

# Citi Bike Usage Visualization and Analysis in New York city



**Presenters:**  
Aryaman Rao  
Sai Ram

# Agenda

- Introduction
- Problem Statement
- Related work
- Data
- Method proposal
- Final results
- Future work
- Conclusion

## CITI BIKE SNAPSHOT: THE LARGEST BIKE SHARE SYSTEM IN THE NORTH AMERICA

Faster than a cab and more convenient than the subway, Citi Bike has quickly been adopted by New Yorkers and visitors alike as the best way to get around NYC.

Current System Size	601 stations and 10,000 bikes (growing to 700 stations and 12,000 bikes in 2017)
2016 Trips Taken	14,400,000
Total Trips Taken	49,074,312
Annual Members	125,000
2016 Unique Riders	548,000
Average # of trips per member	124 trips per year





# Introduction

- Bike sharing systems have become an increasingly popular mode of transportation in urban areas worldwide, with a growing number of cities implementing them to promote sustainable mobility and reduce traffic congestion.
- However, one of the most significant challenges facing bike sharing systems is ensuring bikes are available when and where they are needed most.
- To address this challenge, the project proposes the use of a multi-agent system that analyzes historical data and makes predictions about future bike demand for each station.

# Problem-

- Due to the Inadequate Bike availability at a particular location, users may not be able to find a bike and may choose alternative modes of transportation
- some stations having too many bikes while others have too few, leading to imbalances in the system that can affect its overall efficiency.
- limited station coverage, can make it difficult for users to access bikes when they need them. This is especially problematic in areas with a low population density or areas that are poorly served by public transportation.
- We want to analyze different data, find potential factors and help bike- sharing company make decisions.

## Related work

- Ma, Z., Sun, Y., & Chen, H. (2016). Short-term bike demand prediction with a deep learning approach. *Transportation Research Part C: Emerging Technologies*, 75, 205-216.
- Zhang, X., Guan, H., Sun, Y., & Cheng, Y. (2019). User segmentation for bike-sharing systems: A trip clustering approach.
- Sun, Y., Ma, Z., Zhang, X., Guan, H., & Chen, H. (2020). A visualization tool for bike-sharing system data analysis.

# Data

- New York Citibike trip data :
  - <https://www.citibikenyc.com/system-data>
- Some features of this dataset include the following:
  - Trip Duration.
  - Start and End Times
  - Start and end station's latitude and longitude values.
  - Bike ID
  - Usertype
  - Birth Year
  - Gender

