DELFT UNIVERSITY OF TECHNOLOGY

CS4180 DEEP LEARNING

Project Proposal

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1 Problem Statement

Generative adversarial networks (GANs) [1] are deep neural network architectures comprised of two networks, pitting one against the other. GANs can be used to mimic the probability distribution of a real world dataset, which makes them a versatile network to choose from. However, there are some issues that creep up while training GANs, chief among them is the issue of mode collapse. Here the generator will try fooling the discriminator by producing samples with extremely low variety and as a result, the network will have poor generalization capabilities. Many approaches have been used to tackle this issue such as in [2][3][4]. The question is whether an evolutionary approach to training GANs can resolve the issue of mode collapse?.

2 Method

In this approach we maintain a population of individual solutions i.e. a generator-discriminator pair. Ranking these individuals is done according to a Tournament Selection process[5], wherein the best individual for each tournament is selected on the basis of the fitness function value. To generate a fitness value for a individual:

- Train all individuals.
- For an individual, compute the loss that its discriminator incurs across all the generators and the loss the its generator incurs across all discriminators.
- Sum of two losses defined above will be the fitness value.

The best individuals after the selection process is referred to as *parents*. To produce *children*, we perform crossover of the parents and then mutate. Crossover is perform by taking the generator of one *parent* and mating it with the discriminator of the other. To mutate the individuals, we add noise to the network weights of the generator and discriminator. Thus, we have a new generation of individuals and we repeat the process until there is minimal or no improvement in best fitness value of successive generations.

We think that the tournament selection process and the design of the fitness function motivates the generators to learn the entire distribution which alleviates the mode collapse issue.

3 Experiment and Evaluation

To investigate our method's impact on resolving the issue in question, we train the GANs on 2D synthetic Gaussian. In particular, the first dataset will have 8 Gaussian distributions arranged in a circle and the second one will 25 Gaussian distribution arranged in grid as shown in Figure 1. We choose these datasets as it would allow us to compare the effectiveness of our method with that of GAN[1], MGAN[2] and VEEGAN[3], since they[2][3] also use this as one of their approach to evaluate mode collapse.

Evaluation Method: To quantitatively compare the quality of generated data, we use the Kullback-Leibler (KL) divergence and Wasserstein distance measures, as we know the true distribution in this case. Lower the value of these measures, better the generator mimics the true distribution.

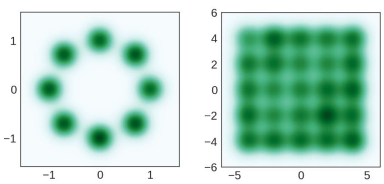

Figure 1: True data

We estimate it should be feasible for our us to code and evaluate our method within the course deadlines. Figure 2 depicts a milestone chart for this project.

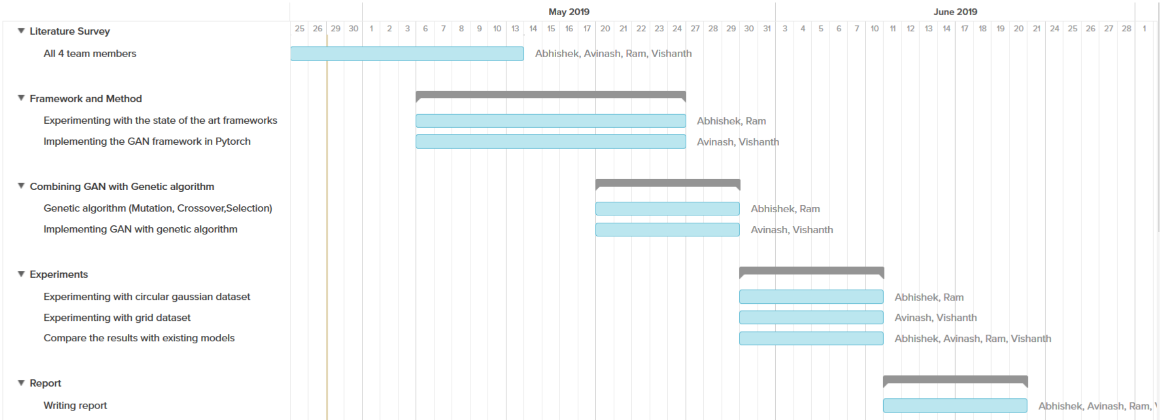

Figure 2: Milestone Chart

References

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[2] Q. Hoang, T. D. Nguyen, T. Le, and D. Q. Phung. Multi-generator generative adversarial nets. CoRR, abs/1708.02556, 2017.

[3] Akash Srivastava, Lazar Valkov, Chris Russell, Michael U. Gutmann, Charles Sutton. VEEGAN: Reducing Mode Collapse in GANs using Implicit Variational Learning. arXiv:1705.0776161v3 [stat.ML] 6 Nov 2017.

[4] Martin Arjovsky, Soumith Chintala and L´eon Bottou.Wasserstein GAN.arXiv:1701.07875v3 [stat.ML] 6 Dec 2017.

[5] Goldberg, D. E., and Deb, K, "A Comparative Analysis of Selection Schemes used in Genetic Algorithms," Foundations of Genetic Algorithms, 1 (1991) 69- 93 (also TCGA Report 90007).