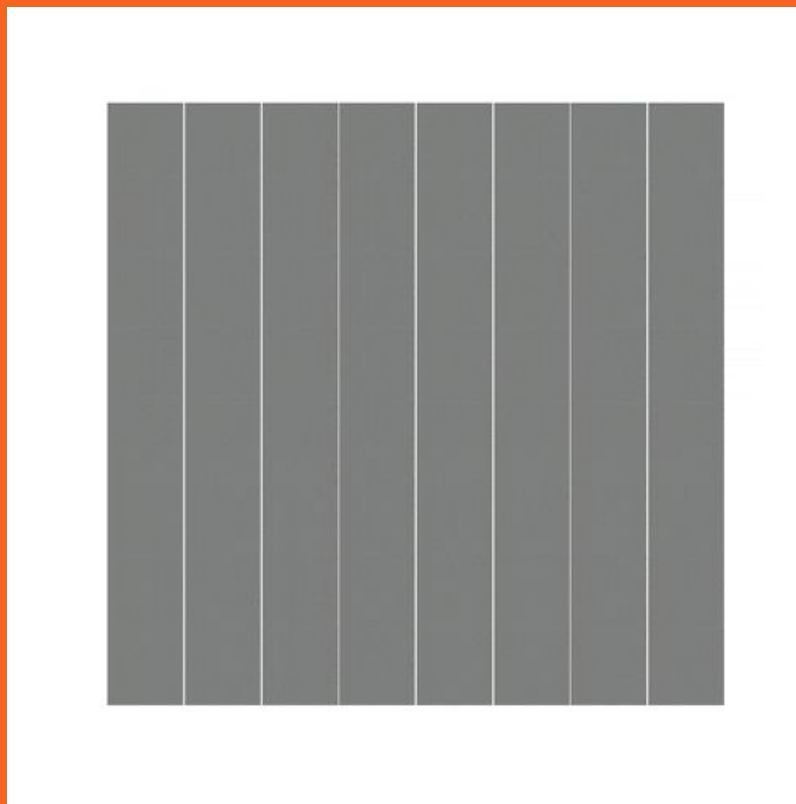# CANimals

Yarne Hermann and Jose Ronaldo Pinheiro Carneiro Filho

Goal: generate new categories of animals

Start from dog breeds

Dogs generated with DCGAN

Creativity

Novelty is the difference of the piece relative to similar pieces.

Surprisingness is the difference between what the viewer expects and what the viewer sees.

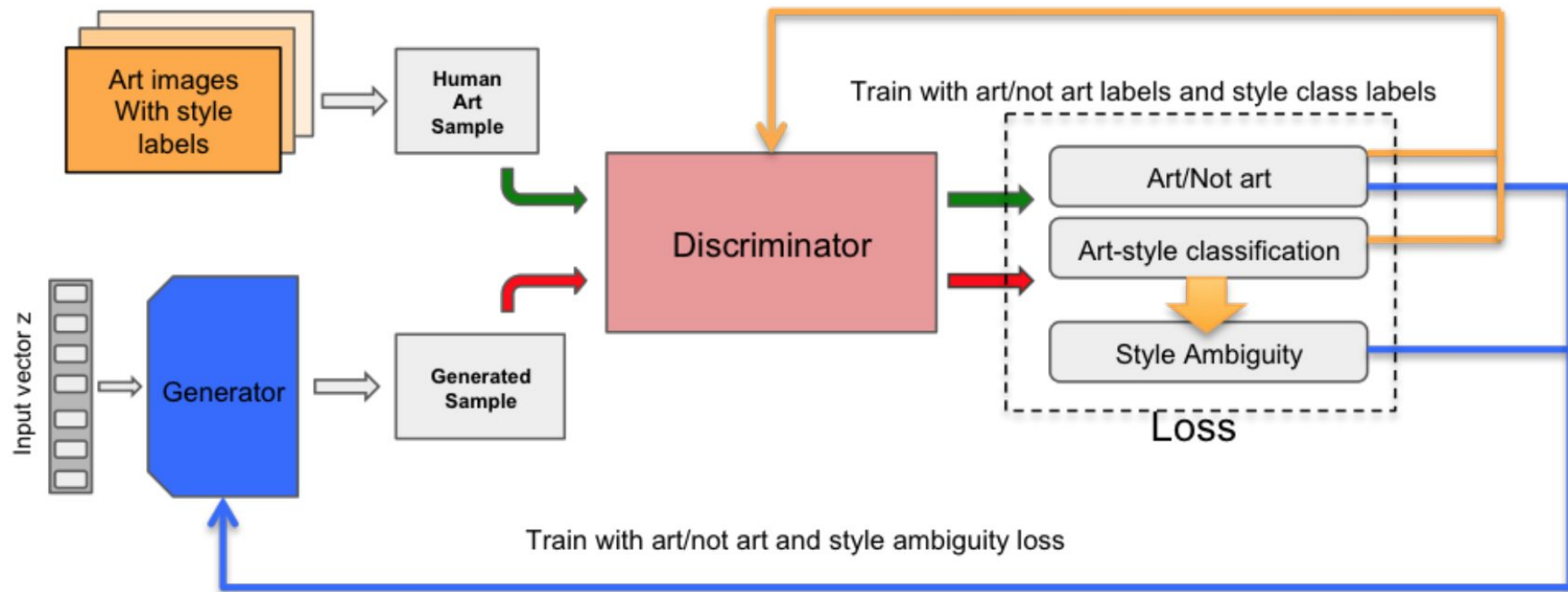**Complexity** refers to the amount of independent stimuli in a piece.

