BASES DE DATOS PARA DATA SCIENCE

Lopez, Yoel
Pelli, Nahuel

AGENDA

Presentación

Programa

Introducción a DB’s

Tipos de DB’s

Estructuras de datos

Presentación

- Nahuel Pelli
  - Ingeniero en Telecomunicaciones, Instituto Balseiro
  - Maestría en Ciencia de datos, UdeSA
  - Senior Developer/Data Scientist en Accenture Argentina (2017-presente)
  - Contacto:
    - Email: nahuelpelli91@gmail.com
- Yoel Lopez
  - Ingeniero en Sistemas, UTN
  - Head of Data Governance, AB InBev
  - Vasta experiencia Big Data, Deep Learning, software engineering.
  - Contacto:
    - Email: lopez.yoel25@gmail.com

Programa

- Introducción a bases de datos. Tipos de base de datos. Estructuras de datos.
- Diagramas de entidad relación. Interpretación de los diagramas y construcción. Introducción lenguaje SQL
- DER y normalización de datos. Construcción de queries.
- Sistemas NoSQL. Tipos y utilización. Querying en NoSQL.
- Implementaciones cloud. Principales vendors. Arquitecturas típicas y soluciones híbridas.
- Concurrencia y recuperabilidad de datos. Escalabilidad de bases.
- Mejores prácticas en SQL. Trabajo final.
- Presentación de Trabajo Final

Evaluación

La evaluación de la materia consta de un trabajo final integrador y unos cuestionarios cortos que se tomarán al principio de cada clase.
El trabajo final es grupal en grupos de 2 y consta de:

- Diseño a alto nivel (si se animan en detalle siempre va a ser bienvenido) de una arquitectura híbrida para una aplicación específica. De nuestro lado vamos a proponer aplicaciones de ejemplo, pero si tienen una idea que nos quieren aportar que, por ejemplo, aporte a su trabajo final va a ser super bienvenido.
- 2 preguntas que van a tener que responder con queries respecto a su arquitectura.
- 4 preguntas relacionadas a dos bases que vamos a darles como ejemplo (común a todos los grupos)

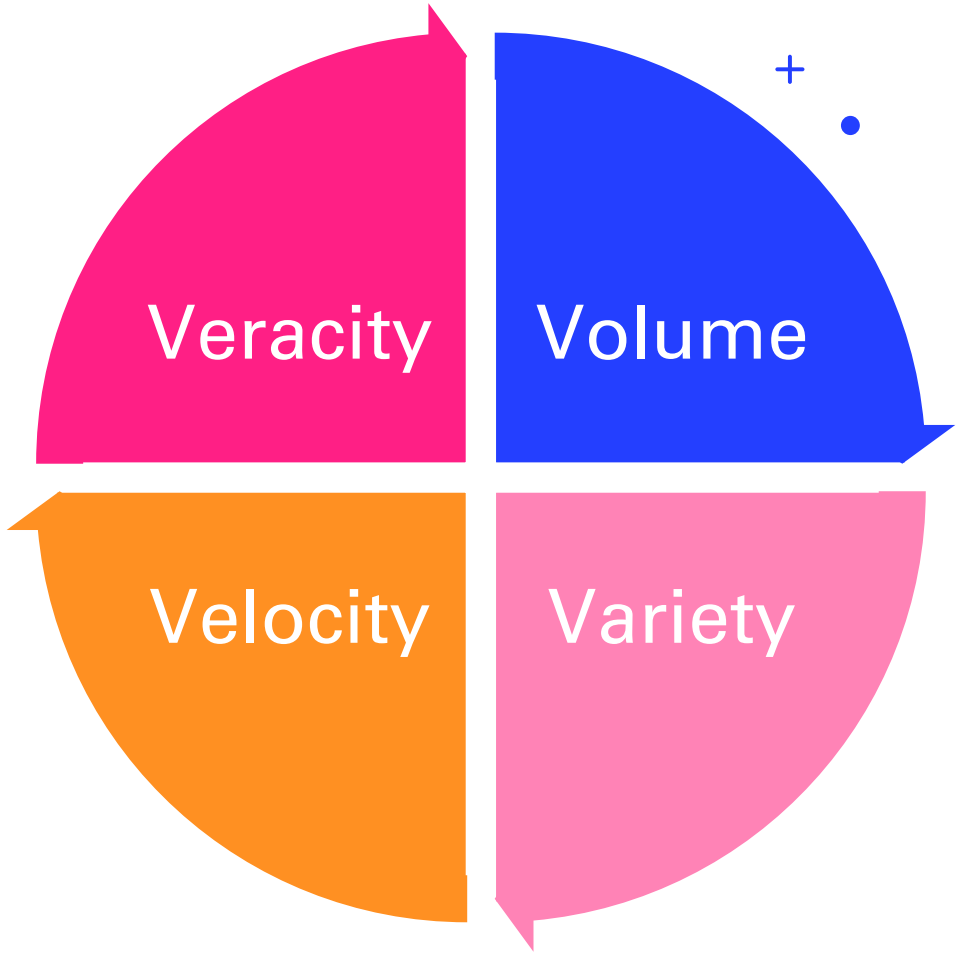
BASES DE DATOS

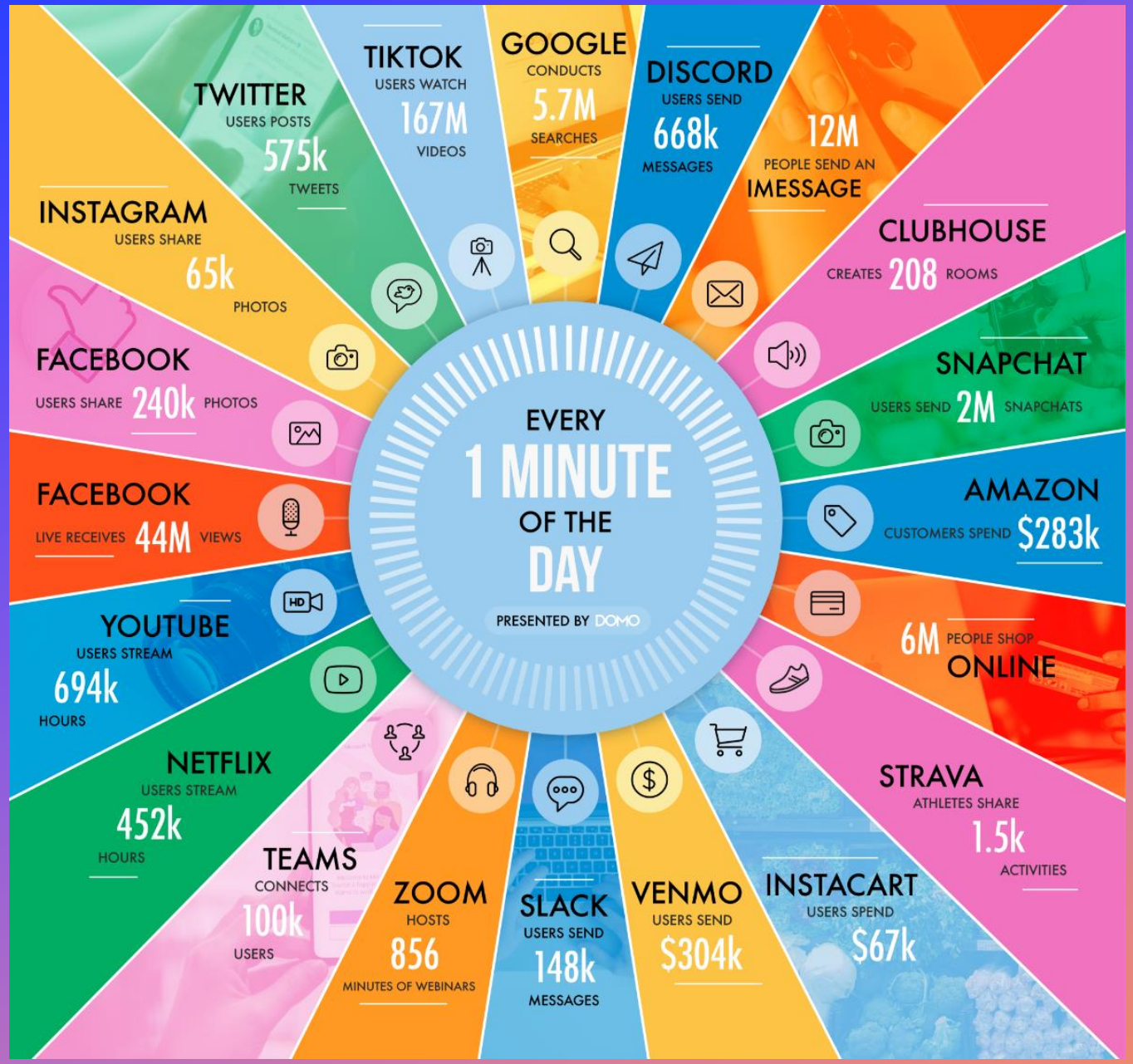
Motivación y conceptos básicos

The 4 V's of big data

Cuando analizamos un sistema de datos, en la actualidad podemos considerar que el concepto de *big data* está asociado con 4 conceptos claves:

- Volumen
- Variedad
- Velocidad
- Veracidad





DATA Never Sleeps 9.0

The 2020 pandemic upended everything, from how we engage with each other to how we engage with brands and the digital world. At the same, it transformed how we eat, how we work and how we entertain ourselves.
Data never sleeps and it shows no signs of slowing down.

Ref: https://www.domo.com/learn/guide/data-never-sleeps-9

"Data is the New Oil."

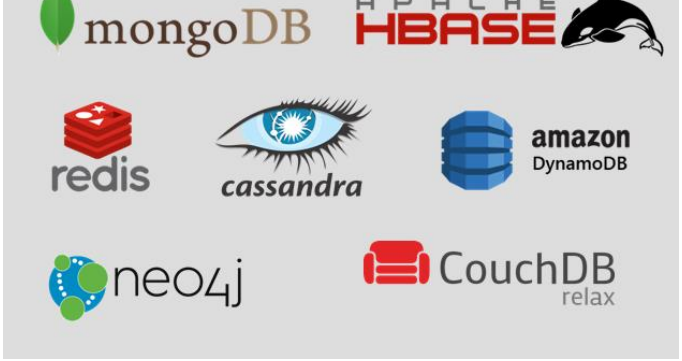
Clive Humby | 2006
British data commercialization entrepreneur

¿Qué es una base de datos?

