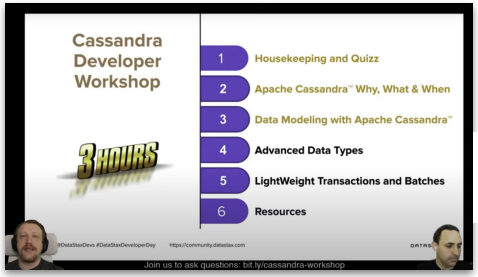
DataStax

# Intro to Cassandra for Developers

LEVEL UP with the DataStax Developers

# Housekeeping

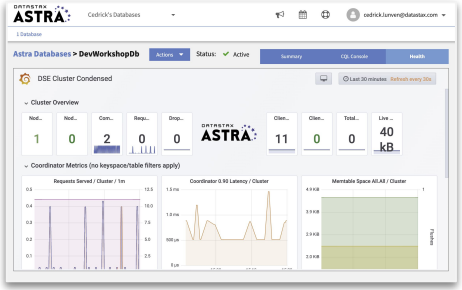
## **Courses**: youtube.com/DataStaxDevs




YouTube

Twitch

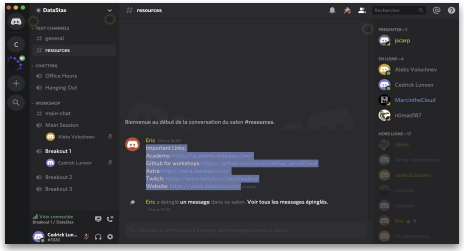
## **Runtime**: dtsx.io/workshop




DataStax Astra

cassandra

## **Questions**: bit.ly/cassandra-workshop

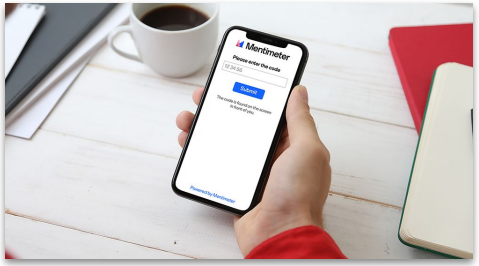


Discord

YouTube

Available on the iPhone App Store

## **Quizz**: menti.com




Mentimeter

GET IT ON Google play

DATASTAX ASTRA == cassandra

Fully managed Cassandra
Without the ops!

# DataStax Astra

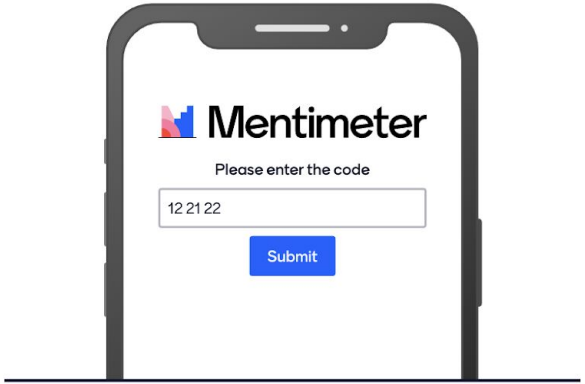
**Global Scale**
Put your data where you need it without compromising performance, availability, or accessibility.

**No Operations**
Eliminate the overhead to install, operate, and scale Cassandra.

**5 Gig Free Tier**
Launch a database in the cloud with a few clicks, no credit card required.

Go to

# www.menti.com




Enter the code

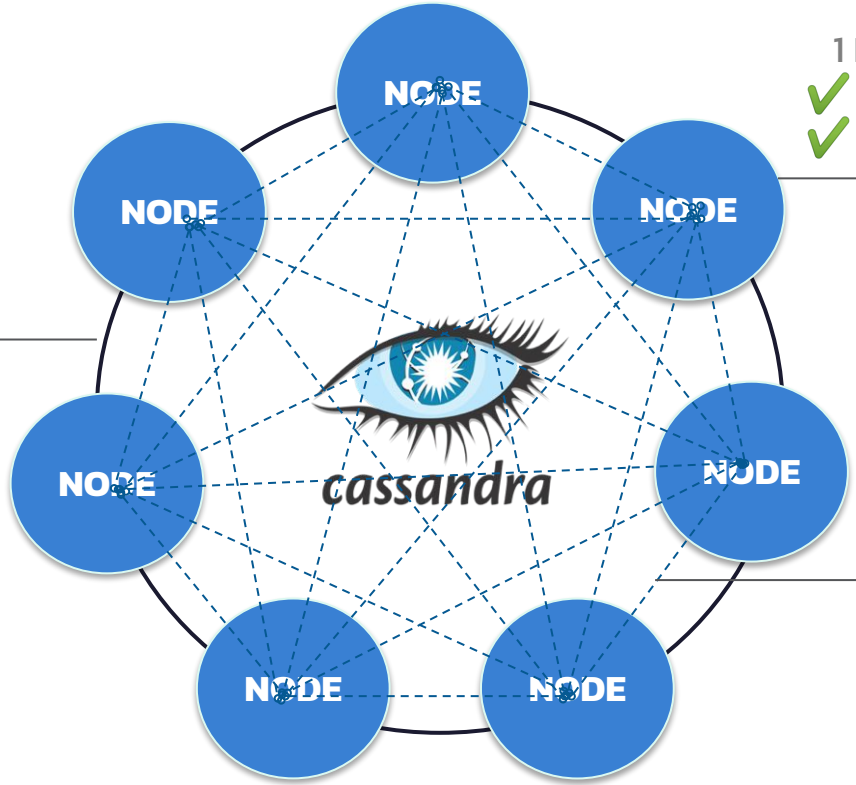
# 12 21 22

Or use QR code

Available on the iPhone App Store

GET IT ON Google play

# Apache Cassandra™ = NoSQL Distributed Database




1 Installation = 1 NODE
- ✓ Capacity = ~ 2-4TB
- ✓ Throughput = LOTS Tx/sec/core

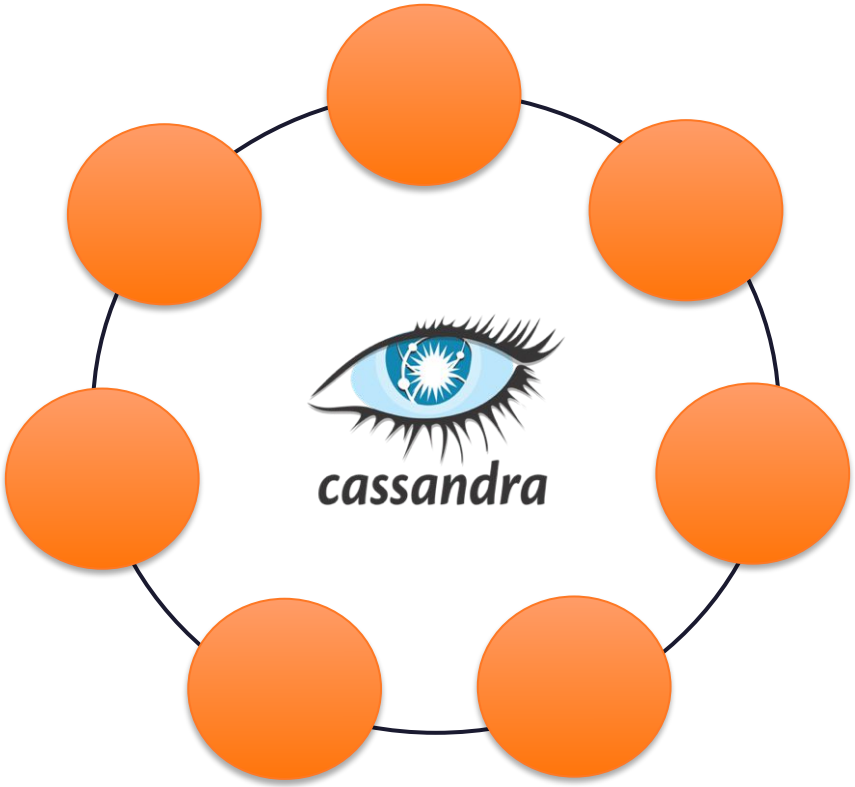
DataCenter | Ring

Communication:
- ✓ Gossiping

# Apache Cassandra™ = NoSQL Distributed Database


- Big Data Ready
- Highest Availability
- Geographical Distribution
- Read/Write Performance
- Vendor Independent

