

**IIT CSP586: Software Modeling Dev with UML**  
 Name: Muhao Chen      IIT ID Number: A20456889  
 Homework 4

**1 . Requirement 1:**

The table of the dataset name and the URL:

Style	Dataset	URL	URL(json)
Transportation	taxi_trips	<a href="https://data.cityofchicago.org/Transportation/Taxi-Trips/wrvz-psew">https://data.cityofchicago.org/Transportation/Taxi-Trips/wrvz-psew</a>	<a href="https://data.cityofchicago.org/resource/wrvz-psew.json">https://data.cityofchicago.org/resource/wrvz-psew.json</a>
	taxi_trips_network	<a href="https://data.cityofchicago.org/Transportation/Transportation-Network-Providers-Trips/m6dm-c72p">https://data.cityofchicago.org/Transportation/Transportation-Network-Providers-Trips/m6dm-c72p</a>	<a href="https://data.cityofchicago.org/resource/m6dm-c72p.json">https://data.cityofchicago.org/resource/m6dm-c72p.json</a>
Building	building_permits	<a href="https://www.chicago.gov/city/en/depts/bldgs/data/set/building_permits.html">https://www.chicago.gov/city/en/depts/bldgs/data/set/building_permits.html</a>	<a href="https://data.cityofchicago.org/resource/ydr8-5enu.json">https://data.cityofchicago.org/resource/ydr8-5enu.json</a>
unemployment	Public_Health_Statistics	<a href="https://data.cityofchicago.org/Health-Human-Services/Public-Health-Statistics-Selected-public-health-in/iqnk-2tcu/data">https://data.cityofchicago.org/Health-Human-Services/Public-Health-Statistics-Selected-public-health-in/iqnk-2tcu/data</a>	<a href="https://data.cityofchicago.org/resource/iqnk-2tcu.json">https://data.cityofchicago.org/resource/iqnk-2tcu.json</a>
COVID-19	Covid_daily_case	<a href="https://data.cityofchicago.org/Health-Human-Services/COVID-19-Daily-Cases-Deaths-and-Hospitalizations/naz8-j4nc">https://data.cityofchicago.org/Health-Human-Services/COVID-19-Daily-Cases-Deaths-and-Hospitalizations/naz8-j4nc</a>	<a href="https://data.cityofchicago.org/resource/naz8-j4nc.json">https://data.cityofchicago.org/resource/naz8-j4nc.json</a>
	Covid_weekly_case	<a href="https://data.cityofchicago.org/Health-Human-Services/COVID-19-Cases-Tests-and-Deaths-by-ZIP-Code/yhhz-zm2v">https://data.cityofchicago.org/Health-Human-Services/COVID-19-Cases-Tests-and-Deaths-by-ZIP-Code/yhhz-zm2v</a>	<a href="https://data.cityofchicago.org/resource/yhhz-zm2v.json">https://data.cityofchicago.org/resource/yhhz-zm2v.json</a>
	Covid_ccvi	<a href="https://data.cityofchicago.org/Health-Human-Services/Chicago-COVID-19-Community-Vulnerability-Index-CCV/xhc6-88s9">https://data.cityofchicago.org/Health-Human-Services/Chicago-COVID-19-Community-Vulnerability-Index-CCV/xhc6-88s9</a>	<a href="https://data.cityofchicago.org/resource/xhc6-88s9.json">https://data.cityofchicago.org/resource/xhc6-88s9.json</a>
cross-reference	Neighborhood_community_zip	<a href="https://www.chicagotribune.com/chi-community-areas-htmlstory.html">https://www.chicagotribune.com/chi-community-areas-htmlstory.html</a>	Null

The requirements in the requirements specification:

Style	Dataset	Requirements
Transportation	taxi_trips	Requirement 1,2,3,4;9. We should get the trips, then help report covid, from airport to the neighborhoods, ccvi, street investing and streetscaping projects.
	taxi_trips_network	Requirement 1,2,3,4;9. We should get the trips, then help report covid, from airport to the neighborhoods, ccvi, street investing and streetscaping projects.
Building	building_permits	Requirement 5,6 find the location/zipcode, find the per capital income is low
unemployment	Public_Health_Statistics	Requirement 5;6 find the unemployment is high; find the per capital income is low
COVID-19	Covid_daily_case	Requirement 1,2 show every neighborhoods, zip code's covid, predict and alert
	Covid_weekly_case	Requirement 1,2 show every neighborhoods, zip code's covid, predict and alert
	Covid_ccvi	Requirement 3 high ccvi's neighborhoods should be monitored
cross-reference	Neighborhood_community_zip	Requirement 7, because sometimes, some tables need Neighborhood, community or zip code while the table only have one, and then it require this table to search.

## 2 . Requirement 2:

taxi\_trips:

name	initial or generate or need	example
id	generate	3
trip_id	initial	b75d0e728ef64abdc898759411c3598e5a0ba446
trip_start_timestamp	initial	2022-03-01T00:00:00.000
trip_end_timestamp	initial	2022-03-01T00:15:00.000
pickup_centroid_latitude	initial	41.944226601
pickup_centroid_longitude	initial	-87.655998182
dropoff_centroid_latitude	initial	41.857183858
dropoff_centroid_longitude	initial	-87.620334624
pickup_zip_code	generate	60657
dropoff_zip_code	generate	60616

Taxi\_trip have latitude and longitude, which can generate zipcode from google map api. And it can get community and neighbors through combing the table of neighborhood\_community\_zip.

taxi\_trips\_network:

name	initial or generate or need	example
id	generate	
trip_id	initial	b75d0e728ef64abdc898759411c3598e5a0ba446
trip_start_timestamp	initial	2022-03-01T00:00:00.000
trip_end_timestamp	initial	2022-03-01T00:15:00.000
pickup_centroid_latitude	initial	41.944226601
pickup_centroid_longitude	initial	-87.655998182
dropoff_centroid_latitude	initial	41.857183858
dropoff_centroid_longitude	initial	-87.620334624
pickup_zip_code	generate	60657
dropoff_zip_code	generate	60616

taxi\_trips\_network have latitude and longitude, which can generate zipcode from google map api. And it can get community and neighbors through combing the table of neighborhood\_community\_zip.

building\_permits:

name	initial or generate or need	example
id	generate	1
permit_id	initial	3218940
permit_type	initial	PERMIT - NEW CONSTRUCTION
total_fee	initial	40
latitude	initial	41.79197805
longitude	initial	-87.617378865
zipcode	generate	60637

building\_permits can generate zipcode, which is enough.

public\_health\_statistics:

name	initial or generate or need	example
id	generate	67
community_area_name	initial	West Englewood
below_poverty_level	initial	32.3
per_capita_income	initial	10559
unemployment	initial	34.7
zipcode	Require, but we should not input here.	

public\_health\_statistics has zipcode, which is enough.

