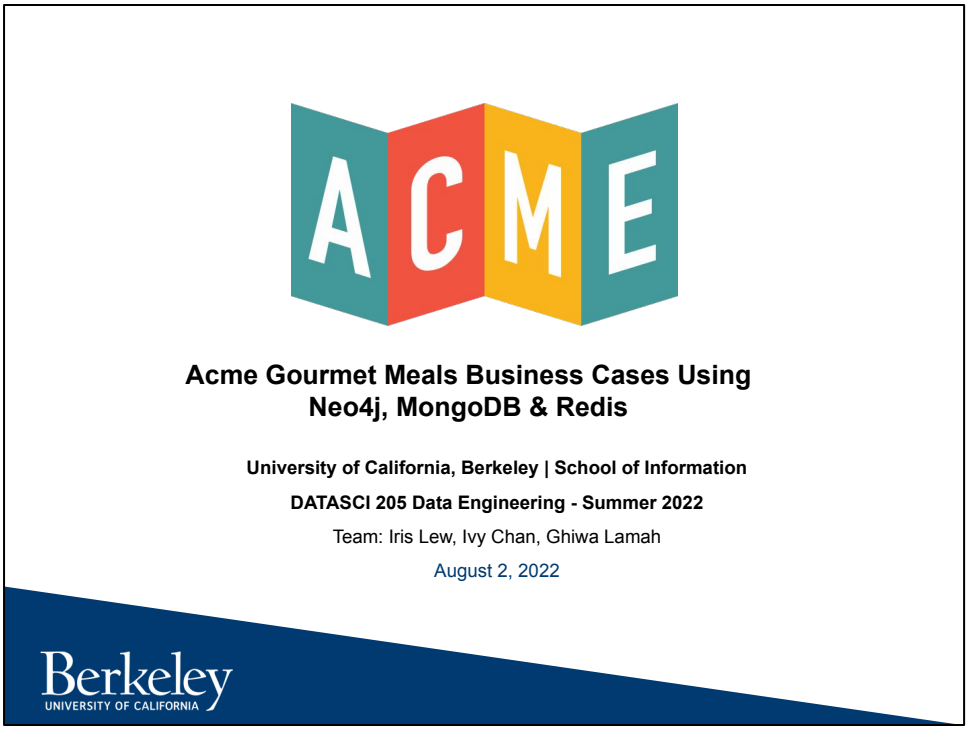
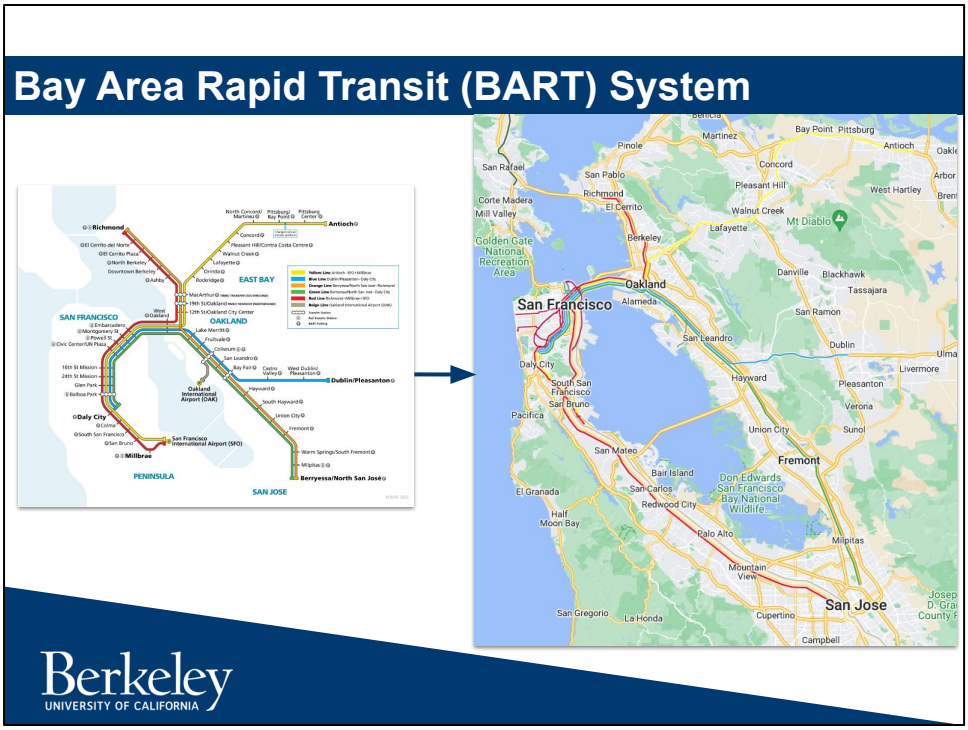


