Course Project

CS773: Data Mining and Security

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Data Changes

For questions two through four the data was reduced to *cuisine,atmosphere,occasion,price,style*. Any restaurant that did not have one of those features the fake feature none was added and for those that had multiple features per feature category i.e one atmosphere, cuisine and price but two occasion features with non style the following was done. This is shown in table 1.

Table 1: Data change example

cuisine	atmosphere	occasion	price	style
Italian	Excellent Decor	Open on Sundays	$15-$30	none
Italian	Excellent Decor	Open on Mondays	$15-$30	none

Task i

```
Study the provided features and classify them into one of the standard (cuisine, style,
price, atmosphere, and occasion) or into your own created additional categories. Limit
the new categories to at most 5. If you think that a feature fits into more than one of
your categories, do put them in all the categories that they fit in. This could be more
an exception than a role. Typically, there should be a 1-1 mapping of features to
categories.
```

Results

In order to get this classification in a timely manner python was used to perform data manipulation to aid in this by hand classification. The libraries nltk and pycountry were utilized to do the bulk of this work. This file can be seen in the appendices section listing 8. The first step was to group like features through usage of n-grams. Features such as *Fine for Dining Alone* and *Dining After the Theater* were grouped together as both had grams produced that started with Dining. This method did not work for all of the features and left roughly five to eight percent ungrouped. Due to the vast majority of the features being grouped already by this technique it was simple enough to move these features to the correct classification group. The results can be seen below.

Table 2: Atmosphere Classification

An Historic Spot	An Out Of The Way Find	Authentic
Buffet Dining	Business Scene	Cafe/Garden Dining
Classic Hotel Dining	Creative	Credit cards are not accepted
Excellent Decor	Excellent Food	Excellent Service
Extraordinary Decor	Extraordinary Food	Extraordinary Service
Fabulous Views	Fabulous Wine Lists	Fair Decor
Fair Food	Fair Service	Focus on Dessert
For the Young and Young at Heart	Good Decor	Good Food
Good Out of Town Business	Good Service	Good for Younger Kids
Great for People Watching	Health Conscious Menus	Hip Place To Be
Little Known But Well Liked	Near-perfect Decor	Near-perfect Food
Near-perfect Service	Need To Dress	No Liquor Served
No Reservations	No Smoking Allowed	Old World Cafe Charm
On the Beach	Parking/Valet	People Keep Coming Back
Place for Singles	Poor Decor	Pub Feel
Quiet for Conversation	Quirky	Relaxed Senior Scene
Romantic	Singles Scene	Tourist Appeal
Up and Coming	Very Busy - Reservations a Must	Warm spots by the fire
Wheelchair Access		

Table 3: Cuisine Classification

Afghanistan	African	American	Argentinean	Armenian
Asian	Austrian	Bar-B-Q	Belgian	Brazilian
Burmese	Burritos	Cajun	Cambodian	Canadian
Caribbean	Chinese	Coffee and Dessert	Creole	Cuban
Czech	Dim Sum	Egyptian	Ethiopian	Filipino
Fountain and Ice Cream	French	German	Greek	Guatemalan
Hamburgers	Beer & Hot Dogs	Hungarian	Indian	Indonesian
Irish	Italian	Jamaican	Japanese	Jewish
Korean	Latin	Lebanese	Malaysian	Mediterranean
Mexican	Moroccan	Nicaraguan	Pacific New Wave	Pacific Rim
Persian	Peruvian	Polish	Polynesian	Portuguese
Puerto Rican	Romanian	Roumanian	Russian	Salvadoran
Scandinavian	Seafood	Spanish	Sushi	Swiss
Tapas	Tex Mex	Tex-Mex	Thai	Tibetan
Tunisian	Turkish	Ukrainian	Ukranian	Vegetarian
Venezuelan	Vietnamese	Wine and Beer	Yugoslavian	

Table 4: Occasion Classification

After Hours Dining	Catering for Special Events	Dancing	Delivery Available
Dining After the Theater	Dining Outdoors	Early Dining	Entertainment
Fine for Dining Alone	Game	Great Place to Meet for a Drink	Happy Hour
Late Night Menu	Long Drive	Margaritas	Menus in Braille
Open for Breakfast	Open on Mondays	Open on Sundays	Other Quick Food
Parties and Occasions	Picnics	Pre-theater Dining	Private Parties
Private Rooms Available	Prix Fixe Menus	See the Game	Short Drive
Special Brunch Menu	Takeout Available	Walk	Weekend Brunch
Weekend Dining	Weekend Jazz Brunch	Weekend Lunch	

Table 5: Style Classification

A	American (Contemporary)	American (New)	American (Regional)
American (Traditional)	Bakeries	Brasserie	Cab
Cafe/Espresso Bars	Cafeterias	Californian	Carry in Wine and Beer
Caviar	Central	Coffee Houses	Continental
Haute Creole	Haute New Orleans	Coffeehouses	Coffee Shops
Deli	Diners	Down-Home	Eastern European
Eclectic	Down-Home Creole	Southern	Southwestern
South American	Southeast Asian	English	Fast Food
Fondue	Franco-Russian	Frankfurters	French Bistro
French Classic	French Contemporary	French-Japanese	French (New)
French Nouvelle	Grills	Hamburgers	Health Food
High Tea	International	Italian (North	Italian (Northern)
Italian (North & South)	Italian Nuova Cucina	Italian (Southern)	Kosher
Lithuanian	Middle Eastern	N	Noodle Houses
Noodle Shops	Omelettes	Oyster Bars	Pancakes
Pastries	Pastry Shops	Pizza	Pizzerias
Po' Boys	Power Brokers	Scottish	Soul Food
Soulfood	Southern Comfort	Steakhouses	Swiss-French
Tacos	Traditional	Yogurt Bar	

Table 6: Price Classification

$15-$30 $30-$50   below $15   over $50

Task ii

Analyze and form rules to characterize the following five types of cuisine: (i) Indian
(ii) Mexican (iii) Italian (iv) French (v) American. For each category, derive a set of
rules based on data available from all cities.

Results

Assumptions

1. There would be clear and concise rules

2. Low error margin when generating rules

The results for task ii were generated from an R script seen in listing 9 which uses the C50 decision tree algorithm to produce rules. Data used in this script was generated using a python file `rules.py` which accompanies this report. The classification was aided through using boosting which is indicated by setting the *trialNum* to ten. The *rules* R script can be seen in this listing 12 in the appendices for this report. We also set the flag of rules to true in order to decompose the tree into the bare rules.

Overall the classification of the data the features *price*, *style*, *occasion* were heavily used when generating the rules as seen in table 9. Boosting resulted in a **38.7%** error margin with trials 0, 7 and 8 resulting in least error. The entire rule set for each trial can be found in the files *c50_10Trial(2).txt* which accompanies this report. Trial 0 generated the most number of rules which was 118 with the average number of rules being between 40-60. We omit listing the rules here as the file is 5977 lines long but include notable rules as seen below. This is a sampling seen in figure 1 is taken from all trials.

```
Rule 0/24: (582, lift 6.4)
style in {Bakeries, Brasserie, Caviar}
->  class French  [0.998]

Rule 0/38: (3, lift 5.1)
atmosphere = Romantic
occasion = After Hours Dining
price = $30-$50
style = none
->  class French  [0.800]

Rule 0/58: (4, lift 56.3)
atmosphere in {Good Food, Good Service}
price = $15-$30
style = Carry in Wine and Beer
->  class Indian  [0.833]

Rule 0/106: (8, lift 11.5)
occasion in {Dining Outdoors, Late Night Menu}
price = below $15
style = Carry in Wine and Beer
->  class Mexican  [0.900]

Rule 3/4: (1984.1/437.8, lift 1.8)
occasion in {Dancing, Delivery Available, Dining After the Theater,
                  Early Dining, Fine for Dining Alone,
                  Great Place to Meet for a Drink, Long Drive,
                  Menus in Braille, Open on Mondays, Open on Sundays,
                  Picnics, See the Game, Short Drive, Special Brunch Menu,
                  Takeout Available, Weekend Dining}
style in {Coffee Shops, Eclectic, High Tea, Omelettes, Pastries,
                  Steakhouses}
->  class American  [0.779]
```

Figure 1: Sampling of rules from C50

Table 7: Task ii Classification Errors

```
Evaluation on training data (61063 cases):
Trial          Rules
-----   ----------------
   No      Errors

   0      119 22584(37.0%)
   1       60 25297(41.4%)
   2       61 24058(39.4%)
   3       45 25904(42.4%)
   4       61 24293(39.8%)
   5       53 25591(41.9%)
   6       43 25873(42.4%)
   7       78 23947(39.2%)
   8       65 23669(38.8%)
   9       52 24269(39.7%)
boost          23614(38.7%)
```

Table 8: Task ii Classification Confusion Matrix

```
   (a)   (b)   (c)   (d)   (e)    <-classified as
   ----  ----  ----  ----  ----
  25111  1206         2420   360   (a): class American
   4754  3533         1220    10   (b): class French
    640    15          229    20   (c): class Indian
   8781   572         7247   150   (d): class Italian
   2769                468  1558   (e): class Mexican
```

Table 9: Task ii Attribute Usage

```
100.00% price
100.00% style
 99.99% occasion
 89.66% atmosphere
```

Task iii

Derive association rules among the given features. In other words, does Creative
atmosphere imply a specific category? In particular, experiment with the following
associations:
a. Cuisine and atmosphere
b. Price and atmosphere
c. Price and style
d. Cuisine and occasion.
e. Dcor and Price

Results

Assumptions

1. The fake feature none would not have a great impact in the generated rules

2. The number of item tuples(cuisine,atmosphere,occasion,price,style) used for rule mining, which was 99881, would produce rules with a minimal support of at least 0.2

3. The minimal confidence that the generated rules would have to have to be considered acceptable would be 0.49

We chose to use R for this task and library arules. The *arules* library allows for control over the left(lhs) and right(rhs) hand sides of the *apriori* algorithm which was a specific requirement for this task. Being able to control the lhs or the rhs of the apriori algorithm in this library does not mean the we artificially created the generated rules. Rather it means that the library allows us to state which item labels can appear in regards to what kind of rules we wish to find. For example for part *a* of this task, we were able, through using this library, to specify only the usage of features that are classified as cuisine and atmosphere for the lhs and all others features are the implication of the rule. By implication we mean the rhs whose lhs is either one of or both cuisine and atmosphere features found in the dataset. The R script used for this task can be seen in the appendices listing 10.

After generating the rules it was found that the first two assumptions turned out to be untrue. The maximum support found for the majority of the rules generated was 0.15 but the confidence assumption for all generated rules was confirmed. We believe that is was due to the need for specifying the fake feature none and the number of item tuples generated to meet the requirements of the *apriori* algorithm. The feature classification of *style* had the most *none* items which resulted in rules whose rhs was *style=none*. Since the *apriori* algorithm mines rules from frequent itemsets and the data given to it is considered transactions(the item tuples defined in assumptions). We feel our belief as to why the first two assumptions were proven wrong is correct and that our results are still valid due to the nature of the *apriori* algorithm.

To accommodate for our initial assumptions being proven wrong we re-ran the rule mining for each part of this task but with the following additions:

1. Rules were generated from data that had all item tuples with *style=none* removed

2. Rules were generated from the data whose lhs had only the unique feature pairs for each respective part of this task both with *style=none* item tuples and without *style=none* item tuples. It must be noted for the rules generated through unique pair, it was gotten by filtering the original data with unique pairs used in computing the lhs. Example: (atmosphere=Good for Younger Kids,cuisine=Portuguese) this was present in the data so we looked for this in the generated rule

The data generated for this task can be seen in the folder **q3** which accompanies this report. It must be noted we omit the support, confidence and lift metrics in the rules shown as doing so would not allow the results to be presentable for this report. For the the rules shown in this report, we took at most the first 50 rules from a subset of the rules which meet the constraint of assumption three. To accommodate for this we will first present an overview of the generated rules per section table 10 and then show the rules in tabular format and these tables are included in the appendices of this report due to their size.

As seen in table 10 using the feature Cuisine in combination with another generated the largest amount of rules, with atmosphere pairing generating the second largest. We believe this is the case because of the subjective nature of such ratings(atmosphere), so this pairing is not as substantial to others per the reasons stated before. We apply this same logic to Cuisine and occasion. Price in combination with another did not generate as many rules as was the case when paired with atmosphere, we believe this is indicative of Price being an important determiner to rules in comparison to the others. Our own intuition and experience tells us price is an important factor in where to eat and its quality. Price in combination with Décor also matched our intuition about how we ourselves judge a restaurant.

Table 10: Task iii Rule Overview

Cuisine and atmosphere

Rule Generation	Number of Rules	Support	Confidence	Lift	Conviction
Normal	550	[0.000501, 0.153192]	[0.490066, 1.000000]	[0.862753, 387.135659]	[0.847118, 20.972037]
No *style=none*	417	[0.000501, 0.074147]	[0.491667, 1.000000]	[1.042620, 193.310078]	[1.039538, 29.900309]
Unique pairs	399	[0.000501, 0.014497]	[0.490066, 1.000000]	[0.862753, 25.736673]	[0.847118, 14.471131]
Unique pairs and No *style=none*	417	[0.000501, 0.074147]	[0.491667, 1.000000]	[1.042620, 193.310078]	[1.039538, 29.900309]

Price and atmosphere

Normal	112	[0.000501, 0.332556]	[0.491228, 0.915493]	[0.981150, 10.255605]	[0.981450, 5.908788]
No *style=none*	69	[0.000501, 0.017544]	[0.490196, 1.000000]	[1.354738, 144.982558]	[1.256716, 16.154309]
Unique pairs	56	[0.000501, 0.007760]	[0.490196, 1.000000]	[1.354738, 144.982558]	[1.256716, 16.154309]
Unique pairs and No *style=none*	79	[0.000511, 0.036453]	[0.491228, 0.886792]	[0.981150, 10.255605]	[0.981450, 4.410786]

Price and style

Normal	64	[0.000551, 0.332556]	[0.490196, 1.000000]	[1.169360, 245.407862]	[1.204546, 22.391736]
No *style=none*	80	[0.000541, 0.042607]	[0.490196, 1.000000]	[1.341456, 184.718519]	[1.244751, 22.212175]
Unique pairs	54	[0.000541, 0.032642]	[0.490196, 1.000000]	[1.341456, 184.718519]	[1.244751, 22.212175]
Unique pairs and No *style=none*	41	[0.000551, 0.016299]	[0.490196, 1.000000]	[1.682691, 245.407862]	[1.390110, 22.391736]

Cuisine and occasion

Normal	477	[0.000501, 0.153192]	[0.490385, 1.000000]	[0.883225, 387.135659]	[0.866887, 20.972037]
No *style=none*	367	[0.000501, 0.074147]	[0.490385, 1.000000]	[1.042910, 193.310078]	[1.039817, 20.243142]
Unique pairs	352	[0.000501, 0.022096]	[0.490385, 1.000000]	[0.884756, 243.703641]	[0.868401, 18.229305]
Unique pairs and No *style=none*	271	[0.000501, 0.025785]	[0.490385, 1.000000]	[1.042910, 121.689565]	[1.039817, 11.969015]

Décor and Price

Normal	14	[0.000501, 0.332556]	[0.492777, 0.683673]	[0.984243, 5.889286]	[0.984447, 2.061567]
No *style=none*	7	[0.000622, 0.017544]	[0.525424, 0.648148]	[1.746907, 6.037227]	[1.754707, 2.367642]
Unique pairs	5	[0.000622, 0.004672]	[0.525424, 0.644068]	[1.746907, 6.037227]	[1.754707, 2.355837]
Unique pairs and No *style=none*	8	[0.000781, 0.026251]	[0.498507, 0.683673]	[1.200877, 5.889286]	[1.252212, 2.061567]

Task iv

Let us now concentrate specifically on the quality of the food. This is specified
through features 73-78. Assuming that the outcome you are interested is in one of the
following categories, determine if there is any relationship between type of cuisine
and the quality indicator. Categories to be considered are: Fair, Good, Excellent.
You can combine the given 6 categories into these 3 categories.

Results

Assumptions

1. Combining quality indicators would result in worse significance levels(p-values) than uncombined

2. There is medium to high relationship between quality indicators and the cuisine

We chose R again for this task as its inherently built for fitting linear models. To test assumption one we used two linear
models the first being uncombined data and the second being the combined data. The R script used to produce the following
data is found in the appendices listing 11.

The none-combined quality indicator models summary and data plot can be seen in figure 2 and the combined model
summary with plot in figure 3. Assumption one was confirmed as the p-value for the non-combined was 0.791 whereas for
the combined it was 0.5326. This 0.2584 drop in significance shows that the exact quality indicator plays a very large part.
Assumption two was confirmed on inspection of the $Pr(>|t|)$ values for each quality indicator. As seen in table 11 which lists
the counts for the quality indicator we feel that the models in figures 2 none-combined and 3 combined meet the requirements
for this task based on the counts of the data. We use the following abrivations in order to get the data presentable for this
report cuisine = c, Excellent Food = ExcF, Extraordinary Food = ExtF, Fair Food = FF, Good Food=GF, Near-perfect
Food =NPF.

Table 11: Quality Indicator Counter

c	ExcF	ExtF	FF	GF	NPF						
Afghanistan	9	12	0	0	0						
African	17	0	0	0	0	Korean	26	15	0	14	4
American	1692	1055	20	1165	122	Latin	12	11	0	5	0
Argentinean	5	1	0	4	0	Lebanese	11	4	0	12	0
Armenian	1	0	0	1	0	Malaysian	4	0	0	0	0
Asian	8	5	0	4	7	Mediterranean	95	83	0	33	0
Austrian	6	6	0	0	0	Mexican	406	111	10	295	6
Bar-B-Q	153	49	4	79	0	Moroccan	16	2	0	3	0
Belgian	1	3	0	0	0	Nicaraguan	1	0	0	5	0
Brazilian	20	0	0	15	0	Pacific New Wave	10	48	0	4	5
Burmese	2	2	0	1	0	Pacific Rim	0	6	0	0	0
Burritos	11	0	0	6	0	Persian	8	0	0	1	0
Cajun	82	75	6	49	1	Peruvian	11	4	0	1	0
Cambodian	0	6	0	0	0	Polish	32	2	0	5	0
Canadian	0	0	0	3	0	Polynesian	6	0	0	3	0
Caribbean	86	29	0	36	0	Portuguese	23	3	0	0	0
Chinese	319	217	0	72	2	Puerto Rican	0	0	0	2	0
Coffee and Dessert	86	35	1	42	0	Romanian	5	0	0	0	0
Creole	52	63	0	45	0	Roumanian	0	0	0	4	0
Cuban	44	11	0	15	0	Russian	30	7	0	27	2
Czech	12	0	0	0	0	Salvadoran	32	2	0	20	0
Dim Sum	63	55	0	6	0	Scandinavian	0	7	0	1	0
Egyptian	0	0	0	9	0	Seafood	485	262	4	240	17
Ethiopian	17	7	0	1	0	Spanish	126	42	7	12	0
Filipino	4	0	0	2	0	Sushi	0	3	0	0	0
Fountain and Ice Cream	240	254	0	112	44	Swiss	15	0	0	1	0
French	441	680	8	120	155	Tapas	32	35	0	26	0
German	66	14	0	16	0	Thai	112	107	0	13	1
Greek	97	29	0	36	0	Tibetan	2	0	0	0	0
Guatemalan	4	0	0	0	0	Tunisian	3	0	0	0	0
Hamburgers & Beer	19	10	2	88	0	Turkish	2	7	0	7	0
Hot Dogs	4	0	0	0	0	Ukrainian	2	0	0	0	0
Hungarian	20	4	0	0	0	Ukranian	4	0	0	0	0
Indian	86	68	0	33	0	Vegetarian	86	25	0	75	0
Indonesian	25	5	0	1	0	Venezuelan	10	0	0	0	0
Irish	3	4	6	14	0	Vietnamese	49	53	0	10	0
Italian	1607	787	3	497	48	Wine and Beer	110	133	0	51	18
Jamaican	0	0	0	3	0	Yugoslavian	2	0	0	0	0
Japanese	130	147	0	34	11						
Jewish	65	21	0	28	0						

```
Call:
lm(formula = cuisine ~ 'Excellent Food' + 'Extraordinary Food' +
    'Fair Food' + 'Good Food' + 'Near-perfect Food', data = cuisine_fq_spread)

Residuals:
    Min      1Q  Median      3Q     Max
-39.151 -19.160   0.278  18.047  37.624

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)         40.058858   2.858897  14.012   <2e-16 ***
'Excellent Food'     0.008465   0.062930   0.135    0.893
'Extraordinary Food' 0.001337   0.134509   0.010    0.992
'Fair Food'         -0.332084   1.771826  -0.187    0.852
'Good Food'         -0.026458   0.061197  -0.432    0.667
'Near-perfect Food' -0.080117   0.483008  -0.166    0.869
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1   1

Residual standard error: 22.77 on 71 degrees of freedom
Multiple R-squared:  0.03261,Adjusted R-squared:  -0.03552
F-statistic: 0.4786 on 5 and 71 DF,  p-value: 0.791
```
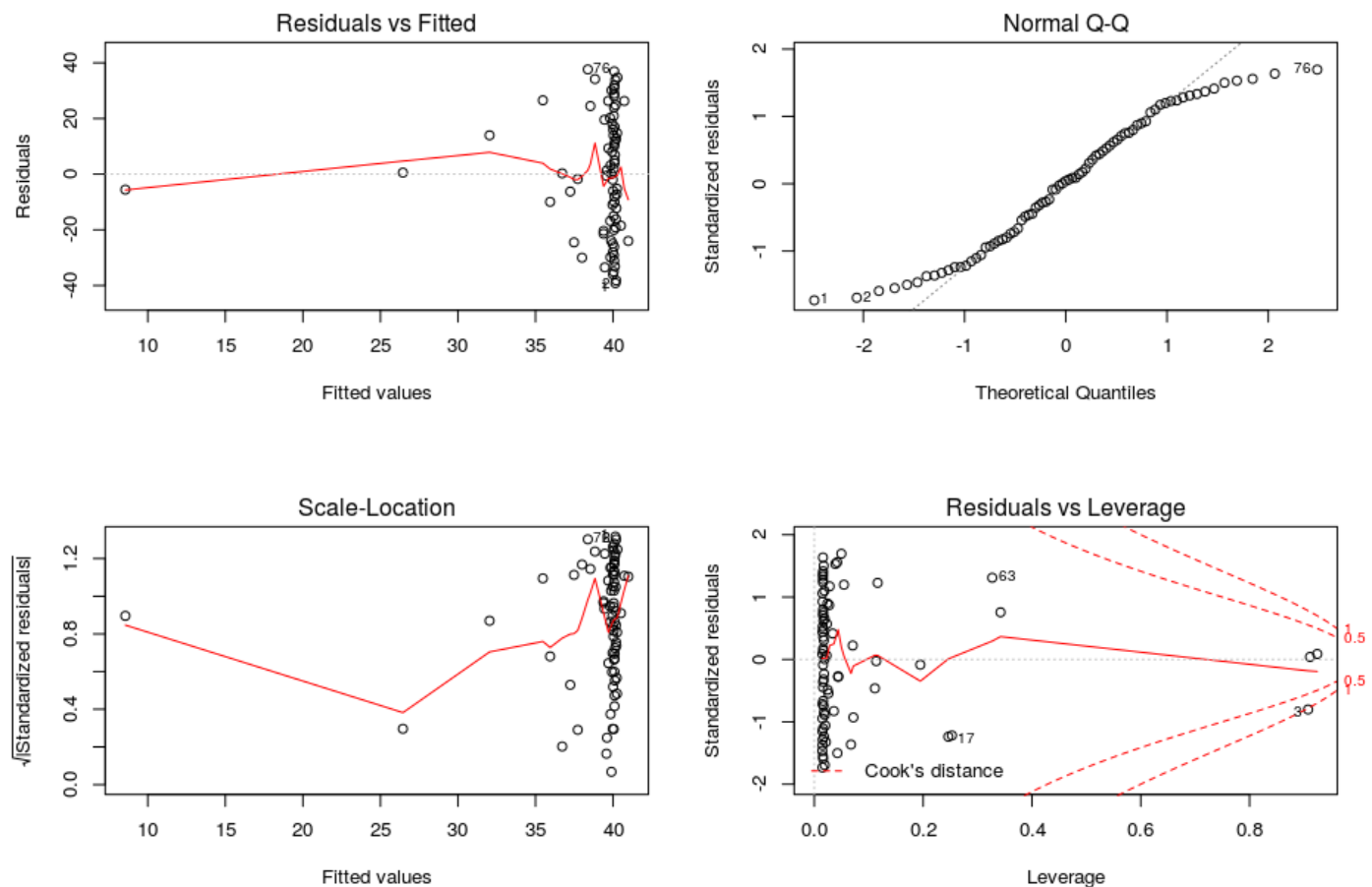