# Dataset sample

ride_id	rideable_type	started_at	ended_at	start_station_name	start_station_id	end_station_name	end_station_id	start_lat	start_lng	end_lat	end_lng	member_casual
211A73DFC6752EFC	classic_bike	2022-11-30 21:36:23	2022-11-30 21:49:31	2 Ave & E 29 St	6122.09	Pitt St & Stanton St	5406.04	40.741723510974700	-73.97809267044070	40.71926081	-73.98178024	member
568E7F54B3EFB8C3	classic_bike	2022-11-20 11:06:30	2022-11-20 11:17:18	E 97 St & Madison Ave	7393.09	E 74 St & 1 Ave	6953.08	40.787825704	-73.953423142	40.7689738	-73.95482273	member
0ED37DE3609F47A1	classic_bike	2022-11-17 09:48:34	2022-11-17 09:56:14	E 97 St & Madison Ave	7393.09	Adam Clayton Powell Blvd & W 118 St	7670.09	40.787899137	-73.953395605	40.804372	-73.951475	member
AF0F9BAB2B4AA126	classic_bike	2022-11-02 12:23:36	2022-11-02 12:26:35	Morningside Ave & W 123 St	7741.01	Adam Clayton Powell Blvd & W 118 St	7670.09	40.809931278	-73.955209017	40.804372	-73.951475	member
215FF85772BA2D2B	classic_bike	2022-11-07 16:46:20	2022-11-07 16:54:16	2 Ave & E 29 St	6122.09	W 13 St & 5 Ave	5947.04	40.741802573	-73.978003502	40.735445	-73.99431	member
4CE40ACCCFD8038B	classic_bike	2022-11-01 08:30:41	2022-11-01 08:34:45	57 St & 4 Ave	3093.07	55 St & 7 Ave	2951.05	40.642754197	-74.01697433	40.639673	-74.008957	member
E67E2CFF2B14352D	classic_bike	2022-11-18 10:58:37	2022-11-18 11:11:30	Avenue D & E 12 St	5575.08	Pike St & E Broadway	5270.05	40.72580614	-73.97422494	40.71406667	-73.99293911	member
3406ECEB6D20B528	classic_bike	2022-11-03 09:22:40	2022-11-03 09:27:21	E 11 St & 3 Ave	5788.16	E 9 St & Avenue C	5616.01	40.73127	-73.98849	40.72521311	-73.97768752	member
461DD36E363BED7C	classic_bike	2022-11-19 11:51:20	2022-11-19 12:09:43	W 116 St & Broadway	7713.11	Riverside Dr & W 104 St	7623.13	40.8082	-73.9641	40.8013434	-73.9711457439	member
FC09CBD0F03EEDED	classic_bike	2022-11-10 08:50:31	2022-11-10 09:05:05	Avenue D & E 12 St	5575.08	Warren St & W Broadway	5288.09	40.725870132	-73.974310279	40.71473993	-74.00910627	member
C23784F94374B5E2	classic_bike	2022-11-09 17:42:46	2022-11-09 17:50:49	Hanson Pl & Ashland Pl	4395.07	Berkeley Pl & 7 Ave	4051.01	40.68506807308180	-73.97790759801860	40.675146838709800	-73.97523209452630	member
729F5CD4118C2445	electric_bike	2022-11-09 16:34:20	2022-11-09 16:44:24	E 11 St & 3 Ave	5788.16	Norfolk St & Broome St	5374.01	40.73127	-73.98849	40.7172274	-73.98802084	member
1E4E1C94E321E6DE	electric_bike	2022-11-12 22:07:08	2022-11-12 22:27:10	Douglass St & 3 Ave	4217.02	41 St & 4 Ave	3347.03	40.6802133	-73.98432695	40.651354	-74.007168	member
56F96DCC4746ADF3	electric_bike	2022-11-09 23:17:36	2022-11-09 23:20:19	E 97 St & Madison Ave	7393.09	E 103 St & Lexington Ave	7463.09	40.787801	-73.953559	40.7903051	-73.94755757	member
087A07BE794C0FFD	classic_bike	2022-11-19 13:38:44	2022-11-19 13:44:33	E 33 St & 5 Ave	6322.01	W 29 St & 9 Ave	6416.06	40.747637153	-73.984824181	40.7500727	-73.99839279	member
DD426CE3FDB8EE2B	classic_bike	2022-11-20 17:16:00	2022-11-20 17:21:33	2 Ave & E 29 St	6122.09	1 Ave & E 39 St	6303.01	40.741723510974700	-73.97809267044070	40.74714	-73.97113	member
D364519032295070	classic_bike	2022-11-15 11:02:11	2022-11-15 11:08:34	E 11 St & 3 Ave	5788.16	E 1 St & Bowery	5636.13	40.73127	-73.98849	40.72486122254820	-73.99213135242460	member
1A608142E71BBBAA	classic_bike	2022-11-01 14:47:33	2022-11-01 14:49:43	Stanton St & Mangin St	5326.06	E Houston St & Columbia St	5436.11	40.71782143	-73.97628939	40.71978635452820	-73.97871628403660	member
