

Neural Reconstruction

Applying A.I. to Art Restoration

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December 13, 2016

Can Artificial Intelligence rival humans in Semantic Image Reconstruction?



Original Image



Damaged Image



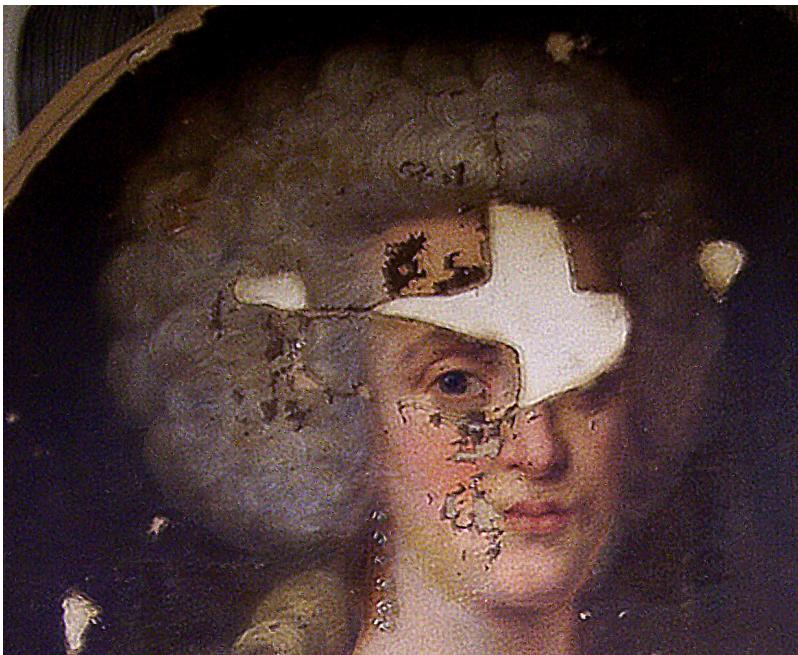
Restored Image



- + Goal: Restore unseen damaged images/photographs with a content-aware neural net



Art Restoration with Deep Learning



- + How would you fill in the missing information?
- + Can one train a computer to have the necessary cognition to fill in the missing **structural, textual and content** information?



Weighing Various Architectures

	Non-Parametric Image Matching	Variational Sampling	Convolutional Neural Net	Adversarial Networks
Contextual Awareness	✓	✓	✓	✓
Perceptual Awareness	✗	✓	✓	✓
High Resolution	✓	✗	✗	✓
Large Missing Patches	✗	✗	✓	✓
Easy to Train	✓	✓	✗	✗



Data Mining and Image Augmentation

1

Scrape and augment
zook artsy.net images



2

Retrieve and
pre-process images



3

Train autoencoder as
image generator &
extract latent features



4

Simultaneously train
an “adversarial” neural
net to discriminate
real vs. “fake” images