covid\_daily\_case:

name	initial or generate or need	example
id	generate	1
lab_report_date	initial	2022-04-01T00:00:00.000
cases_total	initial	16
deaths_total	initial	0

covid\_daily\_case has no zipcode, but it is Chicago total cases.

covid\_weekly\_case:

name	initial or generate or need	example
id	generate	4
zip_code	initial	60656
week_number	initial	12
week_start	initial	2022-03-20T00:00:00.000
week_end	initial	2022-03-26T00:00:00.000
cases_weekly	initial	20
cases_cumulative	initial	6327
community	Require, but we should not input here.	
neighborhood	Require, but we should not input here.	

covid\_weekly\_case have zip\_code, which can generate community and neighbors through combing the table of neighborhood\_community\_zip.

covid\_ccvi:

name	initial or generate or need	example
id	generate	1
community_area_name	initial	Ashburn
ccvi_score	initial	45.1
ccvi_category	initial	MEDIUM
zipcode	Require, but we should not input here.	
neighborhood	Require, but we should not input here.	

covid\_ccvi have community\_area\_name, which can generate zipcode and neighbors through combining the table of neighborhood\_community\_zip.

neighborhood\_community\_zip:

name	initial or generate or need	example
id	generate	1
geo_id	generate	0
neighborhood	initial	60601
community	initial	Loop
zipcode	initial	Printer's Row

It is generated by the excel, requests from the website, and it is basic for other tables to generate relative attribute.

### 3 . Requirement 3:

Database engine: Postgre Database

Database Management GUI: PgAdmin4

I have create 9 tables, 8 of them is generated from url, and **one of them is merged**.

Among them, Table Named taxi\_trip\_total is merged from Table taxi\_trips and Table taxi\_trips\_network, because it does not matter that whether you from taxi or other network provided. We regard them as the same driver, and alert them.

source	table	attribute	initial/required/generated	type
url	taxi_trips	id	generate	SERIAL
url	taxi_trips	trip_id	initial	VARCHAR(255) UNIQUE
url	taxi_trips	trip_start_timestamp	initial	TIMESTAMP WITH TIME ZONE
url	taxi_trips	trip_end_timestamp	initial	TIMESTAMP WITH TIME ZONE
url	taxi_trips	pickup_centroid_latitude	initial	DOUBLE PRECISION
url	taxi_trips	pickup_centroid_longitude	initial	DOUBLE PRECISION
url	taxi_trips	dropoff_centroid_latitude	initial	DOUBLE PRECISION
url	taxi_trips	dropoff_centroid_longitude	initial	DOUBLE PRECISION
url	taxi_trips	pickup_zip_code	generate	VARCHAR(255)
url	taxi_trips	dropoff_zip_code	generate	VARCHAR(256)
url	taxi_trips_network	id	generate	SERIAL

url	taxi_trips_network	trip_id	initial	VARCHAR(255) UNIQUE
url	taxi_trips_network	trip_start_timestamp	initial	TIMESTAMP WITH TIME ZONE
url	taxi_trips_network	trip_end_timestamp	initial	TIMESTAMP WITH TIME ZONE
url	taxi_trips_network	pickup_centroid_latitude	initial	DOUBLE PRECISION
url	taxi_trips_network	pickup_centroid_longitude	initial	DOUBLE PRECISION
url	taxi_trips_network	dropoff_centroid_latitude	initial	DOUBLE PRECISION
url	taxi_trips_network	dropoff_centroid_longitude	initial	DOUBLE PRECISION
url	taxi_trips_network	pickup_zip_code	generate	VARCHAR(255)
url	taxi_trips_network	dropoff_zip_code	generate	VARCHAR(256)
url	building_permits	id	generate	SERIAL
url	building_permits	permit_id	initial	VARCHAR(255) UNIQUE
url	building_permits	permit_type	initial	VARCHAR(255)
url	building_permits	total_fee	initial	DOUBLE PRECISION
url	building_permits	latitude	initial	VARCHAR(255)
url	building_permits	longitude	initial	VARCHAR(255)
url	building_permits	zipcode	generate	VARCHAR(255)
url	public_health_statistics	id	generate	SERIAL
url	public_health_statistics	community_area_name	initial	VARCHAR(255) UNIQUE
url	public_health_statistics	below_poverty_level	initial	DOUBLE PRECISION
url	public_health_statistics	per_capita_income	initial	DOUBLE PRECISION
url	public_health_statistics	unemployment	initial	DOUBLE PRECISION
url	public_health_statistics	zipcode	Require, but we should not input here.	
url	covid_daily_case	id	generate	SERIAL
url	covid_daily_case	lab_report_date	initial	TIMESTAMP WITH TIME ZONE

url	covid_daily_case	cases_total	initial	DOUBLE PRECISION
url	covid_daily_case	deaths_total	initial	DOUBLE PRECISION
url	covid_weekly_case	id	generate	SERIAL
url	covid_weekly_case	zip_code	initial	VARCHAR(255)
url	covid_weekly_case	week_number	initial	DOUBLE PRECISION
url	covid_weekly_case	week_start	initial	TIMESTAMP WITH TIME ZONE
url	covid_weekly_case	week_end	initial	TIMESTAMP WITH TIME ZONE
url	covid_weekly_case	cases_weekly	initial	DOUBLE PRECISION
url	covid_weekly_case	cases_cumulative	initial	DOUBLE PRECISION
url	covid_weekly_case	community	Require, but we should not input here.	
url	covid_weekly_case	neighborhood	Require, but we should not input here.	
url	covid_ccvi	id	generate	SERIAL
url	covid_ccvi	community_area_name	initial	VARCHAR(255)
url	covid_ccvi	ccvi_score	initial	DOUBLE PRECISION
url	covid_ccvi	ccvi_category	initial	VARCHAR(255)
url	covid_ccvi	zipcode	Require, but we should not input here.	
url	covid_ccvi	neighborhood	Require, but we should not input here.	
url	neighborhood_community_zip	id	generate	SERIAL
url	neighborhood_community_zip	geo_id	generate	VARCHAR(255)
url	neighborhood_community_zip	neighborhood	initial	VARCHAR(255)
url	neighborhood_community_zip	community	initial	VARCHAR(255)
url	neighborhood_community_zip	zipcode	initial	DOUBLE PRECISION
merge	taxi_trip_total	id	generate	SERIAL
merge	taxi_trip_total	trip_id	initial	VARCHAR(255) UNIQUE
merge	taxi_trip_total	trip_start_timestamp	initial	TIMESTAMP WITH TIME ZONE

merge	taxi_trip_total	trip_end_timestamp	initial	TIMESTAMP WITH TIME ZONE
merge	taxi_trip_total	pickup_centroid_latitude	initial	DOUBLE PRECISION
merge	taxi_trip_total	pickup_centroid_longitude	initial	DOUBLE PRECISION
merge	taxi_trip_total	dropoff_centroid_latitude	initial	DOUBLE PRECISION
merge	taxi_trip_total	dropoff_centroid_longitude	initial	DOUBLE PRECISION
merge	taxi_trip_total	pickup_zip_code	generate	VARCHAR(255)
merge	taxi_trip_total	dropoff_zip_code	generate	VARCHAR(256)

