

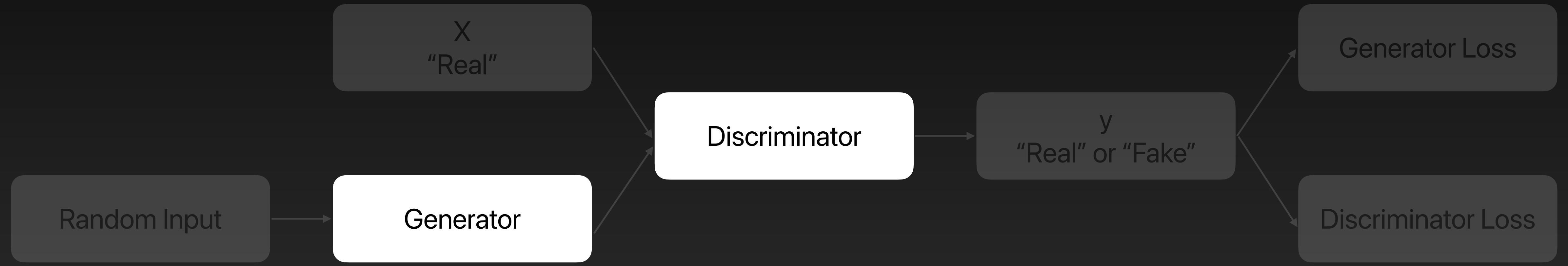
GAN You Feel the Love Tonight

Generative Adversarial Networks

Brian Ho • Chinmay Kamerkar • Pratik Kasle • Andrew Selvia • 2021.3.9

What is a GAN?

Generative Adversarial Network



What can a GAN do?

Generate data that approximates an input space.

Applications

Applications

- Generate photos



Applications

- Generate photos
- Text-to-Image

"This flower has petals that are yellow with shades of orange."

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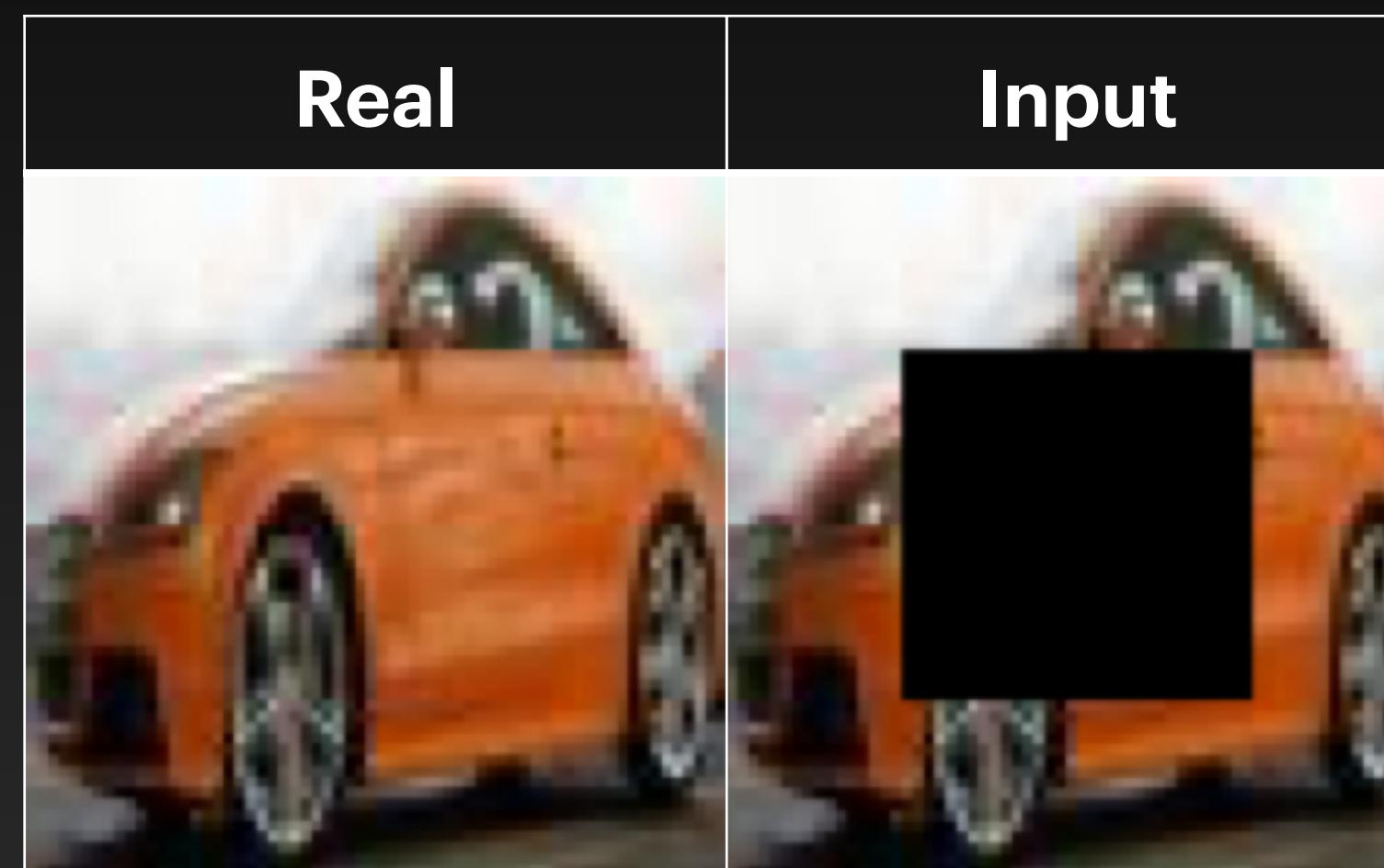
Applications

