



Acme Gourmet Meals

Leveraging NoSQL Databases:
Driving Efficiency, Speed, Scalability, and Growth

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Introduction

Benefits of NoSQL technologies

- Scalable
- Flexible
- Real-time data handling
- High-performance

AGM's business needs and adopting NoSQL solutions

- **Optimal Delivery Path, Neo4j:**
 - Choose an optimal distribution center
 - Find shortest delivery route path
 - Quickly recalculate route in response to real-time traffic
- **Inventory Management, Redis:**
 - Real-time inventory management
- **Customer Engagement and satisfaction, MongoDB:**
 - Personalize recommendations and tailor services, improving customer engagement

Page Rank

- Coliseum
- Bay Fair
- MacArthur
- Daly City



Centrality Analysis

Baseline Weighted Betweenness

	name	betweenness	line	station
0	yellow MacArthur	5999.809223	yellow	MacArthur
1	yellow Rockridge	5509.000000	yellow	Rockridge
2	orange Lake Merritt	5155.831877	orange	Lake Merritt
3	orange 12th Street	5139.715461	orange	12th Street
4	yellow Orinda	4997.000000	yellow	Orinda
5	yellow 19th Street	4820.250748	yellow	19th Street
6	orange Fruitvale	4641.959661	orange	Fruitvale
7	yellow Lafayette	4469.000000	yellow	Lafayette
8	yellow 12th Street	4423.507563	yellow	12th Street
9	orange Coliseum	4306.942363	orange	Coliseum
10	orange 19th Street	4117.894371	orange	19th Street
11	yellow West Oakland	3942.135136	yellow	West Oakland
12	yellow Walnut Creek	3925.000000	yellow	Walnut Creek

MacArthur and
Coliseum In Top 12
with both algorithms.

RA Brandes Weighted : Sample Size 2

	name	betweenness	line	station
0	green West Oakland	81.251008	green	West Oakland
1	blue West Oakland	79.072436	blue	West Oakland
2	yellow West Oakland	55.322595	yellow	West Oakland
3	yellow 12th Street	53.322595	yellow	12th Street
4	green Lake Merritt	52.825825	green	Lake Merritt
5	blue Lake Merritt	49.194872	blue	Lake Merritt
6	blue Montgomery Street	48.615476	blue	Montgomery Street
7	green Montgomery Street	48.615476	green	Montgomery Street
8	yellow 19th Street	47.533582	yellow	19th Street
9	green Fruitvale	46.418218	green	Fruitvale
10	red West Oakland	43.282899	red	West Oakland
11	yellow MacArthur	42.544569	yellow	MacArthur
12	green Coliseum	41.791198	green	Coliseum

Centrality Analysis

RA Brandes Weighted : Sample Size 4

	name	betweenness	line	station
0	green West Oakland	140.341658	green	West Oakland
1	yellow West Oakland	140.026232	yellow	West Oakland
2	red West Oakland	121.836536	red	West Oakland
3	blue West Oakland	118.500571	blue	West Oakland
4	yellow 12th Street	110.946535	yellow	12th Street
5	green Lake Merritt	109.916475	green	Lake Merritt
6	yellow 19th Street	98.550248	yellow	19th Street
7	green Fruitvale	97.546439	green	Fruitvale
8	yellow MacArthur	88.777902	yellow	MacArthur
9	red 12th Street	88.656839	red	12th Street
10	green Coliseum	87.756989	green	Coliseum

Increasing the sample size causes RA Brandes to approximate the baseline Dijkstra algorithm

RA Brandes Weighted : Sample Size 16

	name	betweenness	line	station
0	green West Oakland	554.374176	green	West Oakland
1	green Lake Merritt	493.816752	green	Lake Merritt
2	yellow MacArthur	459.219561	yellow	MacArthur
3	green Coliseum	455.888117	green	Coliseum
4	green Bay Fair	450.616253	green	Bay Fair
5	green San Leandro	435.971670	green	San Leandro
6	orange Lake Merritt	431.633058	orange	Lake Merritt
7	yellow Rockridge	430.000000	yellow	Rockridge
8	green Fruitvale	429.852120	green	Fruitvale
9	yellow 19th Street	402.356035	yellow	19th Street
10	yellow Orinda	402.000000	yellow	Orinda

Centrality Analysis

Louvain Community : MacArthur

	name	communityId	line	station
77	orange MacArthur	181	orange	MacArthur
78	red MacArthur	181	red	MacArthur
79	yellow MacArthur	181	yellow	MacArthur
86	orange 12th Street	181	orange	12th Street
87	red 12th Street	181	red	12th Street
88	yellow 12th Street	181	yellow	12th Street
89	orange 19th Street	181	orange	19th Street
90	red 19th Street	181	red	19th Street
91	yellow 19th Street	181	yellow	19th Street