5

Image Restoration
Application

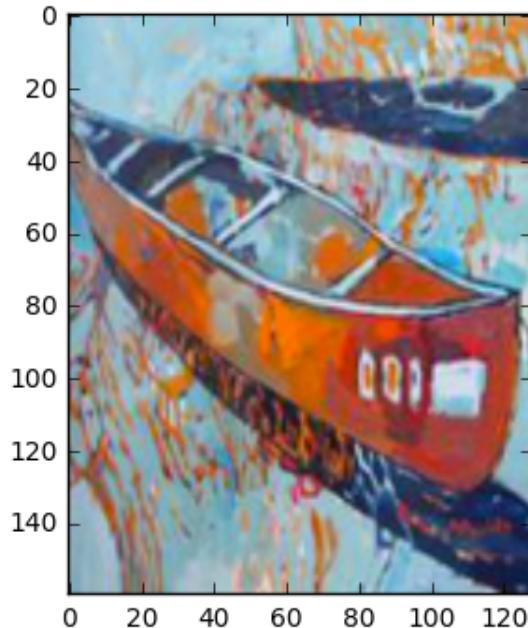




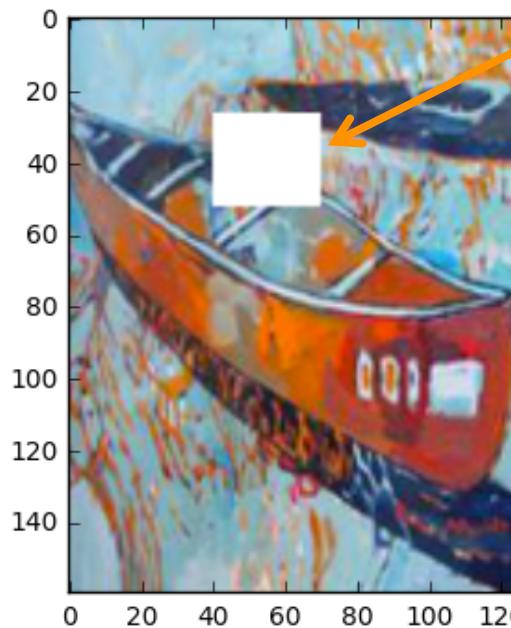
Retrieval and Pre-Processing Pipeline

- + Images are resized and normalized for zero mean/unit variance
- + 1,000 images are set aside each for validation and test set

