D94 Week 6 Update

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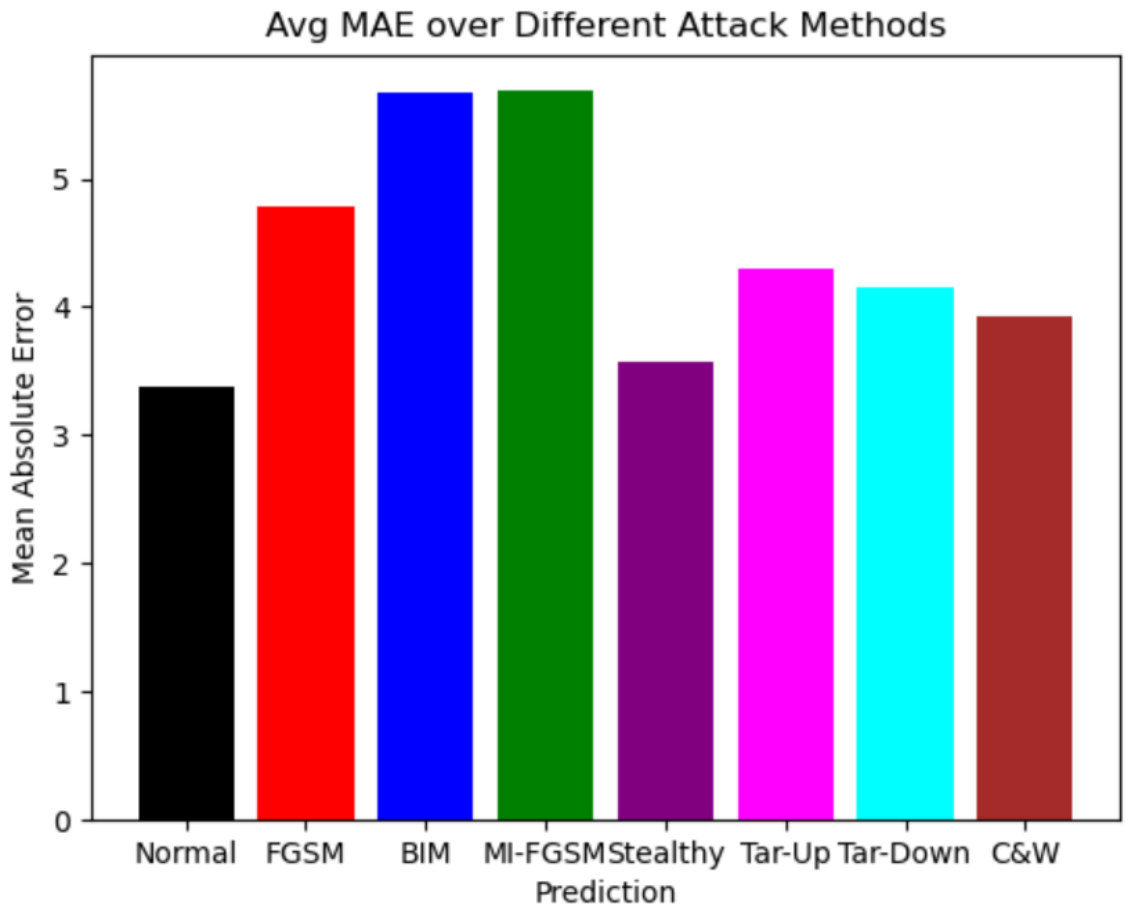
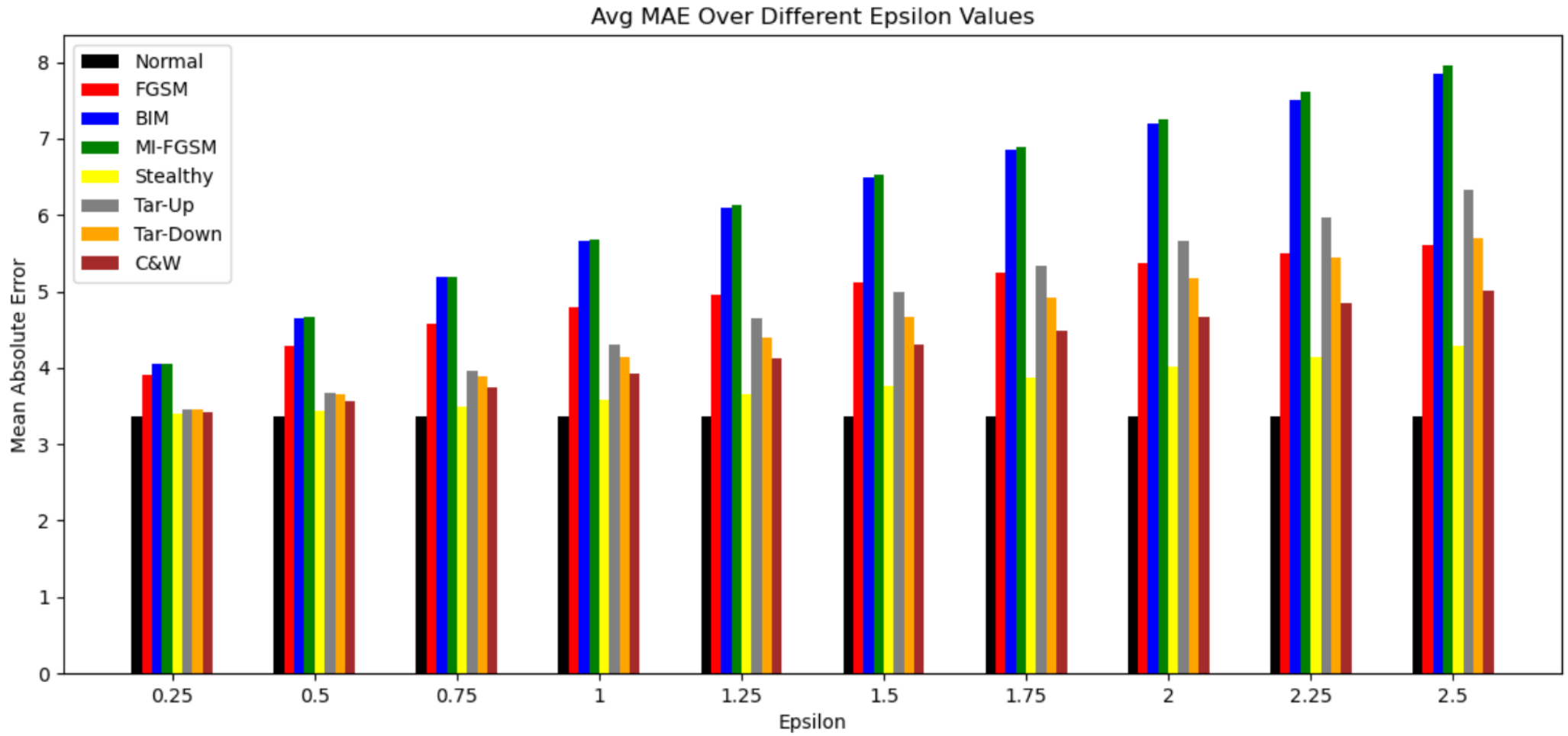
Completed Tasks

