



Introduction

In Australia, online shopping is devastating retail. In 2018 alone, the number of online purchases grew by more than 13% year on year in every State and Territory. While Australia's major metro cities still dominate online purchasing, there is also rapid growth in online shopping in regional areas. Even in remote areas of Australia, it's clear that the households that shop online are doing more frequently and they are buying a wider variety of products.

Foot traffic in physical stores has continuously fallen. Physical stores have to create compelling reasons for customers to leave their homes and go shopping.

Some shopping centre operators are responding by expanding their offerings of food, events and shopping experiences. For example, the

redevelopment of the Chadstone shopping centre in Victoria included a new dine-in restaurant precinct, and movie theatre and a Lego Discovery Centre.

This study explores physical retail shops in shopping centres across Australia, to discover what types of physical shops are popular and pickup by customers. Furthermore, it is also interesting to understand if types of physical shops are different across Australia.

(The completed source code is available from this [GitHub location](#).)

Business Problem & Stakeholders

This study aims for shopping centre operators and physical retail shop owners to understand the top picked shop types, and its pattern across Australia.

Data

Considering physical retail shops are gathered in shopping centres, this study makes use of Australian shopping centers as the starting point. Then we use Foursquare APIs to explore top picked shops within or near each shopping centre.

- The Wikipedia link provides a list of shopping centers in Australia https://en.wikipedia.org/wiki/List_of_shopping_centres_in_Australia)
- Top picked shops and their categories are obtained by Foursquare API

Important Notes,

- In this study, the top picked shops are obtained directly from Foursquare recommendation. The data therefore could be biased by Foursquare engine. Ideally, we shall use check-in statistic data of each shops to decide shops' rank, rather than a simple return from Foursquare engine.
- The shopping centre list provided from Wikipedia is not completed and up-to-date, further coordinate data of some centres are also missed. This study simply ignore those not well formatted data.

Shopping Centre List

The Wikipedia link provides the majority shopping centers in Australia. For each shopping center, normally a detailed Wikipedia link associated. The detailed page provides coordinates, which can be prepared for Foursquare API. We have noticed that not all shopping centers have the detailed page associated. This study will simply ignore these shopping centers if the detailed pages are not existed.

I live in Melbourne Australia. My wife likes shopping at Chadstone Shopping Centre, let's take Chadstone Shopping Centre as a check point along with this study.

- Check point

"Chadstone Shopping Centre in Victoria" is recorded in the Wikipedia shopping centre

list(https://en.wikipedia.org/wiki/List_of_shopping_centres_in_Australia).

The associated detailed page is also found from Wikipedia

(https://en.wikipedia.org/wiki/Chadstone_Shopping_Centre), the page

provides its coordinate as 37°53'9"S 145°4'57"E.

Total 200 shopping centres are retrieved from Wiki pages with latitude & longitude obtained from the associated detailed page.

```
In [184]: 1 shoppingcentrepd.head()
```

Out[184]:

	State	shopping centre	url	Coordinate	latitude	longitude
0	Australian Capital Territory	Canberra Centre	https://en.wikipedia.org/wiki/Canberra_Centre	35°16'50"S,149°08'0"E	-35.28056	149.13333
1	Australian Capital Territory	Erindale Centre	https://en.wikipedia.org/wiki/Erindale_Centre	35°24'11"S,149°05'56"E	-35.40306	149.09889
2	Australian Capital Territory	Kippax Fair	https://en.wikipedia.org/wiki/Kippax_Fair	35°13'21"S,149°01'12"E	-35.22250	149.02000
3	Australian Capital Territory	Majura Park Shopping Centre	https://en.wikipedia.org/wiki/Majura_Park_Shopping_Centre	35°17'57"S,149°11'27"E	-35.29917	149.19083
4	Australian Capital Territory	South Point Tuggeranong	https://en.wikipedia.org/wiki/South_Point_Tuggeranong	35°24'59"S,149°03'59"E	-35.41639	149.06639