Un conjunto de **datos almacenados** en un formato específico e interrelacionados por un contexto en común.

Podemos pensar como una colección de datos que están:

- *Lógicamente relacionados**
- *Compartidos*
- *Protegidos*
- *Administrados*



Componentes de una DB

Informacion:

- La información se obtiene de la base de datos, está integrada y compartida

DBMS:

- Es el Sistema de gestion de los datos (dbms por sus siglas en ingles). Es nuestro motor

USERS:

- Quienes acceden ya sean personas o aplicaciones

HARDWARE:

- Donde montamos nuestro dbms

TIPOS DE BASES DE DATOS

SQL

Modelo Logico/Relacional

El modelo Lógico

- El modelo debería mantenerse indistinto del volumen de datos
- Los datos están organizados de acuerdo a lo que representa (Las tablas deben ser consistentes)
- Es genérico, el modelo es un template para la implementación física en *cualquier* rdbms

Normalización

- Es el proceso de reducción de complejidad de nuestra estructura de datos inicial a un modelo simple y *estable.*
- Es un proceso que involucra la remoción de *atributos*, *keys* y *relaciones* del modelo conceptual

Procesamiento transaccional

Es la unidad de trabajo que tiene que ser ejecutada atómicamente y en un entorno aparentemente aislado. Tiene las siguientes características:

- **Logging:** Para asegurar durabilidad de las mismas
- **Control de concurrencia:** La ejecución de las transacciones tienen que (en apariencia) ser aisladas las unas de las otras.
- **Resolución de impasses (*Deadlocks*):** debemos considerar que las transacciones "pelean" por los recursos.

Principio de transacciones *ACID*

Las transacciones ejecutadas en una RDBMS cumplen con las siguientes propiedades:

- **Atomicity**: Everything in a transaction succeeds lest it is rolled back.
- **Consistency**: A transaction cannot leave the database in an inconsistent state.
- **Isolation**: One transaction cannot interfere with another.
- **Durability**: A completed transaction persists, even after applications restart.

Tablas

Una tabla (también conocida como *entidad*) es una estructura bidimensional compuesta por ***tuplas*** (filas, registros) y ***atributos*** (campos, columnas o celdas).

Para crear/analizar las tablas que componen el MR, utilizamos *algebra relacional.*

EMPLOYEE NUMBER	MANAGER EMPLOYEE NUMBER	DEPARTMENT NUMBER	JOB CODE	LAST NAME	FIRST NAME	HIRE DATE	BIRTH DATE	SALARY AMOUNT
1006	1019	301	312101	Stein	John	861015	631015	3945000
1008	1019	301	312102	Kanieski	Carol	870201	680517	3925000
1005	0801	403	431100	Ryan	Loretta	861015	650910	4120000
1004	1003	401	412101	Johnson	Darlene	861015	560423	4630000
1007				Villegas	Arnando	870102	470131	5970000
1003	0801	401	411100	Trader	James	860731	570619	4785000

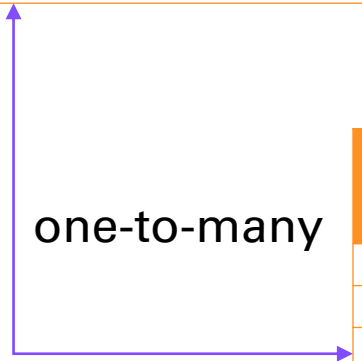
La tabla que observamos es una “proyección” conveniente del modelo relacional que planteamos

Relaciones en tablas

Así mismo, las tablas pueden contener relaciones con otras tablas que componen nuestro MR. Existen 3 tipos de relaciones:

- *one-to-one*
- *one-to-many*
- *many-to-many*

EMPLOYEE NUMBER	MANAGER EMPLOYEE NUMBER	DEPARTMENT NUMBER	JOB CODE	LAST NAME	FIRST NAME	HIRE DATE	BIRTH DATE	SALARY AMOUNT
1006	1019	301	312101	Stein	John	861015	631015	3945000
1008	1019	301	312102	Kanieski	Carol	870201	680517	3925000
1005	0801	403	431100	Ryan	Loretta	861015	650910	4120000
1004	1003	401	412101	Johnson	Darlene	861015	560423	4630000
1007		501		Villegas	Arnando	870102	470131	5970000
1003	0801	401	411100	Trader	James	860731	570619	4785000



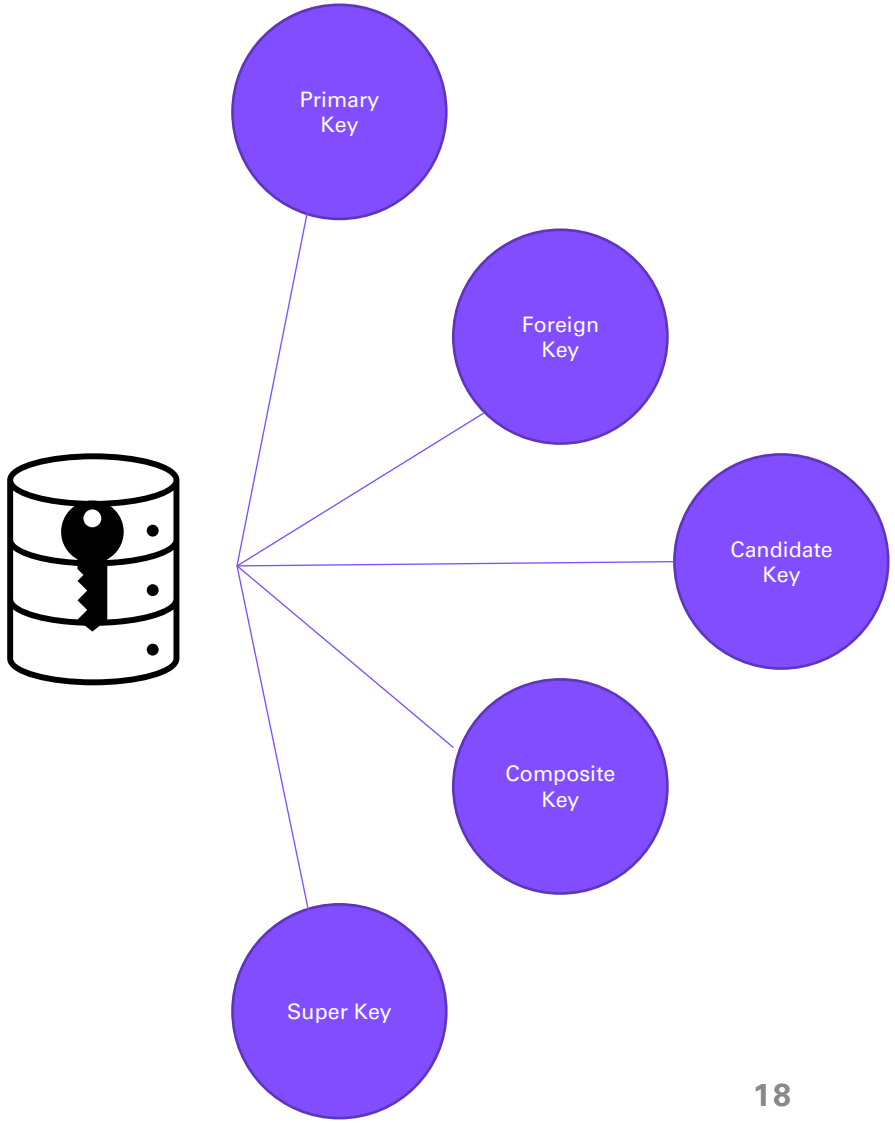
DEPARMENT NUMBER	DEPARTMENT NAME	BUDGET AMOUNT	MANAGER EN
501	marketing sales	80050000	1017
301	R&D	46560000	1019
302	product planning	22600000	1016
403	Education	93200000	1005
402	software support	30800000	1011
401	customer support	98230000	1003
201	technical operations	29380000	1025

Claves (Keys)

Dentro del mundo de RDBs vamos a encontrar que siempre se habla de distintos tipos de llaves (*keys*) que gobiernan nuestros datos.

Estas llaves no son más que uno o más atributos que nos permiten identificar de manera univoca un dato en nuestra tabla.

Además permiten establecer las relaciones del modelo.



Claves

Clave primaria (PK)

- Es un requerimiento de una tabla tener una PK asignada para identificar cada una de ellas.
- Una PK es *única* por lo cual no pueden existir dos en una misma tabla.
- No pueden tener valores duplicados.
- Puede estar compuesta por una o más columnas
- **NO** puede ser nula
- Se consideran que son valores “no cambiantes”

Clave Foranea (FK)

- FK son valores opcionales
- Puede haber más de una FK por tabla
- Se permiten duplicados y nulos
- Son valores que pueden cambiar.
- Una FK **tiene** que existir en otra tabla como una **PK.**

Ventajas del MR

- Favorece el proceso de ***Normalización*** (por construcción), esto permite eliminar la redundancia de los datos
- Mediante el uso del lenguaje SQL podemos rápidamente generar “proyecciones” de nuestro MR para generar reportes/consultas
- Podemos crear varias relaciones no solo una
- Estas relaciones nos permite además evitar la duplicidad de registros.
- Garantiza la ***Integridad Referenciada***. Esto significa que si un dato está relacionado a otro, el modelo no va a permitir que se elimine.

Objetos de una RDB

Tablas

Son los elementos que contienen los registros de mis datos

Vistas:

Son proyecciones predefinidas de las tablas existentes.

Usualmente las crean los equipos de DbA’s para optimizer el uso la base.

Triggers:

SQL Statements asociados a una tabla. Que automatizan procesos típicos cuando ciertos eventos ocurren

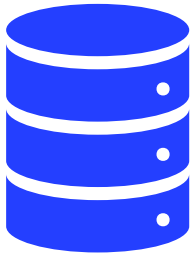
Stored Procedures:

Procedimientos generalizados/normalizados que se utilizan cross usuarios.

User Defined Functions

Programas/scripts que definimos para agilizar consultas.