Figure 2: None Combined Quality Model Summary and Plot

```
Call:
lm(formula = cuisine ~ Good + Fair + Excellent, data = cuisine_fqd_spread)

Residuals:
    Min      1Q  Median      3Q     Max
-39.225 -19.339   0.871  17.665  36.990

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 40.332472   2.722391  14.815   <2e-16 ***
Good         0.000577   0.016492   0.035    0.972
Fair        -0.862551   1.358988  -0.635    0.528
Excellent   -0.009374   0.033799  -0.277    0.782
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1   1

Residual standard error: 22.49 on 73 degrees of freedom
Multiple R-squared:  0.02945,Adjusted R-squared:  -0.01044
F-statistic: 0.7383 on 3 and 73 DF,  p-value: 0.5326
```
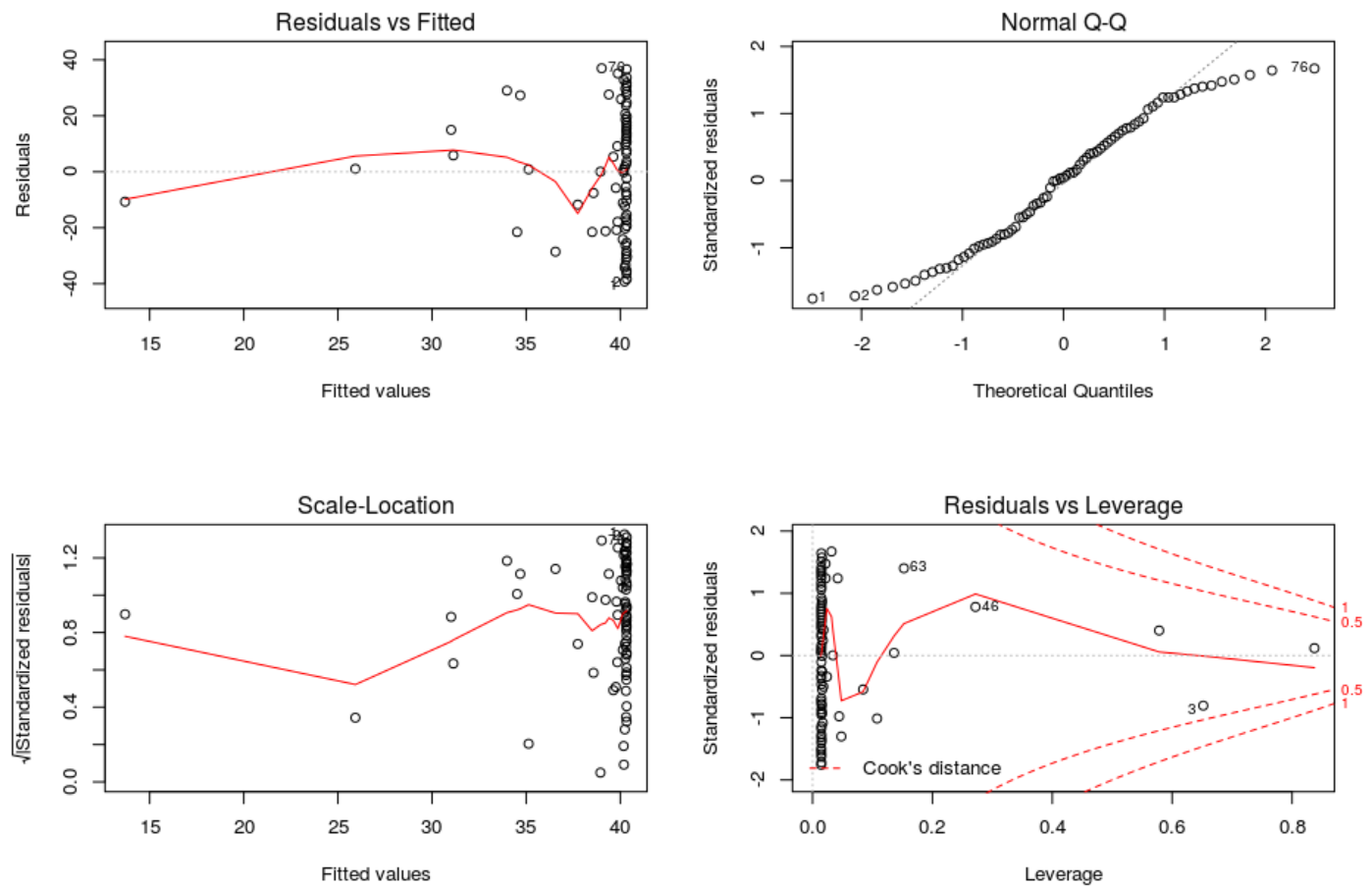

Figure 3: Combined Quality Model Summary and Plot

Task v

Find an association between a restaurant offering vegetarian (243) to its price and
cuisine.

Results

1. Assumptions

    (a) The cuisine types are divided manually and are most of the origination of the food type.

    (b) The restaurants that do not have vegetarian (243) feature are considered not offering vegetarian

    (c) The first cuisine type encountered in the restaurant data is extracted for association rule mining.

    (d) Weka is used to mine the association rules between the three attributes: cuisine, price and vegietarian

The Tertius method works well to mine the association rules for vegetarian restaurant. Below in figure 4 please find the
results from Weka. The default scheme was used (weka.associations.Tertius -K 10 -F 0.0 -N 1.0 -L 4 -G 0 -c 0 -I 0 -P 0). The
perl code used for the task is seen in listing 4.

```
 1. /* 0.098122 0.017548 */ price = 162 ==> vegie = Yes or cuisine = 221
 2. /* 0.094522 0.016346 */ price = 162 ==> vegie = Yes or cuisine = 229
 3. /* 0.093922 0.018029 */ price = 162 ==> vegie = Yes or cuisine = 058
 4. /* 0.093168 0.018510 */ price = 162 ==> cuisine = 221
 5. /* 0.092312 0.017548 */ price = 162 ==> vegie = Yes or cuisine = 142
 6. /* 0.091351 0.018269 */ price = 162 ==> vegie = Yes or cuisine = 009
 7. /* 0.089326 0.017308 */ price = 162 ==> cuisine = 229
 8. /* 0.088972 0.018990 */ price = 162 ==> cuisine = 058
 9. /* 0.088802 0.018269 */ price = 162 ==> cuisine = 142
10. /* 0.088764 0.018990 */ price = 162 ==> vegie = Yes or cuisine = 186
Number of hypotheses considered: 10543
Number of hypotheses explored: 6667
```

Figure 4: Tertius results

Task vi

Determine the error that would be incurred by categorizing the restaurants based on
the continents they represent: Asia, Europe, Africa, North America, and South
America. For each continent, form rules to determine the outcome (which continent
they come from) based on other attributes such as price, atmosphere, quality of food,
etc.

Results

1. Assumptions

    (a) The restaurants that contain geographical information features can be accurately categorized by continent.

    (b) The list of countries and continents is a complete list.

    (c) The restaurants that do not match the list of countries and continents cannot be categorized by continents and
        generate errors.

The total number of restaurants: 4160. The number of restaurants that contain geographical features: 3758.

$$Error = \frac{4160 - 3758}{4160} * 100\% = 9.66\%$$

Perl code to get the number of total restaurants and the number of restaurants that contain geographical features can bee
seen in listing 5.

Task vii

Selecting the Europe continent, state rules to determine the city based on the given features. (Choose your own features or categories that are most relevant)

Results

Assumptions

1. Each restaurant has one feature in each category. If multiple features are found, the last one was chosen.

2. Any of the features that contain European geographical information are considered Europe continent and the restaurants are included.

3. Weka is used to determine the city based on the features. NaiveBayes listing 1 and J48 method listing 2 are employed.

The code used to produce the arff file is seen in listing 6

```
1  === Run information ===
2
3  Scheme: weka.classifiers.bayes.NaiveBayes
4  Relation:      Europe-city
5  Instances:     896
6  Attributes:    5
7                 atmosphere
8                 style
9                 price
10                occasion
11                city
12 Test mode:10-fold cross-validation
13
14 === Classifier model (full training set) ===
15
16 Naive Bayes Classifier
17
18                                             Class
19 Attribute                                   atlanta      boston      chicago    los_angeles    new_orleans
         new_york san_francisco washington_dc
20                                             (0.02)       (0.03)      (0.26)       (0.12)         (0.05)
                                              (0.45)       (0.01)      (0.06)
21 =======================================================================================================
22 atmosphere
23    An Historic Spot                         1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
24    An Out Of The Way Find                   1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
25    Authentic                                1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
26    Buffet Dining                            1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
27    Business Scene                           1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
28    CafeGarden Dining                        1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
29    Classic Hotel Dining                     1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
30    Creative                                 1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
31    Credit cards are not accepted            1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
32    Excellent Decor                          10.0         3.0         90.0         56.0
         10.0             161.0          4.0          31.0
33    Excellent Food                           1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
34    Excellent Service                        1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
35    Extraordinary Decor                      6.0          3.0         33.0         10.0
         7.0              36.0           2.0          9.0
36    Extraordinary Food                       1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
37    Extraordinary Service                    1.0          1.0         1.0          1.0
         1.0              1.0            1.0          1.0
```

#	Label								
38	Fabulous Views	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
39	Fabulous Wine Lists	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
40	Fair Decor	3.0	3.0	15.0	5.0	8.0	24.0	1.0	2.0
41	Fair Food	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
42	Fair Service	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
43	Focus on Dessert	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
44	For the Young and Young at Heart	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
45	Good Decor	3.0	17.0	94.0	35.0	25.0	178.0	5.0	17.0
46	Good Food	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
47	Good Out of Town Business	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
48	Good Service	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
49	Good for Younger Kids	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
50	Great for People Watching	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
51	Health Conscious Menus	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
52	Hip Place To Be	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
53	Little Known But Well Liked	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
54	Near−perfect Decor	1.0	1.0	4.0	2.0	1.0	15.0	1.0	2.0
55	Near−perfect Food	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
56	Near−perfect Service	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
57	Need To Dress	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
58	No Liquor Served	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
59	No Reservations	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
60	No Smoking Allowed	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
61	Old World Cafe Charm	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
62	On the Beach	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
63	ParkingValet	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
64	People Keep Coming Back	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
65	Place for Singles	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
66	Poor Decor	1.0	2.0	1.0	2.0	1.0	2.0	1.0	1.0
67	Pub Feel	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
68	Quiet for Conversation	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
69	Quirky	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
70	Relaxed Senior Scene	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
71	Romantic	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
72	Singles Scene	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
73	Tourist Appeal	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
74	Up and Coming	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
75	Very Busy − Reservations a Must	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

	C1	C2	C3	C4	C5	C6	C7	C8
Warm spots by the fire	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Wheelchair Access	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
[total]	73.0	78.0	286.0	159.0	101.0	465.0	63.0	111.0

style

	C1	C2	C3	C4	C5	C6	C7	C8
A	1.0	3.0	1.0	1.0	1.0	1.0	1.0	1.0
Southern	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
French	10.0	1.0	16.0	1.0	1.0	40.0	1.0	1.0
Japanese	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Southwestern	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.0
Swiss	2.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0
Asian	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0
Southeast Asian	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
International	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0
Southern Comfort	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Deli	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
Kosher	1.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0
Afghanistan	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Argentinean	1.0	1.0	1.0	1.0	1.0	2.0	1.0	1.0
Eclectic	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0
Continental	2.0	2.0	4.0	3.0	1.0	4.0	2.0	1.0
Bakeries	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Belgian	1.0	1.0	1.0	1.0	1.0	2.0	1.0	1.0
Brasserie	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cab	1.0	1.0	57.0	2.0	1.0	5.0	1.0	1.0
CafeEspresso Bars	1.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0
Cafeterias	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Californian	1.0	1.0	1.0	6.0	1.0	1.0	1.0	1.0
Wine and Beer	1.0	1.0	1.0	2.0	1.0	1.0	1.0	3.0
Carry in Wine and Beer	1.0	2.0	6.0	1.0	1.0	1.0	1.0	1.0
Caviar	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Central	1.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0
Coffee Houses	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Coffee Shops	1.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0
Coffeehouses	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Czech	1.0	1.0	3.0	1.0	1.0	2.0	1.0	1.0
Diners	1.0	1.0	2.0	1.0	1.0	2.0	1.0	1.0
Down–Home	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Eastern European	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

115	Egyptian				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
116	English				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
117	Fast Food				1.0	1.0	1.0	2.0	
		1.0	1.0	1.0	1.0				
118	Fondue				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
119	Franco−Russian				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
120	Frankfurters				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
121	French−Japanese				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
122	Grills				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
123	Guatemalan				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
124	Hamburgers				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	2.0				
125	Health Food				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
126	High Tea				1.0	1.0	1.0	1.0	
		1.0	2.0	1.0	1.0				
127	Jewish				1.0	1.0	1.0	1.0	
		1.0	6.0	1.0	1.0				
128	Latin				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	2.0				
129	Lithuanian				1.0	1.0	3.0	1.0	
		1.0	1.0	1.0	1.0				
130	Middle Eastern				1.0	4.0	1.0	1.0	
		1.0	2.0	2.0	1.0				
131	N				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
132	Nicaraguan				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
133	Noodle Houses				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
134	Noodle Shops				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
135	Omelettes				1.0	1.0	1.0	1.0	
		1.0	2.0	1.0	1.0				
136	Oyster Bars				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
137	Pancakes				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
138	Pastries				1.0	1.0	1.0	1.0	
		1.0	2.0	1.0	1.0				
139	Pastry Shops				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
140	Pizza				1.0	1.0	22.0	1.0	
		3.0	15.0	1.0	17.0				
141	Pizzerias				1.0	1.0	1.0	5.0	
		1.0	1.0	1.0	1.0				
142	Po Boys				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
143	Power Brokers				1.0	2.0	11.0	7.0	
		1.0	8.0	1.0	2.0				
144	Roumanian				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
145	Russian				1.0	1.0	1.0	1.0	
		1.0	4.0	1.0	1.0				
146	Salvadoran				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	2.0				
147	Scottish				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
148	Soul Food				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
149	Soulfood				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
150	Steakhouses				1.0	1.0	3.0	1.0	
		1.0	5.0	1.0	1.0				
151	Swiss−French				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				
152	Tacos				1.0	1.0	1.0	1.0	
		1.0	1.0	1.0	1.0				

	col1	col2	col3	col4	col5	col6	col7	col8
Traditional	2.0	3.0	16.0	7.0	3.0	28.0	1.0	5.0
Ukrainian	1.0	1.0	1.0	1.0	1.0	3.0	1.0	1.0
Ukranian	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Venezuelan	1.0	1.0	1.0	1.0	1.0	2.0	1.0	1.0
Yogurt Bar	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Yugoslavian	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
[total]	90.0	89.0	212.0	107.0	82.0	202.0	80.0	107.0

price

	col1	col2	col3	col4	col5	col6	col7	col8
15−30	14.0	16.0	186.0	86.0	37.0	186.0	9.0	50.0
30−50	4.0	2.0	22.0	17.0	2.0	187.0	1.0	3.0
below 15	3.0	8.0	24.0	4.0	10.0	10.0	1.0	6.0
over 50	1.0	1.0	3.0	1.0	1.0	31.0	1.0	1.0
[total]	22.0	27.0	235.0	108.0	50.0	414.0	12.0	60.0

occasion

	col1	col2	col3	col4	col5	col6	col7	col8
Game	1.0	4.0	1.0	1.0	3.0	21.0	1.0	1.0
After Hours Dining	1.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0
Catering for Special Events	11.0	2.0	3.0	1.0	1.0	1.0	3.0	9.0
Dancing	2.0	2.0	1.0	5.0	1.0	1.0	1.0	1.0
Delivery Available	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Dining After the Theater	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Dining Outdoors	2.0	1.0	24.0	10.0	2.0	38.0	2.0	7.0
Early Dining	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Entertainment	5.0	4.0	14.0	16.0	4.0	32.0	2.0	6.0
Fine for Dining Alone	1.0	2.0	1.0	1.0	4.0	10.0	1.0	1.0
Great Place to Meet for a Drink	1.0	1.0	1.0	1.0	1.0	3.0	1.0	1.0
Happy Hour	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0
Late Night Menu	1.0	3.0	4.0	6.0	5.0	36.0	1.0	1.0
Long Drive	1.0	1.0	14.0	1.0	1.0	1.0	1.0	1.0
Margaritas	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Menus in Braille	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0
Open for Breakfast	1.0	3.0	2.0	5.0	2.0	8.0	2.0	3.0
Open on Mondays	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Open on Sundays	1.0	1.0	1.0	1.0	11.0	1.0	1.0	1.0
Other Quick Food	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Parties and Occasions	1.0	1.0	1.0	3.0	1.0	1.0	1.0	1.0
Picnics	1.0	1.0	1.0	6.0	1.0	1.0	1.0	1.0
Pre−theater Dining	1.0	1.0	1.0	2.0	1.0	3.0	1.0	1.0
Private Parties	1.0	4.0	1.0	1.0	10.0	1.0	1.0	1.0

```
193  Private Rooms Available                        2.0        1.0        48.0        13.0
         5.0            10.0          2.0        4.0
194  Prix Fixe Menus                                1.0        1.0         5.0         1.0
         1.0            26.0          1.0        2.0
195  See the Game                                   1.0        1.0         1.0         1.0
         1.0             1.0          1.0        1.0
196  Short Drive                                    1.0        1.0        11.0         1.0
         1.0             2.0          1.0        1.0
197  Special Brunch Menu                            1.0        1.0         1.0         1.0
         3.0            16.0          1.0       13.0
198  Takeout Available                              1.0        2.0         7.0         1.0
         1.0            29.0          1.0       10.0
199  Walk                                           1.0        1.0         7.0         1.0
         1.0             1.0          1.0        1.0
200  Weekend Brunch                                 1.0        1.0        89.0        27.0
         1.0             1.0          1.0        1.0
201  Weekend Dining                                 1.0        4.0         1.0         1.0
         1.0            16.0          3.0        4.0
202  Weekend Jazz Brunch                            1.0        1.0         1.0        14.0
         1.0             1.0          1.0        1.0
203  Weekend Lunch                                  1.0        1.0         1.0         4.0
         1.0             1.0          1.0        6.0
204  [total]                                       53.0       56.0       251.0       135.0
        74.0           275.0         43.0       89.0



208  Time taken to build model: 0 seconds

210  === Stratified cross-validation ===
211  === Summary ===

213  Correctly Classified Instances         620               69.1964 %
214  Incorrectly Classified Instances       276               30.8036 %
215  Kappa statistic                          0.5134
216  Mean absolute error                      0.1086
217  Root mean squared error                  0.2384
218  Relative absolute error                 61.6621 %
219  Root relative squared error             80.419  %
220  Total Number of Instances              896

222  === Detailed Accuracy By Class ===

224              TP Rate   FP Rate   Precision   Recall   F-Measure   ROC Area   Class
225                0        0.001       0          0         0          0.851     atlanta
226                0        0.001       0          0         0          0.832     boston
227              0.805      0.125     0.691      0.805      0.744       0.901     chicago
228              0.221      0.004     0.885      0.221      0.354       0.849     los_angeles
229              0.37       0.011     0.654      0.37       0.472       0.865     new_orleans
230              0.937      0.352     0.692      0.937      0.796       0.872     new_york
231                0        0           0          0         0          0.682     san_francisco
232              0.179      0.01      0.556      0.179      0.27        0.874     washington_dc
233  Weighted Avg.  0.692   0.195     0.666      0.692      0.638       0.873

235  === Confusion Matrix ===

237     a    b    c    d    e    f    g    h    <-- classified as
238     0    0    7    1    0    9    0    1 |    a = atlanta
239     0    0    4    0    4   15    0    0 |    b = boston
240     1    0  186    0    1   42    0    1 |    c = chicago
241     0    1   36   23    0   41    0    3 |    d = los_angeles
242     0    0    6    0   17   23    0    0 |    e = new_orleans
243     0    0   21    0    4  384    0    1 |    f = new_york
244     0    0    1    0    0    5    0    2 |    g = san_francisco
245     0    0    8    2    0   36    0   10 |    h = washington_dc
```

Listing 1: Task vii NaiveBayes Output

```
1  Scheme:weka.classifiers.trees.J48 -C 0.25 -M 2
2  Relation:      Europe-city
3  Instances:     896
4  Attributes:    5
5             atmosphere
6             style
7             price
```

```
 8                   occasion
 9                   city
10  Test mode:10−fold cross−validation
11
12  ═══ Classifier model (full training set) ═══
13
14  J48 pruned tree
15  ──────────────────
16
17  occasion = Game: new_york (32.18/6.08)
18  occasion = After Hours Dining: los_angeles (1.29/0.28)
19  occasion = Catering for Special Events
20  |    style = A: boston (0.06/0.03)
21  |    style = Southern: atlanta (0.0)
22  |    style = French: atlanta (10.82/3.72)
23  |    style = Japanese: atlanta (0.0)
24  |    style = Southwestern: atlanta (0.0)
25  |    style = Swiss: new_york (0.12/0.03)
26  |    style = Asian: atlanta (0.0)
27  |    style = Southeast Asian: atlanta (0.0)
28  |    style = International: atlanta (0.0)
29  |    style = Southern Comfort: atlanta (0.0)
30  |    style = Deli: atlanta (0.0)
31  |    style = Kosher: atlanta (0.0)
32  |    style = Afghanistan: atlanta (0.0)
33  |    style = Argentinean: new_york (0.06/0.02)
34  |    style = Eclectic: atlanta (0.0)
35  |    style = Continental: boston (1.88/0.88)
36  |    style = Bakeries: atlanta (0.0)
37  |    style = Belgian: atlanta (0.0)
38  |    style = Brasserie: atlanta (0.0)
39  |    style = Cab: chicago (0.76/0.31)
40  |    style = CafeEspresso Bars: atlanta (0.0)
41  |    style = Cafeterias: atlanta (0.0)
42  |    style = Californian: atlanta (0.0)
43  |    style = Wine and Beer: washington_dc (1.76/0.7)
44  |    style = Carry in Wine and Beer: atlanta (0.0)
45  |    style = Caviar: atlanta (0.0)
46  |    style = Central: atlanta (0.0)
47  |    style = Coffee Houses: atlanta (0.0)
48  |    style = Coffee Shops: new_york (0.06/0.02)
49  |    style = Coffeehouses: atlanta (0.0)
50  |    style = Czech: new_york (0.06/0.02)
51  |    style = Diners: atlanta (0.0)
52  |    style = Down–Home: atlanta (0.0)
53  |    style = Eastern European: atlanta (0.0)
54  |    style = Egyptian: atlanta (0.0)
55  |    style = English: atlanta (0.0)
56  |    style = Fast Food: atlanta (0.0)
57  |    style = Fondue: atlanta (0.0)
58  |    style = Franco−Russian: atlanta (0.0)
59  |    style = Frankfurters: atlanta (0.0)
60  |    style = French−Japanese: atlanta (0.0)
61  |    style = Grills: atlanta (0.0)
62  |    style = Guatemalan: atlanta (0.0)
63  |    style = Hamburgers: atlanta (0.0)
64  |    style = Health Food: atlanta (0.0)
65  |    style = High Tea: new_york (0.06/0.02)
66  |    style = Jewish: new_york (0.12/0.03)
67  |    style = Latin: washington_dc (1.76/0.7)
68  |    style = Lithuanian: atlanta (0.0)
69  |    style = Middle Eastern: atlanta (0.0)
70  |    style = N: atlanta (0.0)
71  |    style = Nicaraguan: atlanta (0.0)
72  |    style = Noodle Houses: atlanta (0.0)
73  |    style = Noodle Shops: atlanta (0.0)
74  |    style = Omelettes: atlanta (0.0)
75  |    style = Oyster Bars: atlanta (0.0)
76  |    style = Pancakes: atlanta (0.0)
77  |    style = Pastries: atlanta (0.0)
78  |    style = Pastry Shops: atlanta (0.0)
79  |    style = Pizza: washington_dc (7.29/3.03)
80  |    style = Pizzerias: atlanta (0.0)
81  |    style = Po Boys: atlanta (0.0)
82  |    style = Power Brokers: washington_dc (2.0/0.93)
83  |    style = Roumanian: atlanta (0.0)
```

```
84 |     style = Russian: new_york (0.06/0.02)
85 |     style = Salvadoran: atlanta (0.0)
86 |     style = Scottish: atlanta (0.0)
87 |     style = Soul Food: atlanta (0.0)
88 |     style = Soulfood: atlanta (0.0)
89 |     style = Steakhouses: atlanta (0.0)
90 |     style = Swiss−French: atlanta (0.0)
91 |     style = Tacos: atlanta (0.0)
92 |     style = Traditional: atlanta (2.76/1.48)
93 |     style = Ukrainian: atlanta (0.0)
94 |     style = Ukranian: atlanta (0.0)
95 |     style = Venezuelan: atlanta (0.0)
96 |     style = Yogurt Bar: atlanta (0.0)
97 |     style = Yugoslavian: atlanta (0.0)
98 occasion = Dancing: los_angeles (7.72/3.69)
99 occasion = Delivery Available: atlanta (1.29/0.29)
100 occasion = Dining After the Theater: new_york (0.0)
101 occasion = Dining Outdoors: new_york (100.41/44.36)
102 occasion = Early Dining: new_york (0.0)
103 occasion = Entertainment: new_york (96.55/47.23)
104 occasion = Fine for Dining Alone: new_york (16.74/4.56)
105 occasion = Great Place to Meet for a Drink: new_york (2.57/0.09)
106 occasion = Happy Hour: boston (1.29/0.28)
107 occasion = Late Night Menu: new_york (63.08/16.11)
108 occasion = Long Drive: chicago (16.74/3.46)
109 occasion = Margaritas: new_york (0.0)
110 occasion = Menus in Braille: new_york (5.15/0.17)
111 occasion = Open for Breakfast: new_york (23.17/11.78)
112 occasion = Open on Mondays: new_york (0.0)
113 occasion = Open on Sundays: new_orleans (12.87/2.77)
114 occasion = Other Quick Food: new_york (0.0)
115 occasion = Parties and Occasions: los_angeles (2.57/0.56)
116 occasion = Picnics: los_angeles (6.44/1.41)
117 occasion = Pre−theater Dining: new_york (3.86/1.13)
118 occasion = Private Parties
119 |     price = 15−30: new_orleans (10.93/2.81)
120 |     price = 30−50: new_york (1.36/0.02)
121 |     price = below 15: boston (3.07/1.05)
122 |     price = over 50: new_york (0.09)
123 occasion = Private Rooms Available: chicago (99.13/50.47)
124 occasion = Prix Fixe Menus: new_york (38.62/6.29)
125 occasion = See the Game: new_york (0.0)
126 occasion = Short Drive: chicago (14.16/3.92)
127 occasion = Special Brunch Menu: new_york (37.33/15.25)
128 occasion = Takeout Available
129 |     price = 15−30
130 |     |     atmosphere = An Historic Spot: new_york (0.0)
131 |     |     atmosphere = An Out Of The Way Find: new_york (0.0)
132 |     |     atmosphere = Authentic: new_york (0.0)
133 |     |     atmosphere = Buffet Dining: new_york (0.0)
134 |     |     atmosphere = Business Scene: new_york (0.0)
135 |     |     atmosphere = CafeGarden Dining: new_york (0.0)
136 |     |     atmosphere = Classic Hotel Dining: new_york (0.0)
137 |     |     atmosphere = Creative: new_york (0.0)
138 |     |     atmosphere = Credit cards are not accepted: new_york (0.0)
139 |     |     atmosphere = Excellent Decor: washington_dc (7.33/1.26)
140 |     |     atmosphere = Excellent Food: new_york (0.0)
141 |     |     atmosphere = Excellent Service: new_york (0.0)
142 |     |     atmosphere = Extraordinary Decor: washington_dc (3.19/0.19)
143 |     |     atmosphere = Extraordinary Food: new_york (0.0)
144 |     |     atmosphere = Extraordinary Service: new_york (0.0)
145 |     |     atmosphere = Fabulous Views: new_york (0.0)
146 |     |     atmosphere = Fabulous Wine Lists: new_york (0.0)
147 |     |     atmosphere = Fair Decor: new_york (2.57/1.06)
148 |     |     atmosphere = Fair Food: new_york (0.0)
149 |     |     atmosphere = Fair Service: new_york (0.0)
150 |     |     atmosphere = Focus on Dessert: new_york (0.0)
151 |     |     atmosphere = For the Young and Young at Heart: new_york (0.0)
152 |     |     atmosphere = Good Decor: new_york (15.99/3.01)
153 |     |     atmosphere = Good Food: new_york (0.0)
154 |     |     atmosphere = Good Out of Town Business: new_york (0.0)
155 |     |     atmosphere = Good Service: new_york (0.0)
156 |     |     atmosphere = Good for Younger Kids: new_york (0.0)
157 |     |     atmosphere = Great for People Watching: new_york (0.0)
158 |     |     atmosphere = Health Conscious Menus: new_york (0.0)
159 |     |     atmosphere = Hip Place To Be: new_york (0.0)
```

```
|   |      atmosphere = Little Known But Well Liked: new_york (0.0)
|   |      atmosphere = Near−perfect Decor: new_york (0.0)
|   |      atmosphere = Near−perfect Food: new_york (0.0)
|   |      atmosphere = Near−perfect Service: new_york (0.0)
|   |      atmosphere = Need To Dress: new_york (0.0)
|   |      atmosphere = No Liquor Served: new_york (0.0)
|   |      atmosphere = No Reservations: new_york (0.0)
|   |      atmosphere = No Smoking Allowed: new_york (0.0)
|   |      atmosphere = Old World Cafe Charm: new_york (0.0)
|   |      atmosphere = On the Beach: new_york (0.0)
|   |      atmosphere = ParkingValet: new_york (0.0)
|   |      atmosphere = People Keep Coming Back: new_york (0.0)
|   |      atmosphere = Place for Singles: new_york (0.0)
|   |      atmosphere = Poor Decor: new_york (0.0)
|   |      atmosphere = Pub Feel: new_york (0.0)
|   |      atmosphere = Quiet for Conversation: new_york (0.0)
|   |      atmosphere = Quirky: new_york (0.0)
|   |      atmosphere = Relaxed Senior Scene: new_york (0.0)
|   |      atmosphere = Romantic: new_york (0.0)
|   |      atmosphere = Singles Scene: new_york (0.0)
|   |      atmosphere = Tourist Appeal: new_york (0.0)
|   |      atmosphere = Up and Coming: new_york (0.0)
|   |      atmosphere = Very Busy − Reservations a Must: new_york (0.0)
|   |      atmosphere = Warm spots by the fire: new_york (0.0)
|   |      atmosphere = Wheelchair Access: new_york (0.0)
|    price = 30−50: new_york (21.99/0.06)
|    price = below 15: chicago (5.25/1.25)
|    price = over 50: new_york (0.32)
occasion = Walk: chicago (7.72/1.59)
occasion = Weekend Brunch
|    price = 15−30: chicago (115.34/39.05)
|    price = 30−50: new_york (16.94/4.16)
|    price = below 15: chicago (13.66/1.66)
|    price = over 50: new_york (0.82)
occasion = Weekend Dining: new_york (29.61/8.99)
occasion = Weekend Jazz Brunch: los_angeles (16.74/3.66)
occasion = Weekend Lunch: washington_dc (10.3/5.28)

Number of Leaves  :    175

Size of the tree :   181


Time taken to build model: 0.03 seconds

=== Stratified cross−validation ===
=== Summary ===

Correctly Classified Instances          626               69.8661 %
Incorrectly Classified Instances        270               30.1339 %
Kappa statistic                           0.5251
Mean absolute error                       0.1273
Root mean squared error                   0.248
Relative absolute error                  72.2554 %
Root relative squared error              83.6457 %
Total Number of Instances               896

=== Detailed Accuracy By Class ===
```