#### 4 . Requirement 4:

Dataset	URL	neighborhood	community	zipcode
taxi_trips	<a href="https://data.cityofchicago.org/Transportation/Taxi-Trips/wrvz-psew">https://data.cityofchicago.org/Transportation/Taxi-Trips/wrvz-psew</a>	N	N	Y
taxi_trips_network	<a href="https://data.cityofchicago.org/Transportation/Transportation-Network-Providers-Trips/m6dm-c72p">https://data.cityofchicago.org/Transportation/Transportation-Network-Providers-Trips/m6dm-c72p</a>	N	N	Y
building_permits	<a href="https://www.chicago.gov/city/en/depts/bldgs/dataset/building_permits.html">https://www.chicago.gov/city/en/depts/bldgs/dataset/building_permits.html</a>	N	N	Y
Public_Health_Statistics	<a href="https://data.cityofchicago.org/Health-Human-Services/Public-Health-Statistics-Selected-public-health-in/iqnk-2tcu/data">https://data.cityofchicago.org/Health-Human-Services/Public-Health-Statistics-Selected-public-health-in/iqnk-2tcu/data</a>	N	Y	N
Covid_daily_case	<a href="https://data.cityofchicago.org/Health-Human-Services/COVID-19-Daily-Cases-Deaths-and-Hospitalizations/naz8-j4nc">https://data.cityofchicago.org/Health-Human-Services/COVID-19-Daily-Cases-Deaths-and-Hospitalizations/naz8-j4nc</a>	N	N	N
Covid_weekly_case	<a href="https://data.cityofchicago.org/Health-Human-Services/COVID-19-Cases-Tests-and-Deaths-by-ZIP-Code/yhhz-zm2v">https://data.cityofchicago.org/Health-Human-Services/COVID-19-Cases-Tests-and-Deaths-by-ZIP-Code/yhhz-zm2v</a>	N	N	Y
Covid_ccvi	<a href="https://data.cityofchicago.org/Health-Human-Services/Chicago-COVID-19-Community-Vulnerability-Index-CCV/xhc6-88s9">https://data.cityofchicago.org/Health-Human-Services/Chicago-COVID-19-Community-Vulnerability-Index-CCV/xhc6-88s9</a>	N	Y	N
Neighborhood_community_zip	<a href="https://www.chicagotribune.com/chi-community-areas-htmlstory.html">https://www.chicagotribune.com/chi-community-areas-htmlstory.html</a>	Y	Y	Y
taxi_trip_total	Merged from taxi_trips and taxi_trips_network	N	N	Y

## 5 . Requirement 5:

Actually, the URL <https://www.chicagotribune.com/chi-community-areas-htmlstory.html> help us to make sure there are relations between neighborhood, community and zip code.

Relations:

One neighborhood has many communities.

Many communities have many zip codes.

I deign a table, Neighborhood\_community\_zip:

Data Output		Explain	Messages	Notifications		
	<div>id</div> <div>[PK] integer</div>		<div>geo_id</div> <div>character varying (255)</div>	<div>zipcode</div> <div>double precision</div>	<div>community</div> <div>character varying (255)</div>	<div>neighborhood</div> <div>character varying (255)</div>
1	1	0		60601	Loop	Printer's Row
2	2	1		60602	Loop	Printer's Row
3	3	2		60603	Loop	Printer's Row
4	4	3		60604	Loop	Printer's Row
5	5	4		60605	Loop	Printer's Row
6	6	5		60606	Loop	Printer's Row
7	7	6		60607	Loop	Printer's Row
8	8	7		60661	Loop	Printer's Row
9	9	8		60605	Near South Side	Dearborn Park
10	10	9		60605	Near South Side	South Loop
11	11	10		60607	Near South Side	Dearborn Park
12	12	11		60607	Near South Side	South Loop
13	13	12		60616	Near South Side	Dearborn Park
14	14	13		60616	Near South Side	South Loop
15	15	14		60606	Near West Side	Medical Center
16	16	15		60606	Near West Side	Museum Park
17	17	16		60606	Near West Side	Pilsen

Therefore, if you have one attribute, for example, zip code, you can find many communities and many neighborhoods.

In my program, if you find you use other tables, and lack the neighborhoods, while you only have zip code, you can read this table to return the [neighborhood1, neighborhood2 ...]



## 6 . Requirement 6:

Actually, the government have two sources of transportation, one is taxi, and the other one is reported by Transportation Network Providers (sometimes called rideshare companies. No matter which transportation, the trip must have the driver, and we should alert, and inform them about the COVID, and take them into consideration of the development of neighborhoods, communities and zip code area.

Therefore, we create a merged table, the sources:

taxi\_trips <https://data.cityofchicago.org/Transportation/Taxi-Trips/wrvz-psew>

taxi\_trips\_network <https://data.cityofchicago.org/Transportation/Transportation-Network-Providers-Trips/m6dm-c72p>

The merged one, taxi\_trip\_total:

Data Output		Explain	Messages	Notifications								
	id [PK] integer		trip_id character varying (255)		trip_start_timestamp timestamp with time zone	trip_end_timestamp timestamp with time zone	pickup_centroid_latitude double precision	pickup_centroid_longitude double precision	dropoff_centroid_latitude double precision			
1			d685d4584ba0ee84f76cd82d11bc621c2fe15172		2022-03-01 00:00:00+08	2022-03-01 00:00:00+08	41.980264315	-87.913624596	41.980264315			
2			d5e6b54514cd47fa97de827832c4942ca50064af		2022-03-01 00:00:00+08	2022-03-01 00:15:00+08	41.899602111	-87.633308037	41.899602111			
3			b75d0e728ef64abdc898759411c3598e5a0ba446		2022-03-01 00:00:00+08	2022-03-01 00:15:00+08	41.944226601	-87.655998182	41.944226601			
4			9f6cd473daf9f0d0c4f300d28a80306d121fc0fb		2022-03-01 00:00:00+08	2022-03-01 01:00:00+08	41.899602111	-87.633308037	41.899602111			
5			95e8a5e899d3bae6f7509c12ddc2e485f0a80b5be		2022-03-01 00:00:00+08	2022-03-01 00:15:00+08	41.980264315	-87.913624596	41.980264315			
6			67dcefa7b0a902921097521c6d8224e207684		2022-03-01 00:00:00+08	2022-03-01 00:15:00+08	41.980264315	-87.913624596	41.980264315			
7			67d776e02bafcc014f8e990d30ef06dde1963424		2022-03-01 00:00:00+08	2022-03-01 01:30:00+08	41.899602111	-87.633308037	41.899602111			
8			596d5e979430c224c4f7fa7c1dab445830d25e41		2022-03-01 00:00:00+08	2022-03-01 00:00:00+08	41.899602111	-87.633308037	41.899602111			
9			3ac3c4870982cccbf29702ce04d510e6258a24c8		2022-03-01 00:00:00+08	2022-03-01 00:00:00+08	41.878865584	-87.625192142	41.878865584			
10			374beb184f6367dcf6464f375858507ad8cdfc43		2022-03-01 00:00:00+08	2022-03-01 00:00:00+08	41.874005383	-87.66351755	41.874005383			
11			1eb80da6fd97277a45e9fd08f77d87f3176d66f		2022-03-01 00:00:00+08	2022-03-01 00:15:00+08	41.9867118	-87.663416405	41.9867118			
12			1fde3f63f05f14a5dca41499d74868b6f1b91e8		2022-03-01 00:00:00+08	2022-03-01 00:15:00+08	41.980264315	-87.913624596	41.980264315			
13			14e821718869018118c76aad89e1f3e8458e5fb1		2022-03-01 00:00:00+08	2022-03-01 00:15:00+08	41.79259236	-87.769615453	41.79259236			
14			0b8b0cd72fee4bc673f5380aba551c241f253dd		2022-03-01 00:00:00+08	2022-03-01 00:00:00+08	41.901206994	-87.676355989	41.901206994			
15			117a86416f19f520f32de9c84dd0b542f96d09eb		2022-03-01 00:00:00+08	2022-03-01 00:30:00+08	41.980264315	-87.913624596	41.980264315			
16			0fa953b855f51be8fcaaa4ce2e908c6989b307bb		2022-03-01 00:00:00+08	2022-03-01 00:00:00+08	41.899602111	-87.633308037	41.899602111			
17			0072059e89f7b98b5467d64998838e917adfc265		2022-03-01 00:00:00+08	2022-03-01 00:15:00+08	41.79259236	-87.769615453	41.79259236			

taxi_trips_network							
General	Columns	Advanced	Constraints	Parameters	Security	SQL	
Inherited from table(s) <span>Select to inherit from...</span>							
Columns <span>+</span>							
Name	Data type	Length/Precision	Scale	Not NULL?	Primary key?	Default	
id	integer			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	nextval('tax	
trip_id	character varying	255		<input type="checkbox"/>	<input type="checkbox"/>		
trip_start_timestamp	timestamp with time zone			<input type="checkbox"/>	<input type="checkbox"/>		
trip_end_timestamp	timestamp with time zone			<input type="checkbox"/>	<input type="checkbox"/>		
pickup_centroid_latitude	double precision			<input type="checkbox"/>	<input type="checkbox"/>		
pickup_centroid_longitude	double precision			<input type="checkbox"/>	<input type="checkbox"/>		
dropoff_centroid_latitude	double precision			<input type="checkbox"/>	<input type="checkbox"/>		
dropoff_centroid_longitude	double precision			<input type="checkbox"/>	<input type="checkbox"/>		
pickup_zip_code	character varying	255		<input type="checkbox"/>	<input type="checkbox"/>		
dropoff_zip_code	character varying	255		<input type="checkbox"/>	<input type="checkbox"/>		
<span>Close</span> <span>Reset</span> <span>Save</span>							

## 7 . Requirement 7:

I have designed 7 reports.

report_name	report description
report_alert	1.daily new cases&alert of COVID will be sent to every trip and every neighborhoods. 2. weekly new cases&alert of COVID will be sent to every trip and specific neighborhoods.
report_airport	1. the weekly new cases of COVID of O'Hare and trip's destination's neighborhoods and zip code, these information will be sent to the trip.
report_CCVI	Find the number of trips from or to neighborhoods that have High CCVI
report_streetcaping	Find the daily/weekly from one zipcode to other zipcode's trips' number
report_infra_investment	Find the top 5 neighborhoods with high unemployment and poverty rate, and find the projects of building permits' total fee, and waive them.
report_loan	Find the community's new construction with per capita income less than 30,000, and give them the low interest loans.
report_construction	forecast the daily and weekly taxi trips fro every zip code and neighborhood.

report_name	dataset
report_alert	taxi_trips
	taxi_trips_network
	taxi_trip_total
	Neighborhood_community_zip
	covid_weekly_case
	Covid_daily_case
report_airport	taxi_trips
	taxi_trips_network
	taxi_trip_total
	Neighborhood_community_zip
	covid_weekly_case
report_CCVI	Neighborhood_community_zip
	taxi_trip_total
	Covid_ccvi
report_streetcaping	taxi_trip_total
report_infra_investment	building_permits
	public_health_statistics
	Neighborhood_community_zip
report_loan	building_permits
	public_health_statistics
	Neighborhood_community_zip
report_construction	Neighborhood_community_zip
	taxi_trip_total

## 8 . Requirement 8:

**Report name:** report\_alert

**Data source and API:**

dataset	source	api
taxi_trips	<a href="https://data.cityofchicago.org/Transportation/Taxi-Trips/wrvz-psew">https://data.cityofchicago.org/Transportation/Taxi-Trips/wrvz-psew</a>	<a href="https://data.cityofchicago.org/resource/wrvz-psew.json">https://data.cityofchicago.org/resource/wrvz-psew.json</a>
taxi_trips_network	<a href="https://data.cityofchicago.org/Transportation/Transportation-Network-Providers-Trips/m6dm-c72p">https://data.cityofchicago.org/Transportation/Transportation-Network-Providers-Trips/m6dm-c72p</a>	<a href="https://data.cityofchicago.org/resource/m6dm-c72p.json">https://data.cityofchicago.org/resource/m6dm-c72p.json</a>
taxi_trip_total	Merged from taxi_trips and taxi_trips_network	Null
Neighborhood_community_zip	<a href="https://www.chicagotribune.com/chi-community-areas-htmlstory.html">https://www.chicagotribune.com/chi-community-areas-htmlstory.html</a>	Null
covid_weekly_case	<a href="https://data.cityofchicago.org/Health-Human-Services/COVID-19-Cases-Tests-and-Deaths-by-ZIP-Code/yhhz-zm2v">https://data.cityofchicago.org/Health-Human-Services/COVID-19-Cases-Tests-and-Deaths-by-ZIP-Code/yhhz-zm2v</a>	<a href="https://data.cityofchicago.org/resource/yhhz-zm2v.json">https://data.cityofchicago.org/resource/yhhz-zm2v.json</a>
Covid_daily_case	<a href="https://data.cityofchicago.org/Health-Human-Services/COVID-19-Daily-Cases-Deaths-and-Hospitalizations/naz8-j4nc">https://data.cityofchicago.org/Health-Human-Services/COVID-19-Daily-Cases-Deaths-and-Hospitalizations/naz8-j4nc</a>	<a href="https://data.cityofchicago.org/resource/naz8-j4nc.json">https://data.cityofchicago.org/resource/naz8-j4nc.json</a>