- Started to work on the report.
- Experimented with the DCGAN.
- Built a WGAN-GP, C-WGAN-GP
  - WGAN with the same architecture as the DCGAN
  - WGAN-GP/C-WGAN-GP
    - CNN-based architecture
    - TCN-based architecture
    - GRU-based architecture
    - TCN/GRU-based architecture
- Note: converted all GANs to the one-stock version.

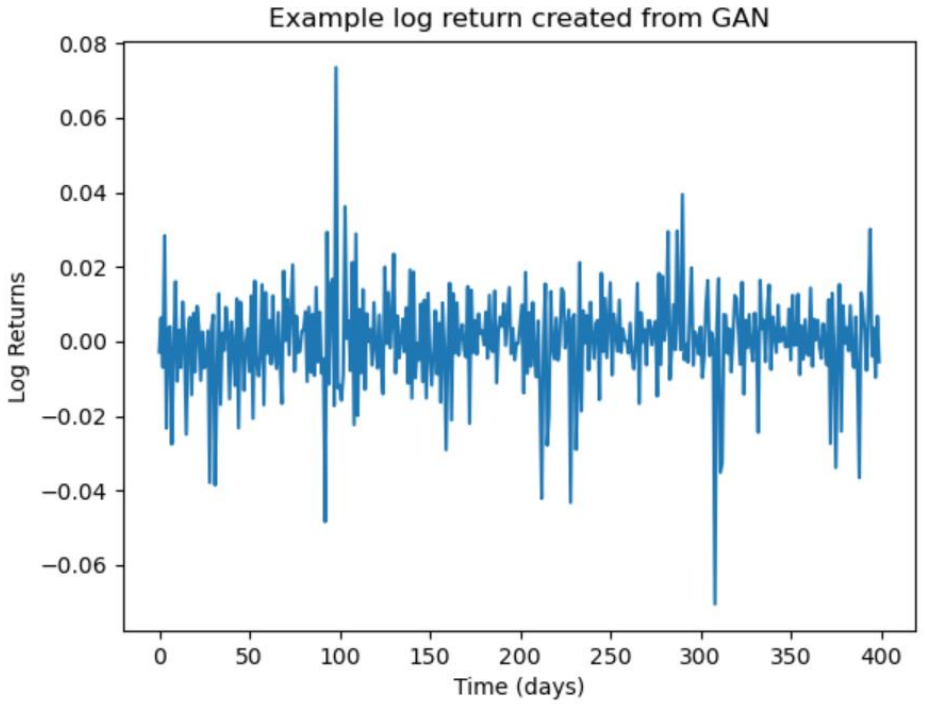
Baseline Attack Figures

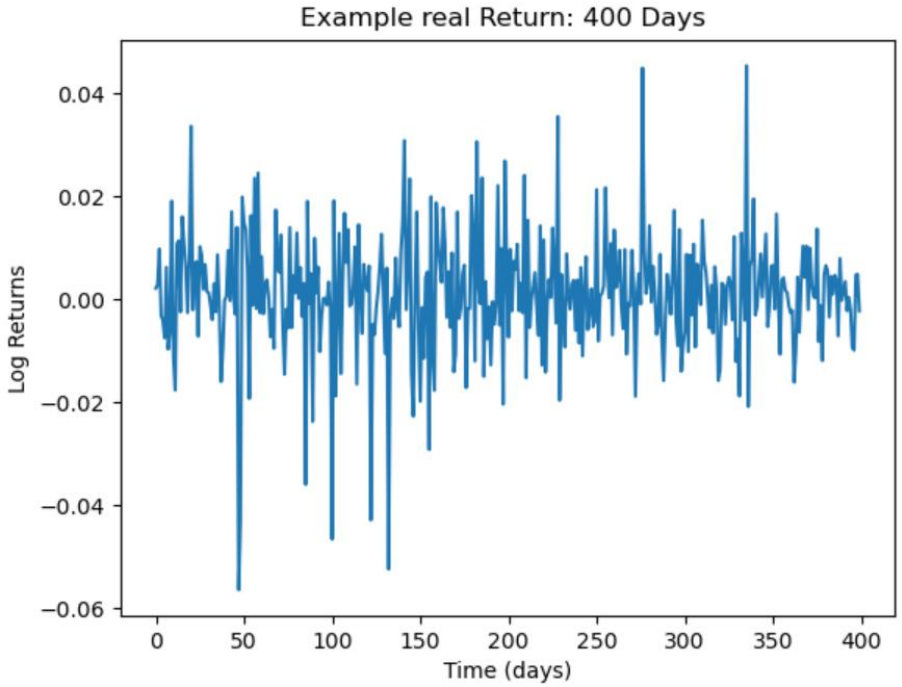


Epsilon Experiment



DCGAN (400-day generation)

