



Analyzing Social Distancing Based on Sensory Inputs

Open House Presentation
WINLAB Summer Internship 2021

The Team



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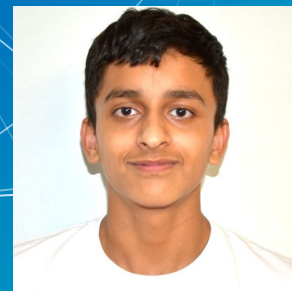
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Background



- The effectiveness of social distancing as a disease-slowing measure is dependent on the degree of compliance from the public
- Our objective is to quantitatively measure compliance with social distancing measures implemented in New York City

March 20, 2020:

“

We know the most effective way to reduce the spread of this virus is through social distancing and density reduction measures.

Governor Andrew M. Cuomo

Dataset

- Traffic camera images and dashcam images from Uber and Lyft vehicles
- Three main NYC boroughs -- Manhattan, Brooklyn, and Queens
- Focus on March to August 2020
- Images provided by Nexar



Natural Language Processing

Image
Captioning
Tool

Latent Dirichlet
Allocation (LDA)

Hellinger
Distance

Nexar images

Project Pipeline

Brightness
filter

People filter
using YOLOv3

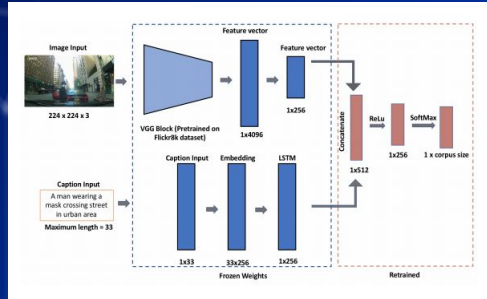
Pairwise Distance
Estimations,
Count of People

Computer Vision

Techniques & Tools

NLP Workflow:

Image-to-Caption:



Computer Vision Workflow:

YOLO - You Only Look Once:



LDA Model:

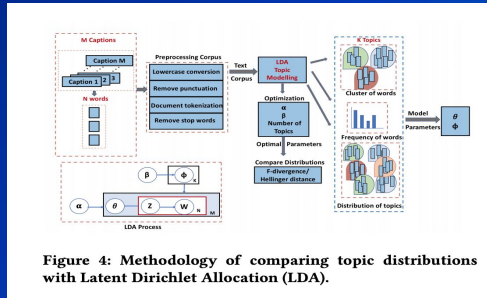
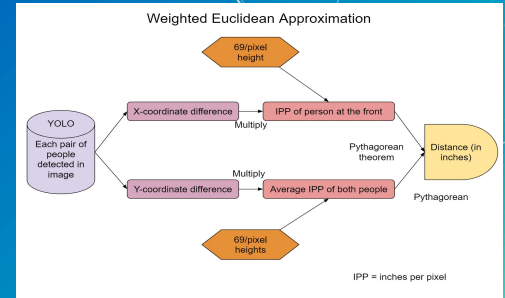


Figure 4: Methodology of comparing topic distributions with Latent Dirichlet Allocation (LDA).

Distance Estimation:



IPP = inches per pixel

Hellinger Distance + Results

Example:

Hellinger (A, A) = 0

Hellinger (A, Z) = 0.967

Interesting Months: **April, June, and July**

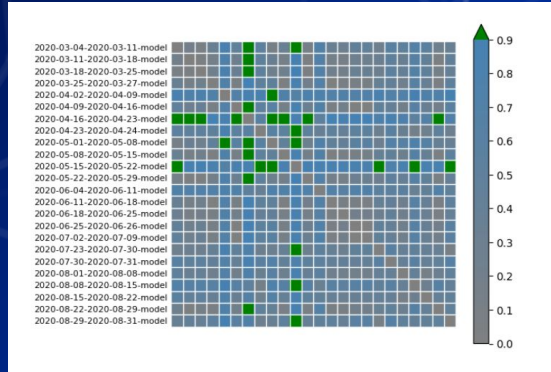


Figure 5: Comparison between topic distributions from weekly images. Changes (cluster of green cells) are observed during April-May due to the newly imposed social distancing policy that shapes street activities.

