
Colourization of Grayscale Images

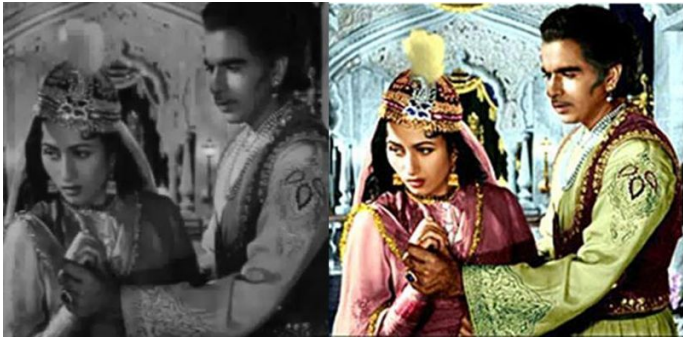
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Background & Context

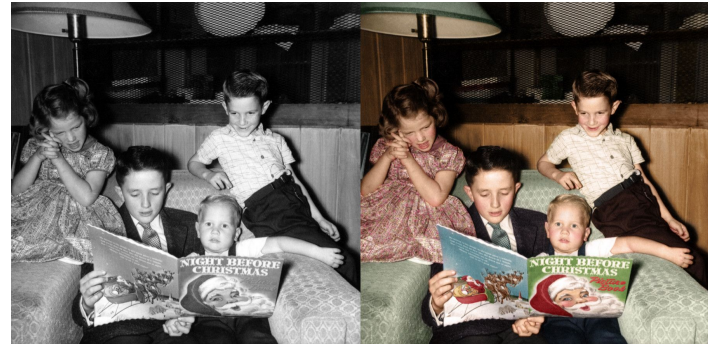
Photographs connect us to the past, tell stories, and share rare sightings

The importance of colour: information, contrast, detail

Traditional colourization done on Photoshop taking up to a month



Google Image Result for <https://i.stack.imgur.com/NXbZk.jpg>. [Online].
Available: <https://images.app.goo.gl/Ueuswt3QNuE6G6128>.



Google Image Result for <https://i.imgur.com/YGyku5.jpg>. [Online].
Available: <https://images.app.goo.gl/H3feYoMFe2LFHrXd8>.

Our Goal

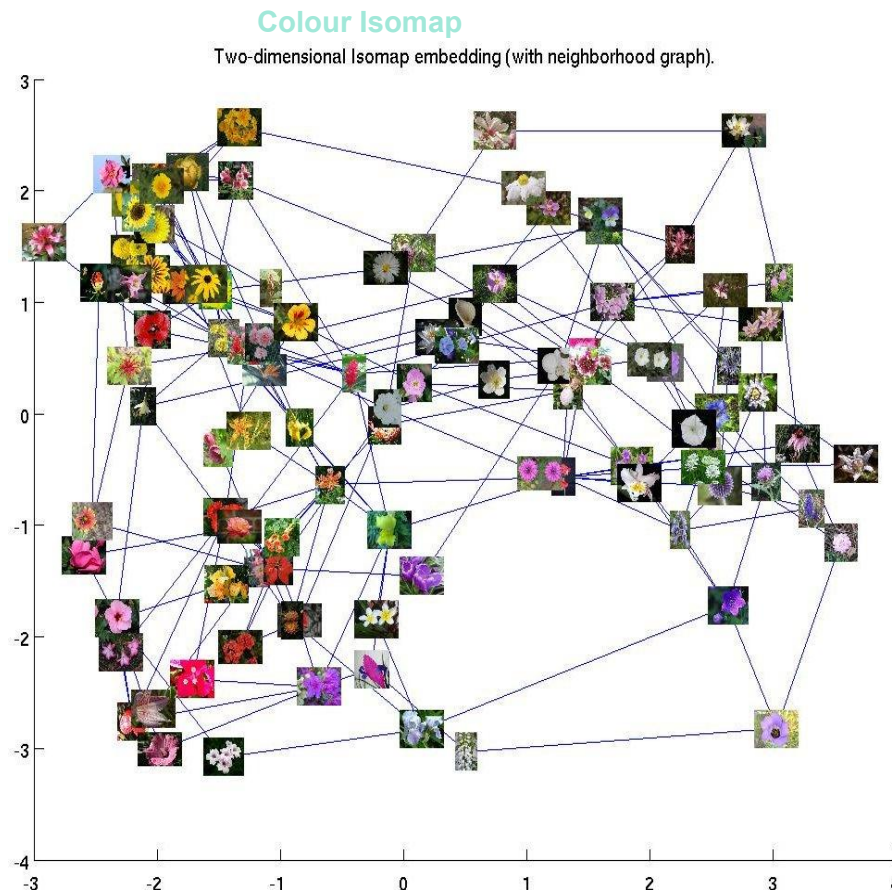
Realistically colourize gray-scale images

Note: Doesn't have to be an exact match of the what the real life colours are - it just has to look plausible