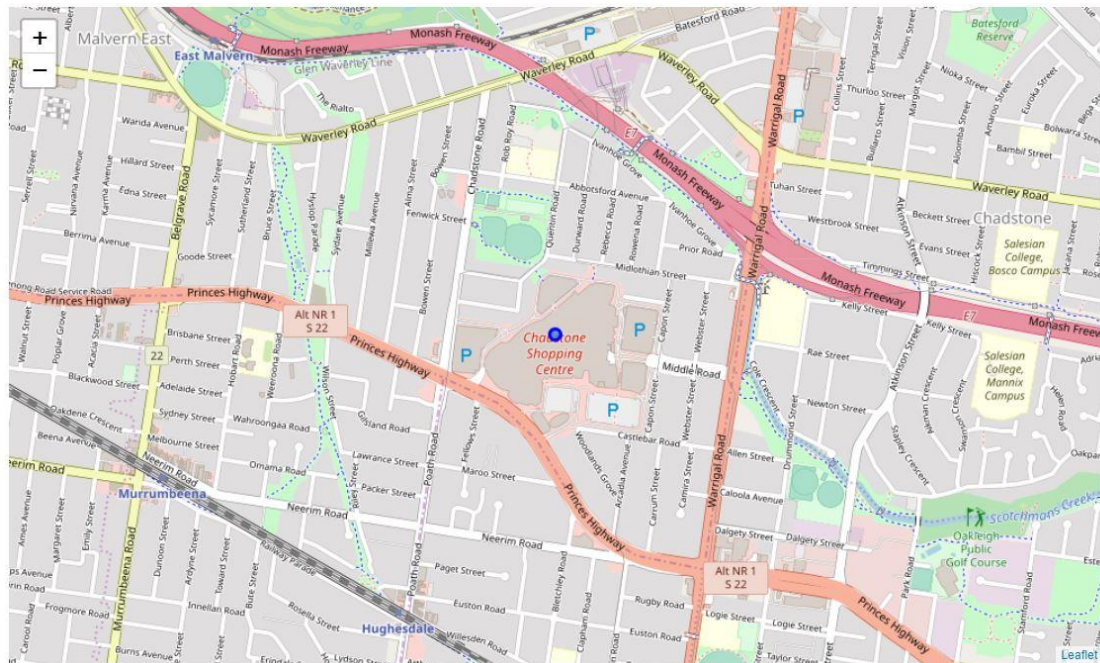
Let's visualize shopping centres physical location on the Australian map, by centring from Chadstone shopping centre. This verifies if obtained coordinates are correct.

```
In [185]: 1 shoppingcentrepd[shoppingcentrepd["shopping centre"] == 'Chadstone Shopping Centre']
```

Out[185]:

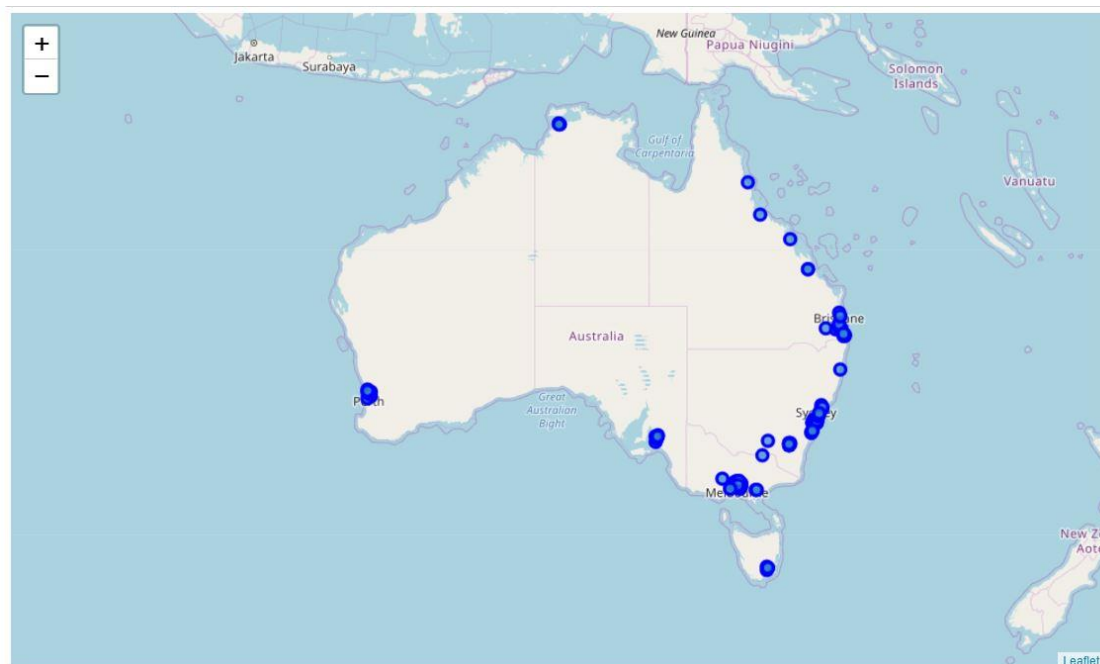
	State	shopping centre	url	Coordinate	latitude	longitude
213	Victoria	Chadstone Shopping Centre	https://en.wikipedia.org/wiki/Chadstone_Shopping_Centre	37°53'9"S,145°4'57"E	-37.88583	145.0825