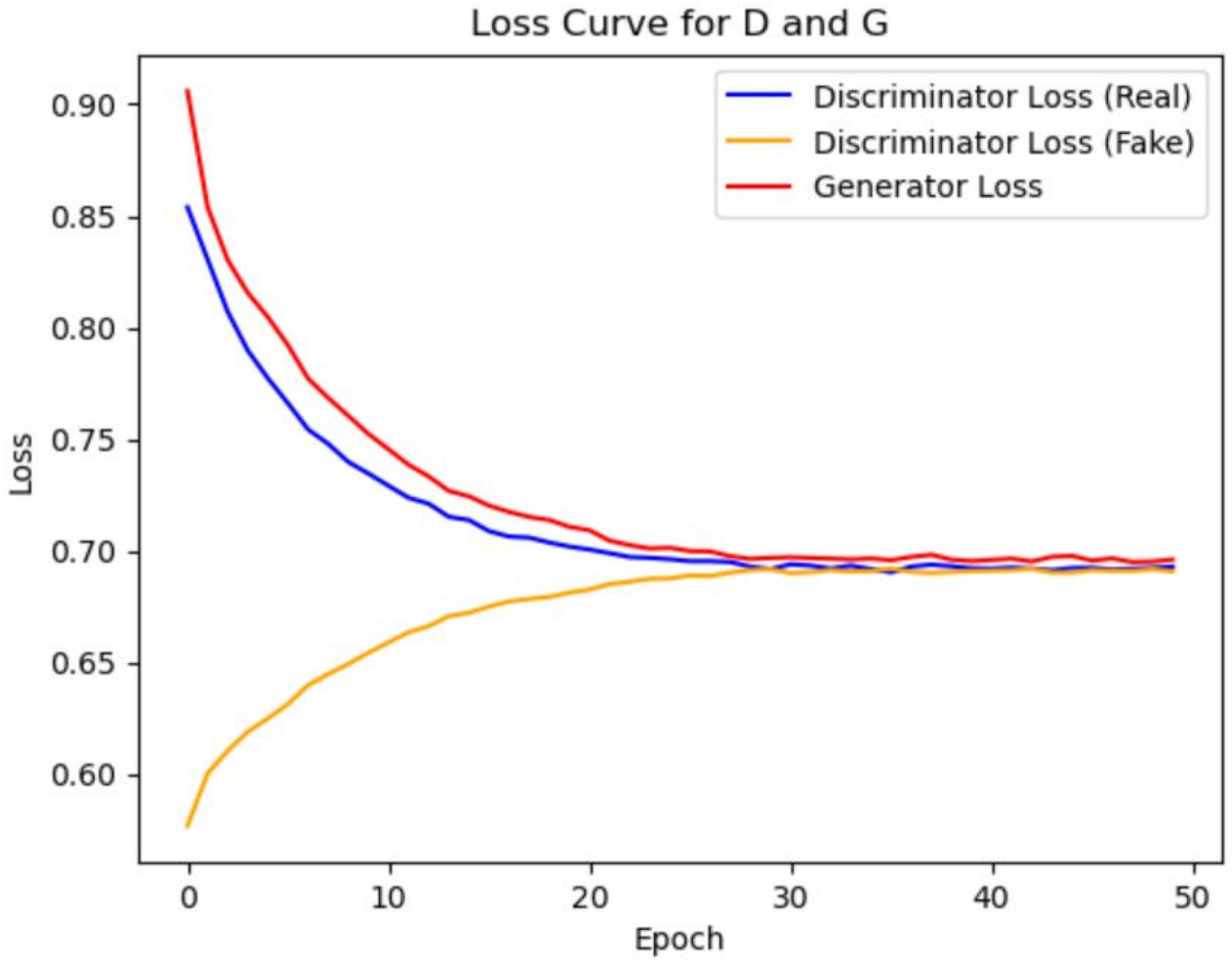




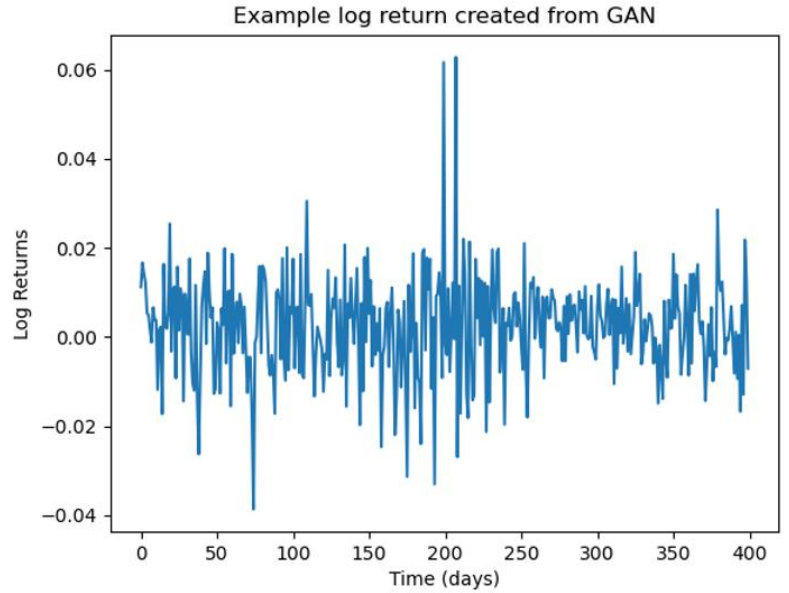
DCGAN (400-day generation)

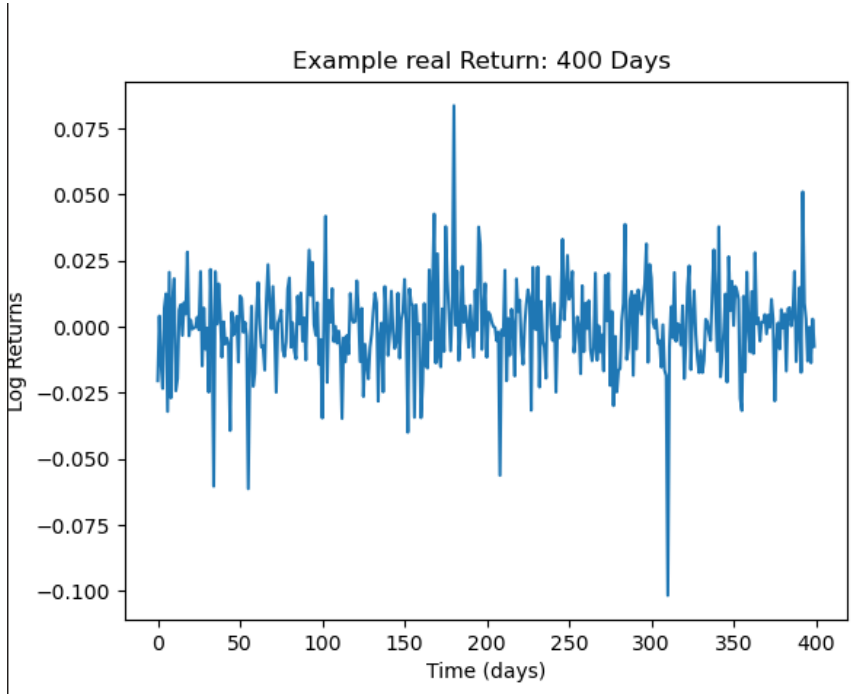
	REAL	FAKE
Mean	0.00075	0
Stdev	0.01532	0.01489
