Algorithms and Optimization for Big Data

Project

GAN Training using Regret Minimization

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Motivation

The regret minimization approach in games is well-established. Generative adversarial network is also a minimax game between the generator(G) and discriminator(D).

Since, regret minimization approach is natural in games, we were motivated to apply this approach in the domain of GANs and check if this approach results in convergence or not.

Approach & Objective

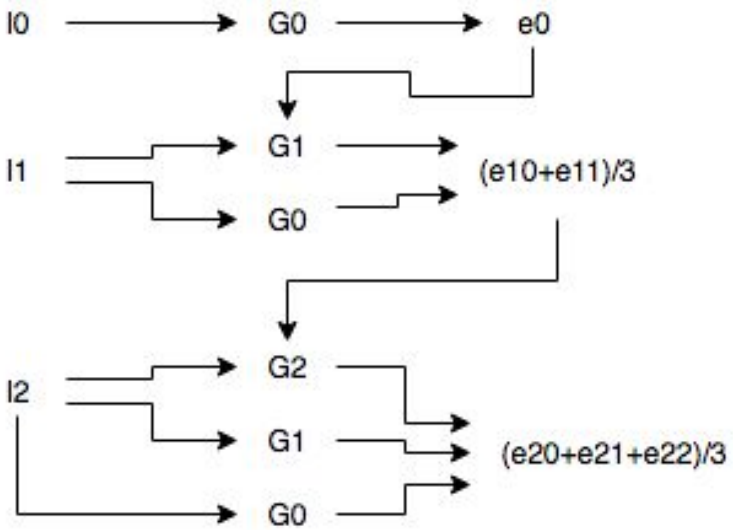
$$\min_G \max_D V(D,G) = \mathbb{E}_{\boldsymbol{x}\sim p_{\text{data}}(\boldsymbol{x})}[\log D(\boldsymbol{x})] + \mathbb{E}_{\boldsymbol{z}\sim p_{\boldsymbol{z}}(\boldsymbol{z})}[\log(1 - D(G(\boldsymbol{z})))].$$

- Minimax game highlighted in the GAN loss function
- Connection between regret setting and GAN setting
- Global regret - computationally infeasible; introduce notion of local regret

➔ Applied notion of local regret to GANs

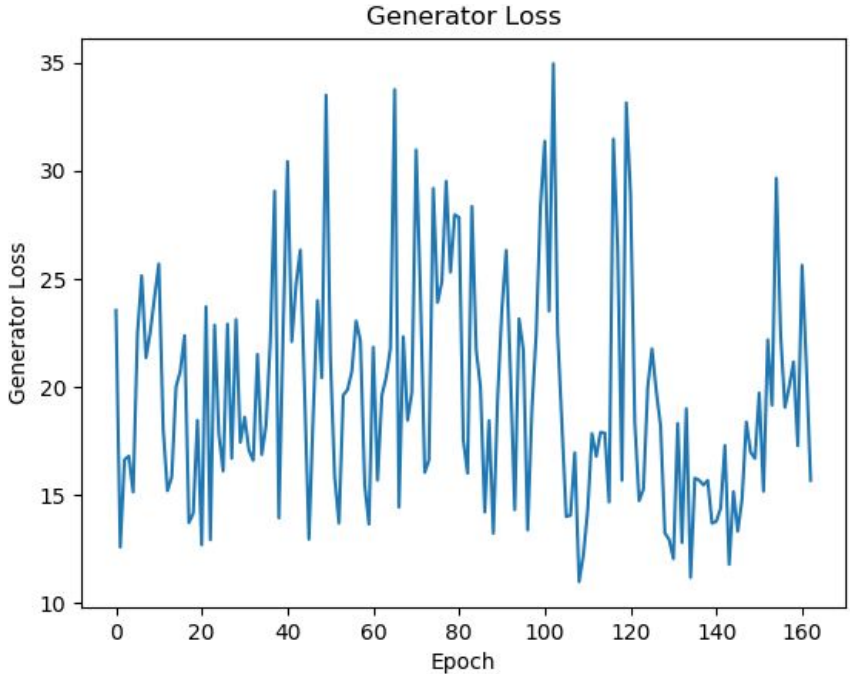
➔ Find weights of the neural net such that the network suffers minimum loss for all inputs