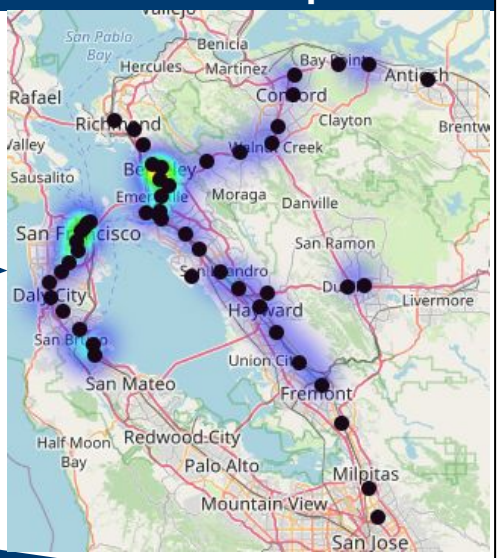
- Hello everyone! My name is Ivy.
- I am here today with Iris and Ghiwa to talk about the business cases using different types of the database for our Acme Gourmet Meals (AGM).
- We will introduce different types of NoSQL databases and provide business cases on how they can help us achieve AGM's company visions.

- AGM executives set the company's future visions, including:
  - Add more pickup locations,
  - Use public transit to transport deliveries,
  - Use Delivery drones, delivery robots, and
  - Use Hybrid combinations of public transit, drones, robots, and delivery trucks.
- In addition, for our data science team, we also want to expand and diversify our skill set to include NoSQL databases.
- Therefore, our focus will be on:
  - graph database - Neo4j,
  - document database - MongoDB, and
  - key-value database - Redis



- We are going to use BART as the example for the public transportation.
- Here's the BART map
- The left graph shows the colored transit lines going to different locations in the Bay Area.
- On the right is the same colored transit lines shown on Google Map.

BART Stations and Closest Customer Zips



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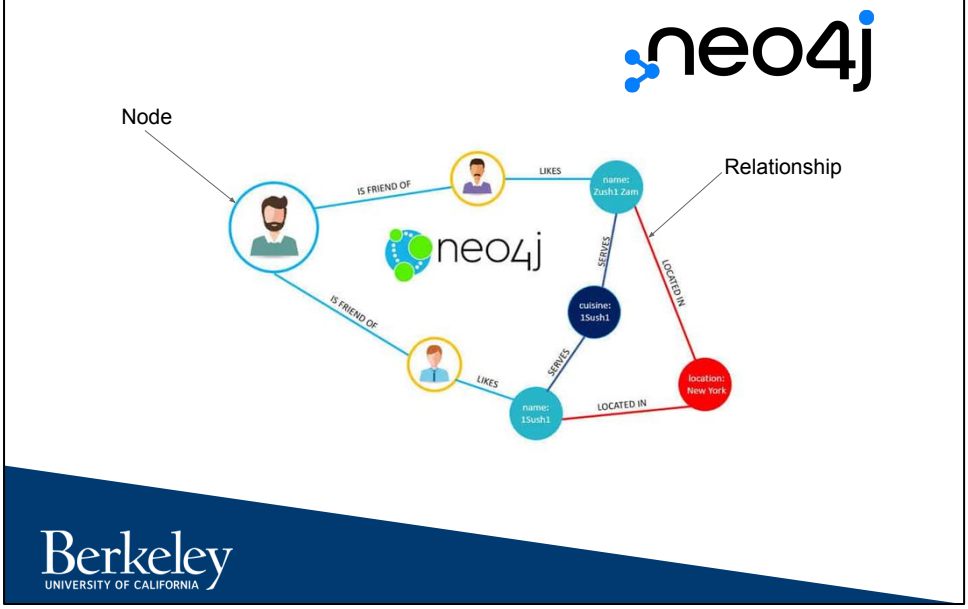
- This is the same map, but we show the number of customers who live within 1 mile of the store or the BART stations.
- We find that most of the customers are concentrated around Berkeley and San Francisco.
- This is a business opportunity for AGM.

