A "Smart" Way to Design Future Smartphones

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Act1: Prologue

Introduction & Motivation

Introduction

- The mobile phone industry is one of the most **innovative** and **rapidly developing** field.
- The design of mobile phones are frequently renewed by manufacturers to improve competitiveness and **make profits**!

Q: How will the smartphone look like in the future?

Let's design it using deep learning techniques!

Motivation

Ok! Let's try it on phones! 😀

Inspiration: **The chair project** by Philipp Schmiit

What he did:

❖ 600 training images

DCGAN → Hundreds of creative designs

P. Schmitt, "The chair project," *https://philippschmitt.com/work/chair*, 2019.

Act2

The First Trial

Collect Images

DroidChart.com
FIND AND COMPARE ANDROID POWERED PHONES

Request.py
Download raw images

Use superresolution pretrained model to improve quality of raw images.

Superresolution using an efficient sub-pixel convolutional neural network
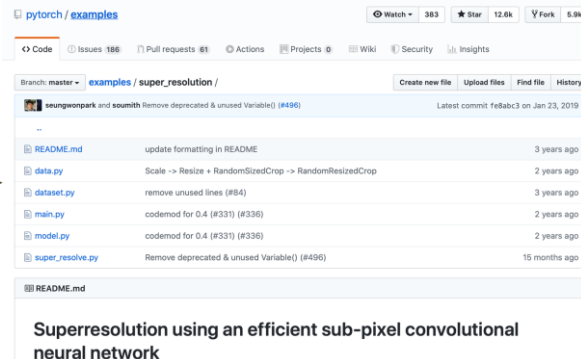
DCGAN

★ Deep Convolutional Generative Adversarial Networks = DCGAN
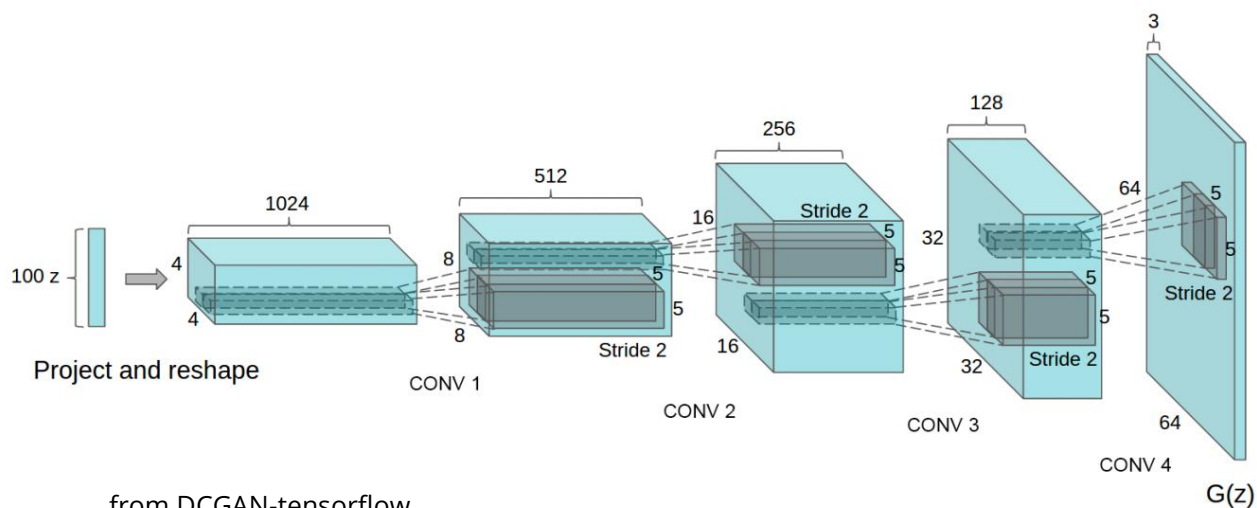
from DCGAN-tensorflow
(https://github.com/carpedm20/DCGAN-tensorflow)

➔ GAN can **capture the training data's distribution** and generate new data from this distribution.

