Generative Adversarial Networks for the generation of realistic mobility traces in urban scenarios

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Contents

Objective:

- Understanding mobility, being it from pedestrians or any other moving object, is practical and insightful.
- Predicting **real mobility traces** is challenging.
- The alternative for this problem is to produce GAN generated mobility traces with enhanced accuracy.
- The use of GANs is the perfect solution for this problem.
- The main objective is to generate realistic mobility traces in urban areas using Generative Adversarial Networks.

Motivation:

- McKinsey estimates that the potential economic value of open data in transport is between $720 – 920 billion globally, with innovation in commuter decision-making and the growth of new mobility businesses accounting for $300 billion of that.

- Generative adversarial network (GANs) is one of the most important research avenues in the field of artificial intelligence, and its outstanding data generation capacity has received wide attention.

Literature Review

- **Generative Adversarial Nets Ian J. Goodfellow, Jean Pouget-Abadie* , Mehdi Mirza, Bing Xu, David Warde-Farley, Sherjil Ozair† , Aaron Courville, Yoshua Bengio‡**

  This is the first published paper on GAN by Dr. Ian J Goodfellow.It gives us the understanding of the origin of GANs and how GANs can be useful in various domains.

- **Recent Progress on Generative Adversarial Networks (GANs): A Survey**

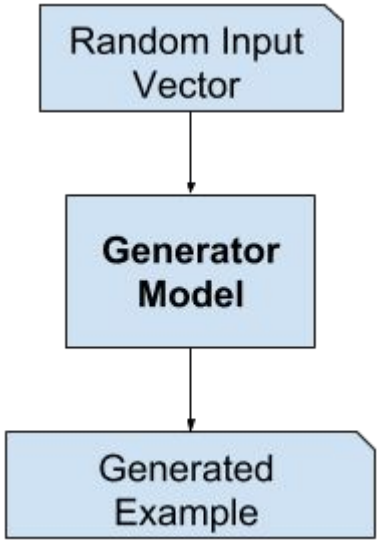
  This survey paper gives us a clear understanding about GANs and its attributes such as Unsupervised Learning, Training tricks and Evaluation metrics.

Literature Review

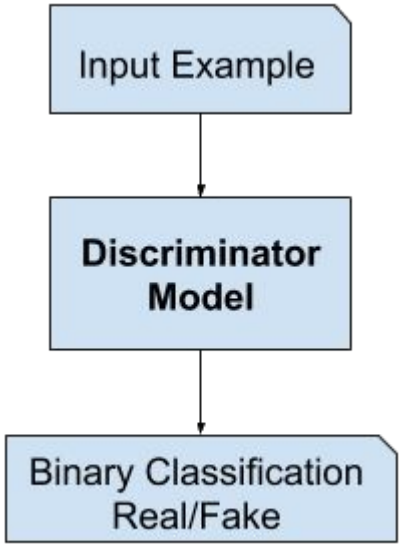
- **Lei Xu, Kalyan Veeramachaneni. 2018. Synthesizing Tabular Data using Generative Adversarial Networks**

  This paper points out the difficulties in implementing GAN for generating tabular data. Tabular data usually contains a mix of discrete and continuous columns, building such a model is a non-trivial task. Continuous columns may have multiple modes, while discrete columns are sometimes imbalanced, making modeling difficult.

Generator and Discriminator Flow Chart:

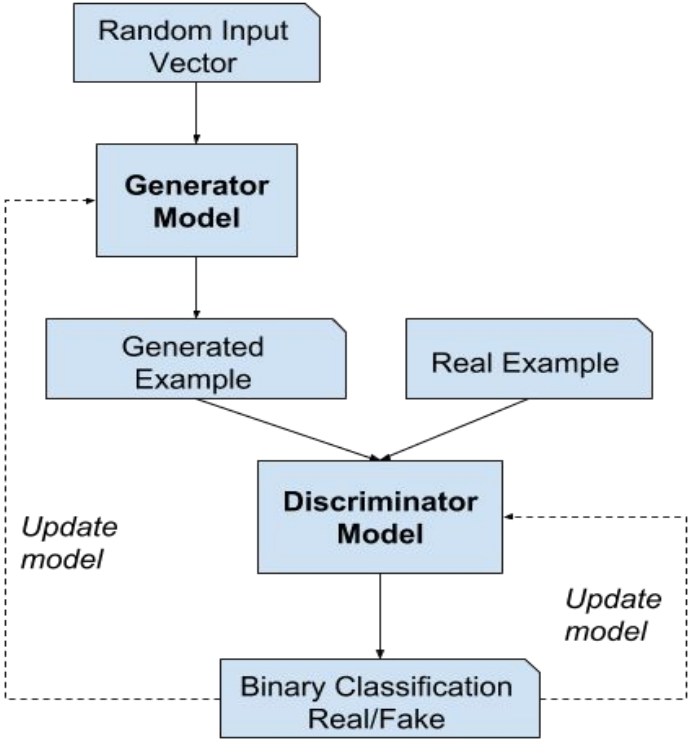


Generator Flowchart



Discriminator Flowchart

GAN Flow Chart:



Complete Flowchart of GAN

Dataset

We have chose taxi navigation dataset by Uber Movement for Bangalore city for training the GAN. The dataset contains the following information.

- Source Id , Destination Id
- Time Slot
- Day and Month

The expected output from the generator neural network is to produce a source id and destination id which can’t be distinguished by discriminator model.

Snapshot of dataset

sourceid	dstid	month	day	start_hour	end_hour
142	148	1	1	0	7
145	118	1	1	0	7
143	138	1	1	0	7
141	158	1	1	0	7
144	128	1	1	0	7
141	16	1	1	0	7
140	26	1	1	0	7

The sample of the dataset used in the process

Results
Generated Output

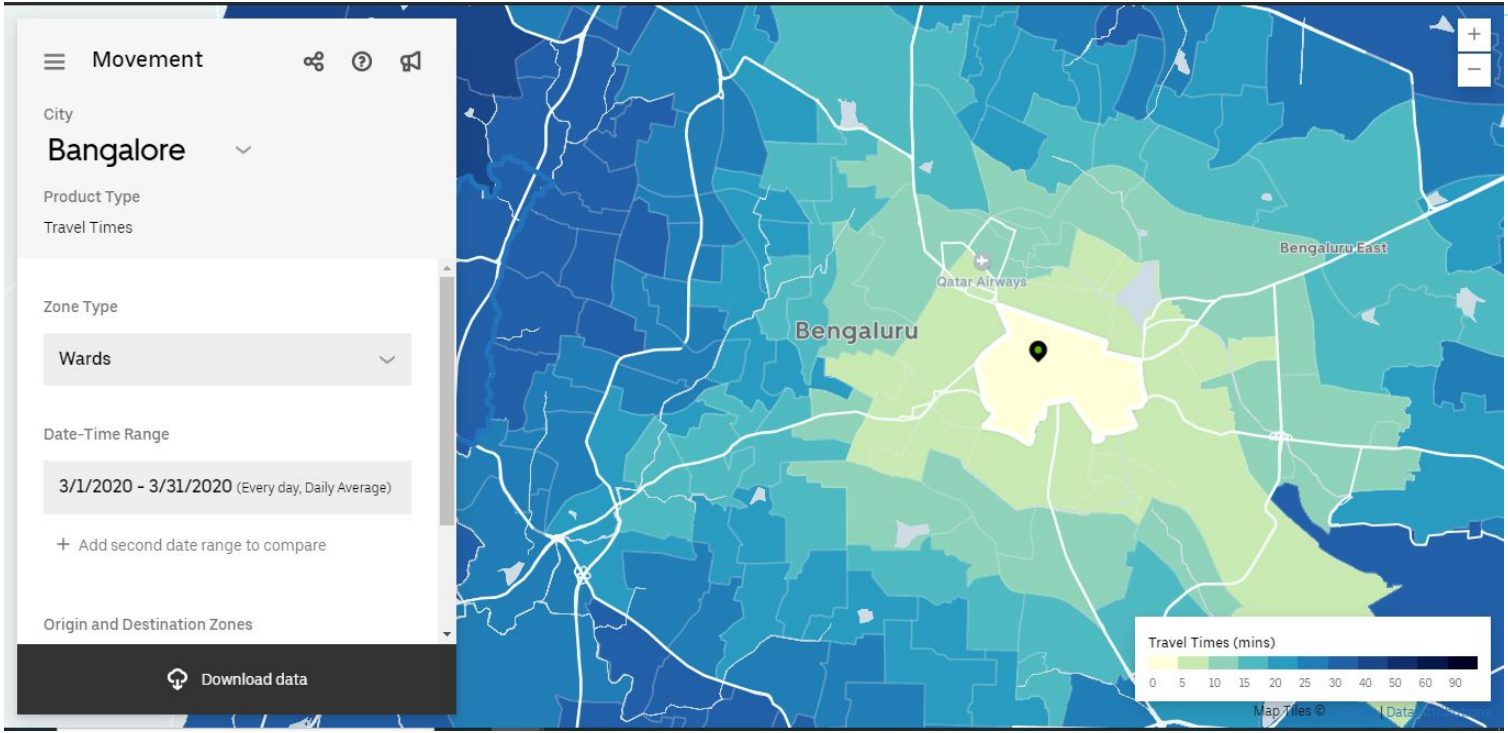
src	Dst
34	115
66	129
212	132
165	97
89	120
69	103
43	55
51	127
41	94
122	104
35	126
68	96
39	110
32	58
84	88
227	126
131	145
282	191
163	115
127	190