	TP Rate	FP Rate	Precision	Recall	F−Measure	ROC Area	Class
	0.333	0.011	0.375	0.333	0.353	0.806	atlanta
	0	0.001	0	0	0	0.705	boston
	0.727	0.098	0.721	0.727	0.724	0.865	chicago
	0.221	0.01	0.742	0.221	0.341	0.76	los_angeles
	0.391	0.004	0.857	0.391	0.537	0.776	new_orleans
	0.963	0.36	0.693	0.963	0.806	0.83	new_york
	0	0	0	0	0	0.597	san_francisco
	0.286	0.01	0.667	0.286	0.4	0.788	washington_dc
Weighted Avg.	0.699	0.192	0.682	0.699	0.655	0.82	

```
=== Confusion Matrix ===

    a   b   c   d   e   f   g   h   <−− classified as
    6   0   1   1   0   7   0   3 |   a = atlanta
    1   0   0   1   3  18   0   0 |   b = boston
    2   0 168   2   0  59   0   0 |   c = chicago
```

```
236    0    0   40   23    0   38    0    3 |    d = los_angeles
237    0    1    4    0   18   23    0    0 |    e = new_orleans
238    0    0   12    1    0  395    0    2 |    f = new_york
239    2    0    2    0    0    4    0    0 |    g = san_francisco
240    5    0    6    3    0   26    0   16 |    h = washington_dc
```

Listing 2: Task vii J48 Output

Task viii

Finally, given that a user likes a specific continent food and provides the feature set
(you can limit these if you like), you should have rules to determine which restaurant
they should visit for each city.

Results

Assumptions

1. The user lies Europe food. The features he likes are: Atmosphere: Excellent Decor, Style: "French", Price: "15−30",
   Occasion: "Catering for Special Events"

2. Weka was used and method of decision trees (J48) was employed to determine the rules.

The perl code used to generate the arff file is seen in listing 7 and the results are seen in listing 3

```
1  1. Atlanta : The  user  should  go  to  the    0 0 0 0 0 1 4   Le  Rendez−V o u s    restaurant .
2  === Run information ===
3
4  Scheme : weka . c l a s s i f i e r s . t r e e s . J48 −C 0.25 −M 2
5  Relation :       city−res
6  Instances :      18
7  Attributes :     5
8                  restaurant
9                  atmosphere
10                 style
11                 price
12                 occasion
13 Test mode : evaluate on training data
14
15 === Classifier model ( full training set ) ===
16
17 J48 pruned tree
18 ------------------
19
20 atmosphere = An Historic Spot : 0000011 (0.0)
21 atmosphere = An Out Of The Way Find : 0000011 (0.0)
22 atmosphere = Authentic : 0000011 (0.0)
23 atmosphere = Buffet Dining : 0000011 (0.0)
24 atmosphere = Business Scene : 0000011 (0.0)
25 atmosphere = CafeGarden Dining : 0000011 (0.0)
26 atmosphere = Classic Hotel Dining : 0000011 (0.0)
27 atmosphere = Creative : 0000011 (0.0)
28 atmosphere = Credit cards are not accepted : 0000011 (0.0)
29 atmosphere = Excellent Decor : 0000014 (9.0/8.0)
30 atmosphere = Excellent Food : 0000011 (0.0)
31 atmosphere = Excellent Service : 0000011 (0.0)
32 atmosphere = Extraordinary Decor
33 |    price = 15−30: 0000011 (2.0/1.0)
34 |    price = 30−50: 0000169 (3.0/2.0)
35 |    price = below 15: 0000011 (0.0)
36 |    price = over 50: 0000011 (0.0)
37 atmosphere = Extraordinary Food : 0000011 (0.0)
38 atmosphere = Extraordinary Service : 0000011 (0.0)
39 atmosphere = Fabulous Views : 0000011 (0.0)
40 atmosphere = Fabulous Wine Lists : 0000011 (0.0)
41 atmosphere = Fair Decor : 0000093 (2.0/1.0)
42 atmosphere = Fair Food : 0000011 (0.0)
43 atmosphere = Fair Service : 0000011 (0.0)
44 atmosphere = Focus on Dessert : 0000011 (0.0)
45 atmosphere = For the Young and Young at Heart : 0000011 (0.0)
46 atmosphere = Good Decor : 0000236 (2.0/1.0)
47 atmosphere = Good Food : 0000011 (0.0)
48 atmosphere = Good Out of Town Business : 0000011 (0.0)
49 atmosphere = Good Service : 0000011 (0.0)
50 atmosphere = Good for Younger Kids : 0000011 (0.0)
51 atmosphere = Great for People Watching : 0000011 (0.0)
52 atmosphere = Health Conscious Menus : 0000011 (0.0)
53 atmosphere = Hip Place To Be : 0000011 (0.0)
54 atmosphere = Little Known But Well Liked : 0000011 (0.0)
55 atmosphere = Near−perfect Decor : 0000011 (0.0)
56 atmosphere = Near−perfect Food : 0000011 (0.0)
57 atmosphere = Near−perfect Service : 0000011 (0.0)
```

```
58  atmosphere = Need To Dress: 0000011 (0.0)
59  atmosphere = No Liquor Served: 0000011 (0.0)
60  atmosphere = No Reservations: 0000011 (0.0)
61  atmosphere = No Smoking Allowed: 0000011 (0.0)
62  atmosphere = Old World Cafe Charm: 0000011 (0.0)
63  atmosphere = On the Beach: 0000011 (0.0)
64  atmosphere = ParkingValet: 0000011 (0.0)
65  atmosphere = People Keep Coming Back: 0000011 (0.0)
66  atmosphere = Place for Singles: 0000011 (0.0)
67  atmosphere = Poor Decor: 0000011 (0.0)
68  atmosphere = Pub Feel: 0000011 (0.0)
69  atmosphere = Quiet for Conversation: 0000011 (0.0)
70  atmosphere = Quirky: 0000011 (0.0)
71  atmosphere = Relaxed Senior Scene: 0000011 (0.0)
72  atmosphere = Romantic: 0000011 (0.0)
73  atmosphere = Singles Scene: 0000011 (0.0)
74  atmosphere = Tourist Appeal: 0000011 (0.0)
75  atmosphere = Up and Coming: 0000011 (0.0)
76  atmosphere = Very Busy - Reservations a Must: 0000011 (0.0)
77  atmosphere = Warm spots by the fire: 0000011 (0.0)
78  atmosphere = Wheelchair Access: 0000011 (0.0)
79
80  Number of Leaves  :    58
81
82  Size of the tree :   60
83
84
85  Time taken to build model: 0 seconds
86
87  === Evaluation on training set ===
88  === Summary ===
89
90  Correctly Classified Instances          5               27.7778 %
91  Incorrectly Classified Instances        13              72.2222 %
92  Kappa statistic                         0.2353
93  Mean absolute error                     0.0802
94  Root mean squared error                 0.2003
95  Relative absolute error                 76.4706 %
96  Root relative squared error             87.4475 %
97  Total Number of Instances               18
98
99  === Detailed Accuracy By Class ===
100         TP Rate   FP Rate   Precision   Recall   F-Measure   ROC Area   Class
101                   1         0.059       0.5      1           0.667      0.971      0000011
102                   1         0.471       0.111    1           0.2        0.765      0000014
103                   0         0           0        0           0          0.765      0000050
104                   0         0           0        0           0          0.765      0000052
105                   0         0           0        0           0          0.765      0000054
106                   0         0           0        0           0          0.765      0000062
107                   0         0           0        0           0          0.765      0000085
108                   1         0.059       0.5      1           0.667      0.971      0000093
109                   0         0           0        0           0          0.765      0000125
110                   0         0           0        0           0          0.971      0000149
111                   0         0           0        0           0          0.971      0000163
112                   1         0.118       0.333    1           0.5        0.941      0000169
113                   0         0           0        0           0          0.765      0000185
114                   0         0           0        0           0          0.941      0000200
115                   0         0           0        0           0          0.765      0000213
116                   0         0           0        0           0          0.941      0000230
117                   1         0.059       0.5      1           0.667      0.971      0000236
118                   0         0           0        0           0          0.971      0000264
119  Weighted Avg.    0.278     0.042       0.108    0.278       0.15       0.863
120
121  === Confusion Matrix ===
122
123   a b c d e f g h i j k l m n o p q r   <-- classified as
124   1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  a = 0000011
125   0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  b = 0000014
126   0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  c = 0000050
127   0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  d = 0000052
128   0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  e = 0000054
129   0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  f = 0000062
130   0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  g = 0000085
131   0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 |  h = 0000093
132   0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  i = 0000125
133   0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 |  j = 0000149
```

```
134   1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  k = 0000163
135   0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 |  l = 0000169
136   0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  m = 0000185
137   0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 |  n = 0000200
138   0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  o = 0000213
139   0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 |  p = 0000230
140   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 |  q = 0000236
141   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 |  r = 0000264
```

=== Re-evaluation on test set ===

User supplied test set
Relation: Europe-city
Instances: unknown (yet). Reading incrementally
Attributes: 5

=== Predictions on test set ===

inst#,   actual, predicted, error, probability distribution
     1   ? 2:0000014   +   0   *0.111   0.111   0.111   0.111   0.111   0.111   0   0.111   0
                  0   0   0.111 0   0.111 0   0   0

=== Summary ===

Total Number of Instances   0
Ignored Class Unknown Instances   1

=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0	0	0	0	0	?	0000011
	0	0	0	0	0	?	0000014
	0	0	0	0	0	?	0000050
	0	0	0	0	0	?	0000052
	0	0	0	0	0	?	0000054
	0	0	0	0	0	?	0000062
	0	0	0	0	0	?	0000085
	0	0	0	0	0	?	0000093
	0	0	0	0	0	?	0000125
	0	0	0	0	0	?	0000149
	0	0	0	0	0	?	0000163
	0	0	0	0	0	?	0000169
	0	0	0	0	0	?	0000185
	0	0	0	0	0	?	0000200
	0	0	0	0	0	?	0000213
	0	0	0	0	0	?	0000230
	0	0	0	0	0	?	0000236
	0	0	0	0	0	?	0000264
Weighted Avg.	NaN	NaN	NaN	NaN	NaN	NaN	

=== Confusion Matrix ===

```
186   a b c d e f g h i j k l m n o p q r   <-- classified as
187   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  a = 0000011
188   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  b = 0000014
189   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  c = 0000050
190   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  d = 0000052
191   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  e = 0000054
192   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  f = 0000062
193   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  g = 0000085
194   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  h = 0000093
195   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  i = 0000125
196   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  j = 0000149
197   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  k = 0000163
198   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  l = 0000169
199   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  m = 0000185
200   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  n = 0000200
201   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  o = 0000213
202   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  p = 0000230
203   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  q = 0000236
204   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  r = 0000264
```

2. Boston
The user should go to 0000108 Alexander's   restaurant.
=== Run information ===

```
209
210  Scheme: weka.classifiers.trees.J48 -C 0.25 -M 2
211  Relation:      boston-res
212  Instances:     23
213  Attributes:    5
214                 restaurant
215                 atmosphere
216                 style
217                 price
218                 occasion
219  Test mode: evaluate on training data
220
221  === Classifier model (full training set) ===
222
223  J48 pruned tree
224  ------------------
225
226  atmosphere = An Historic Spot: 0000006 (0.0)
227  atmosphere = An Out Of The Way Find: 0000006 (0.0)
228  atmosphere = Authentic: 0000006 (0.0)
229  atmosphere = Buffet Dining: 0000006 (0.0)
230  atmosphere = Business Scene: 0000006 (0.0)
231  atmosphere = CafeGarden Dining: 0000006 (0.0)
232  atmosphere = Classic Hotel Dining: 0000006 (0.0)
233  atmosphere = Creative: 0000006 (0.0)
234  atmosphere = Credit cards are not accepted: 0000006 (0.0)
235  atmosphere = Excellent Decor: 0000108 (2.0/1.0)
236  atmosphere = Excellent Food: 0000006 (0.0)
237  atmosphere = Excellent Service: 0000006 (0.0)
238  atmosphere = Extraordinary Decor: 0000143 (2.0/1.0)
239  atmosphere = Extraordinary Food: 0000006 (0.0)
240  atmosphere = Extraordinary Service: 0000006 (0.0)
241  atmosphere = Fabulous Views: 0000006 (0.0)
242  atmosphere = Fabulous Wine Lists: 0000006 (0.0)
243  atmosphere = Fair Decor: 0000313 (2.0/1.0)
244  atmosphere = Fair Food: 0000006 (0.0)
245  atmosphere = Fair Service: 0000006 (0.0)
246  atmosphere = Focus on Dessert: 0000006 (0.0)
247  atmosphere = For the Young and Young at Heart: 0000006 (0.0)
248  atmosphere = Good Decor
249  |    price = 15-30: 0000009 (11.0/10.0)
250  |    price = 30-50: 0000006 (0.0)
251  |    price = below 15: 0000006 (5.0/4.0)
252  |    price = over 50: 0000006 (0.0)
253  atmosphere = Good Food: 0000006 (0.0)
254  atmosphere = Good Out of Town Business: 0000006 (0.0)
255  atmosphere = Good Service: 0000006 (0.0)
256  atmosphere = Good for Younger Kids: 0000006 (0.0)
257  atmosphere = Great for People Watching: 0000006 (0.0)
258  atmosphere = Health Conscious Menus: 0000006 (0.0)
259  atmosphere = Hip Place To Be: 0000006 (0.0)
260  atmosphere = Little Known But Well Liked: 0000006 (0.0)
261  atmosphere = Near-perfect Decor: 0000006 (0.0)
262  atmosphere = Near-perfect Food: 0000006 (0.0)
263  atmosphere = Near-perfect Service: 0000006 (0.0)
264  atmosphere = Need To Dress: 0000006 (0.0)
265  atmosphere = No Liquor Served: 0000006 (0.0)
266  atmosphere = No Reservations: 0000006 (0.0)
267  atmosphere = No Smoking Allowed: 0000006 (0.0)
268  atmosphere = Old World Cafe Charm: 0000006 (0.0)
269  atmosphere = On the Beach: 0000006 (0.0)
270  atmosphere = ParkingValet: 0000006 (0.0)
271  atmosphere = People Keep Coming Back: 0000006 (0.0)
272  atmosphere = Place for Singles: 0000006 (0.0)
273  atmosphere = Poor Decor: 0000208 (1.0)
274  atmosphere = Pub Feel: 0000006 (0.0)
275  atmosphere = Quiet for Conversation: 0000006 (0.0)
276  atmosphere = Quirky: 0000006 (0.0)
277  atmosphere = Relaxed Senior Scene: 0000006 (0.0)
278  atmosphere = Romantic: 0000006 (0.0)
279  atmosphere = Singles Scene: 0000006 (0.0)
280  atmosphere = Tourist Appeal: 0000006 (0.0)
281  atmosphere = Up and Coming: 0000006 (0.0)
282  atmosphere = Very Busy - Reservations a Must: 0000006 (0.0)
283  atmosphere = Warm spots by the fire: 0000006 (0.0)
284  atmosphere = Wheelchair Access: 0000006 (0.0)
```

```
Number of Leaves  :     58

Size of the tree :   60


Time taken to build model: 0.01 seconds

=== Evaluation on training set ===
=== Summary ===

Correctly Classified Instances           6                     26.087  %
Incorrectly Classified Instances        17                     73.913  %
Kappa statistic                          0.2273
Mean absolute error                      0.0643
Root mean squared error                  0.1793
Relative absolute error                 77.2727 %
Root relative squared error             87.9049 %
Total Number of Instances               23

=== Detailed Accuracy By Class ===

                 TP Rate    FP Rate   Precision   Recall   F-Measure   ROC Area   Class
                   1         0.182       0.2        1         0.333      0.909     0000006
                   1         0.455       0.091      1         0.167      0.773     0000009
                   0         0           0          0         0          0.773     0000054
                   0         0           0          0         0          0.773     0000056
                   0         0           0          0         0          0.909     0000101
                   1         0.045       0.5        1         0.667      0.977     0000108
                   0         0           0          0         0          0.773     0000114
                   1         0.045       0.5        1         0.667      0.977     0000143
                   0         0           0          0         0          0.773     0000146
                   0         0           0          0         0          0.977     0000198
                   0         0           0          0         0          0.773     0000206
                   1         0           1          1         1          1         0000208
                   0         0           0          0         0          0.773     0000211
                   0         0           0          0         0          0.773     0000224
                   0         0           0          0         0          0.909     0000309
                   1         0.045       0.5        1         0.667      0.977     0000313
                   0         0           0          0         0          0.977     0000321
                   0         0           0          0         0          0.909     0000353
                   0         0           0          0         0          0.773     0000356
                   0         0           0          0         0          0.773     0000370
                   0         0           0          0         0          0.773     0000409
                   0         0           0          0         0          0.977     0000417
                   0         0           0          0         0          0.909     0000432
Weighted Avg.      0.261     0.034       0.121      0.261     0.152      0.866

=== Confusion Matrix ===

 a b c d e f g h i j k l m n o p q r s t u v w   <-- classified as
 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  a = 0000006
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  b = 0000009
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  c = 0000054
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  d = 0000056
 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  e = 0000101
 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  f = 0000108
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  g = 0000114
 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  h = 0000143
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  i = 0000146
 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  j = 0000198
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  k = 0000206
 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 |  l = 0000208
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  m = 0000211
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  n = 0000224
 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  o = 0000309
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 |  p = 0000313
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 |  q = 0000321
 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  r = 0000353
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  s = 0000356
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  t = 0000370
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  u = 0000409
 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  v = 0000417
 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  w = 0000432
```

```
=== Re-evaluation on test set ===

User supplied test set
Relation:      boston-res
Instances:     unknown (yet). Reading incrementally
Attributes:    5

=== Predictions on test set ===

inst#,    actual, predicted, error, probability distribution
    1            ?  6:0000108        +   0       0       0       0       0     *0.5      0       0       0       0
                 0       0       0       0       0       0       0       0       0       0       0     0.5      0

=== Summary ===

Total Number of Instances                0
Ignored Class Unknown Instances          1

=== Detailed Accuracy By Class ===
```