Ambiguitiy refers to the conflict between the semantic and syntactic information of the piece.

Puzzlingness refers to the conflict between disparate meanings in a piece.

CAN

How it works?

DCGAN with modified losses to induce creativity in generation of paintings by increasing Novelty and Surprisingness

Art images With style labels → Human Art Sample

Input vector z → Generator → Generated Sample

Discriminator

Train with art/not art labels and style class labels

Art/Not art

Art-style classification

Style Ambiguity

Loss

Train with art/not art and style ambiguity loss

Algorithm 1 CAN training algorithm with step size α, using mini-batch SGD for simplicity.

1: **Input:** mini-batch images x, matching label $\hat{c}$, number of training batch steps S
2: **for** $n = 1$ **to** S **do**
3:      $z \sim \mathcal{N}(0,1)^Z$ {Draw sample of random noise}
4:      $\hat{x} \leftarrow G(z)$ {Forward through generator}
5:      $s_D^r \leftarrow D_r(x)$ {real image, real/fake loss }
6:      $s_D^c \leftarrow D_c(\hat{c}|x)$ {real image, multi class loss}
7:      $s_G^f \leftarrow D_r(\hat{x})$ {fake image, real/fake loss}
8:      $s_G^c \leftarrow \sum_{k=1}^{K} \frac{1}{K} log(p(c_k|\hat{x}) + (1 - \frac{1}{K})(log(p(c_k|\hat{x}))$ {fake image Entropy loss}
9:      $\mathcal{L}_D \leftarrow \log(s_D^r) + \log(s_D^c) + \log(1 - s_G^f)$
10:     $D \leftarrow D - \alpha \partial \mathcal{L}_D / \partial D$ {Update discriminator}
11:     $\mathcal{L}_G \leftarrow \log(s_G^f) - s_G^c$
12:     $G \leftarrow G - \alpha \partial \mathcal{L}_G / \partial G$ {Update generator}
13: **end for**

Dataset

Stanford Dogs

20,579 images (removed 1 image)
120 different dog breeds (classes)

Rescaled images to 128, 128

Cleaned but not augmented

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Approach

1. Implemented CAN paper and tested on Stanford Dogs:
   - Errors, particularly with the loss
   - Ran but loss got stuck, images bad

2. Ran our CAN as DCGAN for 1 dog breed:
   - Found & fixed errors
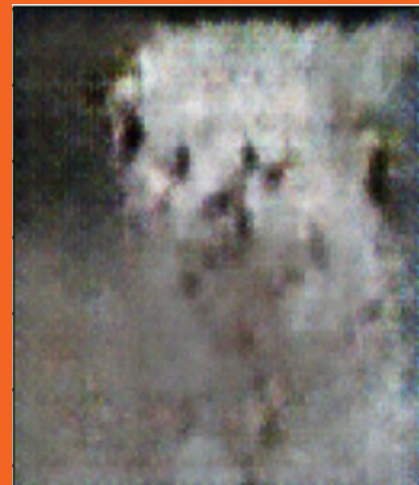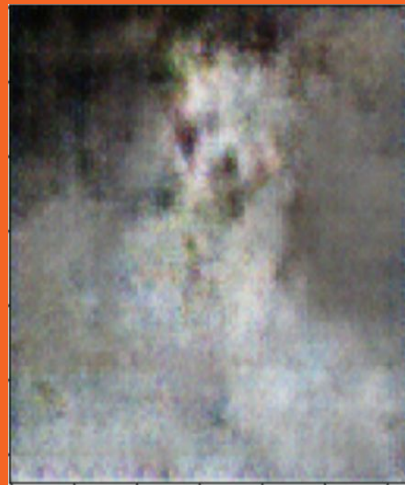
3. Ran CAN for 10 dog breeds

