Modeling Mobility with GRU

Team Ghosted

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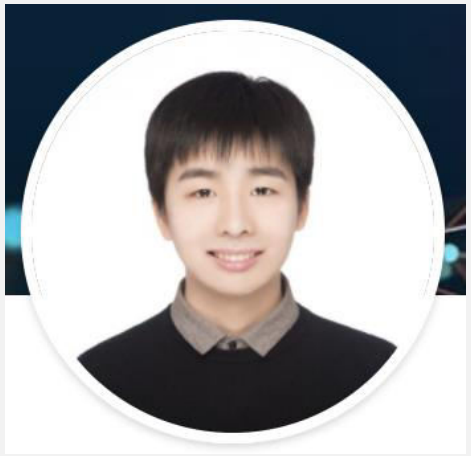

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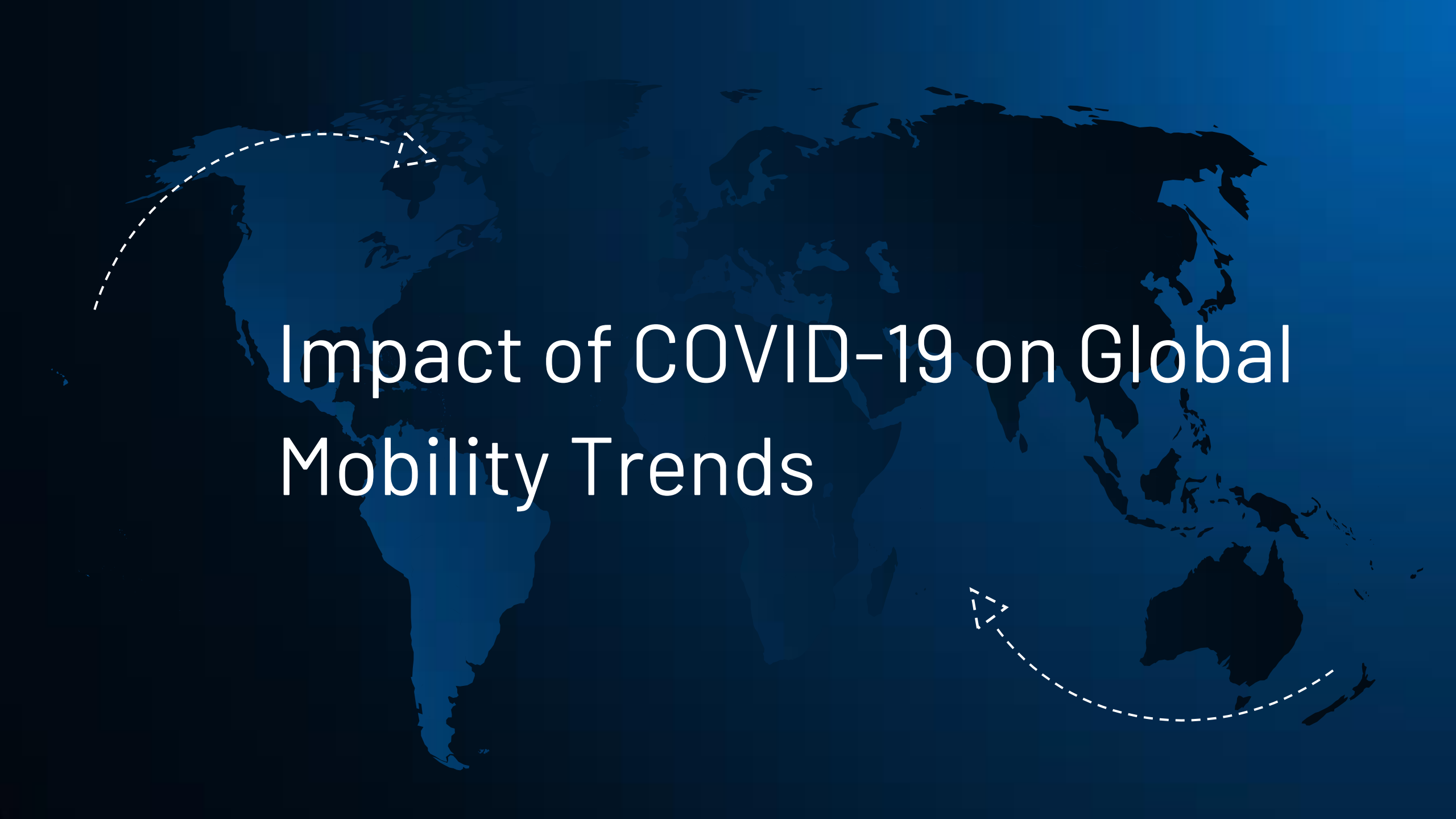
Ghosted by 3 Others...