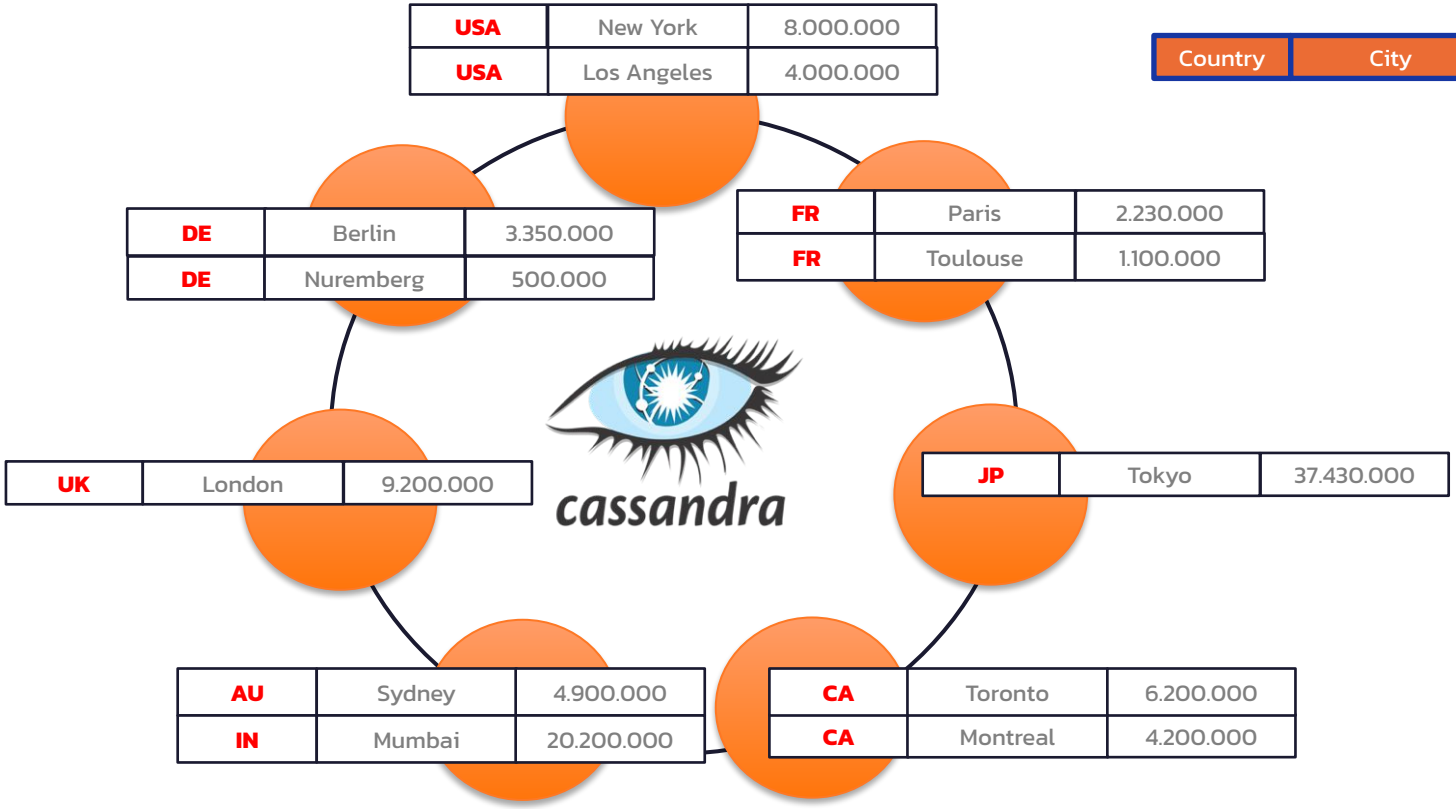
# Data is Distributed




| Country | City | Population |
|---|---|---|
| USA | New York | 8.000.000 |
| USA | Los Angeles | 4.000.000 |
| FR | Paris | 2.230.000 |
| DE | Berlin | 3.350.000 |
| UK | London | 9.200.000 |
| AU | Sydney | 4.900.000 |
| DE | Nuremberg | 500.000 |
| CA | Toronto | 6.200.000 |
| CA | Montreal | 4.200.000 |
| FR | Toulouse | 1.100.000 |
| JP | Tokyo | 37.430.000 |
| IN | Mumbai | 20.200.000 |