Generated Data

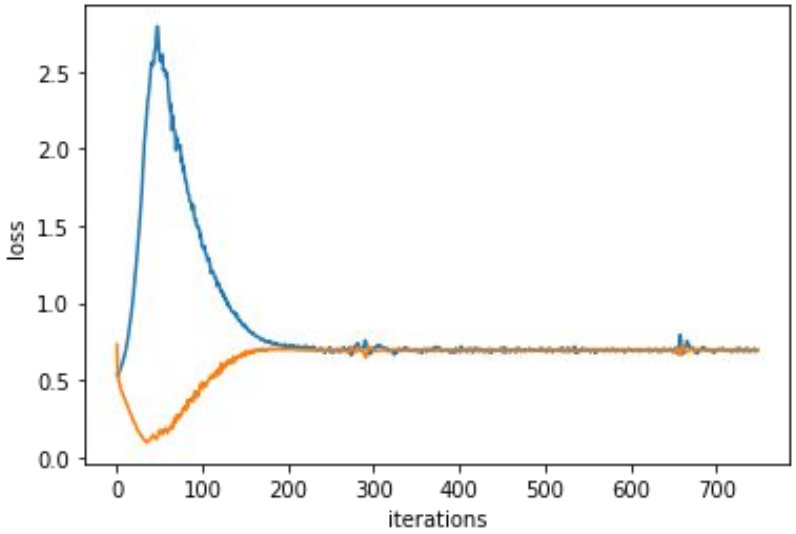
src-Source ID

Dst-Destination ID

UBER MOVEMENTS



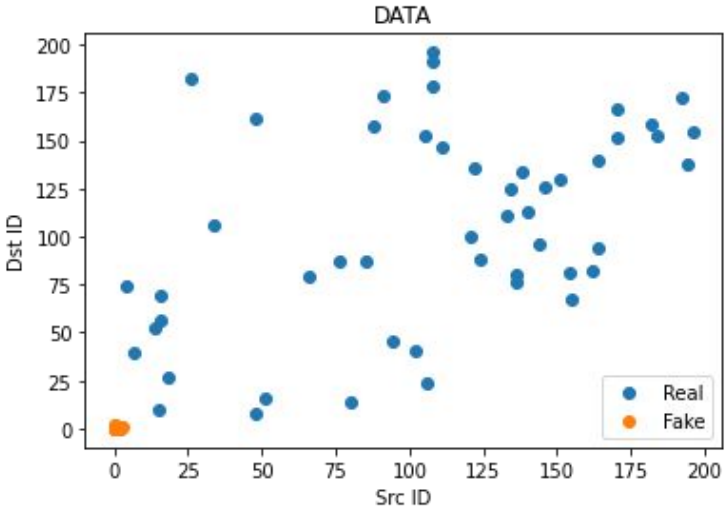
Results : Loss vs Iterations



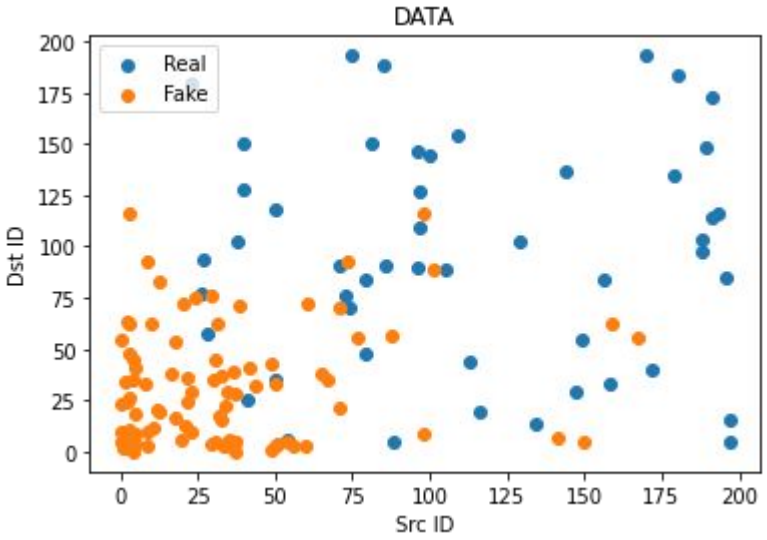
Discriminator Loss

Generator Loss

Statistical Analysis

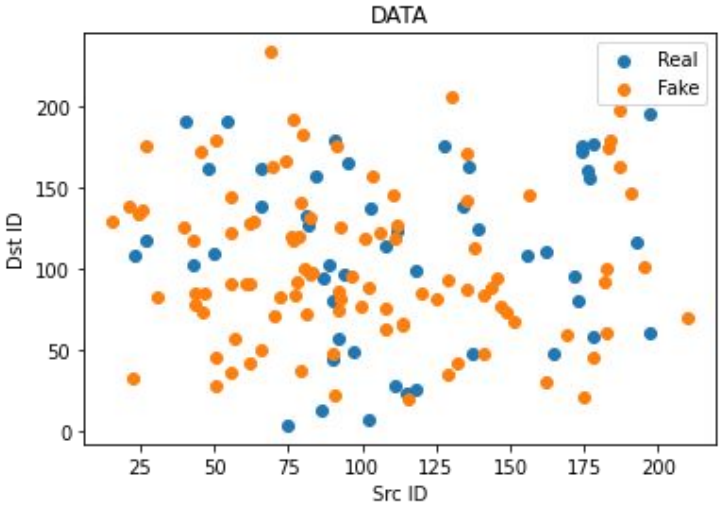


Scatter plot - Epoch 0

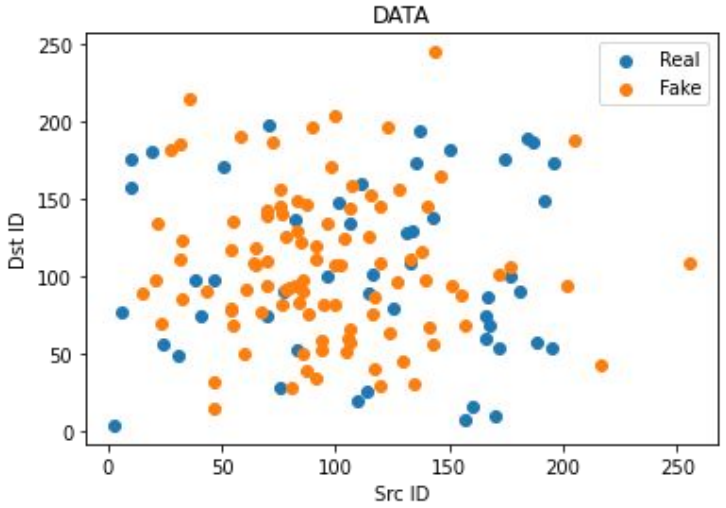


Scatter plot - Epoch 20

Statistical Analysis