**Used Attribute and DataType:**

dataset	attribute name	type
neighborhood_community_zip	neighborhood	VARCHAR(255)
	zipcode	DOUBLE PRECISION
taxi_trip_total	trip_id	VARCHAR(255) UNIQUE
	trip_start_timestamp	TIMESTAMP WITH TIME ZONE
	trip_end_timestamp	TIMESTAMP WITH TIME ZONE
	pickup_zip_code	VARCHAR(255)
	dropoff_zip_code	VARCHAR(256)
covid_weekly_case	zip_code	VARCHAR(255)
	week_start	TIMESTAMP WITH TIME ZONE
	cases_weekly	DOUBLE PRECISION
covid_daily_case	lab_report_date	TIMESTAMP WITH TIME ZONE
	cases_total	DOUBLE PRECISION

## Report result:

There are two results:

Firstly, we should put the information of daily new cases(in Chicago) and predicate future 10 days to the driver and the neighbors.

	time	new	alert
0	2022-04-11	286	medium
1	2022-04-10	282	medium
2	2022-04-09	283	medium
3	2022-04-08	284	medium
4	2022-04-07	286	medium
...	...	...	...
195	2021-09-18	309	high
196	2021-09-17	441	high
197	2021-09-16	475	high
198	2021-09-15	522	high
199	2021-09-14	496	high

```
model.summary()
```

Model: "sequential"

Layer (type)	Output Shape	Param #
=====		
lstm (LSTM)	(None, 9)	396
dense (Dense)	(None, 30)	300
dense_1 (Dense)	(None, 10)	310
dense_2 (Dense)	(None, 1)	11
=====		
Total params: 1,017		
Trainable params: 1,017		
Non-trainable params: 0		

210 rows × 3 columns

Secondly , we should put the information of weekly new cases to the driver and the specific neighbors.

Out[43]:

	zipcode	week_start	cases_weekly	community	neighborhood	alert
0	60601	2022-03-20	20.0	Loop	Printer's Row	medium
1	60602	2022-03-20	0.0	Loop	Printer's Row	low
2	60603	2022-03-20	5.0	Loop	Printer's Row	low
3	60604	2022-03-20	2.0	Loop	Printer's Row	low
4	60605	2022-03-20	29.0	Loop	Printer's Row	medium
...	...	...	...	...	...	...
289	60661	2022-03-20	14.0	Near West Side	Museum Park	medium
290	60661	2022-03-20	14.0	Near West Side	Pilsen	medium
291	60661	2022-03-20	14.0	Near West Side	Tri-Taylor	medium
292	60661	2022-03-20	14.0	Near West Side	University Village	medium
293	60666	2022-03-20	0.0	O'Hare	Schorsch Forest View	low

294 rows × 6 columns

Report name: report\_airport

Data source and API:

dataset	source	api
taxi_trips	https://data.cityofchicago.org/Transportation/Taxi-Trips/wrvz-psew	https://data.cityofchicago.org/resource/wrvz-psew.json
taxi_trips_network	https://data.cityofchicago.org/Transportation/Transportation-Network-Providers-Trips/m6dm-c72p	https://data.cityofchicago.org/resource/m6dm-c72p.json
taxi_trip_total	Merged from taxi_trips and taxi_trips_network	Null
Neighborhood_community_zip	https://www.chicagotribune.com/chi-community-areas-htmlstory.html	Null
covid_weekly_case	https://data.cityofchicago.org/Health-Human-Services/COVID-19-Cases-Tests-and-Deaths-by-ZIP-Code/yhhz-zm2v	https://data.cityofchicago.org/resource/yhhz-zm2v.json

Used Attribute and DataType:

dataset	attribute name	type
neighborhood_community_zip	neighborhood	VARCHAR(255)
	zipcode	DOUBLE PRECISION
taxi_trip_total	trip_id	VARCHAR(255) UNIQUE
	trip_start_timestamp	TIMESTAMP WITH TIME ZONE
	trip_end_timestamp	TIMESTAMP WITH TIME ZONE
	pickup_zip_code	VARCHAR(255)
	dropoff_zip_code	VARCHAR(256)
covid_weekly_case	zip_code	VARCHAR(255)
	week_start	TIMESTAMP WITH TIME ZONE
	cases_weekly	DOUBLE PRECISION

Report result:

report

```
]: # neighborhoodscvi_category
new_w = df_2_total.groupby(by=["dropoff_zip_code"], dropna=False)["week_start"].max().reset_index()
new_w = new_w.merge(df_2_total, how='left', on=['week_start', 'dropoff_zip_code'])
new_w
```

t[38]:

	dropoff_zip_code	week_start	community	trip_id	ymd	cases_weekly
0	60601	2022-03-20	Loop	1217a033e5386f0b655f1fa7cde5644bedbab5e1	2022-02-28	20.0
1	60601	2022-03-20	Loop	b2b64728accd307bf78372479d9cdb89e002068f	2022-02-28	20.0
2	60601	2022-03-20	Loop	7b24367db7ed8d7a78e9afa8a69b96a00713fd6b	2022-02-28	20.0
3	60601	2022-03-20	Loop	66a19019f7721c304d3b1c9d8209929e4b347beb	2022-02-28	20.0
4	60601	2022-03-20	Loop	ba2836ed552e940b04f30536fb1b3ec247824925	2022-02-28	20.0
...	...	...	...	...	...	...
3759	60666	2022-03-20	O'Hare	be2615b04bc74c0637a5e89c08c4abdbc8fe4d6c	2022-02-28	0.0
3760	60666	2022-03-20	O'Hare	9a36d2f9660eb3f74ece57934c431a815ecadc8e	2022-02-28	0.0
3761	60666	2022-03-20	O'Hare	c9ffb5dabae751639a49605df7d6cfd10a6aa1d0	2022-02-28	0.0
3762	60666	2022-03-20	O'Hare	3820d7e1beb37b7270e098a828eb9ada32f75093	2022-02-28	0.0
3763	60666	2022-03-20	O'Hare	d2089e67533e2a8c9b3620f64ac019188eb4b157	2022-02-28	0.0

3764 rows × 6 columns

Report name: report\_ccvi

Data source and API:

dataset	source	api
taxi_trips	https://data.cityofchicago.org/Transportation/Taxi-Trips/wrvz-psew	https://data.cityofchicago.org/resource/wrvz-psew.json
taxi_trips_network	https://data.cityofchicago.org/Transportation/Transportation-Network-Providers-Trips/m6dm-c72p	https://data.cityofchicago.org/resource/m6dm-c72p.json
Covid_ccvi	https://data.cityofchicago.org/Health-Human-Services/Chicago-COVID-19-Community-Vulnerability-Index-CCV/xhc6-88s9	https://data.cityofchicago.org/resource/xhc6-88s9.json
Neighborhood_community_zip	https://www.chicagotribune.com/chi-community-areas-htmlstory.html	Null