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0	0	0	0	0	?	0000006
	0	0	0	0	0	?	0000009
	0	0	0	0	0	?	0000054
	0	0	0	0	0	?	0000056
	0	0	0	0	0	?	0000101
	0	0	0	0	0	?	0000108
	0	0	0	0	0	?	0000114
	0	0	0	0	0	?	0000143
	0	0	0	0	0	?	0000146
	0	0	0	0	0	?	0000198
	0	0	0	0	0	?	0000206
	0	0	0	0	0	?	0000208
	0	0	0	0	0	?	0000211
	0	0	0	0	0	?	0000224
	0	0	0	0	0	?	0000309
	0	0	0	0	0	?	0000313
	0	0	0	0	0	?	0000321
	0	0	0	0	0	?	0000353
	0	0	0	0	0	?	0000356
	0	0	0	0	0	?	0000370
	0	0	0	0	0	?	0000409
	0	0	0	0	0	?	0000417
	0	0	0	0	0	?	0000432
Weighted Avg.	NaN	NaN	NaN	NaN	NaN	NaN	

```
=== Confusion Matrix ===

 a b c d e f g h i j k l m n o p q r s t u v w   <-- classified as
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  a = 0000006
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  b = 0000009
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  c = 0000054
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  d = 0000056
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  e = 0000101
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  f = 0000108
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  g = 0000114
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  h = 0000143
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  i = 0000146
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  j = 0000198
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  k = 0000206
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  l = 0000208
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  m = 0000211
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  n = 0000224
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  o = 0000309
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  p = 0000313
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  q = 0000321
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  r = 0000353
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  s = 0000356
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  t = 0000370
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  u = 0000409
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  v = 0000417
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |  w = 0000432

3. Chicago:
The user should go to  0000534  Convito Italiano   restaurant.
=== Run information ===
```

```
436
437  Scheme:weka.classifiers.trees.J48 -C 0.25 -M 2
438  Relation:     city-res
439  Instances:    231
440  Attributes:   5
441                restaurant
442                atmosphere
443                style
444                price
445                occasion
446  Test mode:evaluate on training data
447
448  === Classifier model (full training set) ===
449
450  J48 pruned tree
451  ------------------
452
453  atmosphere = An Historic Spot: 0000001 (0.0)
454  atmosphere = An Out Of The Way Find: 0000001 (0.0)
455  atmosphere = Authentic: 0000001 (0.0)
456  atmosphere = Buffet Dining: 0000001 (0.0)
457  atmosphere = Business Scene: 0000001 (0.0)
458  atmosphere = CafeGarden Dining: 0000001 (0.0)
459  atmosphere = Classic Hotel Dining: 0000001 (0.0)
460  atmosphere = Creative: 0000001 (0.0)
461  atmosphere = Credit cards are not accepted: 0000001 (0.0)
462  atmosphere = Excellent Decor
463  |     occasion = Game: 0000011 (0.0)
464  |     occasion = After Hours Dining: 0000011 (0.0)
465  |     occasion = Catering for Special Events: 0000534 (1.06/0.06)
466  |     occasion = Dancing: 0000011 (0.0)
467  |     occasion = Delivery Available: 0000011 (0.0)
468  |     occasion = Dining After the Theater: 0000011 (0.0)
469  |     occasion = Dining Outdoors: 0000046 (11.65/10.65)
470  |     occasion = Early Dining: 0000011 (0.0)
471  |     occasion = Entertainment: 0000125 (4.24/3.24)
472  |     occasion = Fine for Dining Alone: 0000011 (0.0)
473  |     occasion = Great Place to Meet for a Drink: 0000011 (0.0)
474  |     occasion = Happy Hour: 0000011 (0.0)
475  |     occasion = Late Night Menu: 0000011 (0.0)
476  |     occasion = Long Drive: 0000072 (2.12/1.12)
477  |     occasion = Margaritas: 0000011 (0.0)
478  |     occasion = Menus in Braille: 0000011 (0.0)
479  |     occasion = Open for Breakfast: 0000011 (0.0)
480  |     occasion = Open on Mondays: 0000011 (0.0)
481  |     occasion = Open on Sundays: 0000011 (0.0)
482  |     occasion = Other Quick Food: 0000011 (0.0)
483  |     occasion = Parties and Occasions: 0000011 (0.0)
484  |     occasion = Picnics: 0000011 (0.0)
485  |     occasion = Pre-theater Dining: 0000011 (0.0)
486  |     occasion = Private Parties: 0000011 (0.0)
487  |     occasion = Private Rooms Available: 0000014 (22.25/21.25)
488  |     occasion = Prix Fixe Menus: 0000127 (3.18/2.18)
489  |     occasion = See the Game: 0000011 (0.0)
490  |     occasion = Short Drive: 0000083 (1.06/0.06)
491  |     occasion = Special Brunch Menu: 0000011 (0.0)
492  |     occasion = Takeout Available: 0000011 (0.0)
493  |     occasion = Walk: 0000011 (0.0)
494  |     occasion = Weekend Brunch: 0000011 (43.44/42.44)
495  |     occasion = Weekend Dining: 0000011 (0.0)
496  |     occasion = Weekend Jazz Brunch: 0000011 (0.0)
497  |     occasion = Weekend Lunch: 0000011 (0.0)
498  atmosphere = Excellent Food: 0000001 (0.0)
499  atmosphere = Excellent Service: 0000001 (0.0)
500  atmosphere = Extraordinary Decor
501  |     occasion = Game: 0000001 (0.0)
502  |     occasion = After Hours Dining: 0000001 (0.0)
503  |     occasion = Catering for Special Events: 0000001 (0.0)
504  |     occasion = Dancing: 0000001 (0.0)
505  |     occasion = Delivery Available: 0000001 (0.0)
506  |     occasion = Dining After the Theater: 0000001 (0.0)
507  |     occasion = Dining Outdoors
508  |     |     price = 15-30: 0000299 (2.17/1.17)
509  |     |     price = 30-50: 0000223 (3.17/2.17)
510  |     |     price = below 15: 0000223 (0.0)
511  |     |     price = over 50: 0000223 (0.0)
```

29

```
512 |      occasion = Early  Dining:  0000001  (0.0)
513 |      occasion = Entertainment:  0000169  (2.13/1.13)
514 |      occasion = Fine  for  Dining  Alone:  0000001  (0.0)
515 |      occasion = Great  Place  to  Meet  for  a  Drink:  0000001  (0.0)
516 |      occasion = Happy  Hour:  0000001  (0.0)
517 |      occasion = Late  Night  Menu:  0000001  (0.0)
518 |      occasion = Long  Drive:  0000123  (2.13/1.13)
519 |      occasion = Margaritas:  0000001  (0.0)
520 |      occasion = Menus  in  Braille:  0000001  (0.0)
521 |      occasion = Open  for  Breakfast:  0000001  (0.0)
522 |      occasion = Open  on  Mondays:  0000001  (0.0)
523 |      occasion = Open  on  Sundays:  0000001  (0.0)
524 |      occasion = Other  Quick  Food:  0000001  (0.0)
525 |      occasion = Parties  and  Occasions:  0000001  (0.0)
526 |      occasion = Picnics:  0000001  (0.0)
527 |      occasion = Pre-theater  Dining:  0000001  (0.0)
528 |      occasion = Private  Parties:  0000001  (0.0)
529 |      occasion = Private  Rooms  Available
530 |      |     price = 15-30:  0000001  (6.37/5.37)
531 |      |     price = 30-50:  0000242  (5.37/4.37)
532 |      |     price = below  15:  0000001  (0.0)
533 |      |     price = over  50:  0000001  (0.0)
534 |      occasion = Prix  Fixe  Menus:  0000001  (0.0)
535 |      occasion = See  the  Game:  0000001  (0.0)
536 |      occasion = Short  Drive:  0000001  (0.0)
537 |      occasion = Special  Brunch  Menu:  0000001  (0.0)
538 |      occasion = Takeout  Available:  0000001  (0.0)
539 |      occasion = Walk
540 |      |     price = 15-30:  0000047  (2.17/1.17)
541 |      |     price = 30-50:  0000283  (3.17/2.17)
542 |      |     price = below  15:  0000047  (0.0)
543 |      |     price = over  50:  0000047  (0.0)
544 |      occasion = Weekend  Brunch:  0000189  (5.33/4.33)
545 |      occasion = Weekend  Dining:  0000001  (0.0)
546 |      occasion = Weekend  Jazz  Brunch:  0000001  (0.0)
547 |      occasion = Weekend  Lunch:  0000001  (0.0)
548 atmosphere = Extraordinary  Food:  0000001  (0.0)
549 atmosphere = Extraordinary  Service:  0000001  (0.0)
550 atmosphere = Fabulous  Views:  0000001  (0.0)
551 atmosphere = Fabulous  Wine  Lists:  0000001  (0.0)
552 atmosphere = Fair  Decor
553 |      occasion = Game:  0000012  (0.0)
554 |      occasion = After  Hours  Dining:  0000012  (0.0)
555 |      occasion = Catering  for  Special  Events:  0000480  (1.0)
556 |      occasion = Dancing:  0000012  (0.0)
557 |      occasion = Delivery  Available:  0000012  (0.0)
558 |      occasion = Dining  After  the  Theater:  0000012  (0.0)
559 |      occasion = Dining  Outdoors:  0000012  (0.0)
560 |      occasion = Early  Dining:  0000012  (0.0)
561 |      occasion = Entertainment:  0000012  (0.0)
562 |      occasion = Fine  for  Dining  Alone:  0000012  (0.0)
563 |      occasion = Great  Place  to  Meet  for  a  Drink:  0000012  (0.0)
564 |      occasion = Happy  Hour:  0000012  (0.0)
565 |      occasion = Late  Night  Menu:  0000012  (0.0)
566 |      occasion = Long  Drive:  0000424  (1.0)
567 |      occasion = Margaritas:  0000012  (0.0)
568 |      occasion = Menus  in  Braille:  0000012  (0.0)
569 |      occasion = Open  for  Breakfast:  0000583  (1.0)
570 |      occasion = Open  on  Mondays:  0000012  (0.0)
571 |      occasion = Open  on  Sundays:  0000012  (0.0)
572 |      occasion = Other  Quick  Food:  0000012  (0.0)
573 |      occasion = Parties  and  Occasions:  0000012  (0.0)
574 |      occasion = Picnics:  0000012  (0.0)
575 |      occasion = Pre-theater  Dining:  0000012  (0.0)
576 |      occasion = Private  Parties:  0000012  (0.0)
577 |      occasion = Private  Rooms  Available:  0000012  (0.0)
578 |      occasion = Prix  Fixe  Menus:  0000012  (0.0)
579 |      occasion = See  the  Game:  0000012  (0.0)
580 |      occasion = Short  Drive:  0000012  (0.0)
581 |      occasion = Special  Brunch  Menu:  0000012  (0.0)
582 |      occasion = Takeout  Available:  0000131  (4.0/3.0)
583 |      occasion = Walk:  0000012  (0.0)
584 |      occasion = Weekend  Brunch:  0000012  (7.0/6.0)
585 |      occasion = Weekend  Dining:  0000012  (0.0)
586 |      occasion = Weekend  Jazz  Brunch:  0000012  (0.0)
587 |      occasion = Weekend  Lunch:  0000012  (0.0)
```

```
588  atmosphere = Fair Food: 0000001 (0.0)
589  atmosphere = Fair Service: 0000001 (0.0)
590  atmosphere = Focus on Dessert: 0000001 (0.0)
591  atmosphere = For the Young and Young at Heart: 0000001 (0.0)
592  atmosphere = Good Decor
593  |    occasion = Game: 0000006 (0.0)
594  |    occasion = After Hours Dining: 0000006 (0.0)
595  |    occasion = Catering for Special Events: 0000006 (0.0)
596  |    occasion = Dancing: 0000006 (0.0)
597  |    occasion = Delivery Available: 0000006 (0.0)
598  |    occasion = Dining After the Theater: 0000006 (0.0)
599  |    occasion = Dining Outdoors: 0000233 (7.66/6.66)
600  |    occasion = Early Dining: 0000006 (0.0)
601  |    occasion = Entertainment: 0000037 (7.66/6.66)
602  |    occasion = Fine for Dining Alone: 0000006 (0.0)
603  |    occasion = Great Place to Meet for a Drink: 0000006 (0.0)
604  |    occasion = Happy Hour: 0000006 (0.0)
605  |    occasion = Late Night Menu: 0000020 (3.28/2.28)
606  |    occasion = Long Drive: 0000039 (8.75/7.75)
607  |    occasion = Margaritas: 0000006 (0.0)
608  |    occasion = Menus in Braille: 0000006 (0.0)
609  |    occasion = Open for Breakfast: 0000006 (0.0)
610  |    occasion = Open on Mondays: 0000006 (0.0)
611  |    occasion = Open on Sundays: 0000006 (0.0)
612  |    occasion = Other Quick Food: 0000006 (0.0)
613  |    occasion = Parties and Occasions: 0000006 (0.0)
614  |    occasion = Picnics: 0000006 (0.0)
615  |    occasion = Pre-theater Dining: 0000006 (0.0)
616  |    occasion = Private Parties: 0000006 (0.0)
617  |    occasion = Private Rooms Available
618  |    |    price = 15-30: 0000134 (12.32/11.32)
619  |    |    price = 30-50: 0000134 (0.0)
620  |    |    price = below 15: 0000315 (3.0/2.0)
621  |    |    price = over 50: 0000134 (0.0)
622  |    occasion = Prix Fixe Menus: 0000006 (0.0)
623  |    occasion = See the Game: 0000006 (0.0)
624  |    occasion = Short Drive: 0000006 (9.85/8.85)
625  |    occasion = Special Brunch Menu: 0000006 (0.0)
626  |    occasion = Takeout Available: 0000452 (2.19/1.19)
627  |    occasion = Walk: 0000006 (0.0)
628  |    occasion = Weekend Brunch
629  |    |    price = 15-30: 0000018 (33.29/32.29)
630  |    |    price = 30-50: 0000018 (0.0)
631  |    |    price = below 15: 0000095 (5.0/4.0)
632  |    |    price = over 50: 0000018 (0.0)
633  |    occasion = Weekend Dining: 0000006 (0.0)
634  |    occasion = Weekend Jazz Brunch: 0000006 (0.0)
635  |    occasion = Weekend Lunch: 0000006 (0.0)
636  atmosphere = Good Food: 0000001 (0.0)
637  atmosphere = Good Out of Town Business: 0000001 (0.0)
638  atmosphere = Good Service: 0000001 (0.0)
639  atmosphere = Good for Younger Kids: 0000001 (0.0)
640  atmosphere = Great for People Watching: 0000001 (0.0)
641  atmosphere = Health Conscious Menus: 0000001 (0.0)
642  atmosphere = Hip Place To Be: 0000001 (0.0)
643  atmosphere = Little Known But Well Liked: 0000001 (0.0)
644  atmosphere = Near-perfect Decor: 0000260 (3.0/2.0)
645  atmosphere = Near-perfect Food: 0000001 (0.0)
646  atmosphere = Near-perfect Service: 0000001 (0.0)
647  atmosphere = Need To Dress: 0000001 (0.0)
648  atmosphere = No Liquor Served: 0000001 (0.0)
649  atmosphere = No Reservations: 0000001 (0.0)
650  atmosphere = No Smoking Allowed: 0000001 (0.0)
651  atmosphere = Old World Cafe Charm: 0000001 (0.0)
652  atmosphere = On the Beach: 0000001 (0.0)
653  atmosphere = ParkingValet: 0000001 (0.0)
654  atmosphere = People Keep Coming Back: 0000001 (0.0)
655  atmosphere = Place for Singles: 0000001 (0.0)
656  atmosphere = Poor Decor: 0000001 (0.0)
657  atmosphere = Pub Feel: 0000001 (0.0)
658  atmosphere = Quiet for Conversation: 0000001 (0.0)
659  atmosphere = Quirky: 0000001 (0.0)
660  atmosphere = Relaxed Senior Scene: 0000001 (0.0)
661  atmosphere = Romantic: 0000001 (0.0)
662  atmosphere = Singles Scene: 0000001 (0.0)
663  atmosphere = Tourist Appeal: 0000001 (0.0)
```

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664  atmosphere = Up and Coming: 0000001 (0.0)
665  atmosphere = Very Busy − Reservations a Must: 0000001 (0.0)
666  atmosphere = Warm spots by the fire: 0000001 (0.0)
667  atmosphere = Wheelchair Access: 0000001 (0.0)
668
669  Number of Leaves  :    206
670
671  Size of the tree :   216
672
673
674  Time taken to build model: 0.02 seconds
675
676  === Evaluation on training set ===
677  === Summary ===
678
679  Correctly Classified Instances          33                 14.2857 %
680  Incorrectly Classified Instances       198                 85.7143 %
681  Kappa statistic                          0.1391
682  Mean absolute error                      0.0075
683  Root mean squared error                  0.0609
684  Relative absolute error                 86.7326 %
685  Root relative squared error             92.8083 %
686  Total Number of Instances              231
687
688  Scheme:weka.classifiers.trees.J48 −C 0.25 −M 2
689  Relation:       city−res
690  Instances:      104
691  Attributes:     5
692                  restaurant
693                  atmosphere
694                  style
695                  price
696                  occasion
697  Test mode:evaluate on training data
698
699  === Classifier model (full training set) ===
700
701  J48 pruned tree
702  ------------------
703
704  atmosphere = An Historic Spot: 0000000 (0.0)
705  atmosphere = An Out Of The Way Find: 0000000 (0.0)
706  atmosphere = Authentic: 0000000 (0.0)
707  atmosphere = Buffet Dining: 0000000 (0.0)
708  atmosphere = Business Scene: 0000000 (0.0)
709  atmosphere = CafeGarden Dining: 0000000 (0.0)
710  atmosphere = Classic Hotel Dining: 0000000 (0.0)
711  atmosphere = Creative: 0000000 (0.0)
712  atmosphere = Credit cards are not accepted: 0000000 (0.0)
713  atmosphere = Excellent Decor
714  |    price = 15−30: 0000000 (43.0/42.0)
715  |    price = 30−50: 0000083 (12.0/11.0)
716  |    price = below 15: 0000000 (0.0)
717  |    price = over 50: 0000000 (0.0)
718  atmosphere = Excellent Food: 0000000 (0.0)
719  atmosphere = Excellent Service: 0000000 (0.0)
720  atmosphere = Extraordinary Decor
721  |    price = 15−30: 0000011 (6.0/5.0)
722  |    price = 30−50: 0000050 (3.0/2.0)
723  |    price = below 15: 0000011 (0.0)
724  |    price = over 50: 0000011 (0.0)
725  atmosphere = Extraordinary Food: 0000000 (0.0)
726  atmosphere = Extraordinary Service: 0000000 (0.0)
727  atmosphere = Fabulous Views: 0000000 (0.0)
728  atmosphere = Fabulous Wine Lists: 0000000 (0.0)
729  atmosphere = Fair Decor: 0000122 (4.0/3.0)
730  atmosphere = Fair Food: 0000000 (0.0)
731  atmosphere = Fair Service: 0000000 (0.0)
732  atmosphere = Focus on Dessert: 0000000 (0.0)
733  atmosphere = For the Young and Young at Heart: 0000000 (0.0)
734  atmosphere = Good Decor: 0000008 (34.0/33.0)
735  atmosphere = Good Food: 0000000 (0.0)
736  atmosphere = Good Out of Town Business: 0000000 (0.0)
737  atmosphere = Good Service: 0000000 (0.0)
738  atmosphere = Good for Younger Kids: 0000000 (0.0)
739  atmosphere = Great for People Watching: 0000000 (0.0)
```

