	✓
0.6	0.4	1	✗
0.3	0.7	0	✗



Content Reference : Microsoft Corporation

Clustering

	6	3
	5	3
	2	3
	1	3
	3	8
	4	8



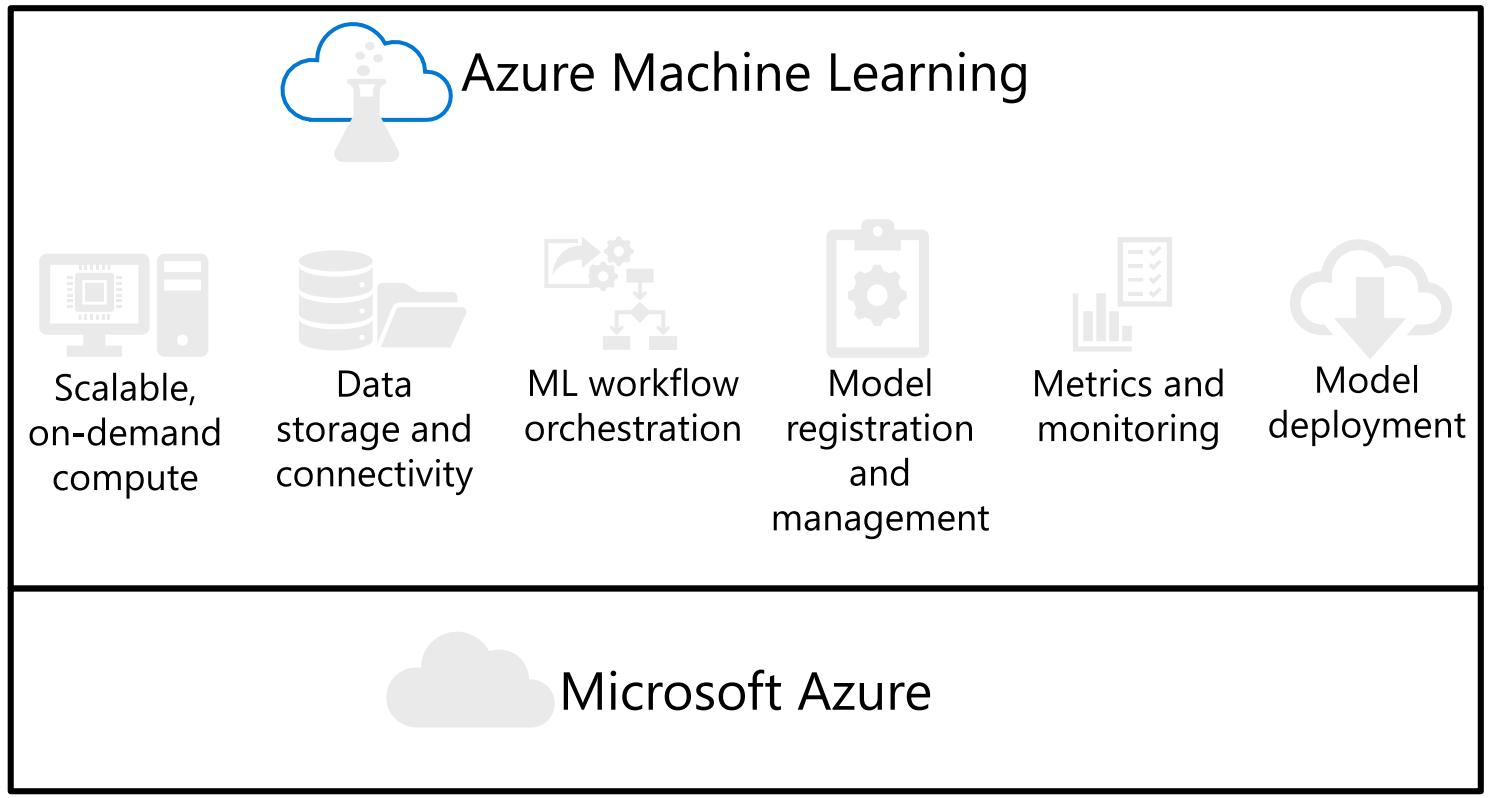
Content Reference : Microsoft Corporation