Espacios en una base de datos



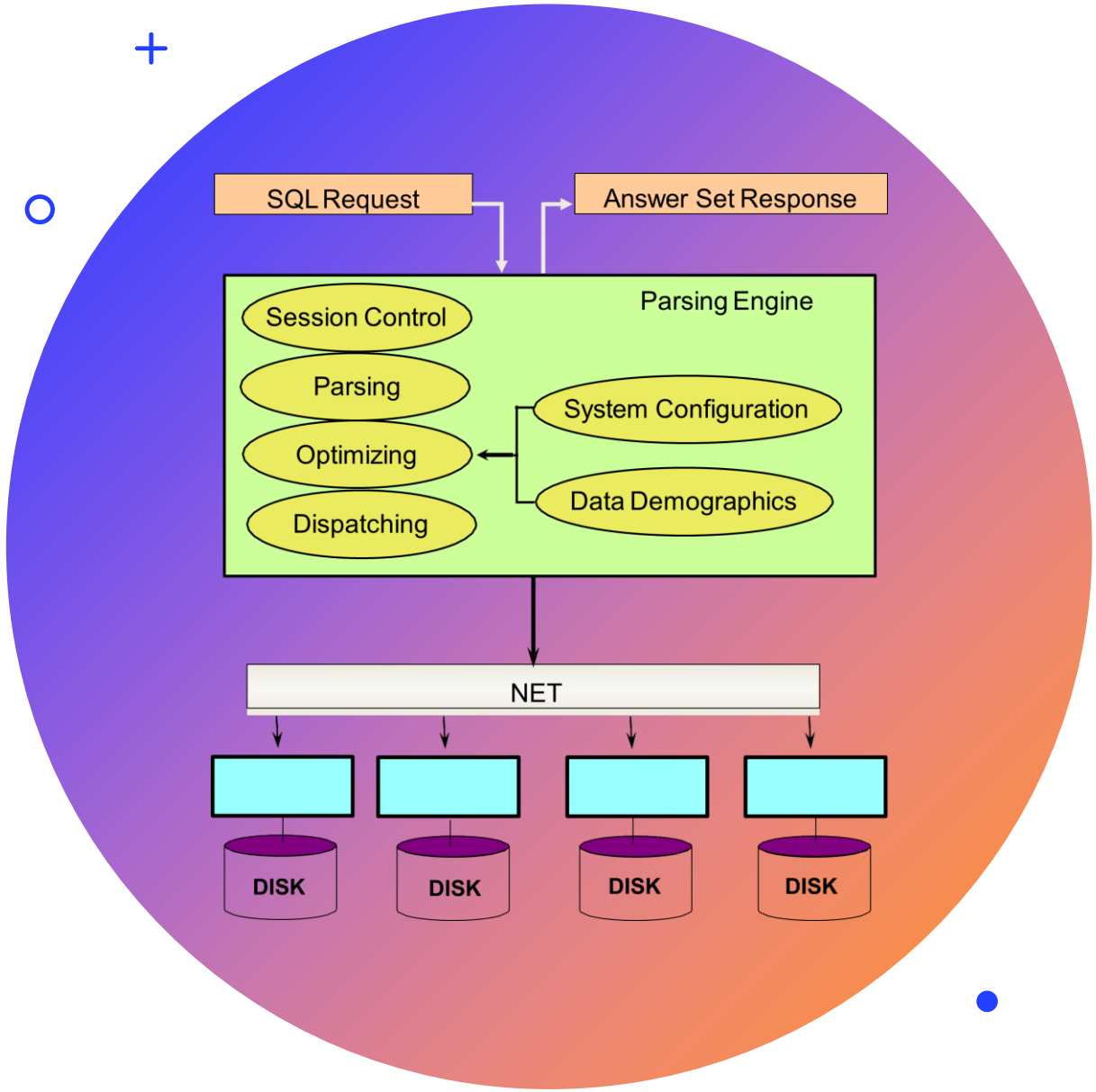
Perm Space:

Es el espacio máximo disponible para el guardado permanente de nuestros datos (tablas, vistas, indices…)

Spool Space

Es el máximo espacio disponible para nuestro procesamiento particular (nuestra query)

Es también donde guardamos nuestros resultados intermedios de la query

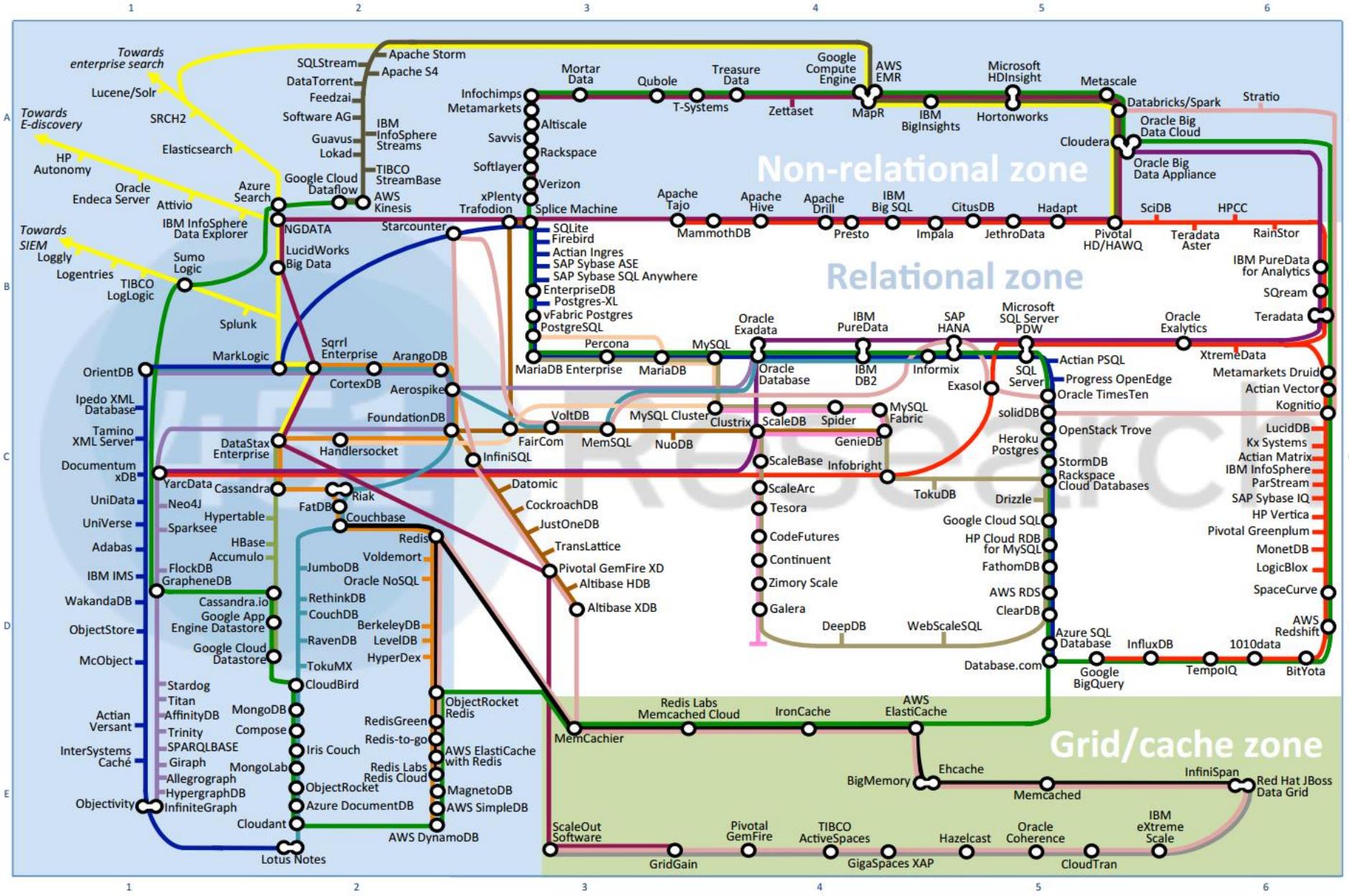


El motor de *parsing*

- El motor de analizado (*parsing engine*) es el responsible de:
- Manejar las sesiones
- Parsear y optimizer los requests de usuarios
- Crear los planes de consulta con la ayuda del optimizador.
- Entregar en medida de lo possible el plan más optimizado.
- Enviar el set de respuestas necesarias al cliente que lo solicitó

TIPOS DE BASES DE DATOS

~SQL



451 Research

Data Platforms Map

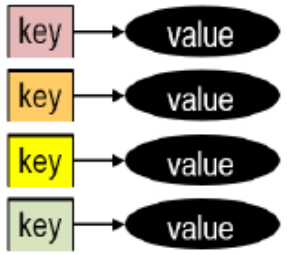
October 2014

Key:

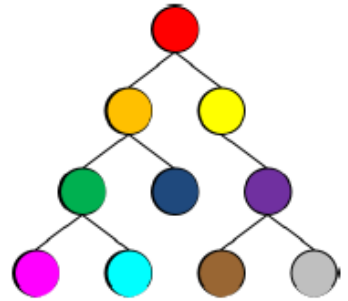
- General purpose
- Specialist analytic
- -as-a-Service
- BigTables
- Graph
- Document
- Key value stores
- Key value direct access
- Hadoop
- MySQL ecosystem
- Advanced clustering/sharding
- New SQL databases
- Data caching
- Data grid
- Search
- Appliances
- In-memory
- Stream processing

https://451research.com/dashboard/dpa

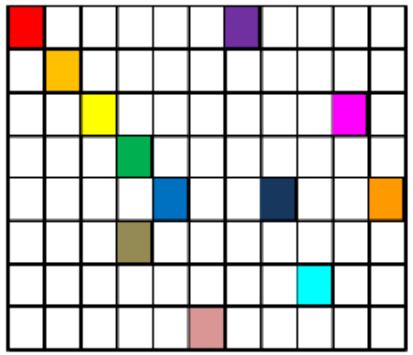
Tipos de bases NoSQL



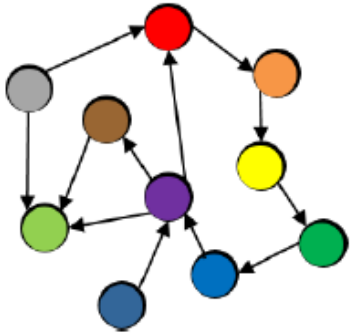
Key-Vlue



Document



Column Family



Graph Database

Sistemas híbridos (poliglotas)