Model approach: Develop a Generative Adversarial Network (GAN) to generate new coloured images

Data

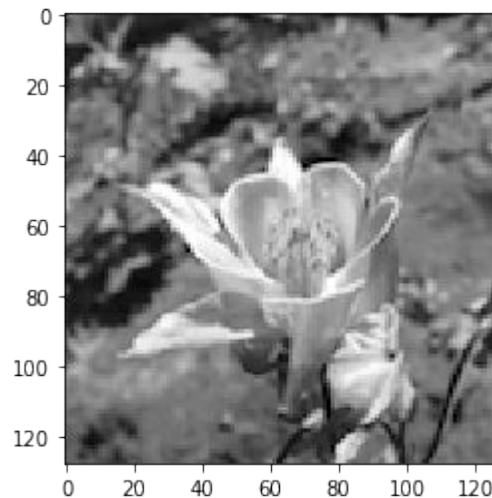
- Flower Dataset University of Oxford
- 8189 images from 102 different flowers
- Test set contains 210 flowers
- Initially tried random images but then settled upon a Category
- Generalizes well to different colors
- Does not generalize to different types of images



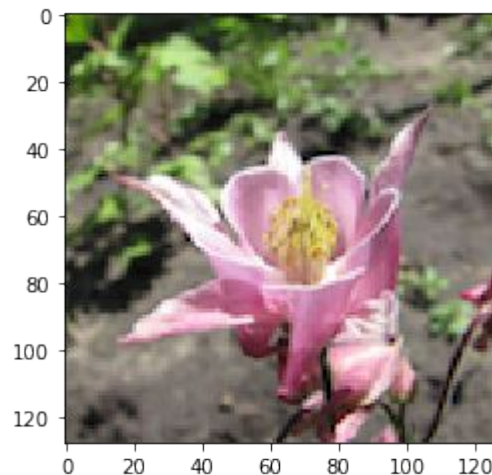
M.-E. Nilsback and A. Zisserman, "Flower Datasets," *Visual Geometry Group - University of Oxford*.

Data Processing

- Resize images to 128x128
- Convert to grayscale
 - Linux commands
- Imagefolder
- Shuffle Data
- Convert to dataloader