Microsoft

Azure Machine Learning No-Code with Designer

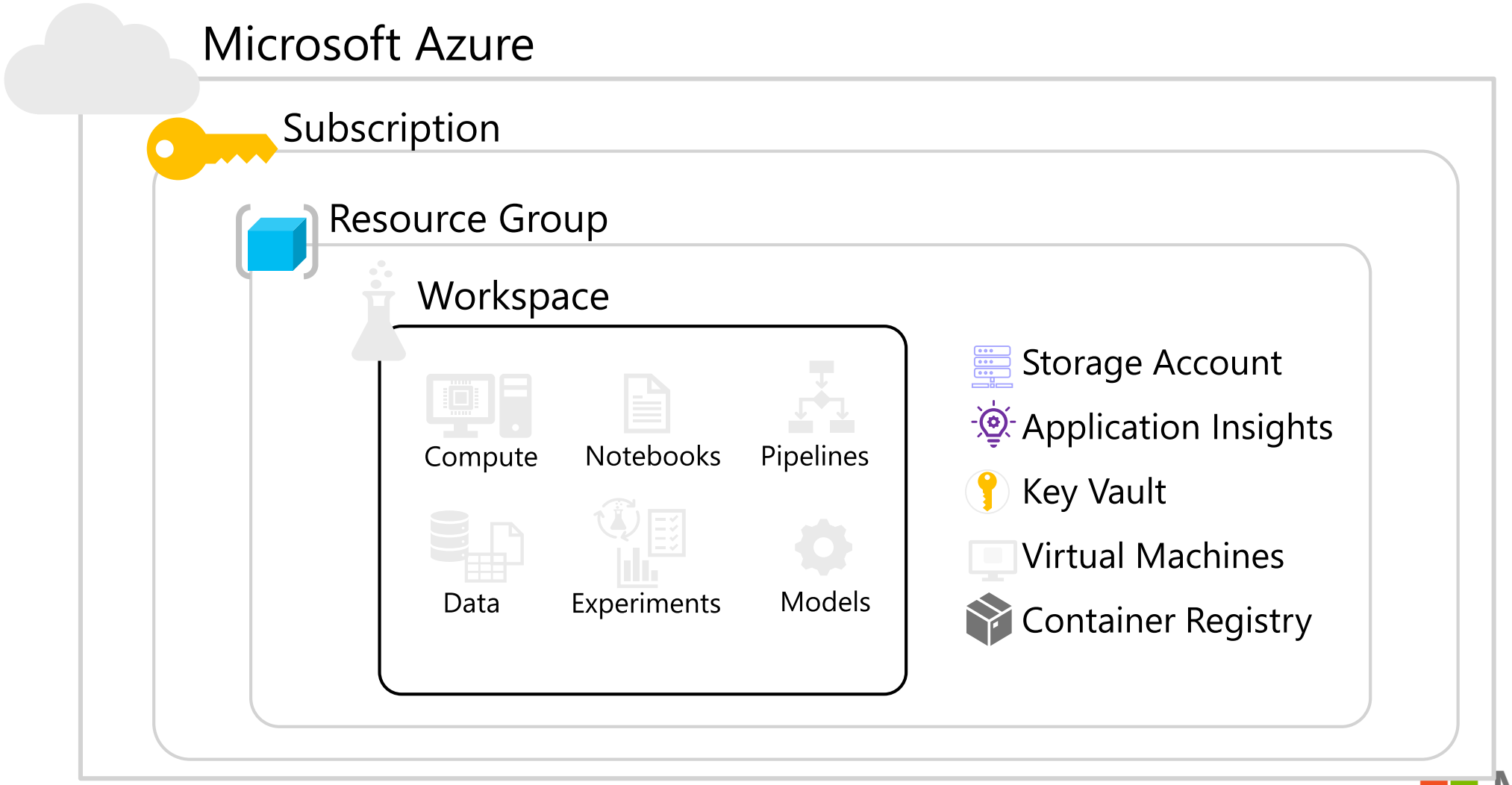
What is Azure Machine Learning?