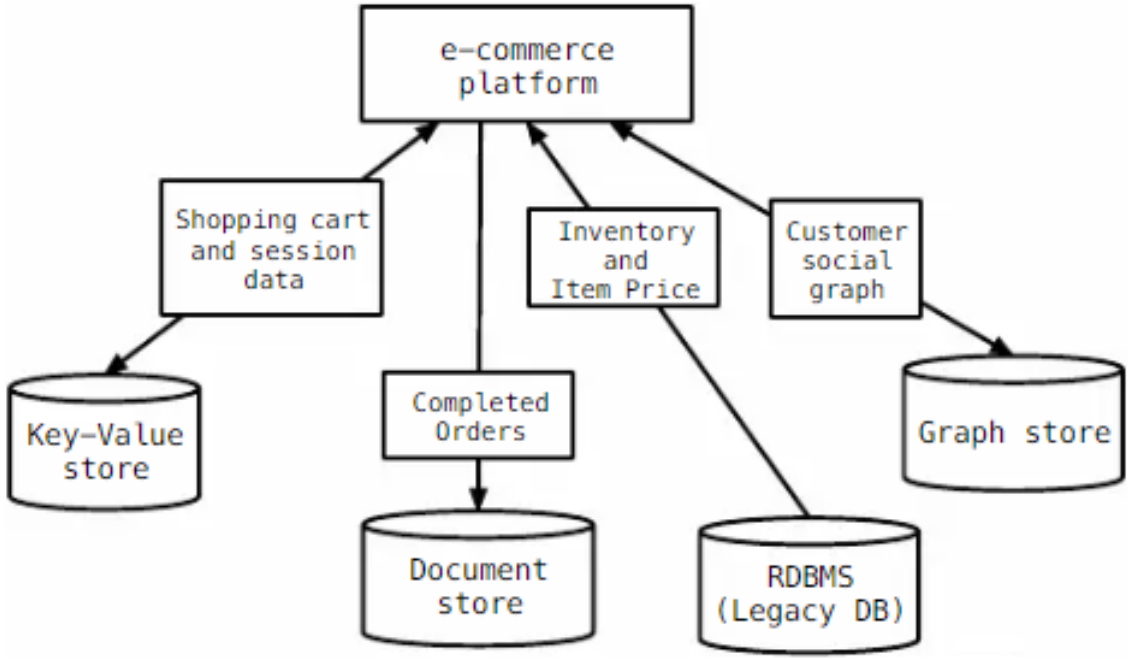


Figure 13.3 *Example implementation of polyglot persistence*

NoSQL Distilled

A Brief Guide to the Emerging World of Polyglot Persistence

Pramod J. Sadalage
Martin Fowler

371 systems in ranking, June 2021

Rank			DBMS	Database Model	Score		
Jun 2021	May 2021	Jun 2020			Jun 2021	May 2021	Jun 2020
1.	1.	1.	Oracle	Relational, Multi-model	1270.94	+1.00	-72.65
2.	2.	2.	MySQL	Relational, Multi-model	1227.86	-8.52	-50.03
3.	3.	3.	Microsoft SQL Server	Relational, Multi-model	991.07	-1.59	-76.24
4.	4.	4.	PostgreSQL	Relational, Multi-model	568.51	+9.26	+45.53
5.	5.	5.	MongoDB	Document, Multi-model	488.22	+7.20	+51.14
6.	6.	6.	IBM Db2	Relational, Multi-model	167.03	+0.37	+5.23
7.	7.	↑ 8.	Redis	Key-value, Multi-model	165.25	+3.08	+19.61
8.	8.	↓ 7.	Elasticsearch	Search engine, Multi-model	154.71	-0.65	+5.02
9.	9.	9.	SQLite				
10.	10.	↑ 11.	Microsoft Access				
11.	11.	↓ 10.	Cassandra				
12.	12.	12.	MariaDB				
13.	13.	13.	Splunk				
14.	14.	14.	Hive				
15.	15.	↑ 23.	Microsoft Azure SQL Database				
16.	16.	16.	Amazon DynamoDB				
17.	17.	↓ 15.	Teradata				

DB-Engines

DB-Engines is an initiative to collect and present information on database management systems (DBMS). In addition to established relational DBMS, systems and concepts of the growing NoSQL area are emphasized.

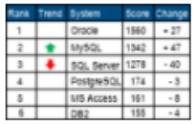
The DB-Engines Ranking is a list of DBMS ranked by their current popularity. The list is updated monthly.

THE GROWING DICHOTOMY

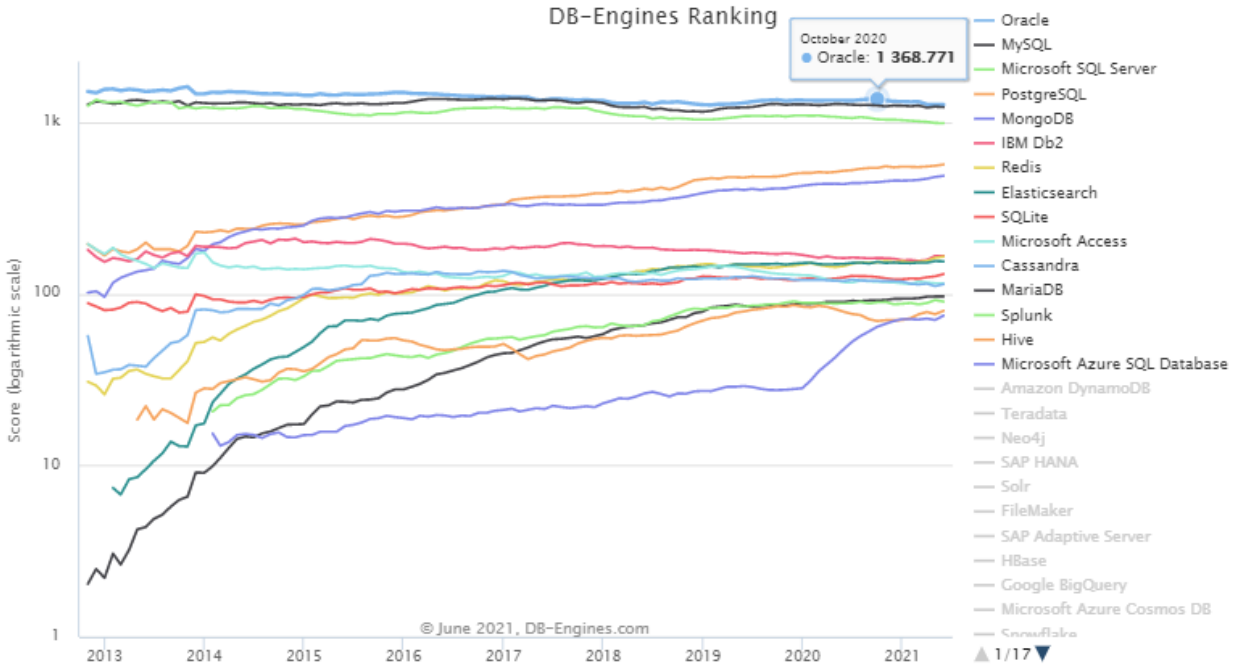
DB-Engines Ranking - Trend Popularity

The DB-Engines Ranking ranks database management systems according to their popularity.

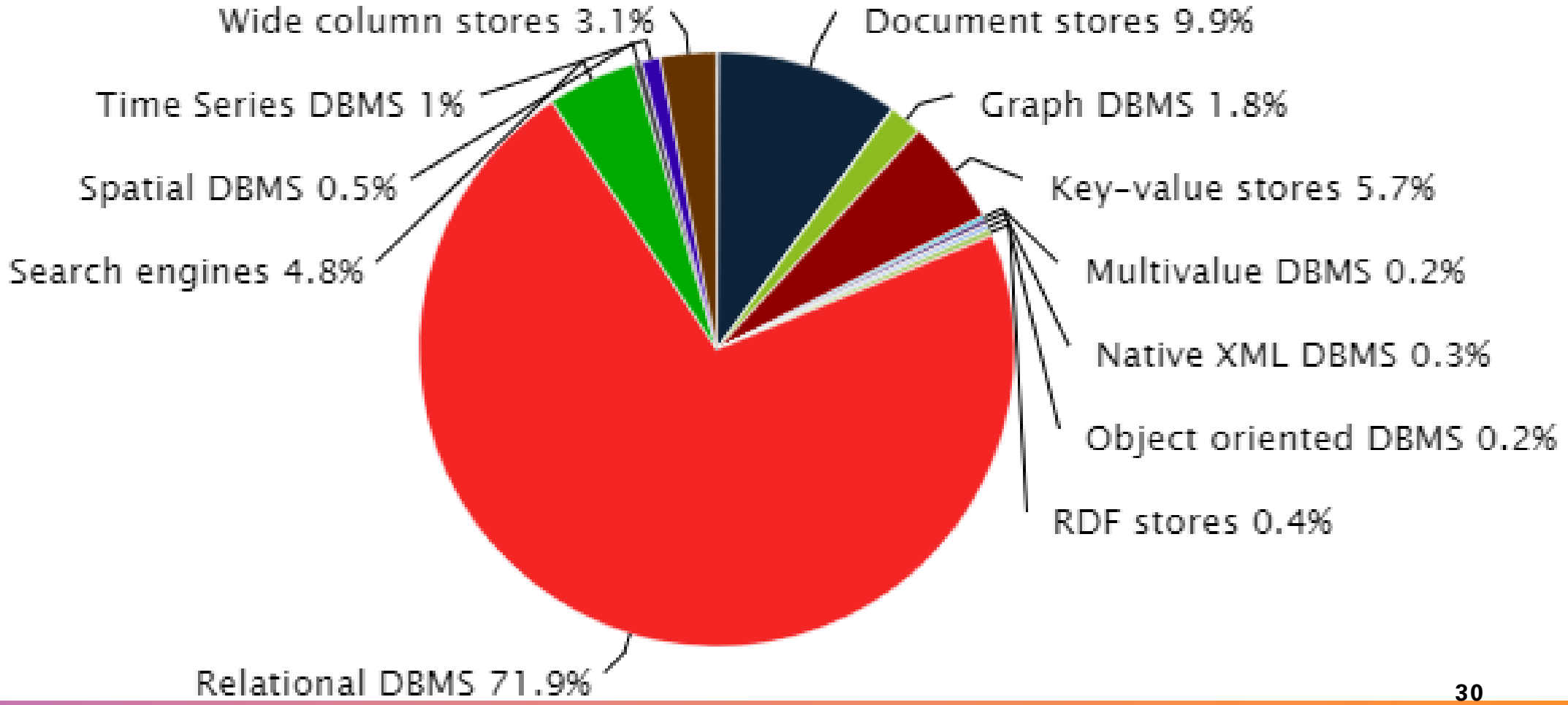
Read more about the method of calculating the scores.