Target Image



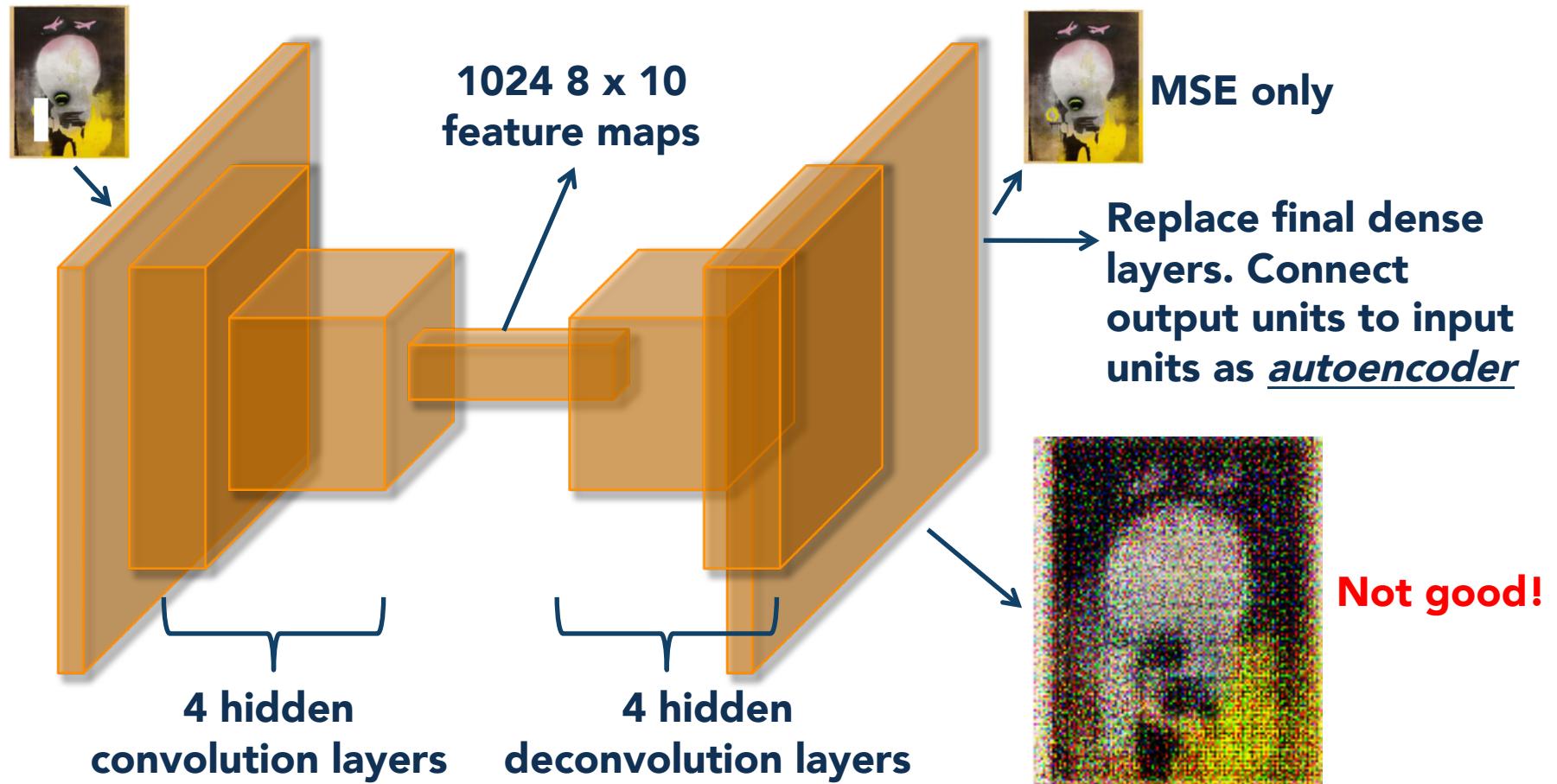
Training Image



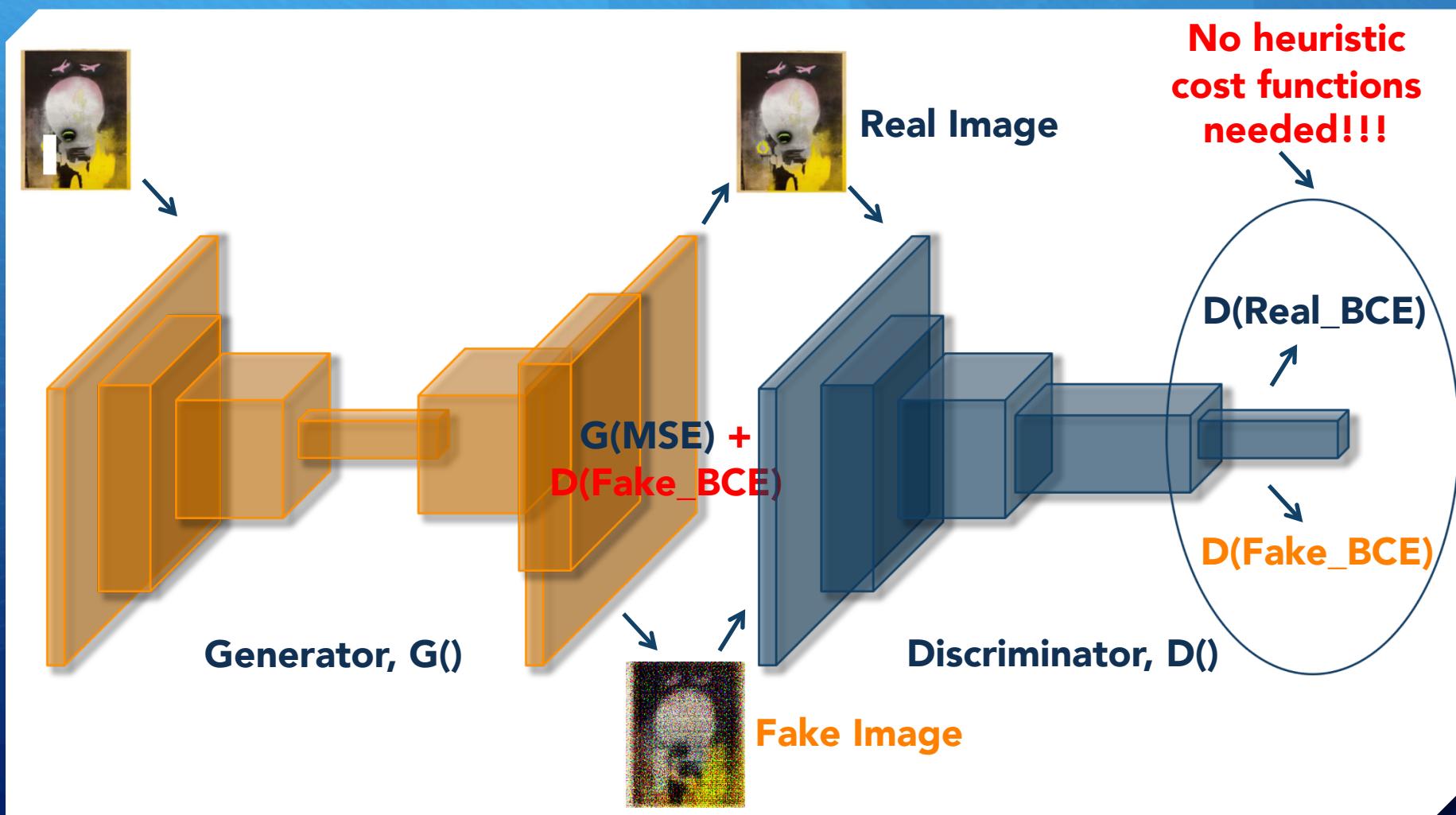
Arbitrarily sized
mask is placed
randomly to
“corrupt” the
training image