How has COVID-19 affected the mobility of people across the globe?

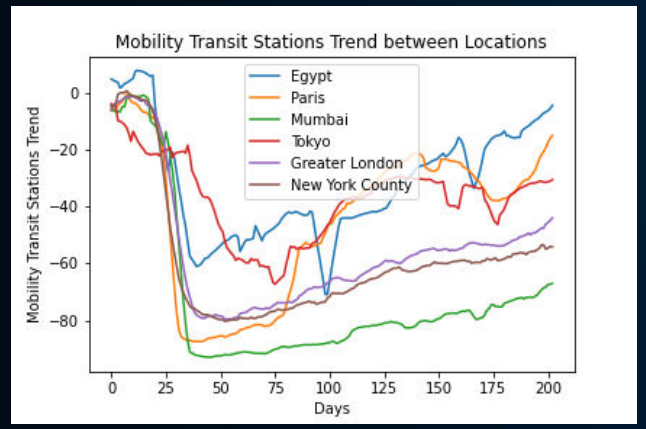
- Impact of COVID-19 on Global Mobility Trends
- Mobility Prediction


Impact of COVID-19 on Global Mobility Trends

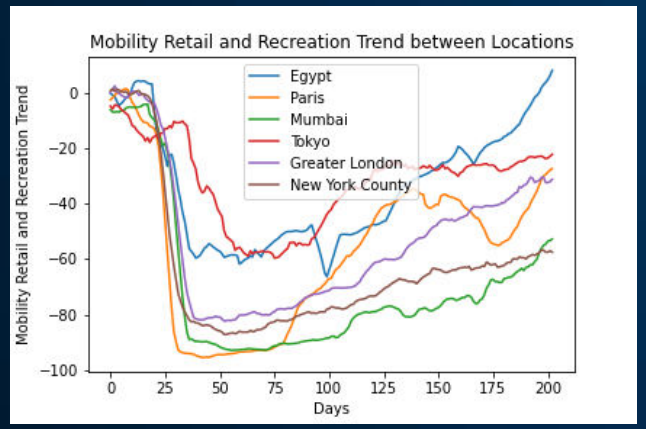
Mobility Trends in Major Locations

We focus on Egypt, France, India, Japan, United Kingdom, and USA, since they are major locations and have few missing values. It seems like some locations have similar trends, while others are quite different (confirmed in next slide)