ranking table
June 2021



Ranking scores per category in percent, April 2022



Open source vs Commercial

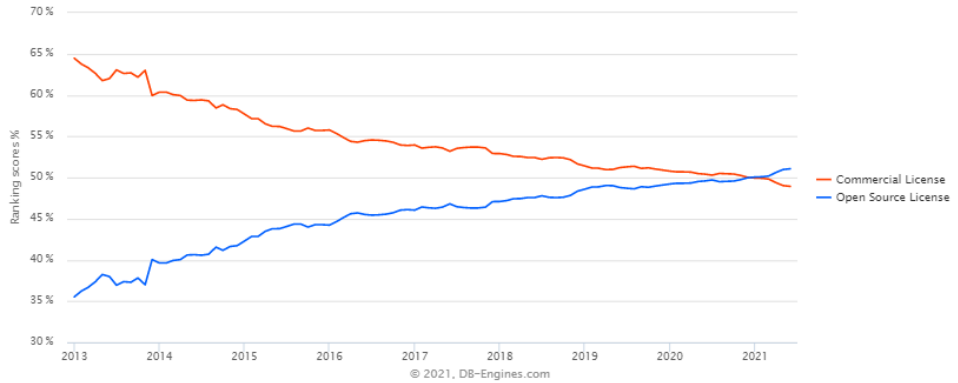
The top 5 commercial systems, June 2021

Rank	System	Score	Overall Rank
1.	Oracle	1271	1.
2.	Microsoft SQL Server	991	3.
3.	IBM Db2	167	6.
4.	Microsoft Access	115	10.
5.	Splunk	90	13.

The top 5 open source systems, June 2021

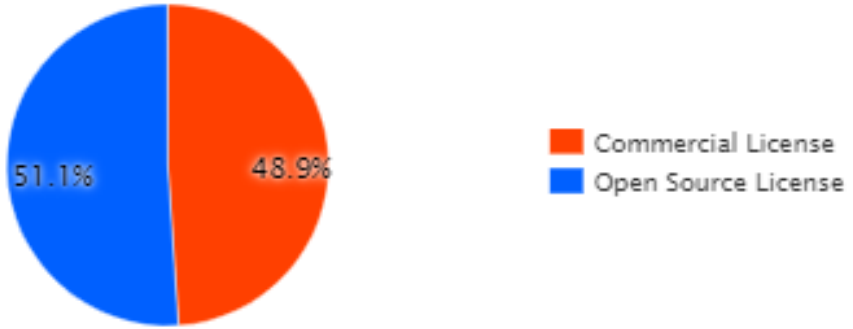
Rank	System	Score	Overall Rank
1.	MySQL	1228	2.
2.	PostgreSQL	569	4.
3.	MongoDB	488	5.
4.	Redis	165	7.
5.	Elasticsearch	155	8.

Popularity trend

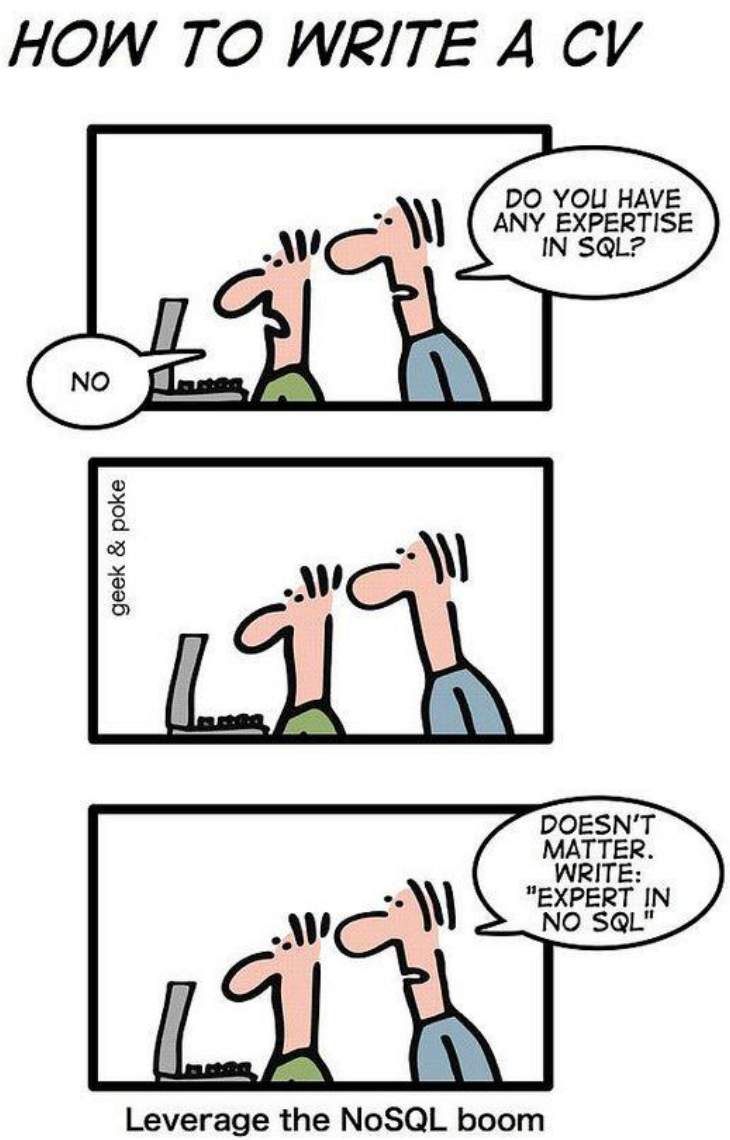


The above chart shows the historical trend of the popularity of open source and commercial database management systems.

Popularity scores, June 2021



© 2021, DB-Engines.com


HOW TO WRITE A CV
DO YOU HAVE ANY EXPERTISE IN SQL?
NO
geek & poke
DOESN'T MATTER. WRITE: "EXPERT IN NO SQL"
Leverage the NoSQL boom

Scaling horizontally relational databases is a challenging task, if not impossible.

One of the main problems that a **NoSQL databases** solves is scale, among others.

No to SQL? Anti-Database Movement Gains Steam

The meet-up in San Francisco last month had a whiff of revolution about it, like a latter-day techie version of the American Patriots planning the Boston Tea Party.

By Eric Lai

Computerworld | JUL 1, 2009 8:00 AM PT

The meet-up in San Francisco last month had a whiff of revolution about it, like a latter-day techie version of the American Patriots planning the Boston Tea Party.

The inaugural get-together of the burgeoning NoSQL community crammed 150 attendees into a meeting room at CBS Interactive.

Like the Patriots, who rebelled against Britain's heavy taxes, NoSQLers came to share how they had overthrown the tyranny of slow, expensive relational databases in favor of more efficient and cheaper ways of managing data.

MORE LIKE THIS ::

Java in the Cloud: Google, Aptana, and Stax

Open Source CRM and ERP: Bending the Back Office


Review: Google Bigtable scales with ease

NoSQL originally started off as a simple combination of two words—No and SQL—clearly and completely visible in the new term. No acronym. What it literally means is, "I do not want to use SQL". To elaborate, "I want to access database without using any SQL syntax"

"...people are continually interpreting nosql to be *anti-RDBMS*, it's the only rational conclusion when the only thing some of these projects share in common is that they are *not relational databases*."

Hitos

Bigtable: A Distributed Storage System for Structured Data

Fay Chang, Jeffrey Dean, Sanjay Ghemawat, Wilson C. Hsieh, Deborah A. Wallach
har Chandra, Andrew Fikes, Robert E. Gruber
wilsonh,kerr,m3b,tushar,fikes,gruber}@google.com
Google, Inc.

achieved scalability and high performance, but Bigtable provides a different interface than such systems. Bigtable does not support a full relational data model; instead, it provides clients with a simple data model that supports dynamic control over data layout and format, and allows clients to reason about the locality properties of the data represented in the underlying storage. Data is indexed using row and column names that can be arbitrary strings. Bigtable also treats data as uninterpreted strings, although clients often serialize various forms of structured and semi-structured data into these strings. Clients can control the locality of their data through careful choices in their schemas. Finally, Bigtable schema parameters let clients dynamically control whether to serve

emory or from disk.

lescribes the data model in more detail, and ovides an overview of the client API. Sec-

Dynamo: Amazon's Highly Available Key-value Store

Giuseppe DeCandia, Deniz Hastorun, Madan Jampani, Gunavardhan Kakulapati, Avinash Lakshman, Alex Pilchin, Swaminathan Sivasubramanian, Peter Vosshall and Werner Vogels

Amazon.com

ABSTRACT

Reliability at massive scale is one of the biggest challenges we face at Amazon.com, one of the largest e-commerce operations in the world; even the slightest outage has significant financial consequences and impacts customer trust. The Amazon.com platform, which provides services for many web sites worldwide, is implemented on top of an infrastructure of tens of thousands of servers and network components located in many datacenters around the world. At this scale, small and large components fail continuously and the way persistent state is managed in the face of these failures drives the reliability and scalability of the software systems.

