



# “Watch” a Machine Learn

Casey Backes

/github.com/caseybackes  
 in /in/caseybackes  
 casey.backes@gmail.com

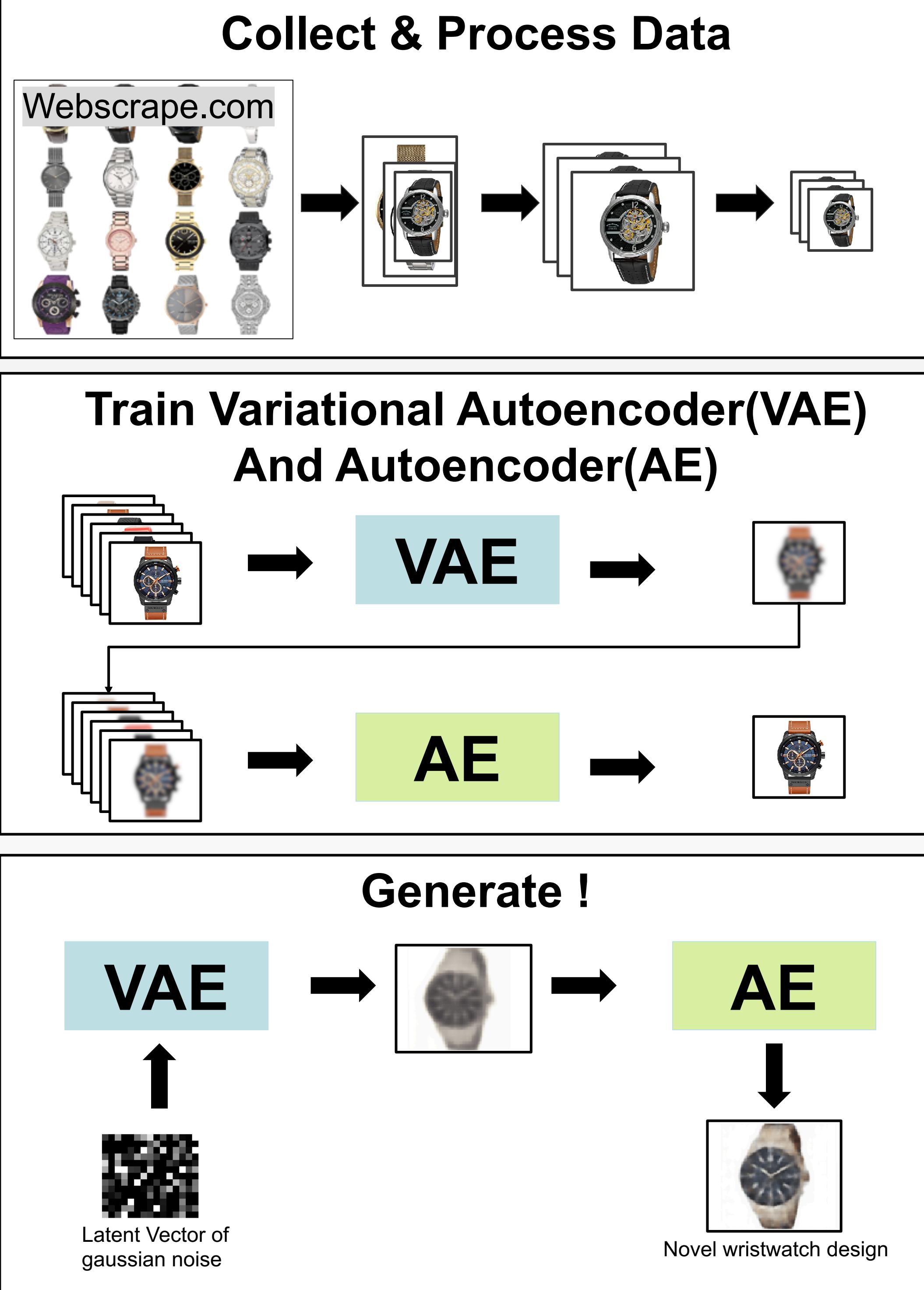
## Background

- Generative deep learning models have the power to produce novel content in a way that mirrors that of humans.
- While human creativity will not be replaced with generative modeling any time soon, these models can aid in many kinds of creative content production.