➔ DCGAN uses **convolutional** and **convolutional-transpose layers** in the discriminator and generator.

The first result

- 6000 phone images
- DCGAN

OOPs
The result is not good!

We can't recognize the positions of microphone, the front camera or the buttons.
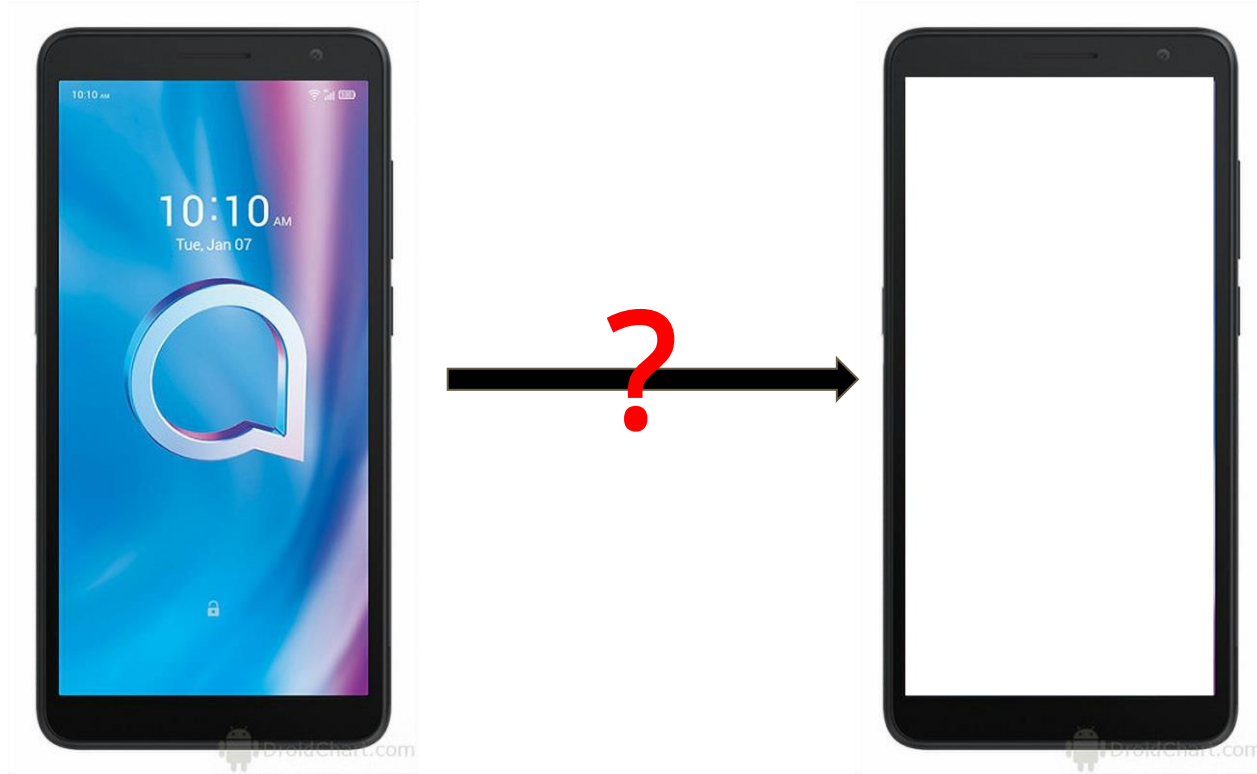
ONLY a colorful wallpaper.