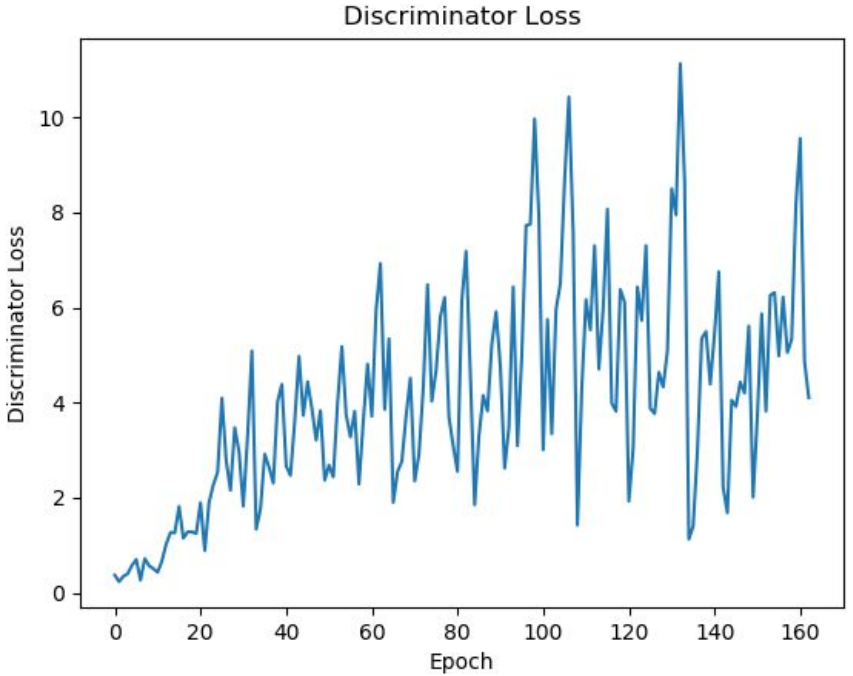
Architecture



Convergence

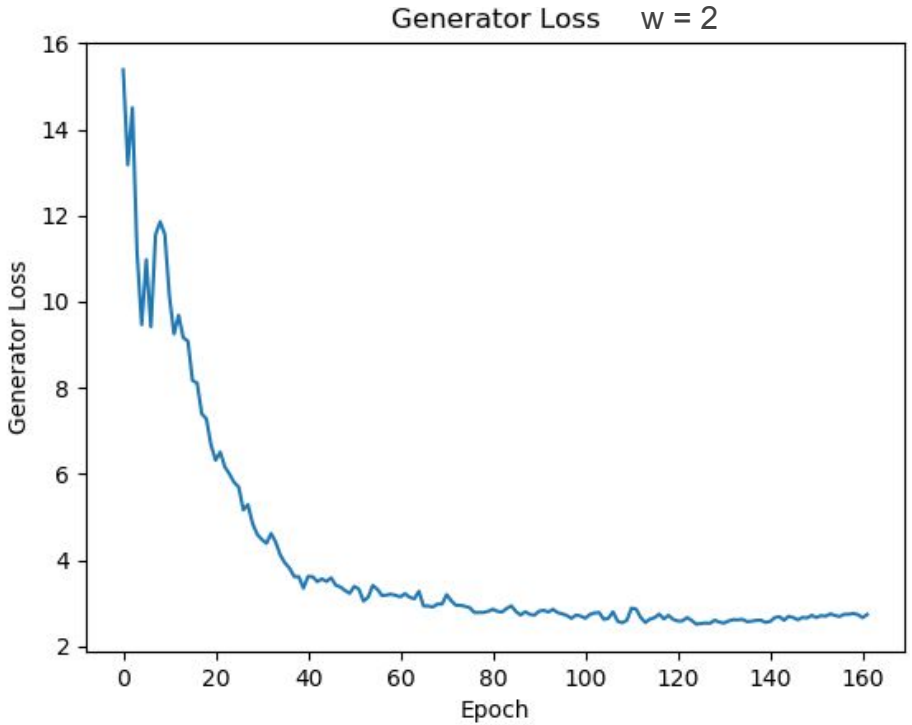
Failed to converge when regret minimization applied to discriminator loss, w = 2.