Out[250]:



The above map shows the correct location of Chadstone shopping centre. Now let's inspect the overall shopping centres' location distribution over the Australian map.

Out[251]:



The shopping centres are all in the major cities of Australia, no shopping centres are from the centre of Australia. Further, most of the shopping centres are from east area of Australia. On other other side, we only can see Perth, Darwin and Hobart have big shopping centres recorded in Wikipedia.

From this distribution, we can say most of Australian population live in the major cities, especially in east of Australia.

Shop details

We use Foursquare API Explore Venues Recommendation to obtain up to 100 shops. The neighborhoods are defined as circular areas from the centre of shopping centres, with a radius of 1,000 meters.

The search defines no restriction on open time and return is sorted by popularity.

The Foursquare API provides hierarchy of venue categories. This study consolidates categories into the 2nd level.

Foursquare returned total 9952 shops near the shopping centres, and there are 229 unique categories.


```
In [53]: 1 shopping_venues.head()
```

```
Out[53]:
```

	State	shopping centre	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Australian Capital Territory	Canberra Centre	-35.28056	149.13333	Canberra Centre	-35.280422	149.132817	Shopping Mall
1	Australian Capital Territory	Canberra Centre	-35.28056	149.13333	Garema Place	-35.278245	149.131847	Plaza
2	Australian Capital Territory	Canberra Centre	-35.28056	149.13333	Lower Ground Food Court	-35.280299	149.133199	Food Court
3	Australian Capital Territory	Canberra Centre	-35.28056	149.13333	Dendy Cinemas	-35.277595	149.132742	Movie Theater
4	Australian Capital Territory	Canberra Centre	-35.28056	149.13333	Apple Canberra	-35.280284	149.133653	Electronics Store

Let's inspect shops from Chadstone shopping centre, to verify if they are correct shops, and if they are popular.

```
In [5]: 1 shopping_venues[shopping_venues['shopping centre'] == 'Chadstone Shopping Centre'][["Venue", "Venue Category"]].head(20)
```

```
Out[5]:
```

	Venue	Venue Category
7508	Kmart	Department Store
7509	David Jones	Department Store
7510	Hoyts	Movie Theater
7511	Uniqlo	Clothing Store
7512	Coles	Food & Drink Shop
7513	Woolworths	Food & Drink Shop
7514	Myer	Department Store
7515	JB Hi-Fi	Electronics Store
7516	Apple Chadstone	Electronics Store
7517	Lindt Chocolat Café	Café
7518	Axil Coffee Roasters	Coffee Shop
7519	Starbucks	Coffee Shop
7520	Legoland	Toy / Game Store
7521	New Shanghai	Dumpling Restaurant
7522	Mr Pilgrim	Café
7523	Chemist Warehouse	Pharmacy
7524	Daiso	Miscellaneous Shop
7525	MUJI 無印良品	Miscellaneous Shop
7526	Laurent Boulangerie Patisserie	Café
7527	Nando's	Portuguese Restaurant

The list sounds good. My wife indeed like Nando's and Daiso.