Act3

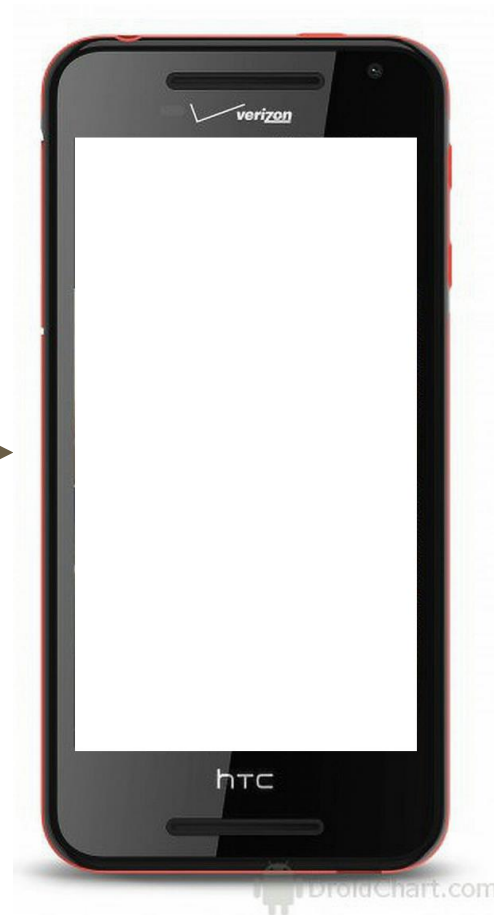The Second Trial: Remove Screens

Get Rid of the Phone Screen

Get Rid of the Phone Screen
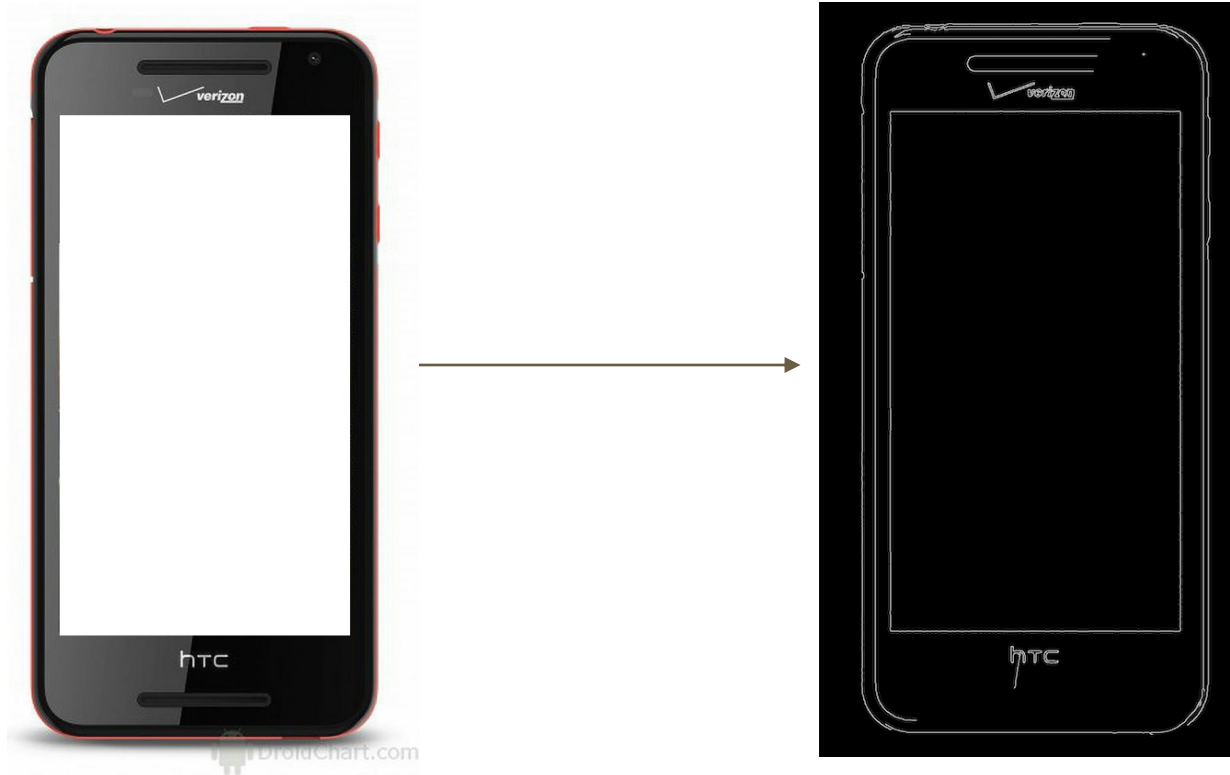
~~OpenCV/Canny Edge Detection~~