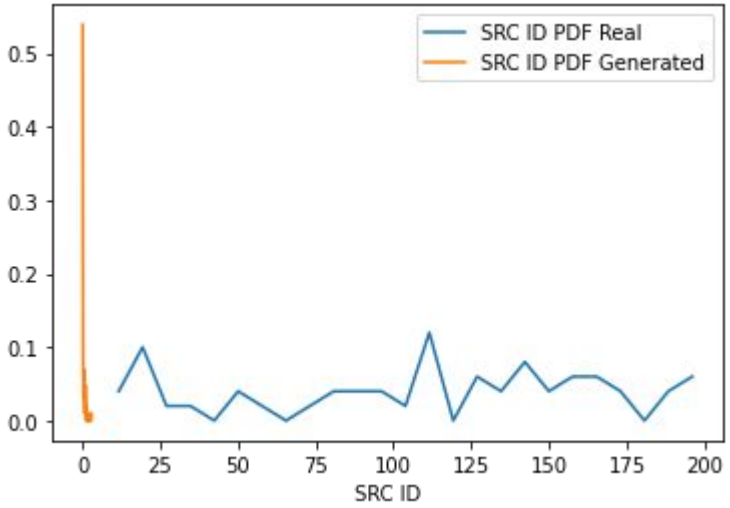


Scatter plot - Epoch 77

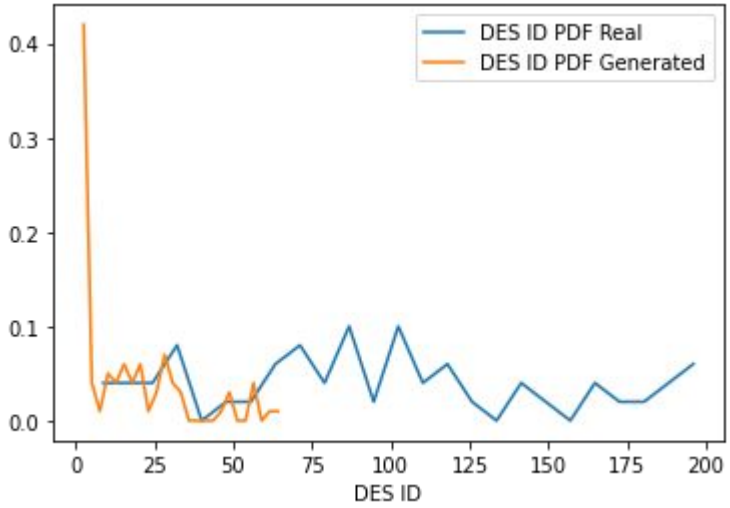


Scatter plot - Epoch 150

Statistical Analysis - Probability Density Function

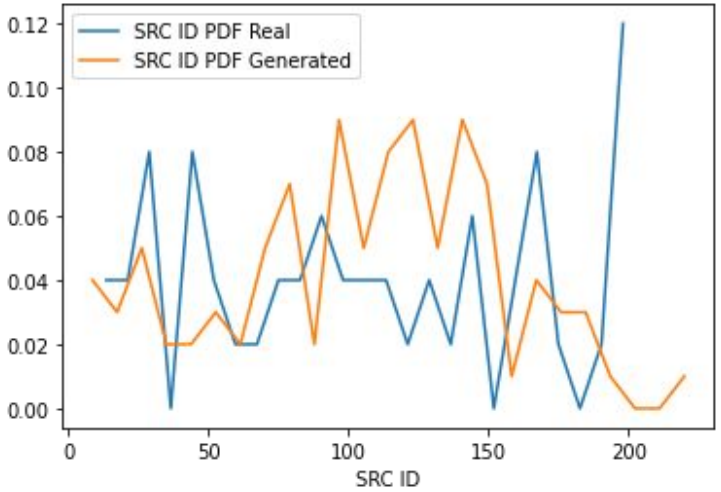


PDF - Epoch 0

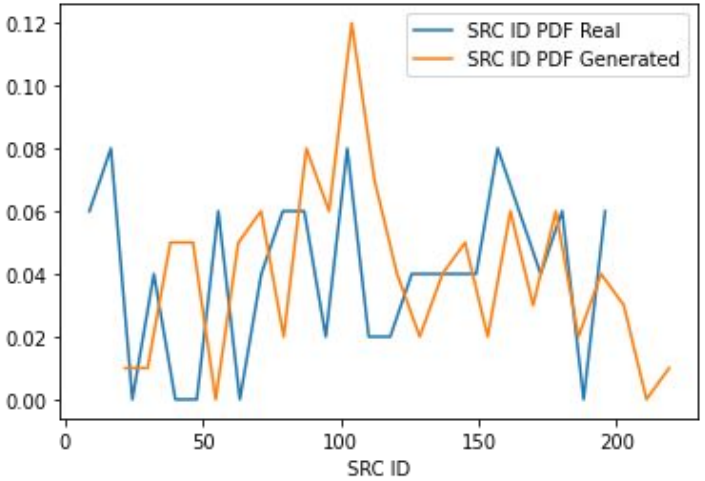


PDF - Epoch 10

Statistical Analysis - Probability Density Function

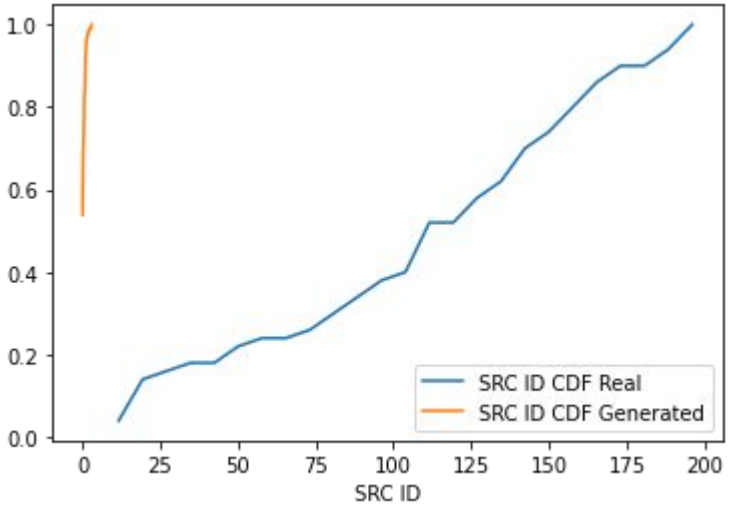


PDF - Epoch 105

