Capstone Project

Machine learning for identification of commercial opportunities in Lincoln, Nebraska

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Introduction

Lincoln is the capitol city of Nebraska. It is the home of the University of Nebraska at Lincoln. It has a population of 287,000 and covers an area of approximately 96 square miles.
For this project, I will split the city into a 26x26 grid of ¼ square mile regions and explore the makeup of these regions using FourSquare location data. Using insights gained from this analysis, I will be able to categorize each region on the grid by the types of venues they contain.

Business Problem

The final objective of this project will be to use geographic data to find a suitable location for a new Chinese restaurant within the city of Lincoln, Nebraska.

Target Audience

The target audience of this project includes entrepreneurs seeking opportunity for new business development, commercial real estate brokers, and city planners and other government agencies.

Data

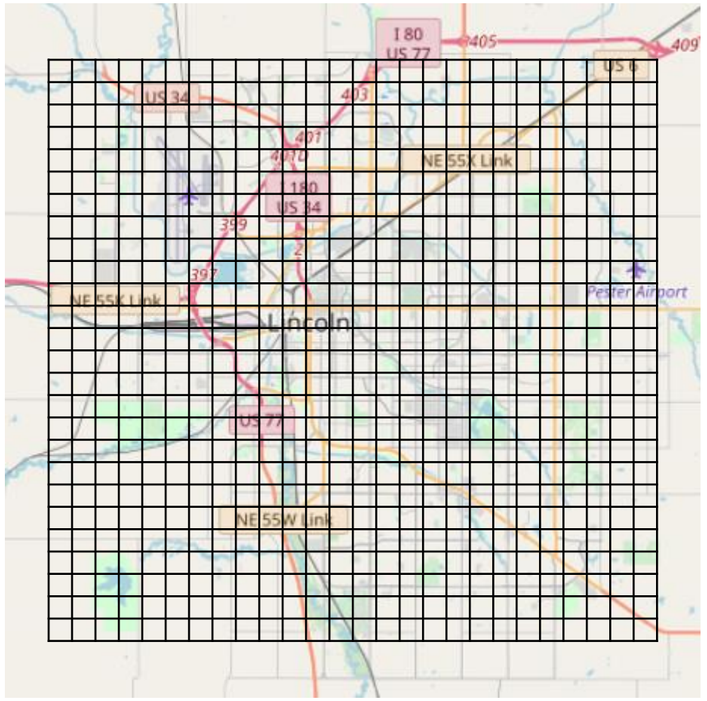
- Latitude and Longitude coordinates of a suitable city center for Lincoln, Nebraska
  - Coordinates of the city center will be obtained by converting an address to coordinates using the Nominatim geocoding tool
- Latitude and Longitude of all points of grid overlay of the city
  - The grid overlay and associated Latitude and Longitude coordinates will be calculated using Python.
- Venue data from FourSquare for each region in the grid
  - Venue data will be retrieved from the FourSquare places api and will leverage the explore endpoint

Methodology

After finding an address in the approximate center of the city, I generated a grid of 26x26 0.25sq mile regions centered on that point.

Using the grid overlay coordinate points, I retrieved FourSquare data including up to 100 total venues found within each of the grid regions. Venue category counts were then calculated for each region in the grid and the values stored in a dictionary for easy retrieval and converted to a pandas dataframe for further analysis.

Using the dataframe of venue counts by region, I found that Chinese was the 6th highest of the food-related venue categories. This meant that Chinese restaurants are relatively popular in Lincoln but are not as abundant as some of the standard fare including Sandwiches, Pizza, and Mexican.



Fast Food	169.0
Sandwiches	140.0
Pizza	128.0
Convenience Store	110.0
Mexican	87.0
Coffee Shop	87.0
Park	86.0
Bar	83.0
American	77.0
Hotel	70.0
Pharmacy	67.0
Gym / Fitness	64.0
Grocery Store	58.0
Chinese	57.0
Gas Station	54.0
Construction	48.0
Spa	44.0
Gym	42.0
Burgers	40.0
Ice Cream	39.0

Methodology cont.

Once I confirmed the viability of introducing additional Chinese venues in Lincoln, I used KMeans clustering to group the grid regions into similar categories based on the mean of the venue counts for each category.
I chose 6 for the number of clusters to optimize the differentiation between the clusters but still be able to easily identify different usage patterns within each cluster.

cluster	0
Fast Food	1.524590
Sandwiches	0.819672
Pizza	0.721311
American	0.606557
Pharmacy	0.573770
Hotel	0.557377
Convenience Store	0.540984
Chinese	0.491803
Mexican	0.491803
Grocery Store	0.442623

cluster	1
Park	0.068
Bar	0.066
Fast Food	0.056
Baseball Field	0.054
Pizza	0.054
Gym / Fitness	0.048
Convenience Store	0.046
Golf Course	0.046
Lake	0.046
Sandwiches	0.038

cluster	2
Bar	7.0
Sandwiches	6.5
Pizza	3.5
Brewery	2.5
Burgers	2.5
Coffee Shop	2.5
Mexican	2.5
Cocktail	2.0
Concert Hall	2.0
Hotel	2.0