- Generate photos
- Text-to-Image
- Inpainting



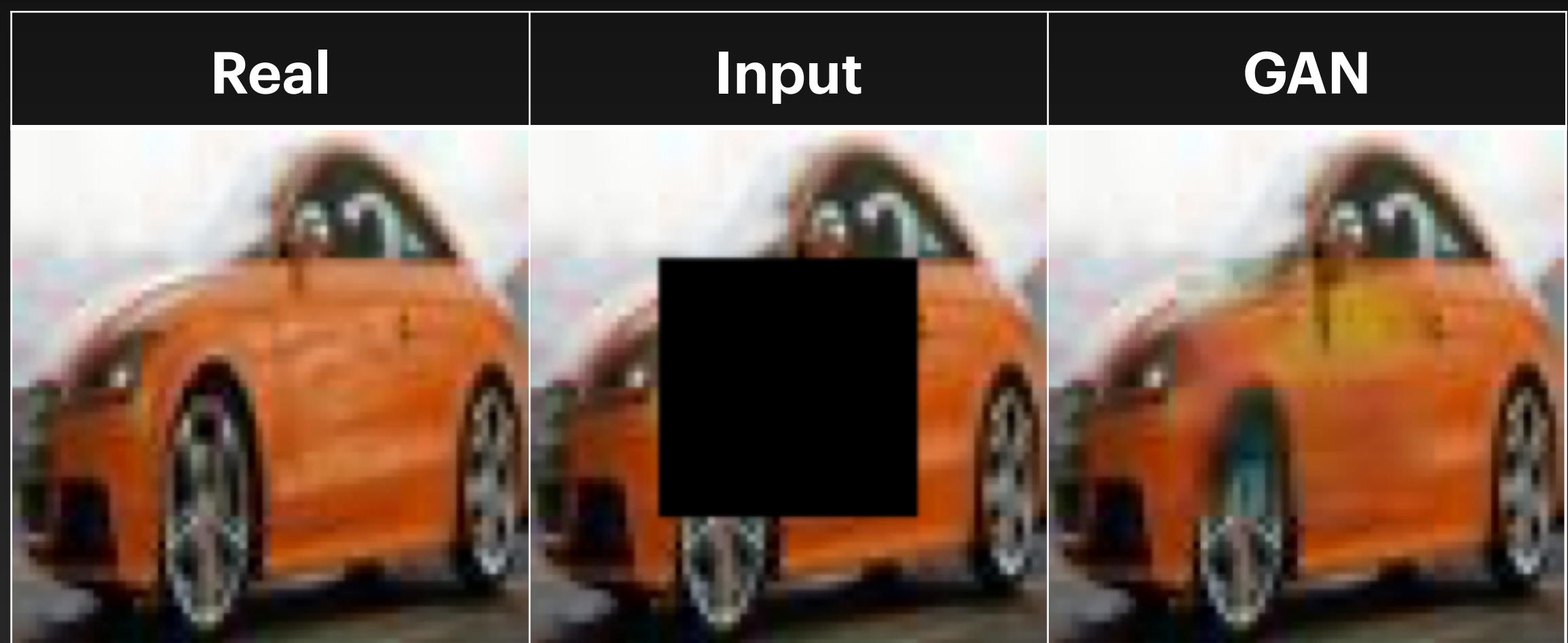
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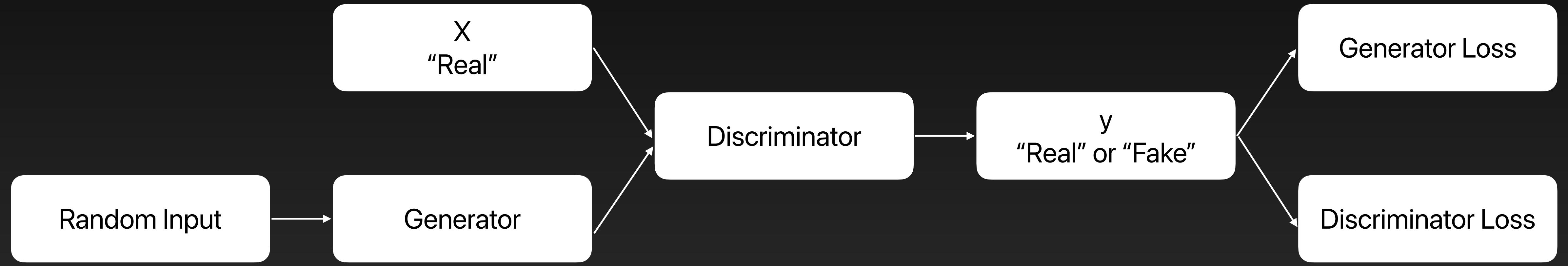
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Applications

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How does a GAN learn?



GAN Training

GAN Training

1. Train *Discriminator* independently

- Pass *real* and *generated* samples to Discriminator
- Classify samples as *real* or *fake*
- Calculate *discriminator loss* then back-propagate

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2. Train *Generator* independently

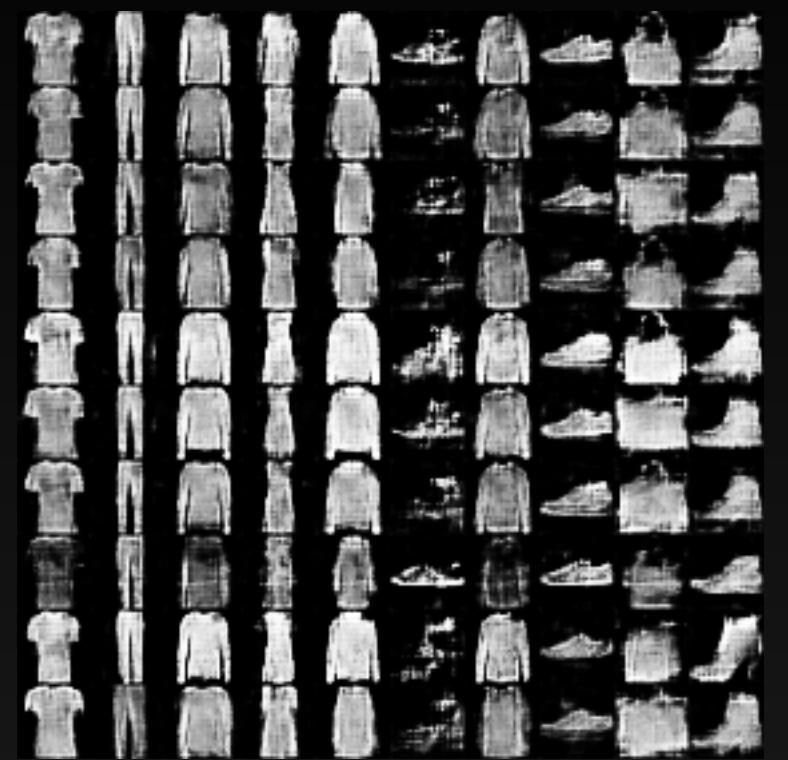
- Same; but this time, back-propagate *generator loss*

GAN Training

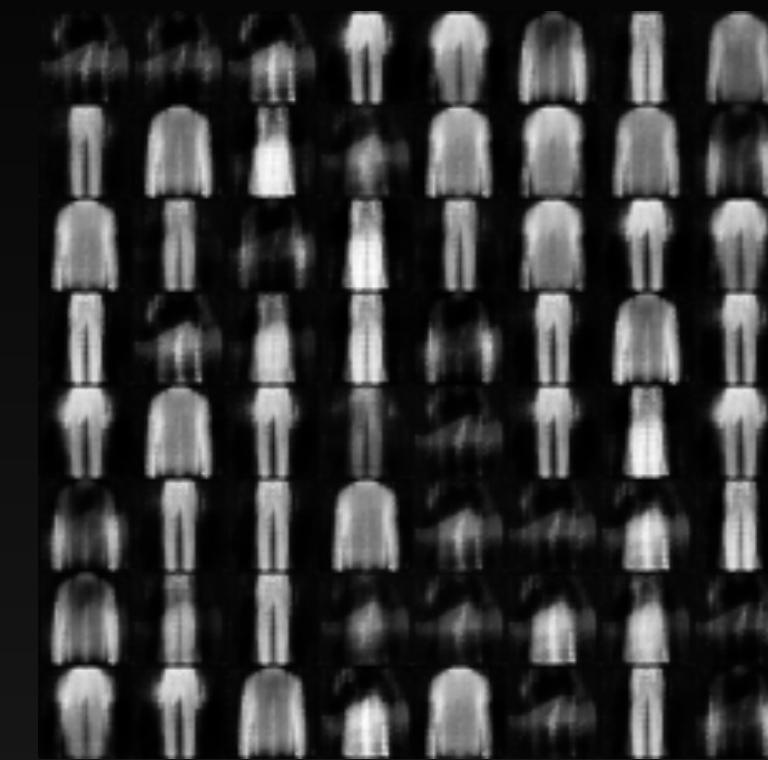
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2. Train *Generator* independently
 - Same; but this time, back-propagate *generator loss*
3. Repeat
 - Train each network independently in phases