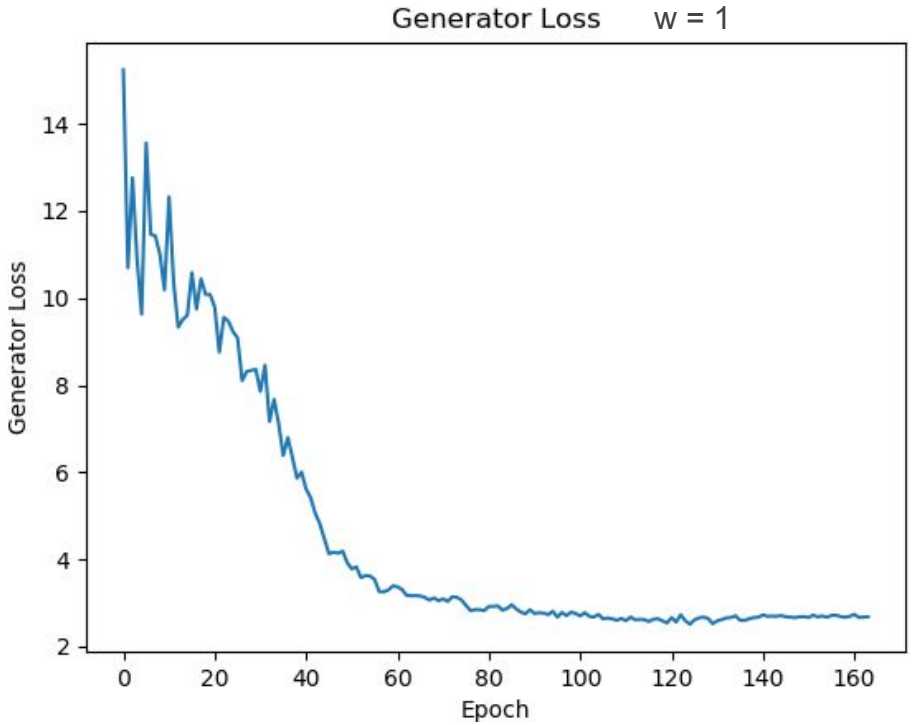


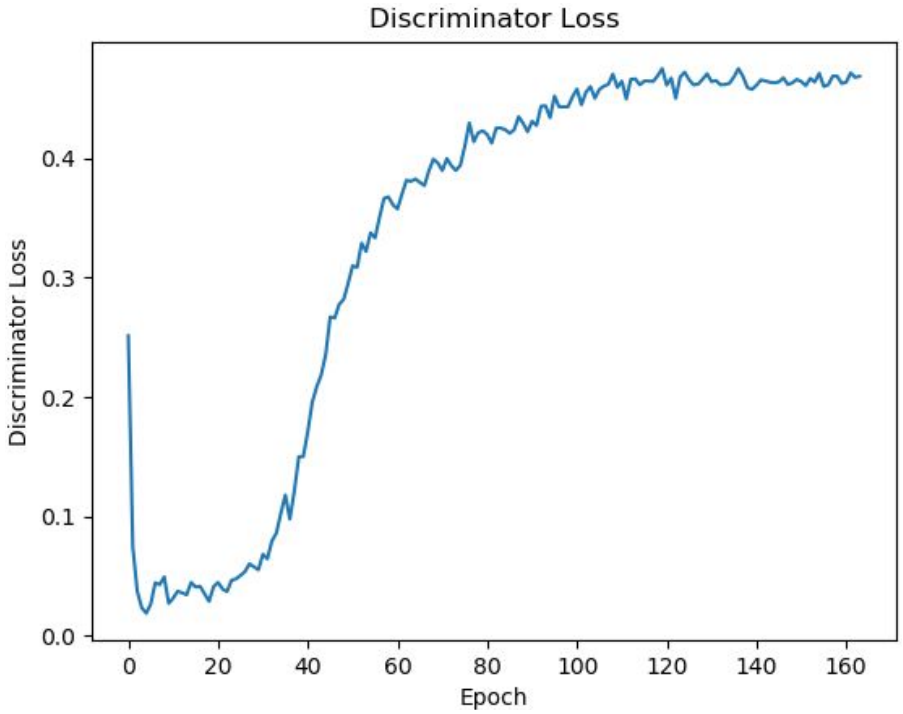


Convergence

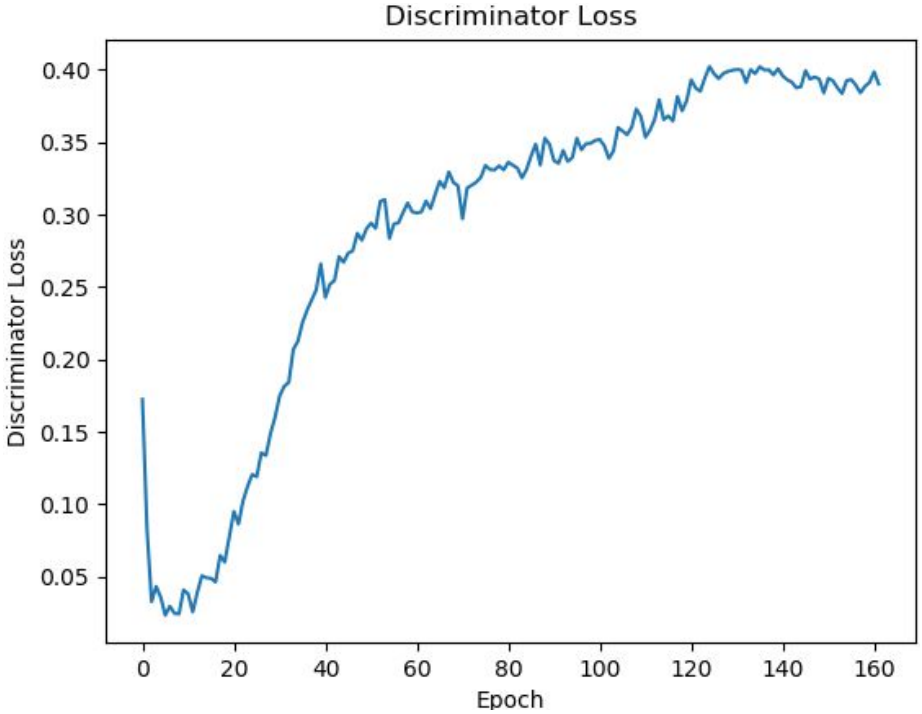
Regret Minimization applied to only generator loss.