1D619E0B4F4A1A72	electric_bike	2022-11-14 16:45:02	2022-11-14 16:53:04	Norman St & Wyckoff Ave	4654.01	Irving Ave & Harman St	4856.05	40.69517	-73.90311	40.70108	-73.9179	member
AB8DC112A4D558B5	electric_bike	2022-11-03 19:49:50	2022-11-03 19:54:43	Morningside Ave & W 123 St	7741.01	Frederick Douglass Blvd & W 115 St	7658.13	40.81	-73.9551508	40.8038654	-73.9559308	member
BDE665C3D44CB30D	classic_bike	2022-11-19 12:53:13	2022-11-19 12:54:58	57 St & 4 Ave	3093.07	59 St & 4 Ave	3011.03	40.642622	-74.016866	40.641269	-74.017651	member
D8ABB98182401BAD	classic_bike	2022-11-06 16:04:50	2022-11-06 16:26:32	E 97 St & Madison Ave	7393.09	West End Ave & W 107 St	7650.05	40.787801	-73.953559	40.8021174	-73.9681805305	member
E92343BEA7B8DCF5	classic_bike	2022-11-08 09:31:45	2022-11-08 09:32:39	E 97 St & Madison Ave	7393.09	Madison Ave & E 99 St	7443.01	40.787801	-73.953559	40.78948541553220	-73.95242929458620	member
673B8DCAA734FE68	classic_bike	2022-11-08 13:47:10	2022-11-08 13:48:14	E 97 St & Madison Ave	7393.09	Madison Ave & E 99 St	7443.01	40.787801	-73.953559	40.78948541553220	-73.95242929458620	member
49F5B39FD6146018	classic_bike	2022-11-10 14:31:20	2022-11-10 14:46:42	E 11 St & 3 Ave	5788.16	W 24 St & 7 Ave	6257.03	40.73127	-73.98849	40.74487634	-73.99529885	member
D506ADEB69E886E8	classic_bike	2022-11-09 16:07:47	2022-11-09 16:36:39	W 116 St & Broadway	7713.11	Audobon Ave & W 179 St	8316.02	40.808264256	-73.964231849	40.847305	-73.933291	member
F1D50CFE363B8B64	classic_bike	2022-11-10 12:55:17	2022-11-10 13:11:24	Stanton St & Mangin St	5326.06	Spruce St & Nassau St	5137.10	40.71782143	-73.97628939	40.71146364	-74.00552427	member
19EADA0CB989B3E6	classic_bike	2022-11-09 18:45:09	2022-11-09 19:08:40	E 33 St & 5 Ave	6322.01	North Moore St & Greenwich St	5470.12	40.74765947	-73.98490707	40.72019521437470	-74.0103006362915	member
076EE78F276ED95A	electric_bike	2022-11-04 08:57:23	2022-11-04 09:05:42	Douglass St & 3 Ave	4217.02	Underhill Ave & Lincoln Pl	4042.08	40.6802133	-73.98432695	40.6740123	-73.9671457	member
D3A1F1A8F71FD090	electric_bike	2022-11-05 13:04:54	2022-11-05 13:23:01	2 Ave & E 29 St	6122.09	W Broadway & Spring St	5569.06	40.741723510974700	-73.97809267044070	40.72494672359420	-74.00165855884550	casual
66E2A80D9F8B1531	classic_bike	2022-11-05 12:00:41	2022-11-05 12:25:04	2 Ave & E 29 St	6122.09	North Moore St & Greenwich St	5470.12	40.741723510974700	-73.97809267044070	40.72019521437470	-74.0103006362915	member
877B68F3DC61E20C	electric_bike	2022-11-08 08:42:59	2022-11-08 08:53:27	W 116 St & Broadway	7713.11	W 84 St & Columbus Ave	7382.04	40.8082	-73.9641	40.78499979	-73.97283406	member
8CB15B07F373CA18	classic_bike	2022-11-18 16:18:57	2022-11-18 16:56:28	Stanton St & Mangin St	5326.06	W 84 St & Columbus Ave	7382.04	40.71784091	-73.976183534	40.78499979	-73.97283406	member
E8D8A0E1C716CF01	classic_bike	2022-11-03 13:03:39	2022-11-03 13:33:02	Garfield Pl & 8 Ave	3978.13	49 Ave & 21 St	6128.04	40.671243072	-73.974855065	40.74252	-73.948852	member
D322CADD440D725C	electric_bike	2022-11-20 14:59:05	2022-11-20 15:09:40	Hanson Pl & Ashland Pl	4395.07	4 Ave & 3 St	4028.04	40.68506807308180	-73.97790759801860	40.673746	-73.985649	member
D0AB1D99CDE55DA5	classic_bike	2022-11-16 08:52:44	2022-11-16 09:14:44	57 St & 4 Ave	3093.07	4 Ave & 3 St	4028.04	40.642622	-74.016866	40.673746	-73.985649	member
E2CE1B492B3C8BE6	classic_bike	2022-11-09 21:31:26	2022-11-09 21:41:42	Concourse Village West & E 156 St	7962.01	E 138 St & 5 Av	7809.13	40.823162	-73.923267	40.81449	-73.936153	member