*Partition Key*

# Data is Distributed

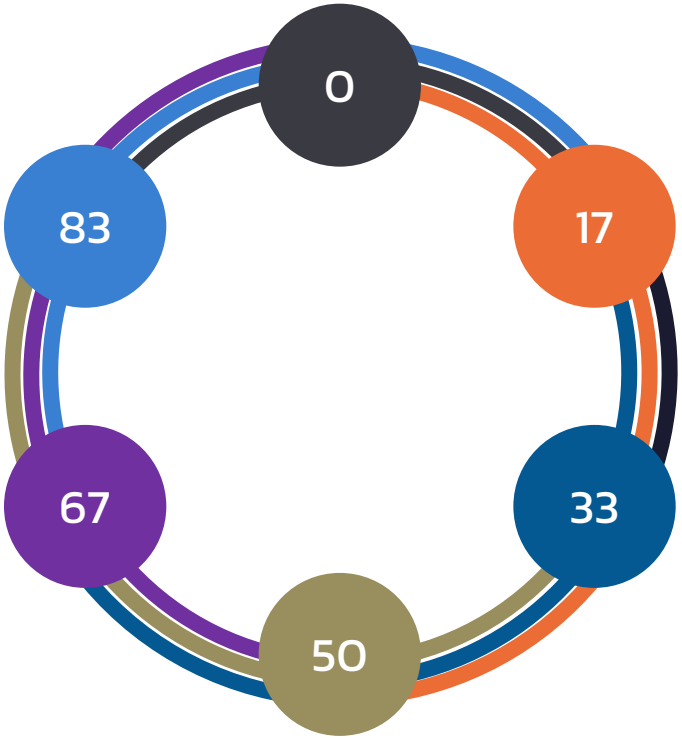



| Country | City | Population |
|---|---|---|

# Data is Replicated

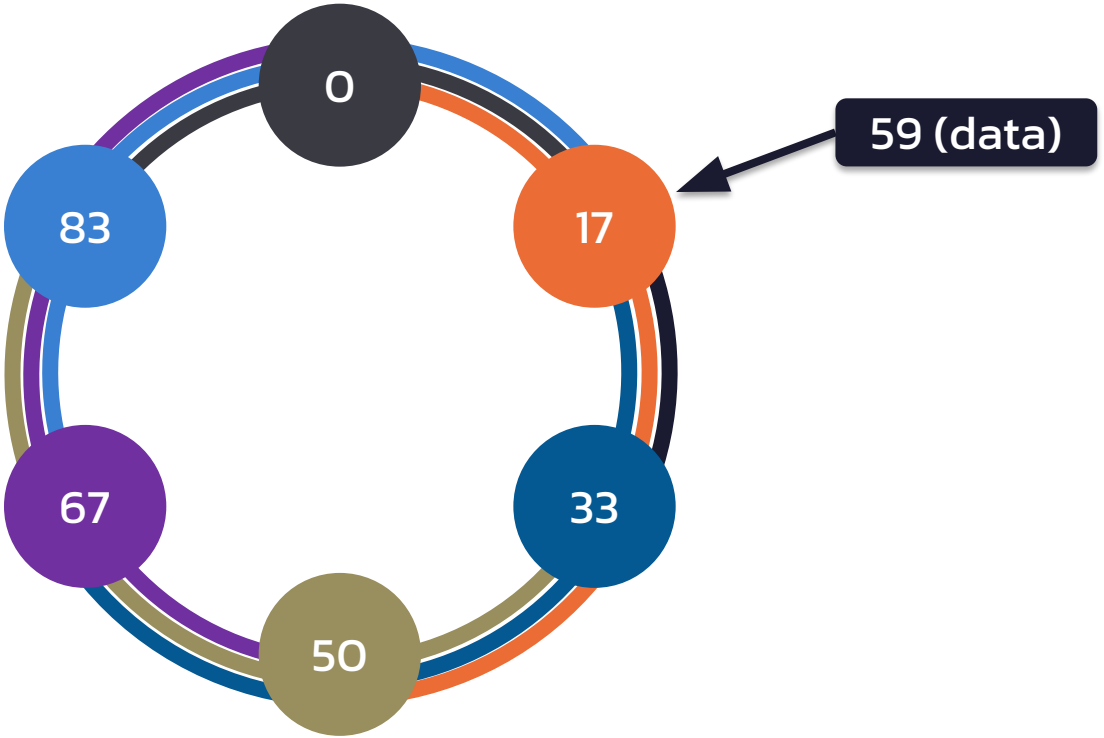
RF = 3

Replication Factor 3 means that every row is stored on 3 different nodes



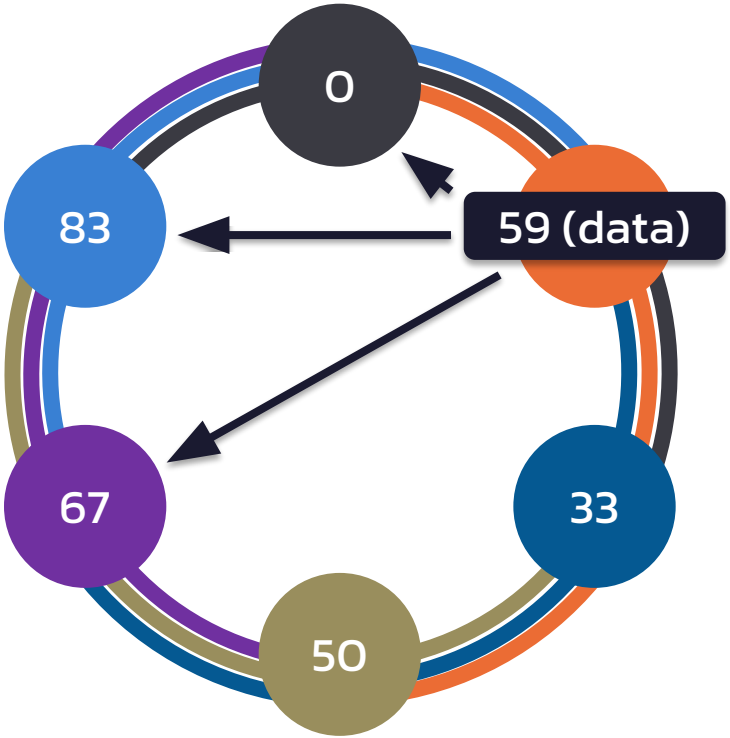
# Replication within the Ring

RF = 3



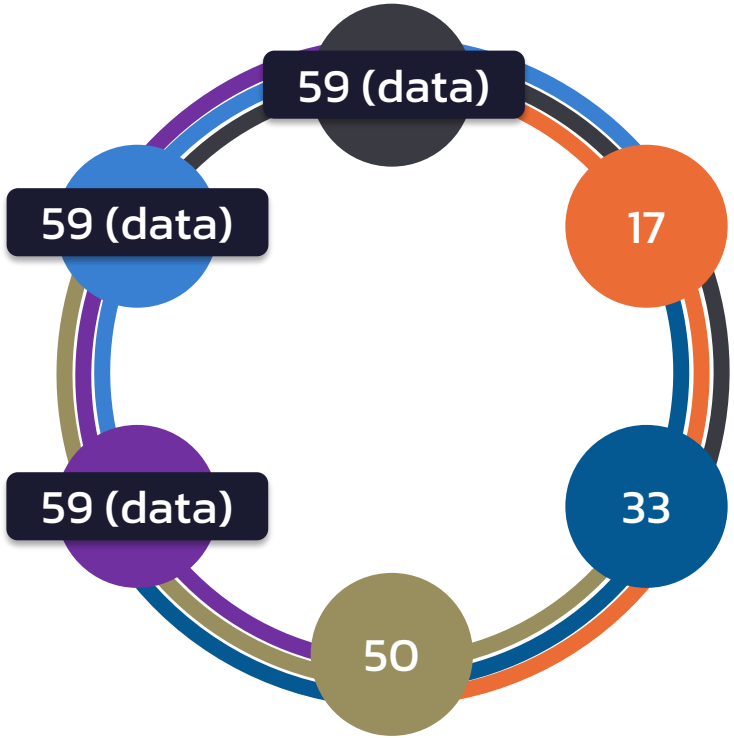
# Replication within the Ring

RF = 3



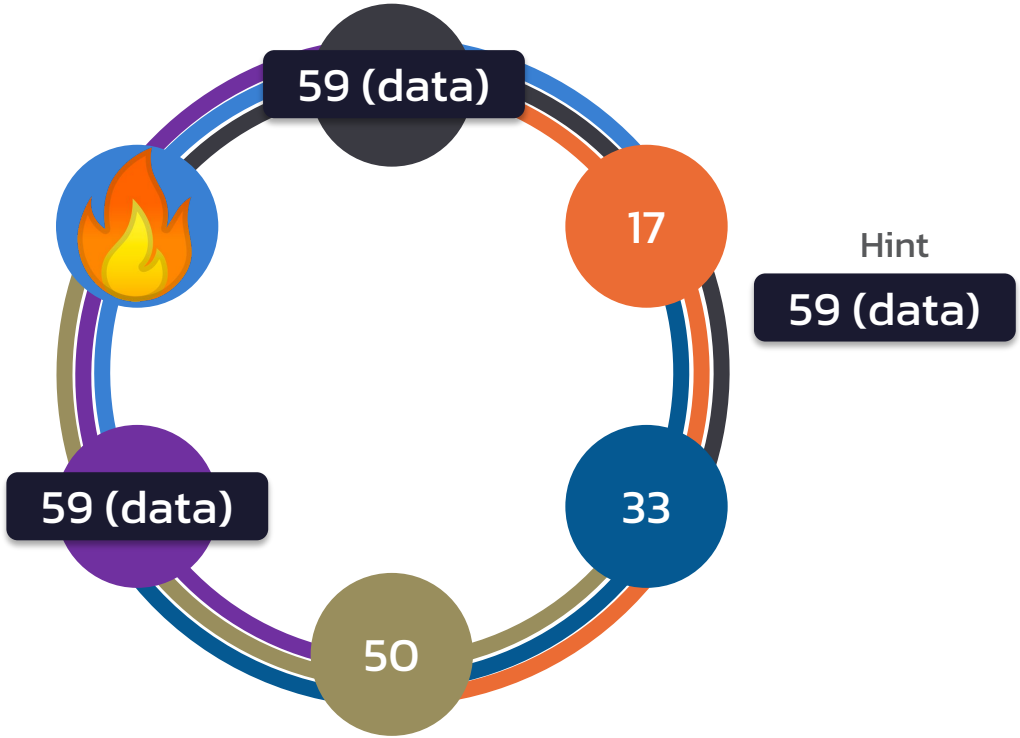
# Replication within the Ring

RF = 3



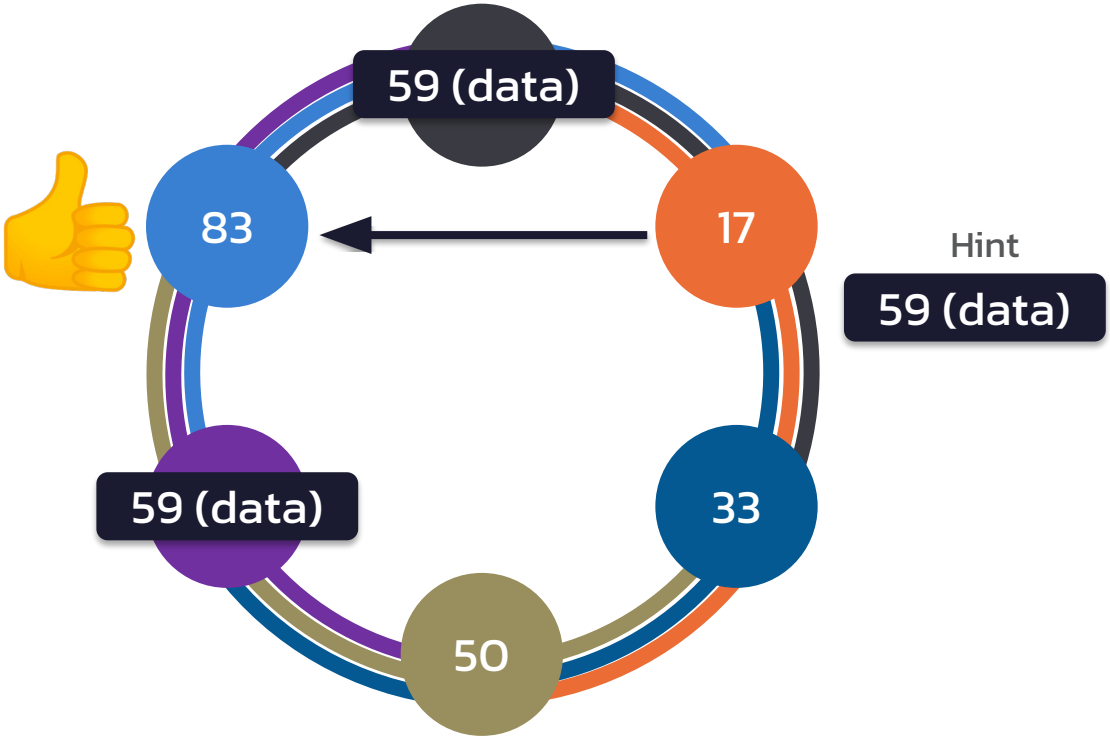
# Node Failure

RF = 3

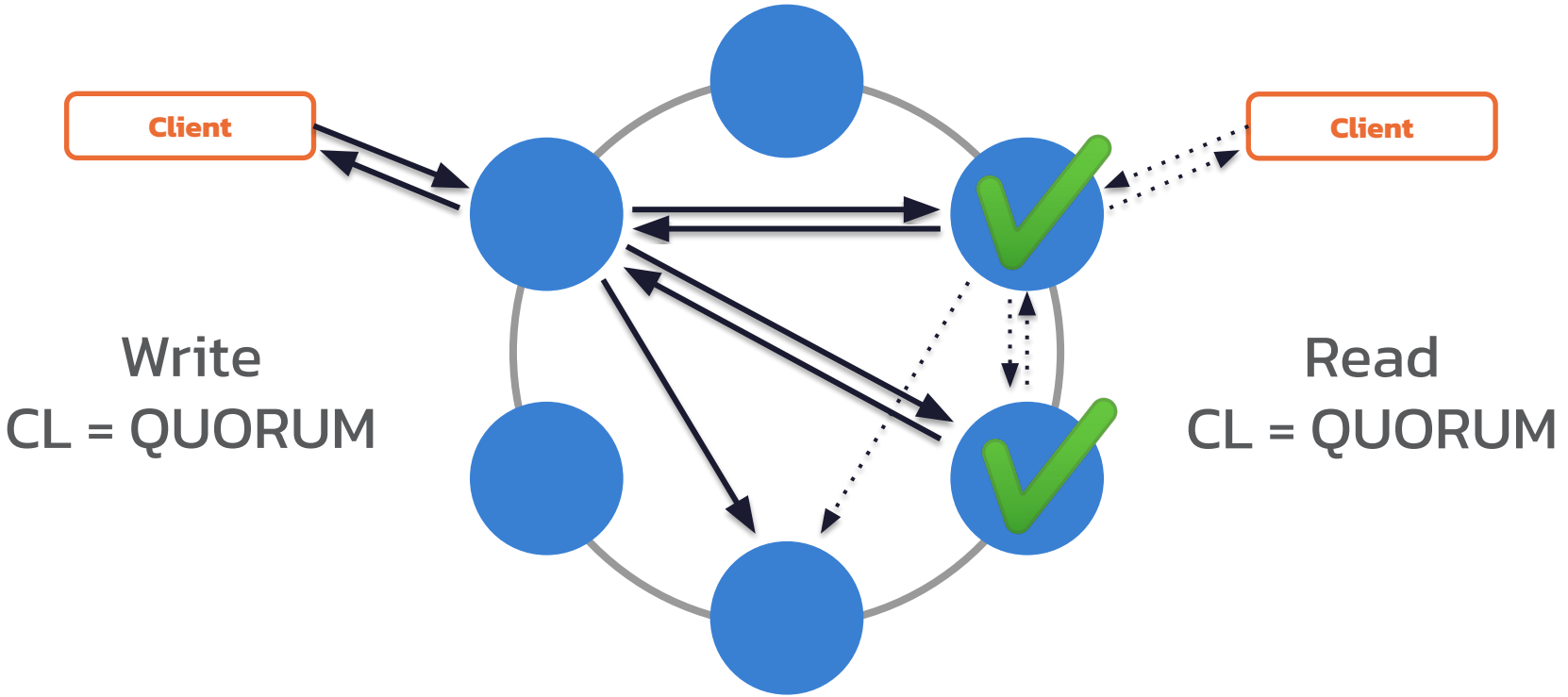


# Node Failure Recovered

RF = 3

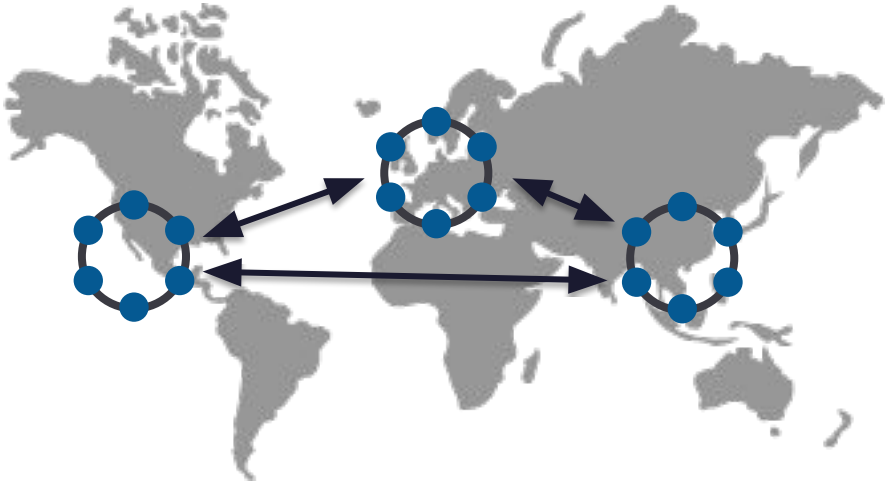