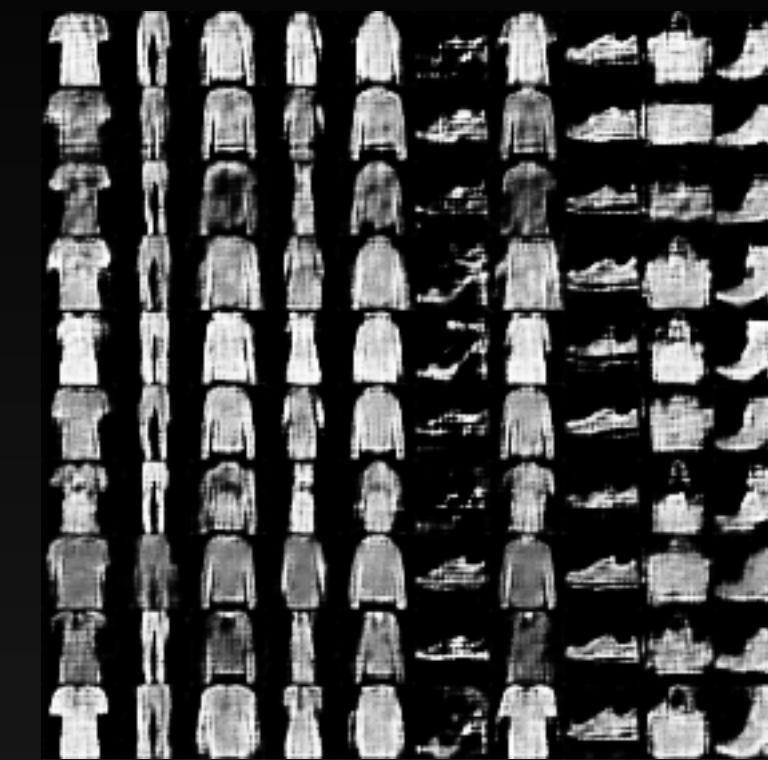




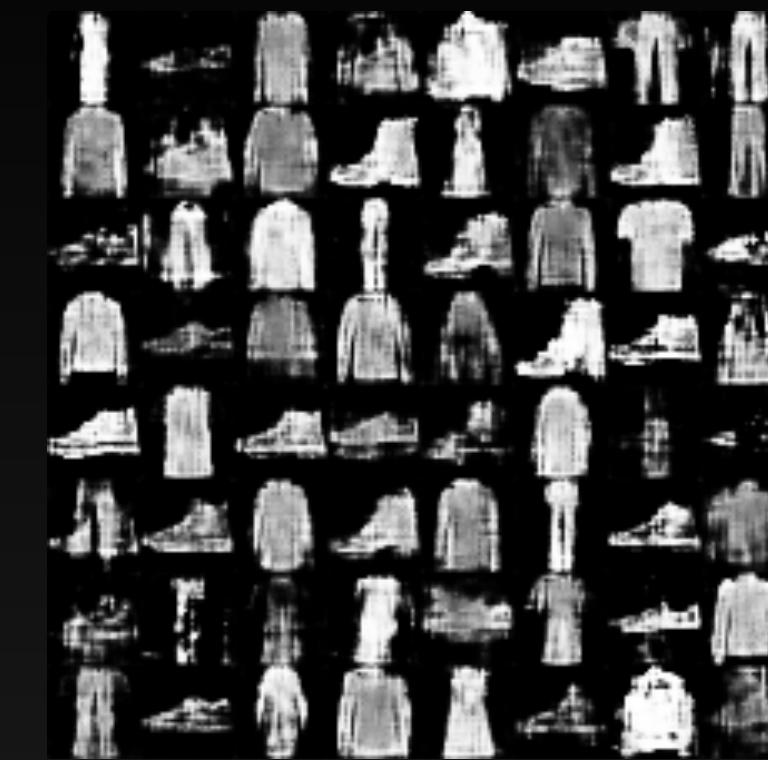
ACGAN



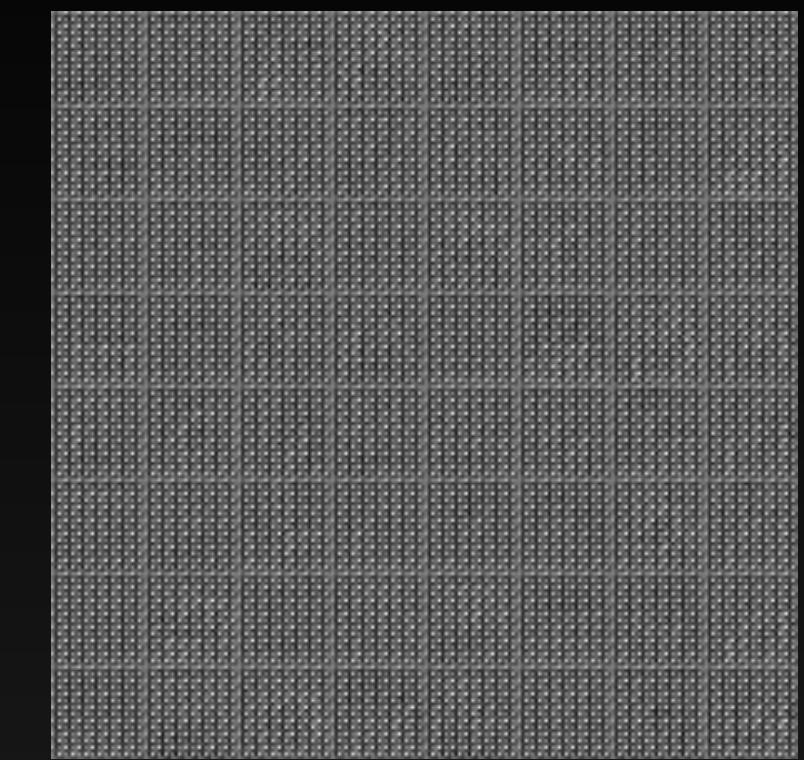
BEGAN



CGAN



DRAGAN



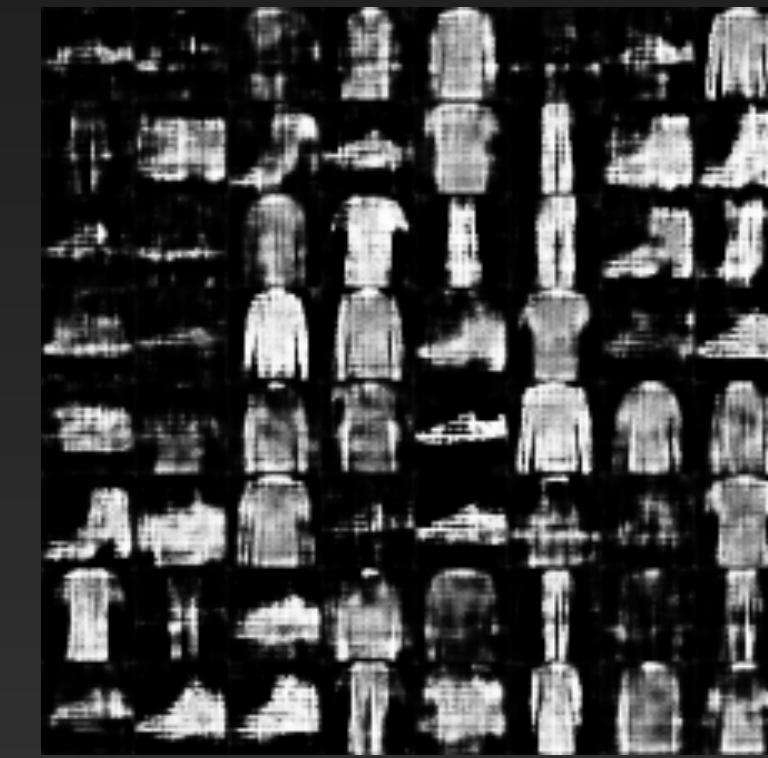