Methodology

In this study, we will detect what types of retail shops are popular, that will help stakeholders to attract foot traffic. Further, we will investigate how types of retails shops are different across Australia.

In the above step, we already collected all the top picked shop list among major Australian shopping centres, and their categories.

In the second step, we will count number of shops in each category across the whole Australia. This will help us to find out the most popular shop type.

In the third step, we will explore characters of each shopping center. Then we will cluster shopping centres by k-mean, to detect if shopping centers can be classified with different groups.

Analysis

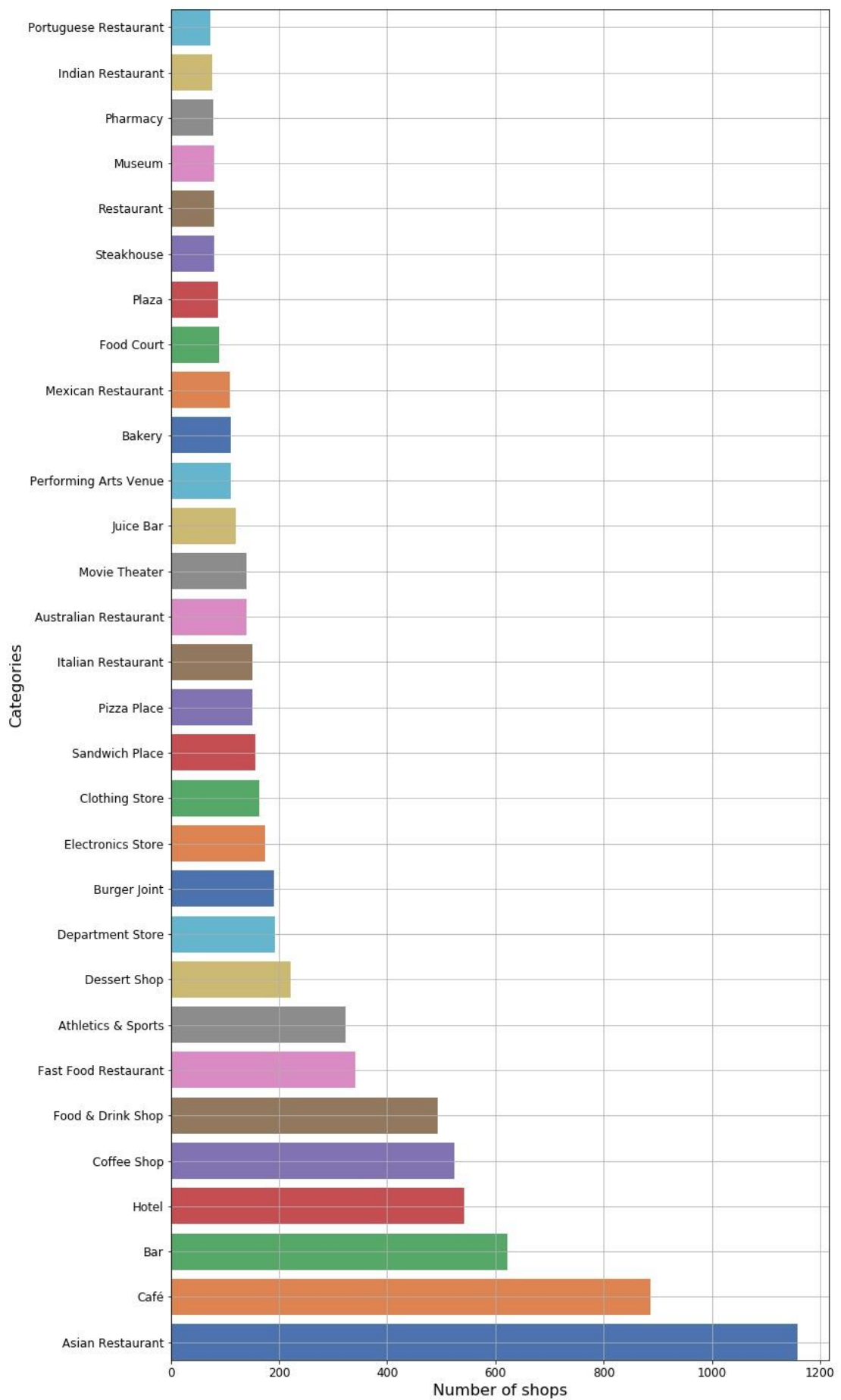
Let's convert shopping category as one-hot vector, so that we can count number of shops in each category, and compare shop categories.

```
1 shopping_onehot.head()
```