# Immediate Consistency – A Better Way

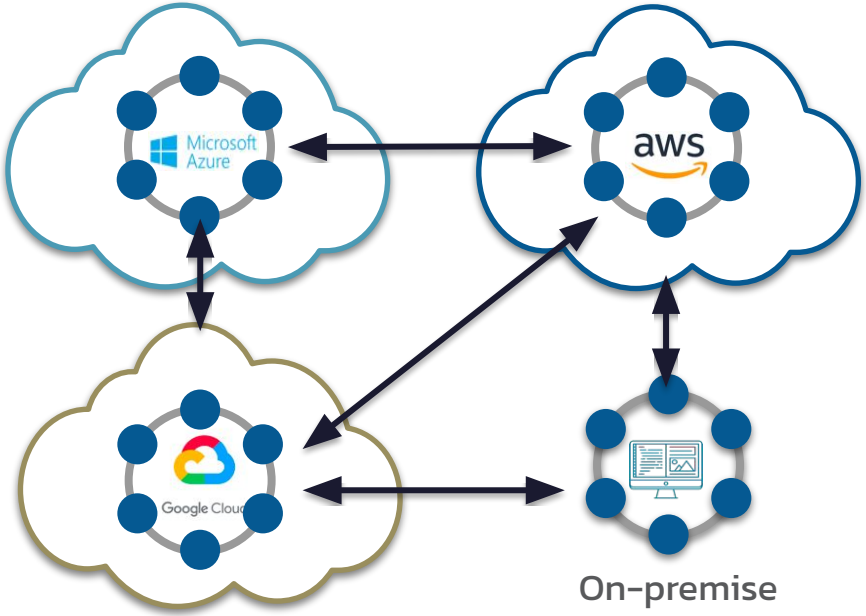


# Data Distributed Everywhere

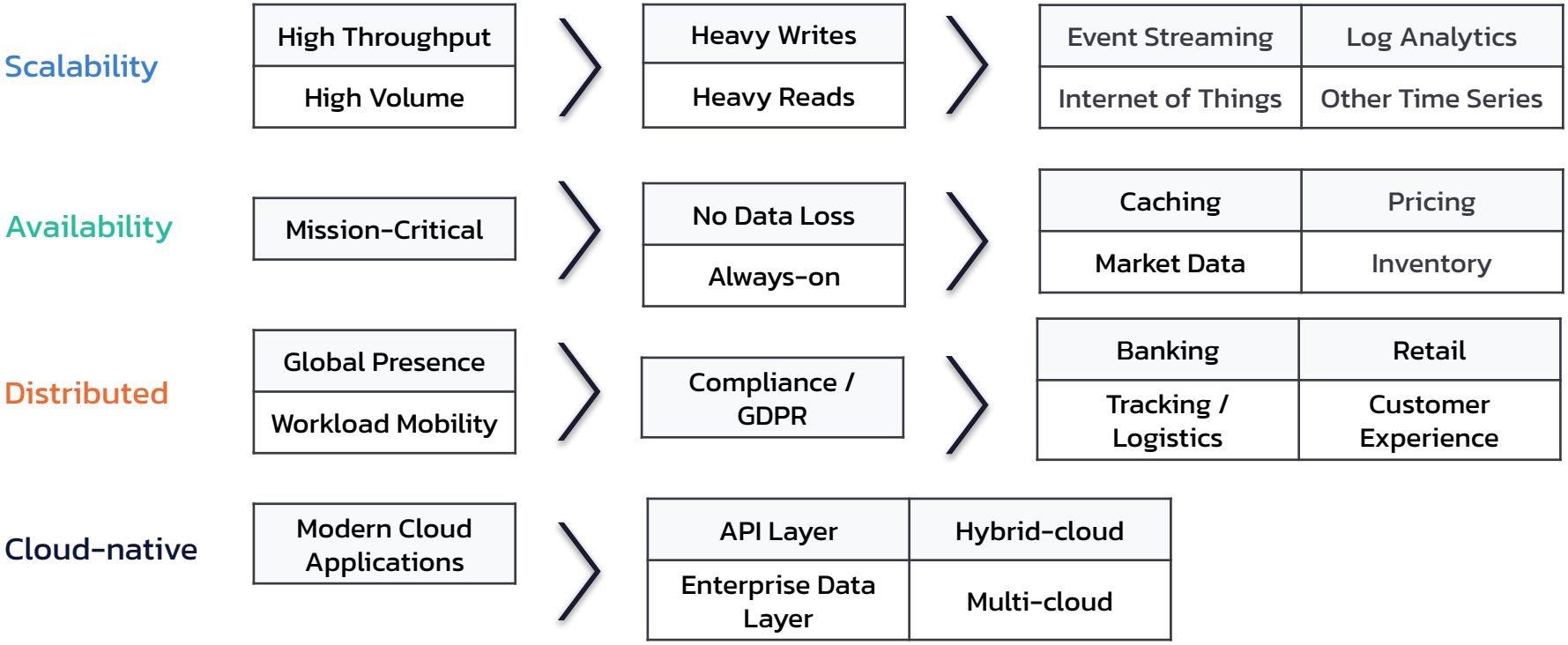
- Geographic Distribution



- Hybrid-Cloud and Multi-Cloud



# Understanding Use Cases



https://github.com/DataStax-Academy/Intro-to-Cassandra-for-Developers

# Intro to Cassandra for Developers

1. Tables, Partitions
2. The Art of Data Modelling
3. What's NEXT?

# Intro to Cassandra for Developers

1. Tables, Partitions
2. The Art of Data Modelling
3. What's NEXT?

# Data Structure: a Cell


An intersection of a row and a column, stores data.

# Data Structure: a Row


A single, structured data item in a table.

| | | | |
|---|---|---|---|