EBGAN



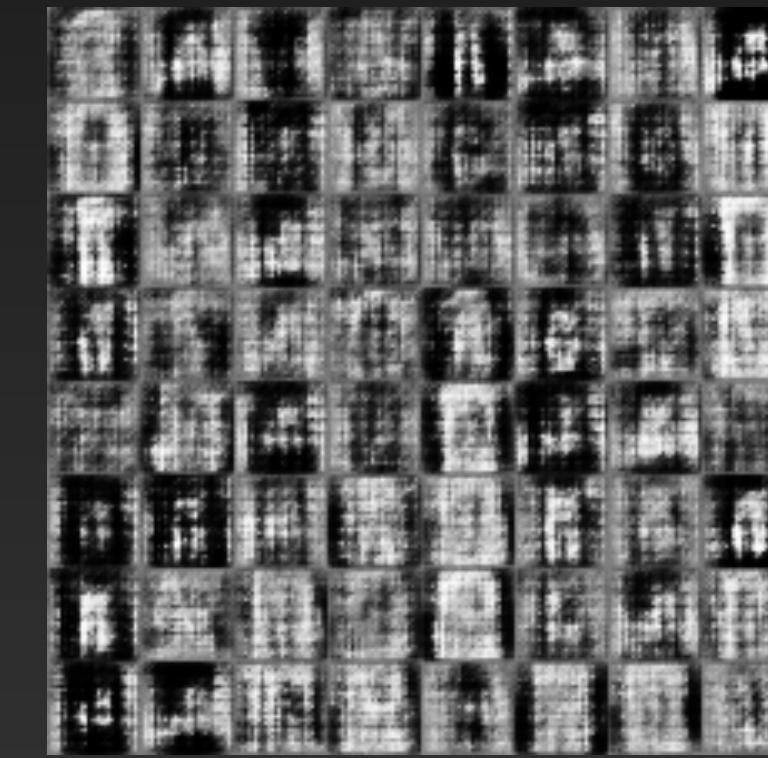
GAN



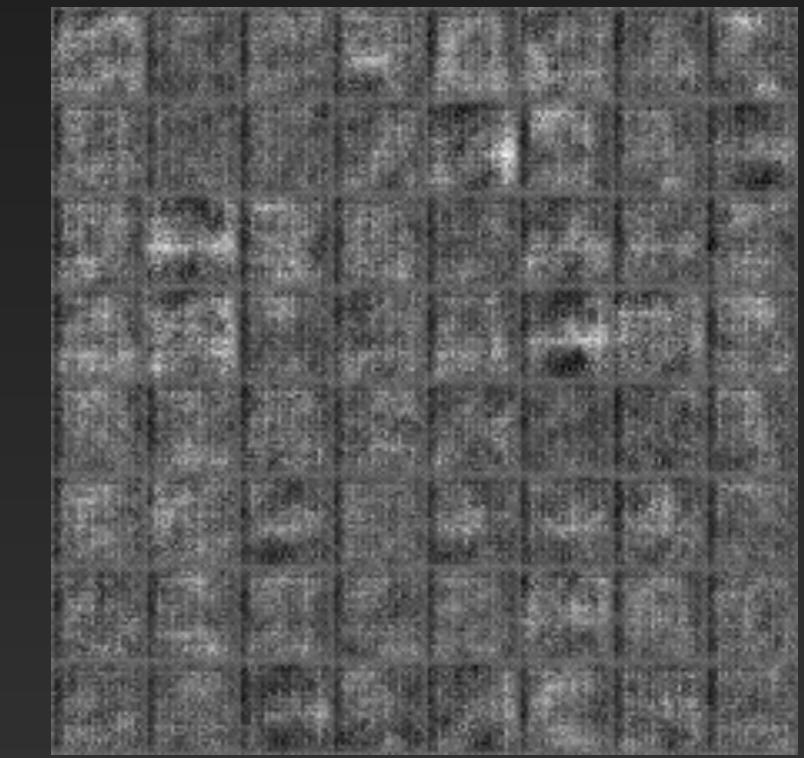
infoGAN



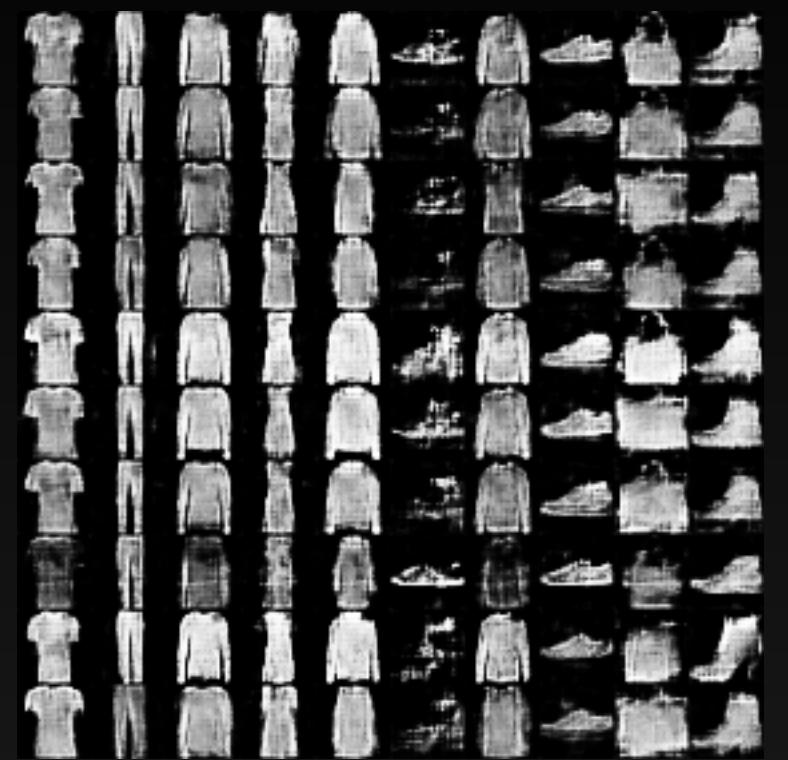
LSGAN



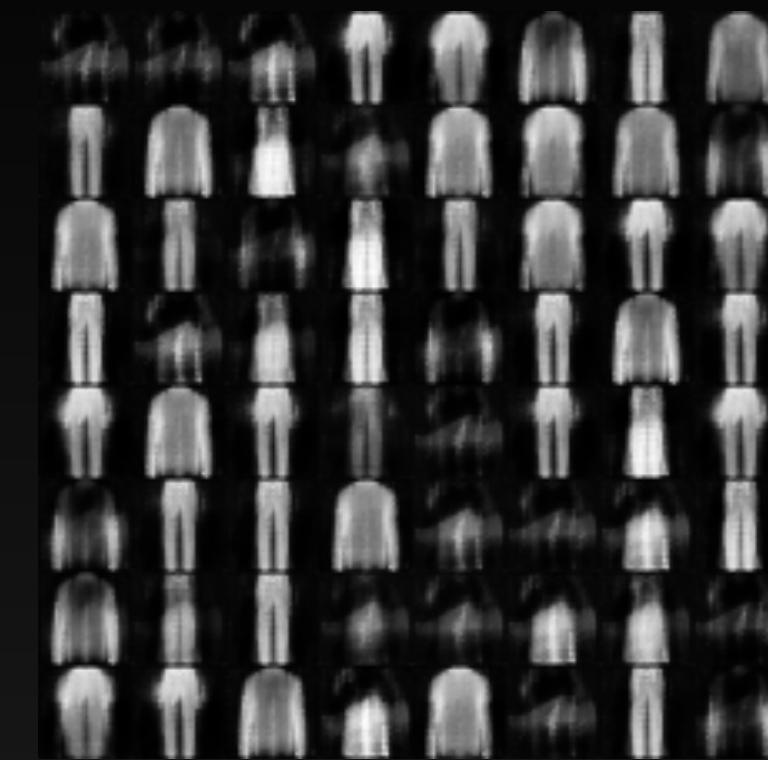
WGAN