```
740  atmosphere = Health Conscious Menus: 0000000 (0.0)
741  atmosphere = Hip Place To Be: 0000000 (0.0)
742  atmosphere = Little Known But Well Liked: 0000000 (0.0)
743  atmosphere = Near−perfect Decor: 0000289 (1.0)
744  atmosphere = Near−perfect Food: 0000000 (0.0)
745  atmosphere = Near−perfect Service: 0000000 (0.0)
746  atmosphere = Need To Dress: 0000000 (0.0)
747  atmosphere = No Liquor Served: 0000000 (0.0)
748  atmosphere = No Reservations: 0000000 (0.0)
749  atmosphere = No Smoking Allowed: 0000000 (0.0)
750  atmosphere = Old World Cafe Charm: 0000000 (0.0)
751  atmosphere = On the Beach: 0000000 (0.0)
752  atmosphere = ParkingValet: 0000000 (0.0)
753  atmosphere = People Keep Coming Back: 0000000 (0.0)
754  atmosphere = Place for Singles: 0000000 (0.0)
755  atmosphere = Poor Decor: 0000016 (1.0)
756  atmosphere = Pub Feel: 0000000 (0.0)
757  atmosphere = Quiet for Conversation: 0000000 (0.0)
758  atmosphere = Quirky: 0000000 (0.0)
759  atmosphere = Relaxed Senior Scene: 0000000 (0.0)
760  atmosphere = Romantic: 0000000 (0.0)
761  atmosphere = Singles Scene: 0000000 (0.0)
762  atmosphere = Tourist Appeal: 0000000 (0.0)
763  atmosphere = Up and Coming: 0000000 (0.0)
764  atmosphere = Very Busy − Reservations a Must: 0000000 (0.0)
765  atmosphere = Warm spots by the fire: 0000000 (0.0)
766  atmosphere = Wheelchair Access: 0000000 (0.0)
767
768  Number of Leaves  :    61
769
770  Size of the tree :   64
771
772
773  Time taken to build model: 0 seconds
774
775  6. New York:
776  The user should go to the   0000011  Le Train Bleu   restaurant.
777  === Run information ===
778
779  Scheme:weka.classifiers.trees.J48 −C 0.25 −M 2
780  Relation:      city−res
781  Instances:     410
782  Attributes:    5
783                 restaurant
784                 atmosphere
785                 style
786                 price
787                 occasion
788  Test mode:evaluate on training data
789
790  === Classifier model (full training set) ===
791
792  J48 pruned tree
793  ------------------
794
795  atmosphere = An Historic Spot: 0000000 (0.0)
796  atmosphere = An Out Of The Way Find: 0000000 (0.0)
797  atmosphere = Authentic: 0000000 (0.0)
798  atmosphere = Buffet Dining: 0000000 (0.0)
799  atmosphere = Business Scene: 0000000 (0.0)
800  atmosphere = CafeGarden Dining: 0000000 (0.0)
801  atmosphere = Classic Hotel Dining: 0000000 (0.0)
802  atmosphere = Creative: 0000000 (0.0)
803  atmosphere = Credit cards are not accepted: 0000000 (0.0)
804  atmosphere = Excellent Decor
805  |    occasion = Game: 0000216 (3.4/2.4)
806  |    occasion = After Hours Dining: 0000011 (0.0)
807  |    occasion = Catering for Special Events: 0000011 (0.0)
808  |    occasion = Dancing: 0000011 (0.0)
809  |    occasion = Delivery Available: 0000011 (0.0)
810  |    occasion = Dining After the Theater: 0000011 (0.0)
811  |    occasion = Dining Outdoors: 0000019 (28.94/27.94)
812  |    occasion = Early Dining: 0000011 (0.0)
813  |    occasion = Entertainment: 0000068 (27.23/26.23)
814  |    occasion = Fine for Dining Alone
815  |    |    price = 15−30: 0000011 (2.55/1.55)
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816 |    |      price = 30−50: 0000793 (4.17/3.17)
817 |    |      price = below 15: 0000011 (0.0)
818 |    |      price = over 50: 0000354 (0.09/0.04)
819 |    occasion = Great Place to Meet for a Drink: 0000163 (3.4/2.4)
820 |    occasion = Happy Hour: 0000011 (0.0)
821 |    occasion = Late Night Menu
822 |    |      price = 15−30: 0000097 (9.52/8.52)
823 |    |      price = 30−50: 0000095 (8.97/7.97)
824 |    |      price = below 15: 0000095 (0.0)
825 |    |      price = over 50: 0000354 (0.23/0.12)
826 |    occasion = Long Drive: 0000011 (0.0)
827 |    occasion = Margaritas: 0000011 (0.0)
828 |    occasion = Menus in Braille: 0001074 (1.7/0.7)
829 |    occasion = Open for Breakfast: 0000011 (0.0)
830 |    occasion = Open on Mondays: 0000011 (0.0)
831 |    occasion = Open on Sundays: 0000011 (0.0)
832 |    occasion = Other Quick Food: 0000011 (0.0)
833 |    occasion = Parties and Occasions: 0000011 (0.0)
834 |    occasion = Picnics: 0000011 (0.0)
835 |    occasion = Pre−theater Dining: 0000052 (3.4/2.4)
836 |    occasion = Private Parties: 0000011 (0.0)
837 |    occasion = Private Rooms Available: 0000109 (6.81/5.81)
838 |    occasion = Prix Fixe Menus
839 |    |      price = 15−30: 0000493 (2.52/1.52)
840 |    |      price = 30−50: 0000051 (15.97/14.97)
841 |    |      price = below 15: 0000051 (0.0)
842 |    |      price = over 50: 0000354 (0.23/0.12)
843 |    occasion = See the Game: 0000011 (0.0)
844 |    occasion = Short Drive: 0000011 (0.0)
845 |    occasion = Special Brunch Menu
846 |    |      price = 15−30: 0000440 (2.55/1.55)
847 |    |      price = 30−50: 0000278 (4.17/3.17)
848 |    |      price = below 15: 0000278 (0.0)
849 |    |      price = over 50: 0000354 (0.09/0.04)
850 |    occasion = Takeout Available: 0000107 (22.13/21.13)
851 |    occasion = Walk: 0000011 (0.0)
852 |    occasion = Weekend Brunch: 0000011 (0.0)
853 |    occasion = Weekend Dining: 0000023 (11.91/10.91)
854 |    occasion = Weekend Jazz Brunch: 0000011 (0.0)
855 |    occasion = Weekend Lunch: 0000011 (0.0)
856 atmosphere = Excellent Food: 0000000 (0.0)
857 atmosphere = Excellent Service: 0000000 (0.0)
858 atmosphere = Extraordinary Decor
859 |    occasion = Game
860 |    |      style = A: 0000017 (0.0)
861 |    |      style = Southern: 0000017 (0.0)
862 |    |      style = French: 0000017 (9.15/8.15)
863 |    |      style = Japanese: 0000017 (0.0)
864 |    |      style = Southwestern: 0000017 (0.0)
865 |    |      style = Swiss: 0000017 (0.0)
866 |    |      style = Asian: 0000017 (0.0)
867 |    |      style = Southeast Asian: 0000017 (0.0)
868 |    |      style = International: 0000017 (0.0)
869 |    |      style = Southern Comfort: 0000017 (0.0)
870 |    |      style = Deli: 0000017 (0.0)
871 |    |      style = Kosher: 0000017 (0.0)
872 |    |      style = Afghanistan: 0000017 (0.0)
873 |    |      style = Argentinean: 0000017 (0.0)
874 |    |      style = Eclectic: 0000017 (0.0)
875 |    |      style = Continental: 0000017 (0.0)
876 |    |      style = Bakeries: 0000017 (0.0)
877 |    |      style = Belgian: 0000017 (0.0)
878 |    |      style = Brasserie: 0000017 (0.0)
879 |    |      style = Cab: 0000017 (0.0)
880 |    |      style = CafeEspresso Bars: 0000017 (0.0)
881 |    |      style = Cafeterias: 0000017 (0.0)
882 |    |      style = Californian: 0000017 (0.0)
883 |    |      style = Wine and Beer: 0000017 (0.0)
884 |    |      style = Carry in Wine and Beer: 0000017 (0.0)
885 |    |      style = Caviar: 0000017 (0.0)
886 |    |      style = Central: 0000017 (0.0)
887 |    |      style = Coffee Houses: 0000017 (0.0)
888 |    |      style = Coffee Shops: 0000017 (0.0)
889 |    |      style = Coffeehouses: 0000017 (0.0)
890 |    |      style = Czech: 0000017 (0.0)
891 |    |      style = Diners: 0000017 (0.0)
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892 |   |      style = Down−Home: 0000017  (0.0)
893 |   |      style = Eastern European: 0000017  (0.0)
894 |   |      style = Egyptian: 0000017  (0.0)
895 |   |      style = English: 0000017  (0.0)
896 |   |      style = Fast Food: 0000017  (0.0)
897 |   |      style = Fondue: 0000017  (0.0)
898 |   |      style = Franco−Russian: 0000017  (0.0)
899 |   |      style = Frankfurters: 0000017  (0.0)
900 |   |      style = French−Japanese: 0000017  (0.0)
901 |   |      style = Grills: 0000017  (0.0)
902 |   |      style = Guatemalan: 0000017  (0.0)
903 |   |      style = Hamburgers: 0000017  (0.0)
904 |   |      style = Health Food: 0000017  (0.0)
905 |   |      style = High Tea: 0000017  (0.0)
906 |   |      style = Jewish: 0000322  (0.43/0.08)
907 |   |      style = Latin: 0000017  (0.0)
908 |   |      style = Lithuanian: 0000017  (0.0)
909 |   |      style = Middle Eastern: 0000017  (0.0)
910 |   |      style = N: 0000017  (0.0)
911 |   |      style = Nicaraguan: 0000017  (0.0)
912 |   |      style = Noodle Houses: 0000017  (0.0)
913 |   |      style = Noodle Shops: 0000017  (0.0)
914 |   |      style = Omelettes: 0000017  (0.0)
915 |   |      style = Oyster Bars: 0000017  (0.0)
916 |   |      style = Pancakes: 0000017  (0.0)
917 |   |      style = Pastries: 0000017  (0.0)
918 |   |      style = Pastry Shops: 0000017  (0.0)
919 |   |      style = Pizza: 0000017  (0.0)
920 |   |      style = Pizzerias: 0000017  (0.0)
921 |   |      style = Po Boys: 0000017  (0.0)
922 |   |      style = Power Brokers: 0000295  (2.49/1.49)
923 |   |      style = Roumanian: 0000017  (0.0)
924 |   |      style = Russian: 0000017  (0.0)
925 |   |      style = Salvadoran: 0000017  (0.0)
926 |   |      style = Scottish: 0000017  (0.0)
927 |   |      style = Soul Food: 0000017  (0.0)
928 |   |      style = Soulfood: 0000017  (0.0)
929 |   |      style = Steakhouses: 0000017  (0.0)
930 |   |      style = Swiss−French: 0000017  (0.0)
931 |   |      style = Tacos: 0000017  (0.0)
932 |   |      style = Traditional: 0000017  (0.0)
933 |   |      style = Ukrainian: 0000017  (0.0)
934 |   |      style = Ukranian: 0000017  (0.0)
935 |   |      style = Venezuelan: 0000017  (0.0)
936 |   |      style = Yogurt Bar: 0000017  (0.0)
937 |   |      style = Yugoslavian: 0000017  (0.0)
938 |   occasion = After Hours Dining: 0000003  (0.0)
939 |   occasion = Catering for Special Events: 0000003  (0.0)
940 |   occasion = Dancing: 0000003  (0.0)
941 |   occasion = Delivery Available: 0000003  (0.0)
942 |   occasion = Dining After the Theater: 0000003  (0.0)
943 |   occasion = Dining Outdoors: 0000116  (3.62/2.62)
944 |   occasion = Early Dining: 0000003  (0.0)
945 |   occasion = Entertainment: 0000818  (1.21/0.21)
946 |   occasion = Fine for Dining Alone: 0000003  (0.0)
947 |   occasion = Great Place to Meet for a Drink: 0000003  (0.0)
948 |   occasion = Happy Hour: 0000003  (0.0)
949 |   occasion = Late Night Menu: 0000106  (2.41/1.41)
950 |   occasion = Long Drive: 0000003  (0.0)
951 |   occasion = Margaritas: 0000003  (0.0)
952 |   occasion = Menus in Braille: 0000044  (2.41/1.41)
953 |   occasion = Open for Breakfast: 0000003  (0.0)
954 |   occasion = Open on Mondays: 0000003  (0.0)
955 |   occasion = Open on Sundays: 0000003  (0.0)
956 |   occasion = Other Quick Food: 0000003  (0.0)
957 |   occasion = Parties and Occasions: 0000003  (0.0)
958 |   occasion = Picnics: 0000003  (0.0)
959 |   occasion = Pre−theater Dining: 0000003  (0.0)
960 |   occasion = Private Parties: 0000003  (0.0)
961 |   occasion = Private Rooms Available: 0000246  (1.21/0.21)
962 |   occasion = Prix Fixe Menus
963 |   |      price = 15−30: 0000014  (0.0)
964 |   |      price = 30−50: 0000014  (3.69/2.69)
965 |   |      price = below 15: 0000014  (0.0)
966 |   |      price = over 50: 0000046  (2.34/1.34)
967 |   occasion = See the Game: 0000003  (0.0)
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 968 |     occasion = Short Drive: 0000003 (0.0)
 969 |     occasion = Special Brunch Menu: 0000003 (4.83/3.83)
 970 |     occasion = Takeout Available: 0000181 (1.21/0.21)
 971 |     occasion = Walk: 0000003 (0.0)
 972 |     occasion = Weekend Brunch: 0000003 (0.0)
 973 |     occasion = Weekend Dining: 0000003 (0.0)
 974 |     occasion = Weekend Jazz Brunch: 0000003 (0.0)
 975 |     occasion = Weekend Lunch: 0000003 (0.0)
 976 atmosphere = Extraordinary Food: 0000000 (0.0)
 977 atmosphere = Extraordinary Service: 0000000 (0.0)
 978 atmosphere = Fabulous Views: 0000000 (0.0)
 979 atmosphere = Fabulous Wine Lists: 0000000 (0.0)
 980 atmosphere = Fair Decor
 981 |     occasion = Game: 0000103 (0.0)
 982 |     occasion = After Hours Dining: 0000103 (0.0)
 983 |     occasion = Catering for Special Events: 0000103 (0.0)
 984 |     occasion = Dancing: 0000103 (0.0)
 985 |     occasion = Delivery Available: 0000103 (0.0)
 986 |     occasion = Dining After the Theater: 0000103 (0.0)
 987 |     occasion = Dining Outdoors: 0000687 (1.77/0.77)
 988 |     occasion = Early Dining: 0000103 (0.0)
 989 |     occasion = Entertainment: 0000306 (3.54/2.54)
 990 |     occasion = Fine for Dining Alone: 0001005 (1.77/0.77)
 991 |     occasion = Great Place to Meet for a Drink: 0000103 (0.0)
 992 |     occasion = Happy Hour: 0000103 (0.0)
 993 |     occasion = Late Night Menu: 0000491 (5.31/4.31)
 994 |     occasion = Long Drive: 0000103 (0.0)
 995 |     occasion = Margaritas: 0000103 (0.0)
 996 |     occasion = Menus in Braille: 0000610 (1.77/0.77)
 997 |     occasion = Open for Breakfast: 0000103 (3.54/2.54)
 998 |     occasion = Open on Mondays: 0000103 (0.0)
 999 |     occasion = Open on Sundays: 0000103 (0.0)
1000 |     occasion = Other Quick Food: 0000103 (0.0)
1001 |     occasion = Parties and Occasions: 0000103 (0.0)
1002 |     occasion = Picnics: 0000103 (0.0)
1003 |     occasion = Pre-theater Dining: 0000103 (0.0)
1004 |     occasion = Private Parties: 0000103 (0.0)
1005 |     occasion = Private Rooms Available: 0000103 (0.0)
1006 |     occasion = Prix Fixe Menus: 0001020 (1.77/0.77)
1007 |     occasion = See the Game: 0000103 (0.0)
1008 |     occasion = Short Drive: 0000103 (0.0)
1009 |     occasion = Special Brunch Menu: 0000103 (0.0)
1010 |     occasion = Takeout Available: 0001086 (1.77/0.77)
1011 |     occasion = Walk: 0000103 (0.0)
1012 |     occasion = Weekend Brunch: 0000103 (0.0)
1013 |     occasion = Weekend Dining: 0001099 (1.77/0.77)
1014 |     occasion = Weekend Jazz Brunch: 0000103 (0.0)
1015 |     occasion = Weekend Lunch: 0000103 (0.0)
1016 atmosphere = Fair Food: 0000000 (0.0)
1017 atmosphere = Fair Service: 0000000 (0.0)
1018 atmosphere = Focus on Dessert: 0000000 (0.0)
1019 atmosphere = For the Young and Young at Heart: 0000000 (0.0)
1020 atmosphere = Good Decor
1021 |     occasion = Game
1022 |     |     price = 15-30: 0000621 (3.1/2.1)
1023 |     |     price = 30-50: 0000335 (2.77/1.77)
1024 |     |     price = below 15: 0001128 (0.03)
1025 |     |     price = over 50: 0000335 (0.0)
1026 |     occasion = After Hours Dining: 0000000 (0.0)
1027 |     occasion = Catering for Special Events: 0000000 (0.0)
1028 |     occasion = Dancing: 0000000 (0.0)
1029 |     occasion = Delivery Available: 0000000 (0.0)
1030 |     occasion = Dining After the Theater: 0000000 (0.0)
1031 |     occasion = Dining Outdoors
1032 |     |     price = 15-30: 0000179 (26.2/25.2)
1033 |     |     price = 30-50: 0000165 (5.09/4.09)
1034 |     |     price = below 15: 0001128 (0.18)
1035 |     |     price = over 50: 0000165 (0.0)
1036 |     occasion = Early Dining: 0000000 (0.0)
1037 |     occasion = Entertainment
1038 |     |     price = 15-30: 0000021 (17.7/16.7)
1039 |     |     price = 30-50: 0000633 (3.81/2.81)
1040 |     |     price = below 15: 0001128 (0.12)
1041 |     |     price = over 50: 0000021 (0.0)
1042 |     occasion = Fine for Dining Alone: 0000031 (7.87/6.87)
1043 |     occasion = Great Place to Meet for a Drink: 0000000 (0.0)
```

```
1044 |     occasion = Happy Hour: 0000000 (0.0)
1045 |     occasion = Late Night Menu
1046 |     |     price = 15−30: 0000032 (27.3/26.3)
1047 |     |     price = 30−50: 0000224 (9.86/8.86)
1048 |     |     price = below 15: 0001128 (0.21)
1049 |     |     price = over 50: 0000032 (0.0)
1050 |     occasion = Long Drive: 0000000 (0.0)
1051 |     occasion = Margaritas: 0000000 (0.0)
1052 |     occasion = Menus in Braille: 0000000 (0.0)
1053 |     occasion = Open for Breakfast: 0000008 (3.93/2.93)
1054 |     occasion = Open on Mondays: 0000000 (0.0)
1055 |     occasion = Open on Sundays: 0000000 (0.0)
1056 |     occasion = Other Quick Food: 0000000 (0.0)
1057 |     occasion = Parties and Occasions: 0000000 (0.0)
1058 |     occasion = Picnics: 0000000 (0.0)
1059 |     occasion = Pre−theater Dining: 0000000 (0.0)
1060 |     occasion = Private Parties: 0000000 (0.0)
1061 |     occasion = Private Rooms Available
1062 |     |     price = 15−30: 0000905 (3.1/2.1)
1063 |     |     price = 30−50: 0000101 (2.77/1.77)
1064 |     |     price = below 15: 0001128 (0.03)
1065 |     |     price = over 50: 0000101 (0.0)
1066 |     occasion = Prix Fixe Menus
1067 |     |     price = 15−30: 0000060 (8.6/7.6)
1068 |     |     price = 30−50: 0000067 (7.04/6.04)
1069 |     |     price = below 15: 0001128 (0.09)
1070 |     |     price = over 50: 0000060 (0.0)
1071 |     occasion = See the Game: 0000000 (0.0)
1072 |     occasion = Short Drive: 0000893 (1.97/0.97)
1073 |     occasion = Special Brunch Menu
1074 |     |     price = 15−30: 0000720 (5.8/4.8)
1075 |     |     price = 30−50: 0000030 (2.02/1.02)
1076 |     |     price = below 15: 0001128 (0.04)
1077 |     |     price = over 50: 0000030 (0.0)
1078 |     occasion = Takeout Available
1079 |     |     price = 15−30: 0000081 (17.4/16.4)
1080 |     |     price = 30−50: 0000147 (6.07/5.07)
1081 |     |     price = below 15: 0001128 (0.13)
1082 |     |     price = over 50: 0000081 (0.0)
1083 |     occasion = Walk: 0000000 (0.0)
1084 |     occasion = Weekend Brunch: 0000000 (0.0)
1085 |     occasion = Weekend Dining
1086 |     |     price = 15−30: 0000173 (9.9/8.9)
1087 |     |     price = 30−50: 0000748 (3.79/2.79)
1088 |     |     price = below 15: 0001128 (0.08)
1089 |     |     price = over 50: 0000173 (0.0)
1090 |     occasion = Weekend Jazz Brunch: 0000000 (0.0)
1091 |     occasion = Weekend Lunch: 0000000 (0.0)
1092 atmosphere = Good Food: 0000000 (0.0)
1093 atmosphere = Good Out of Town Business: 0000000 (0.0)
1094 atmosphere = Good Service: 0000000 (0.0)
1095 atmosphere = Good for Younger Kids: 0000000 (0.0)
1096 atmosphere = Great for People Watching: 0000000 (0.0)
1097 atmosphere = Health Conscious Menus: 0000000 (0.0)
1098 atmosphere = Hip Place To Be: 0000000 (0.0)
1099 atmosphere = Little Known But Well Liked: 0000000 (0.0)
1100 atmosphere = Near−perfect Decor
1101 |     occasion = Game: 0000045 (5.38/4.38)
1102 |     occasion = After Hours Dining: 0000045 (0.0)
1103 |     occasion = Catering for Special Events: 0000045 (0.0)
1104 |     occasion = Dancing: 0000045 (0.0)
1105 |     occasion = Delivery Available: 0000045 (0.0)
1106 |     occasion = Dining After the Theater: 0000045 (0.0)
1107 |     occasion = Dining Outdoors: 0000045 (0.0)
1108 |     occasion = Early Dining: 0000045 (0.0)
1109 |     occasion = Entertainment: 0001021 (1.08/0.08)
1110 |     occasion = Fine for Dining Alone: 0000045 (0.0)
1111 |     occasion = Great Place to Meet for a Drink: 0000045 (0.0)
1112 |     occasion = Happy Hour: 0000045 (0.0)
1113 |     occasion = Late Night Menu: 0000045 (0.0)
1114 |     occasion = Long Drive: 0000045 (0.0)
1115 |     occasion = Margaritas: 0000045 (0.0)
1116 |     occasion = Menus in Braille: 0000045 (0.0)
1117 |     occasion = Open for Breakfast: 0000830 (3.23/2.23)
1118 |     occasion = Open on Mondays: 0000045 (0.0)
1119 |     occasion = Open on Sundays: 0000045 (0.0)
```

```
|    occasion = Other Quick Food: 0000045 (0.0)
|    occasion = Parties and Occasions: 0000045 (0.0)
|    occasion = Picnics: 0000045 (0.0)
|    occasion = Pre-theater Dining: 0000045 (0.0)
|    occasion = Private Parties: 0000045 (0.0)
|    occasion = Private Rooms Available: 0000161 (1.08/0.08)
|    occasion = Prix Fixe Menus: 0000045 (0.0)
|    occasion = See the Game: 0000045 (0.0)
|    occasion = Short Drive: 0000045 (0.0)
|    occasion = Special Brunch Menu: 0000353 (3.23/2.23)
|    occasion = Takeout Available: 0000045 (0.0)
|    occasion = Walk: 0000045 (0.0)
|    occasion = Weekend Brunch: 0000045 (0.0)
|    occasion = Weekend Dining: 0000045 (0.0)
|    occasion = Weekend Jazz Brunch: 0000045 (0.0)
|    occasion = Weekend Lunch: 0000045 (0.0)
atmosphere = Near-perfect Food: 0000000 (0.0)
atmosphere = Near-perfect Service: 0000000 (0.0)
atmosphere = Need To Dress: 0000000 (0.0)
atmosphere = No Liquor Served: 0000000 (0.0)
atmosphere = No Reservations: 0000000 (0.0)
atmosphere = No Smoking Allowed: 0000000 (0.0)
atmosphere = Old World Cafe Charm: 0000000 (0.0)
atmosphere = On the Beach: 0000000 (0.0)
atmosphere = ParkingValet: 0000000 (0.0)
atmosphere = People Keep Coming Back: 0000000 (0.0)
atmosphere = Place for Singles: 0000000 (0.0)
atmosphere = Poor Decor: 0000741 (1.0)
atmosphere = Pub Feel: 0000000 (0.0)
atmosphere = Quiet for Conversation: 0000000 (0.0)
atmosphere = Quirky: 0000000 (0.0)
atmosphere = Relaxed Senior Scene: 0000000 (0.0)
atmosphere = Romantic: 0000000 (0.0)
atmosphere = Singles Scene: 0000000 (0.0)
atmosphere = Tourist Appeal: 0000000 (0.0)
atmosphere = Up and Coming: 0000000 (0.0)
atmosphere = Very Busy - Reservations a Must: 0000000 (0.0)
atmosphere = Warm spots by the fire: 0000000 (0.0)
atmosphere = Wheelchair Access: 0000000 (0.0)

Number of Leaves  :    344

Size of the tree :   365


Time taken to build model: 0.11 seconds

7. San Francisco:
The user should go to the   0000181  Sol y Luna   restaurant.
=== Run information ===

Scheme:weka.classifiers.trees.J48 -C 0.25 -M 2
Relation:      city-res
Instances:     8
Attributes:    5
               restaurant
               atmosphere
               style
               price
               occasion
Test mode:evaluate on training data

=== Classifier model (full training set) ===

J48 pruned tree
------------------

occasion = Game: 0000024 (0.0)
occasion = After Hours Dining: 0000024 (0.0)
occasion = Catering for Special Events: 0000181 (2.0/1.0)
occasion = Dancing: 0000024 (0.0)
occasion = Delivery Available: 0000024 (0.0)
occasion = Dining After the Theater: 0000024 (0.0)
occasion = Dining Outdoors: 0000024 (1.0)
occasion = Early Dining: 0000024 (0.0)
occasion = Entertainment: 0000374 (1.0)
```

```
1196 occasion = Fine for Dining Alone: 0000024 (0.0)
1197 occasion = Great Place to Meet for a Drink: 0000024 (0.0)
1198 occasion = Happy Hour: 0000024 (0.0)
1199 occasion = Late Night Menu: 0000024 (0.0)
1200 occasion = Long Drive: 0000024 (0.0)
1201 occasion = Margaritas: 0000024 (0.0)
1202 occasion = Menus in Braille: 0000024 (0.0)
1203 occasion = Open for Breakfast: 0000217 (1.0)
1204 occasion = Open on Mondays: 0000024 (0.0)
1205 occasion = Open on Sundays: 0000024 (0.0)
1206 occasion = Other Quick Food: 0000024 (0.0)
1207 occasion = Parties and Occasions: 0000024 (0.0)
1208 occasion = Picnics: 0000024 (0.0)
1209 occasion = Pre−theater Dining: 0000024 (0.0)
1210 occasion = Private Parties: 0000024 (0.0)
1211 occasion = Private Rooms Available: 0000033 (1.0)
1212 occasion = Prix Fixe Menus: 0000024 (0.0)
1213 occasion = See the Game: 0000024 (0.0)
1214 occasion = Short Drive: 0000024 (0.0)
1215 occasion = Special Brunch Menu: 0000024 (0.0)
1216 occasion = Takeout Available: 0000024 (0.0)
1217 occasion = Walk: 0000024 (0.0)
1218 occasion = Weekend Brunch: 0000024 (0.0)
1219 occasion = Weekend Dining: 0000144 (2.0/1.0)
1220 occasion = Weekend Jazz Brunch: 0000024 (0.0)
1221 occasion = Weekend Lunch: 0000024 (0.0)
1222
1223 Number of Leaves  :    35
1224
1225 Size of the tree :   36
1226
1227
1228 Time taken to build model: 0 seconds
1229 === Evaluation on training set ===
1230 === Summary ===
1231
1232 Correctly Classified Instances           6                    75      %
1233 Incorrectly Classified Instances         2                    25      %
1234 Kappa statistic                          0.7143
1235 Mean absolute error                      0.0625
1236 Root mean squared error                  0.1768
1237 Relative absolute error                 28.5714 %
1238 Root relative squared error             53.4522 %
1239 Total Number of Instances                8
1240
1241 === Detailed Accuracy By Class ===
1242
1243               TP Rate    FP Rate    Precision    Recall   F−Measure   ROC Area   Class
1244                 1          0          1           1         1           1         0000024
1245                 1          0          1           1         1           1         0000033
1246                 1          0.143      0.5         1         0.667       0.929     0000144
1247                 1          0.143      0.5         1         0.667       0.929     0000181
1248                 1          0          1           1         1           1         0000217
1249                 0          0          0           0         0           0.929     0000227
1250                 0          0          0           0         0           0.929     0000262
1251                 1          0          1           1         1           1         0000374
1252 Weighted Avg.    0.75       0.036      0.625       0.75      0.667       0.964
1253
1254 8. Washington DC:
1255 The user should go to the   0000004   Notte Luna   restaurant.
1256 === Run information ===
1257
1258 Scheme:weka.classifiers.trees.J48 −C 0.25 −M 2
1259 Relation:      city−res
1260 Instances:     56
1261 Attributes:    5
1262               restaurant
1263               atmosphere
1264               style
1265               price
1266               occasion
1267 Test mode:evaluate on training data
1268
1269 === Classifier model (full training set) ===
1270
1271 J48 pruned tree
```

39

```
————————————————————

atmosphere = An Historic Spot: 0000004 (0.0)
atmosphere = An Out Of The Way Find: 0000004 (0.0)
atmosphere = Authentic: 0000004 (0.0)
atmosphere = Buffet Dining: 0000004 (0.0)
atmosphere = Business Scene: 0000004 (0.0)
atmosphere = CafeGarden Dining: 0000004 (0.0)
atmosphere = Classic Hotel Dining: 0000004 (0.0)
atmosphere = Creative: 0000004 (0.0)
atmosphere = Credit cards are not accepted: 0000004 (0.0)
atmosphere = Excellent Decor: 0000004 (30.0/29.0)
atmosphere = Excellent Food: 0000004 (0.0)
atmosphere = Excellent Service: 0000004 (0.0)
atmosphere = Extraordinary Decor: 0000048 (8.0/7.0)
atmosphere = Extraordinary Food: 0000004 (0.0)
atmosphere = Extraordinary Service: 0000004 (0.0)
atmosphere = Fabulous Views: 0000004 (0.0)
atmosphere = Fabulous Wine Lists: 0000004 (0.0)
atmosphere = Fair Decor: 0000104 (1.0)
atmosphere = Fair Food: 0000004 (0.0)
atmosphere = Fair Service: 0000004 (0.0)
atmosphere = Focus on Dessert: 0000004 (0.0)
atmosphere = For the Young and Young at Heart: 0000004 (0.0)
atmosphere = Good Decor
|    price = 15−30: 0000018 (14.0/13.0)
|    price = 30−50: 0000018 (0.0)
|    price = below 15: 0000197 (2.0/1.0)
|    price = over 50: 0000018 (0.0)
atmosphere = Good Food: 0000004 (0.0)
atmosphere = Good Out of Town Business: 0000004 (0.0)
atmosphere = Good Service: 0000004 (0.0)
atmosphere = Good for Younger Kids: 0000004 (0.0)
atmosphere = Great for People Watching: 0000004 (0.0)
atmosphere = Health Conscious Menus: 0000004 (0.0)
atmosphere = Hip Place To Be: 0000004 (0.0)
atmosphere = Little Known But Well Liked: 0000004 (0.0)
atmosphere = Near−perfect Decor: 0000227 (1.0)
atmosphere = Near−perfect Food: 0000004 (0.0)
atmosphere = Near−perfect Service: 0000004 (0.0)
atmosphere = Need To Dress: 0000004 (0.0)
atmosphere = No Liquor Served: 0000004 (0.0)
atmosphere = No Reservations: 0000004 (0.0)
atmosphere = No Smoking Allowed: 0000004 (0.0)
atmosphere = Old World Cafe Charm: 0000004 (0.0)
atmosphere = On the Beach: 0000004 (0.0)
atmosphere = ParkingValet: 0000004 (0.0)
atmosphere = People Keep Coming Back: 0000004 (0.0)
atmosphere = Place for Singles: 0000004 (0.0)
atmosphere = Poor Decor: 0000004 (0.0)
atmosphere = Pub Feel: 0000004 (0.0)
atmosphere = Quiet for Conversation: 0000004 (0.0)
atmosphere = Quirky: 0000004 (0.0)
atmosphere = Relaxed Senior Scene: 0000004 (0.0)
atmosphere = Romantic: 0000004 (0.0)
atmosphere = Singles Scene: 0000004 (0.0)
atmosphere = Tourist Appeal: 0000004 (0.0)
atmosphere = Up and Coming: 0000004 (0.0)
atmosphere = Very Busy − Reservations a Must: 0000004 (0.0)
atmosphere = Warm spots by the fire: 0000004 (0.0)
atmosphere = Wheelchair Access: 0000004 (0.0)

