EC-GAN: Low-Sample Classification using Semi-Supervised Algorithms and GANs

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https://arxiv.org/pdf/2012.15864.pdf

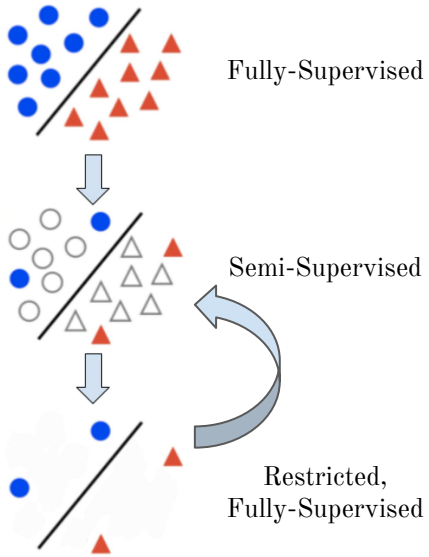
Accepted to AAAI Conference on Artificial Intelligence 2021, Finalist for Student Abstract

Introduction and Problem

- Semi-Supervised Learning
- Low-Sampled, Fully-Supervised Learning
- Generative Models

Contributions

- Artificial data for classification
- 3-Player Game
- Low-sample application, academic and real dataset

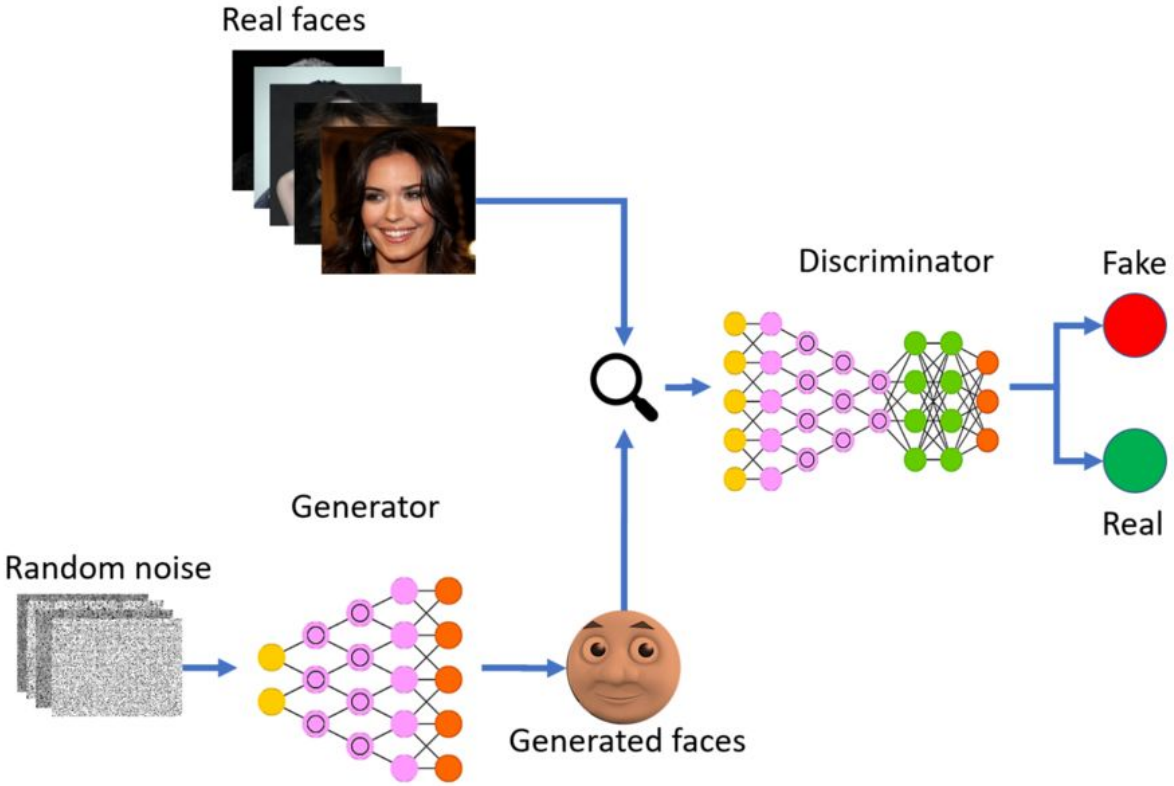


Related Work

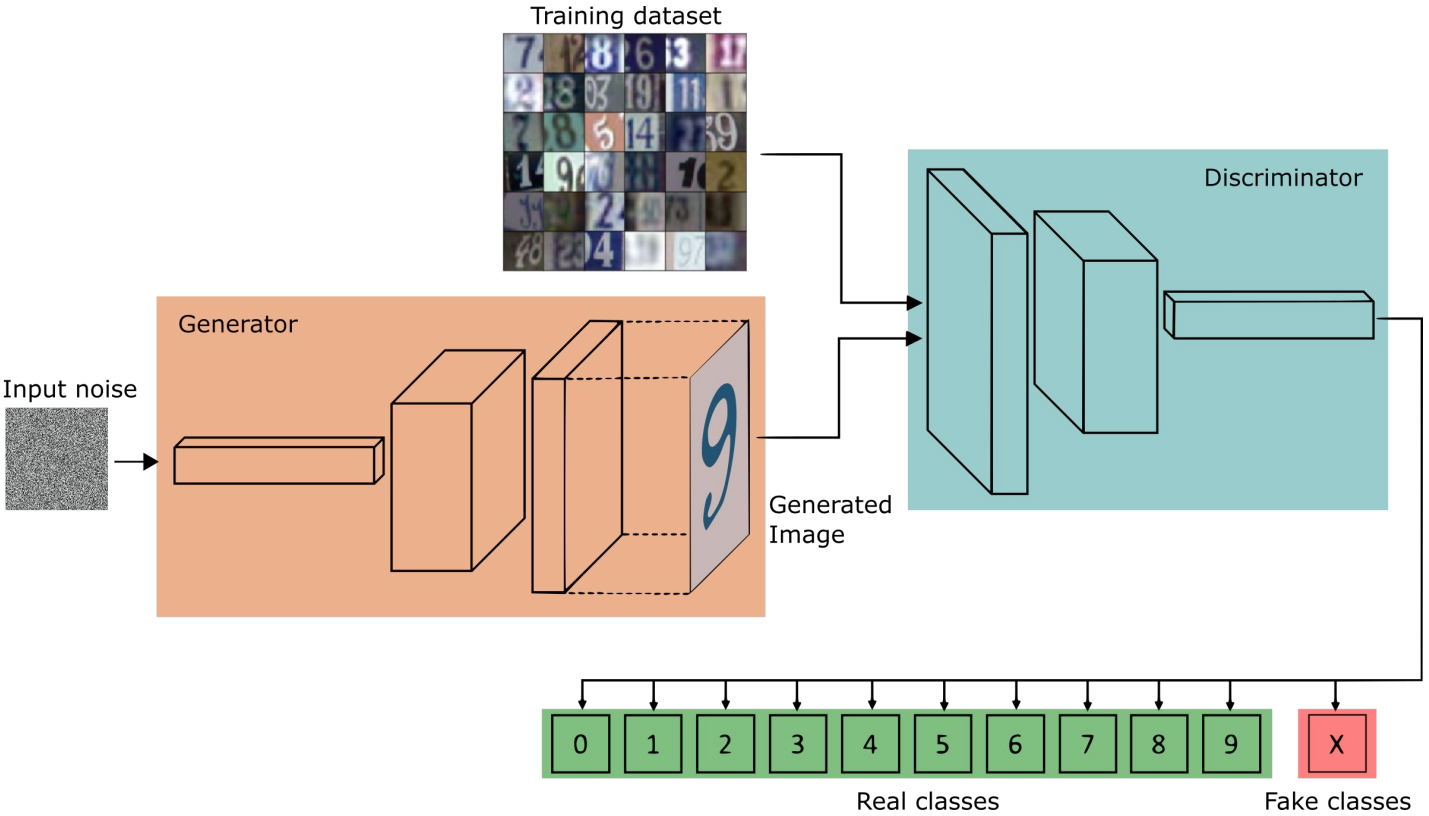
- GANs
  - State-of-the-art generative model, two-player game
- Deep Convolutional GAN (DCGAN)
  - Model architecture, state-of-the-art model
- Pseudo-Labeling
  - Other semi-supervised methods
- Shared Discriminator Architecture
  - Multi-tasking framework may not be beneficial
- Triple-GAN
  - Separation of tasks