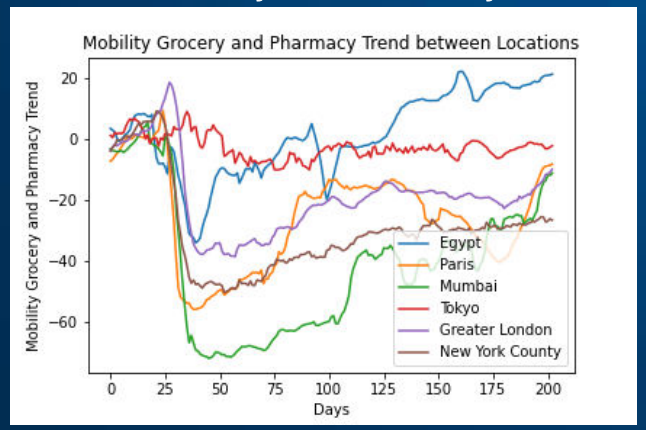
Transit Stations



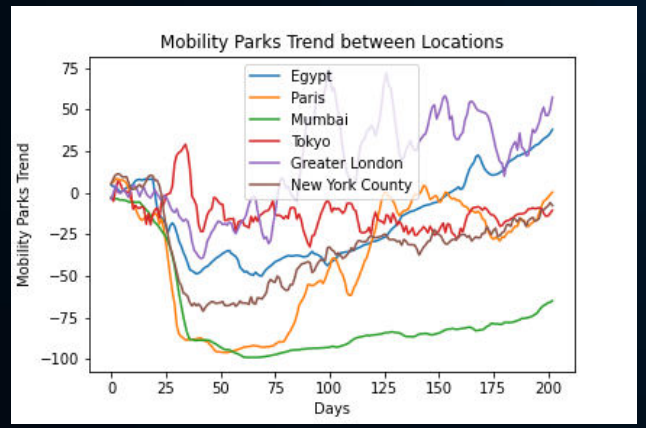
Retail and Recreation



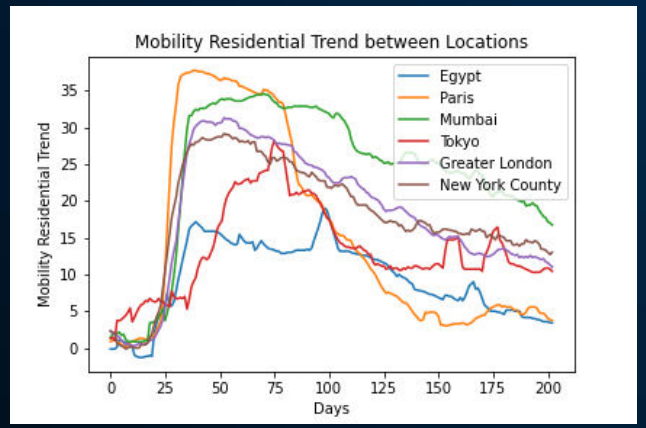
Grocery and Pharmacy



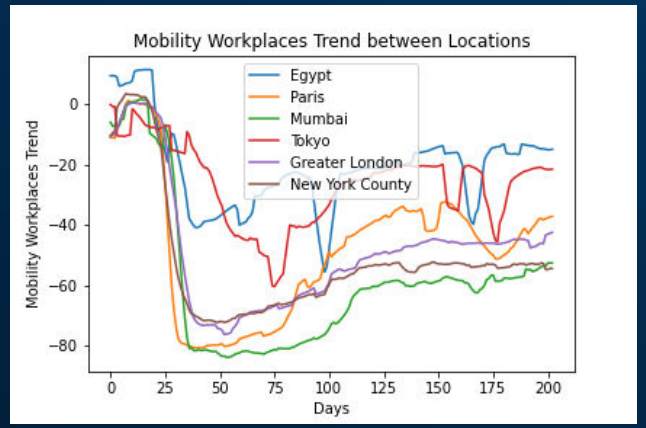
Parks



Residential

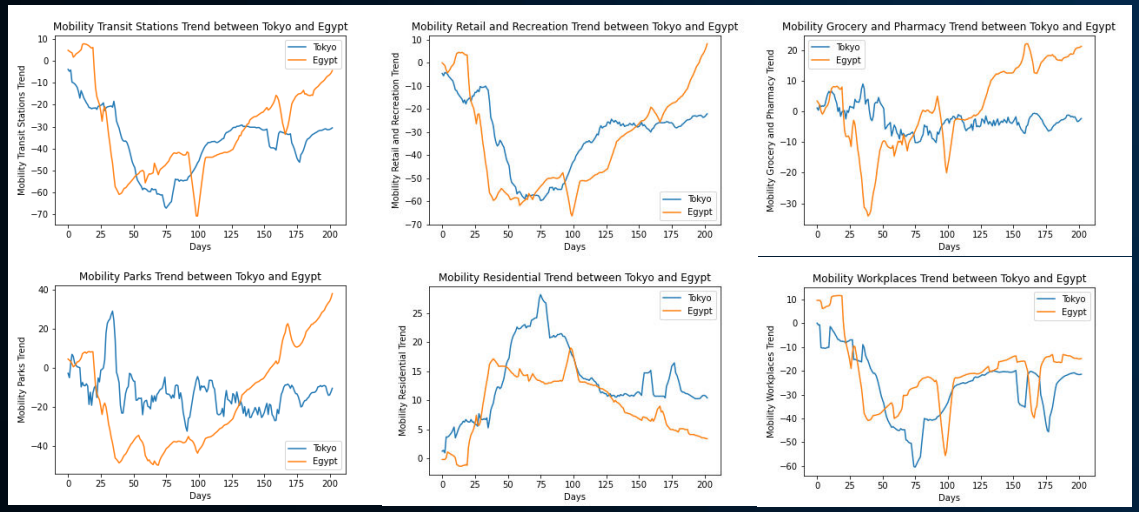


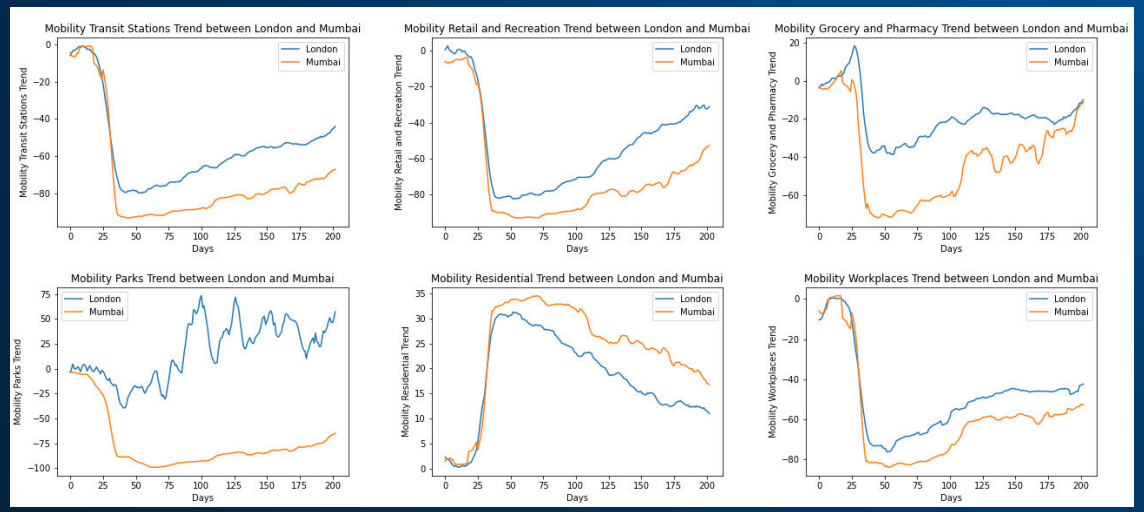
Workplaces



Similarity of Mobility Trends

We measure the similarity of time series using Dynamic Time Warping (DTW) w/squared Euclidean distance.
DTW allows the comparison of multivariate time series.
(the below plots show each mobility trend comparison independently, but in reality mobility trends multivariate time series were compared)





Egypt and Tokyo Distance: 559.618

Most Similar Locations

London and Mumbai Distance:1370.352

Least Similar Locations

Some locations do have relatively similar mobility trends.