Used Attribute and DataType:

dataset	attribute name	type
neighborhood_community_zip	neighborhood	VARCHAR(255)
	community	VARCHAR(255)
	zipcode	DOUBLE PRECISION
taxi_trip_total	trip_id	VARCHAR(255) UNIQUE
	trip_start_timestamp	TIMESTAMP WITH TIME ZONE
	trip_end_timestamp	TIMESTAMP WITH TIME ZONE
	pickup_zip_code	VARCHAR(255)
	dropoff_zip_code	VARCHAR(256)
covid_ccvi	community_area_name	VARCHAR(255)
	ccvi_category	VARCHAR(255)

Report result:

	trip_start_timestamp	neighborhood	type	ccvi_high_count
0	2022-02-28 19:15:00+08:00	Belmont Gardens	drop	4
1	2022-02-28 19:15:00+08:00	Brainerd	drop	3
2	2022-02-28 19:15:00+08:00	Fernwood	drop	1
3	2022-02-28 19:15:00+08:00	Fifth City	pick	1
4	2022-02-28 19:15:00+08:00	Galewood	drop	1
...	...	...	...	...
590	2022-03-01 00:00:00+08:00	Lawndale	drop	1
591	2022-03-01 00:00:00+08:00	Le Claire Courts	pick	2
592	2022-03-01 00:00:00+08:00	Little Village	drop	1
593	2022-03-01 00:00:00+08:00	Sleepy Hollow	pick	2
594	2022-03-01 00:00:00+08:00	Vittum Park	pick	2

595 rows × 4 columns

Report name: report\_streetcaping

Data source and API:

dataset	source	api
taxi_trips	https://data.cityofchicago.org/Transportation/Taxi-Trips/wrvz-psew	https://data.cityofchicago.org/re-source/wrvz-psew.json
taxi_trips_network	https://data.cityofchicago.org/Transportation/Transportation-Network-Providers-Trips/m6dm-c72p	https://data.cityofchicago.org/re-source/m6dm-c72p.json
Neighborhood_community_zip	https://www.chicagotribune.com/chi-community-areas-htmlstory.html	Null

Used Attribute and DataType:

dataset	attribute name	type
taxi_trip_total	trip_id	VARCHAR(255) UNIQUE
	trip_start_timestamp	TIMESTAMP WITH TIME ZONE
	trip_end_timestamp	TIMESTAMP WITH TIME ZONE
	pickup_zip_code	VARCHAR(255)
	dropoff_zip_code	VARCHAR(256)

Report result:

Out[35]:

	ymd	zipcode	trip_count
0	2022-02-28	60018	2
1	2022-02-28	60601	84
2	2022-02-28	60603	174
3	2022-02-28	60604	406
4	2022-02-28	60605	64
...	...	...	...
58	2022-03-01	60622	2
59	2022-03-01	60638	4
60	2022-03-01	60657	2
61	2022-03-01	60660	2
62	2022-03-01	60666	12

63 rows × 3 columns

Out[54]:

	zipcode	predict_count	predict_date
0	60018	2.0	2022-03-02
1	60601	84.0	2022-03-02
2	60603	174.0	2022-03-02
3	60604	204.0	2022-03-02
4	60605	64.0	2022-03-02
5	60607	208.0	2022-03-02
6	60608	70.0	2022-03-02
7	60609	68.0	2022-03-02
8	60610	397.0	2022-03-02
9	60611	132.0	2022-03-02
10	60612	26.0	2022-03-02

**Report name:** report\_infra\_investment

**Data source and API:**

dataset	source	api
building_permits	<a href="https://www.chicago.gov/city/en/depts/bldgs/dataset/building_permits.html">https://www.chicago.gov/city/en/depts/bldgs/dataset/building_permits.html</a>	<a href="https://data.cityofchicago.org/resource/ydr8-5enu.json">https://data.cityofchicago.org/resource/ydr8-5enu.json</a>
Public_Health_Statistics	<a href="https://data.cityofchicago.org/Health-Human-Services/Public-Health-Statistics-Selected-public-health-in/iqnk-2tcu/data">https://data.cityofchicago.org/Health-Human-Services/Public-Health-Statistics-Selected-public-health-in/iqnk-2tcu/data</a>	<a href="https://data.cityofchicago.org/resource/iqnk-2tcu.json">https://data.cityofchicago.org/resource/iqnk-2tcu.json</a>
Neighborhood_community_zip	<a href="https://www.chicagotribune.com/chi-community-areas-htmlstory.html">https://www.chicagotribune.com/chi-community-areas-htmlstory.html</a>	Null

**Used Attribute and DataType:**

dataset	attribute name	type
neighborhood_community_zip	neighborhood	VARCHAR(255)
	community	VARCHAR(255)
	zipcode	DOUBLE PRECISION
building_permits	permit_id	VARCHAR(255) UNIQUE
	total_fee	DOUBLE PRECISION
	zipcode	VARCHAR(255)
public_health_statistics	community_area_name	VARCHAR(255) UNIQUE
	below_poverty_level	DOUBLE PRECISION
	unemployment	DOUBLE PRECISION

**Report result:**

Out[25]:

	neighborhood	poverty+unemployment	total_fee
0	Englewood	67.0	4250.00
1	Hamilton Park	63.5	6343.40
2	Lawndale	57.1	60513.16
3	Fifth City	56.1	9384.08
4	Jackson Park Highlands	49.2	35810.40



Report name: report\_loan

Data source and API:

dataset	source	api
building_permits	https://www.chicago.gov/city/en/depts/bldgs/dataset/building_permits.html	https://data.cityofchicago.org/resource/ydr8-5enu.json
Public_Health_Statistics	https://data.cityofchicago.org/Health-Human-Services/Public-Health-Statistics-Selected-public-health-in/iqnk-2tcu/data	https://data.cityofchicago.org/resource/iqnk-2tcu.json
Neighborhood_community_zip	https://www.chicagotribune.com/chi-community-areas-htmlstory.html	Null

Used Attribute and DataType:

dataset	attribute name	type
neighborhood_community_zip	community	VARCHAR(255)
	zipcode	DOUBLE PRECISION
building_permits	permit_id	VARCHAR(255) UNIQUE
	permit_type	VARCHAR(255)
	zipcode	VARCHAR(255)
public_health_statistics	community_area_name	VARCHAR(255) UNIQUE
	per_capita_income	DOUBLE PRECISION

Report result:

report

```
[10]: In [10]: rp_loan = pro_df_2[pro_df_2["permit_type"] == "PERMIT - NEW CONSTRUCTION"]
rp_loan = rp_loan[rp_loan["per_capita_income"] < 30000]
rp_loan = rp_loan.reset_index(drop=True)
rp_loan
```