Graph Database - Neo4j

- In the following, we will introduce the graph database - Neo4j

Graph Databases



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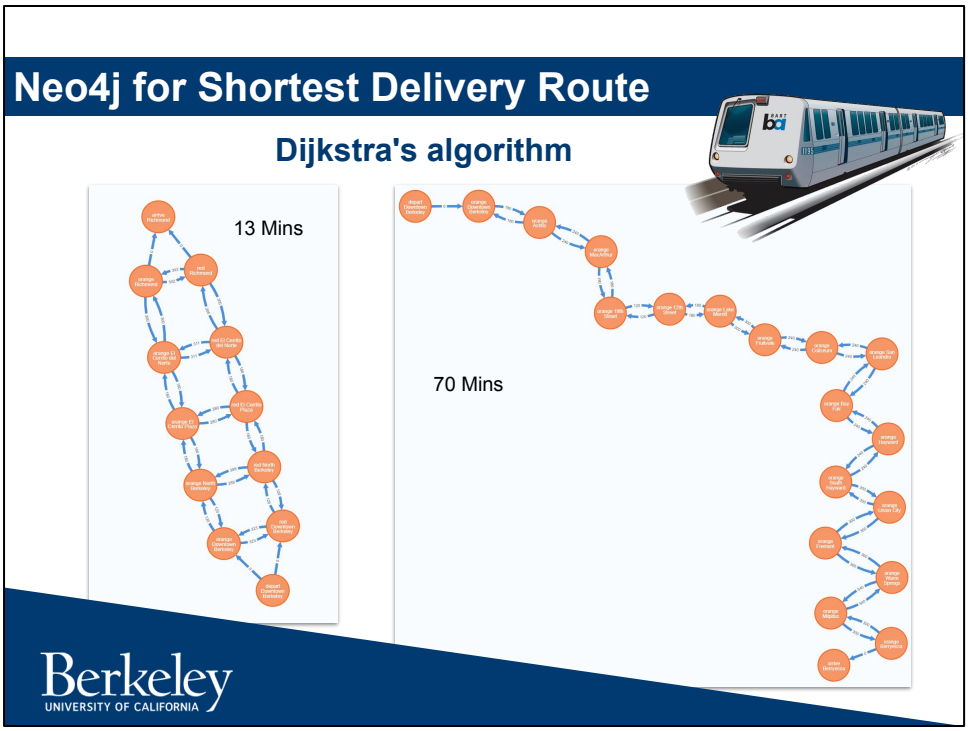
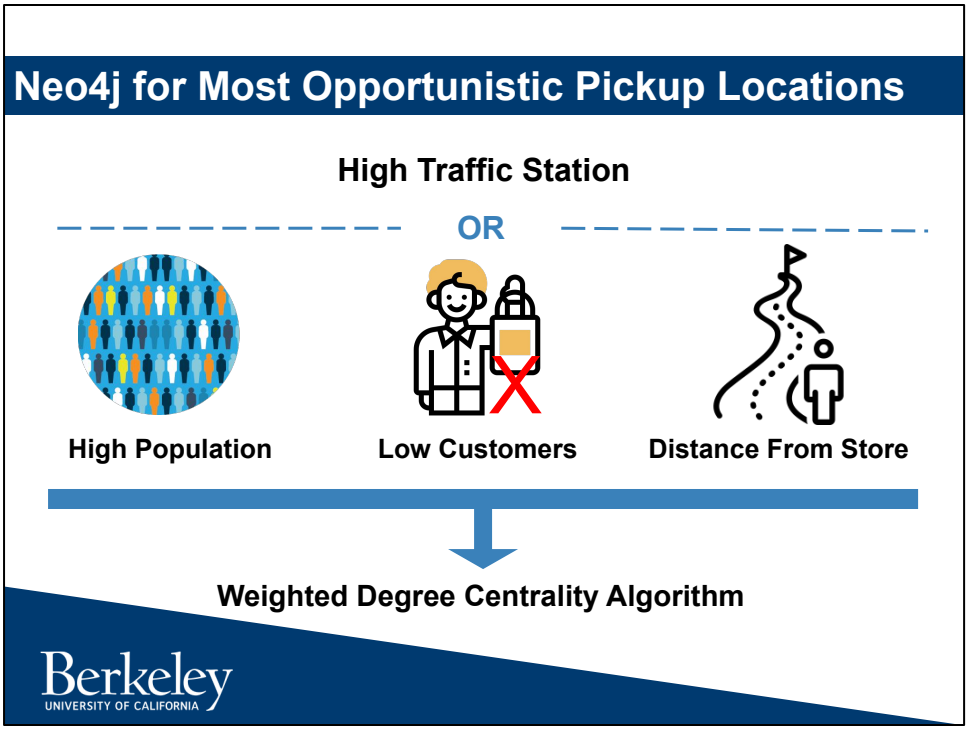
- Neo4j is an open source, NoSQL, native graph database
- It stores nodes and relationships in graphs instead of rows and columns in tables
- It is Ideal for:
    - Studying connections between different items (networks)
    - Navigating hierarchies
    - Finding hidden connections



