

# Restaurant Recommendation for Groups

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DIGITAL AND ALGORITHMIC MARKETING

BUSN 37304-85

WINTER 2020

LI LIU

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XI ZHAO





I want  
Chinese  
Food



I'm in the mood for a  
Burger



Something close please.  
I'm starving

## Preferences Differ (1/2)



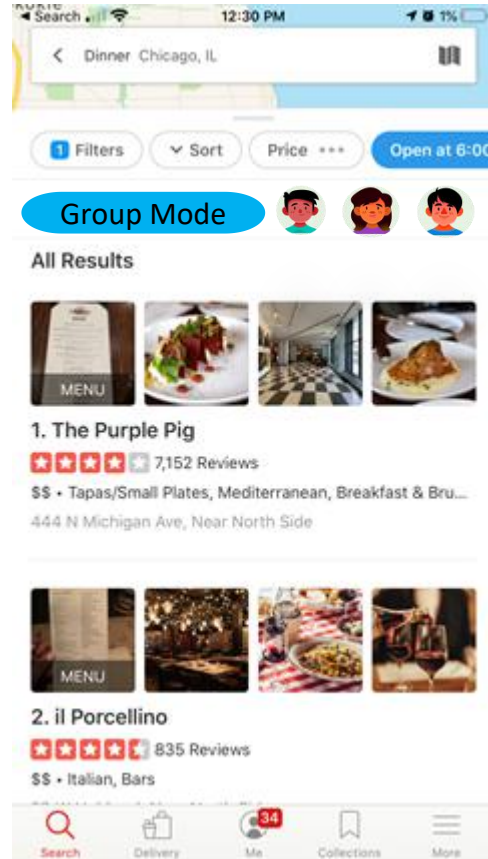
## Preferences Differ (2/2)

# Missing Feature: Recommendations for Groups

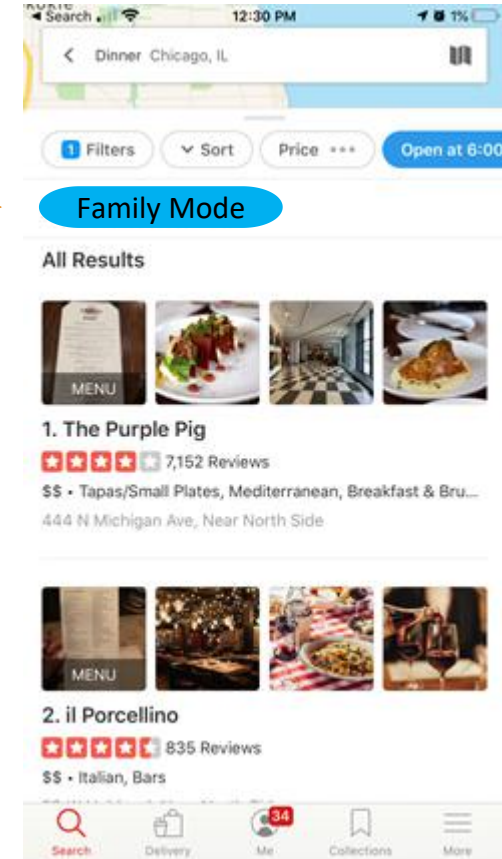
## Group Mode

takes preferences of all users in the dining party to make recommendations.

Option to link other users to aggregate preferences



Family Mode takes preferences of all members in the user profile



# Data

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Source: Yelp Daraset Challenge (Round 13)