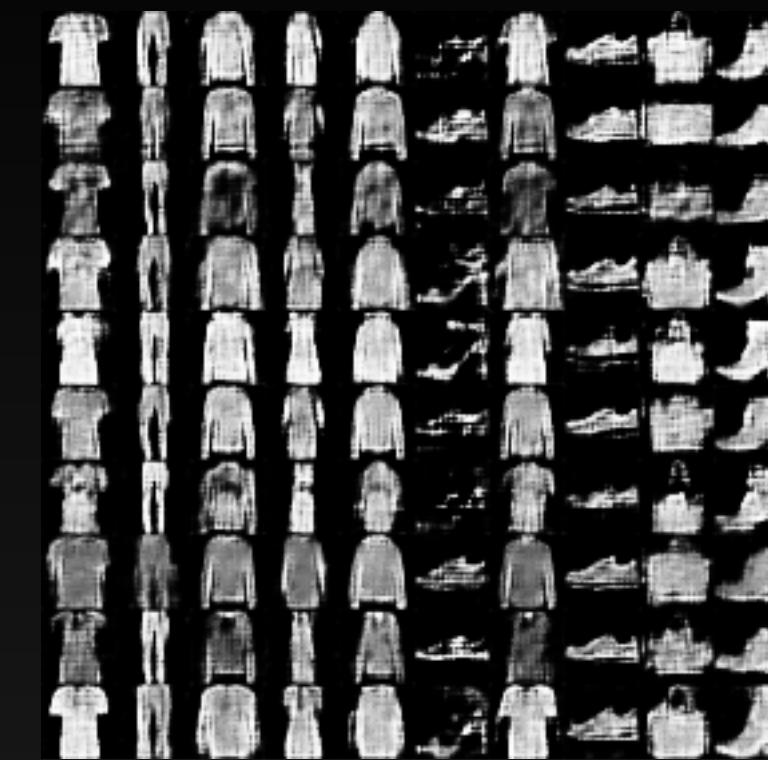
WGAN_GP



ACGAN



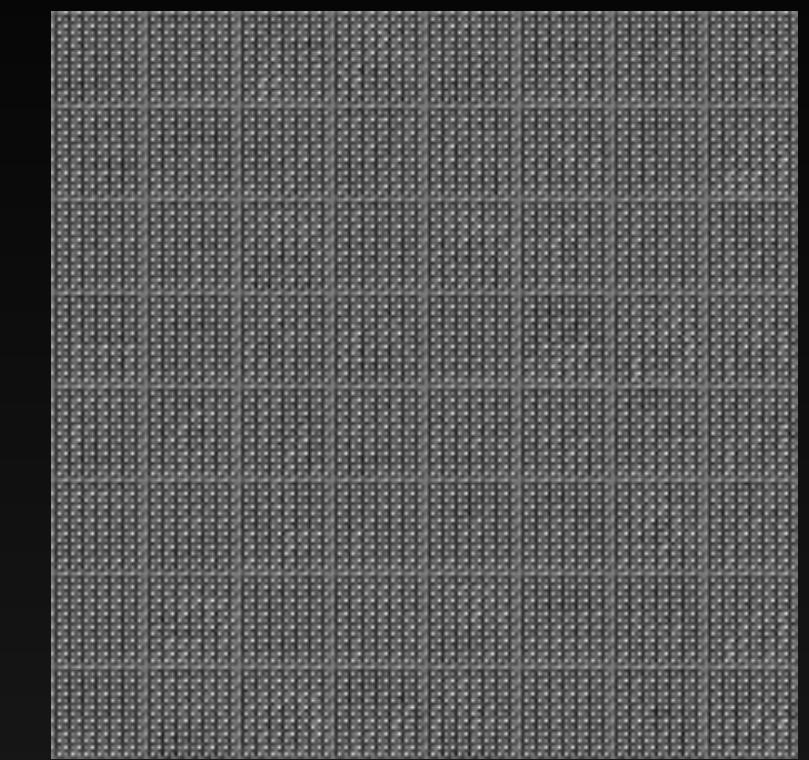
BEGAN



CGAN



DRAGAN



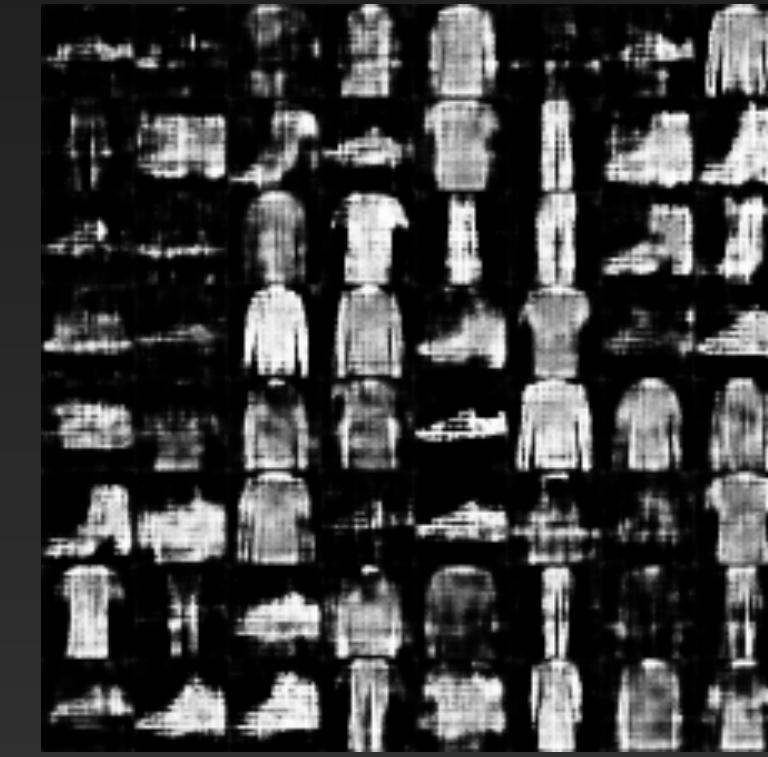
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