cluster	3
Apparel	6.5
Women's Store	3.0
Department Store	2.0
Lingerie	2.0
Mexican	2.0
Shoes	2.0
Accessories	1.5
Gift Shop	1.5
Pharmacy	1.5
Supplement Shop	1.5

cluster	4
Sandwiches	2.500000
Coffee Shop	2.250000
Fast Food	1.666667
Mexican	1.500000
Pizza	1.083333
American	1.000000
Bar	1.000000
Hotel	1.000000
Mobile Phones	1.000000
Grocery Store	0.666667

cluster	5
Convenience Store	0.484848
Pizza	0.373737
Sandwiches	0.262626
Park	0.252525
Coffee Shop	0.242424
Fast Food	0.242424
Mexican	0.202020
American	0.151515
Spa	0.151515
Gas Station	0.141414

Analysis of the cluster data made it clear that two of the clusters (1 and 5) were regions with primarily residential usage. These clusters included venues like parks, baseball fields, golf courses, and lakes in the top 10 venues. I excluded these two regions from consideration for the new Chinese restaurant. The rest of the clusters were mostly commercial regions with higher food, entertainment, and shopping venue scores. I was also able to further define the remaining clusters based on their relative mean score values (high/med/low) and the primary venue types (food/shopping/entertainment).

Cluster 0:
Tier 3 commercial
Low-Medium venue density
Primarily Food and Service venues

Cluster 2:
Tier 1 commercial
High venue density
Primarily Bars/Food/Entertainment

Cluster 3:
Tier 1 commercial
High venue density
Primarily Shopping/Food

Cluster 4:
Tier 2 commercial
Medium venue density
Primarily Food

Methodology cont.

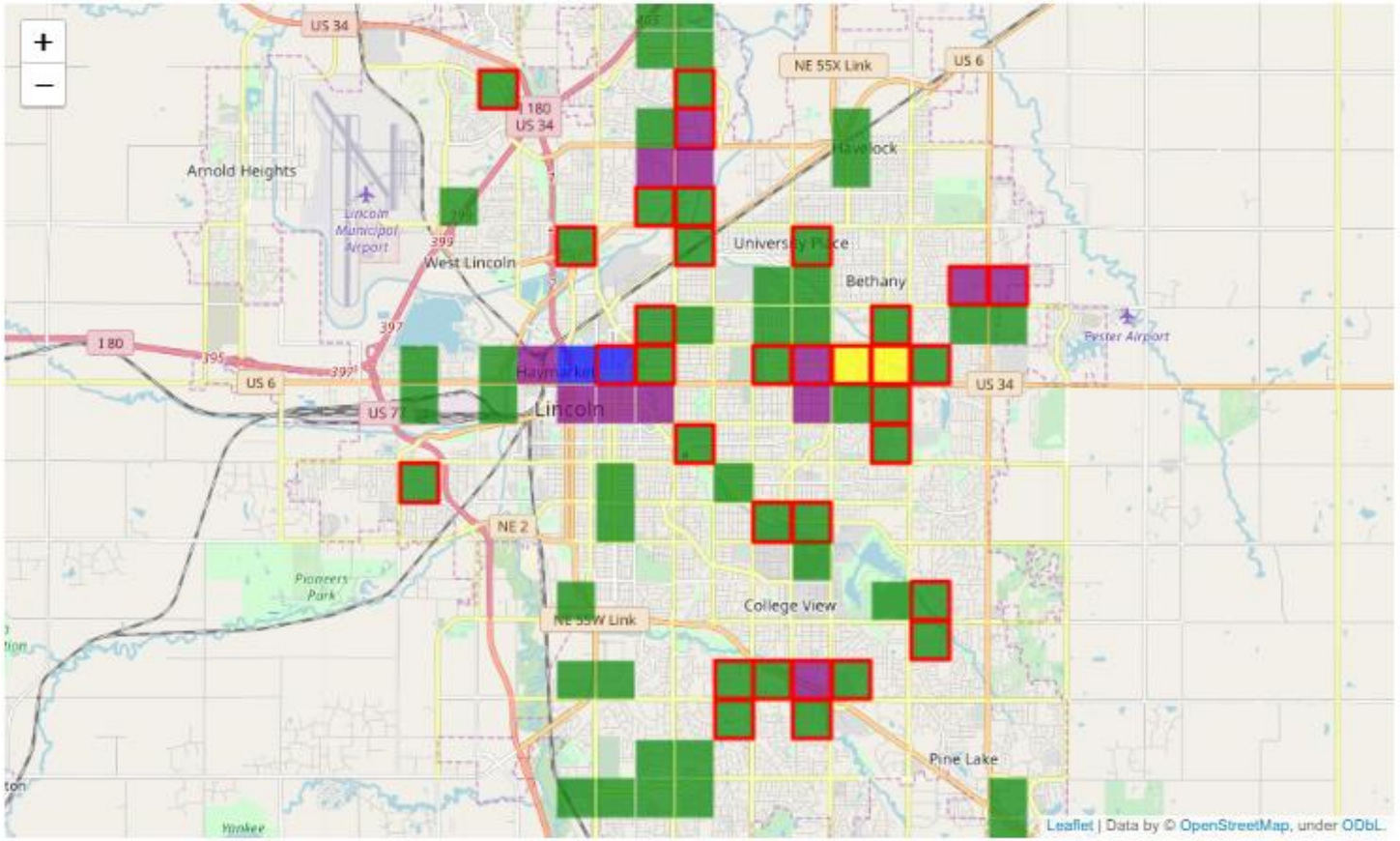
Having defined the clusters, I generated a map showing the plot regions to be considered and color coded them according to the cluster to which they belonged. I also added a red border if the region already included a Chinese venue.