Community Populations

MacArthur

- 55k <= 1mi
- 868k <= 3mi

Coliseum

- 68k <= 1mi
- 1020k <= 3mi

Louvain Community : Coliseum

	name	communityId	line	station
141	blue Fruitvale	197	blue	Fruitvale
142	green Fruitvale	197	green	Fruitvale
143	orange Fruitvale	197	orange	Fruitvale
144	blue Lake Merritt	197	blue	Lake Merritt
145	green Lake Merritt	197	green	Lake Merritt
146	orange Lake Merritt	197	orange	Lake Merritt
147	gray OAK	197	gray	OAK
156	blue Coliseum	197	blue	Coliseum
157	gray Coliseum	197	gray	Coliseum
158	green Coliseum	197	green	Coliseum
159	orange Coliseum	197	orange	Coliseum

Centrality Analysis

Louvain Community : BayFair

	name	communityId	line	station
110	blue San Leandro	191	blue	San Leandro
111	green San Leandro	191	green	San Leandro
112	orange San Leandro	191	orange	San Leandro
113	blue West Dublin	191	blue	West Dublin
124	blue Bay Fair	191	blue	Bay Fair
125	green Bay Fair	191	green	Bay Fair
126	orange Bay Fair	191	orange	Bay Fair
127	blue Castro Valley	191	blue	Castro Valley
128	blue Dublin	191	blue	Dublin

Community Populations

Bay Fair

- 144k <= 1mi
- 857k <= 3mi

Daly City

- 222k <= 1mi
- 1503k <= 3mi

Louvain Community : Daly City

	name	communityId	line	station
92	blue Glen Park	182	blue	Glen Park
93	green Glen Park	182	green	Glen Park
94	red Glen Park	182	red	Glen Park
95	yellow Glen Park	182	yellow	Glen Park
102	blue Balboa Park	182	blue	Balboa Park
103	green Balboa Park	182	green	Balboa Park
104	red Balboa Park	182	red	Balboa Park
105	yellow Balboa Park	182	yellow	Balboa Park
106	blue Daly City	182	blue	Daly City
107	green Daly City	182	green	Daly City
108	red Daly City	182	red	Daly City
109	yellow Daly City	182	yellow	Daly City

Distribution Center Recommendation :

MacArthur Station

- High Centrality Scores
- Direct Population Access
 - $22k \leq 1 \text{ mi}$ – Robot
 - $271k \leq 3 \text{ mi}$ – Vehicle
- Louvain Community Population
 - $55k \leq 1 \text{ mi}$
 - $868k \leq 3 \text{ mi}$
- Follow-on Stations
 - Coliseum
 - Daly City



Potential Shortest Path Delivery Methods



- Option 1: Drive directly from AGM to customer.
- Option 2: Drive from AGM to BART, then BART close, then drive to customer.
- Option 3: Distribute from a BART station. BART close from there, then drive to customer.
- Option 4: Distribute from a BART station. BART close from there, then allow customer pickup from their BART station.

Shortest-Path Delivery Times to Customers

Customer	Location	1: Drive Directly	2: Drive, BART, Drive	3: BART, Drive	4: BART & Pickup
Customer A	N. Berkeley	11	13	12	7
Customer B	Fruitvale	17	27	18	13
Customer C	Ferry Plaza	21	30	21	17
Customer D	Oak. City Center	13	16	7	5
Customer E	Richmond	21	24	23	20

Notes: All times are in minutes. Customer locations are arbitrarily selected. MacArthur is the BART distribution center. AGM is at 3000 Telegraph Avenue, Berkeley CA.

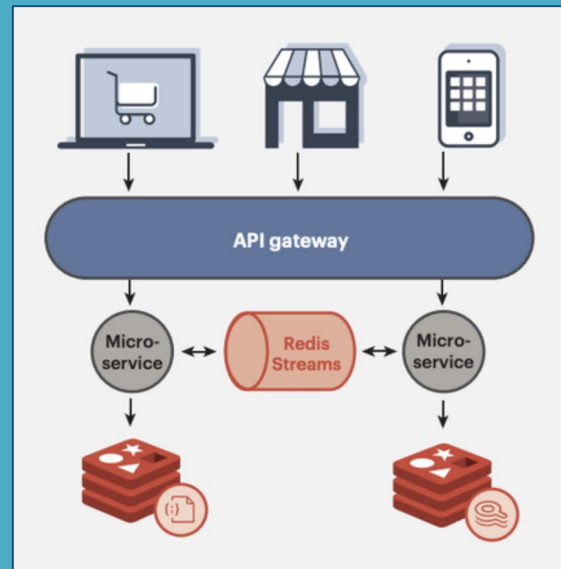
Rush Hour Shortest-Path Delivery Times

Customer	Location	1: Drive Directly	2: Drive, BART, Drive	3: BART, Drive	4: BART & Pickup
Customer A	N. Berkeley	17	18	15	7
Customer B	Fruitvale	26	32	21	13
Customer C	Ferry Plaza	32	35	23	17
Customer D	Oak. City Center	20	20	8.0	5
Customer E	Richmond	32	28	25	20

Note: Driving times are increased by 50% relative to the non – rush hour table. No other changes.