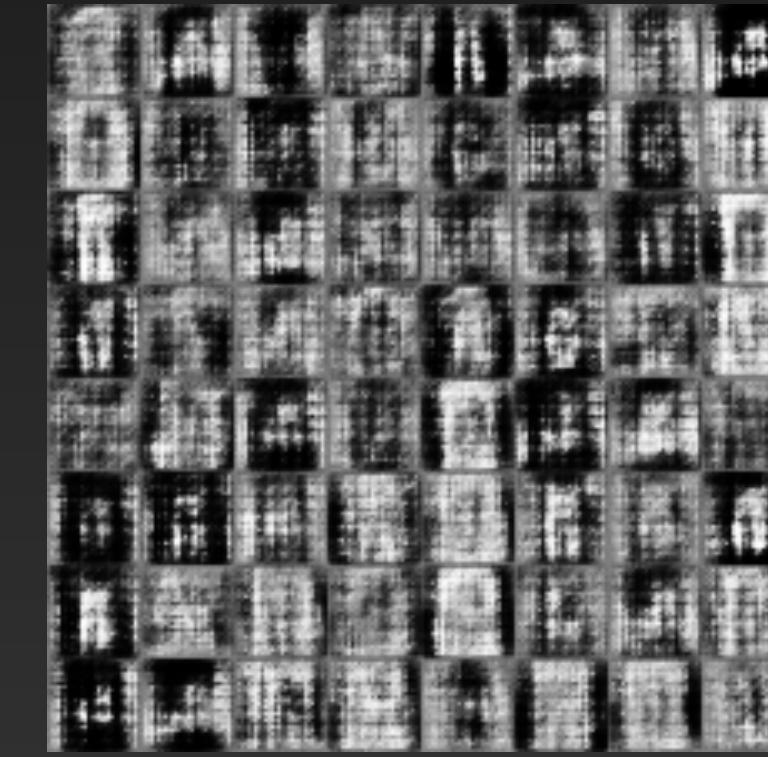
GAN



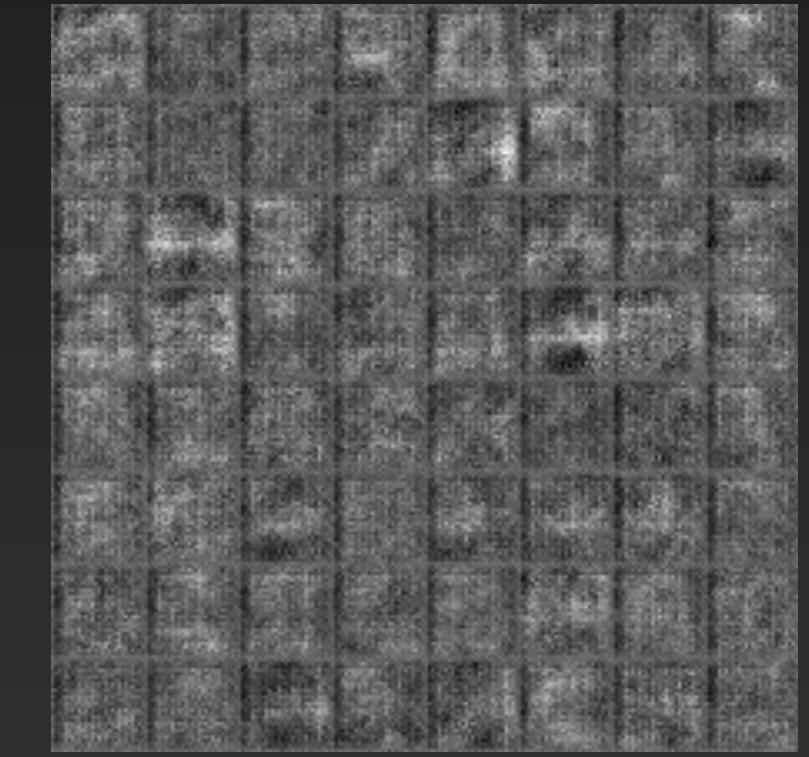
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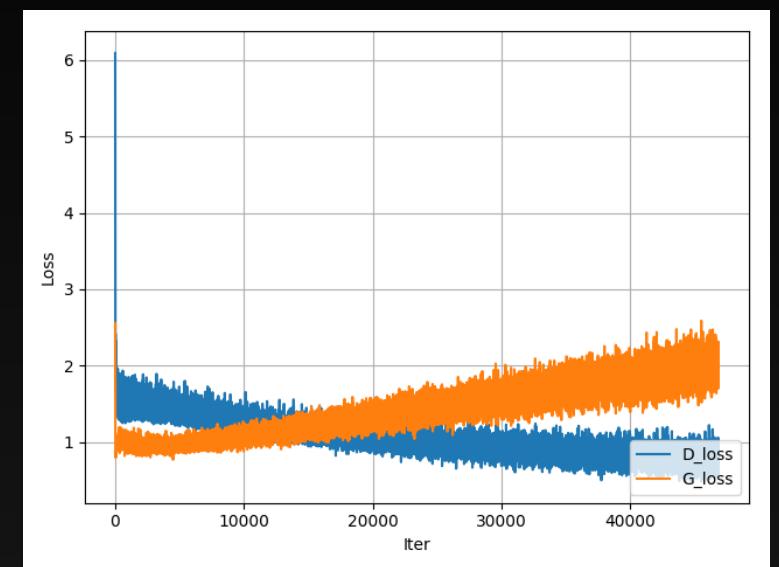
LSGAN