Out[10]:

	permit_id	permit_type	per_capita_income	community
0	3229248	PERMIT - NEW CONSTRUCTION	21375.0	West Ridge
1	3229248	PERMIT - NEW CONSTRUCTION	21375.0	West Ridge
2	3229248	PERMIT - NEW CONSTRUCTION	21375.0	West Ridge
3	3229248	PERMIT - NEW CONSTRUCTION	21375.0	West Ridge
4	3229248	PERMIT - NEW CONSTRUCTION	24941.0	North Park
5	3229248	PERMIT - NEW CONSTRUCTION	24941.0	North Park
6	3216461	PERMIT - NEW CONSTRUCTION	24941.0	North Park
7	3216461	PERMIT - NEW CONSTRUCTION	24941.0	North Park
8	3216461	PERMIT - NEW CONSTRUCTION	20355.0	Albany Park
9	3216461	PERMIT - NEW CONSTRUCTION	20355.0	Albany Park
10	3216461	PERMIT - NEW CONSTRUCTION	20355.0	Albany Park
11	3239080	PERMIT - NEW CONSTRUCTION	26713.0	Irving Park
12	3239080	PERMIT - NEW CONSTRUCTION	26713.0	Irving Park
13	3239080	PERMIT - NEW CONSTRUCTION	26713.0	Irving Park
14	3239080	PERMIT - NEW CONSTRUCTION	26713.0	Irving Park
15	3228200	PERMIT - NEW CONSTRUCTION	29026.0	Logan Square
16	3240381	PERMIT - NEW CONSTRUCTION	15411.0	Hermosa
17	3240380	PERMIT - NEW CONSTRUCTION	15411.0	Hermosa
18	3240381	PERMIT - NEW CONSTRUCTION	15411.0	Hermosa

Report name: report\_construction

Data source and API:

dataset	source	api
taxi_trips	https://data.cityofchicago.org/Transportation/Taxi-Trips/wrvz-psew	https://data.cityofchicago.org/resource/wrvz-psew.json
taxi_trips_network	https://data.cityofchicago.org/Transportation/Transportation-Network-Providers-Trips/m6dm-c72p	https://data.cityofchicago.org/resource/m6dm-c72p.json
Neighborhood_community_zip	https://www.chicagotribune.com/chi-community-areas-htmlstory.html	Null
taxi_trip_total	Merged from taxi_trips and taxi_trips_network	Null

Used Attribute and DataType:

dataset	attribute name	type
taxi_trip_total	trip_id	VARCHAR(255) UNIQUE
	trip_start_timestamp	TIMESTAMP WITH TIME ZONE
	trip_end_timestamp	TIMESTAMP WITH TIME ZONE
	pickup_zip_code	VARCHAR(255)
	dropoff_zip_code	VARCHAR(256)
neighborhood_community_zip	neighborhood	VARCHAR(255)
	zipcode	DOUBLE PRECISION

Report result (zip\_code based) :

Out[11]:

	zipcode	predict_count	predict_date
0	60018	2.0	2022-03-02
1	60601	84.0	2022-03-02
2	60603	174.0	2022-03-02
3	60604	204.0	2022-03-02
4	60605	64.0	2022-03-02
5	60607	208.0	2022-03-02
6	60608	70.0	2022-03-02
7	60609	68.0	2022-03-02
8	60610	397.0	2022-03-02
9	60611	132.0	2022-03-02
10	60612	26.0	2022-03-02

Report result (community based) :

Out[13]:

	community	predict_count	predict_date
0	Albany Park	360.0	2022-03-02
1	Armour Square	476.0	2022-03-02
2	Ashburn	120.0	2022-03-02
3	Austin	328.0	2022-03-02
4	Avalon Park	300.0	2022-03-02
5	Beverly	62.0	2022-03-02
6	Calumet Heights	150.0	2022-03-02
7	Chatham	112.0	2022-03-02
8	Chicago Lawn	120.0	2022-03-02
9	Clearing	154.0	2022-03-02
10	Danville	576.0	2022-03-02

## 8-6 procession and preparation the data

I give some examples I prepare and process the data.

1. While I grasp data from internet, I will process, through filter.

```
# delete the info if useless
content_list_after_delete = []
for i in content_list:
    if (len(i['Trip_start_timestamp']) < 23) or (len(i['Trip_end_timestamp']) < 23):
        pass
    elif "" in list(i.values()):
        pass
    else:
        content_list_after_delete.append(i)
```

2. While generating the report, I will use dropna function.

```
pre_list = [pre_list[i] for i in range(len(pre_list)-1, -1, -1)]
pre_list_df = pd.DataFrame(pre_list)
pre_list_df.columns = ["time", "new"]
new_case_pre_df = pre_list_df.append(daily_new)
new_case_pre_df["time"] = new_case_pre_df["time"].apply(lambda x: x.strftime("%Y-%m-%d"))
new_case_pre_df.dropna()
new_case_pre_df["new"] = new_case_pre_df["new"].apply(lambda x: int(round(x, 2)))
new_case_pre_df["alert"] = new_case_pre_df["new"].apply(lambda x: alert_func(x))
new_case_pre_df
```

3. While using machine learning, I will use standardization to process data

```
# predict
scaler = MinMaxScaler()
scaled_close_ori = [daily_new["new"][i] for i in range(len(daily_new["new"])-1, -1, -1)]
avg_item = np.average(scaled_close_ori[-10:])
scaled_close_ori = scaled_close_ori + [avg_item]*10
scaled_close = np.array(scaled_close_ori).reshape([len(scaled_close_ori), 1])
scaled_close = scaler.fit_transform(scaled_close)
scaled_close = scaled_close.reshape(-1, 1)
```

4. While there is unknow, which is not we want, I will delete

```
# set dataframe
df_3 = pd.DataFrame(result_1)
df_3.columns = ["id", "dropoff_zip_code", "week_number", "week_start", "week_end", "cases_weekly", "cases_cumulative"]
df_3 = df_3[["dropoff_zip_code", "week_start", "cases_weekly"]]
df_3["week_start"] = df_3["week_start"].apply(lambda x: x.strftime("%Y-%m-%d"))
df_3 = df_3[df_3["dropoff_zip_code"] != "Unknown"]
df_3.dropoff_zip_code = df_3.dropoff_zip_code.astype("int")
df_3
```

5. While there is some datatype false, I will transfer the datatype

```
df_3.dropoff_zip_code = df_3.dropoff_zip_code.astype("int")
df_3
```

## 9 . Requirement 9:

I get 2000 data from api json, while, getting taxi\_trips.

```
0*%2C%203Aid%20order%20by%20%60trip_start_timestamp%60%20desc%20limit%202000"
```

## 10 . Requirement 10:

I get 2000 data from api json, while, getting taxi\_trips\_network.

```
%203Aid%20order%20by%20%60trip_start_timestamp%60%20desc%20limit%202000"
```