		ATM	Afghan Restaurant	African Restaurant	Airport	American Restaurant	Antique Shop	Aquarium	Arcade	Art Gallery	Arts & Crafts Store	...	Turkish Restaurant	Vegetarian / Vegan Restaurant	Video Game Store	Video Store
State	shopping centre															
Australian Capital Territory	Canberra Centre	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0
	Canberra Centre	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0
	Canberra Centre	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0
	Canberra Centre	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0
	Canberra Centre	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0

5 rows × 229 columns

Let's find out most popular shop categories.



It is no surprise to see food type of shops (Restaurant, Café, Bar etc.) occupy large percentage in shopping centres. But it sounds a little bit surprise to have Asian Restaurant in first place, rather than Australian Restaurant. Australia is a migration country, an mix up different cultures. And Australian love Asian food!

Hotels tend to be near shopping centres. That shall bring convenience to travellers, meanwhile hotels direct people traffic to the shopping centres.

Australian love sports, it is no wonder we find "Athletics & Sports" in/near the shopping centres, that shall serve good meet-points.

It is not weird to have Pharmacy in the top 30 list. In Australia, the Pharmacy not only provides medicines, but all kinds of skin care, makeup etc.

Let's continue to explore characters of different shopping centre grouped by states.

1 neighborhoods_venues_sorted											
	State	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Australian Capital Territory	Asian Restaurant	Café	Coffee Shop	Bar	Athletics & Sports	Food & Drink Shop	Fast Food Restaurant	Dessert Shop	Electronics Store	Sandwich Place
1	New South Wales	Asian Restaurant	Café	Coffee Shop	Food & Drink Shop	Hotel	Athletics & Sports	Bar	Fast Food Restaurant	Dessert Shop	Electronics Store
2	Northern Territory	Hotel	Asian Restaurant	Bar	Café	Fast Food Restaurant	Coffee Shop	Australian Restaurant	Steakhouse	Department Store	Food & Drink Shop
3	Queensland	Hotel	Café	Asian Restaurant	Bar	Food & Drink Shop	Coffee Shop	Fast Food Restaurant	Burger Joint	Clothing Store	Italian Restaurant
4	South Australia	Bar	Asian Restaurant	Café	Hotel	Food & Drink Shop	Coffee Shop	Italian Restaurant	Dessert Shop	Sculpture Garden	Athletics & Sports
5	Tasmania	Food & Drink Shop	Fast Food Restaurant	Department Store	Café	Sandwich Place	Bakery	Asian Restaurant	Pizza Place	Athletics & Sports	Movie Theater
6	Victoria	Asian Restaurant	Café	Bar	Coffee Shop	Food & Drink Shop	Fast Food Restaurant	Athletics & Sports	Hotel	Department Store	Performing Arts Venue
7	Western Australia	Asian Restaurant	Hotel	Bar	Coffee Shop	Café	Food & Drink Shop	Dessert Shop	Fast Food Restaurant	Department Store	Athletics & Sports

The top three "Asian Restaurant", "Bar", "Café" overwhelm other types of shops. Obviously, these three have widely presented across all Australian shop centres.

In order to character different shopping centres, let's use TF-IDF concept to weight down those frequent shop types.