~~Scikit-image/Li thresholding~~
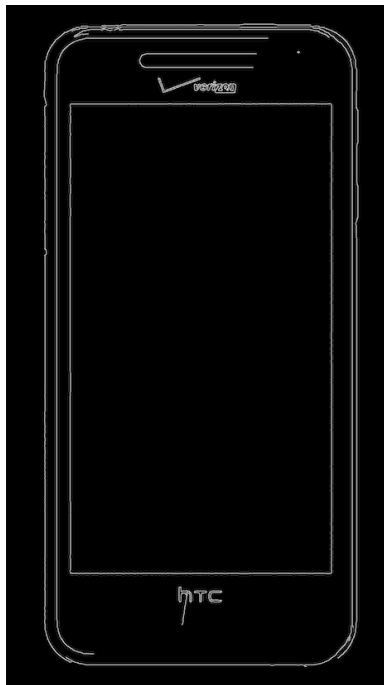
~~Scikit-image/Canny Edge Detector~~

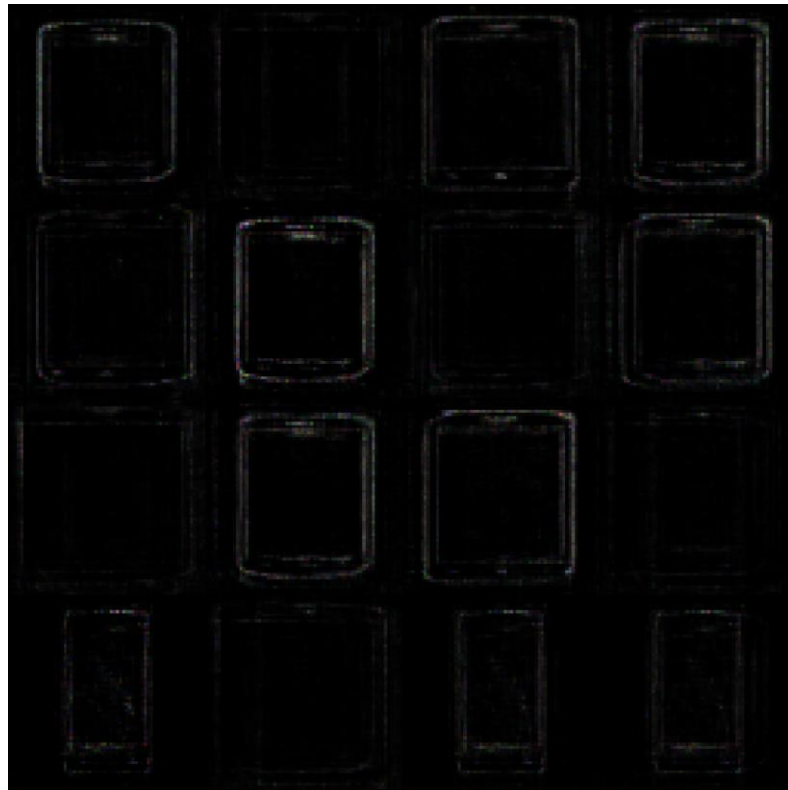Manually Cover the Screens with White

Edge Detection

DCGAN W/O phone screen & after edge detection

Real

Fake

Act4

The Third Trial: Transfer Learning