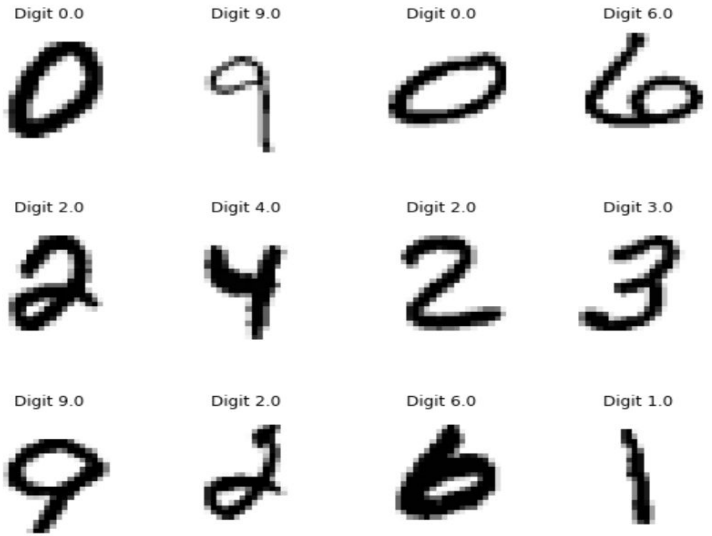
Window size (w) = 2



Window size (w) = 1

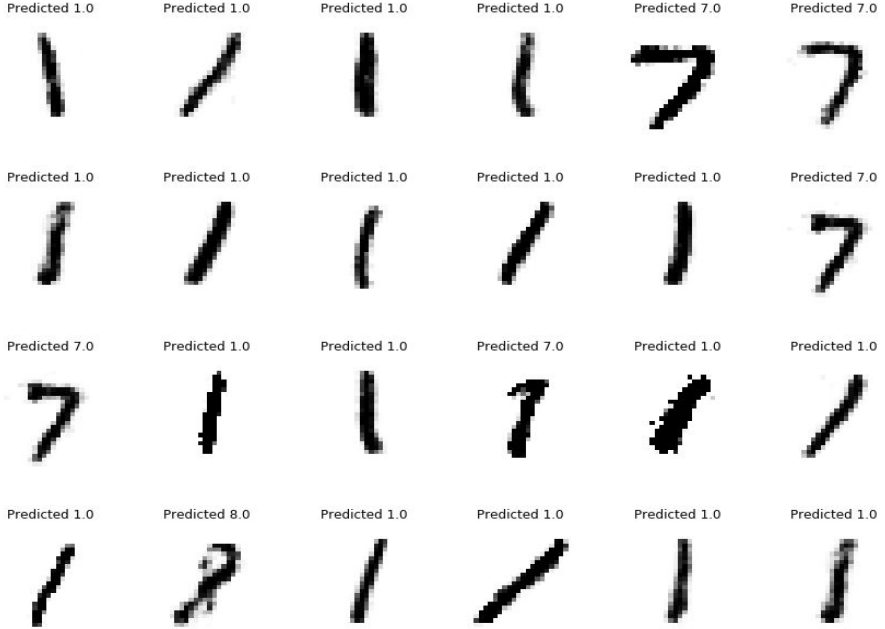
Accuracy

- We used SVM to check the accuracy with which it can classify digits which were generated by GANs using window size one and two.
- SVM hyperparameters were C=5 and Gamma=0.05 (Kernel: RBF)
- The testing accuracy for SVM for w=2 was 96% and for w=1, accuracy = 95%



SVM Results with w=1 and w=2

SVM Classification w=1



SVM Classification w=2

Challenges Faced

- Most of the challenges faced were from coding perspective. The first challenge was how to get the previous loss function based on the current input?
- Image compatibility issue.

Conclusion and Future Work

- Concept of windowing for training GANs with higher convergence rate.
- Greater window size - more computations - more training time.
- Can be applied for applied for optimization theory problems.

References

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4. Kodali, Naveen, James Hays, Jacob Abernethy, and Zsolt Kira. "On convergence and stability of gans." (2018).
5. SVM classfier - https://github.com/ksopyla/svm_mnist_digit_classification

THANK YOU