Image Generator Architecture



Deep Convolutional Generative Adversarial Networks (DCGANs)





Key Model Insights

- + **Generative Adversarial Networks**, since its introduction by Ian Goodfellow in 2014, is known to be very tricky to train
- + A number of stabilizing measures were introduced, based on the groundbreaking paper "Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks" by Alec Radford, Luke Metz and Soumith Chintala
- + The main benefit for using adversarial networks is the model's ability to **learn its own cost function** in an unsupervised fashion

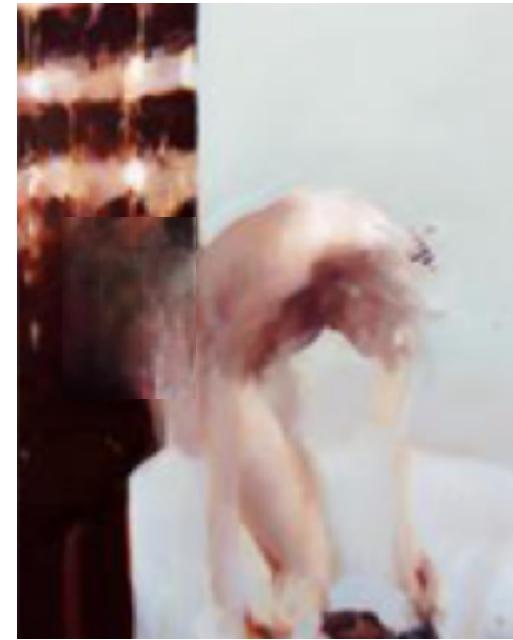


Sample Outputs from Test Set

Damaged Image



Restored Image





Sample Outputs from Test Set

Damaged Image



Restored Image



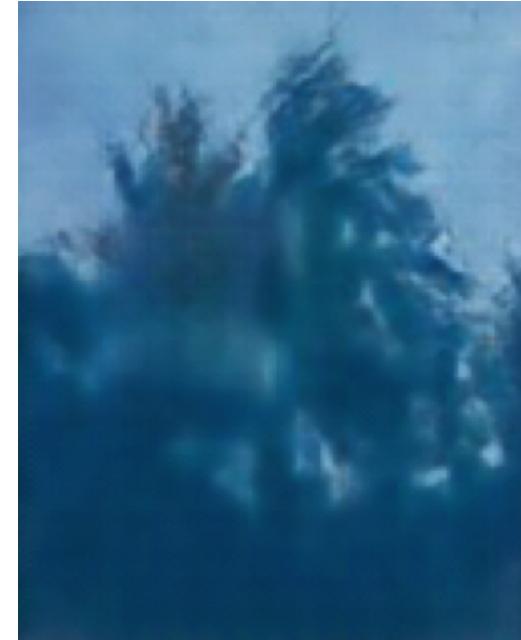


Sample Outputs from Test Set

Damaged Image



Restored Image





Sample Outputs from Test Set

Damaged Image



Restored Image



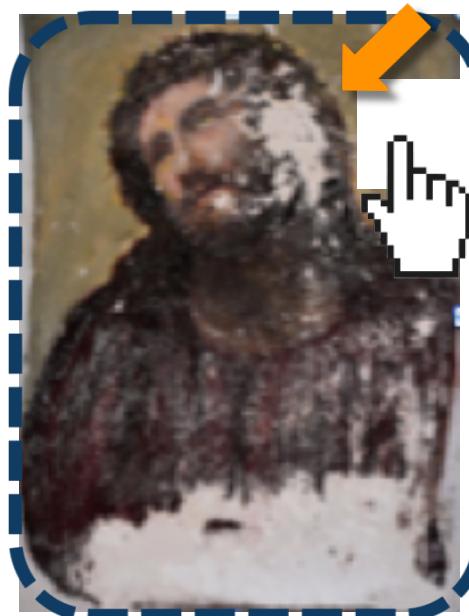


ArtWorld – Image Restoration App

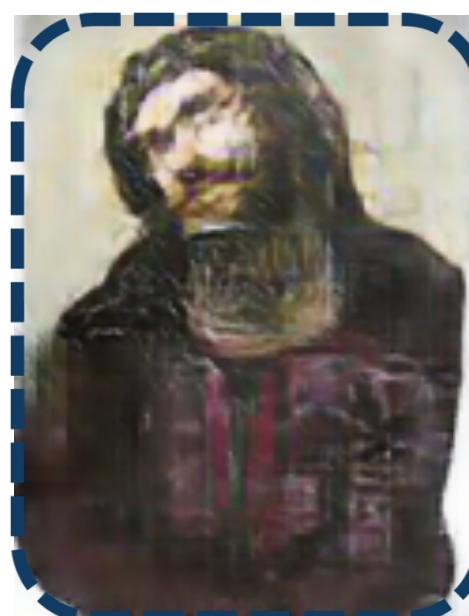


Step 1

Drag & Drop a File



Step 2



Step 3

Drag or Upload
flawed image
to website

Place user
defined mask on
damaged area

Hit repair button.
Receive repaired
image instantly



Which one would you prefer?

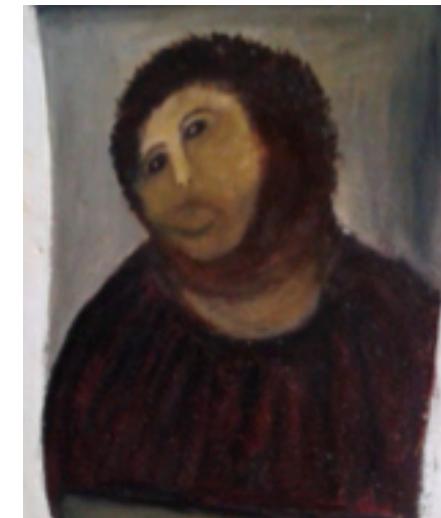
Damaged Image



A.I.
Restored Image



Human
Restored Image



OR

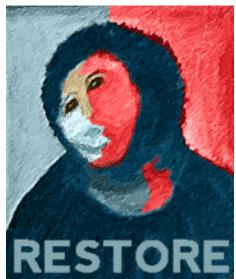
Other Commercial Applications of the DCGANs Architecture



- + Learn high-order functions like reasoning, planning and prediction
- + Dimension reduction/ Latent Feature Extraction
(more powerful than PCA)
- + Generate super resolution or up-sampled images
- + Forward video prediction



Contact Information



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