GANs

$$\mathbb{E}_x[log(D(x))] + \mathbb{E}_z[log(1 - D(G(z)))]$$

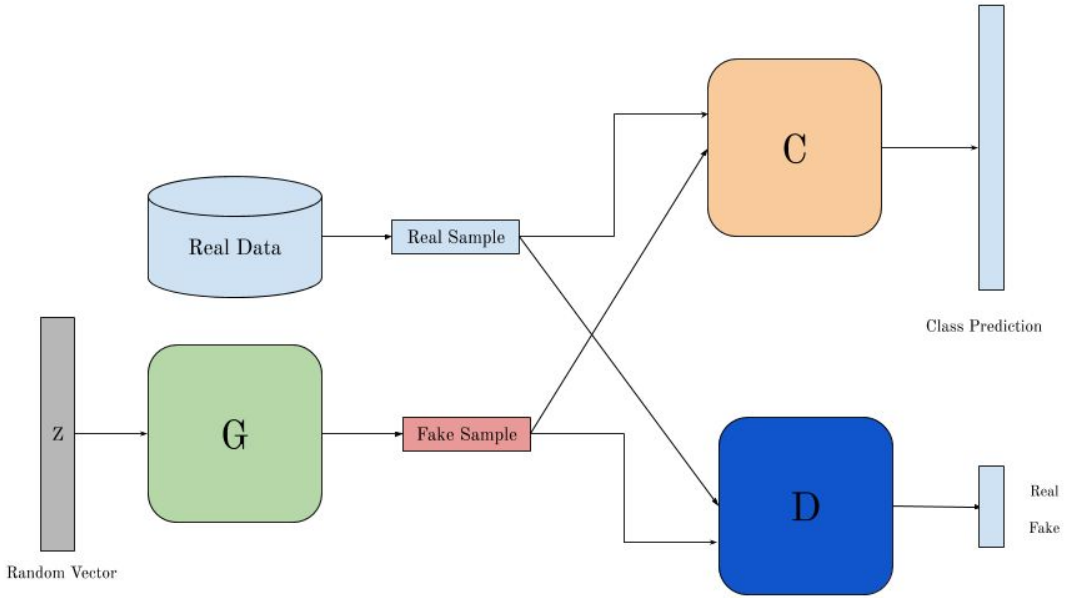


Shared Discriminator

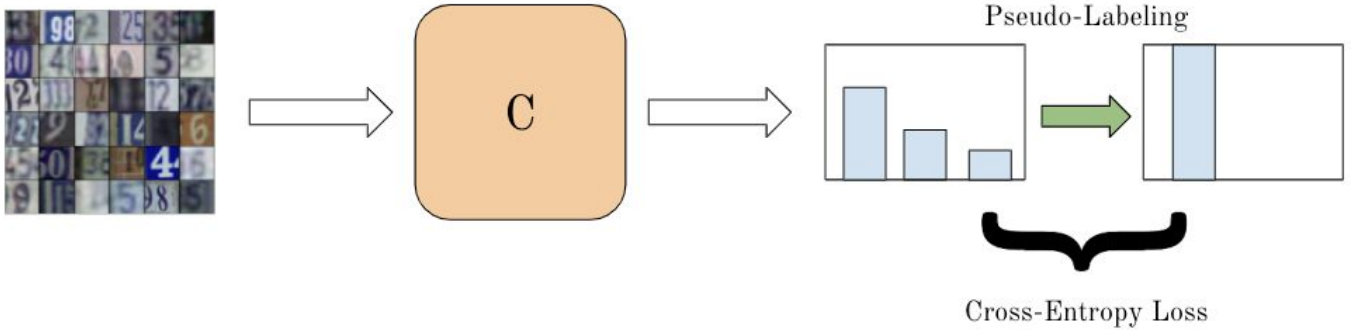


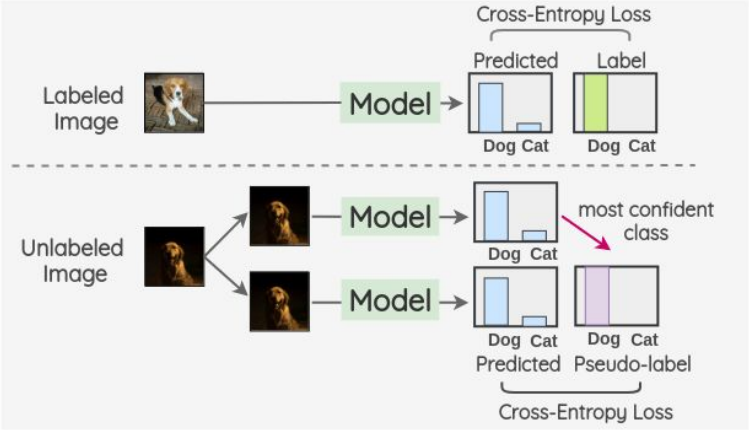
$$\lambda(BCE(D_d(D(G(z))),0) + BCE(D_d(D(x)),1)) + CE(D_c(D(x)),y)$$

EC-GAN: Method Overview



EC-GAN: Pseudo-Labeling





EC-GAN: Loss Functions

Generator

$$L_G(z) = BCE(D(G(z)), 1)$$

Discriminator

$$L_D(x, z) = BCE(D(x), 1) + BCE(D(G(z)), 0)$$

Classifier

$$L_C(x, y, z) = CE(C(x), y) + \lambda CE(C(G(z)), argmax(C(G(z))) > t)$$

Results: Shared Discriminator

Dataset Size (%)	EC-GAN (%)		Shared DCDiscriminator (%)		Shared ResNetDiscriminator (%)	
	Classifier	GAN	Classifier	GAN	Classifier	GAN
10	88.63	91.15	83.54	86.17	88.63	89.32
15	90.88	92.21	85.20	88.72	90.88	91.37
20	92.61	93.40	86.77	89.39	92.61	93.24
25	92.89	93.93	87.58	87.93	92.89	93.96
30	93.12	94.32	87.78	90.62	93.12	93.42

Dataset Size (%)	EC-GAN (%)	
	Classifier	GAN
25	94.37	96.48
50	95.24	97.83
75	95.64	97.40
100	96.42	97.99

GAN Performance

Real

Fake

Code Review

- Annotated Notebook, written with PyTorch
- https://github.com/ayaanzhaque/EC-GAN/blob/main/EC-GAN.ipynb