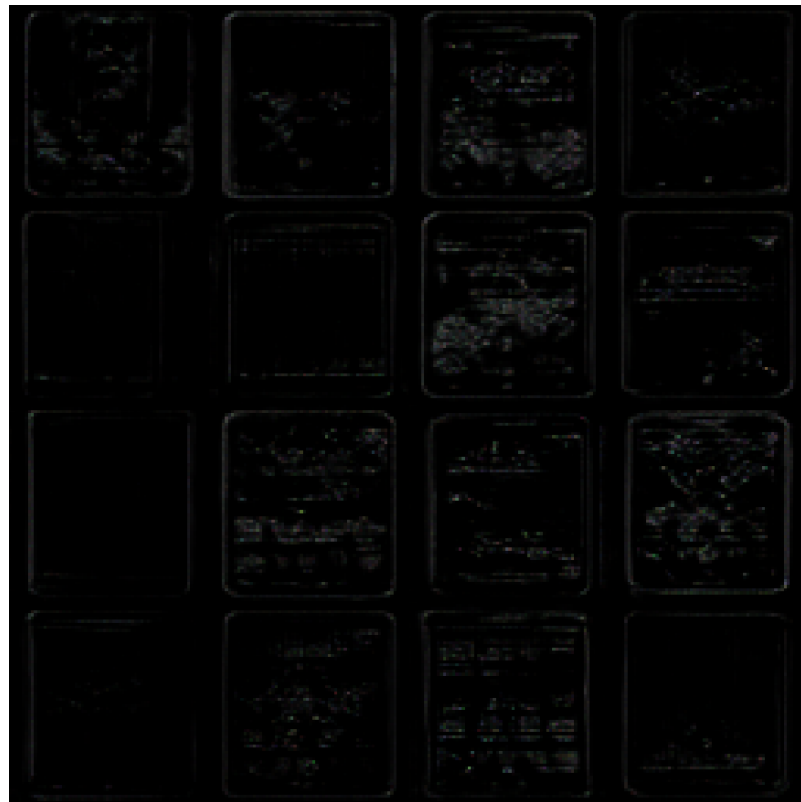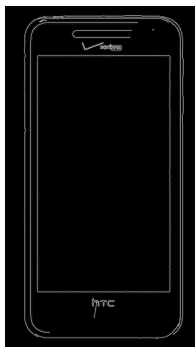
Transfer Learning with Original Dataset

Pretrained with 6000+:

Freeze the weights

Train last layer with 800+:

Transfer Learning with FashionGen Dataset
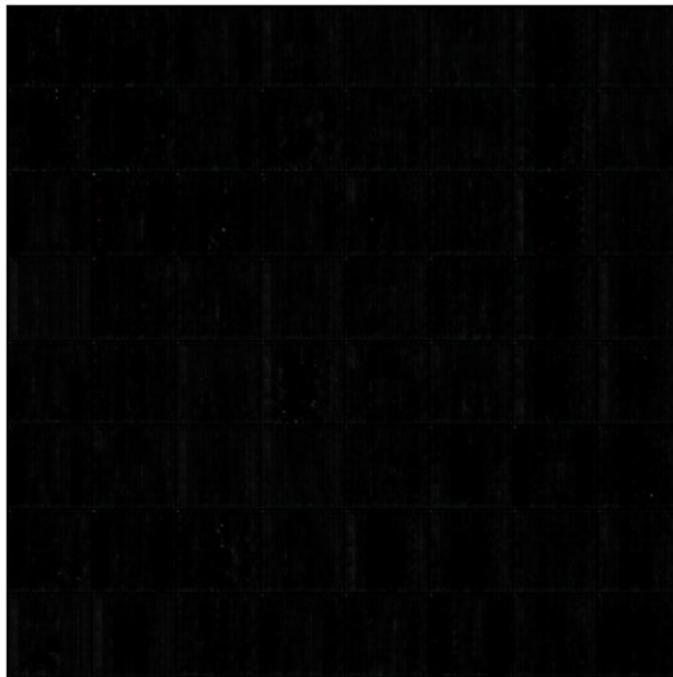
Compare
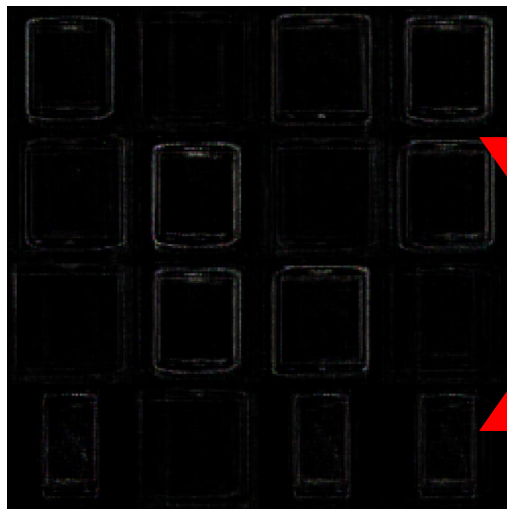
Before Transfer Learning