A platform for operating machine learning workloads in the cloud



Microsoft

Azure Machine Learning Workspaces



Microsoft

Considerations for Creating a Workspace

Region

Check Azure Resource availability

For example, NC-Series Virtual Machines for GPU processing

Edition

Enterprise

- All features

Basic

- No Visual Designer
- No Automated ML user interface
- No Data Drift user interface

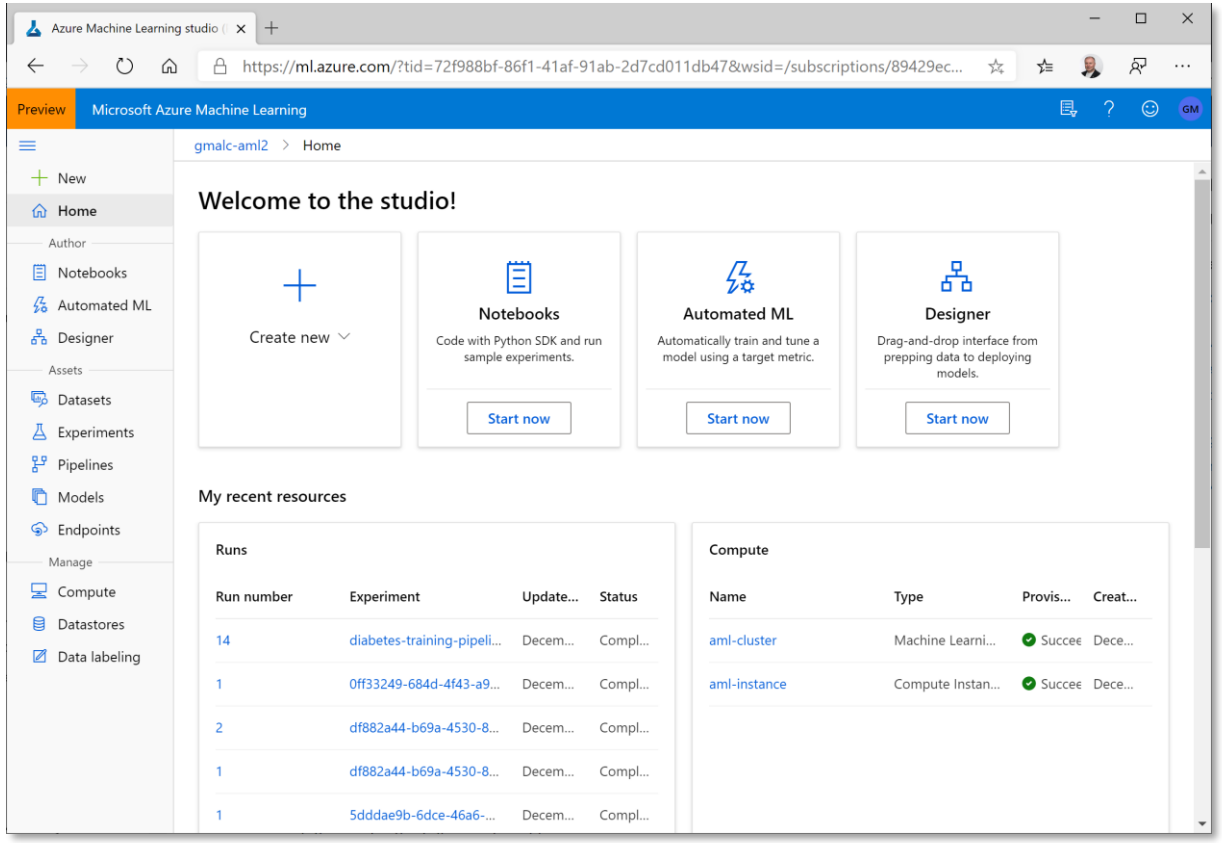
Microsoft

Azure Machine Learning studio

Manage compute and data
Run experiments
View metrics
Manage and deploy models
Manage endpoints
Use graphical modeling tools:

Designer - "no-code" model development

Automated Machine Learning - find the best model for your data



Microsoft

The Azure Machine Learning SDK for Python

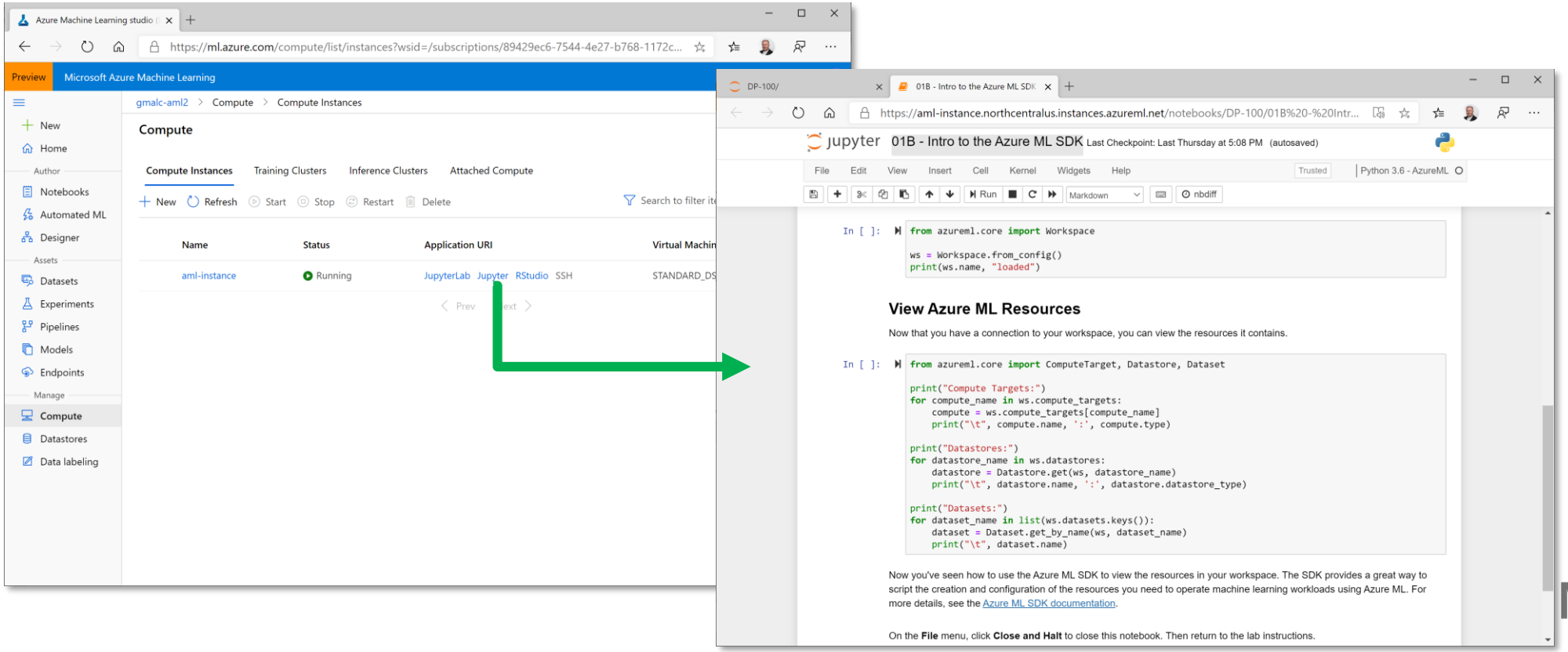
Code-based configuration for machine learning assets:
Automate repeatable asset creation
Ensure consistency across development, test, and production environments
Incorporate machine learning asset configuration into DevOps

```
pip install azureml-sdk
```

```
from azureml.core import Workspace

ws = Workspace.from_config()
for compute_name in ws.compute_targets:
    compute = ws.compute_targets[compute_name]
    print(compute.name, ":", compute.type)
```

Compute Instances

Jupyter Notebook and JupyterLab servers in your workspace
Choose the compute specifications you need



Microsoft

Walkthrough :