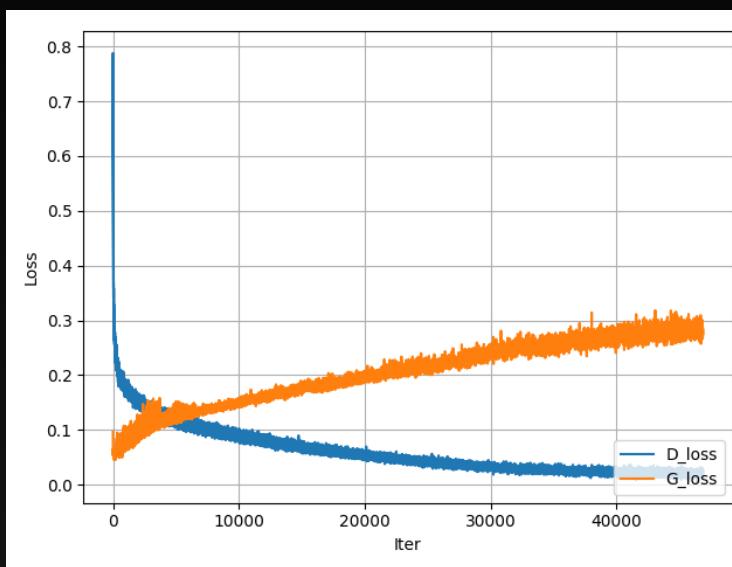
WGAN



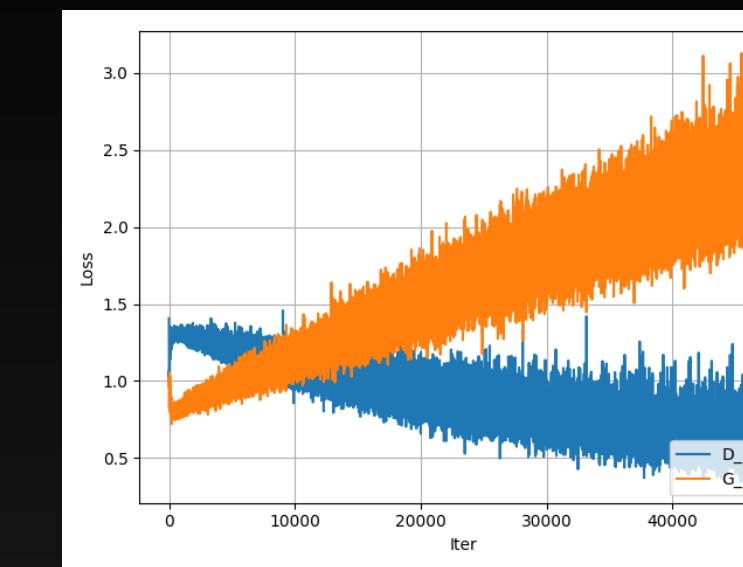
WGAN_GP



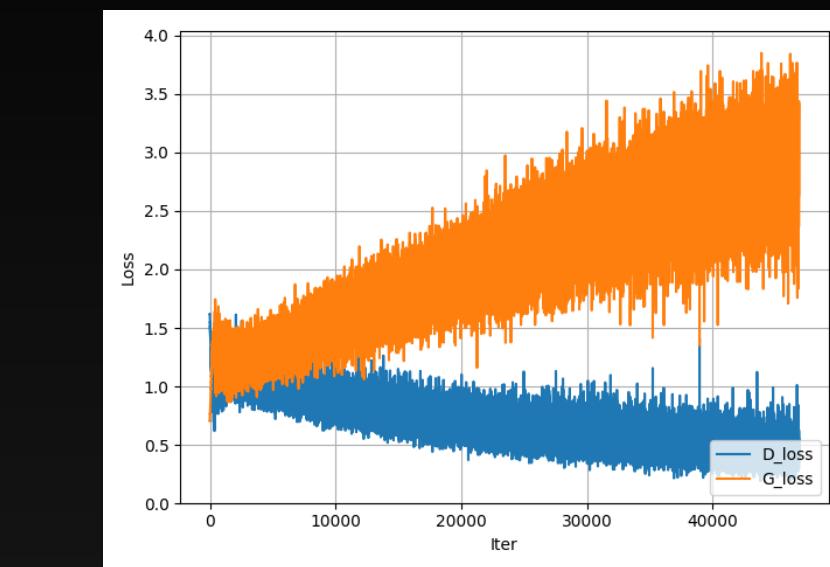
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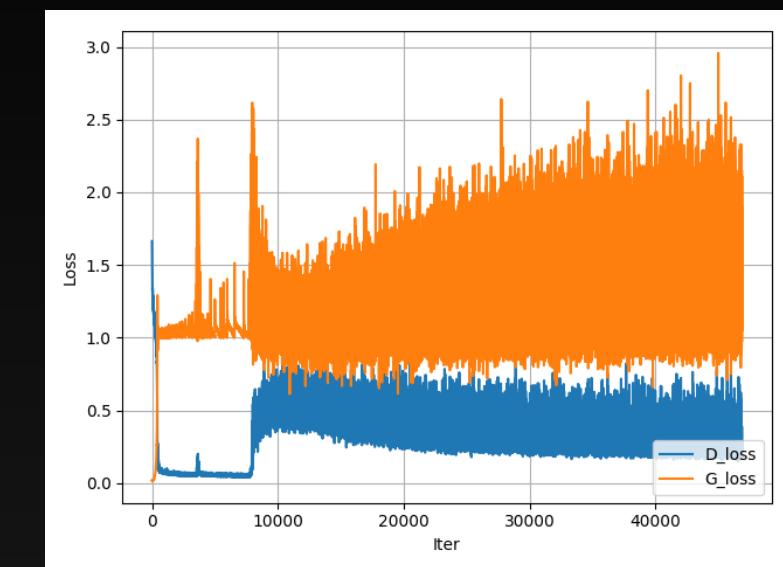
BEGAN