start_station_id	started_at	start_station_name	start_lat	start_lng	Rides
3138.09	2021-02-04	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	2
3138.09	2021-02-05	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	1
3138.09	2021-02-06	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	2
3138.09	2021-02-10	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	1
3138.09	2021-02-11	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	1
3138.09	2021-02-12	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	1
3138.09	2021-02-14	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	4
3138.09	2021-02-16	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	7
3138.09	2021-02-17	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	3
3138.09	2021-02-20	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	4
3138.09	2021-02-21	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	6
3138.09	2021-02-22	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	4
3138.09	2021-02-23	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	5
3138.09	2021-02-24	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	4
3138.09	2021-02-25	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	10
3138.09	2021-02-26	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	4
3138.09	2021-02-27	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	10
3138.09	2021-02-28	58 St & 2 Ave - Brooklyn Army Terminal Vaccination Site	40.644512	-74.021506	8
3161.02	2021-02-27	46 St & 6 Ave	40.645921	-74.005708	1
3178.02	2021-02-05	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	1
3178.02	2021-02-06	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	2
3178.02	2021-02-08	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	1
3178.02	2021-02-09	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	3
3178.02	2021-02-10	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	4
3178.02	2021-02-14	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	2
3178.02	2021-02-15	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	1
3178.02	2021-02-23	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	1
3178.02	2021-02-24	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	2
3178.02	2021-02-25	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	6
3178.02	2021-02-26	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	5
3178.02	2021-02-27	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	6
3178.02	2021-02-28	57 St & 1 Ave - Brooklyn Army Terminal Vaccination Site	40.646377	-74.023087	1
3233.06	2021-02-27	44 St & 6 Ave	40.647105	-74.004483	3