Shortest Delivery Route

- For AGM to transport deliveries using BART, we want to plan the delivery by finding the shortest delivery route.
- We applied Dijkstra's algorithm on the Neo4j graph database to identify and compare the shortest delivery routes from the Downtown Berkeley station to the end stations of all lines.
- The end stations include Richmond, Antioch, Daly City, Millbrae, Dublin, Berryessa, Oakland Airport, and San Francisco Airport.
- The commute time ranges from 13 minutes to 70 minutes.
- On the left is the shortest trip from the Downtown Berkeley Station to the Richmond Station, which takes 13 minutes with either the red or the orange line.
- On the right is the most extended trip from the Downtown Berkeley Station to the Berryessa Station, which takes 70 minutes with the orange line.
- Coincidently, both trips do not need to transfer at any transferring stations.
- We can also conclude that we can access any station within 70 minutes.
- Of course, the closer the Downtown Berkeley station, the shorter the commute time.

Now Iris will take us through the most opportunistic pickup locations and delivery to customers' homes.



Pick-Up Locations

If AGM wants to expand its offerings to include pickup locations, AGM should look to identify which BART stations would provide the most opportunity to increase its customer base.

If we decide to use BART stations as a pickup location, then we can use weighted degree centrality algorithm in order to determine the most opportunistic pick-up locations: central BART stations OR stations with high population and low customers who live a relatively far distance to the Berkeley store. Weighted degree centrality is a variation of the Degree centrality algorithm, which measures the number of incoming or outgoing (or both) relationships from a node, depending on the orientation of a relationship projection.

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This is a combination of both:

1. **How high traffic is the station (# of potential customers that naturally pass through it)**
2. **How much opportunity does it present for a new customer base (stations near high populations but low customer base, the latter found to be because they are too far from the store)**