Number of Leaves  :    58

Size of the tree :   60



Time taken to build model: 0 seconds
=== Evaluation on training set ===
=== Summary ===

Correctly Classified Instances           6                10.7143 %
Incorrectly Classified Instances        50                89.2857 %
Kappa statistic                          0.0909
Mean absolute error                      0.0319
Root mean squared error                  0.1263
```

```
1348  Relative absolute error              90.9091 %
1349  Root relative squared error          95.3463 %
1350  Total Number of Instances            56
```

Listing 3: Task viii J48 Output

Appendices

Perl Scripts

```perl
use strict;
use warnings;

my @cuisine = split /,/, "
    002,003,005,006,007,008,009,012,013,014,015,018,020,022,031,032,033,034,038,039,045,048,049,058,067,069,070,07
    ";
my %cuisine_elements;
@cuisine_elements{@cuisine} = ();
my @price = split /,/, "161,162,163,164,165,166,167,168,169,170";
my %price_elements;
@price_elements{@price} = ();

my $dir = 'C:/Users/yhan/Documents/data';
my $out = 'C:/Users/yhan/Documents/CS773/q5/vegie_cuisinePrice.arff';
open(my $file, '>', $out) or die "Could not open file '$out' $!";
foreach my $fp (glob("$dir/*.txt")) {
    open my $fh, "<", $fp or die "can't read open '$fp'";
    while (<$fh>) {
        chomp;
        my $line = $_;
        my @features = split /[\s,\t]/, $_;
        my @rescui = grep exists $cuisine_elements{$_}, @features;
        if (length($rescui[0]) == 0) {$rescui[0] = '?'}
        my @respri = grep exists $price_elements{$_}, @features;
        if (length($respri[0]) == 0) {$respri[0] = '?'}
        if ($line =~ /243/) {
            printf $file "$rescui[0], $respri[0], Yes \n"
        } else {
            printf $file "$rescui[0], $respri[0], No \n"
        };

    }

    close $fh or die "can't read close";
}
```

Listing 4: Task v Perl script

```perl
use strict;
use warnings;

my $features = 'C:/Users/yhan/Documents/CS773/q6/features.txt';
open(my $featurefile, '<', $features) or die "Could not open file!";
my %feature;
while (<$featurefile>) {
    my $line = $_;
    my ($i, $j) = split(/\t/, $line);
    $feature{$i} = $j;
    #print "$i is $feature{$i}\n";
}


my @countries;
my $country = 'C:/Users/yhan/Documents/CS773/q6/countries.txt';
open(my $file, '<', $country) or die "Could not open file!";
while(<$file>) {
    chomp;
    my $line = $_;
    push(@countries, $line);
    #print $_;
}
#my %country_elements;
#@country_elements{@countries} = ();

my $countrys = "African Afro-Eurasian ...";
my $total = 0;
my $geo = 0;

my $dir = 'C:/Users/yhan/Documents/data';
```

```perl
foreach my $fp (glob("$dir/*.txt")) {
   open my $fh, "<", $fp or die "can't read open '$fp'";
   while (<$fh>) {
      chomp;
      my $line = $_;
      $total = $total + 1;
      my $flag = 0;
      my @resfeatures = split /[\s,\t]/, $_;
      foreach my $ele (@resfeatures)
      {
      if(exists $feature{$ele}){
        my $cty = $feature{$ele};
        $cty =~ tr/A-Za-z//cd;
        if ($countrys =~ /$cty/)
        {
        $flag = 1
        #print $feature{$ele};
        }

     #print $feature{$ele};
     }
           }
     $geo = $geo + $flag;
     }
close $fh or die "can't read close";
}

print "$total, $geo \n";
```

Listing 5: Task vi Perl script

```perl
use strict;
use warnings;

my @europe;
my $european = 'C:/Users/yhan/Documents/CS773/q6/european.txt';
open(my $file5, '<', $european) or die "Could not open file!";
while(<$file5>) {
   chomp;
   my $line5 = $_;
   push(@europe, $line5);
   #print $_;
   }
my $europeans = join(" ", @europe);

my $features = 'C:/Users/yhan/Documents/CS773/q6/features.txt';
open(my $featurefile, '<', $features) or die "Could not open file!";
my %feature;
while (<$featurefile>) {
   my $line = $_;
   my ($i, $j) = split(/\t/, $line);
   $feature{$i} = $j;
   #print "$i is $feature{$i}\n";
   }
   #open (my $out, '>', 'C:/Users/yhan/Documents/CS773/q7/city.txt');
my $atmosphere = '"An Historic Spot","An Out Of The Way Find","Authentic","Buffet Dining","Business Scene
   ","Cafe/Garden Dining",   "Classic Hotel Dining",   "Creative",   "Credit cards are not accepted",
      "Excellent Decor",   "Excellent Food",   "Excellent Service",   "Extraordinary Decor",   "
   Extraordinary Food",   "Extraordinary Service",   "Fabulous Views",   "Fabulous Wine Lists",   "
   Fair Decor",   "Fair Food",   "Fair Service",   "Focus on Dessert",   "For the Young and Young at
   Heart",   "Good Decor",   "Good Food",   "Good Out of Town Business",   "Good Service",   "Good
   for Younger Kids",   "Great for People Watching",   "Health Conscious Menus",   "Hip Place To Be",
      "Little Known But Well Liked",   "Near-perfect Decor",   "Near-perfect Food",   "Near-perfect
   Service",   "Need To Dress",   "No Liquor Served",   "No Reservations",   "No Smoking Allowed",
      "Old World Cafe Charm",   "On the Beach",   "Parking/Valet",   "People Keep Coming Back",   "
   Place for Singles",   "Poor Decor",   "Pub Feel",   "Quiet for Conversation",   "Quirky",   "
   Relaxed Senior Scene",   "Romantic",   "Singles Scene",   "Tourist Appeal",   "Up and Coming",
      "Very Busy - Reservations a Must",   "Warm spots by the fire",   "Wheelchair Access"';
$atmosphere =~ s/[\#@~!&*()\[\];.:?^`'\\\/]+//g;
#printf $out $atmosphere;
my $occasion = '"Game",   "After Hours Dining",   "Catering for Special Events",   "Dancing",   "
   Delivery Available",   "Dining After the Theater",   "Dining Outdoors",   "Early Dining",   "
   Entertainment",   "Fine for Dining Alone",   "Great Place to Meet for a Drink",   "Happy Hour",
   "Late Night Menu",   "Long Drive",   "Margaritas",   "Menus in Braille",   "Open for Breakfast",
      "Open on Mondays",   "Open on Sundays",   "Other Quick Food",   "Parties and Occasions",   "
```

```perl
       Picnics",    "Pre-theater Dining",    "Private Parties",    "Private Rooms Available",    "Prix Fixe
       Menus",    "See the Game",    "Short Drive",    "Special Brunch Menu",    "Takeout Available",    "
       Walk",    "Weekend Brunch",    "Weekend Dining",    "Weekend Jazz Brunch",    "Weekend Lunch"';
29 $occasion =~ s/[\#@~!&*()\[\];.:?^`\\\/]+//g;
30 #printf $out $occasion;
31 my $price = '"$15-$30", "$30-$50", "below $15", "over $50"';
32 $price =~ s/[\#@~!\$&*()\[\];.:?^`\\\/]+//g;
33 #printf $out $price;
34 my $style = '"A","Southern","Southwestern","Southeast Asian","International","Southern Comfort","Deli","
       Kosher",    "Afghanistan",    "Argentinean","Eclectic",    "Continental","Bakeries",    "Belgian",
       "Brasserie",    "Cab",    "Cafe/Espresso Bars",    "Cafeterias",    "Californian",    "Carry in Wine
       and Beer","Caviar",    "Central",    "Coffee Houses",    "Coffee Shops",    "Coffeehouses",    "Czech
       ",    "Diners",    "Down-Home",    "Eastern European",    "Egyptian",    "English",    "Fast Food",
        "Fondue",    "Franco-Russian",    "Frankfurters",    "French-Japanese",    "Grills",    "Guatemalan
       ",    "Hamburgers",    "Health Food",    "High Tea",    "Jewish",    "Latin",    "Lithuanian",    "
       Middle Eastern",    "N",    "Nicaraguan",    "Noodle Houses",    "Noodle Shops",    "Omelettes",    "
       Oyster Bars",    "Pancakes",    "Pastries",    "Pastry Shops",    "Pizza",    "Pizzerias",    "Po Boys
       ",    "Power Brokers",    "Roumanian",    "Russian",    "Salvadoran",    "Scottish",    "Soul Food",
        "Soulfood" ,    "Steakhouses",    "Swiss-French",    "Tacos",    "Traditional",    "Ukrainian",
       "Ukranian",    "Venezuelan",    "Yogurt Bar",    "Yugoslavian"';
35 $style =~   s/[\#@~!&*()\[\];.:?^`\\\/]+//g;
36 #printf $out $style;
37
38 my $dir = 'C:/Users/yhan/Documents/CS773/q7/data';
39 open (my $out, '>', 'C:/Users/yhan/Documents/CS773/q7/europeCity2.arff');
40 foreach my $fp (glob("$dir/*.txt")) {
41   open my $fh, "<", $fp or die "can't read open '$fp'";
42   #print $fp;
43   my $city = (split '\/', $fp)[-1];
44   $city = substr($city, 0, -4);
45   #printf $out "\"$city\",";
46   while (<$fh>) {
47   chomp;
48   my $line = $_;
49   my @res = split /[\s,\t]/, $line;
50   my $resatom = '?';
51   my $resocc = '?';
52   my $resprice = '?';
53   my $ressty = '?';
54   my $resf;
55   foreach my $ele (@res) {
56     if (exists $feature{$ele} ) {
57
58       $resf = $feature{$ele};
59       chomp ($resf);
60       $resf =~   s/[\#@~!\$&*()\[\];.:?^`\\\/]+//g;
61       #print $resprice;
62       if($price =~ /$resf/) {
63         $resprice = $resf;
64
65       }
66       elsif ($style =~ /$resf/) {
67         $ressty = $resf;
68
69       }
70
71       elsif ($atmosphere =~ /$resf/) {
72         $resatom = $resf;
73
74       }
75       elsif ($occasion =~ /$resf/){
76         $resocc = $resf;
77
78       }
79
80     }
81     }
82   #print "\"$city\"\n";
83   printf $out "\"$resatom\",\"$ressty\",\"$resprice\",\"$resocc\",\"$city\"\n";
84
85   }
86
87
88 }
```

Listing 6: Task vii Perl script

```perl
use strict;
use warnings;

my @europe;
my $european = 'C:/Users/yhan/Documents/CS773/q6/european.txt';
open(my $file5, '<', $european) or die "Could not open file!";
while(<$file5>) {
    chomp;
    my $line5 = $_;
    push(@europe, $line5);
    #print $_;
    }
my $europeans = join(" ", @europe);

my $features = 'C:/Users/yhan/Documents/CS773/q6/features.txt';
open(my $featurefile, '<', $features) or die "Could not open file!";
my %feature;
while (<$featurefile>) {
    my $line = $_;
    my ($i, $j) = split(/\t/, $line);
    $feature{$i} = $j;
    #print "$i is $feature{$i}\n";
    }
    #open (my $out, '>', 'C:/Users/yhan/Documents/CS773/q7/city.txt');
my $atmosphere = '"An Historic Spot","An Out Of The Way Find","Authentic","Buffet Dining","Business Scene
    ","Cafe/Garden Dining",    "Classic Hotel Dining",    "Creative",    "Credit cards are not accepted",
    "Excellent Decor",    "Excellent Food",    "Excellent Service",    "Extraordinary Decor",    "
    Extraordinary Food",    "Extraordinary Service",    "Fabulous Views",    "Fabulous Wine Lists",    "
    Fair Decor",    "Fair Food",    "Fair Service",    "Focus on Dessert",    "For the Young and Young at
    Heart",    "Good Decor",    "Good Food",    "Good Out of Town Business",    "Good Service",    "Good
    for Younger Kids",    "Great for People Watching",    "Health Conscious Menus",    "Hip Place To Be",
    "Little Known But Well Liked",    "Near-perfect Decor",    "Near-perfect Food",    "Near-perfect
    Service",    "Need To Dress",    "No Liquor Served",    "No Reservations",    "No Smoking Allowed",
    "Old World Cafe Charm",    "On the Beach",    "Parking/Valet",    "People Keep Coming Back",    "
    Place for Singles",    "Poor Decor",    "Pub Feel",    "Quiet for Conversation",    "Quirky",    "
    Relaxed Senior Scene",    "Romantic",    "Singles Scene",    "Tourist Appeal",    "Up and Coming",
    "Very Busy - Reservations a Must",    "Warm spots by the fire",    "Wheelchair Access"';
$atmosphere =~ s/[\#@~!&*()\[\];.:?^`\\\/]+//g;
#printf $out $atmosphere;
my $occasion = '"Game",    "After Hours Dining",    "Catering for Special Events",    "Dancing",    "
    Delivery Available",    "Dining After the Theater",    "Dining Outdoors",    "Early Dining",    "
    Entertainment",    "Fine for Dining Alone",    "Great Place to Meet for a Drink",    "Happy Hour",
    "Late Night Menu",    "Long Drive",    "Margaritas",    "Menus in Braille",    "Open for Breakfast",
    "Open on Mondays",    "Open on Sundays",    "Other Quick Food",    "Parties and Occasions",    "
    Picnics",    "Pre-theater Dining",    "Private Parties",    "Private Rooms Available",    "Prix Fixe
    Menus",    "See the Game",    "Short Drive",    "Special Brunch Menu",    "Takeout Available",    "
    Walk",    "Weekend Brunch",    "Weekend Dining",    "Weekend Jazz Brunch",    "Weekend Lunch"';
$occasion =~ s/[\#@~!&*()\[\];.:?^`\\\/]+//g;
#printf $out $occasion;
my $price = '"$15-$30", "$30-$50", "below $15", "over $50"';
$price =~ s/[\#@~!\$&*()\[\];.:?^`\\\/]+//g;
#printf $out $price;
my $style = '"A","Southern","Southwestern","Southeast Asian","International","Southern Comfort","Deli","
    Kosher",    "Afghanistan",    "Argentinean","Eclectic",    "Continental","Bakeries",    "Belgian",
    "Brasserie",    "Cab",    "Cafe/Espresso Bars",    "Cafeterias",    "Californian",    "Carry in Wine
    and Beer","Caviar",    "Central",    "Coffee Houses",    "Coffee Shops",    "Coffeehouses",    "Czech
    ",    "Diners",    "Down-Home",    "Eastern European",    "Egyptian",    "English",    "Fast Food",
    "Fondue",    "Franco-Russian",    "Frankfurters",    "French-Japanese",    "Grills",    "Guatemalan
    ",    "Hamburgers",    "Health Food",    "High Tea",    "Jewish",    "Latin",    "Lithuanian",    "
    Middle Eastern",    "N",    "Nicaraguan",    "Noodle Houses",    "Noodle Shops",    "Omelettes",    "
    Oyster Bars",    "Pancakes",    "Pastries",    "Pastry Shops",    "Pizza",    "Pizzerias",    "Po Boys
    ",    "Power Brokers",    "Roumanian",    "Russian",    "Salvadoran",    "Scottish",    "Soul Food",
    "Soulfood",    "Steakhouses",    "Swiss-French",    "Tacos",    "Traditional",    "Ukrainian",
    "Ukranian",    "Venezuelan",    "Yogurt Bar",    "Yugoslavian"';
$style =~  s/[\#@~!&*()\[\];.:?^`\\\/]+//g;
#printf $out $style;

my $dir = 'C:/Users/yhan/Documents/CS773/q7/data';
#open (my $out, '>', 'C:/Users/yhan/Documents/CS773/q7/europeCity2.arff');
foreach my $fp (glob("$dir/*.txt")) {
    open my $fh, "<", $fp or die "can't read open '$fp'";
    #print $fp;
    my $city = (split '\/', $fp)[-1];
    $city = substr($city, 0, -4);
    #printf $out "\"$city\",";
```

```perl
46    open (my $out, '>', "C:/Users/yhan/Documents/CS773/q8/res/$city.txt");
47
48    while (<$fh>) {
49    chomp;
50    my $line = $_;
51    my @res = split /[\s,\t]/, $line;
52    my $resatom = '?';
53    my $resocc = '?';
54    my $resprice = '?';
55    my $ressty = '?';
56    my $resf;
57    print $out "\"$res[0]\",";
58    foreach my $ele (@res) {
59
60
61      if (exists $feature{$ele} ) {
62
63        $resf = $feature{$ele};
64        chomp ($resf);
65        $resf =~ s/[\#@~!\$&*()\[\];.:?^`\\\/]+//g;
66        #print $resprice;
67        if($price =~ /$resf/) {
68          $resprice = $resf;
69
70          }
71        elsif ($style =~ /$resf/) {
72          $ressty = $resf;
73
74          }
75
76        elsif ($atmosphere =~ /$resf/) {
77          $resatom = $resf;
78
79          }
80        elsif ($occasion =~ /$resf/){
81          $resocc = $resf;
82
83          }
84
85      }
86      }
87    #print "\"$city\"\n";
88    #printf $out "\"$res[0]\",\"$resatom\",\"$ressty\",\"$resprice\",\"$resocc\",\"$city\"\n";
89
90    }
91
92
93 }
```

Listing 7: Task viii Perl script

Python Scripts

```python
1  import csv
2  import glob
3  import json
4  import os
5  import re
6  from collections import Counter
7  from os import path
8
9  from functional import seq
10 from nltk.collocations import ngrams
11 from nltk.corpus import gazetteers
12 from nltk.corpus import stopwords
13 from nltk.stem.snowball import EnglishStemmer
14 from nltk.tag import StanfordNERTagger
15 from nltk.tokenize import RegexpTokenizer
16 from nltk.util import everygrams
17
18 from restaurantOriginalData import Restaurant
19 from nationalityToCountry import convert
20
```

```python
21  foodExtractor = re.compile('^(\d+)\t(.+)\t(.+)$')
22  featureExtractor = re.compile('^(\d+)\t(.+)$')
23
24  engStop = stopwords.words('english')
25  eng = EnglishStemmer()
26
27
28  def cleanFeatures(line):
29      return featureExtractor.match(line.rstrip('\n')).groups()
30
31
32  def cleanFood(line):
33      return foodExtractor.match(line.rstrip('\n')).groups()
34
35
36  class bcolors:
37      HEADER = '\033[95m'
38      OKBLUE = '\033[94m'
39      OKGREEN = '\033[92m'
40      WARNING = '\033[93m'
41      FAIL = '\033[91m'
42      ENDC = '\033[0m'
43
44      def disable(self):
45          self.HEADER = ''
46          self.OKBLUE = ''
47          self.OKGREEN = ''
48          self.WARNING = ''
49          self.FAIL = ''
50          self.ENDC = ''
51
52
53  def explore1():
54      restaurants = []
55      features = {}
56      print(glob.glob('dataset/*.txt'))
57      with open('dataset/features.txt', 'r') as featureIn:
58          for line in map(cleanFeatures, featureIn):
59              features[line[0]] = line[1]
60
61      for file in glob.glob('dataset/*.txt'):
62          if not file == 'dataset/features.txt':
63              with open(file, 'r') as fin:
64                  for food in map(cleanFood, fin):
65                      restaurants.append(Restaurant(file, food, features))
66
67      fr = seq(restaurants)  # type: seq
68
69      grouped = fr.flat_map(lambda f: list(map(lambda v: (v, f), f.featureVector))) \
70          .group_by(lambda fv: fv[0]) \
71          .map(lambda item: (item[0], list(map(lambda it: it[1], item[1])))) \
72          .to_dict()
73      for k, v in grouped.items():
74          print(k, v)
75          print('=========================\n\n')
76
77
78  def word_grams(words, min=1, max=4):
79      s = []
80      for n in range(min, max):
81          for ngram in ngrams(words, n):
82              s.append(' '.join(str(i) for i in ngram))
83      return s
84
85
86  def append_elements(n_gram):
87      for element in range(len(n_gram)):
88          phrase = ''
89          for sub_element in n_gram[element]:
90              phrase += sub_element + ' '
91          n_gram[element] = phrase.strip().lower()
92      return n_gram
93
94
95  def compare(n_gram1, n_gram2):
96      n_gram1 = append_elements(n_gram1)
```

```python
      n_gram2 = append_elements(n_gram2)
      common = []
      for phrase in n_gram1:
          if phrase in n_gram2:
              common.append(phrase)
      if not common:
          print("Nothing in common between")
          # or you could print a message saying no commonality was found
      else:
          for i in common:
              print(i)


def firstPassGrouping():
      words = []

      stemmed = []
      features = {}
      tokenizer = RegexpTokenizer('\s+', gaps=True)
      clean = re.compile("[()\/']")
      split = re.compile("[/]")
      grams = []
      with open('dataset/features.txt', 'r') as featureIn:
          for line in map(cleanFeatures, featureIn):
              ws = []
              for w in tokenizer.tokenize(clean.sub(' ', line[1])):
                  if w not in engStop:
                      stemmed.append((eng.stem(w).lower(), line[1]))
                      words.append((w.lower(), line[1]))
                      ws.append(w.lower())

              grams.append((list(everygrams(ws, min_len=2, max_len=2)), line[1]))
              features[line[0]] = line[1]


      # cuisine, style, price, atmosphere, and occasion


      noGrams = set(map(lambda x: x[1], filter(lambda x: len(x[0]) == 0, grams)))

      grams = list(filter(lambda x: len(x[0]) > 0, grams))
      groupedw = seq(grams) \
          .flat_map(lambda x: set([(w, x[1]) for w in seq(x[0]).flat_map(lambda y: list(y)).to_list()])) \
          .group_by(lambda w: w[0]) \
          .map(lambda x: (x[0], list(map(lambda y: y[1], x[1])))) \
          .to_dict()

      noGramsId = {}
      for g in noGrams:
          noGramsId[g] = g
      simGrouped = {}
      simular = set()
      for k, v in sorted(groupedw.items(), key=lambda x: x[0]):
          # print(k, v)
          nl = v.copy()
          match = noGramsId.get(k, None)
          for nk in noGramsId.keys():
              if len(nk) > 1:
                  if nk in v:
                      nl.append(nk)
                      simular.add(nk)
                  for vv in v:
                      if nk in vv:
                          nl.append(nk)
                          simular.add(nk)

          if match is not None:
              nl.append(match)
              simGrouped[k] = list(set(nl))
              simular.add(match)
          else:
              if len(k) > 1:
                  simGrouped[k] = v

      noSim = noGrams - simular
      #
```

```
173        nationalities = gazetteers.words()
174
175        featureNationality = []
176        for nosim in noSim:
177            didConvert = convert(nosim)
178            if didConvert is not None:
179                if didConvert in nationalities:
180                    featureNationality.append(nosim)
181            else:
182                if nosim in nationalities:
183                    featureNationality.append(nosim)
184                else:
185                    split = nosim.split('-')
186                    for sp in split:
187                        if sp in nationalities:
188                            featureNationality.append(nosim)
189
190        # print("----------------------")
191
192
193        noSim = noSim - set(featureNationality)
194        # occasions = ['monday']
195        ## cuisine, style, price, atmosphere, and occasion
196        for k, v in sorted(simGrouped.items(), key=lambda x: x[0]):
197            # print(k,v)
198            if k in nationalities:
199                featureNationality.append(k)
200                featureNationality.extend(v)
201                simGrouped.pop(k)
202            didConvert = convert(k)
203            if didConvert is not None:
204                if didConvert in nationalities:
205                    simGrouped.pop(k)
206                    featureNationality.append(k)
207                    featureNationality.extend(v)
208
209        with open('q1/noSim.json', 'w+') as nsOut:
210            nsOut.write(json.dumps(list(noSim), indent=2, sort_keys=True))
211
212        with open('q1/featureNationality.json', 'w+') as nsOut:
213            nsOut.write(json.dumps(featureNationality, indent=2, sort_keys=True))
214
215        with open('q1/grouped.json', 'w+') as nsOut:
216            nsOut.write(json.dumps(simGrouped, indent=2, sort_keys=True))
217
218
219    def useOtherDataSet():
220        knownCuisine = set()
221        cuisineCounter = Counter()
222        with open('chefmozcuisine.csv', 'r') as cin:
223            for row in csv.DictReader(cin):
224                cuisineCounter[row['Rcuisine']] += 1
225                knownCuisine.add(row['Rcuisine'])
226
227        with open('usercuisine.csv', 'r') as cin:
228            for row in csv.DictReader(cin):
229                cuisineCounter[row['Rcuisine']] += 1
230                knownCuisine.add(row['Rcuisine'])
231
232        q1Cuisine = set()
233        with open('dataset/features.txt', 'r') as featureIn:
234            for line in map(cleanFeatures, featureIn):
235                if line[1] in knownCuisine:
236                    q1Cuisine.add(line[1])
237                    print(line[1])
238        #
239        with open('notq1/q1Labels.json', 'r') as cin:
240            labels = json.load(cin)
241            labels["cuisine"] = sorted(list(q1Cuisine))
242            print(labels)
243            with open('q1/q1Labels.json', 'w+') as cout:
244                json.dump(labels, cout, indent=2, sort_keys=1)
245
246
247    def cleanUp():
248        split = re.compile("[\-\_]")
```