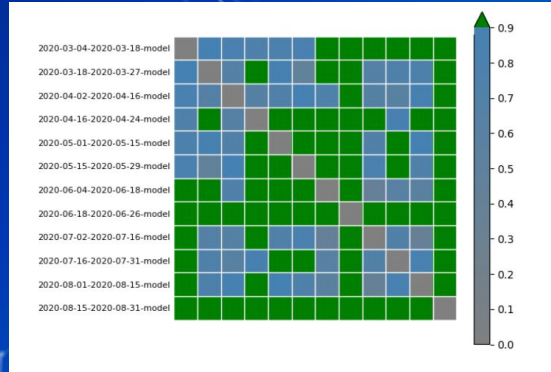


Figure 6: Comparison between topic distributions from bi-weekly images. Sequences of green cells around June observed when phases 1 and 2 of reopening happened around the city.

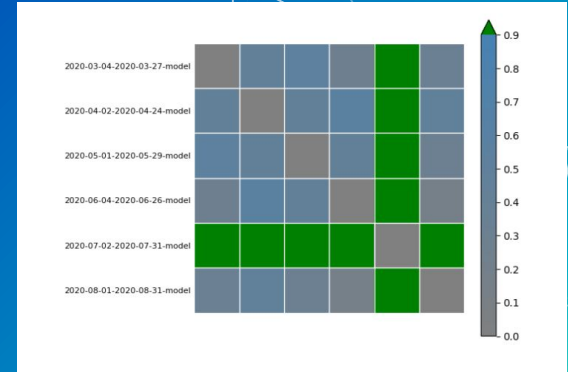


Figure 7: Comparison between topic distributions from monthly images. A sharp change is July when phases 3 and 4 of reopening occurred, permitting social gatherings and recreation activities.

Weekly Time Bin

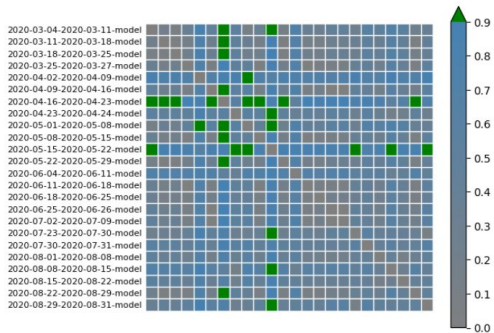


Figure 5: Comparison between topic distributions from weekly images. Changes (cluster of green cells) are observed during April-May due to the newly imposed social distancing policy that shapes street activities.

Two-Week Time Bin

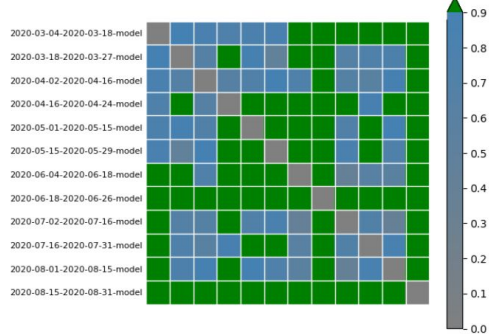


Figure 6: Comparison between topic distributions from bi-weekly images. Sequences of green cells around June observed when phases 1 and 2 of reopening happened around the city.