Revolutionizing Inventory Management with Redis

- Adopting Redis for real-time inventory management: integrate into AGM app
- Improved operational efficiency and centralized inventory data
- Scalability to handle peak loads with rapid data access
- Automates purchase orders and minimizes waste
- Enables dynamic pricing and promotions
- Data-driven decision-making for new dishes



Recommendation Model with MongoDB: Solution Overview

Customer Profiles in MongoDB:

- MongoDB's document model allows for flexible storage of customer profiles with varying fields, such as BART station of arrival, dietary preferences, and order history.
- The schema-less nature of MongoDB enables easy updates and additions to customer profiles without disrupting the database structure, allowing for easy use of running models.

Why MongoDB?

Scalability

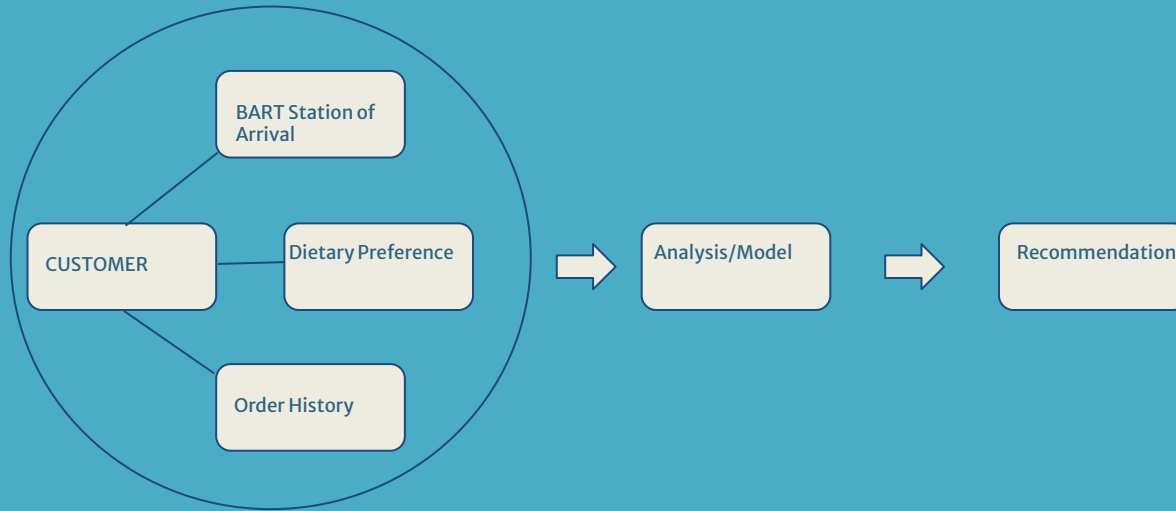
**Query
Performance**

**Aggregation
Framework**

Integration

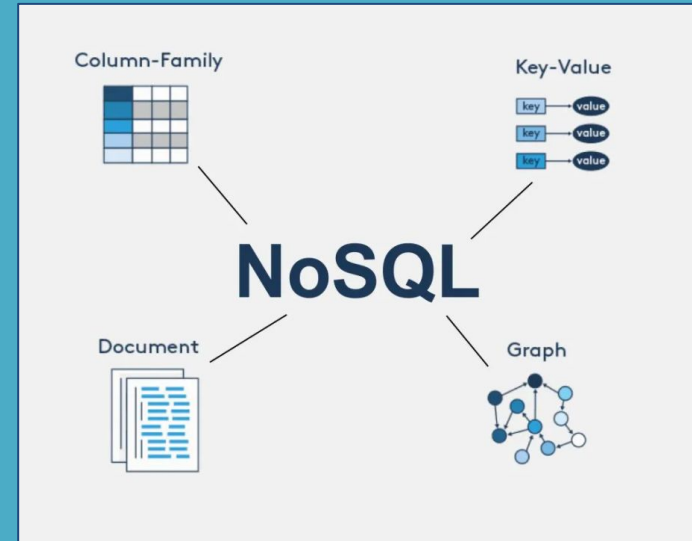
Cost-Effective

Recommendation Model with MongoDB: Illustration



Conclusion

- Continue to analyze data to confirm business case
 - Distribution center (Macarthur)
 - Real time management
 - Personalized customer recommendations
- NoSQL opens up new possibilities for expansion, growth and profitability



Contributions

Scott Abramson:

- Integrated example help notebooks
- Added geo population calculations
- Added betweenness, harmonic and louvain calculations and analysis

Reese Carlton:

- Slide Deck
- MongoDB integration business problem
- Project slide organization

Jacob Jones:

- Slide deck
- Neo4j pagerank algorithm
- Assisted with ideation/early project organization

Tim Majidzadeh:

- Slide deck
- Neo4j Shortest Path algorithms & business problem
- GitHub repo creator / manager

Karen Orozco:

- Slide deck
- Redis integration business problem
- Project design