Use weights trained using the original dataset

Use weights trained using the FashionGen dataset

Act5

The Fourth Trial: Colorized Phones

Manually Colorize

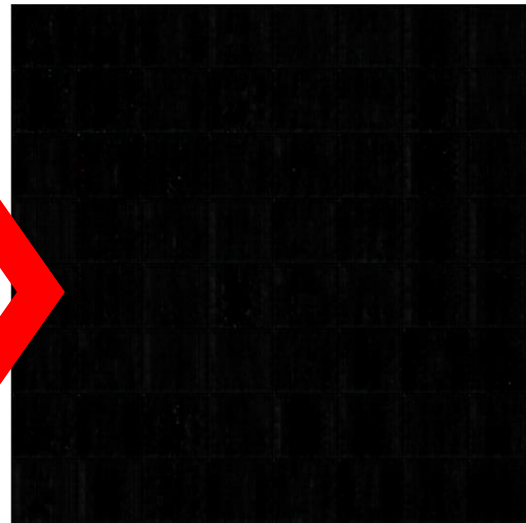- WE DIDN'T GIVE UP YET...
- We select about 250 black phones from different years.
- And try manually **colorize** the phones with different colors.
  - Screen: green
  - Cameras: blue
  - Buttons on screen: white
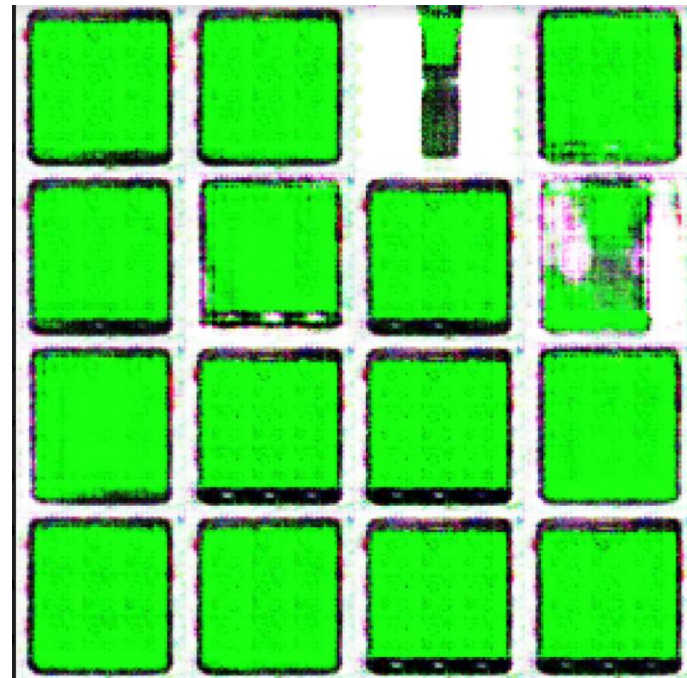 - Buttons on edge: red
  - Middle speaker: yellow