## Objective

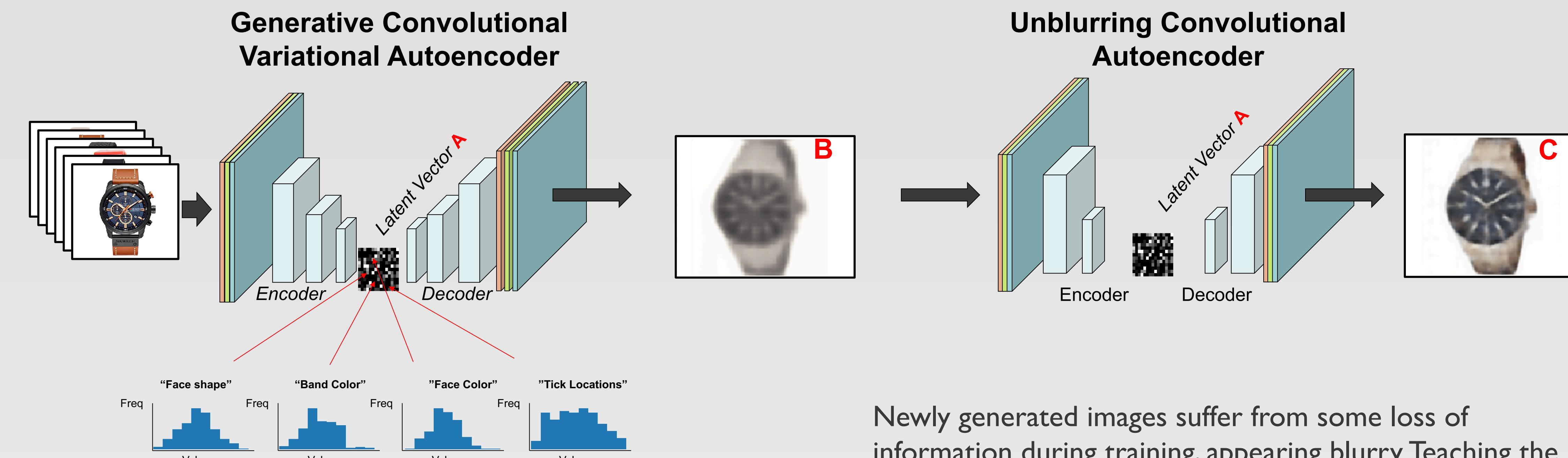
The purpose of this project is to use a generative model to produce new and unique wristwatch designs.

## Pipeline



Gauss Plot: <https://stackoverflow.com/questions/13658799/plot-a-grid-of-gaussians-with-matplotlib>  
 Variational Autoencoder Architecture: Generative Deep Learning(2019). O'Reilly Publishing.

## Model Architectures



Over 400 epochs of training, the VAE encoder learns general image features as a 200-dimension latent vector. The KL loss metric forces these latent features into a normal distribution. The decoder then learns how to remap those features back to the original pixel space.

Newly generated images suffer from some loss of information during training, appearing blurry. Teaching the AE model to encode a blurred version of original training images and decode it to the clean versions allows us to restore much of the lost detail and color. This simpler task does not require as deep a network as the generative VAE model, and we do not interact with the latent vector.

## Results

### Noise > Generate > Deblur



### Generative Design Portfolio



Using the VAE decoder to predict on input of random noise **A** generates image **B**, which passes to AE decoder generating output **C**.

Balancing the two metrics, KL loss and reconstruction loss, is critical to achieving output variability and recognizable broad structure of the object class. Here we have great variability but some of the reconstruction has suffered.

## Discussion

### Generative (VAE) Model

#### Model Limitation

- Finer detail capture and larger image size requires a deeper network which is computationally expensive.

#### Model Performance

- Lower KL loss yields higher reconstruction loss, which means a trade-off between generative variability vs reconstructed detail of each new image.

### Deblur (AE) Model

#### Model Limitation

- The correct distortion must be applied to the training images to get desired results (gaussian blur of 3px).

#### Model Performance

- An unblur model trained for 50 epochs outperforms the same model trained for 300 epochs, meaning it is easy to overfit to the training data.

Notice the QR code? Point your smartphone camera at it and you can “watch a machine learn” to take latent vector and generate an image!

## Tech Stack