IQR	0.01612	0.01402
Skew	**-0.45802**	**-121.628**
Kurtosis	**6.56567**	**2943.202**

DCGAN (400-day generation)



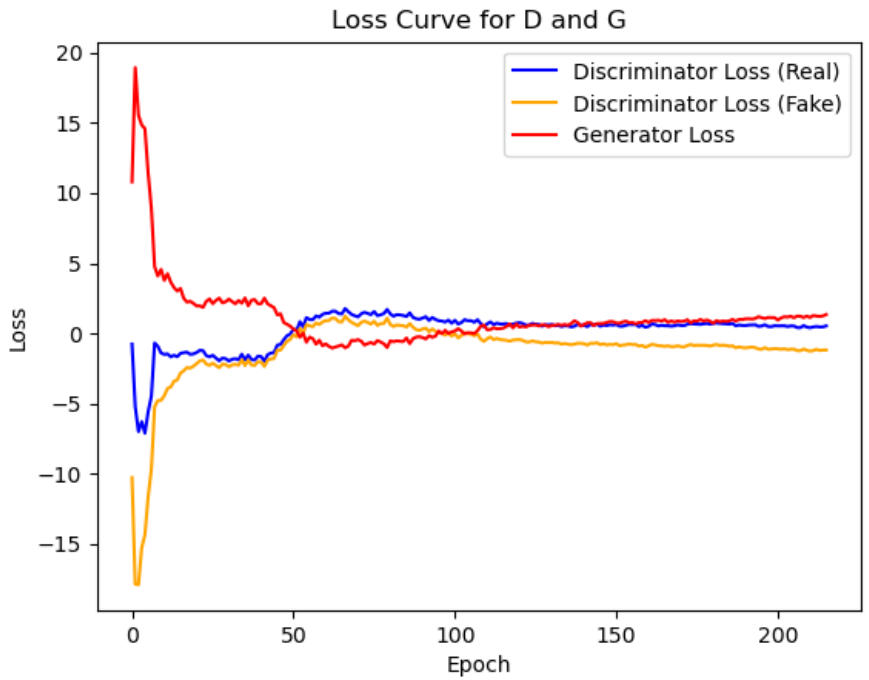
WGAN-GP (TCN) (400-day generation)