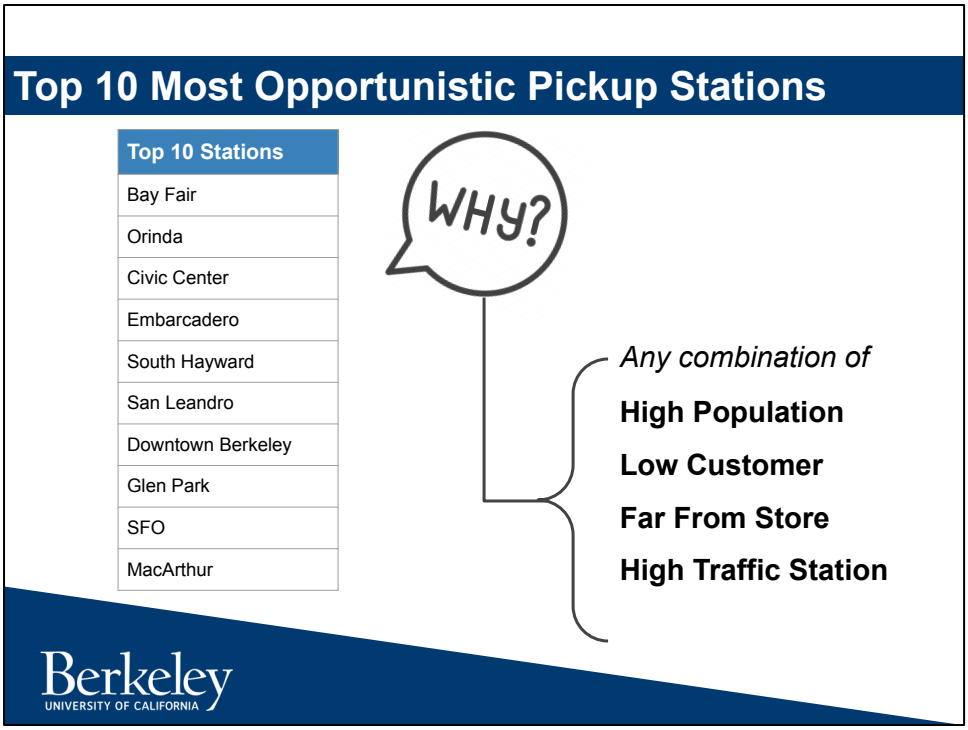
- **Solution**: Apply a weighted degree centrality algorithm on Neo4j to identify best pick up locations.

—--

Goal: Identify the BART station which would provide the most opportunity to increase customers base.

Two types relationships:

- Population and customers within 1 mile to the BART station and their relationship of how close to the store they are.
- Two-way relationship between stations.



Using the weighted degree centrality algorithm, we determined these are the 10 most opportunistic pick-up locations.

AGM can also look at the high traffic locations, determined by the greatest number of customers, and can further entice them by offering drone/robot delivery. But these are an investment, and in order to test whether there is an appetite for drone or robot delivery, it would be best to first try out on a limited number of places where we already have a customer base, and then gradually expand it as one of our key offerings.

We can use Neo4j and a Page Rank algorithm to determine which of the pickup points (the BART station and potentially even the Berkeley store) would serve the greatest number of customers within 1 mile, the radius of drone delivery. The Page Rank algorithm determines which nodes are the most influential by measuring the influencing relationships.

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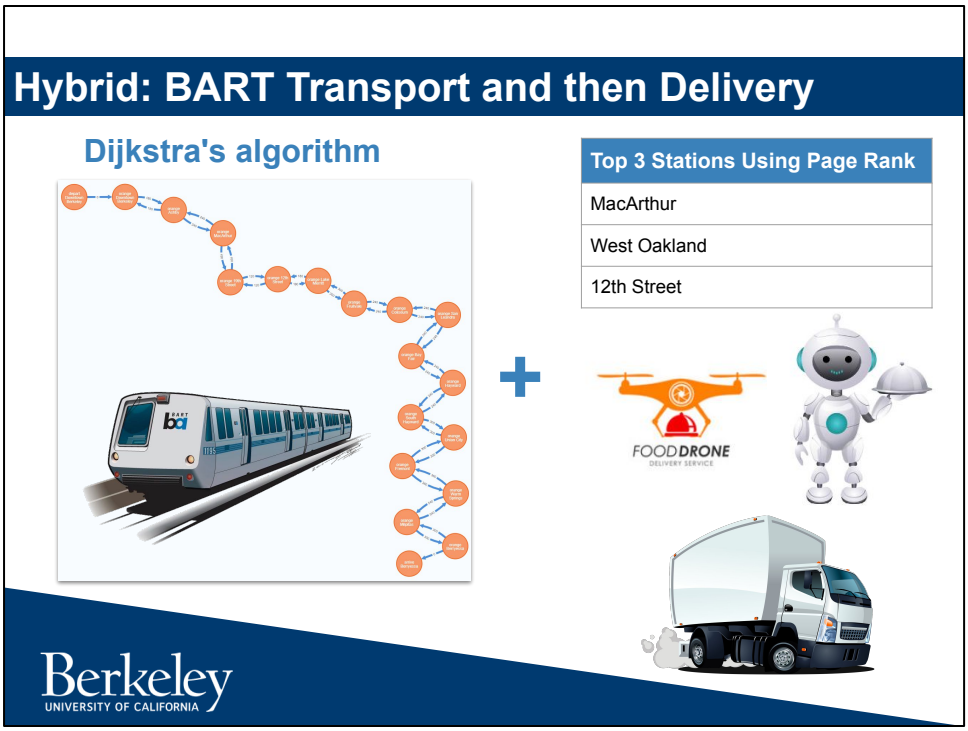
Goal: Identify the BART station which would potentially serve the greatest number of customers.