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CAN as DCGAN

Maltese Dog

252 images

After 255 epochs:

Discriminator loss: 0.117
Generator loss: 4.277

CANines

10 Dogs

1760 images

Gets stuck at epoch 401
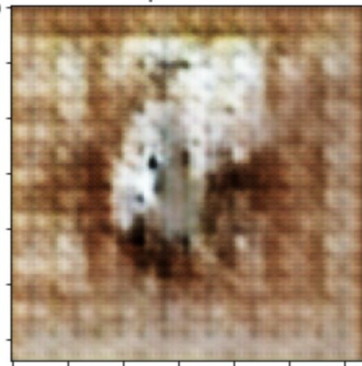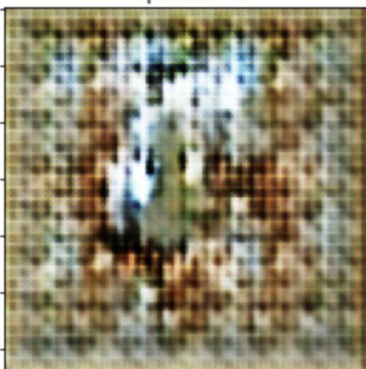
Discriminator loss: 0.0001
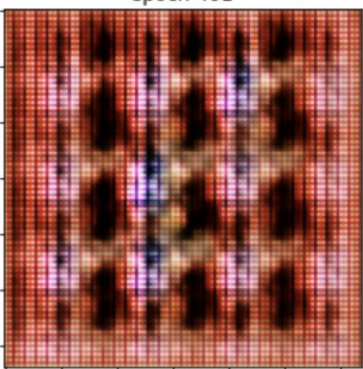Generator loss: 21.97
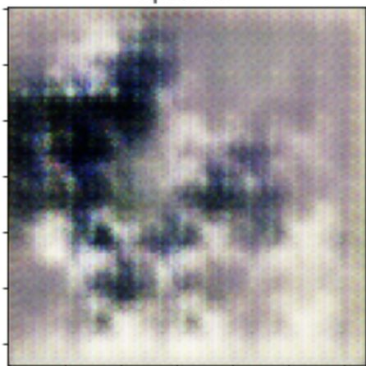
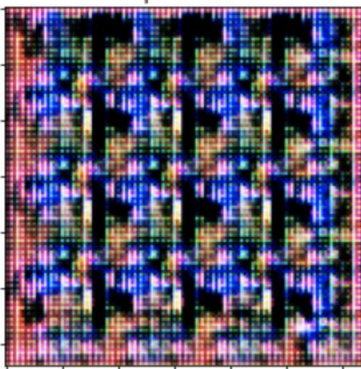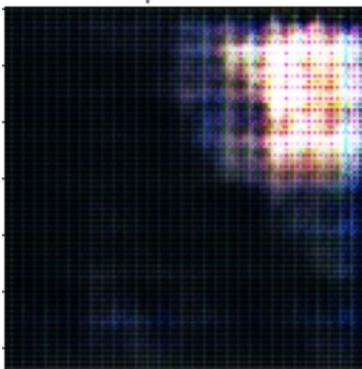epoch 30 | epoch 50 | epoch 100 | epoch 200 | epoch 300
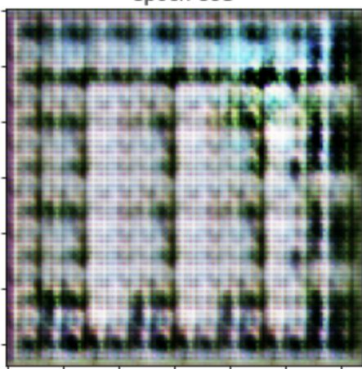epoch 400 | epoch 401 | epoch 800 | epoch 853 | epoch 893
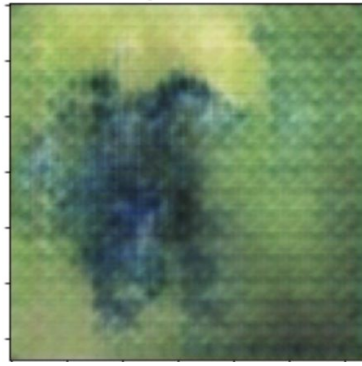
Future Work

Improve CANines 10: First train in DCGAN mode and then continue as CAN

Extend to full Stanford Dogs dataset

Extend to tree of life (our initial goal)

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