Green **Cluster 0**

Blue **Cluster 2**

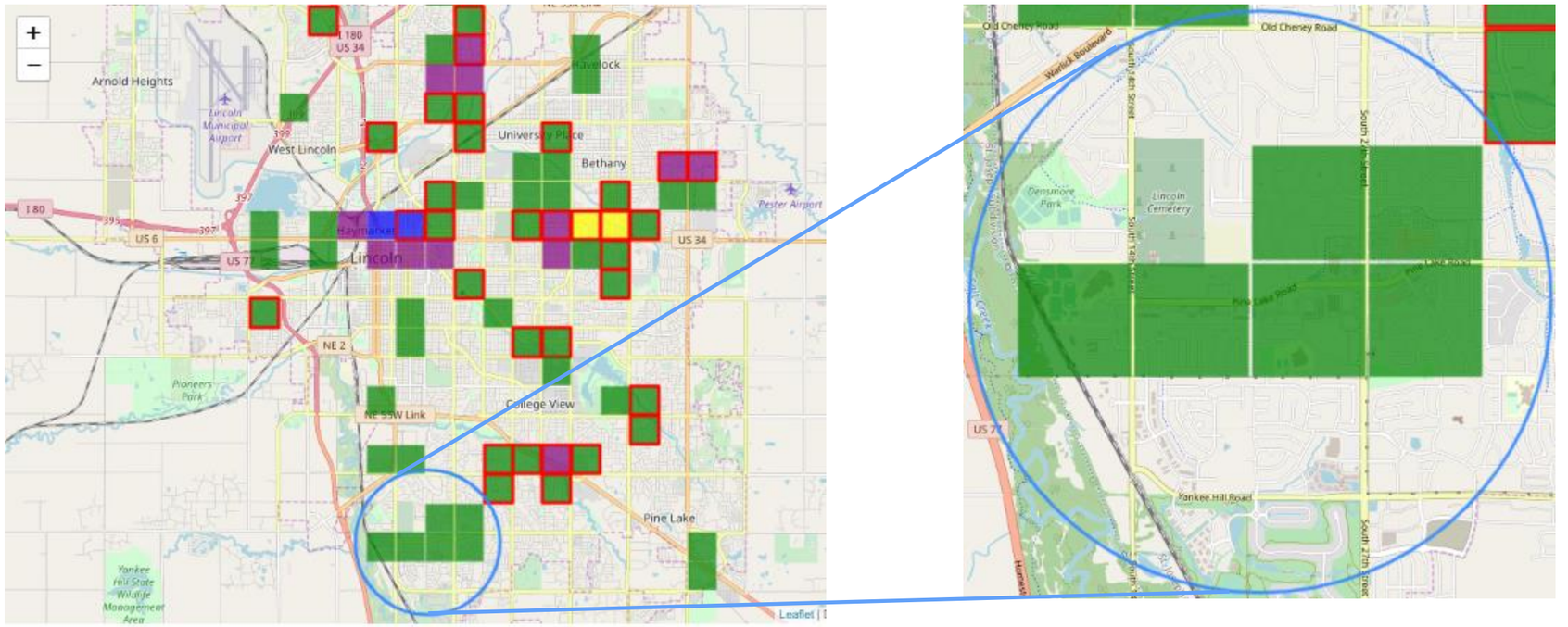
Yellow **Cluster 3**

Purple **Cluster 4**



Results

There are several areas of Lincoln which should be able to support a new Chinese restaurant. From looking at the map it becomes clear that the majority of the viable regions either already have a Chinese venue or are located next to another region which already has one. In the interest of keeping competition to minimum, it would appear that the southwest corner of the city would be the best choice for the new location. This area has a large cluster of Tier 3 commercial areas without any existing Chinese venues. The area is surrounded by dense residential areas, includes a mid-sized shopping mall, grocery, and several fast food venues. It is also located at a crossroads of 2 major north-south roads and 1 major east-west road.



Discussion

I was able to use the data available from FourSquare to identify and differentiate the commercial regions of the city of Lincoln. I was also able to identify areas that were underserved in the Chinese venue market.
However, this project was very limited in data scope and there are several key pieces of information that would still need to be considered before selecting a location for a new restaurant.

Conclusion

This project was successful in using machine learning to classify geographic regions based on the venues located within them. I was able to identify the key commercial districts within a city and pinpoint areas that could be potential sites for a new venture. Stakeholders would be able to use this information as a starting point to focus their search for locations identified by the results.

References

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