| 1 | John | Doe | Wizardry |

# Data Structure: a Partition


A group of rows having the same partition token, a base unit of access in Cassandra.

IMPORTANT: stored together, all the rows are guaranteed to be neighbors.

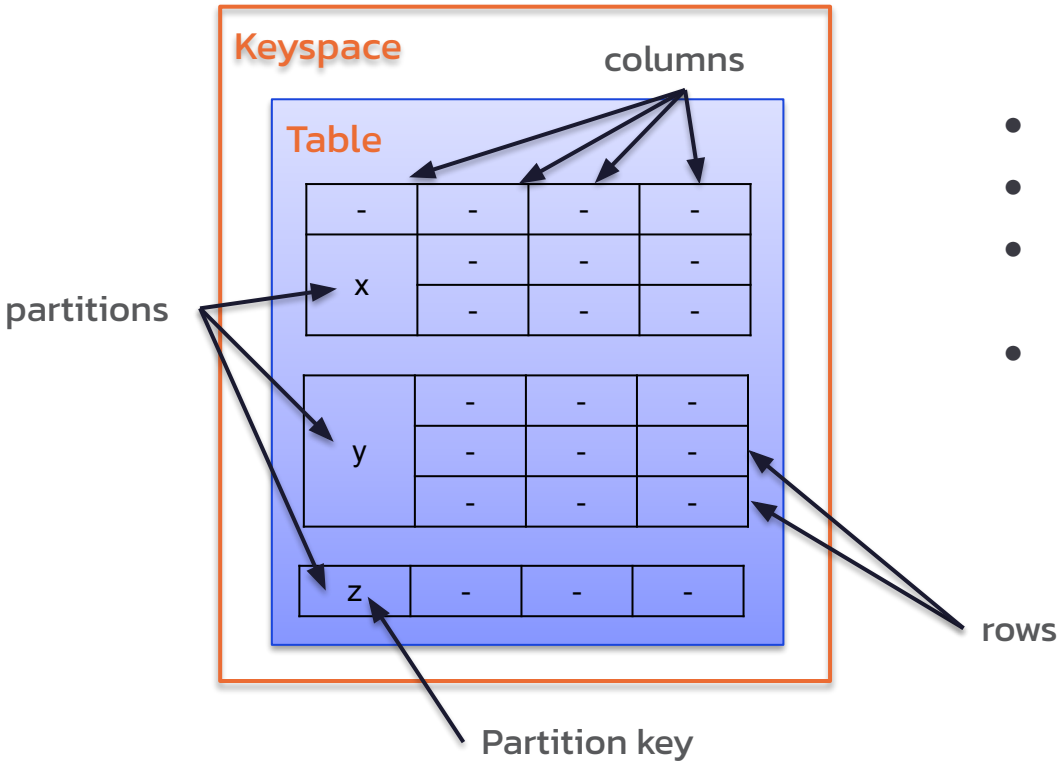
| ID | First Name | Last Name | Department |
|---|---|---|---|
| 1 | John | Doe | Wizardry |
| 399 | Marisha | Chapez | Wizardry |
| 415 | Maximus | Flavius | Wizardry |

# Data Structure: a Table


A group of columns and rows storing partitions.

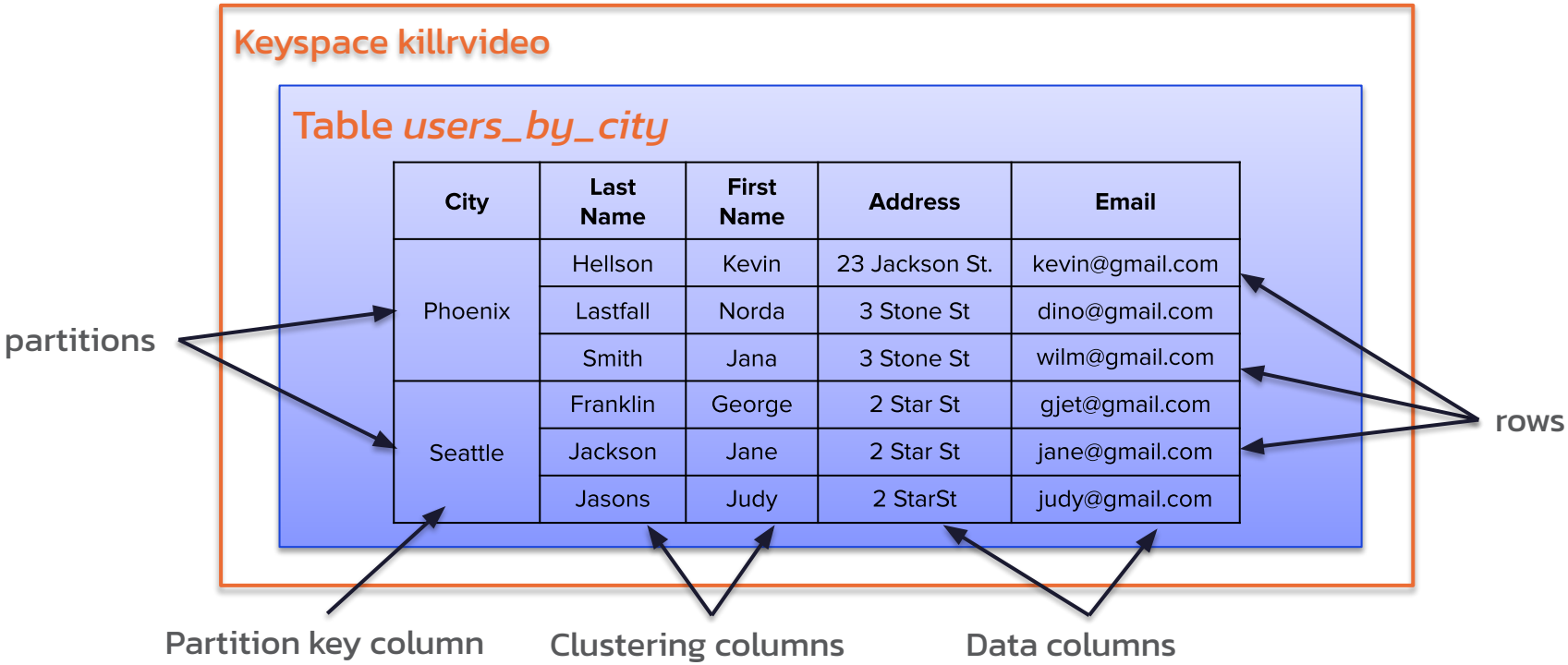
| ID | First Name | Last Name | Department |
|---|---|---|---|
| 1 | John | Doe | Wizardry |
| 2 | Mary | Smith | Dark Magic |
| 3 | Patrick | McFadin | DevRel |