Monthly Time Bin

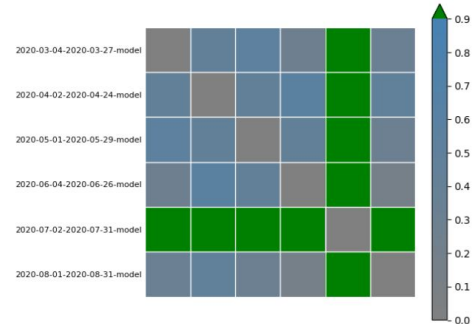
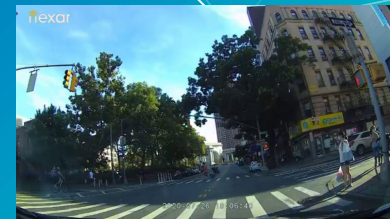
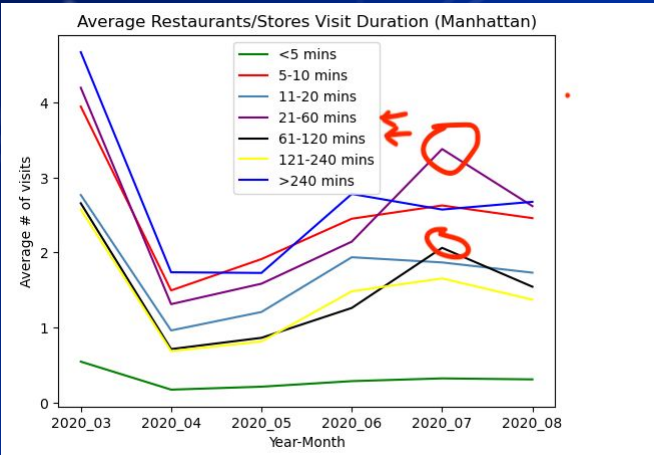
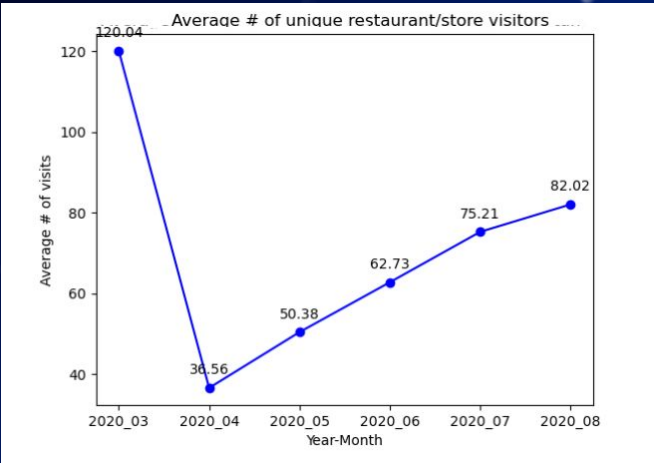


Figure 7: Comparison between topic distributions from monthly images. A sharp change is July when phases 3 and 4 of reopening occurred, permitting social gatherings and recreation activities.



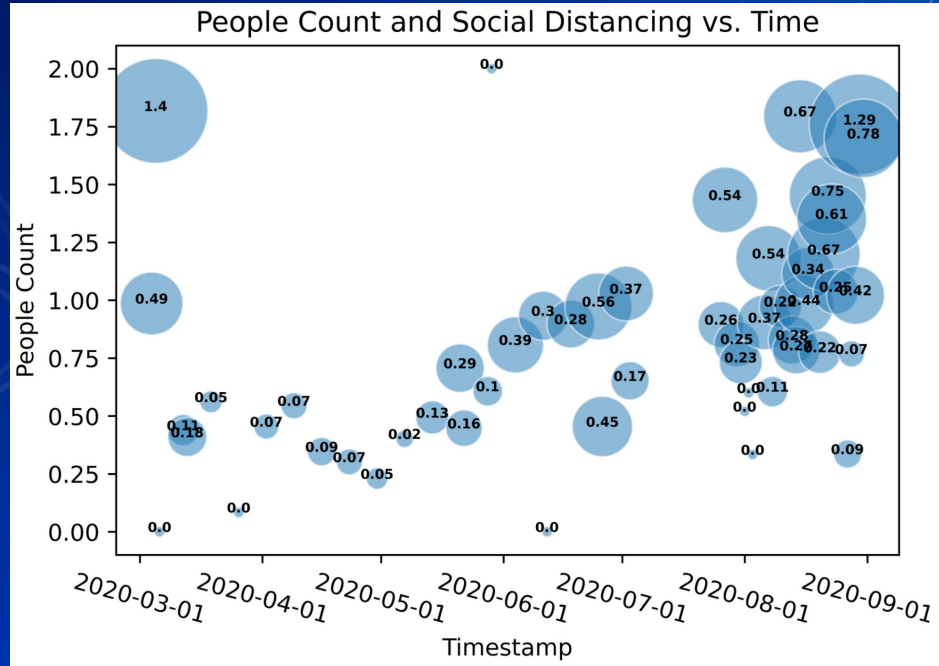
External Data Source (SafeGraph)