Cleaned data sample

# Proposal-

- Our idea was to analyze and visualize the New York Citi Bike usage.
- Aspects of Analysis:
  - Insights from the data.
  - Future Forecasting of City Bike Usage for each Station.

# Analysis Insights

## 1. Modules:

- Station Analysis & Distribution Variation [1]
- Ride Forecasting
- Analysing Top 20 busy Stations
- Demand of Citi Bikes over the years
- Gender analysis
- Subscription analysis

[1] Citi Bike Information Visualization Jing Zhang, Tianyang Li, Ziwei Yuan, and Tong Lyu University of Southern California, Los Angeles CA 90007, USA

# Station Analysis & Distribution Variation

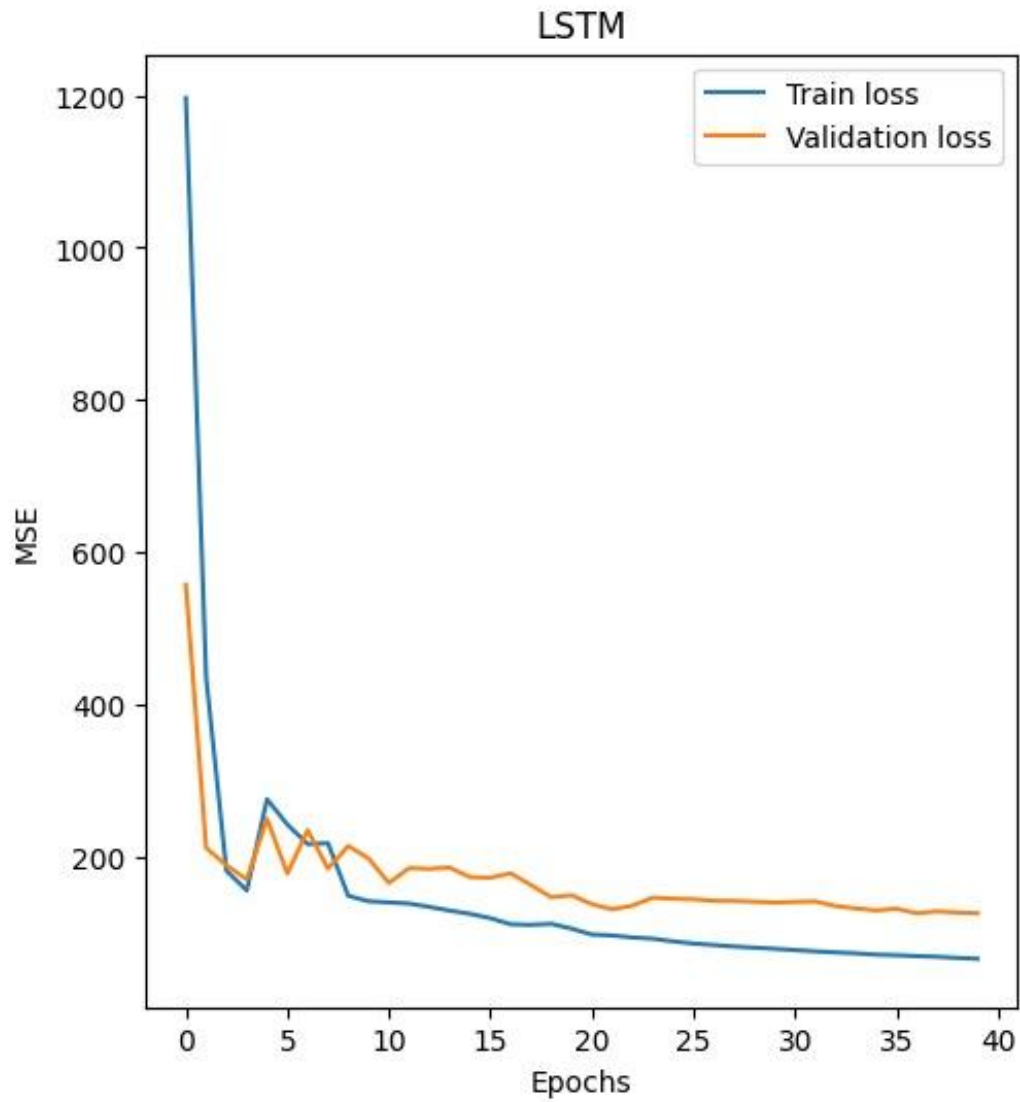




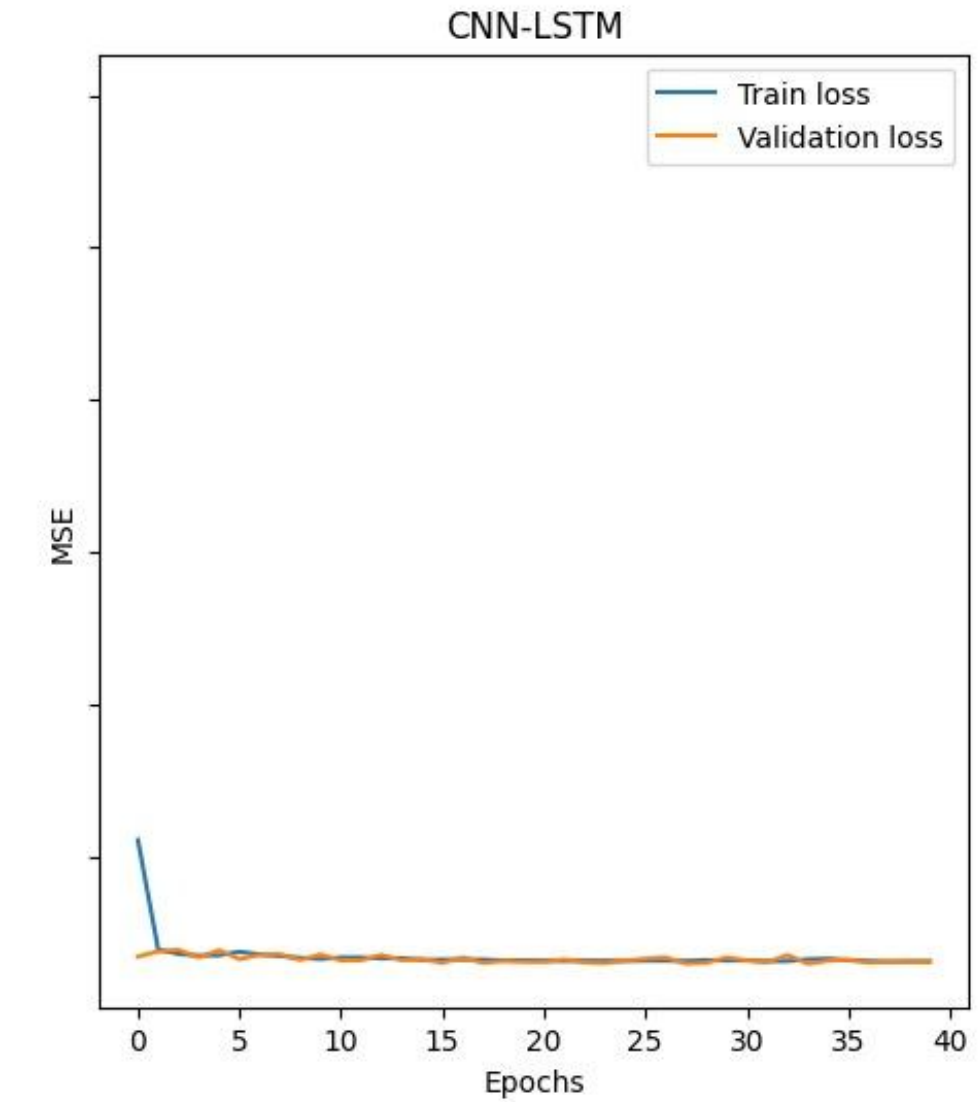
# Future Forecasting of Citi Bike Usage For each Station

## CNN-LSTM

- The Hybrid CNN-LSTM models are popular for time series forecasting as they can capture both local and global temporal patterns
- The Hybrid CNN-LSTM model can perform timing analysis while extracting abstract features
- The CNN model will interpret each sub-sequence and the LSTM will piece together the interpretations from the subsequences.
- Rootmean squared error (RMSE) penalizes larger errors more heavily than smaller errors.
- In order to forecast the demand on per station basis, we trained our hybrid model on the number of rides started on a daily basis.
- We trained around 750 stations to predict the future no. of rides.