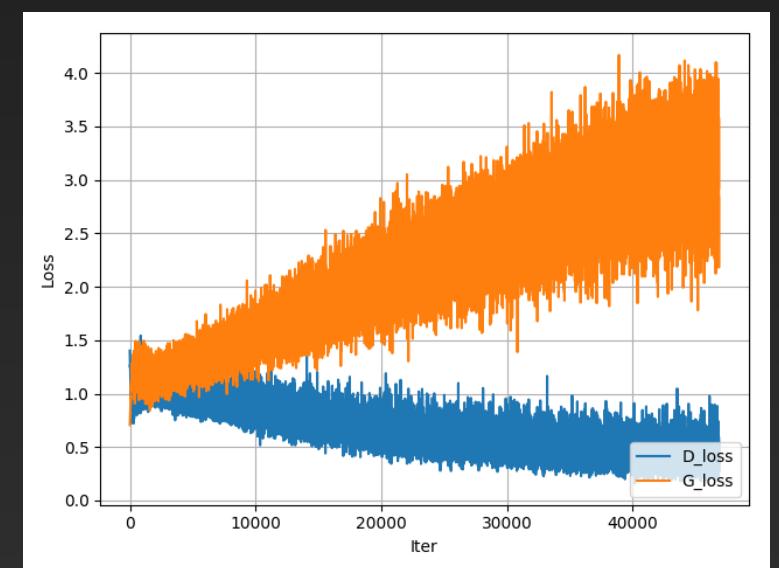
CGAN



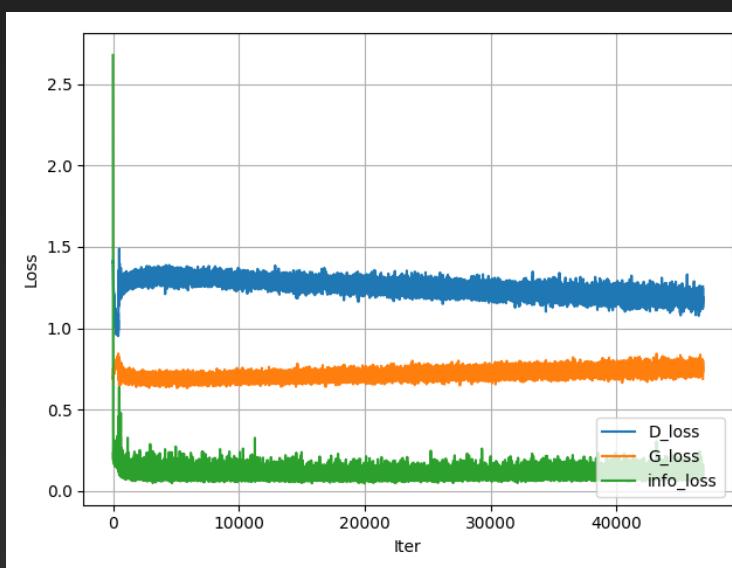
DRAGAN



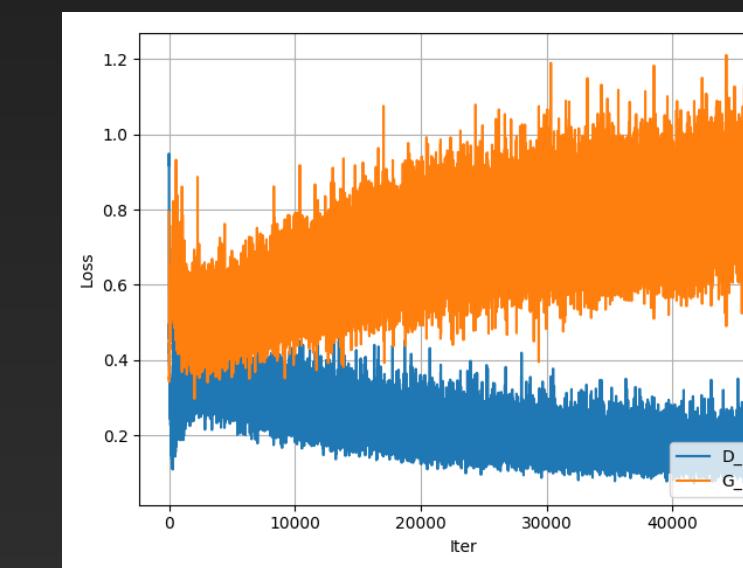
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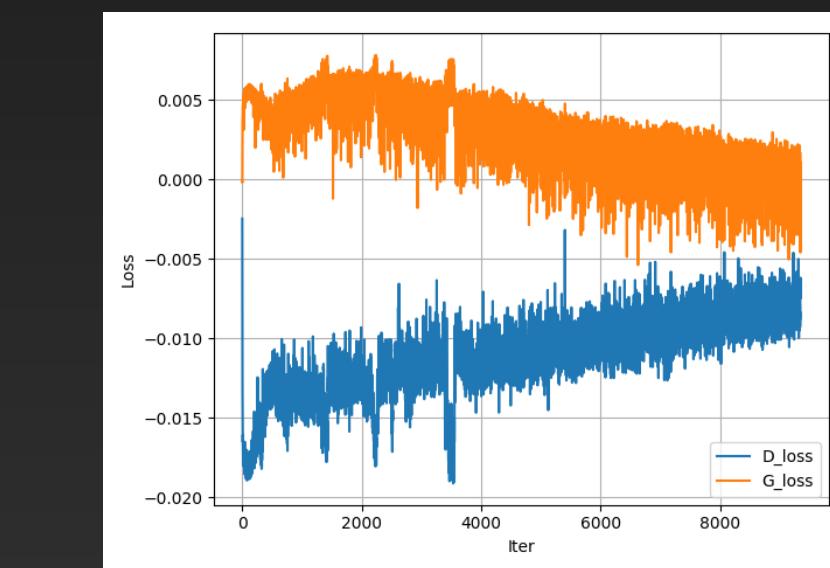
GAN



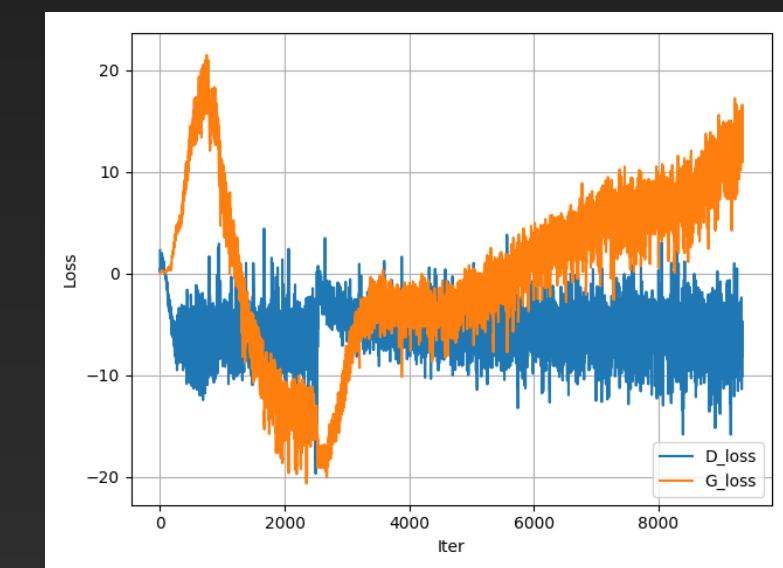
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WGAN_GP

Pitfalls

- Vanishing Gradients: Discriminator races too far ahead
- Mode Collapse: Generator learns to win narrowly without modeling breadth
- Failure to Converge: Learning seesaws without approaching equilibrium

Fundamental GAN Min-Max Equation

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

Conclusion

- Introduced in 2014
- Difficult to train
- Wide applicability to computer vision, voice assistants, etc.
- Ethical gray areas: deepfakes, truth, trust in institutions, etc.
- Active research area



References

- <https://developers.google.com/machine-learning/gan>
- <https://www.youtube.com/watch?v=l82PxsKHxYc>

Papers

- GAN
- CGAN
- WGAN
- infoGAN