# Data Structure: Overall

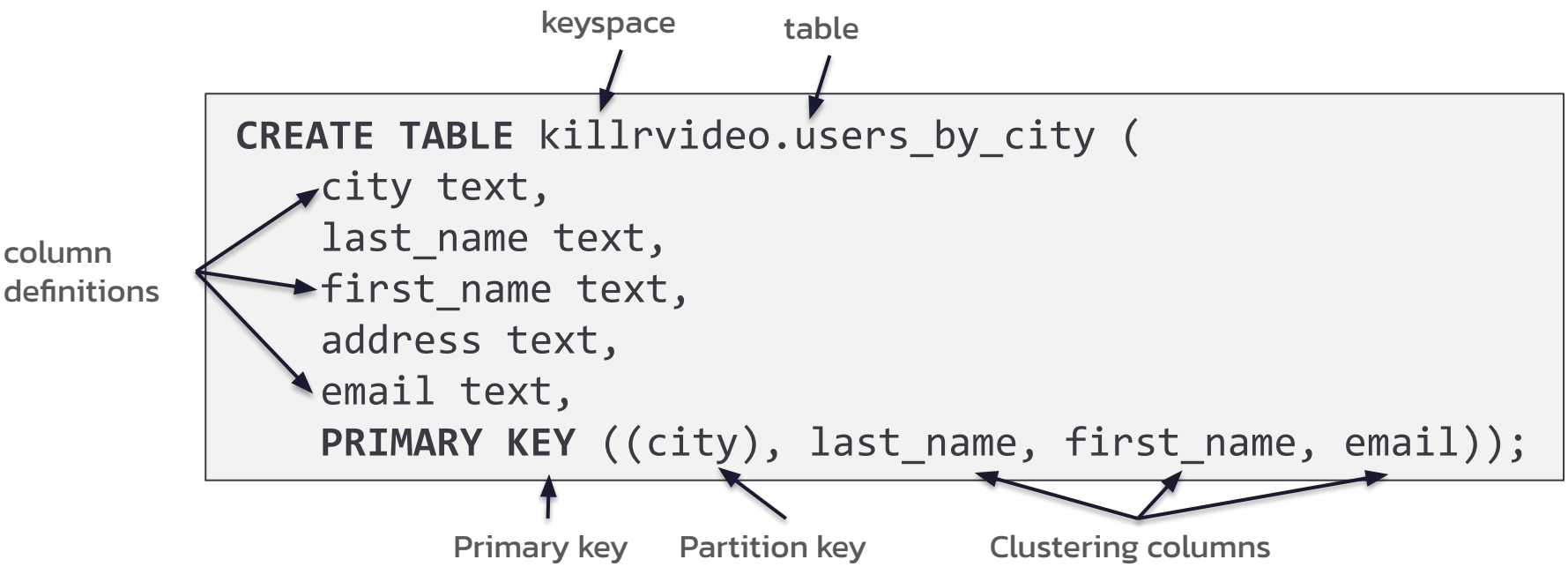



- Tabular data model, with one twist
- *Tables* are organized in *rows* and *columns*
- Groups of related rows called *partitions* are stored together on the same node (or nodes)
- Each row contains a *partition key*
  - One or more columns that are hashed to determine which node(s) store that data

# Example Data: Users organized by city



# Creating a Table in CQL



# Primary Key

An identifier for a row. Consists of at least one Partition Key and zero or more Clustering Columns.

**MUST ENSURE UNIQUENESS.**
**MAY DEFINE SORTING.**

```
CREATE TABLE killrvideo.users_by_city (
      city text,
      last_name text,
      first_name text,
      address text,
      email text,
      PRIMARY KEY ((city), last_name, first_name, email));
```


Good Examples:

```
PRIMARY KEY ((city), last_name, first_name, email);
```

```
PRIMARY KEY (user_id);
```

Bad Example:

```
PRIMARY KEY ((city), last_name, first_name);
```

# Partition Key

An identifier for a partition.
Consists of at least one column, may have more if needed

**PARTITIONS ROWS.**

```
CREATE TABLE killrvideo.users_by_city (
      city text,
      last_name text,
      first_name text,
      address text,
      email text,
      PRIMARY KEY ((city), last_name, first_name, email));
```


Good Examples:

```
PRIMARY KEY (user_id);
```

```
PRIMARY KEY ((video_id), comment_id);
```

Bad Example:

```
PRIMARY KEY ((sensor_id), logged_at);
```

# Clustering Column(s)

**Used to ensure uniqueness and sorting order.** Optional.

```
CREATE TABLE killrvideo.users_by_city (
      city text,
      last_name text,
      first_name text,
      address text,
      email text,
      PRIMARY KEY ((city), last_name, first_name, email));
```

Partition key

Clustering columns

```
PRIMARY KEY ((city), last_name, first_name);
```

**Not Unique**

```
PRIMARY KEY ((city), last_name, first_name, email);
```

```
PRIMARY KEY ((video_id), comment_id);
```

**Not Sorted**

```
PRIMARY KEY ((video_id), created_at, comment_id);
```

The Slide of the Year Award!

# Rules of a Good Partition

- **Store together what you retrieve together**
- Avoid big partitions
- Avoid hot partitions

Example: open a video? Get the comments in a single query!

```
PRIMARY KEY ((video_id), created_at, comment_id);
```

```
PRIMARY KEY ((comment_id), created_at);
```

The Slide of the Year Award!

# Rules of a Good Partition

- Store together what you retrieve together
- **Avoid big partitions**
- Avoid hot partitions

```
PRIMARY KEY ((video_id), created_at, comment_id);
```

```
PRIMARY KEY ((country), user_id);
```

- Up to 2 billion cells per partition
- Up to ~100k rows in a partition
- Up to ~100MB in a Partition

The Slide of the Year Award!

# Rules of a Good Partition

- Store together what you retrieve together
- **Avoid big and constantly growing partitions!**
- Avoid hot partitions

**Example**: a huge IoT infrastructure, hardware all over the world, different sensors reporting their state every 10 seconds. Every sensor reports its UUID, timestamp of the report, sensor's value.

- Sensor ID: UUID
- Timestamp: Timestamp
- Value: float

```
PRIMARY KEY ((sensor_id), reported_at);
```

The Slide of the Year Award!

# Rules of a Good Partition

- Store together what you retrieve together
- **Avoid big and constantly growing partitions!**
- Avoid hot partitions

**Example**: a huge IoT infrastructure, hardware all over the world, different sensors reporting their state every 10 seconds. Every sensor reports its UUID, timestamp of the report, sensor's value.

```
PRIMARY KEY ((sensor_id), reported_at);
```

```
PRIMARY KEY ((sensor_id, month_year), reported_at);
```

# BUCKETING

- Sensor ID: UUID
- **MonthYear**: Integer or String
- Timestamp: Timestamp
- Value: float

The Slide of the Year Award!

# Rules of a Good Partition

- Store together what you retrieve together
- Avoid big partitions
- **Avoid hot partitions**

```
PRIMARY KEY (user_id);
```

```
PRIMARY KEY ((video_id), created_at, comment_id);
```

```
PRIMARY KEY ((country), user_id);
```

https://github.com/DataStax-Academy/Intro-to-Cassandra-for-Developers#2-create-a-table