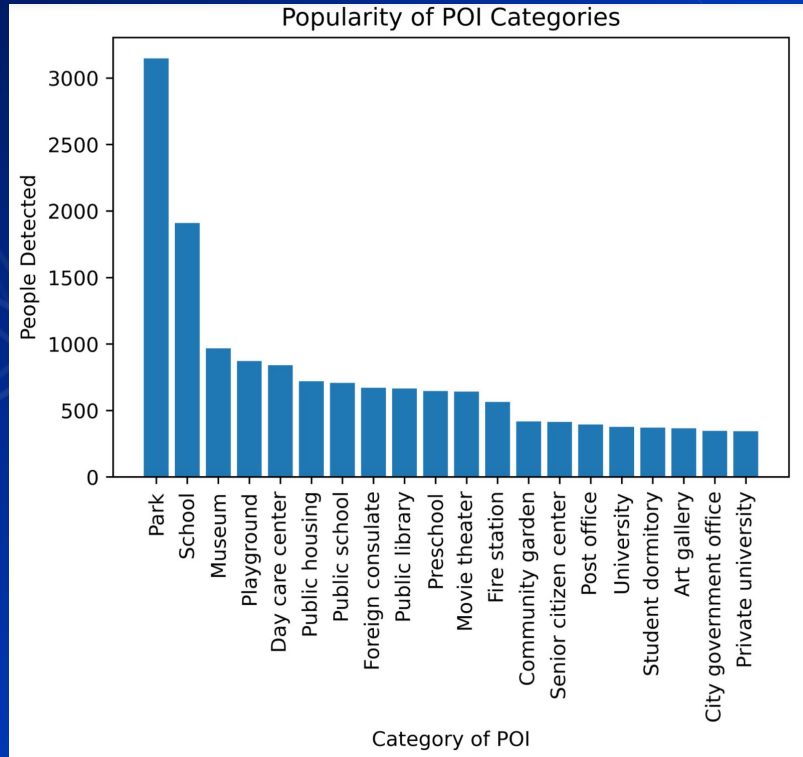
A Historical Timeline of COVID-19 in New York City