Size: 6 GB in JSON format



For simplicity,  
focusing on restaurants in Las Vegas and most recent reviews



**6,685,900 reviews**



**192,609 businesses**



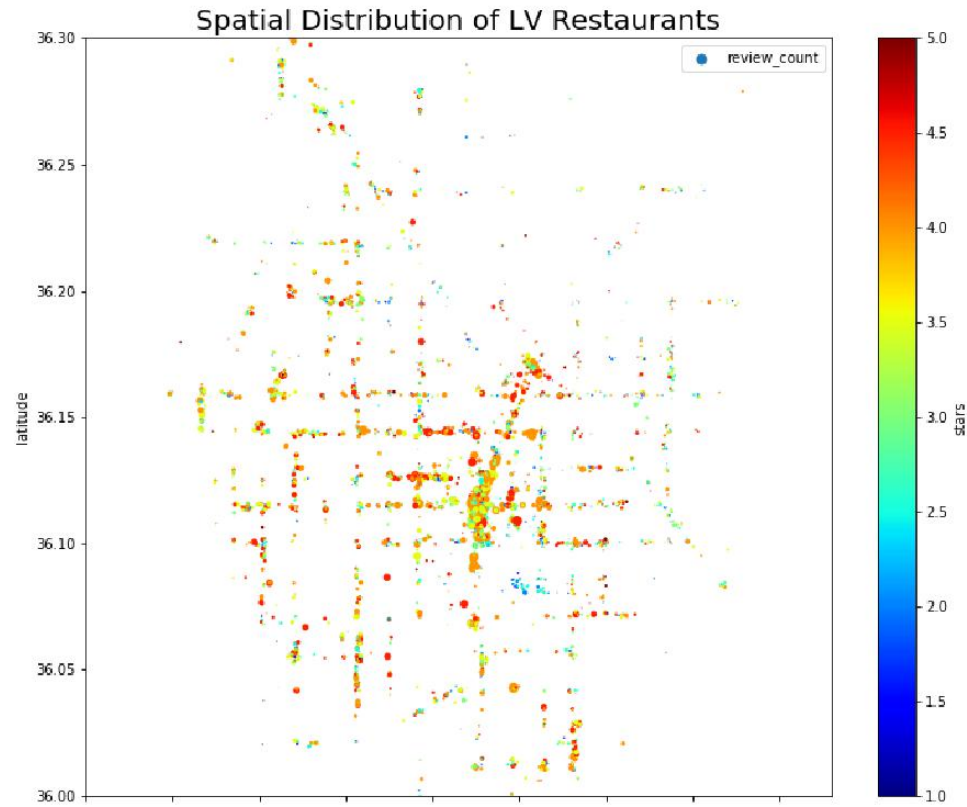
**200,000 pictures**



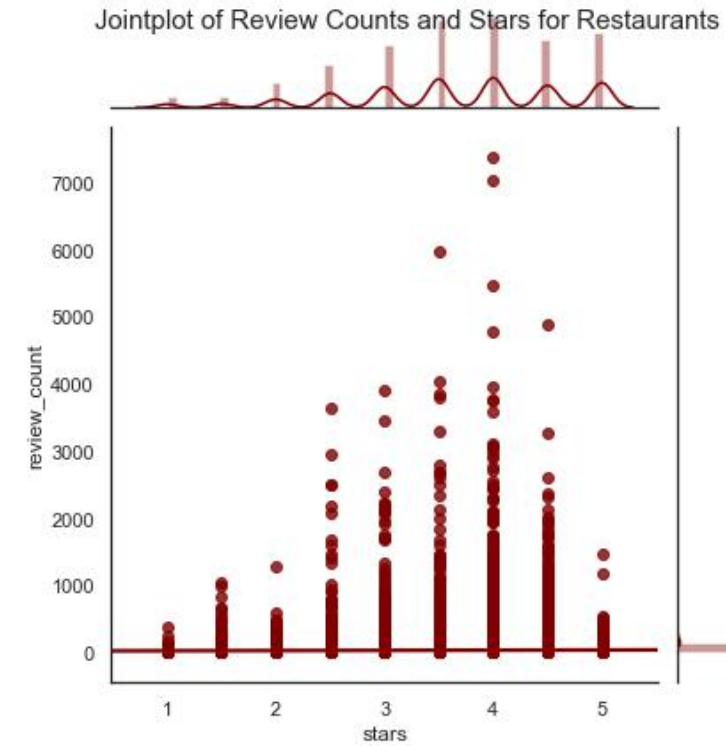
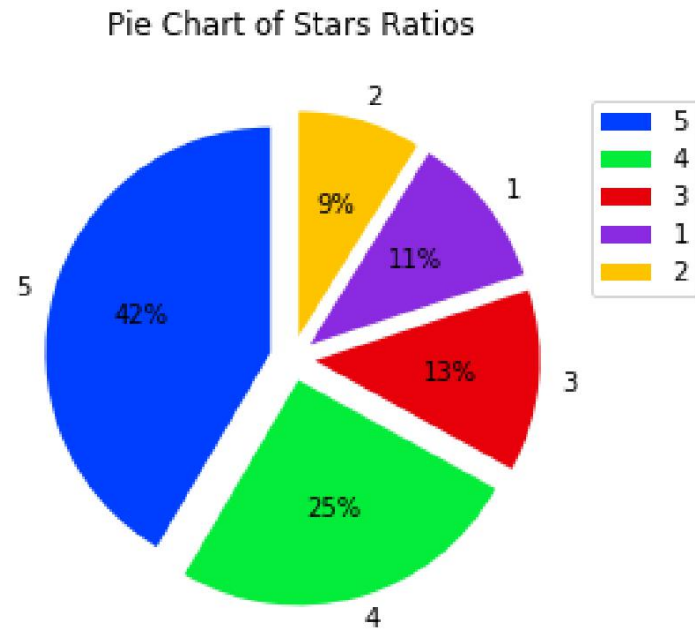
**10 metropolitan areas**

# Las Vegas Restaurant Spatial Distribution

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Dot color: review ratings  
Dot size: review counts



# Visualizing Restaurants' Rating

# Model

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## Dependent Variable (DV):

Compute **Utility** of a restaurant based on past data

$$U_i = \frac{f(R_i)}{S(R_i, G)}$$

- $R_i$  - Preference attributes vector for each Restaurant from past reviews
- $G$  - Preference attributes vector for a group or family
- $S(R_i, G)$  - Similarity score of two preference attributes vector

## Independent Variables (IV):


Popularity, Gender, Weekend, Vegan-Friendly, Kid-Friendly, Group-Friendly, Restaurant Categories



# IV 1: Popularity

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Customers might prefer to choose **popular** restaurants

Popularity = 1 if 

- If rating is greater than average rating
- If there are enough reviews (at least 40% of average rating count per restaurant)

## IV 2: Gender

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Does restaurant utility depend on customer's gender?

Detected from **reviewer's name** (1 if female)

## IV 3: Weekend

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Suitable for weekend or work week?

Detected from **reviews' date** (1 if written on weekend)  
(Assuming date of review same as service date)