- **Business Case:** AGM wants to offer home deliveries using drones/robots to particular stations to attract customers, instead of offering them at all stations, in order to test whether this would be a viable solution.



If AGM desires, we can even do a combination of using the BART and then delivery drones or robots to transport the food. Again, we can employ Dijkstra's algorithm to find the fastest route to transport the food, while using the Page Rank algorithm to ascertain which stations to offer the drone, robot delivery, or truck delivery. It would be best to assess demand in those three stations before we determine if adding truck delivery (which can transport to multiple homes instead of just 1 home like the drones and robots).

Neo4j vs. Relational Database

neo4j	
• Stations are represented in nodes • Relationships can be weighted	• Data are stored in tables with rows and columns
• Graphs to show shapes, characteristics, density, & k-partile	• Table relationships are established using foreign keys between tables
• Graph algorithms to identify graph data; no need to join	• Table joins must be setup; join process is expensive
• Fast speed	• Slow speed

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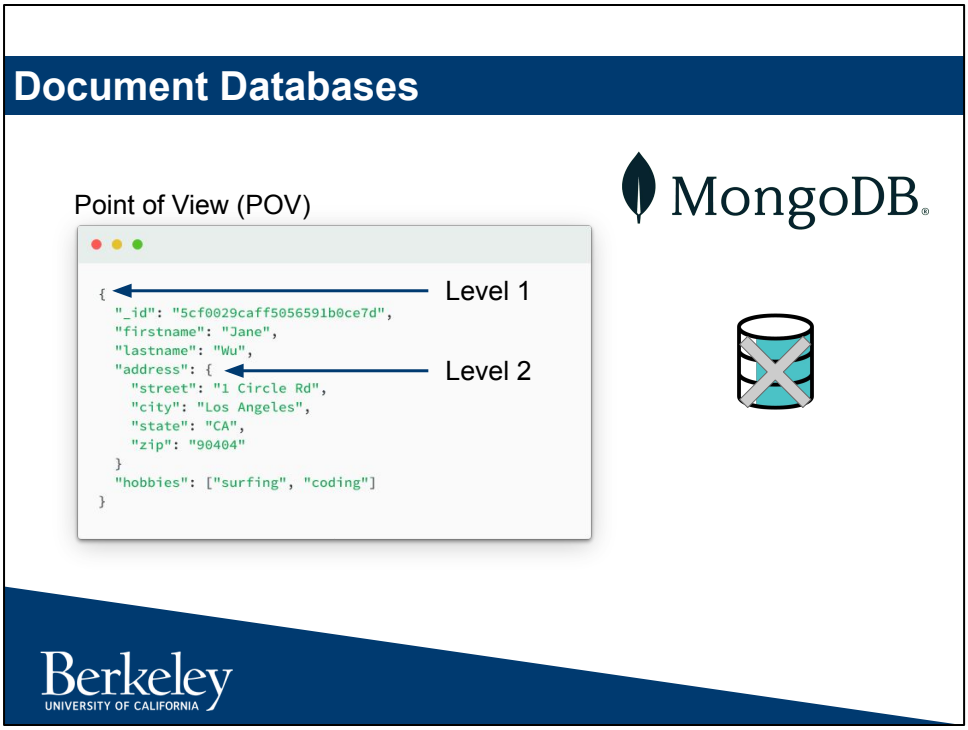
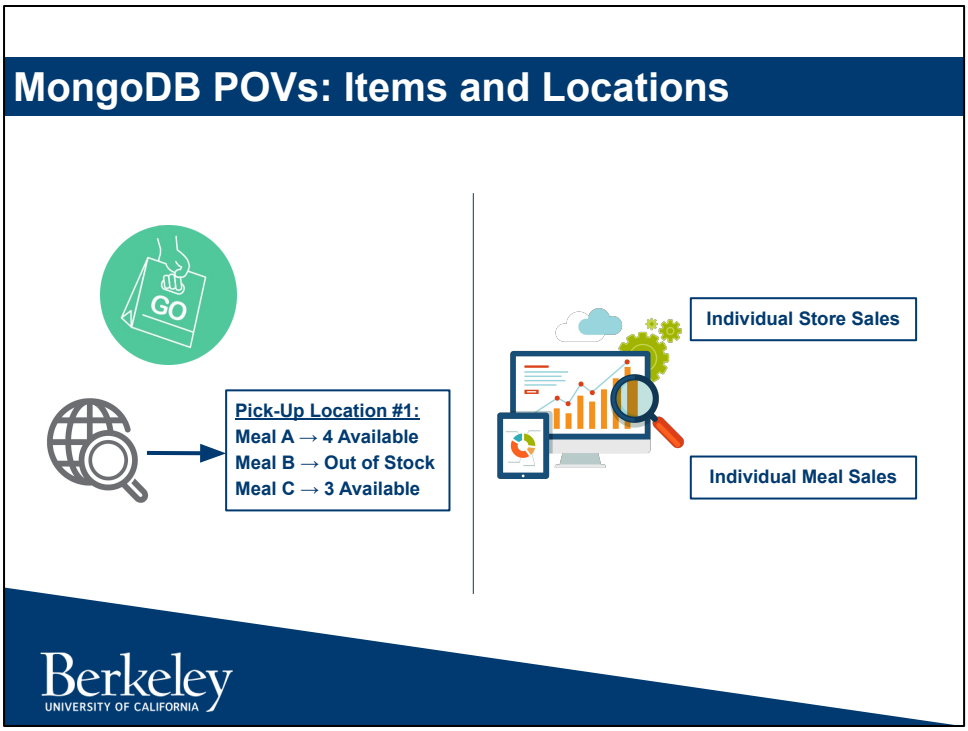
Because Neo4j represents the station in nodes, and we can have time, customer count, or population count be represented as weights on relationships, we can meet AGM's goals better than if we tried to use a relational database where the data are stored in tables with rows and columns. As a graph, we can show shapes, characteristics, density, and k-partite. The graph algorithms can work with the graph data and thus can compute quickly. In a relational database, we would need to perhaps create many joins and use established foreign keys, so it would take much longer to compute.