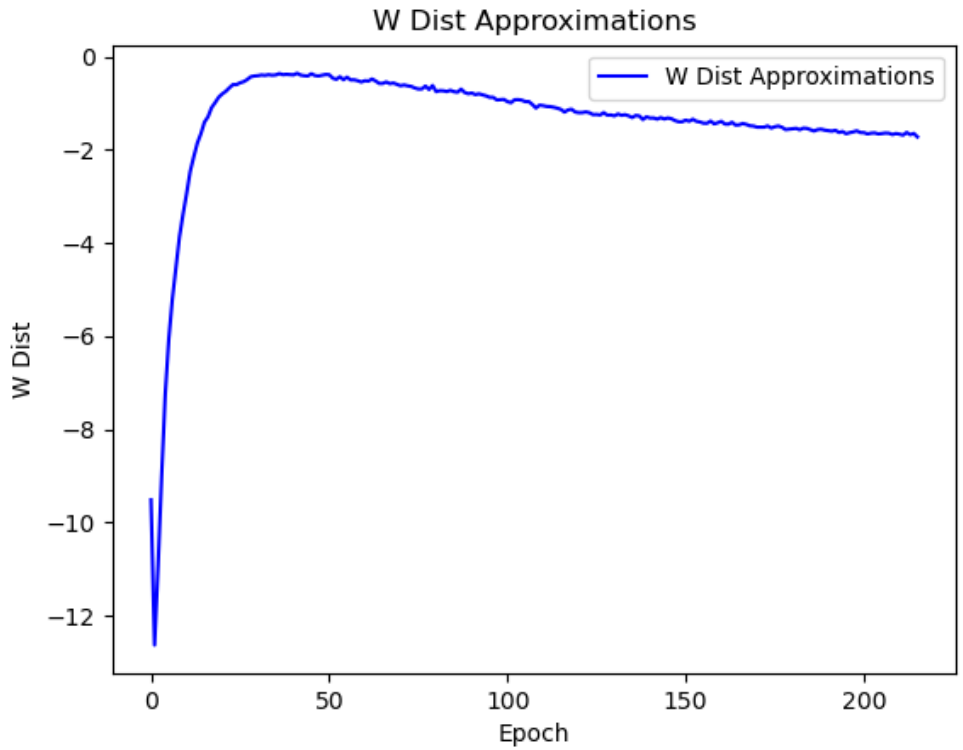




WGAN-GP (TCN) (400-day generation)

	REAL	FAKE
Mean	0.00055	0.00247
Stdev	0.06412	0.01371
IQR	0.01575	0.01459
Skew	**-0.6677**	**-277.797**
Kurtosis	**9.05231**	**3430.46**

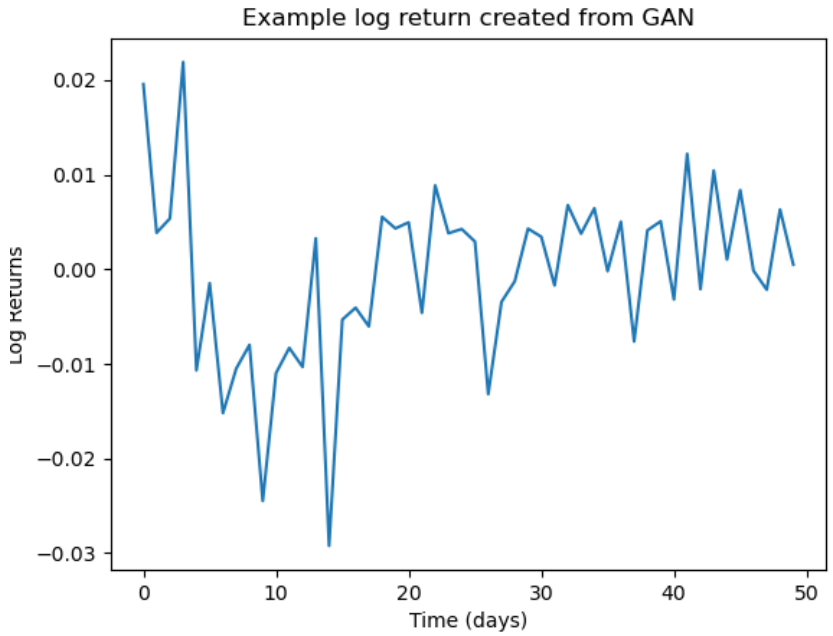

Loss Curve for D and G
Discriminator Loss (Real)
Discriminator Loss (Fake)
Generator Loss
Loss
Epoch
20
15
10
5
0
−5
−10
−15
0
50
100
150
200