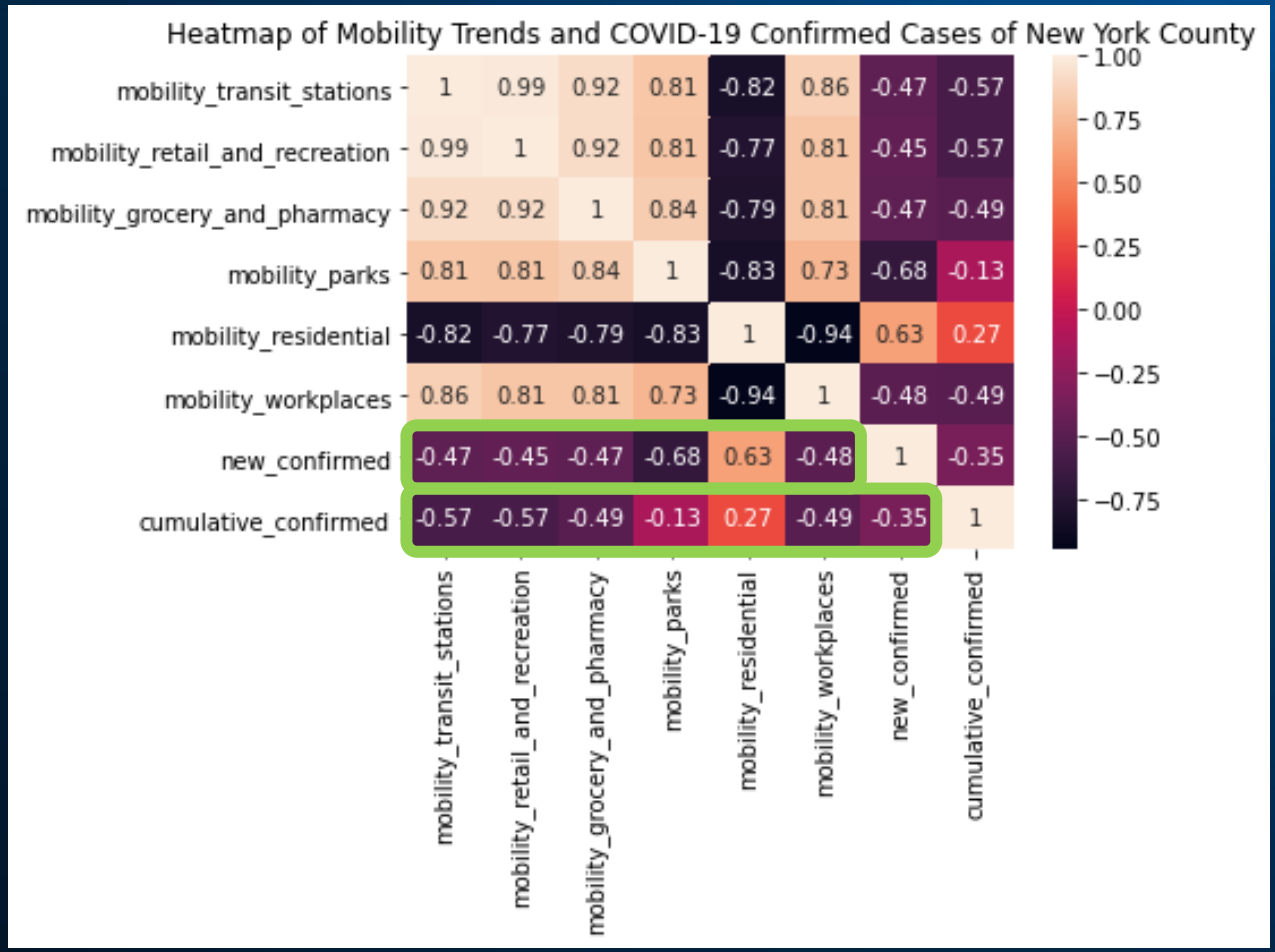
(For more specific DTW similarities of mobility trends between each major city, please check the Appendix.)

COVID-19 New Cases and Mobility Trends

New confirmed COVID-19 cases may have negatively impacted all mobility, except for residential mobility.

(Other locations do have weaker correlation, but COVID-19 cases still seem to affect mobility)

Ex. New York County



Key Findings

➢Some locations have similar mobility trends

= mobility trends in some locations could help in predicting mobility trends in other locations

➢COVID-19 cases seem to affect mobility trends in certain locations

= COVID-19 cases could help in predicting mobility trends

We attempt to validate these findings through modeling mobility


Mobility Prediction

Why is mobility prediction important?