Creating an Azure Machine Learning Workspace

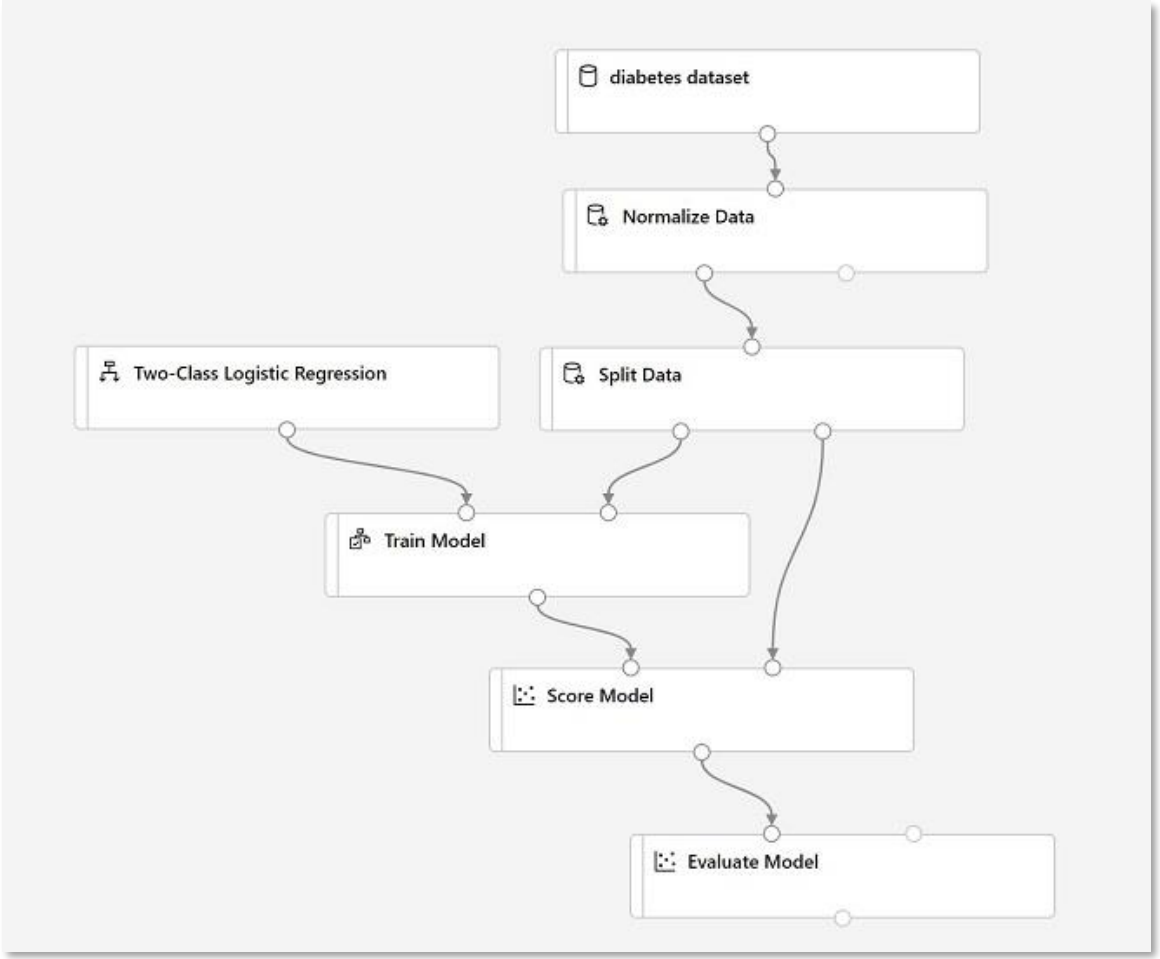
Microsoft

What is Azure Machine Learning Designer?

Drag-and-Drop Interface for:

Preparing data and training models

Publishing models as services



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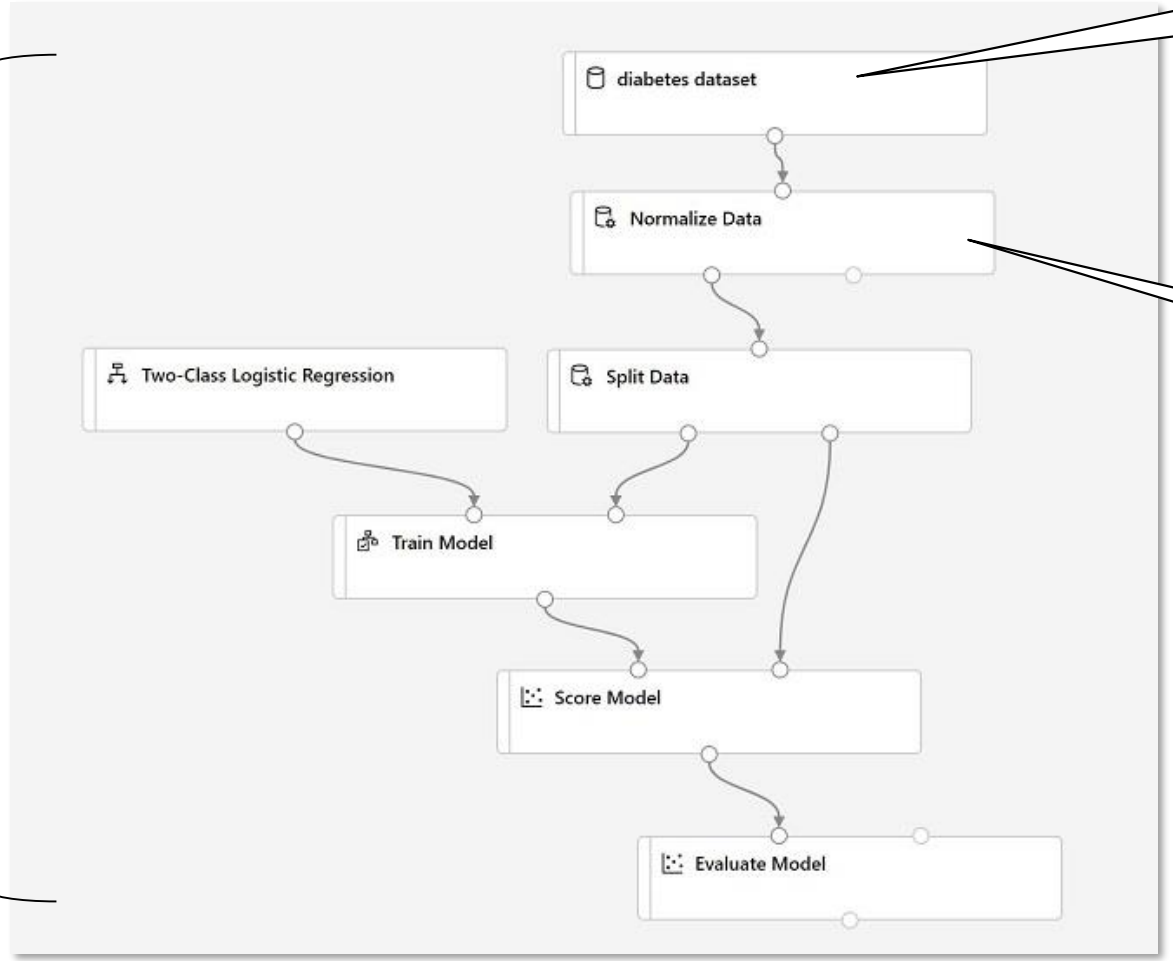
Designer Pipelines and Modules