The following terms are defined for the calculation:

- Shopping category frequency = (frequency of the category in its shopping centre / total number of categories in its shopping centre)
- Shopping centre frequency = number of shopping centres associated with the category
- Shopping category inversed frequency = $\text{Ln}(\text{total number of shopping centres} / (1 + \text{shopping centre frequency}))$
- Weighted shopping category frequency = shopping category frequency * shopping

Now we have got the TF-IDF encoding, let's use it to redo the sorting for each state.

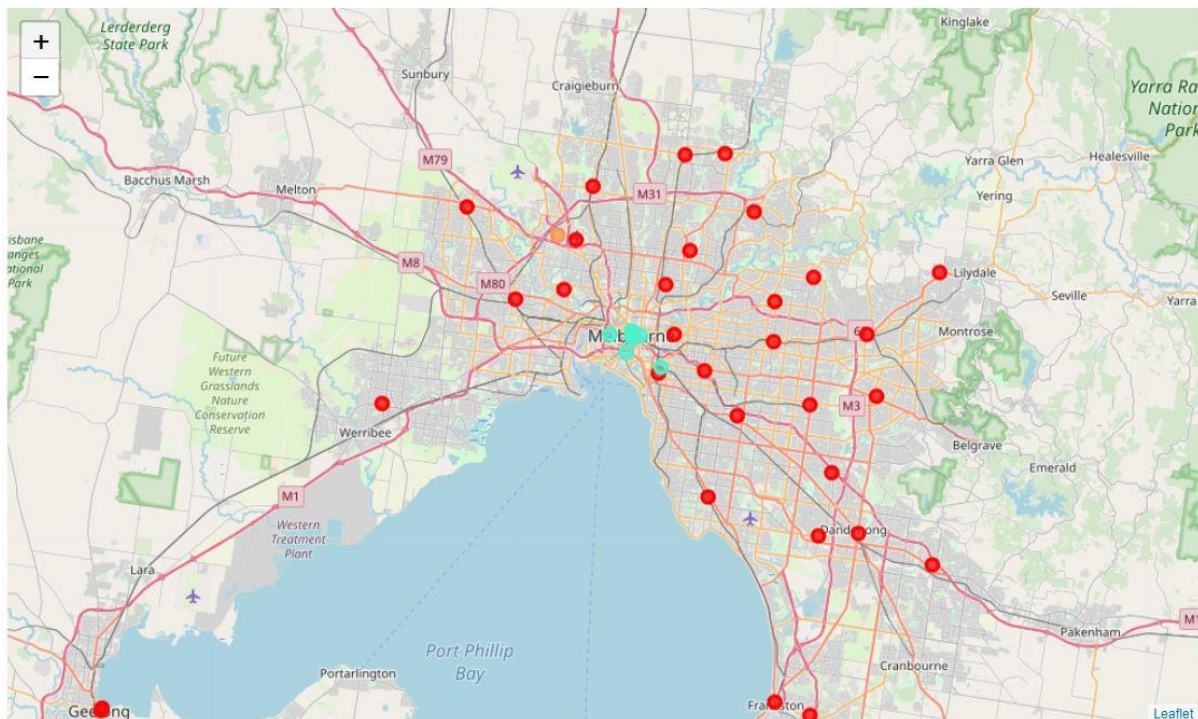
1	neighborhoods_venues_sorted2										
	State	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Australian Capital Territory	Airport	Rental Car Location	Hot Dog Joint	Bus Stop	Home Service	Asian Restaurant	Pizza Place	Newsstand	Bar	Shopping Plaza
1	New South Wales	Asian Restaurant	Fast Food Restaurant	Hotel	Middle Eastern Restaurant	Furniture / Home Store	Bar	Department Store	Café	Food Court	Athletics & Sports
2	Northern Territory	Flea Market	Bus Station	Fast Food Restaurant	Steakhouse	Mobile Phone Shop	Hotel	Record Shop	Bar	Fried Chicken Joint	Australian Restaurant
3	Queensland	Hotel	Campground	Fast Food Restaurant	Bar	Department Store	Clothing Store	Coffee Shop	Historic Site	Drugstore	Donut Shop
4	South Australia	Sculpture Garden	Bar	Hotel	Gas Station	Music Store	Italian Restaurant	Fast Food Restaurant	Vegetarian / Vegan Restaurant	Indian Restaurant	Stadium
5	Tasmania	Field	Video Store	Beach	Bakery	Child Care Service	Video Game Store	Gastropub	Fast Food Restaurant	Fried Chicken Joint	Discount Store
6	Victoria	Fast Food Restaurant	Bar	Portuguese Restaurant	Business Service	Asian Restaurant	Department Store	Donut Shop	Clothing Store	Convenience Store	Hotel
7	Western Australia	Pharmacy	Department Store	Fast Food Restaurant	Hotel	Bar	Cosmetics Shop	Dessert Shop	Indian Restaurant	Brewery	Asian Restaurant