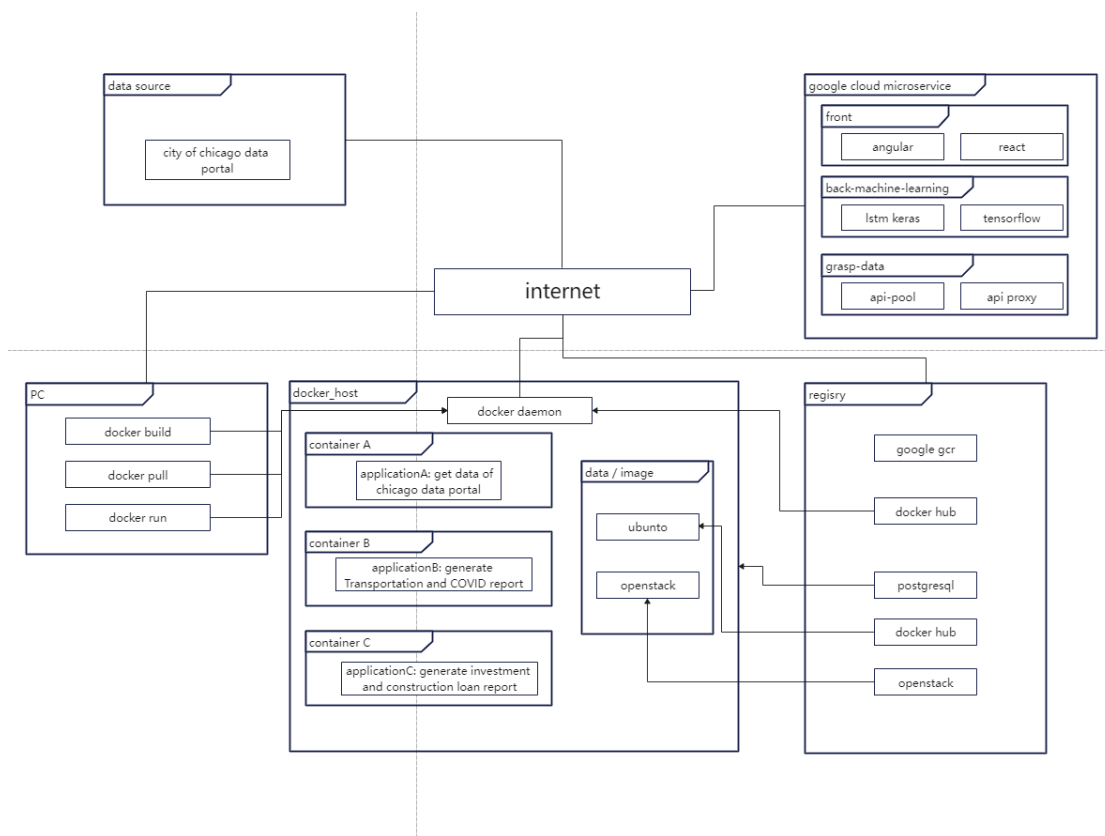
## 11 . Requirement 11:

I design a cloud-native microservice for the Chicago Business Intelligence for Strategic Planning. There are 5 parts in the structure: data source, google cloud microservice, PC, docker host, and registry.

Workflow: 1. Firstly, pc requests to build the docker. 2. Docker daemon will run, can create container and processes. 3. And the image(different versions) will be stored in the registry, and the developer could choose the proper image for docker.

Container and Application: I design 3 containers, including get data, generate transportation, COVID reports and generate investment, loan report. The applications are deployed in different processes.

The google cloud microservice: different from microservice deployed in the docker host, microservice provided by cloud will help applications to run better, for example, the generate report can get the lstm keras, using the computing resources of Google cloud.



## 12 . Requirement 12:

Microservices	Purpose	Provided
Build container image	PC can build container image to help every container have its own historical environment. You can pull image from docker host(from registries), and build, and push.	PC
Get Data	PC could get data through api requests from data source based on internet. We should ensure it have own process/container, and not be disturbed.	PC
Api-ip_Pool	Could can provide api-ip_pool and its network bandwidth to help grasp the data. PC can request ips from cloud, and api-computing resources.	Cloud
Generate transportation and COVID report	Pc requests data from docker's postgresql, and process data, generating the report. Because transportation is highly relative to the COVID, and highly different from the investment, therefore, we loose the report generation.	PC
Generate investment and loan report	Pc requests data from docker's postgresql, and process data, generating the report. Because these two parts always use the same tables in the sql.	PC
LSTM_keras	Because if we want predict amount time series data, we should get most computing resources, and we push a request to the google for on-cloud training and get the result back.	Cloud

## 13 . Requirement 13:

- (1) Use the personal development computer native operating system (OS) to build, deploy, and run loosely-coupled programs (microservices).

**Design solutions:** I divide the full programs into 2 main parts, get\_data and generating the report, and use a manage file to build the different processes for each sub-part. The generating report can be divided into these 7 modulars: report alert, report airport, report CCVI, report streetcaping, report infra investment, report loan, report construction.

**Advantages:** microservices can help to allocate different resources to the different parts, for example, we can allocate more network and computing resource to the get data part everyday 0.00, because this time, more new data are generated. And we can allocate more computing resources to the predictions, because LSTM need more computing.

**Disadvantages:** unfortunately, it could be complex to run the microservices in personal computer, and we can not easily understand which process are running, and how to cut the specific process. And how to allocate the proper resources to these processes.

- (2) Use Docker build, deploy, and run containers for the difference microservices on the development computer native operating system (OS)

**Design solutions:** I decided to design a docker which include the registry, and pc only have the function to build the image and request to run the docker. The applications and microservices would be deployed in the container created by the docker. There are three containers, including Get Data, Generate transportation and COVID report and Generate investment and loan report. The program we have mentioned would be deployed into these container. And first, we run the docker, the docker create container, and run the program step by step. The postgresql is connected to the docker.

**Advantages:** different from native microservices, docker have some advantages, that it is easy for us to control the versions, and images for different processes and container. We can build different environments for the different programs. And the isolation between containers, ensuring the programs running would not be disrupted.

**Disadvantages:** compared with the cloud based, docker is still deployed in our pc, limited by the computing resources, storage and the network bandwidth. And the security is not guaranteed.

(3) Use Google Cloud to build, deploy, and run the needed microservices

**Design solutions:** Based on the docker, we can let PC to request to the google cloud. And, there are two options, the first option is that we can deploy some light program on our pc. The second option is that we deploy almost everything in the cloud. And I choose the second, we can upload all the back-end, front-end, storage into the cloud, and use the storage strategy, bucket storage, ai-lab(LSTM keras), database and so on. Then set a website for the customer to click and request service.

**Advantages:** almost every thing is in the cloud, and there is no limitation of storage resources, computing resources, and there are multiply versions' control, and there are some place to save your data and image.

**Disadvantages:** maybe a little expansive. And the public cloud will have some security problems. And the private cloud is extremely expansive.