Pipeline

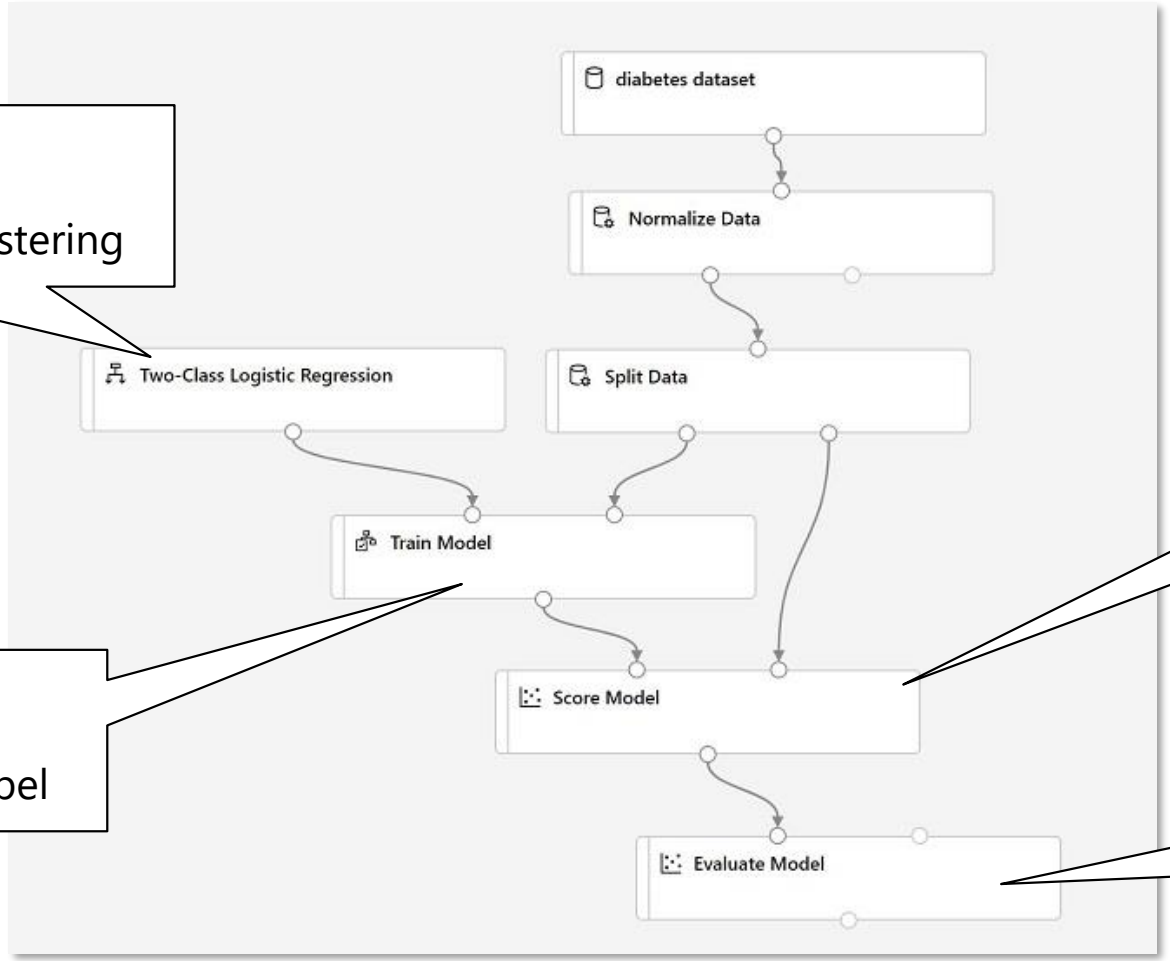


Dataset

Module

Training, Scoring, and Evaluating Models

1. Algorithm
Classification, Regression, Clustering



2. Train
Fit model for specified label

3. Score
Predict from test data

4. Evaluate
model-specific metrics

Custom Code Modules

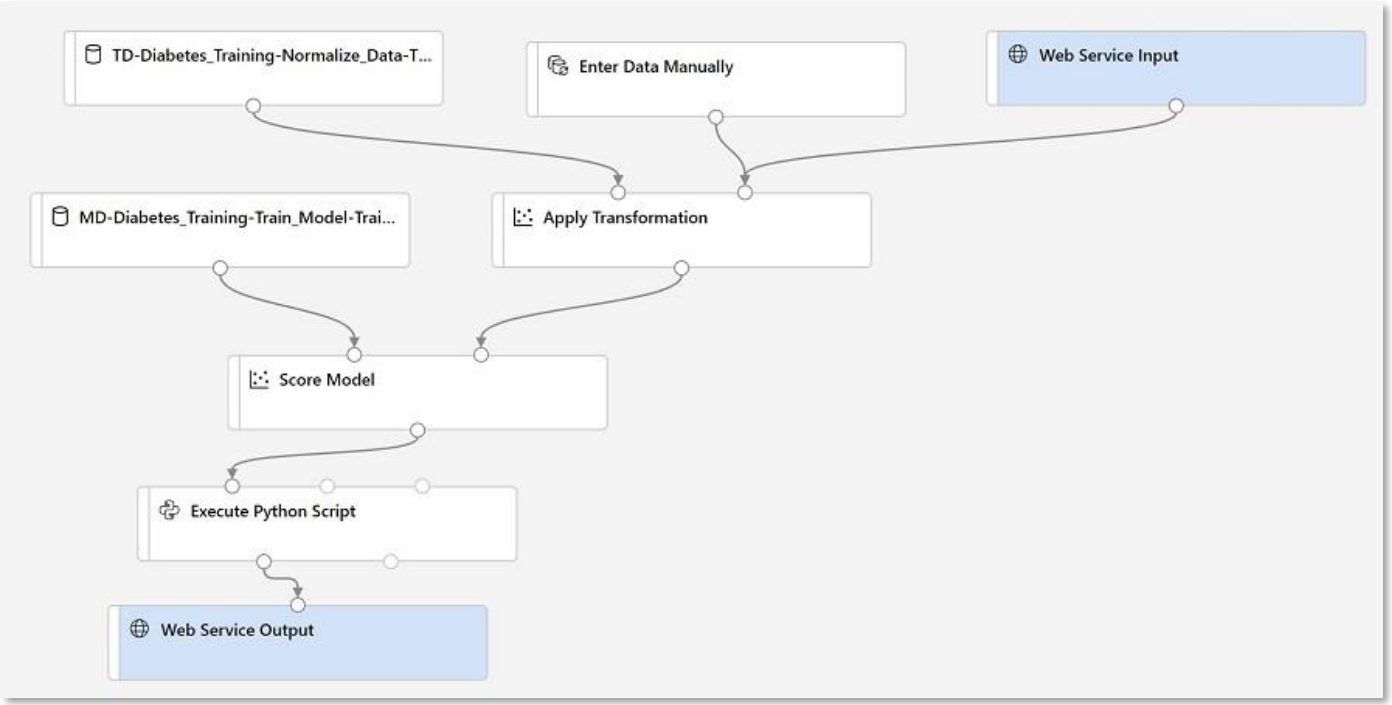
Apply SQL Transformation	Use a SQL statement to process up to three input tables
Execute Python Script	Implement a custom Python function to process up to two dataframes
Create Python Model	Implement a custom Python model in place of a built-in algorithm
Execute R Script	Implement a custom R function to process up to two dataframes

Walkthrough :

Creating a Training Pipeline with the Azure ML Designer

Microsoft

What is an Inference Pipeline?

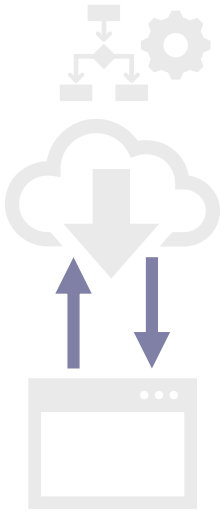


A data flow defining a web service for using the trained model

A **Web Service Input** defines the input data schema
Transformations based on training data are encapsulated in datasets
The trained model is encapsulated in a dataset
A **Web Service Output** defines the output data schema