This paper presents the design a highly available key-value stora core services use to provide achieve this level of availabilit under certain failure scenarios. versioning and application-assis that provides a novel interface f

One of the lessons our organization has learned from operating Amazon's platform is that the reliability and scalability of a system is dependent on how its application state is managed. Amazon uses a highly decentralized, loosely coupled, service oriented architecture consisting of hundreds of services. In this environment there is a particular need for storage technologies that are always available. For example, customers should be able to view and add items to their shopping cart even if disks are failing, network routes are flapping, or data centers are being destroyed by tornados. Therefore, the service responsible for managing shopping carts requires that it can always write to and read from its data store, and that its data needs to be available

for managing
a very large
f commodity
a in Bigtable,
d Google Fi-
rent demands
rom URLs to
requirements
data serving).
successfully
tion for all of
cribe the sim-

A Big Data Modeling Methodology for Apache Cassandra

Artem Chebotko
DataStax Inc.
Email: achebotko@datastax.com

Andrey Kashlev
Wayne State University
Email: andrey.kashlev@wayne.edu

Shiyong Lu
Wayne State University
Email: shiyong@wayne.edu

***Abstract*—Apache Cassandra is a leading distributed database of choice when it comes to big data management with zero downtime, linear scalability, and seamless multiple data center deployment. With increasingly wider adoption of Cassandra**

because of the expressivity of the Structured Query Language (SQL) that readily supports relational joins, nested queries, data aggregation, and numerous other features that help to

Bigtable, 2006

Column family
indexed by a row key, column key, and a timestamp

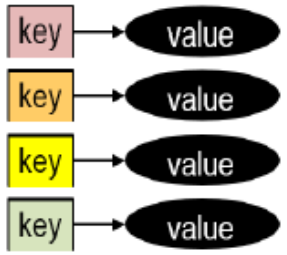
Amazon, Dynamo, 2007

Key value

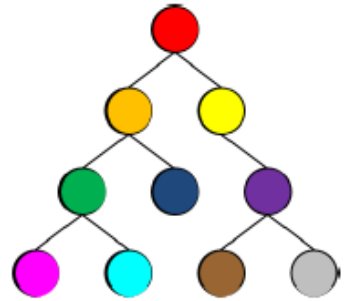
Facebook release Cassandra, 2008

Column family

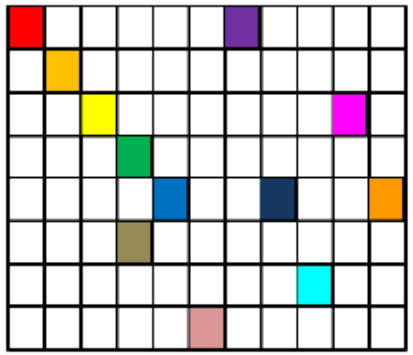
Tipos de bases NoSQL



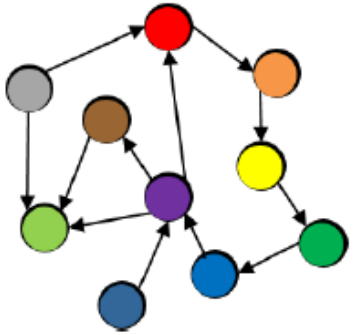
Key-Vlue



Document



Column Family



Graph Database

Key Value Store

En el tipo de almacén Key Value, se utiliza una tabla hash en la que una clave única apunta a un elemento.

Las claves pueden ser organizadas por grupos clave lógicos, requiriendo solamente estas claves para ser únicas dentro de su propio grupo. Esto permite tener claves idénticas en diferentes grupos lógicos. La siguiente tabla muestra un ejemplo de un almacén de valores clave, en el que la clave es el nombre de la ciudad y el valor es la dirección de Ulster University en esa ciudad.

Key	Value
"Belfast"	{"University of Ulster, Belfast campus, York Street, Belfast, BT15 1ED"}
"Coleraine"	{"University of Ulster, Coleraine campus, Cromore Road, Co. Londonderry, BT52 1SA"}

Document store

Most of the databases available under this category use XML or JSON. It is semi-structured as compared to rigid RDBMS.

For example, two records may have completely different set of fields or columns.

The records may or may not adhere to a specific schema (like the table definitions in RDBMS). For that matter, the database may not support a schema or validating a document against the schema at all. (examples of document content using JSON)

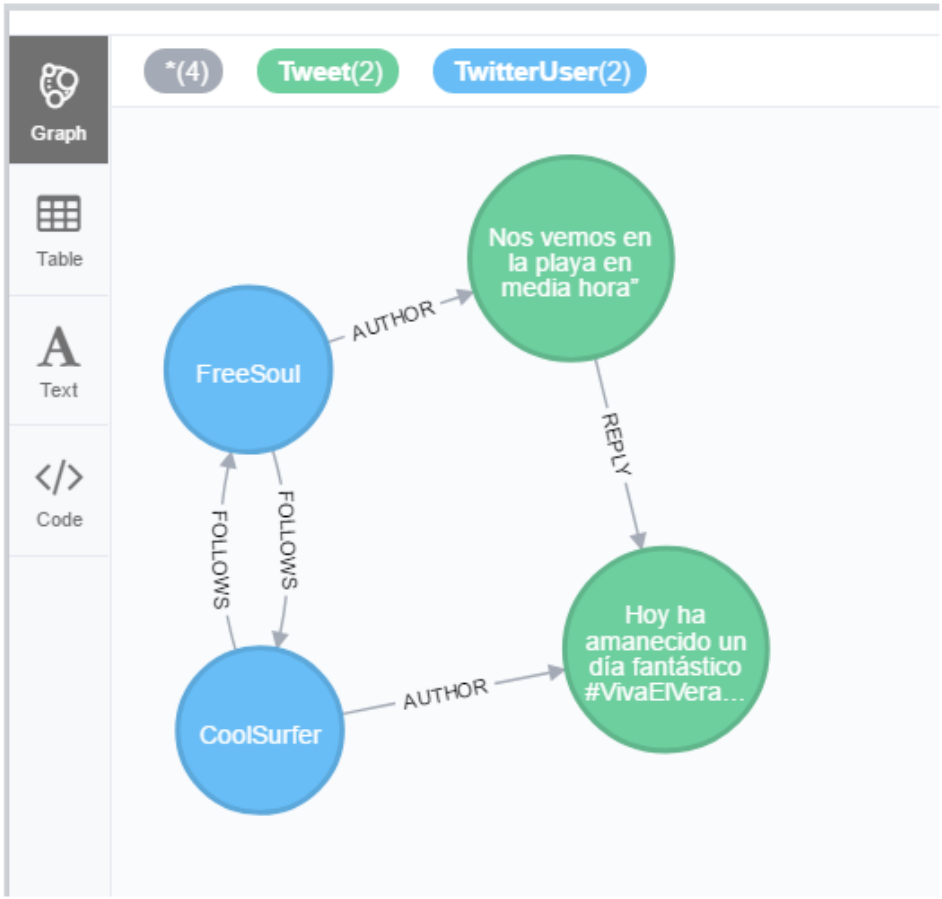

```
{
    "EmployeeID": "SM1",
    "FirstName": "Anuj",
    "LastName": "Sharma",
    "Age": 45,
    "Salary": 10000000
},
{
    "EmployeeID": "MM2",
    "FirstName": "Anand",
    "Age": 34,
    "Salary": 5000000,
    "Address": {
        "Line1": "123, 4th Street",
        "City": "Bangalore",
        "State": "Karnataka"
    },
    "Projects": [
        "nosql-migration",
        "top-secret-007"
    ]
},
{
    "LocationID": "Bangalore-SDC-BTP-CVRN",
    "RegisteredName": "ACME Software Development Ltd",
    "RegisteredAddress": {
        "Line1": "123, 4th Street",
        "City": "Bangalore",
        "State": "Karnataka"
    }
}
```

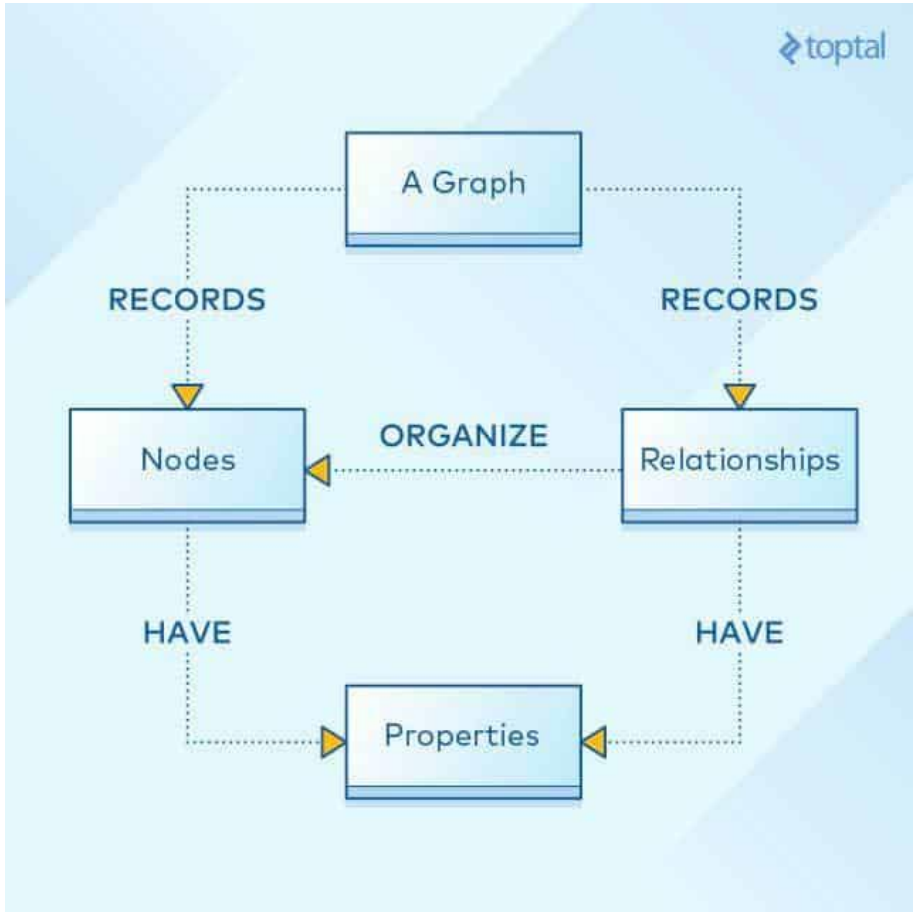
Column Family

ActoresXSerie	
Titulo	K
Nombre	C
Edad	
Personaje	

ROW KEY	C. Cox:Edad	C.Cox:Personaje	J.Aniston:Edad	J.Aniston: Personaje	J.Galecki:Edad	J.Galecki:Personaje	J.Parsons:Edad	J.Parsons:Personaje
Friends	52	Monica Geller	48	Rachel Green				
The Big Bang Theory					40	Leonard Hofsadter	38	Sheldon Cooper

Grafos


Graph
Table
Text
Code
*(4)
Tweet(2)
TwitterUser(2)
Nos vemos en la playa en media hora"
FreeSoul
AUTHOR
REPLY
FOLLOWS
FOLLOWS
Hoy ha amanecido un día fantástico #VivaElVera...
CoolSurfer
AUTHOR


toptal
A Graph
RECORDS
RECORDS
Nodes
ORGANIZE
Relationships
HAVE
HAVE
Properties

List of some of the mature, popular and powerful NoSQL databases

Document	Key-Value	XML	Column	Graph
MongoDB	Redis	BaseX	BigTable	Neo4J
CouchDB	Membase	eXist	Hadoop / HBase	FlockDB
RavenDB	Voldemort		Cassandra	InfiniteGraph
Terrastore	MemcacheDB		SimpleDB	
			Cloudera	

CONSISTENCIA

Modelos de consistencia

Determina la visibilidad y el orden aparente de las actualizaciones.