Inspired by: House-GAN: Relational Generative Adversarial Networks for Graph-constrained House Layout Generation

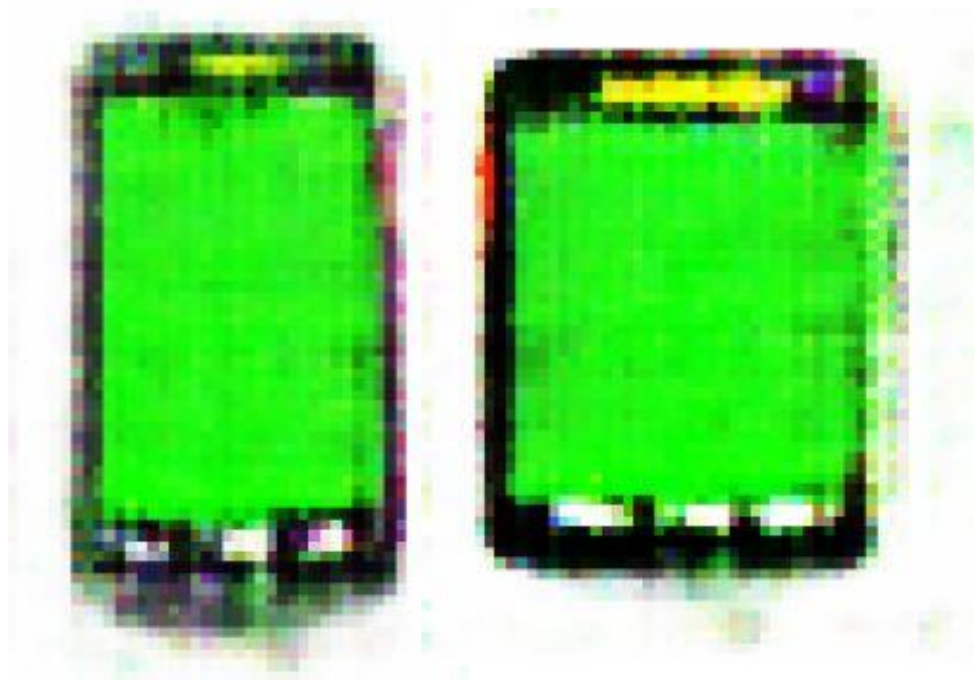# DCGAN with colorized phones

Training set: 2007-2015

Training set: 2016-2020

INVESTIGATE generated images...

- VAGUE images...
- Form a lot of square phones?!
- Capture some colored info
  - Yellow speaker
  - White buttons on screen
  - Red buttons on edge
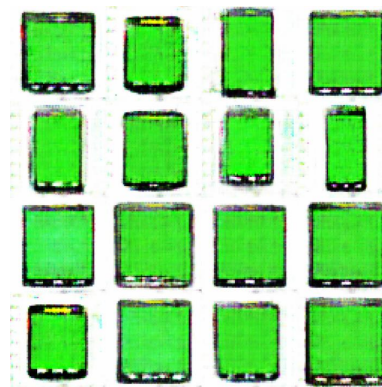- But does not generate creative phone designs...

Act6

Conclusion

It's a TRAGEDY :(

- DCGAN does not generate new phone designs under different training sets.
  - Original phones
  - Phones without phone screen (white out the screen)
  - Transfer Learning
    - With Original Dataset
    - With FashionGEN Dataset
  - Colorized phones
- But why...

But why?

- Chairs have very different designs, but phones don't.
- DCGAN is better at generating images with different textures, but phones focus more on shapes.
- Phones have **BIG** screen, that deviates DCGAN from generating new designs.
- The transfer learning in DCGAN is better at generating human faces instead of phones…

Future Directions

- Use different GANs
- Larger training sets
- Find other datasets (computer, TV…) to generate new kinds of things
  - Generate mixing phones and other weird digital products…
  - Not limited to phones

Thank you!