# IV 4-6: Vegan-Friendly, Kid-Friendly, Group-Friendly

Text mining from review by scanning for related words



Vegan



Kid



Group

# IV 7: Food Categories



American



Asian



European



Mediterranean



Drinks



South American

# Finding $f(R_i)$

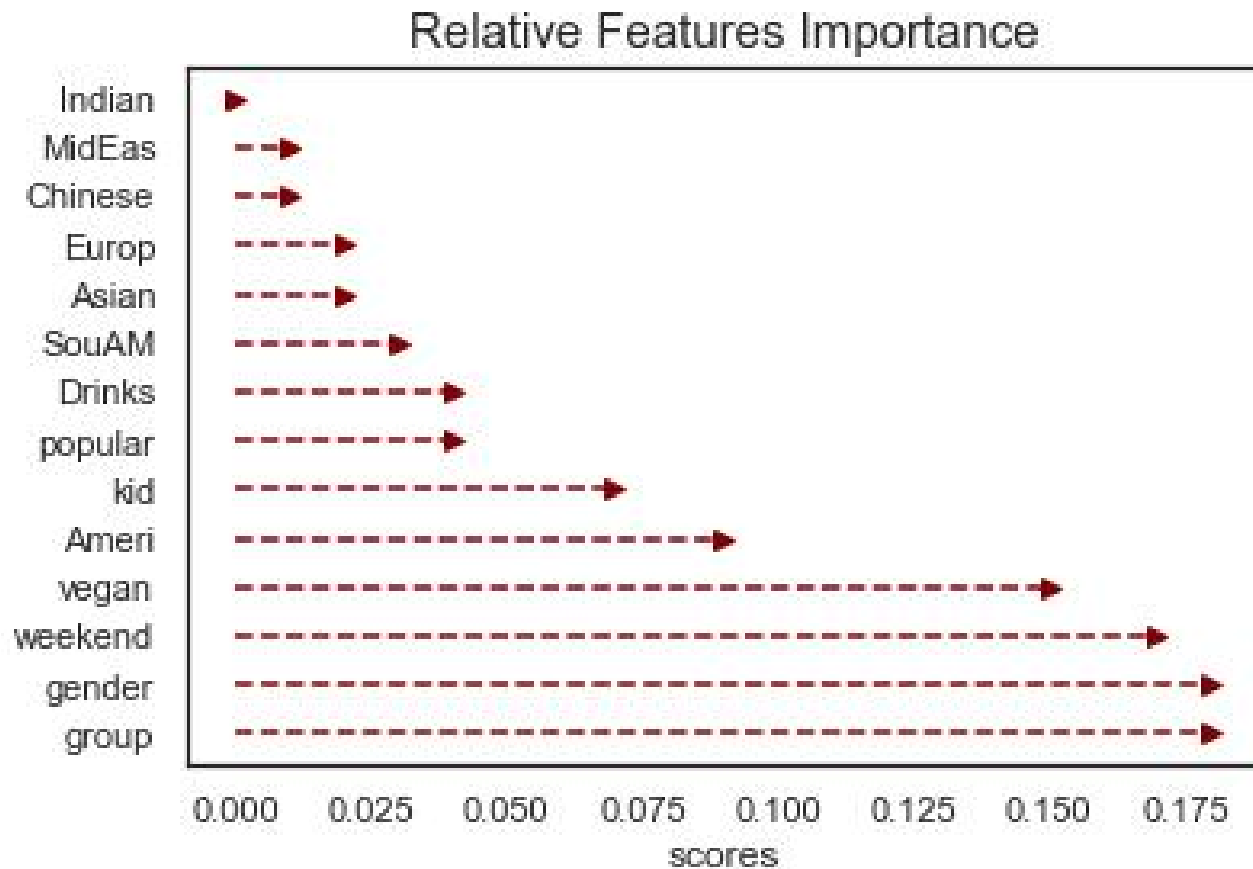
$X (3778 * 14)$

$f(R_i)$  by 8 machine learning algorithms

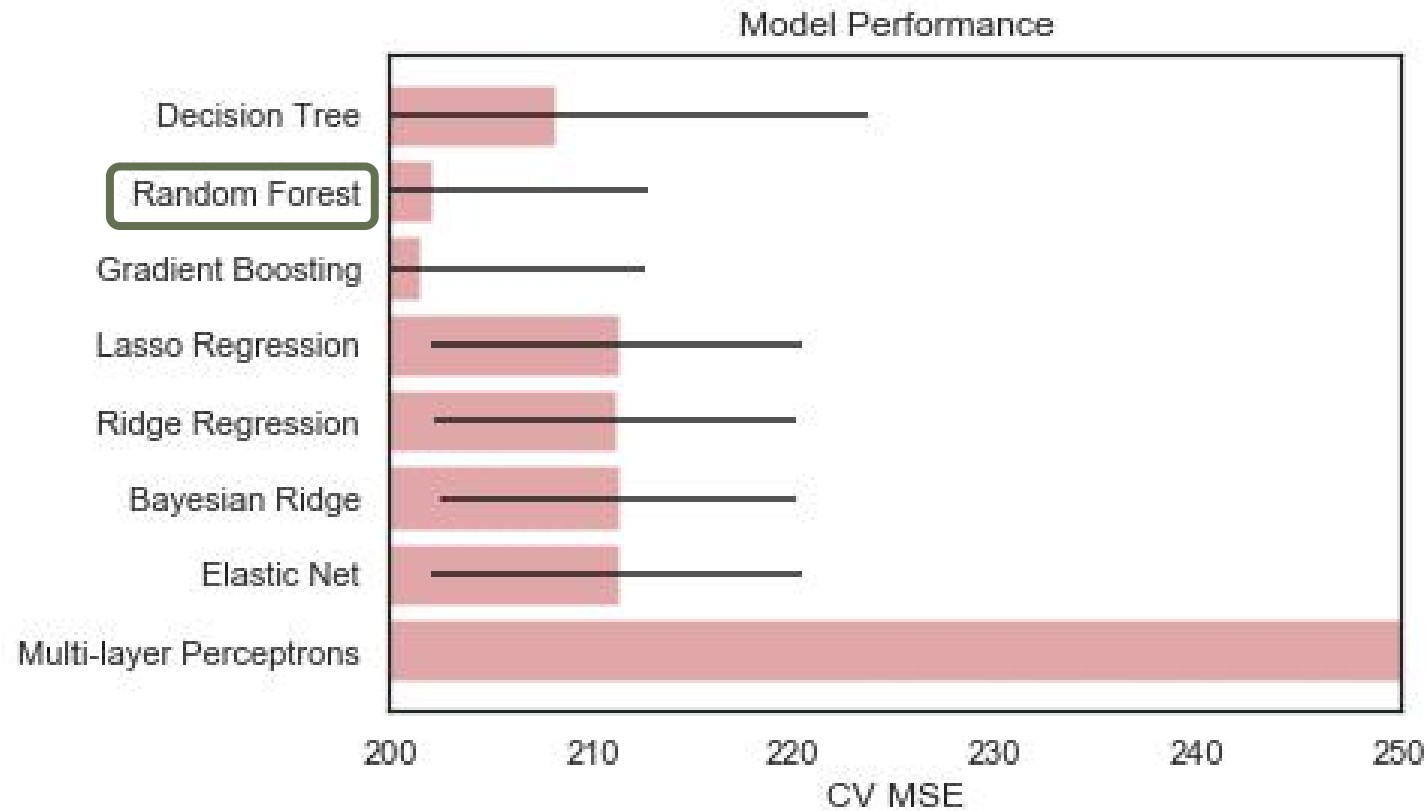
$y (3778 * 1)$

	popular	gender	weekend	vegan	kid	group	Ameri	Europ	SouAM	Asian	Indian	Chinese	MidEas	Drinks
business_id														
--9e1ONYQuAa-CB_Rrw7Tw	1.0	0.383562	0.486301	0.198630	0.006849	0.698630	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
-1m9o3vGRA8IBPNvNqKLmA	0.0	0.289474	0.473684	0.368421	0.026316	0.684211	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
-3zffZUHoY8bQjGfPSoBKQ	1.0	0.444444	0.444444	0.185185	0.037037	0.722222	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
-8R_-EkGpUhBk55K9Dd4mg	0.0	0.482759	0.310345	0.068966	0.000000	0.275862	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
-9YyInW1wapzdNZrhQJ9dg	0.0	0.305556	0.472222	0.138889	0.027778	0.583333	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

```
business_id
--9e1ONYQuAa-CB_Rrw7Tw    53.662383
-1m9o3vGRA8IBPNvNqKLmA    63.648997
-3zffZUHoY8bQjGfPSoBKQ    52.227558
-8R_-EkGpUhBk55K9Dd4mg    51.563956
-9YyInW1wapzdNZrhQJ9dg    32.578294
-AD5PiuJHgdUcAK-Vxao2A    49.972100
-ADt19bLp8wNqYX1k3KuxA    53.280407
-Bf8BQ3yMk8U2f45r2DRKw    42.256620
-Bv-HHUs8aHzDrdWcZHn8w    36.140218
-C8sSrFqaCxp51pyo-fQLQ    55.804888
```