Es básicamente un contrato entre los procesos y el almacén de datos. Este contrato dice que, si los procesos aceptan obedecer ciertas reglas, el almacén promete funcionar correctamente.

Consistencia

Consistencia fuerte

todas las operaciones de lectura deben devolver datos de la última operación de escritura completada.

Consistencia eventual

las operaciones de lectura verán, conforme pasa el tiempo, las escrituras. En un estado de equilibrio, el estado devolvería el último valor escrito.

A medida que $t \rightarrow \infty$ los clientes verán las escrituras

Consistencia no estricta

Read Your Own Writes (RYOW) consistency

El cliente lees sus actualizaciones inmediatamente después de que hayan sido completadas, independientemente si escribe en un server y lee de otro. Las actualizaciones de otros clientes no tienen por qué ser visibles instantáneamente.

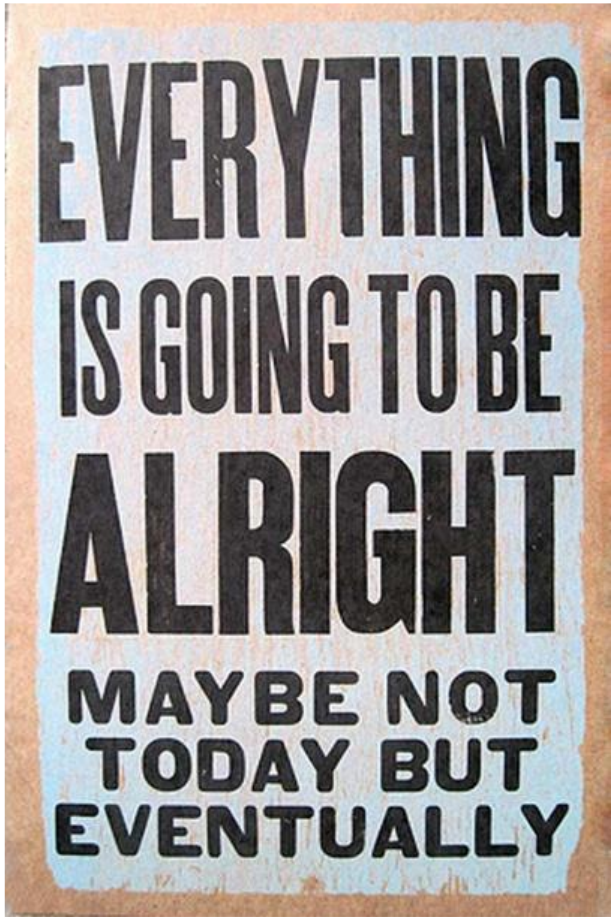
Consistencia no estricta

Consistencia de sesión

Un poco más débil que RYOW. Provee ésta consistencia solo si el cliente está dentro de la misma sesión. Usualmente sobre el mismo server.

Consistencia no estricta

Consistencia eventual



Teorema CAP

Consistency → todos ven los mismos datos al mismo tiempo

Availability → si se puede comunicar con un nodo en el cluster, entonces se pueden leer y escribir datos

Partition tolerance → el cluster puede sobrevivir a roturas de comunicación que lo dividan en particiones que no pueden comunicarse entre ellas

Es imposible para cualquier sistema de computación distribuida proveer las tres propiedades simultáneamente.

Las 8 Falacias de la Computación Distribuida

1. La red es confiable
2. La latencia es cero; la latencia no es problema
3. El ancho de banda es infinito
4. La red es segura
5. La topología no cambia
6. Hay uno y solo un administrador
7. El coste de transporte es cero
8. La red es homogénea

Teorema CAP

Las 8 Falacias de la Computación Distribuida

Consistency

Availability

Partition tolerance

Teorema CAP

Las 8 Falacias de la Computación Distribuida

¡Hay que tolerar particiones!

CP - Consistency/Partition Tolerance

AP - Availability/Partition Tolerance

Ejemplo

Las transacciones bancarias son inconsistentes, particularmente para ATMs, que están diseñados para tener un comportamiento en modo normal y otro en modo partición. En modo partición la *Availability* es elegida por sobre la *Consistencia*

Históricamente la industria financiera ha sido inconsistente a causa de la imperfección de las comunicaciones.

ATMs realizan operaciones conmutativas de manera que el orden en el cuales se aplican no importa.

Si hay una partición el cajero puede seguir funcionando; luego al volver a recuperar la partición se envían las operaciones y el saldo final sigue siendo correcto.
Lo que se hace es delimitar y administrar el riesgo. Los ATMs son rentables aún a costa de alguna pérdida.

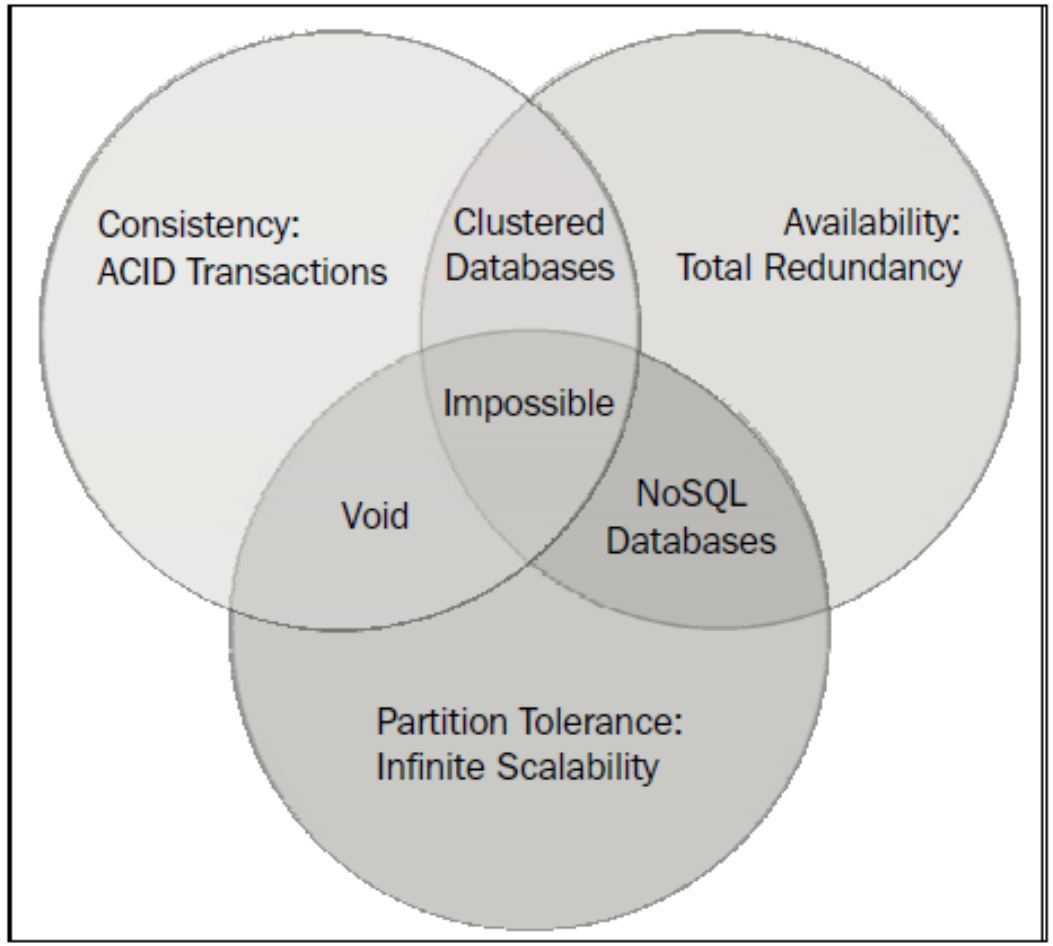
BASE, coined by Eric Brewer:

- **Basic availability**: Each request is guaranteed a response—successful or failed execution.

- **Soft state**: The state of the system may change over time, at times without any input (for eventual consistency).

- **Eventual consistency**: The database may be momentarily inconsistent but will be consistent eventually.

Relationship between CAP, ACID, and NoSQL



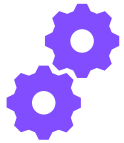
Feature	NoSQL Databases	Relational Databases
Performance	High	Low
Reliability	Poor	Good
Availability	Good	Good
Consistency	Poor	Good
Data Storage	Optimized for huge data	Medium sized to large
Scalability	High	High (but more expensive)

SQL VS NOSQL VS NEWSQL

FINDING THE RIGHT SOLUTION

OLDSQL

Traditional SQL databases have been around for decades.



Serves as the core foundation of nearly every application we use today.

Has an outstanding reliability backed up by years of R&D

THE OLDSQL ADVANTAGES

An established market and ecosystem with vast amounts of standards-based tooling.

THE OLDSQL DISADVANTAGES

They are good for general purpose applications with modest performance requirements, but struggle as needs grow.

NoSQL

Some nosql systems put availability first

Some nosql systems focus on flexibility

Some nosql systems focus on alternative data models or special use cases

THE NOSQL ADVANTAGES

Highest availability across multiple data centers

THE NOSQL DISADVANTAGES

These systems are fundamentally not transactional (ACID)

New SQL

THE NEED FOR SPEED: FAST IN-MEMORY SQL

NewSQL systems all start with the relational data model and the SQL query language.