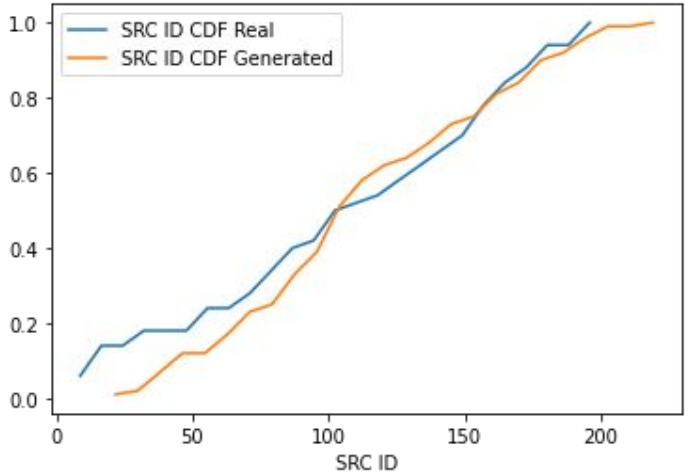


PDF - Epoch 150

Statistical Analysis-Cumulative Distribution Function

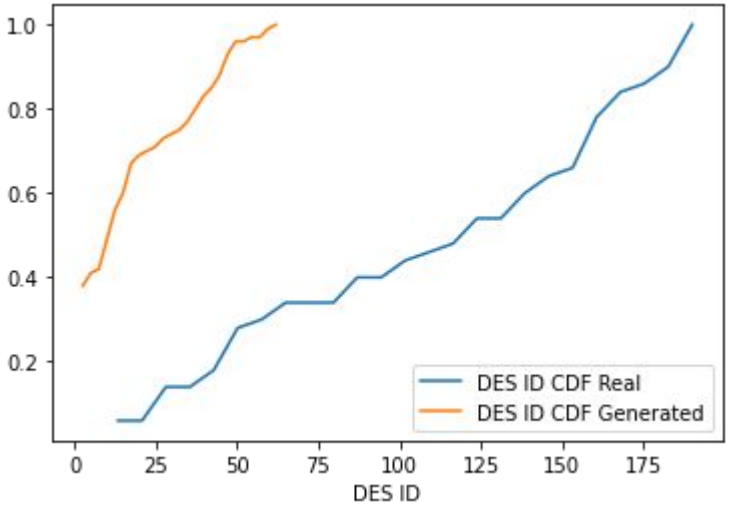


CDF - Epoch 0

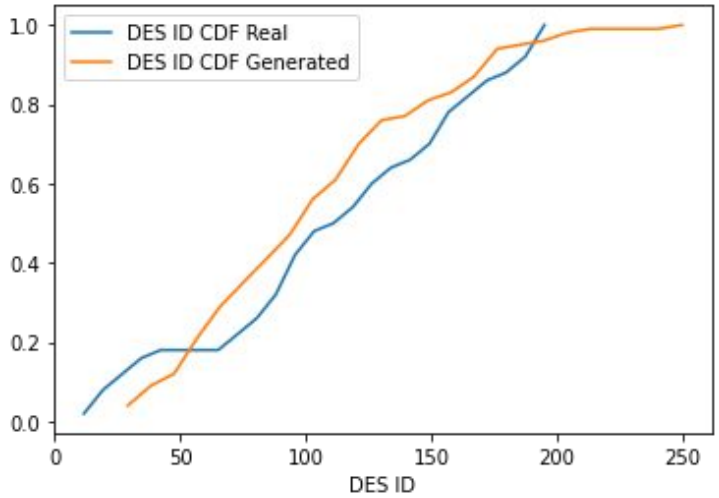


CDF - Epoch 150

Statistical Analysis-Cumulative Distribution Function



CDF - Epoch 10

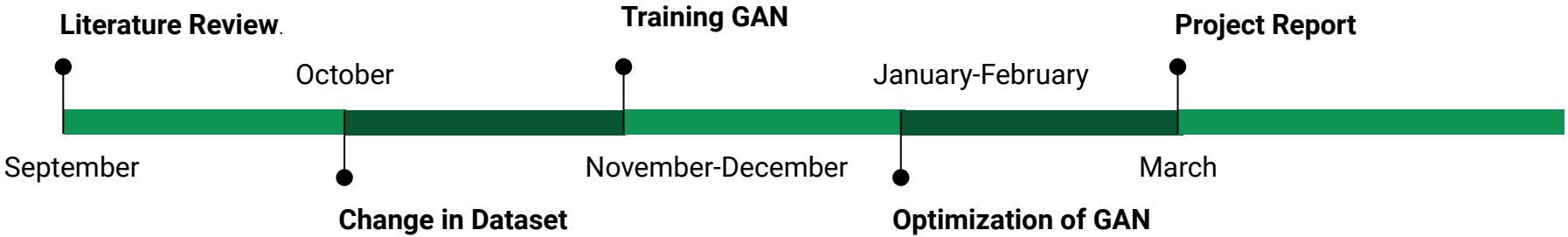


CDF - Epoch 100

Discriminator Accuracy

Epoch	Fake accuracy (%)	Real accuracy (%)
Epoch 1	96	100
Epoch 10	94	96
Epoch 35	58	80
Epoch 50	24	74
Epoch 100	42	58

Plan of Work


Literature Review.
September
October
Change in Dataset
Training GAN
November-December
January-February
Optimization of GAN
Project Report
March

References

- Z. Pan, W. Yu, X. Yi, A. Khan, F. Yuan and Y. Zheng, "Recent Progress on Generative Adversarial Networks (GANs): A Survey," in IEEE Access, vol. 7, pp. 36322-36333, 2019.

- Spohn, Marco & Trichez, Matheus. (2019). An Analysis of a Real Mobility Trace Based on Standard Mobility Metrics. Revista de Informática Teórica e Aplicada. 26. 26. 10.22456/2175-2745.84330.

- Jeff Donahue, Philipp Krähenbühl, & Trevor Darrell. (2017). Adversarial Feature Learning.

- Lei Xu, Kalyan Veeramachaneni. 2018. Synthesizing Tabular Data using Generative Adversarial Networks
- Build Basic Generative Adversarial Networks (GANs) by DeepLearning.AI

THANK YOU