After weighting down, we can see some interesting features for each state:

- Australian Capital Territory, ACT is the capital territory of Australia. It is quite small area actually and not many people living there. Majority are from travelers. It is reasonable to have shop centres are close to airport. And the Rental Car service is also presented as the 2nd top.
- New South Wales, NSW has one of biggest China town in Australia, and best Chinese Restaurants. That makes Asian Restaurant most popular.
- Victoria, I live in Melbourne. As far as I can see, Melbourne people really love McDonald etc. Every time I goes to the shopping centres, I often see long queue to McDonald. Although every one knows fast-food is not heathy, but people like it. And Melbourne is also famous for good bars. On weekends, I can see lots people chatting & drinking.

Let's try to use k-means to cluster shopping centres. Several steps need be conducted.

- First step, group data per shopping centres
- Second step, discover the best k group by searching the fastest drop point.
- Third step, 6 groups sounds a good value. Let's process k-means with 6 groups, and combine coordinate information.
- Finally, let's draw all shopping centres on the Australian map, with clustering in different color. (Note, here we only zoomed into Melbourne area.)



From the map, we can see the majority shopping centres marked as group 0 (Red color). That indicates shopping centers are generally similar on the offerings.

We also noticed that the shopping centres in the city centre tend to a separated group (Group 3, marked as light green).

This makes senses! The shopping centers in city center offers more convenient services, when suburb shopping centers tend to much bigger and offers much more varieties.

Result and Discussion

- The analysis shows the modern Australian shopping centres focuses more on food & entertainment, to provide a place for people hand-out and relax. This is a good direction to complement online shopping, where online shopping is on more "function" level.
- The top three "Asian Restaurant", "Bar", "Café" overwhelm other types across Australian shopping centers. It shall be a good bet on these types of shops when opening a new shop in a shopping center.
- The shopping centers are different categories setup between city center and suburb areas.

The analysis also shows some unique pattern for Australia.

- First of all, the locations of shopping centers indicate majority Australian live in the major cities, especially east of Australia. Few

people live in the centre. It shall be Australian government's challenges to encourage more people moving into rural areas, and developing more.

- Australia is a migration country. People taste are mixed. But it is clear that Australian loves Asian food.
- Different Australian states have their different cultures and lives. From the distribution of shopping centres, we can see some evidences. For example, ACT is more a business travelling oriented area. NSW is more on Chinese food. VIC loves drinks in bars.

Conclusion

Purpose of this report is to identify pattern of physical retail shops in Australia in order to aid stakeholders developing retail business when competing with online shopping. By searching shops within/near the major Australian shopping centre list, we obtained nearly 10k shops across Australia. By analysing these data, we concluded that "Asian Restaurant", "Bar", "Café" are most popular shop types in Australia. And in general, shops turn into places for people hand-out and relax. After running a down-weighting calculation, we also detect some unique shop patterns across different Australian locations. Finally, clustering of these shopping centres, the result indicates city centre and suburb areas displaying different shop setup.

This study provides some initial information for stakeholders to develop shopping centers or open new shops in shopping centres. Final decision on optimal will be made by stakeholders based on specific characteristics of

neighborhoods and locations, taking into consideration additional factors like attractiveness of each location (proximity to park, water, hotel, airport), real estate availability, prices, social and economic dynamics of every neighborhood etc.