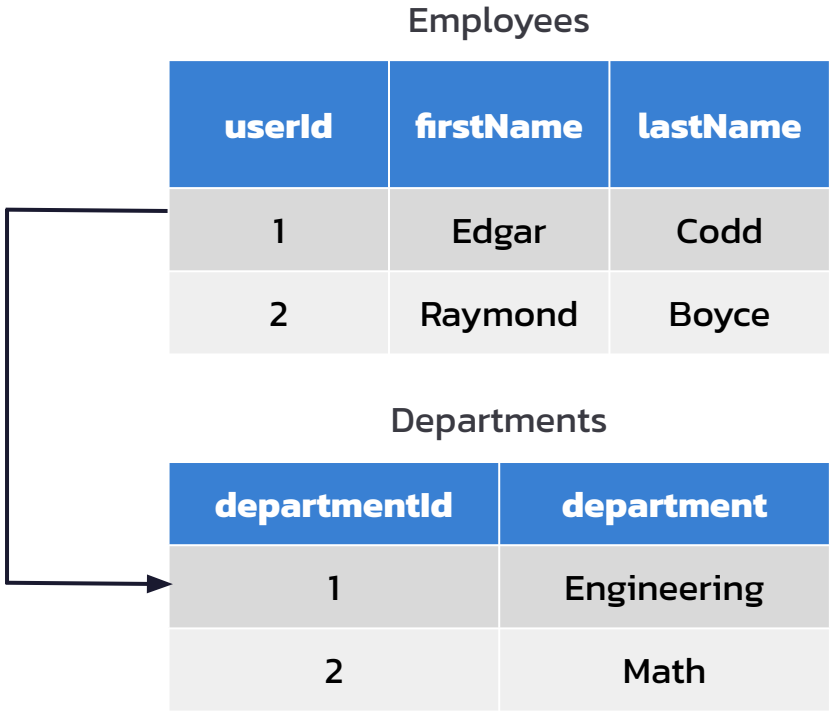
# Intro to Cassandra for Developers

1. Tables, Partitions
2. The Art of Data Modelling
3. What's NEXT?

# Normalization

"Database normalization is the process of structuring a relational database in accordance with a series of so-called normal forms in order to reduce data redundancy and improve data integrity. It was first proposed by Edgar F. Codd as part of his relational model."

**PROS:** Simple write, Data Integrity
**CONS:** Slow read, Complex Queries



# Denormalization

"Denormalization is a strategy used on a database to increase performance. In computing, denormalization is the process of trying to improve the read performance of a database, at the expense of losing some write performance, by adding redundant copies of data"

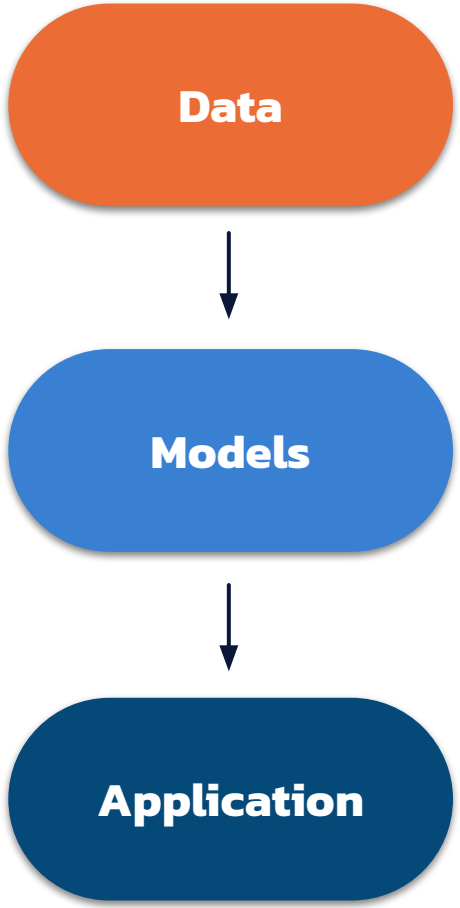
**PROS:** Quick Read, Simple Queries
**CONS:** Multiple Writes, Manual Integrity

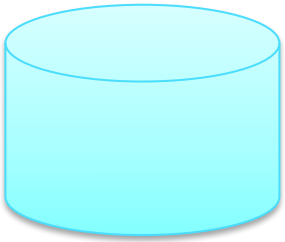
Employees

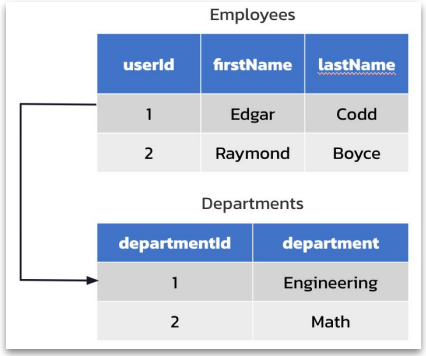
| userId | firstName | lastName | department |
|---|---|---|---|
| 1 | Edgar | Codd | Engineering |
| 2 | Raymond | Boyce | Math |
| 3 | Sage | Lahja | Math |
| 4 | Juniper | Jones | Botany |

# Relational Data Modelling

1. Analyze raw data
2. Identify entities, their properties and relations
3. Design tables, using **normalization** and foreign keys.
4. Use JOIN when doing queries to join normalized data from multiple tables



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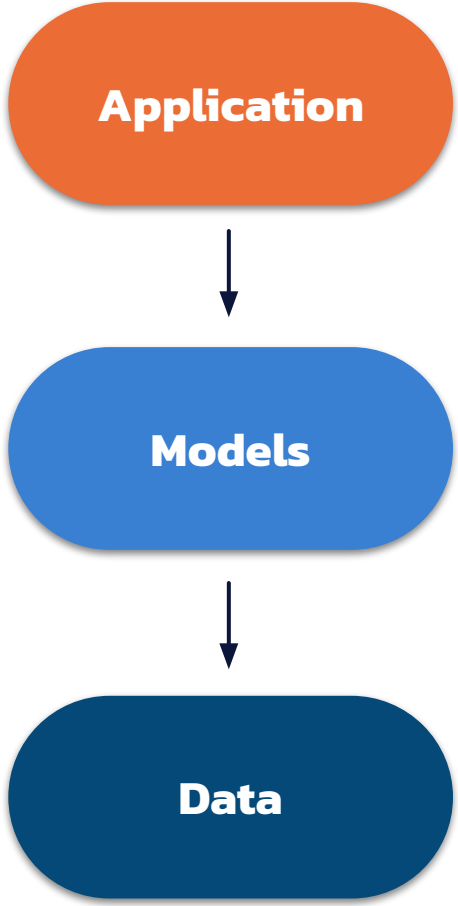
# NoSQL Data Modelling

1. Analyze user behaviour (customer first!)
2. Identify workflows, their dependencies and needs
3. Define Queries to fulfill these workflows
4. Knowing the queries, design tables, using **denormalization**.
5. Use BATCH when inserting or updating denormalized data of multiple tables




Employees

| userId | firstName | lastName | department |
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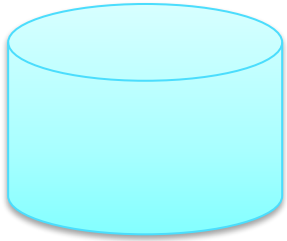
| 4 | Juniper | Jones | Botany |