```
249    knownCuisine = []
250    cuisineCounter = Counter()
251    with open('chefmozcuisine.csv', 'r') as cin:
252        for row in csv.DictReader(cin):
253            cuisineCounter[row['Rcuisine']] += 1
254            knownCuisine.append(row['Rcuisine'])
255
256            knownCuisine.extend(split.sub(' ', row['Rcuisine']).split(' '))
257            knownCuisine.extend(split.sub(' ', row['Rcuisine']))
258
259    with open('usercuisine.csv', 'r') as cin:
260        for row in csv.DictReader(cin):
261            cuisineCounter[row['Rcuisine']] += 1
262            knownCuisine.append(row['Rcuisine'])
263            knownCuisine.extend(split.sub(' ', row['Rcuisine']).split(' '))
264            knownCuisine.extend(split.sub(' ', row['Rcuisine']))
265    labels = []
266    with open('q1/q1Labels.json', 'r') as cin:
267        ls = json.load(cin)
268
269    labelsSorted = {}
270
271    for k, v in ls.items():
272        print(k)
273        labelsSorted[k] = sorted(list(set(v)))
274
275    with open('q1/q1Labels.json', 'w+') as cout:
276        json.dump(labelsSorted, cout, indent=2, sort_keys=1)
277
278    for v in labelsSorted.values():
279        labels.extend(v)
280    labels = set(labels)
281    grouped = {}
282    test = {}
283    with open('q1/grouped.json', 'r') as nsOut:
284        g = json.load(nsOut)
285        for k, v in g.items():
286            if len(v) != 0:
287                test[k] = v
288
289    for k, v in test.items():
290        nv = []
291        for vv in v:
292            if vv not in labels:
293                nv.append(vv)
294        if len(nv) != 0:
295            grouped[k] = nv
296    with open('q1/grouped.json', 'w+') as nsOut:
297        nsOut.write(json.dumps(grouped, indent=2, sort_keys=True))
298    print(grouped)
299
300
301 if __name__ == '__main__':
302     print("hi")
303
304     features = {}
305     restaurants = []
306
307     with open('dataset/features.txt', 'r') as featureIn:
308         for line in map(cleanFeatures, featureIn):
309             features[line[0]] = line[1]
310             print(line[1])
311
312     for file in glob.glob('dataset/*.txt'):
313         if not file == 'dataset/features.txt':
314             with open(file, 'r') as fin:
315                 for food in map(cleanFood, fin):
316                     restaurants.append(Restaurant(file, food, features))
317
318     with open('allCities.csv', 'w+') as cout:
319         cout.write('restaurant,city,features\n')
320         for r in restaurants:
321             print(r)
322             cout.write(r.dump_csv())
```

Listing 8: Feature Classification Task i

R Scripts

```r
#!/usr/bin/Rscript
cwd <- getwd()
setwd(cwd)

#sink to redirect stdout to file

source(file=file.path(cwd,'/r/ruleFunctions.R'))

s1 <- read.csv('q2/cuisineCharacters2.csv')

ruleModel <- ruleGen.c50(d=s1,form =  cuisine ~ .,trialNum = 10,winnow = TRUE)


c50Summary <- capture.output(summary(ruleModel))
cat(c50Summary,file = file.path(cwd,'q2','c50_10Trials2.txt'),sep="\n")
```

Listing 9: Task ii R script

```r
#!/usr/bin/Rscript
cwd <- getwd()
setwd(cwd)

q3Dir <- file.path(cwd, 'q3')


source(file = file.path(cwd, 'r', 'helpers.R'))
source(file = file.path(cwd, 'r', 'ruleFunctions.R'))

q3DataList <- helpers.q3()

styleFiltered <-
  helpers.filter_df(q3DataList$q3Data, style != 'none')

styleFiltered$style <- factor(styleFiltered$style)

#### Q3.A
a_rules <- ruleGen.rules_apriori_lh(q3DataList$q3Data, q3DataList$ca)
a_rules <- subset(a_rules, confidence >= 0.49)

a_rules_no_noneStyle <-
  ruleGen.rules_apriori_lh(styleFiltered, q3DataList$ca)
a_rules_no_noneStyle <-
  subset(a_rules_no_noneStyle , confidence >= 0.49)

a_pairs <- helpers.s1_s2_pairs(q3DataList$ca)

a_rules_filter <-
  a_rules[a_rules$lhs %in% a_pairs$lhs1 |
            a_rules$lhs %in% a_pairs$lhs2 , ]
a_rules_filter <- subset(a_rules_filter , confidence >= 0.49)

a_rules_pair_noneStyle <-
  a_rules_no_noneStyle[a_rules_no_noneStyle$lhs %in% a_pairs$lhs1 |
                         a_rules_no_noneStyle$lhs %in% a_pairs$lhs2 , ]
a_rules_pair_noneStyle  <-
  subset(a_rules_no_noneStyle, confidence >= 0.49)

a_rules <- helpers.orderConfidence(a_rules)
write.csv(
  helpers.select_rules_quality(a_rules),
  file = file.path(q3Dir, 'q3a_rule.csv'),
  fileEncoding = 'utf8',
  row.names = F
)

a_rules_no_noneStyle <- helpers.orderConfidence(a_rules_no_noneStyle)
write.csv(
 helpers.select_rules_quality(a_rules_no_noneStyle),
  file = file.path(q3Dir, 'q3a_rule_NNS.csv'),
  fileEncoding = 'utf8',
  row.names = F
)
```

```
56  a_rules_filter <- helpers.orderConfidence(a_rules_filter)
57  write.csv(
58    helpers.select_rules_quality(a_rules_filter),
59      file = file.path(q3Dir, 'q3a_rule_pairFilter.csv'),
60      fileEncoding = 'utf8',
61      row.names = F
62  )
63
64  a_rules_pair_noneStyle <- helpers.orderConfidence(a_rules_pair_noneStyle)
65  write.csv(
66    helpers.select_rules_quality(a_rules_pair_noneStyle),
67      file = file.path(q3Dir, 'q3a_rule_NNS_pair.csv'),
68      fileEncoding = 'utf8',
69      row.names = F
70  )
71
72  #### Q3.B
73  b_rules <- ruleGen.rules_apriori_lh(q3DataList$q3Data, q3DataList$ap)
74  b_rules <- subset(b_rules, confidence >= 0.49)
75  b_rules_no_noneStyle <-
76      ruleGen.rules_apriori_lh(styleFiltered, q3DataList$ap)
77  b_rules_no_noneStyle <-
78      subset(b_rules_no_noneStyle, confidence >= 0.49)
79  # b_cumaliative_rules = helpers.group_by_lhs(b_rules_no_noneStyle)
80
81  b_pairs <- helpers.s1_s2_pairs(q3DataList$ap)
82
83  b_rules_filter <-
84      b_rules[b_rules$lhs %in% b_pairs$lhs1 |
85                  b_rules$lhs %in% b_pairs$lhs2, ]
86  b_rules_filter <- subset(b_rules_filter, confidence >= 0.49)
87  b_rulesNSN_filter <-
88      b_rules_no_noneStyle[b_rules_no_noneStyle$lhs %in% b_pairs$lhs1 |
89                            b_rules_no_noneStyle$lhs %in% b_pairs$lhs2, ]
90  b_rulesNSN_filter <- subset(b_rulesNSN_filter, confidence >= 0.49)
91
92
93  b_rules <- helpers.orderConfidence(b_rules)
94  write.csv(
95    helpers.select_rules_quality(b_rules),
96      file = file.path(q3Dir, 'q3b_rule.csv'),
97      fileEncoding = 'utf8',
98      row.names = F
99  )
100
101 b_rules_no_noneStyle <- helpers.orderConfidence(b_rules_no_noneStyle)
102 write.csv(
103   helpers.select_rules_quality(b_rules_no_noneStyle),
104     file = file.path(q3Dir, 'q3b_rule_NNS.csv'),
105     fileEncoding = 'utf8',
106     row.names = F
107 )
108
109 b_rules_filter <- helpers.orderConfidence(b_rules_filter)
110 write.csv(
111   helpers.select_rules_quality(b_rules_filter),
112     file = file.path(q3Dir, 'q3b_rule_pairFilter.csv'),
113     fileEncoding = 'utf8',
114     row.names = F
115 )
116
117 b_rulesNSN_filter <- helpers.orderConfidence(b_rulesNSN_filter)
118 write.csv(
119   helpers.select_rules_quality(b_rulesNSN_filter),
120     file = file.path(q3Dir, 'q3b_rule_NNS_filter.csv'),
121     fileEncoding = 'utf8',
122     row.names = F
123 )
124
125 #### Q3.C
126 c_rules <- ruleGen.rules_apriori_lh(q3DataList$q3Data, q3DataList$sp)
127 c_rules <- subset(c_rules, confidence >= 0.49)
128 c_rules_no_noneStyle <-
129   ruleGen.rules_apriori_lh(styleFiltered, q3DataList$sp)
130 c_rules_no_noneStyle <-
131   subset(c_rules_no_noneStyle, confidence >= 0.49)
```

```r
132 # c_cumaliative_rules = helpers.group_by_lhs(c_rules_no_noneStyle)
133
134 c_pairs <- helpers.s1_s2_pairs(q3DataList$sp)
135
136 c_rules_filter <-
137   c_rules[c_rules$lhs %in% c_pairs$lhs1 |
138            c_rules$lhs %in% c_pairs$lhs2, ]
139 c_rulesNSN_filter <-
140   c_rules_no_noneStyle[c_rules_no_noneStyle$lhs %in% c_pairs$lhs1 |
141                         c_rules_no_noneStyle$lhs %in% c_pairs$lhs2, ]
142
143 c_rules <- helpers.orderConfidence(c_rules)
144 c_rules_no_noneStyle <- helpers.orderConfidence(c_rules_no_noneStyle)
145 c_rules_filter <- helpers.orderConfidence(c_rules_filter)
146 c_rulesNSN_filter <- helpers.orderConfidence(c_rulesNSN_filter)
147
148 write.csv(
149  helpers.select_rules_quality(c_rules),
150    file = file.path(q3Dir, 'q3c_rule.csv'),
151    fileEncoding = 'utf8',
152    row.names = F
153 )
154
155 write.csv(
156  helpers.select_rules_quality(c_rules_no_noneStyle),
157    file = file.path(q3Dir, 'q3c_rule_NNS.csv'),
158    fileEncoding = 'utf8',
159    row.names = F
160 )
161 write.csv(
162  helpers.select_rules_quality(c_rules_filter),
163    file = file.path(q3Dir, 'q3c_rule_pairFilter.csv'),
164    fileEncoding = 'utf8',
165    row.names = F
166 )
167 write.csv(
168  helpers.select_rules_quality(c_rulesNSN_filter),
169    file = file.path(q3Dir, 'q3c_rule_NNS_filter.csv'),
170    fileEncoding = 'utf8',
171    row.names = F
172 )
173
174 #### Q3.D
175 d_rules <- ruleGen.rules_apriori_lh(q3DataList$q3Data, q3DataList$co)
176 d_rules <- subset(d_rules, confidence >= 0.49)
177 d_rules_no_noneStyle <-
178   ruleGen.rules_apriori_lh(styleFiltered, q3DataList$co)
179 d_rules_no_noneStyle  <-
180   subset(d_rules_no_noneStyle , confidence >= 0.49)
181 # d_cumaliative_rules = helpers.group_by_lhs(d_rules_no_noneStyle)
182
183 d_pairs <- helpers.s1_s2_pairs(q3DataList$co)
184
185 d_rules_filter <-
186   d_rules[d_rules$lhs %in% d_pairs$lhs1 |
187            d_rules$lhs %in% d_pairs$lhs2, ]
188 d_rules_filter <- subset(d_rules_filter, confidence >= 0.49)
189 d_rulesNSN_filter <-
190   d_rules_no_noneStyle[d_rules_no_noneStyle$lhs %in% d_pairs$lhs1 |
191                         d_rules_no_noneStyle$lhs %in% d_pairs$lh2, ]
192 d_rulesNSN_filter <- subset(d_rulesNSN_filter, confidence >= 0.49)
193
194
195 d_rules <- helpers.orderConfidence(d_rules)
196 d_rules_no_noneStyle <- helpers.orderConfidence(d_rules_no_noneStyle)
197 d_rules_filter <- helpers.orderConfidence(d_rules_filter)
198 d_rulesNSN_filter <- helpers.orderConfidence(d_rulesNSN_filter)
199
200 write.csv(
201  helpers.select_rules_quality(d_rules),
202    file = file.path(q3Dir, 'q3d_rule.csv'),
203    fileEncoding = 'utf8',
204    row.names = F
205 )
206 write.csv(
207  helpers.select_rules_quality(d_rules_no_noneStyle),
```

```
208      file = file.path(q3Dir, 'q3d_rule_NNS.csv'),
209      fileEncoding = 'utf8',
210      row.names = F
211  )
212  write.csv(
213    helpers.select_rules_quality(d_rules_filter),
214      file = file.path(q3Dir, 'q3d_rule_pairFilter.csv'),
215      fileEncoding = 'utf8',
216      row.names = F
217  )
218  write.csv(
219    helpers.select_rules_quality(d_rulesNSN_filter),
220      file = file.path(q3Dir, 'q3d_rule_pairFilter_NNS.csv'),
221      fileEncoding = 'utf8',
222      row.names = F
223  )
224
225  #### Q3.E
226  e_rules <- ruleGen.rules_apriori_lh(q3DataList$q3Data, q3DataList$dp)
227  e_rules <- subset(e_rules, confidence >= 0.49)
228  e_rules_no_noneStyle <-
229    ruleGen.rules_apriori_lh(styleFiltered, q3DataList$dp)
230  e_rules_no_noneStyle  <-
231    subset(e_rules_no_noneStyle , confidence >= 0.49)
232  # e_cumaliative_rules = helpers.group_by_lhs(e_rules_no_noneStyle)
233
234  e_pairs <- helpers.s1_s2_pairs(q3DataList$dp)
235
236  e_rules_filter <-
237    e_rules[e_rules$lhs %in% e_pairs$lhs1 |
238              e_rules$lhs %in% e_pairs$lhs2, ]
239  e_rules_filter <- subset(e_rules_filter, confidence >= 0.49)
240  e_rulesNSN_filter <-
241    e_rules_no_noneStyle[e_rules_no_noneStyle$lhs %in% e_pairs$lhs1 |
242                          e_rules_no_noneStyle$lhs %in% e_pairs$lhs2, ]
243  e_rulesNSN_filter <- subset(e_rulesNSN_filter, confidence >= 0.49)
244
245
246  e_rules <- helpers.orderConfidence(e_rules)
247  e_rules_no_noneStyle <- helpers.orderConfidence(e_rules_no_noneStyle)
248  e_rules_filter <- helpers.orderConfidence(e_rules_filter)
249  e_rulesNSN_filter <- helpers.orderConfidence(e_rulesNSN_filter)
250
251  write.csv(
252    helpers.select_rules_quality(e_rules),
253      file = file.path(q3Dir, 'q3e_rule.csv'),
254      fileEncoding = 'utf8',
255      row.names = F
256  )
257  write.csv(
258    helpers.select_rules_quality(e_rules_no_noneStyle),
259      file = file.path(q3Dir, 'q3e_rule_NNS.csv'),
260      fileEncoding = 'utf8',
261      row.names = F
262  )
263  write.csv(
264    helpers.select_rules_quality(e_rules_filter),
265      file = file.path(q3Dir, 'q3e_rule_pairFilter.csv'),
266      fileEncoding = 'utf8',
267      row.names = F
268  )
269  write.csv(
270    helpers.select_rules_quality(e_rulesNSN_filter),
271      file = file.path(q3Dir, 'q3e_rule_NNS_filtered.csv'),
272      fileEncoding = 'utf8',
273      row.names = F
274  )
275
276  ### everything
277
278  all_data_rules <- ruleGen.apriori(q3DataList$q3Data)
279  all_data_rules <- subset(all_data_rules, confidence >= 0.49)
280
281  all_data_rule_noStyleNone <- ruleGen.apriori(styleFiltered)
282  all_data_rule_noStyleNone <-
283    subset(all_data_rule_noStyleNone, confidence >= 0.49)
```

```
284
285  write.csv(
286    helpers.select_rules_quality(all_data_rules),
287      file = file.path(q3Dir, 'q3All_rule.csv'),
288      fileEncoding = 'utf8',
289      row.names = F
290  )
291  write.csv(
292    helpers.select_rules_quality(all_data_rule_noStyleNone),
293      file = file.path(q3Dir, 'q3All_rule_NNS.csv'),
294      fileEncoding = 'utf8',
295      row.names = F
296  )
297
298  unique_features <- helpers.unqiue_all(q3DataList$q3Data)
```

Listing 10: Task iii R script

```
1   library(lsr)
2   library(foreach)
3   library(iterators)
4   cwd <- getwd()
5   setwd(cwd)
6   source(file = file.path(cwd, 'r', 'helpers.R'))
7
8   q4DataList <- helpers.q4()
9   q4Data <- q4DataList$q4Data
10
11  par(mfrow=c(2,2))
12
13  # table(q4Data)
14
15  cuisine_foodQuality <- q4DataList$cfq
16  cuisine_foodQualityD <- q4DataList$cfqd
17  cuisine_fq_spread <- q4DataList$cq_spread
18  cuisine_fqd_spread <- q4DataList$cqD_spread
19  cuisine_fqSides <- q4DataList$cfqSide
20
21  c_fq_numeric = data.frame(
22      cuisine = as.numeric(cuisine_foodQuality$cuisine),
23      quality = as.numeric(cuisine_foodQuality$quality)
24  )
25
26  cuisine_fq_spread$cuisine <- as.numeric(cuisine_fq_spread$cuisine)
27
28
29  cfq_lm <-
30      lm(
31          cuisine ~ `Excellent Food` + `Extraordinary Food` + `Fair Food` + `Good Food` + `Near-perfect Food`,
32          data = cuisine_fq_spread
33      )
34
35  cfq_lmSum <- capture.output(summary(cfq_lm))
36  cat(cfq_lmSum, file = file.path(cwd,'q4','cuisine_quality_spread_summary.txt'),sep="\n")
37
38  write.csv(
39      cuisine_fq_spread,
40      file = file.path(cwd,'q4','cuisine_quality_spread_count.txt'),
41      fileEncoding = 'utf8',
42      row.names = F
43  )
44
45  plot(cfq_lm)
46
47  cuisine_fqd_spread$cuisine <- as.numeric(cuisine_fqd_spread$cuisine)
48
49  cfqd_lm <-
50      lm(cuisine ~ Good + Fair + Excellent, data = cuisine_fqd_spread)
51
52  cfqd_lmSum <- capture.output(summary(cfqd_lm))
53  cat(cfqd_lmSum, file = file.path(cwd,'q4','cuisine_qualityD_spread_summary.txt'),sep="\n")
54
55  summary(cfqd_lm)
56  plot(cfqd_lm)
57
```

```
58  cuisine_fq_spread <- q4DataList$cq_spread
59  cuisine_fqd_spread <- q4DataList$cqD_spread
60
61  cfq_glm <-
62    glm(
63      cuisine ~ `Excellent Food` + `Extraordinary Food` + `Fair Food` + `Good Food` + `Near-perfect Food`,
64      family= binomial(link = "logit"),
65      data = cuisine_fq_spread
66    )
67
68  cfq_norm_gmSum <- capture.output(summary(cfq_glm))
69  cat(cfq_norm_lmSum,file = file.path(cwd,'q4','cuisine_quality_GLM_summary.txt'),sep="\n")
70  summary(cfq_glm)
71  plot(cfq_glm)
72
73  cfqd_glm <-
74    glm(
75      cuisine ~ Good + Fair + Excellent,
76      family =
77        binomial(link = "logit"),
78      data = cuisine_fqd_spread
79    )
80
81  cfqd_gmSum <- capture.output(summary(cfqd_glm))
82  cat(cfqd_gmSum,file = file.path(cwd,'q4','cuisine_qualityD_GLM_summary.txt'),sep="\n")
83
84  summary(cfqd_glm)
85  plot(cfqd_glm)
```

Listing 11: Task iv R script

```
1   library(caret)
2   library(arules)
3   library(C50)
4   library(Rsenal)
5   library(rpart)
6
7
8   ruleGen.c50 <- function(d,
9                            form,
10                           trialNum = 4,
11                           winnow = FALSE) {
12    C5.0(
13      formula = form,
14      data = d,
15      trials = trialNum,
16      control = C5.0Control(subset = TRUE, winnow = winnow),
17      rules = TRUE
18    )
19  }
20
21  ruleGen.apriori <-
22    function(data, minLen = 2, maxLen = 15,
23             sup = 0.005, conf = 0.005, targ = 'rules',
24             rH = NULL, lH = NULL, deflt = 'lhs',list=F) {
25      appear <- NULL
26      lhNull <- is.null(lH)
27      rhNull <- is.null(rH)
28      if (!lhNull && !rhNull) {
29        appear <- list(rhs = rH,
30                       lhs = lH,
31                       default = deflt)
32      } else if (!lhNull && rhNull) {
33        appear <- list(lhs = lH,
34                       default = deflt)
35      } else if (lhNull && !rhNull) {
36        appear <- list(rhs = rH,
37                       default = deflt)
38      } else {
39        appear <- list(default = 'both')
40      }
41
42      rules <- apriori(
43        data,
44        parameter = list(
```

```r
45              minlen = minLen,
46              maxlen = maxLen,
47              supp = sup,
48              confidence = conf,
49              target = targ
50          ),
51          appearance = appear,
52          control = list(verbose = F, filter = 0)
53      )
54
55      if(length(rules) > 0) {
56        rules2df(addRuleQuality(
57            trans = data,
58            rules = rules,
59            exclude =  c(
60              "hyperConfidence",
61              "cosine",
62              "chiSquare",
63              "coverage",
64              "doc",
65              "gini",
66              "hyperLift",
67              "fishersExactTest",
68              "improvement",
69              "leverage",
70              "oddsRatio",
71              "phi",
72              "RLD"
73            )
74        ), list = list)
75      } else {
76        'no rules'
77      }
78
79 }
80
81 ruleGen.part <- function(data, form) {
82    train(form, data = data, method = "PART")
83 }
84
85 ruleGen.appearance_pair_list <- function(df,notFromHelper=F) {
86    # browser()
87    if(notFromHelper){
88      unlist(c(levels(unique(df$s1)), levels(unique(df$s2))),use.names=F)
89    } else {
90      unlist(c(unique(df$s1), unique(df$s2)),use.names=F)
91      # isS1_list = is.list(df$s1)
92      # isS2_list = is.list(df$s2)
93      #
94      # if(isS1_list && isS2_list) {
95      #   unlist(c(unique(df$s1), unique(df$s2)),use.names=F)
96      # } else if(!isS1_list && isS2_list){
97      #   unlist(c(df$s1, unique(df$s2)),use.names=F)
98      # } else {
99      #   unlist(c(unique(df$s1), df$s2),use.names=F)
100     # }
101   }
102 }
103
104 ruleGen.rules_apriori_lh <- function(data,feature_pair,notFromHelper=F,sup=0.0005, conf = 0.0005,minLen =
105     2, maxLen = 15, list=F)  {
105    rlh <- ruleGen.appearance_pair_list(feature_pair, notFromHelper = notFromHelper)
106    ruleGen.apriori(
107      data,
108      lH = rlh,
109      sup = sup,
110      conf = conf,
111      minLen = minLen,
112      maxLen = maxLen,
113      deflt = 'rhs',
114      list=list
115    )
116 }
117
118 ruleGen.rules_apriori_lhGrouped <- function(data,lhs_grouped,notFromHelper=F,sup=0.0005, conf = 0.0005,
       minLen = 2, maxLen = 15, list=F)  {
```

```
119
120   ruleGen.apriori(
121      data,
122      lH = rlh,
123      sup = sup,
124      conf = conf,
125      minLen = minLen,
126      maxLen = maxLen,
127      deflt = 'rhs',
128      list=list
129   )
130 }
131
132 ruleGen.rules_to_df <- function(rules,list=F){
133    rules2df(rules,list=list)
134 }
```

Listing 12: Rule functions

```
1  library(dplyr)
2  library(tidyr)
3  library(purrr)
4  library(stringr)
5  library(reshape2)
6  library(foreach)
7  library(iterators)
8
9  setwd(getwd())
10
11 helpers.filter_df <- function(data,...) {
12    data %>% filter(...)
13 }
14
15
16 helpers.select_rules_quality <- function(data) {
17    data %>% select(rules,support,confidence,lift,conviction)
18 }
19
20 helpers.orderConfidence <- function(data) {
21    data[with(data,order(confidence,decreasing = T)),]
22 }
23
24 helpers.unqiue_all <- function(data) {
25
26    ucuisine <- data %>% select(cuisine) %>% distinct
27    uatmosphere <- data %>% select(atmosphere) %>% distinct
28    uoccasion <- data %>% select(occasion) %>% distinct
29    uprice <- data %>% select(price) %>% distinct
30    ustyle <- data %>% select(style) %>% distinct
31
32    list(
33     c = ucuisine,
34     a = uatmosphere,
35     o = uoccasion,
36     p = uprice,
37     s = ustyle
38    )
39 }
40
41 helpers.test <- function(d,sides,...) {
42    # it <- sides %>% by_row(function(r)
43    #    c(str_trim(r$s1, side = c(
44    #       "both", "left", "right"
45    #    )), str_trim(r$s2, side = c(
46    #       "both", "left", "right"
47    #    ))), .to = 'rdf')
48    #
49     foreach(r = iter(sides,by='row'),.combine = c) %do% {
50       print(d %>% select(cuisine == r$s1 & atmosphere == r$s2))
51       pair <- c(r$s1,r$s2)
52       1
53     }
54    # View(it)
55 }
56
```