Offers scalability, inflexibility or lack-of-focus that has driven the NoSQL movement.

Many offer stronger consistency guarantees.

THE NEWSQL ADVANTAGES:

- Many systems offer NoSQL-style clustering with more traditional data and query models

THE NEWSQL DISADVANTAGES

- Offers only partial access to the rich tooling of traditional SQL systems

DUDAS?

Replacing Datacenter Oracle with Global Apache Cassandra on AWS

ROOPA TANGIRALA
Engineering Manager
Netflix

1997

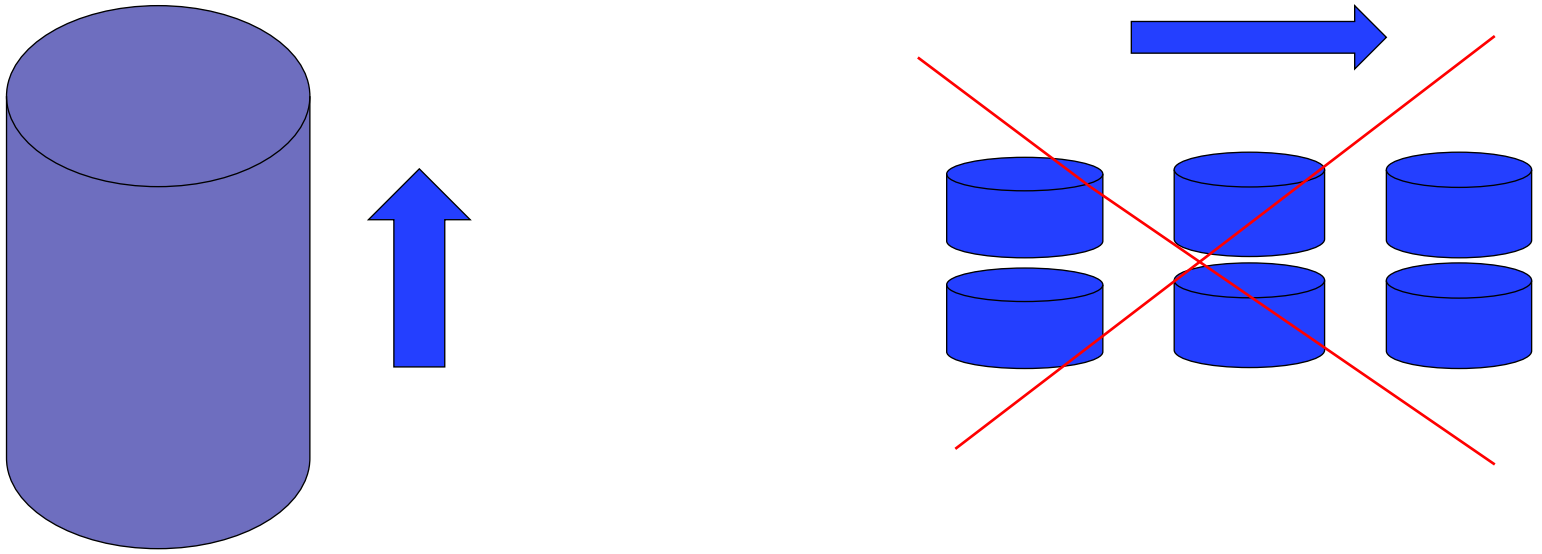
Netflix was originally nothing more than an online version of a traditional video rental store. Customers could visit the Netflix website and choose which items they wished to rent. Each rental cost $4, along with a $2 shipping fee.

2007 Netflix shipped its billionth DVD!

BACKEND

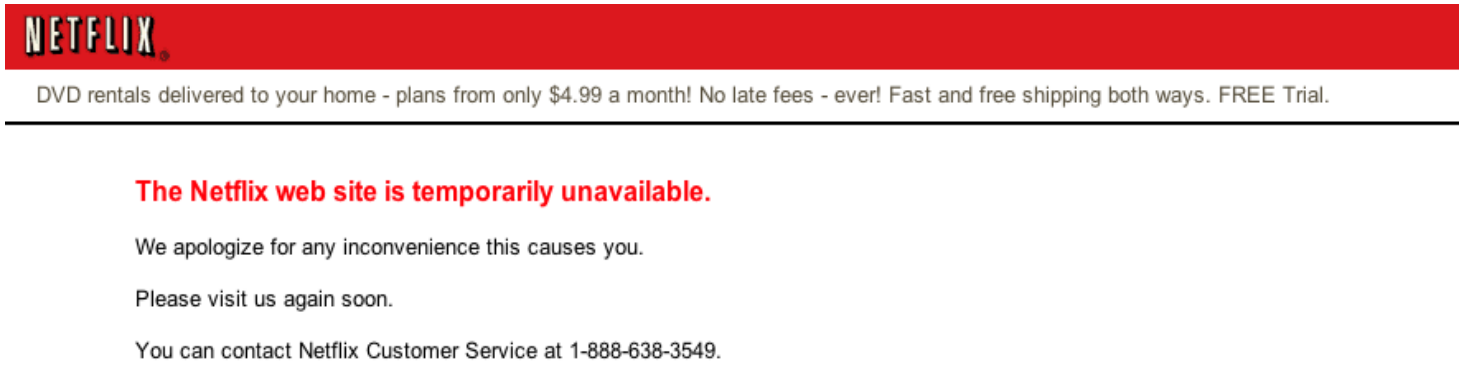
RDBMS not flexible enough to handle modern day applications, which are a mixture of structured, semi-structured and unstructured data. WHILE Oracle handles structured data well it lacks dynamic datamodel which is important for high traffic modern applications.

NO HORIZONTAL SCALING



Oracle scales up , master slave design limits both its scalability and performance for online applications, the failure of Oracle to add more capacity online in an elastic fashion without impacting the applications is a major drawback.

EVERY TWO WEEKS!!



Website went down every two weeks to include changes to PLSQL procedures, packages, schema changes and other backend database changes. Was ok for DVD since the shipping could happen after the site was back up but not acceptable for streaming service.

2008

Home / News & Analysis / **Netflix Outage Blamed on Hardware**

Netflix Outage Blamed on Hardware

BY CHLOE ALBANESIUS AUGUST 25, 2008 10:03AM EST 0 COMMENTS

Faulty hardware is to blame for a glitch that took Netflix shipping systems offline for several days earlier this month, according to a blog post from the company.

0 SHARES

Faulty hardware is to blame for a glitch that took Netflix shipping systems offline for several days earlier this month, according to a blog post from the company.

"With some great forensic help from our vendors, root cause was identified as a key faulty hardware component," according to Mike Osier, head of IT operations at Netflix. "It definitively caused the problem yet reported no detectable errors."

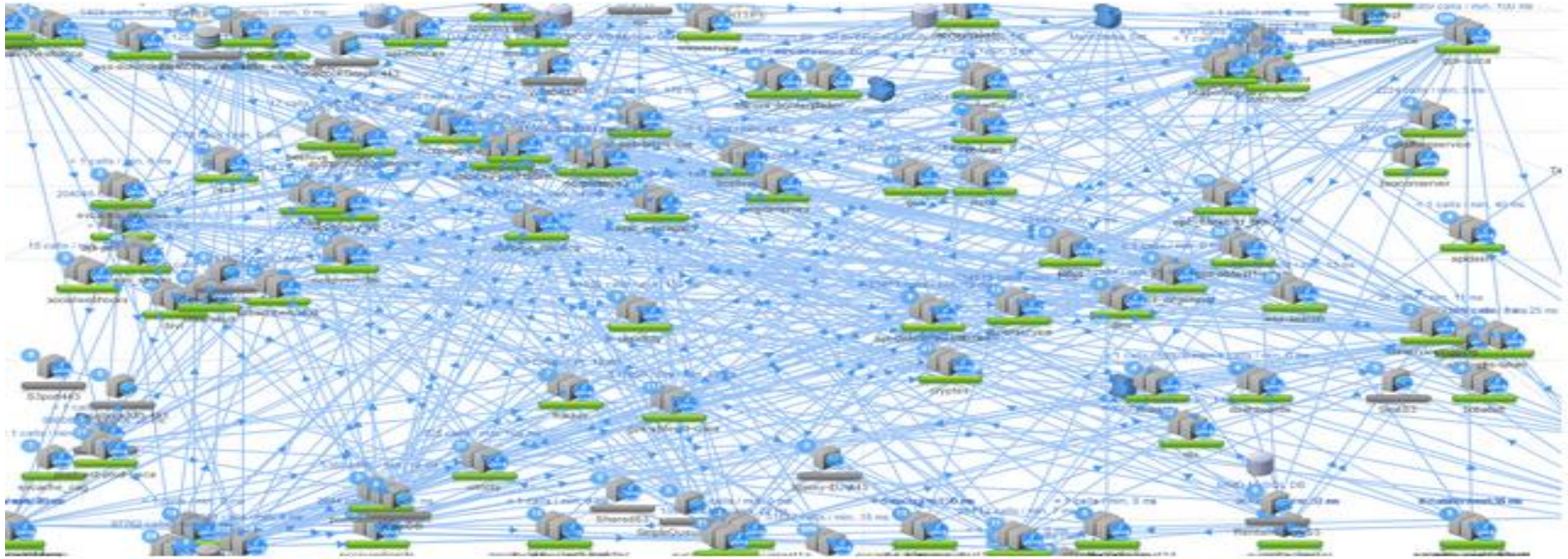
Problems started on Monday, August 11 when Netflix monitors flagged a database corruption in its shipping system. "Over the course of the day, we began experiencing similar problems in peripheral databases until our shipping system went down," Osier wrote.

This was the ugly outage and changed the way they think about infrastructure , reliability and availability.

MOVE TO CLOUD

REQUIREMENTS

- HIGHLY AVAILABLE
- MULTI DATACENTER SUPPORT
- PREDICTABLE PERFORMANCE AT SCALE



- Horizontal, Homogenous, Commoditized

CHALLENGES

SECURITY

DENORMALIZE

DENORMALIZE

DENORMALIZE

DENORMALIZE

DENORMALIZE