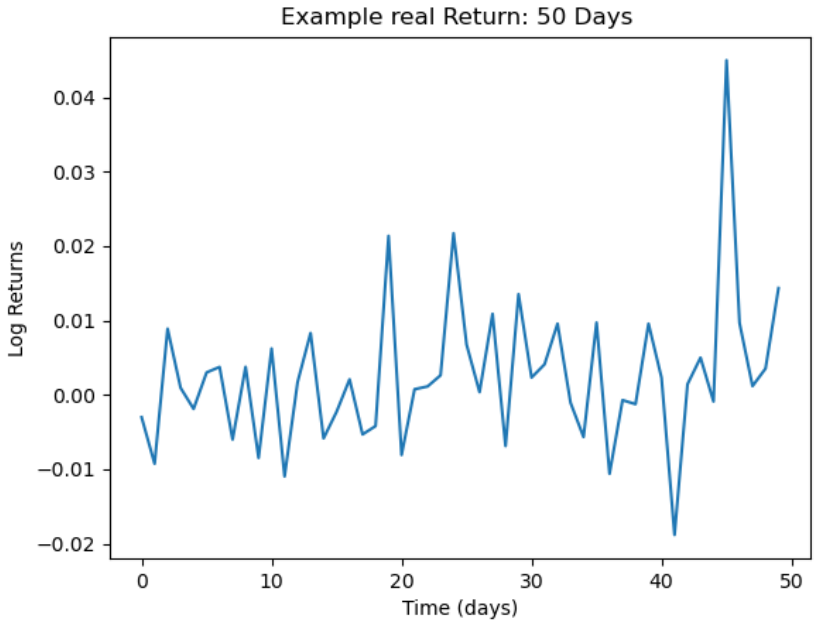

W Dist Approximations
W Dist Approximations
W Dist
Epoch
0
−2
−4
−6
−8
−10
−12
0
50
100
150
200

New Direction

- Rather than predicting these long sequences of data, reduce the prediction length to 50 days.
- Also, condition the W-GAN with the previous 50 days of data [1].

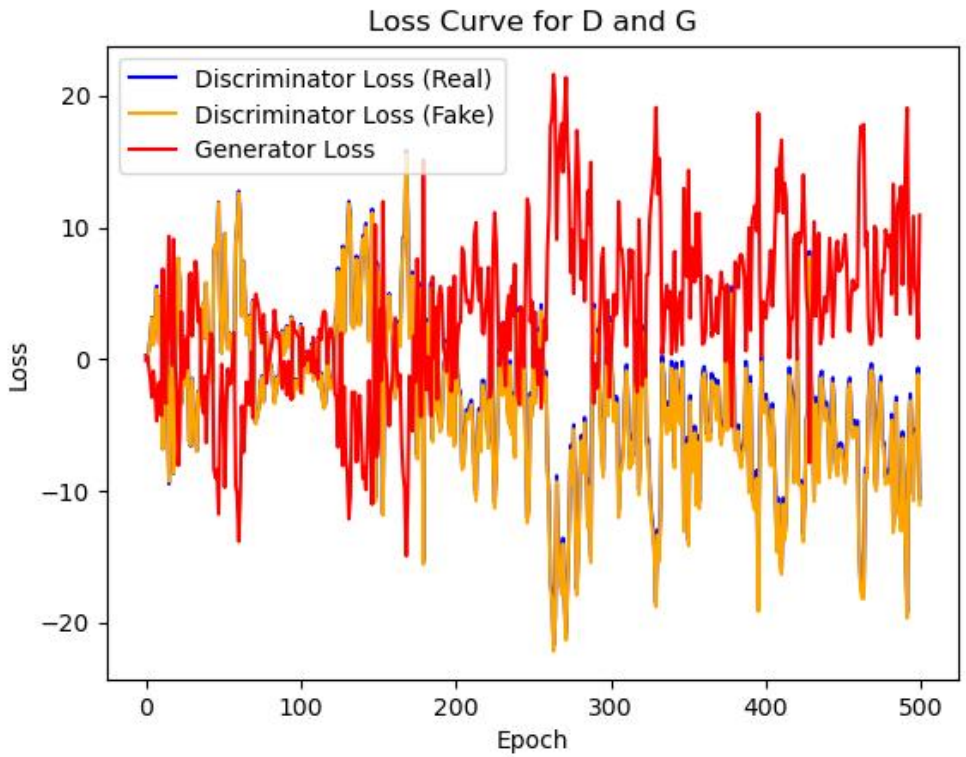
C-WGAN-GP (TCN) (50-day generation)