You may want to modify the pipeline before deploying its as a web service

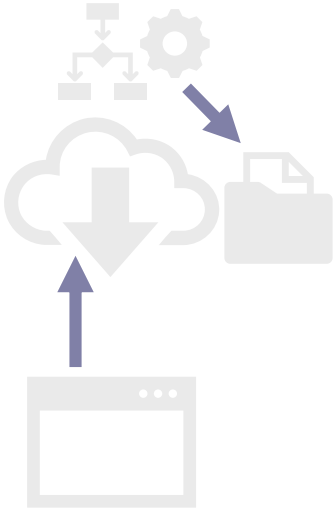
Microsoft

Publishing a Service Endpoint



Deploy a Real-Time Pipeline:

Requires Azure Kubernetes Services Inference Compute
Submit new data to HTTP endpoint for immediate results



Publish a Batch Pipeline

Requires Azure Machine Learning Training Compute
Initiate pipeline experiment run through HTTP endpoint
Results saved in run output

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Consuming a Service Endpoint

View endpoints in Azure Machine Learning studio
Use starter code to build client applications

```
data = {"Inputs": {"input0":[{'feature1': "123", 'feature2': "99",},],},
        "GlobalParameters":  {}}
body = str.encode(json.dumps(data))

url = 'http://10.0.0.1:80/api/v1/service/diabetes_predictor/score'
api_key = 'a1234567890x'
headers = {'Content-Type':'application/json',
           'Authorization':('Bearer '+ api_key)}

req = urllib.request.Request(url, body, headers)
response = urllib.request.urlopen(req)
result = response.read()
```

Microsoft

Walkthrough :

Deploying a Service with the Azure ML Designer

Microsoft

Complete the Course