## Relative Features Importance by Random Forest



# ML Model Comparison

## Default – Utility Based

	name	address	utility
339	"Meraki Greek Grill"	"4950 S Rainbow Blvd, Ste 160"	56.945889
92	"Lucki Thai"	"467 E Silverado Ranch Blvd"	55.816374
3310	"Island Style Restaurant"	"3909 W Sahara Ave, Ste 1"	55.593310
1320	"Ramen Tatsui"	"3400 S Jones Blvd, Ste 6"	55.522444
3953	"Ronald's Donuts"	"4600 Spring Mountain Rd"	55.362644
3027	"Zaytoon Restaurant"	"3655 S Durango Dr, Ste 11-14"	55.290851
895	"Veggie House"	"5115 Spring Mountain Rd, Ste 203"	55.202285
1238	"Yassou"	"7871 W Charleston Blvd"	55.149574
3070	"Firefly"	"3824 Paradise Rd"	55.110550
1390	"é by José Andrés"	"3708 Las Vegas Blvd S"	55.082319

## Sort by Distance

	name	address	distance
682	"Carlos'n Charlie's"	"3555 S Las Vegas Blvd"	0.000847
789	"Paradise Garden Buffet"	"3555 Las Vegas Blvd S"	0.000938
3031	"Flour & Barley"	"3545 Las Vegas Blvd S"	0.001257
31	"Tilted Kilt Pub & Eatery"	"3545 Las Vegas Blvd, Unit L-26"	0.001295
1047	"In-N-Out Burger"	"3545 S Las Vegas Blvd, Ste L24"	0.001367
3667	"Jaburritos"	"3535 S Las Vegas Blvd"	0.001488
2737	"Bonanno's New York Pizzeria"	"Flamingo Hotel and Casino, 3555 Las Vegas Blv..."	0.001508
3304	"Pan Asian Express"	"Flamingo Hotel and Casino, 3555 Las Vegas Blv..."	0.001520
415	"Virgil's Real Barbecue - Las Vegas"	"3545 Las Vegas Blvd"	0.001556
582	"LA Subs & Salads"	"Flamingo Hotel and Casino, 3555 Las Vegas Blv..."	0.001583

## Kid-Friendly Sort

	name	address	kid
998	"Big Horn Cafe"	"6725 Lee Canyon Rd"	1.000000
2911	"Angel & Willy's Roadhouse Grill"	"10950 State Hwy 160"	1.000000
2585	"Chinese New Year Celebration"	"4205 Spring Mountain Rd"	1.000000
3249	"Buck's Tavern"	"1204 N Nellis Blvd"	1.000000
2744	"Chuck E. Cheese's"	"9230 S Eastern Ave, Ste 100"	0.777778
3861	"LOL Kids Club"	"7460 S Rainbow Blvd, Unit 130"	0.761905
154	"McDonald's"	"7200 Arroyo Crossing Pkwy"	0.666667
3176	"Red Shrimp Company"	"4060 S Jones Blvd"	0.666667
1692	"Chuck E. Cheese's"	"7381 W Lake Mead Blvd"	0.652174
2491	"Cobrinha Brazilian Jiu Jitsu Academy"	"321 N Buffalo Dr, Ste 120"	0.538462