Handing it over to Ghiwa to explain about two other types of NoSQL databases.

Document Database - MongoDB



- MongoDB is an open source, NoSQL, document database
- Stores information in a document, JSON-like format, which allows us have different levels in the data hierarchy.
- We can adjust what goes in which level of the hierarchy for different POVs. This makes it a better candidate for POV-type of analyses than relational databases since the latter's optimal form has data in only one location and one form.
- Document databases are Ideal for:
    - Obtaining data quickly for analysis (because it uses a key-value lookup, it is faster than a relational database lookup)
    - Organizing the same data in different point of views
    - Easy to distribute data in a human-readable format



The goal for our document database business case is to **create two POVs: one for customers and another for executives.**

Here, we can organize the data so that there is a hierarchical structure: pickup locations at the top before drilling down into available items, and another version where the items are at the top.

A relational database does not have a hierarchical structure.

- **Business Case #1:** Customers would like to know what food is available at individual pick-up locations using website or app
- **Solution:** Use MongoDB to provide them with information on what food is available at their desired pick-up location
- **POV used:** Individual store POV for meal availability

- **Business Case #2:** Executives would like to analyze sales and performance of different pick-up locations
- **Solution:** Use MongoDB to provide them with POVs on sales by pick-up location, sales by food, and other information

MongoDB vs. Relational Database

MongoDB.	
• Supports duplicate data for analysis	• Optimal form for an analytical database is denormalized • Difficult to scale up; can only store data in one location
• Supports hierarchical structure	• Does not have a hierarchical structure
• Fast speed	• Slow speed