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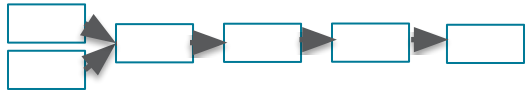
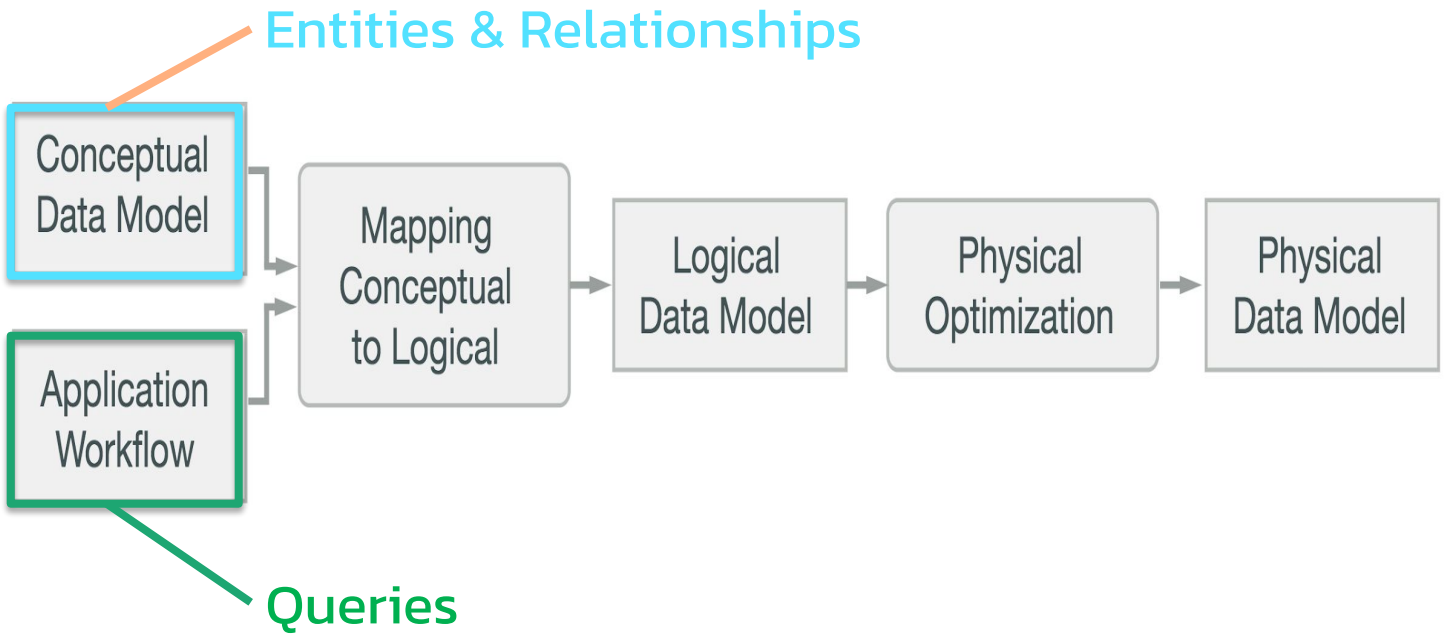
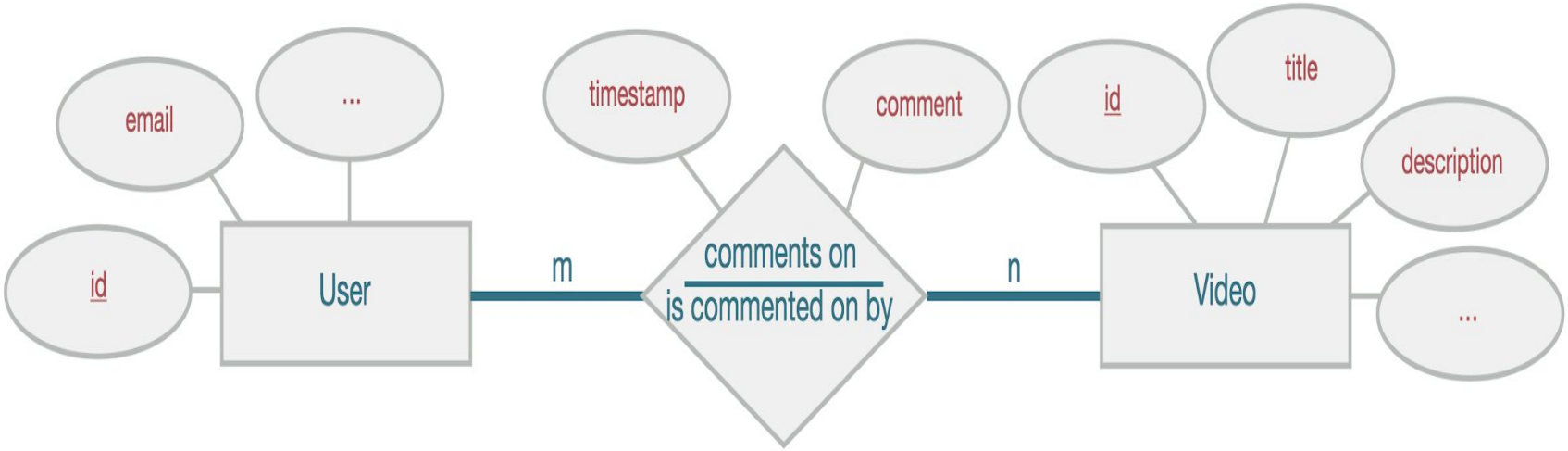
# Designing Process: Step by Step

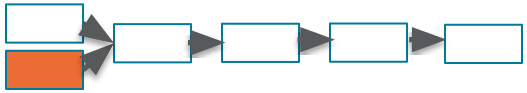




# Designing Process: Conceptual Data Model



# Designing Process: Application Workflow



**Use-Case I:**

- A User opens a Video Page

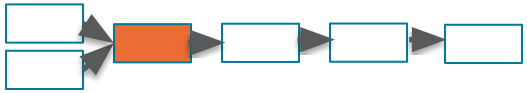
**WF1:** Find comments related to target video using its identifier, most recent first

**Use-Case II:**

- A User opens a Profile

**WF2:** Find comments related to target user using its identifier, get most recent first

# Designing Process: Mapping



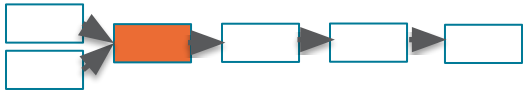
**Query I:** Find comments posted for a user with a known id (show most recent first)

→ comments_by_user

**Query II:** Find comments for a video with a known id (show most recent first)

→ comments_by_video

# Designing Process: Mapping



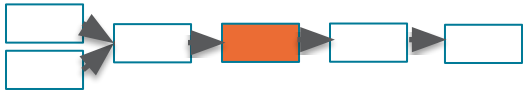
```
SELECT * FROM comments_by_user
WHERE userid = <some UUID>
```

→ comments_by_user

```
SELECT * FROM comments_by_video
WHERE videoid = <some UUID>
```

→ comments_by_video

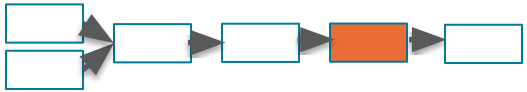
# Designing Process: Logical Data Model



| comments_by_user | |
|---|---|
| userid | K |
| creationdate | C ↓ |
| commentid | C ↑ |
| videoid | |
| comment | |

| comments_by_video | |
|---|---|
| videoid | K |
| creationdate | C ↓ |
| commentid | C ↑ |
| userid | |
| comment | |

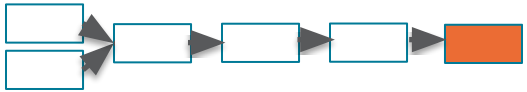
# Designing Process: Physical Data Model



| comments_by_user | | |
|---|---|---|
| userid | UUID | K |
| commentid | TIMEUUID | C ↓ |
| videoid | UUID | |
| comment | TEXT | |

| comments_by_video | | |
|---|---|---|
| videoid | UUID | K |
| commentid | TIMEUUID | C ↓ |
| userid | UUID | |
| comment | TEXT | |

# Designing Process: Schema DDL



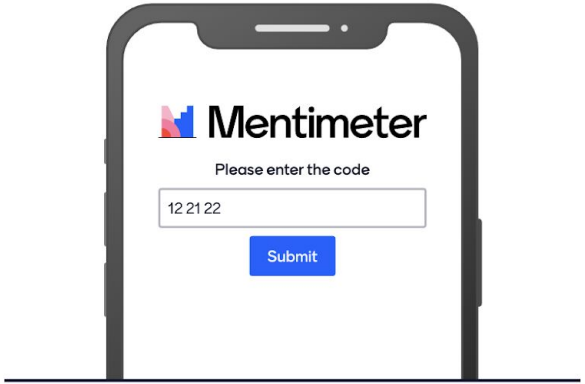
```
CREATE TABLE IF NOT EXISTS comments_by_user (
    userid uuid,
    commentid timeuuid,
    videoid uuid,
    comment text,
    PRIMARY KEY ((userid), commentid)
) WITH CLUSTERING ORDER BY (commentid DESC);

CREATE TABLE IF NOT EXISTS comments_by_video (
    videoid   uuid,
    commentid timeuuid,
    userid    uuid,
    comment   text,
    PRIMARY KEY ((videoid), commentid)
) WITH CLUSTERING ORDER BY (commentid DESC);
```

https://github.com/DataStax-Academy/Intro-to-Cassandra-for-Developers#3-execute-crud-operations

Go to

# www.menti.com




Enter the code

# 12 21 22

Or use QR code

Available on the iPhone App Store

GET IT ON Google play

# Intro to Cassandra for Developers

1. Tables, Partitions
2. The Art of Data Modelling
3. What's NEXT?

# MORE LEARNING!!!!

Developer site: datastax.com/dev

- Developer Stories
- New hands-on learning scenarios with Katacoda
  - Try it Out
  - Cassandra Fundamentals
  - https://katacoda.com/datastax/courses/cassandra-intro
  - New Data Modeling course https://katacoda.com/datastax/courses/cassandra-data-modeling

Classic courses available at DataStax Academy


Katacoda

# Developer Resources

| | |
|---|---|
| **LEARN** | New hands-on learning at www.datastax.com/dev<br>Classic courses available at DataStax Academy |
| **ASK/SHARE** | Join community.datastax.com<br>Ask/answer community user questions – share your expertise |
| **CONNECT** | Follow us @DataStaxDevs<br>We are on Youtube – Twitter – Twitch! |
| **MATERIALS** | Slides and practice questions for this course are available at https://github.com/DataStax-Academy/workshop-cassandra-certificationcassandra-workshop-series |

# Thank You

DataStax Developers