March 14, 2020	First two COVID-19 deaths in NYS
March 15, 2020	C.D.C. recommends no gatherings of 50+ in the U.S.
March 16, 2020	NYC public schools close
March 17, 2020	NYC bars and restaurants close, except for delivery
March 22, 2020	NYS on Pause Program begins, all non-essential workers must stay home
March 27, 2020	President signs the CARES Act
March 27, 2020	U.S. reaches the most COVID-19 cases in the world
March 28, 2020	Governor Cuomo halts all nonessential construction sites in NYS
March 30, 2020	USNS Comfort arrives in NYC
March 31, 2020	NYC passes 1,000 COVID-19 deaths
April 6, 2020	Governor Cuomo extends NYS's stay-at-home order and school closures to April 29
April 10, 2020	NYS records more COVID19 cases than any other country (besides U.S.)
April 15, 2020	Governor Cuomo requires face masks or coverings in public places
April 16, 2020	Governor Cuomo extends NYS's stay-at-home order and school closures to May 15
April 30, 2020	Governor Cuomo announces NYC subway closures from 1 a.m. to 5 a.m.
May 1, 2020	Governor Cuomo closes all schools for the remainder of the academic year
May 7, 2020	Governor Cuomo extends PAUSE order to June 6, but will allow counties to open by May 15 if they meet qualifications
May 14, 2020	Governor Cuomo extends PAUSE order to May 28 for NYC and regions not meeting requirements to reopen
May 14, 2020	State of emergency for NYS extended to June 13
May 15, 2020	Governor Cuomo allows drive-in theaters, landscaping, and low-risk recreational activities to reopen
May 23, 2020	Governor Cuomo allows gatherings of up to 10 people with social distancing
May 27, 2020	U.S. COVID-19 deaths pass 100,000
June 8, 2020	NYC begins Phase 1 reopening
June 22, 2020	NYC begins phase 2 of reopening
June 24, 2020	NY, NJ and CT require travelers to self-quarantine for 14 days if traveling from hot spots
July 6, 2020	U.S. COVID-19 deaths surpass 130,000
July 6, 2020	NYC begins Phase 3 of reopening, without indoor dining
July 19, 2020	NYC begins Phase 4 reopening, excluding malls, museums and indoor dining/bars
July 24, 2020	NYC reports 227,517 COVID-19 cases and 22,934 deaths to date

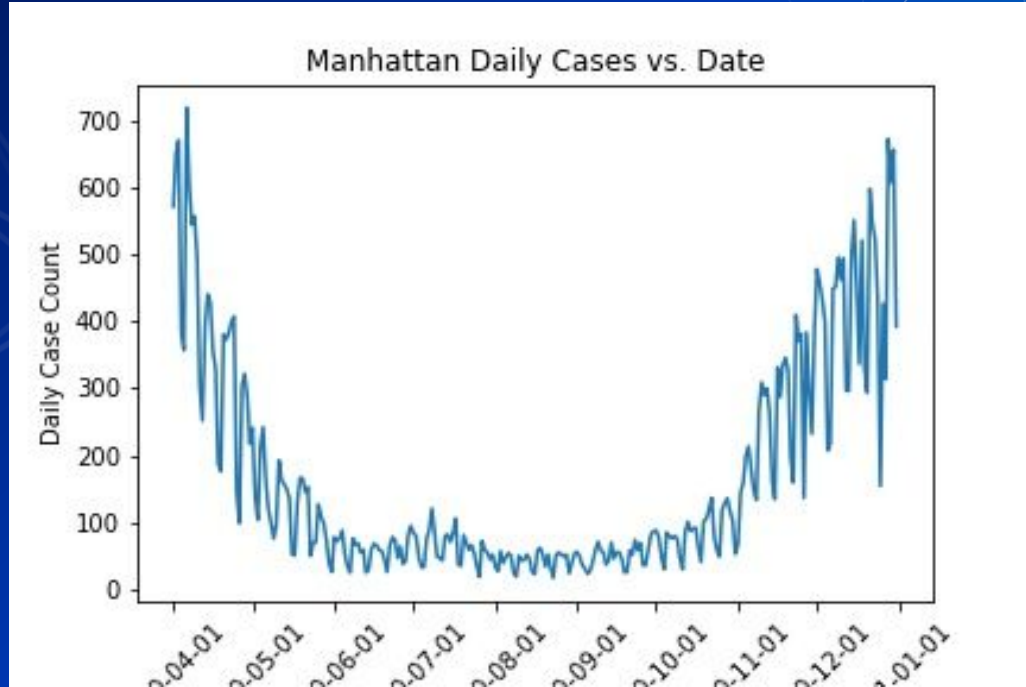
People Count and Distancing



From Location Data



Comparison



Future Plans

- Publish our findings with help from our advisors at the CPI Lab
- Our website and wiki are linked on SI-2021 Orbit page
- Celebrate successful completion of the internship!



Thank You!

Any Questions?