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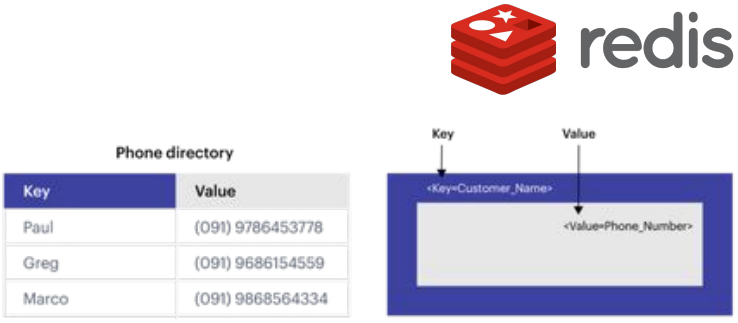
Key-Value Database - Redis

Key-Value Databases



In-Memory for Real-Time Data Updates

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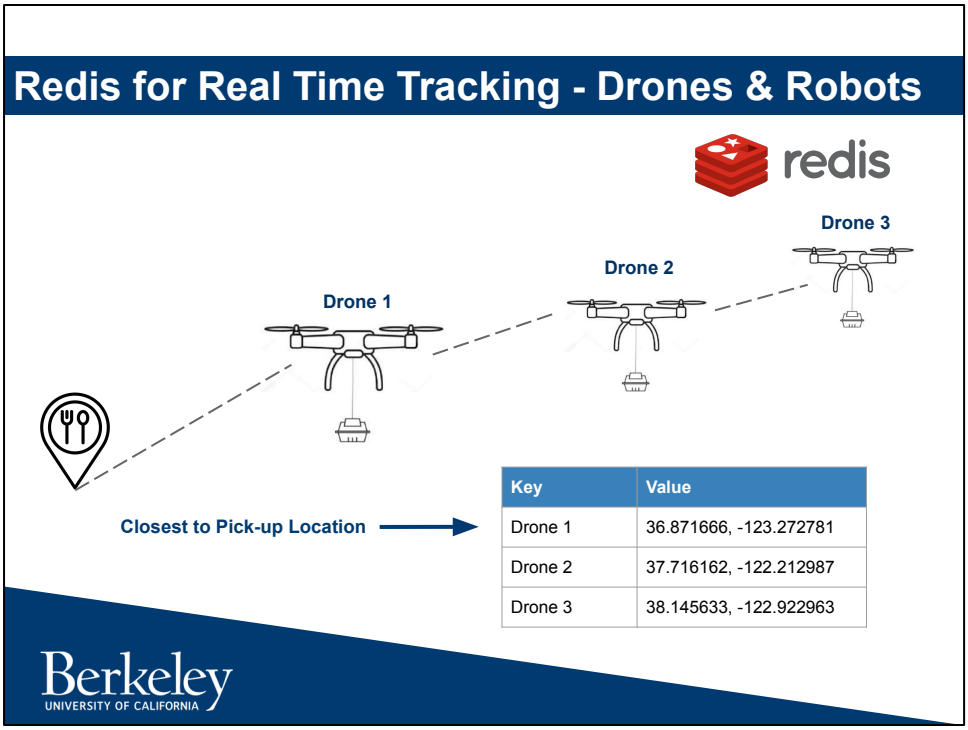
- Redis is an open source, NoSQL, in-memory key-value database
  - Stores data key-value format - unique key is used to access values
  - Very quick and easy lookup whereas relational databases require a join with a foreign key, which would not allow for real-time updates



- Goal: **Provide real-time location tracking of delivery drones and/or robots**
- Scenario:
  - Customer lives within one mile of nearest pickup location and places delivery order
  - Redis database contains real-time location data of available robots/drones
    - Latitude, Longitude Coordinates
  - Info is used to determine which robot/drone is the closest to the pickup location and when it will arrive

Redis vs. Relational Database

redis	
• Stores data in key-value pair	• Stores data in tables with rows and columns
• Very quick and easy to look up	• Must join tables with foreign keys • Slow speed

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- Thanks you Iris & Ghiwa.
- NoSQL databases such as graph database, document database, and key-value database are scalable and provide speedy performance.
- They store unstructured, semi-structured, or structured data.
- They are usually used to solve problems that relational databases are limited or not well suited for getting the answers.
- We use Neo4j, MongoDB, and Redis to solve the proposed business cases, and
- They also fulfills AGM's future company visions.
- Thank you for listening.
- Let us know if you have any questions.

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