```r
helpers.s1_to_groupedS2 <- function(d,sides,rulesFun) {
  sides %>% group_by(s1) %>% summarise(s2 = list(s2)) %>%
    by_row(function(r) unlist(list(r$s1,r$s2)), .to='lhs') %>%
    by_row(function(r)  do.call(rulesFun,list(data=d,lH = r$lhs, deflt = 'rhs' )), .to='rdf')
}


helpers.s1_s2_pairs <- function(sides) {
  sides %>% mutate(lhs1 = paste(s1,s2,sep=','),lhs2 = paste(s2,s1,sep=','))
}


helpers.pair_count <- function(df) {
  df %>% summarise()
}

helpers.q3 <- function(write = F, filter = NULL) {
  data <-
    read.csv(file.path('q3','restaurantsq3.csv'))

  filter <- !is.null(filter)

  cuisine_atmosphere <-
    data %>% select(cuisine, atmosphere) %>% distinct %>%
    filter(cuisine != 'none' & atmosphere != 'none') %>%
    transmute(
      s1 = paste('cuisine', cuisine, sep = '='),
      s2 = paste('atmosphere', atmosphere, sep = '=')
    )

  cuisine_occasion <-
    data %>% select(cuisine, occasion) %>% distinct %>%
    filter(cuisine != 'none' & occasion != 'none') %>%
    transmute(
      s1 = paste('cuisine', cuisine, sep = '='),
      s2 = paste('occasion', occasion, sep = '=')
    )

  cuisine_price <-
    data %>% select(cuisine, price) %>% distinct  %>%
    filter(cuisine != 'none' & price != 'none') %>%
    transmute(s1 = paste('cuisine', cuisine, sep = '='),
              s2 = paste('price', price, sep = '='))

  cuisine_style <-
    data %>% select(cuisine, style) %>% distinct  %>%
    filter(cuisine != 'none' & style != 'none') %>%
    transmute(s1 = paste('cuisine', cuisine, sep = '='),
              s2 = paste('style', style, sep = '='))

  atmosphere_occasion <-
    data %>% select(atmosphere, occasion) %>% distinct  %>%
    filter(atmosphere != 'none' & occasion != 'none') %>%
    transmute(
      s1 = paste('atmosphere', atmosphere, sep = '='),
      s2 = paste('occasion', occasion, sep = '=')
    )

  atmosphere_price <-
    data %>% select(atmosphere, price) %>% distinct  %>%
    filter(atmosphere != 'none' & price != 'none') %>%
    transmute(
      s1 = paste('atmosphere', atmosphere, sep = '='),
      s2 = paste('price', price, sep = '=')
    )

  atmosphere_style <-
    data %>% select(atmosphere, style) %>% distinct  %>%
    filter(atmosphere != 'none' & style != 'none') %>%
    transmute(
      s1 = paste('atmosphere', atmosphere, sep = '='),
      s2 = paste('style', style, sep = '=')
    )
```

```r
133
134    occasion_price <-
135        data %>% select(occasion, price) %>% distinct %>%
136        filter(occasion != 'none' & price != 'none') %>%
137        transmute(
138          s1 = paste('occasion', occasion, sep = '='),
139          s2 = paste('price', price, sep = '=')
140        )
141
142    occasion_style <-
143        data %>% select(occasion, style) %>% distinct %>%
144        filter(occasion != 'none' & style != 'none') %>%
145        transmute(
146          s1 = paste('occasion', occasion, sep = '='),
147          s2 = paste('style', style, sep = '=')
148        )
149
150    style_price <-
151        data %>% select(style, price) %>% distinct %>%
152        filter(style != 'none' & price != 'none') %>%
153        transmute(s1 = paste('style', style, sep = '='),
154                  s2 = paste('price', price, sep = '='))
155
156    decor_price <-
157        data %>% select(atmosphere, price) %>% distinct %>%
158        filter(atmosphere != 'none' &
159                  price != 'none' & grepl('Decor', atmosphere)) %>%
160        transmute(
161          s1 = paste('atmosphere', atmosphere, sep = '='),
162          s2 = paste('price', price, sep = '=')
163        )
164
165    if (write) {
166        dataForR <- file.path('..', 'r_data')
167        dir.create(dataForR, showWarnings = F)
168
169        write.csv(
170          cuisine_atmosphere,
171          file = file.path(dataForR, 'q3_cuisine_atmosphere.csv'),
172          fileEncoding = 'utf8',
173          row.names = F
174        )
175
176        write.csv(
177          cuisine_occasion,
178          file = file.path(dataForR, 'q3_cuisine_occasion.csv'),
179          fileEncoding = 'utf8',
180          row.names = F
181        )
182
183        write.csv(
184          cuisine_price,
185          file = file.path(dataForR, 'q3_cuisine_price.csv'),
186          fileEncoding = 'utf8',
187          row.names = F
188        )
189
190        write.csv(
191          cuisine_style,
192          file = file.path(dataForR, 'q3_cuisine_style.csv'),
193          fileEncoding = 'utf8',
194          row.names = F
195        )
196
197        write.csv(
198          atmosphere_occasion,
199          file = file.path(dataForR, 'q3_atmosphere_occasion.csv'),
200          fileEncoding = 'utf8',
201          row.names = F
202        )
203
204        write.csv(
205          atmosphere_price,
206          file = file.path(dataForR, 'q3_atmosphere_price.csv'),
207          fileEncoding = 'utf8',
208          row.names = F
```

```
209        )
210
211      write.csv(
212        atmosphere_style,
213        file = file.path(dataForR, 'q3_atmosphere_style.csv'),
214        fileEncoding = 'utf8',
215        row.names = F
216      )
217
218      write.csv(
219        occasion_price,
220        file = file.path(dataForR, 'q3_occasion_price.csv'),
221        fileEncoding = 'utf8',
222        row.names = F
223      )
224
225      write.csv(
226        occasion_style,
227        file = file.path(dataForR, 'q3_occasion_style.csv'),
228        fileEncoding = 'utf8',
229        row.names = F
230      )
231
232      write.csv(
233        style_price,
234        file = file.path(dataForR, 'q3_style_price.csv'),
235        fileEncoding = 'utf8',
236        row.names = F
237      )
238
239      write.csv(
240        decor_price,
241        file = file.path(dataForR, 'q3_decor_price.csv'),
242        fileEncoding = 'utf8',
243        row.names = F
244      )
245    }
246
247    list(
248      q3Data = data,
249      ca = cuisine_atmosphere,
250      co = cuisine_occasion,
251      cp = cuisine_price,
252      cs = cuisine_style,
253      ao = atmosphere_occasion,
254      ap = atmosphere_price,
255      as = atmosphere_style,
256      op = occasion_price,
257      os = occasion_style,
258      sp = style_price,
259      dp = decor_price
260    )
261 }
262
263
264
265 helpers.q4 <- function(write = F) {
266    data <- read.csv(file.path('q3', 'restaurantsq3.csv'))
267
268    cuisine_foodQuality <-
269      data %>% select(cuisine, atmosphere) %>%
270      filter(grepl('Food', atmosphere))
271
272    cuisine_foodQualitySide <-
273      cuisine_foodQuality %>% distinct %>%
274      transmute(
275        s1 = paste('cuisine', cuisine, sep = '='),
276        s2 = paste('atmosphere', atmosphere, sep = '=')
277      )
278
279    cuisine_foodQuality <- cuisine_foodQuality %>% transmute(cuisine=cuisine ,quality = atmosphere)
280
281    cuisine_foodQuality <- droplevels(cuisine_foodQuality)
282    cq_spread <- cuisine_foodQuality %>% group_by(cuisine,quality) %>% tally %>% spread(quality,n,fill = 0)
283
284    cuisine_foodQualityD = cuisine_foodQuality
```

```r
    cuisine_foodQualityD$quality <-
      recode_factor(
        cuisine_foodQualityD$quality,
        `Excellent Food` = "Good",
        `Near-perfect Food` = "Excellent",
        `Extraordinary Food` = "Excellent",
        `Fair Food` = 'Fair',
        `Good Food` = 'Good'
      )

    cqD_spread <- cuisine_foodQualityD %>% group_by(cuisine, quality) %>% tally %>% spread(quality, n, fill =
        0)

    # cqD_spread %>% group_by(cuisine) %>% mutate(fit = lm())

    # cuisine_foodQuality$cuisine <- levels(cuisine_foodQuality$cuisine)
    # cuisine_foodQuality$quality <- levels(cuisine_foodQuality$quality)

    list(q4Data = data,
         cfqSide = cuisine_foodQualitySide,
         cfq = cuisine_foodQuality,
         cfqd = cuisine_foodQualityD,
         cqD_spread = cqD_spread,
         cq_spread=cq_spread)
}


helpers.pair_count <- function(df) {
  ldf <- df %>% transmute(
    cuisine = levels(unique(cuisine)),
    atmosphere = levels(unique(atmosphere)),
    occasion = levels(unique(occasion)),
    price = levels(unique(price)),
    style = levels(unique(style))
  )

  list(
      cuisine_atmosphere = df %>% select(cuisine, atmosphere) %>% group_by(cuisine, atmosphere) %>% tally(
          sort = TRUE),
      cuisine_occasion = df %>% select(cuisine, occasion) %>% group_by(cuisine, occasion) %>% tally(sort =
          TRUE),
      cuisine_price = df %>% select(cuisine, price) %>% group_by(cuisine, price) %>% tally(sort = TRUE),
      cuisine_style = df %>% select(cuisine, atmosphere) %>%  group_by(cuisine, atmosphere) %>% tally(sort
          = TRUE),
      atmosphere_occasion = df %>% select(cuisine, style) %>% group_by(cuisine, style) %>% tally(sort =
          TRUE),
      atmosphere_price = df %>% select(atmosphere, price) %>% group_by(atmosphere, price) %>% tally(sort =
          TRUE),
      atmosphere_style = df %>% select(atmosphere, style) %>% group_by(atmosphere, style) %>% tally(sort =
          TRUE),
      occasion_price = df %>% select(occasion, price) %>% group_by(occasion, price) %>% tally(sort = TRUE)
          ,
      occasion_style = df %>% select(occasion, style) %>% group_by(occasion, style) %>% tally(sort = TRUE)
          ,
      style_price = df %>% select(style, price) %>% group_by(style, price) %>% tally(sort = TRUE)
  )
}

helpers.q2_appearance <- function() {
  cuisine_appearance <-
    data %>% distinct(cuisine) %>% transmute(side = paste('cuisine', cuisine, sep = '='))

  atmosphere_appearance <-
    data %>% distinct(atmosphere) %>% transmute(side = paste('atmosphere', atmosphere, sep = '='))

  occasion_appearance <-
    data %>% distinct(occasion) %>% transmute(side = paste('occasion', occasion, sep = '='))

  price_appearance <-
    data %>% distinct(price) %>% transmute(side = paste('price', price, sep = '='))

  style_appearance <-
    data %>% distinct(style) %>% transmute(side = paste('style', style, sep = '='))

  write.csv(
    cuisine_appearance,
```

```r
          file = file.path(dataForR, 'q2_cuisine_ap.csv'),
          fileEncoding = 'utf8'
      )
      write.csv(
          atmosphere_appearance,
          file = file.path(dataForR, 'q2_atmosphere_ap.csv'),
          fileEncoding = 'utf8'
      )
      write.csv(
          occasion_appearance,
          file = file.path(dataForR, 'q2_occasion_ap.csv'),
          fileEncoding = 'utf8'
      )
      write.csv(
          price_appearance,
          file = file.path(dataForR, 'q2_price_ap.csv'),
          fileEncoding = 'utf8'
      )
      write.csv(
          style_appearance,
          file = file.path(dataForR, 'q2_style_ap.csv'),
          fileEncoding = 'utf8'
      )
}

helpers.group_by_lhs <- function(ruleDF) {
    ruleDF %>% select(lhs, rhs, support, confidence, lift, conviction) %>% group_by(lhs) %>% summarise(
        associated = list(rhs),
        cumSup = sum(support),
        cumConf = sum(confidence),
        cumLift = sum(lift),
        sumConv = sum(conviction)
    )
}

# from http://www.r-bloggers.com/measuring-associations-between-non-numeric-variables/
helpers.GKtau <- function(x,y){
    #
    #  First, compute the IxJ contingency table between x and y
    #
    Nij <- table(x,y,useNA='ifany')
    #
    #  Next, convert this table into a joint probability estimate
    #
    PIij <- Nij/sum(Nij)
    #
    #  Compute the marginal probability estimates
    #
    PIiPlus = apply(PIij,MARGIN=1,sum)
    PIPlusj = apply(PIij,MARGIN=2,sum)
    #
    #  Compute the marginal variation of y
    #
    Vy <- 1 - sum(PIPlusj^2)
    #
    #  Compute the expected conditional variation of y given x
    #
    InnerSum <- apply(PIij^2,MARGIN=1,sum)
    VyBarx <-  1 - sum(InnerSum/PIiPlus)
    #
    #  Compute and return Goodman and Kruskal s tau measure
    #
    tau <- (Vy - VyBarx)/Vy
    tau
}
```

Listing 13: Helper functions

Task iii Rules

Cuisine and atmosphere Normal

<div align="center">Normal</div>

{cuisine=Pacific Rim} =>{style=none}
{cuisine=Austrian} =>{price=$15-$30}
{cuisine=Burritos} =>{price=below $15}
{cuisine=Ethiopian} =>{style=none}
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{cuisine=Coffee and Dessert,atmosphere=For the Young and Young at Heart} =>{price=$15-$30}
{cuisine=Creole,atmosphere=Excellent Decor} =>{price=$15-$30}
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No *style=none*

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Unique Pairs

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Unique Pairs and No *style=none*

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{cuisine=American,atmosphere=Need To Dress} =>{price=$30-$50}
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Price and Atmosphere

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{atmosphere=Good for Younger Kids,price=$15-$30} =>{style=none}
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No *style=none*

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Unique Pairs

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{atmosphere=Fair Decor,price=$15-$30} =>{style=none}
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{atmosphere=Good Service,price=$15-$30} =>{style=none}
{atmosphere=Excellent Food,price=$15-$30} =>{style=none}
{atmosphere=Quiet for Conversation,price=over $50} =>{style=none}
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{atmosphere=Relaxed Senior Scene,price=$15-$30} =>{style=none}
{atmosphere=Up and Coming,price=$30-$50} =>{style=none}
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{atmosphere=Fabulous Wine Lists,price=over $50} =>{style=Power Brokers}
{atmosphere=Place for Singles,price=$15-$30} =>{style=none}
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{atmosphere=Old World Cafe Charm,price=$30-$50} =>{style=none}
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{atmosphere=No Smoking Allowed,price=$30-$50} =>{style=none}
{atmosphere=Fabulous Views,price=$15-$30} =>{style=none}
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{atmosphere=Quirky,price=$15-$30} =>{style=none}
{atmosphere=An Historic Spot,price=below $15} =>{cuisine=American}
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{atmosphere=Wheelchair Access,price=$15-$30} =>{style=none}
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{atmosphere=Pub Feel,price=$15-$30} =>{cuisine=American}
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{atmosphere=Parking/Valet,price=$15-$30} =>{style=none}
{atmosphere=Classic Hotel Dining,price=$15-$30} =>{style=none}
{atmosphere=Near-perfect Decor,price=over $50} =>{cuisine=French}
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{atmosphere=Credit cards are not accepted,price=below $15} =>{style=none}
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None

Unique Pairs and No *style=none*

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{atmosphere=Near-perfect Food,price=over $50} =>{style=Power Brokers}
{atmosphere=Up and Coming,price=below $15} =>{style=Tacos}
{atmosphere=Hip Place To Be,price=over $50} =>{style=Power Brokers}
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{atmosphere=Hip Place To Be,price=over $50} =>{cuisine=French}
{atmosphere=An Historic Spot,price=below $15} =>{cuisine=American}
{atmosphere=Romantic,price=over $50} =>{style=Power Brokers}
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{atmosphere=People Keep Coming Back,price=$15-$30} =>{cuisine=American}
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{atmosphere=Very Busy - Reservations a Must,price=over $50} =>{style=Power Brokers}
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{atmosphere=Place for Singles,price=$30-$50} =>{cuisine=American}
{atmosphere=Singles Scene,price=$30-$50} =>{style=Power Brokers}
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{atmosphere=Need To Dress,price=over $50} =>{cuisine=French}
{atmosphere=Business Scene,price=over $50} =>{cuisine=French}
{atmosphere=Great for People Watching,price=below $15} =>{cuisine=American}
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{atmosphere=Near-perfect Food,price=over $50} =>{cuisine=French}
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{atmosphere=Need To Dress,price=over $50} =>{style=Power Brokers}
{atmosphere=Good Out of Town Business,price=over $50} =>{style=Power Brokers}
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{atmosphere=People Keep Coming Back,price=below $15} =>{cuisine=American}
{atmosphere=Classic Hotel Dining,price=$15-$30} =>{cuisine=American}
{atmosphere=Tourist Appeal,price=$15-$30} =>{style=Cab}
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{atmosphere=Singles Scene,price=$15-$30} =>{cuisine=American}
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Price and Style

Normal

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{price=$15-$30,style=Health Food} =>{cuisine=Vegetarian}
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{price=$15-$30,style=Pizza} =>{cuisine=Italian}
{style=Oyster Bars} =>{cuisine=Seafood}
{price=$15-$30,style=Grills} =>{cuisine=American}
{price=below $15,style=Eclectic} =>{cuisine=American}
{price=below $15,style=Tacos} =>{cuisine=Mexican}
{price=$30-$50,style=Brasserie} =>{cuisine=French}
{price=below $15,style=Diners} =>{cuisine=American}
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{style=Pastries} =>{cuisine=Coffee and Dessert}
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{style=Pizzerias} =>{cuisine=Italian}
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{price=$15-$30,style=Oyster Bars} =>{cuisine=Seafood}
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{price=$30-$50,style=High Tea} =>{cuisine=American}
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{style=Deli} =>{cuisine=Jewish}
{style=Pastry Shops} =>{cuisine=Wine and Beer}
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No *style=none*

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{price=below $15,style=Hamburgers} =>{cuisine=American}
{style=Health Food} =>{cuisine=Vegetarian}
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{style=Pizza} =>{cuisine=Italian}
{style=Grills} =>{cuisine=American}
{style=Omelettes} =>{cuisine=American}
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Unique Pairs

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Unique Pairs and No *style=none*

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{price=below $15,style=Pastry Shops} =>{cuisine=Fountain and Ice Cream}
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Cuisine and Occasion

Normal

{cuisine=Pacific Rim} =>{style=none}
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{cuisine=Ethiopian} =>{style=none}
{cuisine=Vietnamese,occasion=Weekend Lunch} =>{style=none}
{cuisine=Greek,occasion=Entertainment} =>{price=$15-$30}
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Unique Pairs

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Unique Pairs and No *style=none*

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{cuisine=French,occasion=Early Dining} =>{price=$30-$50}
{cuisine=Fountain and Ice Cream,occasion=Open on Sundays} =>{price=below $15}
{cuisine=Salvadoran,occasion=Weekend Lunch} =>{price=$15-$30}
{cuisine=Salvadoran,occasion=Weekend Dining} =>{price=$15-$30}
{cuisine=Caribbean,occasion=Weekend Jazz Brunch} =>{style=Central}
{cuisine=German,occasion=Weekend Brunch} =>{price=$15-$30}
{cuisine=German,occasion=Private Rooms Available} =>{price=$15-$30}
{cuisine=Tapas,occasion=Weekend Brunch} =>{price=$15-$30}
{cuisine=Bar-B-Q,occasion=Dining After the Theater} =>{price=$15-$30}
{cuisine=Seafood,occasion=Dining After the Theater} =>{price=$15-$30}
{cuisine=Italian,occasion=Dining After the Theater} =>{price=$15-$30}
{cuisine=Greek,occasion=After Hours Dining} =>{price=$15-$30}
{cuisine=Greek,occasion=Private Parties} =>{price=$15-$30}
{cuisine=Hamburgers & Beer,occasion=Dancing} =>{price=$15-$30}
{cuisine=Creole,occasion=Short Drive} =>{price=below $15}
{cuisine=Creole,occasion=Delivery Available} =>{price=below $15}
{cuisine=Creole,occasion=Takeout Available} =>{price=below $15}
{cuisine=Cajun,occasion=Open for Breakfast} =>{price=below $15}
{cuisine=Cajun,occasion=Entertainment} =>{price=$15-$30}
{cuisine=Fountain and Ice Cream,occasion=Parties and Occasions} =>{price=$30-$50}
{cuisine=Italian,occasion=Parties and Occasions} =>{style=Power Brokers}
{cuisine=Seafood,occasion=Pre-theater Dining} =>{price=$15-$30}
{cuisine=Bar-B-Q,occasion=Weekend Lunch} =>{price=$15-$30}
{cuisine=Mexican,occasion=Weekend Jazz Brunch} =>{price=$15-$30}
{cuisine=Wine and Beer,occasion=After Hours Dining} =>{price=below $15}
{cuisine=Mexican,occasion=Entertainment} =>{price=$15-$30}
{cuisine=American,occasion=Parties and Occasions} =>{price=$30-$50}
{cuisine=Bar-B-Q,occasion=Catering for Special Events} =>{price=below $15}
{cuisine=Mexican,occasion=Weekend Lunch} =>{price=$15-$30}
{cuisine=Vegetarian,occasion=Catering for Special Events} =>{price=below $15}
{cuisine=Mexican,occasion=Weekend Brunch} =>{price=$15-$30}
{cuisine=Vegetarian,occasion=Weekend Brunch} =>{style=Health Food}
{cuisine=Fountain and Ice Cream,occasion=Open on Sundays} =>{style=Coffee Shops}
{cuisine=Jewish,occasion=Open for Breakfast} =>{price=below $15}
{cuisine=Jewish,occasion=Catering for Special Events} =>{price=below $15}
{cuisine=Creole,occasion=Weekend Brunch} =>{price=below $15}
{cuisine=Tapas,occasion=Weekend Brunch} =>{style=Cab}
{cuisine=Cajun,occasion=Private Rooms Available} =>{price=$15-$30}
{cuisine=Jewish,occasion=Weekend Brunch} =>{price=below $15}
{cuisine=Bar-B-Q,occasion=After Hours Dining} =>{price=$15-$30}
{cuisine=Greek,occasion=Weekend Brunch} =>{style=Cab}
{cuisine=Mexican,occasion=Catering for Special Events} =>{style=Southwestern}
{cuisine=Coffee and Dessert,occasion=Delivery Available} =>{price=$15-$30}
{cuisine=Spanish,occasion=Weekend Dining} =>{price=$15-$30}
{cuisine=French,occasion=Special Brunch Menu} =>{price=$30-$50}
{cuisine=Spanish,occasion=Late Night Menu} =>{price=$15-$30}
{cuisine=Mexican,occasion=Private Parties} =>{price=$15-$30}
{cuisine=Seafood,occasion=Dining Outdoors} =>{price=$15-$30}
{cuisine=Vegetarian,occasion=Weekend Brunch} =>{price=below $15}

Décor and Price

Normal

{atmosphere=Fair Decor,price=$15-$30} =>{style=none}   {atmosphere=Excellent Decor,price=$30-$50} =>{style=none}
{atmosphere=Good Decor,price=$15-$30} =>{style=none}   {atmosphere=Good Decor,price=$30-$50} =>{style=none}
{atmosphere=Extraordinary Decor,price=$15-$30} =>{style=none}   {atmosphere=Excellent Decor,price=$15-$30} =>{style=none}
{atmosphere=Excellent Decor} =>{style=none}   {atmosphere=Poor Decor} =>{style=none}
{price=$15-$30} =>{style=none}   {atmosphere=Good Decor} =>{style=none}
{atmosphere=Near-perfect Decor,price=over $50} =>{cuisine=French}   {price=over $50} =>{cuisine=French}
{atmosphere=Near-perfect Decor,price=$30-$50} =>{cuisine=American}   {atmosphere=Fair Decor} =>{style=none}

No *style=none*

{price=over $50} =>{style=Power Brokers}   {atmosphere=Extraordinary Decor,price=over $50} =>{style=Power Brokers}
{atmosphere=Extraordinary Decor,price=$15-$30} =>{cuisine=American}   {atmosphere=Near-perfect Decor,price=over $50} =>{cuisine=French}
{price=over $50} =>{cuisine=French}   {atmosphere=Near-perfect Decor,price=over $50} =>{style=Power Brokers}
{atmosphere=Extraordinary Decor,price=over $50} =>{cuisine=French}   None

Unique Pairs

{atmosphere=Extraordinary Decor,price=over $50} =>{style=Power Brokers}   {atmosphere=Extraordinary Decor,price=$15-$30} =>{cuisine=American}
{atmosphere=Near-perfect Decor,price=over $50} =>{cuisine=French}   {atmosphere=Near-perfect Decor,price=over $50} =>{style=Power Brokers}
{atmosphere=Extraordinary Decor,price=over $50} =>{cuisine=French}   None

Unique Pairs and No *style=none*

{atmosphere=Fair Decor,price=$15-$30} =>{style=none}   {atmosphere=Excellent Decor,price=$30-$50} =>{style=none}
{atmosphere=Good Decor,price=$15-$30} =>{style=none}   {atmosphere=Good Decor,price=$30-$50} =>{style=none}
{atmosphere=Extraordinary Decor,price=$15-$30} =>{style=none}   {atmosphere=Excellent Decor,price=$15-$30} =>{style=none}
{atmosphere=Near-perfect Decor,price=over $50} =>{cuisine=French}   {atmosphere=Near-perfect Decor,price=$30-$50} =>{cuisine=American}