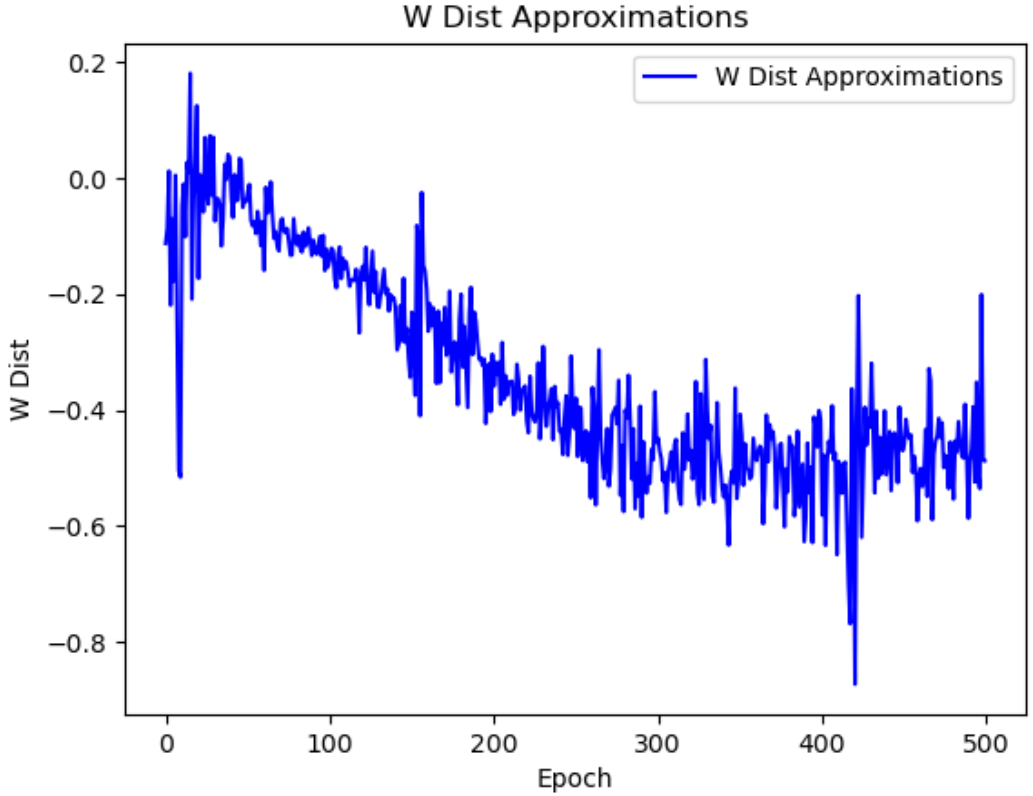




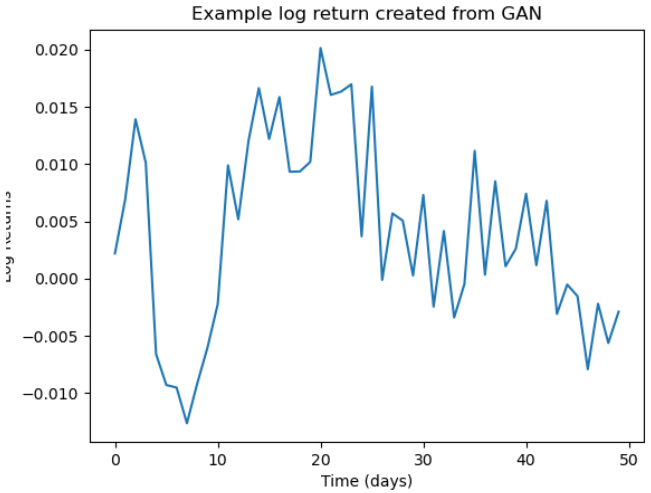
WGAN-GP (TCN) (400-day generation)

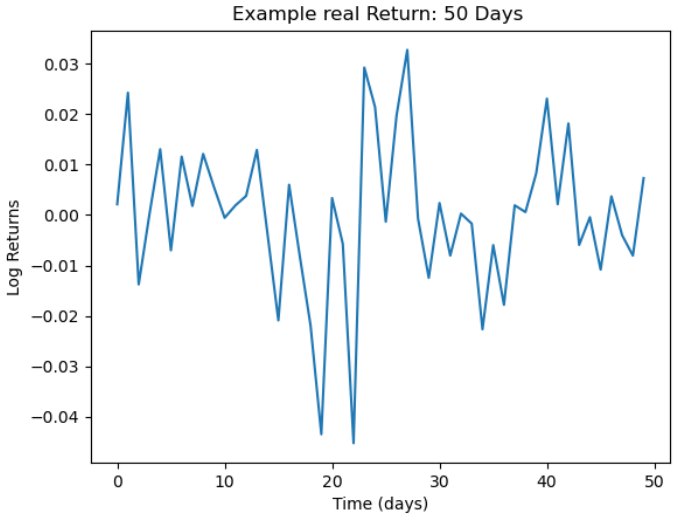
	REAL	FAKE
Mean	0.00051	-0.0001
Stdev	0.0169	0.008
IQR	0.0187	0.0087
Skew	**-0.0709**	**-5.543**
Kurtosis	**4.347**	**281.674**