- **Early detection** of mobility increases and decreases allow more time for **transportation systems** and **businesses** to be prepared
- Allows preventive actions to be taken beforehand to reduce COVID-19 outbreaks

Our Approach

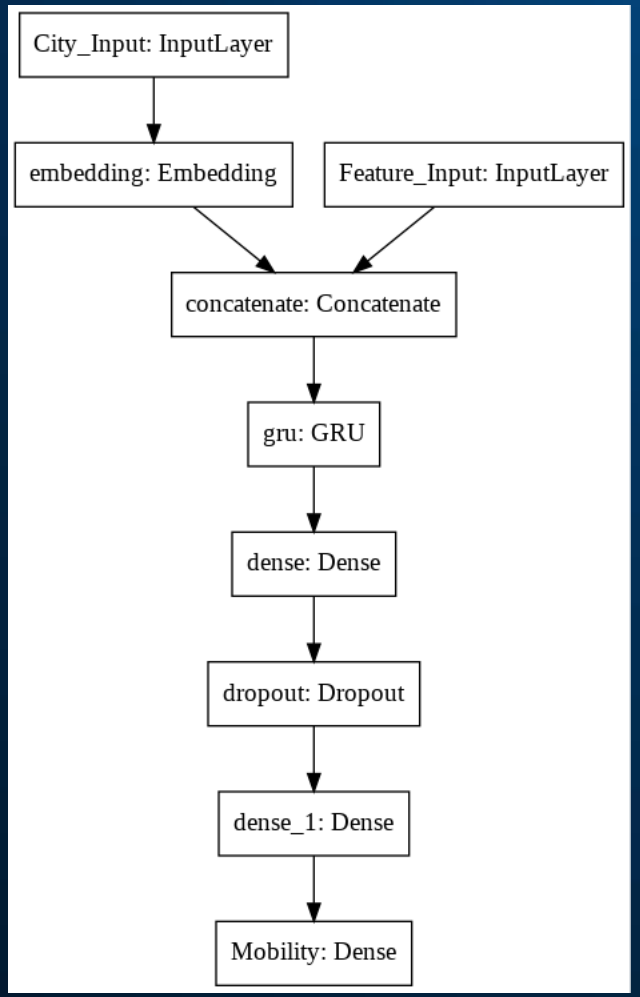
We attempt to predict the 6 mobility trends using a multivariate GRU.

Input of GRU:
- past 50 days of mobility trends
- past 50 days of COVID-19 cases
- past 50 days of weather data
- past 50 days of policy data

Output of GRU:
- 6 mobility trends of the following day

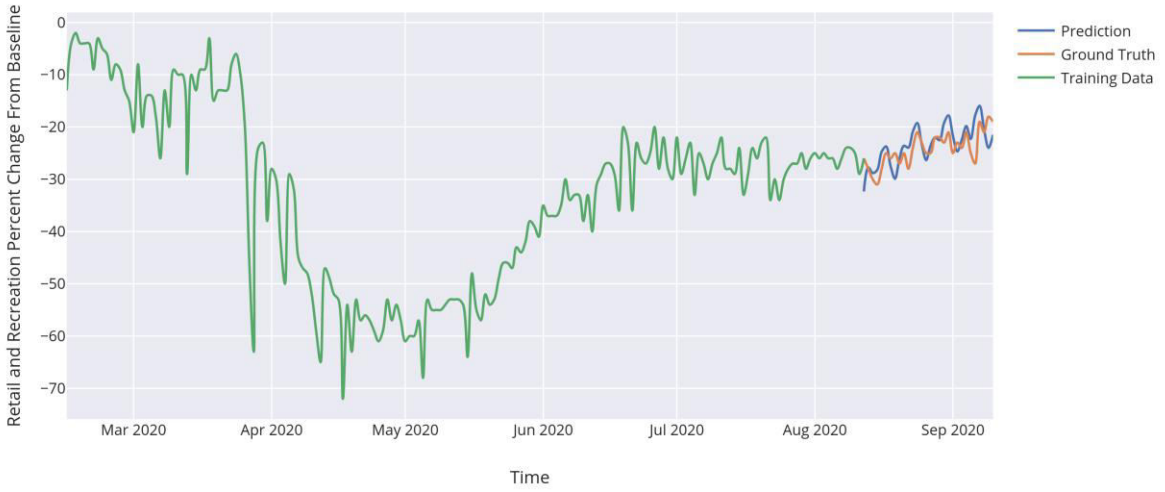
Train Data Period: 2020/2/15 to 2020/7/31
Validation Data Period: 2020/8/1 to 2020/8/10
Test Data Period: 2020/8/11 to 2020/9/10
(Please check Appendix for details)