# Model Output: No Group Preference



# Sample User Case

**Suresh:** male, prefer South American & Indian & Asian food, vegan (important), prefer nearby restaurants

**Suresh's Kid:** kid foods (very important)

**Li:** male, prefer American & Chinese & European & Indian & Asian food, non-vegan (not important), location first

**Xi:** female, prefer Chinese & South American & Middle East & Drink food, non-vegan (not important), location first

	popular	gender	weekend	vegan	kid	group	Ameri	Europ	SouAM	Asian	Indian	Chinese	MidEas	Drinks
Suresh (with kids)	1	0	1	1 (important)	1(important)	1	0	0	1	1	1	0	0	0
Li	1	0	1	0	0	1	1	1	0	1	1	1	0	0
Xi	1	1	1	0	0	1	0	1	0	0	0	1	1	1
Aggregated(G)	1	1/3	1	1	1	1	1/3	2/3	1/3	2/3	2/3	2/3	1/3	1/3

# Similarity between $R_i$ and $G$

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$S(R_i, G)$  = Euclidean distance

If the group's preference attribute is  $G = \langle 1, 0, 1, 0 \rangle$ ,

they will be satisfied at restaurant with close attributes  $R_i = \langle 0.7, 0.1, 0.9, 0.2 \rangle$  ( $S = 0.38$ )

they will be unsatisfied at restaurant with distant attributes  $R_i = \langle 0.5, 0.9, 0.4, 0.3 \rangle$  ( $S = 1.23$ )

$$U_i = \frac{f(R_i)}{S(R_i, G)}$$

As a result, if  $S$  is small,  $U$  will increase; if  $S$  is large,  $U$  will decrease.

# Model Output: With Group Preference

	name	address	similarity	utility_reweighted	distance	walking_minutes
1	"Veggie House"	"5115 Spring Mountain Rd, Ste 203"	3.53	15.65	0.04	0.50
2	"Raku"	"5030 Spring Mountain Rd, Ste 2"	3.67	14.91	0.04	0.50
3	"Chubby Cattle"	"3400 S Jones Blvd, Ste 15"	3.68	14.71	0.05	0.65
4	"Nittaya's Secret Kitchen"	"2110 N Rampart, Ste 110"	3.69	14.63	0.14	1.94
5	"Trattoria Nakamura-Ya"	"5040 W Spring Mountain Rd, Ste 5"	3.81	14.16	0.04	0.50
6	"Meraki Greek Grill"	"4950 S Rainbow Blvd, Ste 160"	4.06	14.01	0.07	0.89
7	"Cleo"	"2535 S Las Vegas Blvd"	3.88	13.97	0.03	0.40
8	"Big Wong Restaurant"	"5040 Spring Mountain Rd"	3.58	13.96	0.04	0.50
9	"Shang Artisan Noodle"	"4983 W Flamingo Rd, Ste B"	3.84	13.93	0.04	0.40
10	"Estiatorio Milos"	"3708 Las Vegas Blvd S"	3.81	13.93	0.01	0.10

## Next Steps



Explore other preference attributes



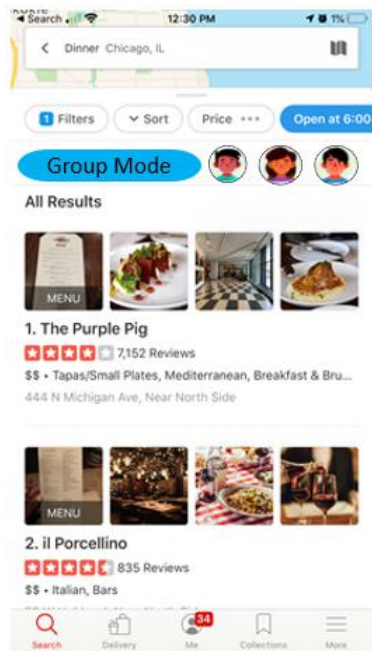
Implement the App support and Launch



Track Algo performance from real-time user feedback and tweak preference weights



Expand to other cities



# Conclusion

Proposed Group Mode and Family Mode to consider multiple user preferences to suggest restaurant recommendations

Developed and implemented a utility theory-based ML model