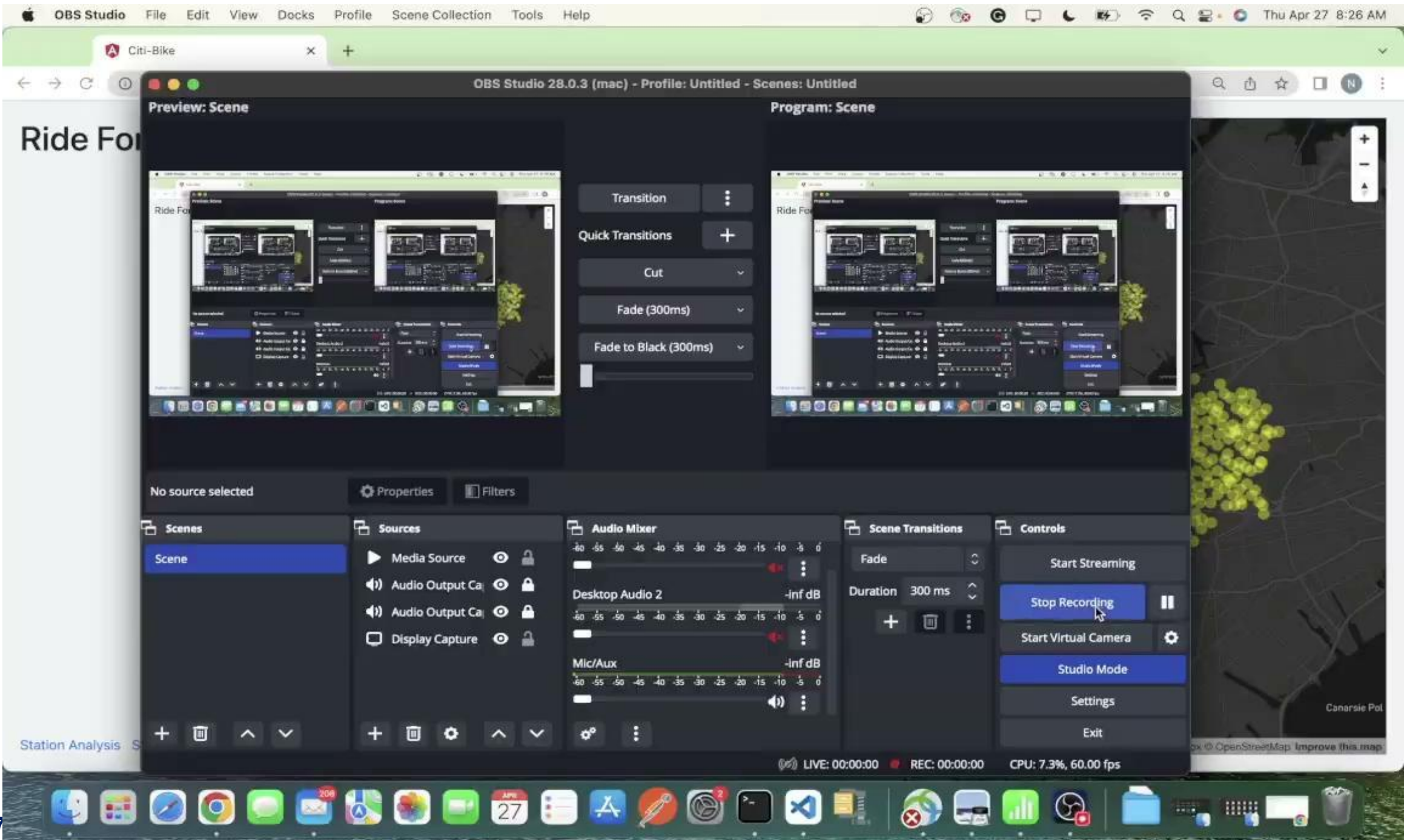
- RSME : Range of (8,20) for each station



- RSME : Range of (2,8) for each station

# Ride forecasting Demo





# Statistical Analysis Demo



# Challenges

- Pre-Processing 50 Gigabytes of data (120 months of data)
- Integrating data from multiple sources.
- One of the main challenges is developing an effective forecasting model that can accurately predict demand and optimize the use of bikes in the bike-sharing system.



# Technologies and Tools used



# Future work & Conclusion

- Improve the accuracy of the present forecasting Model.
- Improving interactivity of visualizations such that it could help the company and user to understand better.
- Streamline the UI for the Dashboard.
- Using state of the art models we expect to produce even more accurate predictions.
- Integrating this dashboard with the current Dashboard that we have with multiple city's bike sharing ecosystem.
- In Conclusion, we developed a dashboard where users can analyse and review the city bike's dataset for New york City.

# THANK YOU