We use the COVID-19 Open Data and COVID-19 Government Response Data from BigQuery.
(COVID-19 Google Mobility Data was included in the COVID-19 Open Data)

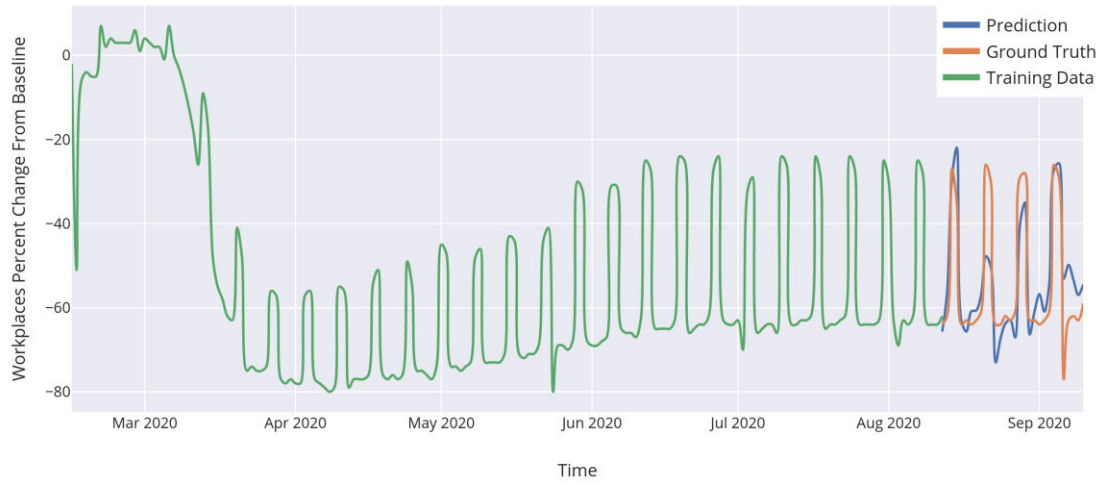


Random samples of our results

Tokyo Retail and Recreation Mobility Prediction



US Workplaces Mobility Prediction



Conclusion and Discussion

- We found a possible relationship between COVID-19 and mobility trends, and were able to forecast mobility by building an accurate GRU model
  -> Validates our earlier findings/hypothesis about how COVID-19 affects mobility

- Our model may have been able to capture similarities between countries within the hidden layers

- We used only 6 major locations for analysis and modeling, so there is still much room for improvement in both aspects

Thank you!

Slides borrowed from SlidesMania.com

Appendix

Similarity of Mobility Trends time series between Major Locations (DTW w/squared Euclidean)

	Egypt	Paris	Mumbai	Tokyo	London	New York
Egypt	0	749.433	1126.082	559.618	983.372	806.360
Paris	749.433	0	791.410	729.578	889.969	606.208
Mumbai	1126.082	791.410	0	1062.144	1370.352	650.711
Tokyo	559.618	729.578	1062.144	0	812.099	730.503
London	983.372	889.969	1370.352	812.099	0	740.210
New York	806.360	606.208	650.711	730.503	740.210	0

Similarity of COVID-19 New Cases time series between Major Locations (DTW w/squared Euclidean)

	Egypt	Paris	Mumbai	Tokyo	London	New York
Egypt	0	4545.993	6588.306	6541.919	2931.451	4369.360
Paris	4545.993	0	6226.918	1328.405	1568.469	1805.624
Mumbai	6588.306	6226.918	0	9887.494	8016.171	9878.802
Tokyo	6541.919	1328.405	9887.494	0	1781.535	1079.542
London	2931.451	1568.469	8016.171	1781.535	0	1341.394
New York	4369.360	1805.624	9878.802	1079.542	1341.394	0

Other COVID-19 New Cases and Mobility Trends