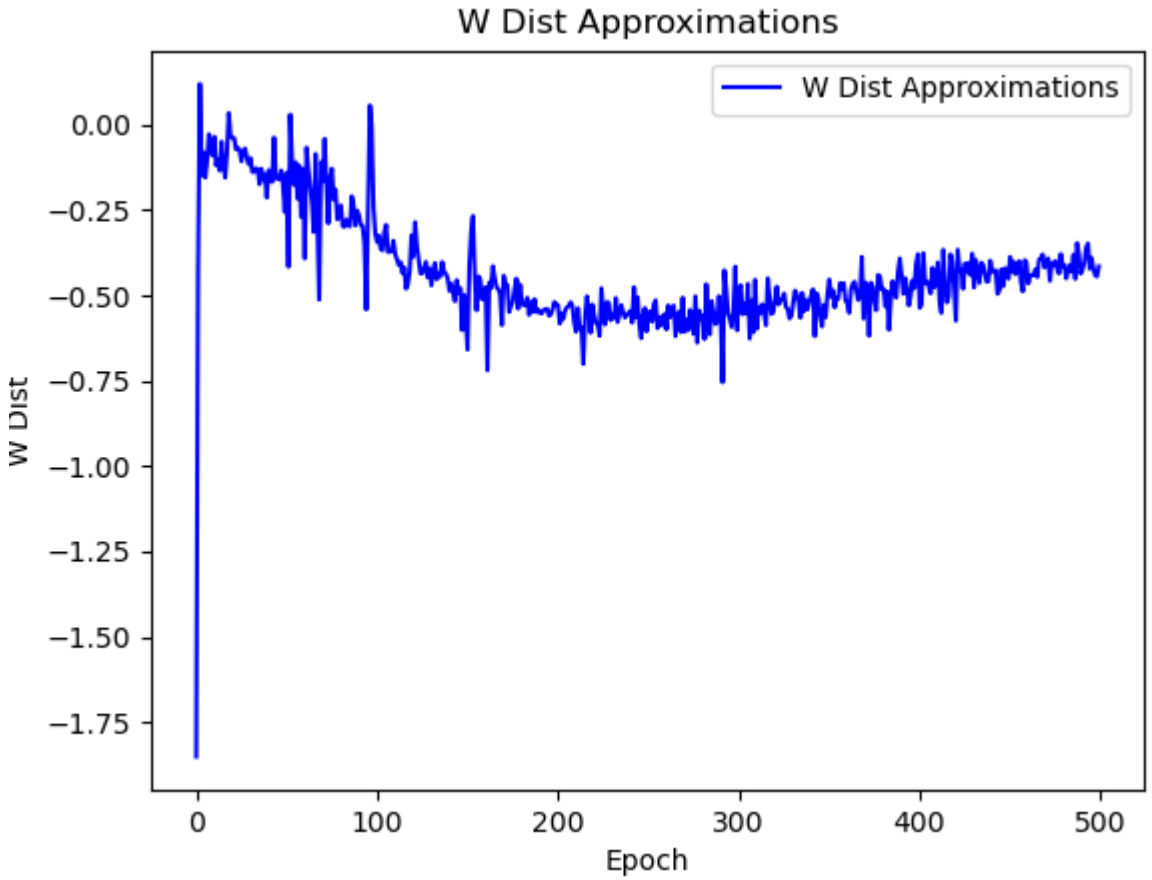

Loss Curve for D and G
Discriminator Loss (Real)
Discriminator Loss (Fake)
Generator Loss
Loss
Epoch
20
10
0
−10
−20
0
100
200
300
400
500


W Dist Approximations
W Dist Approximations
W Dist
Epoch
0.2
0.0
−0.2
−0.4
−0.6
−0.8
0
100
200
300
400
500

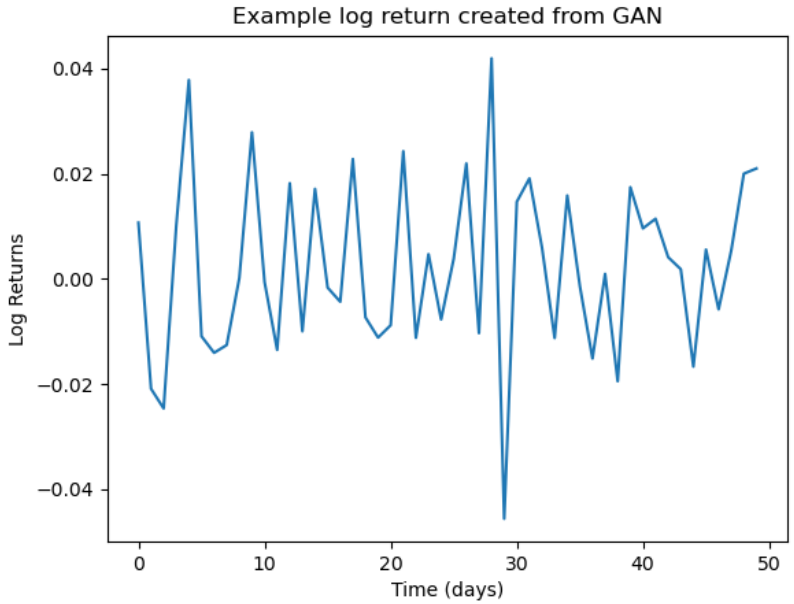
Experimenting without tanh

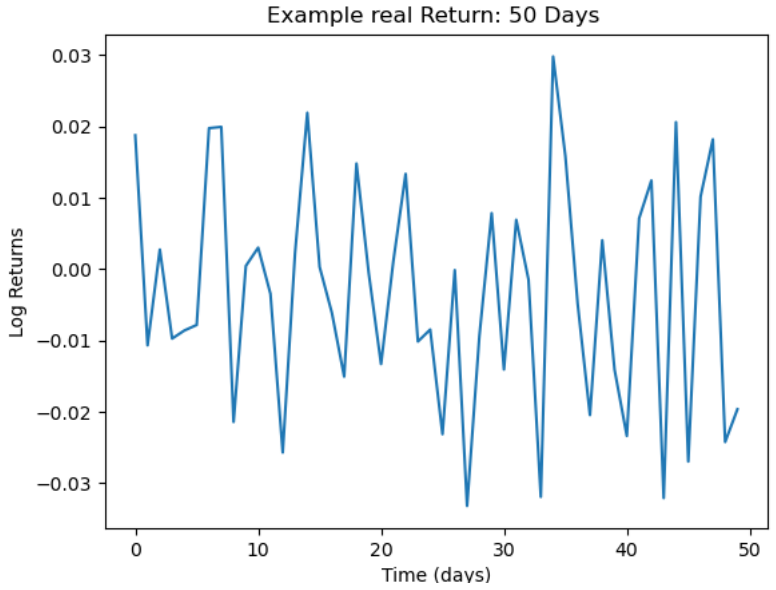






GRU + TCN Hybrid (training right now)





Next Steps

- Implement the PCA and t-SNE plots.
- Continue to experiment and debug with the architecture.
  - If all else fails, try to implement a pre-existing paper like the Sig-GAN or Time-Gan
  - Double check that the new synthetic time series starts when the condition ends (does not happen in some cases).
- Finish the midterm report.
- Once I get a decent GAN, add the second critic/discriminator.

References

- [1] S. Liao, H. Ni, M. Sabate-Vidales, L. Szpruch, M. Wiese, and B. Xiao, “Sig-Wasserstein GANs for conditional time series generation,” *Mathematical finance*, vol. 34, no. 2, pp. 622–670, 2024, doi: 10.1111/mafi.12423.