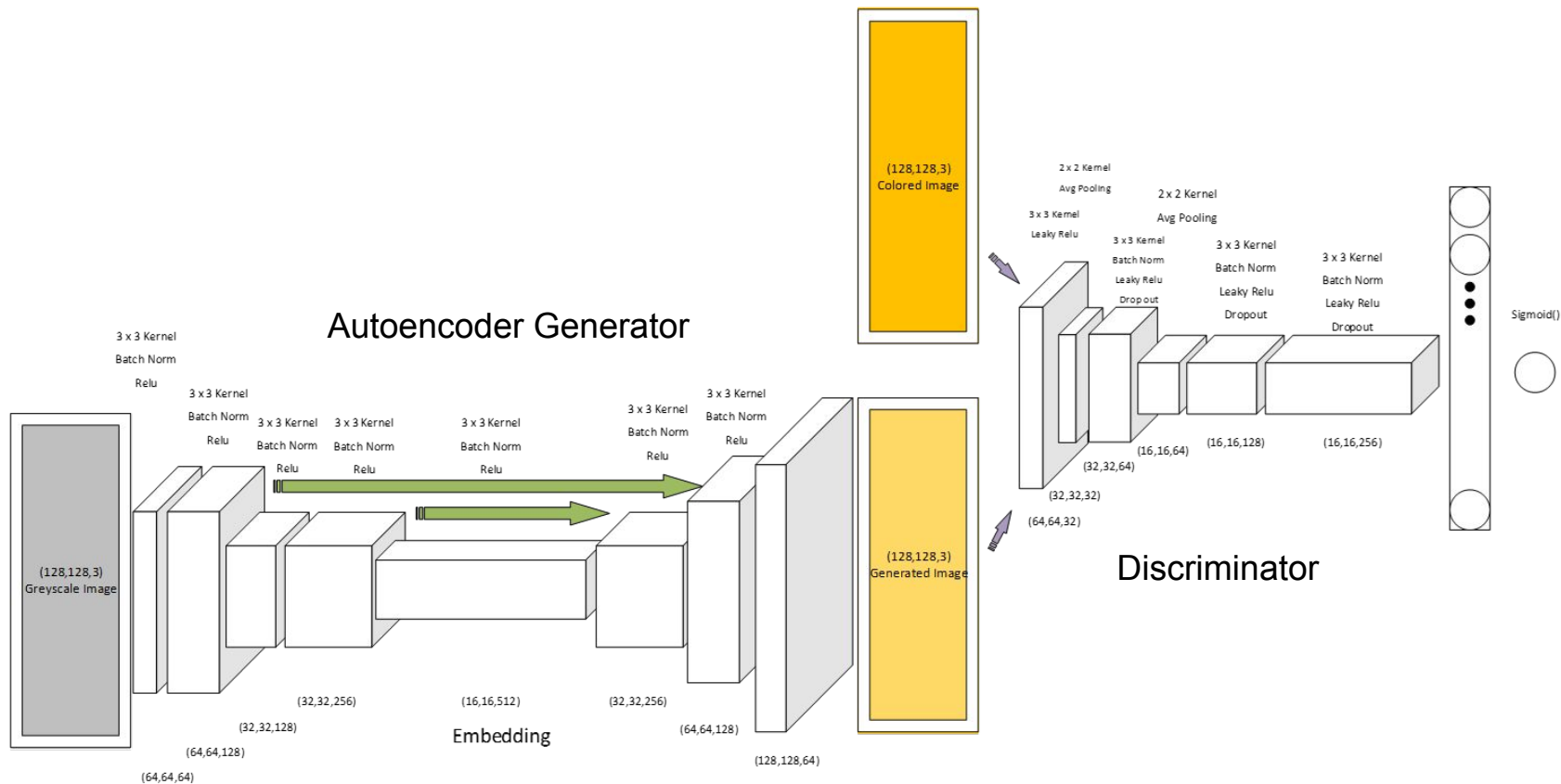


Input



Label

Current: Generative Adversarial Model



3-Pronged Approach to Hyperparameters

1. Model Architecture

- a. Increased layers
- b. Non-linearity (Sigmoid vs TanH vs LeakyReLU vs ReLU)
- c. Skip-connections

2. Regularization of Discriminator

- a. Conditional training
- b. Feed noise for GAN stabilization
- c. Drop-out layers
- d. Varying learning rate

3. Loss function

- a. BCELoss + L1 loss

Training and Testing Results



Training
Samples

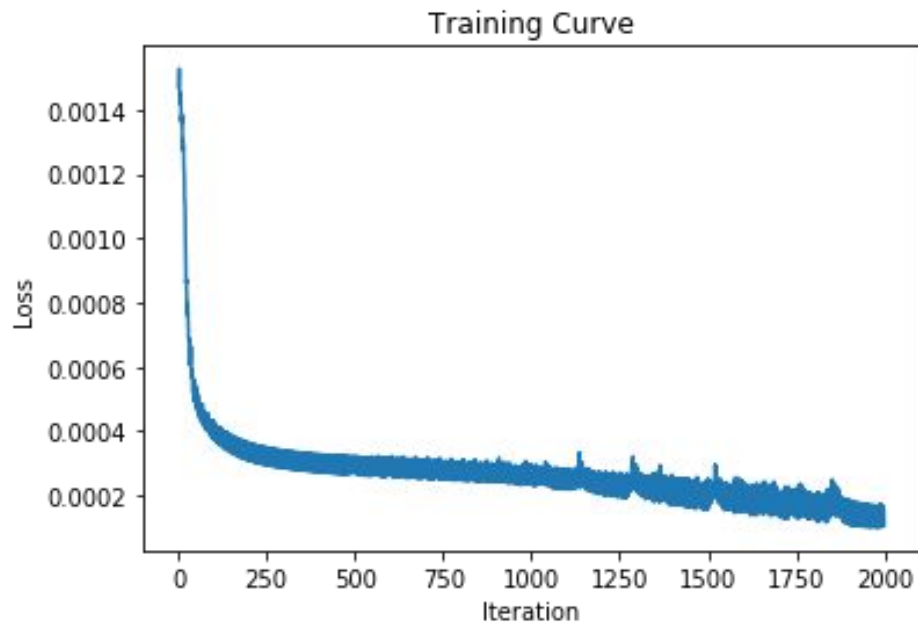


Test Samples

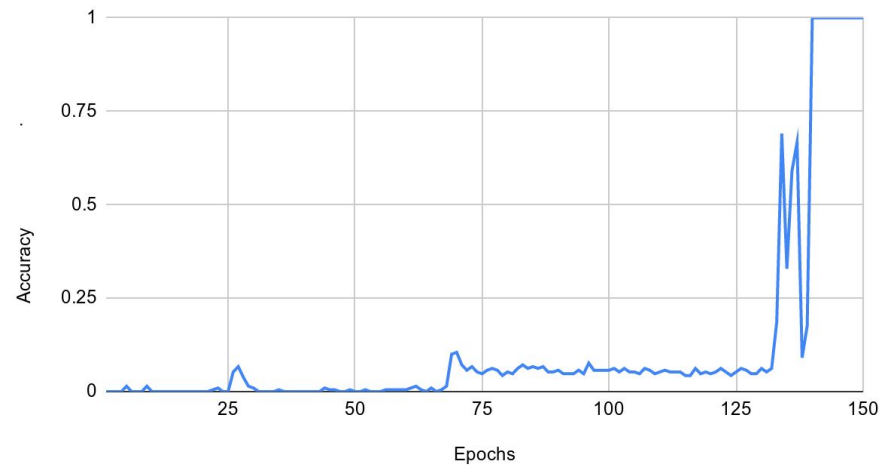


Demonstration

Quantitative Results



Accuracy of predicting generated images



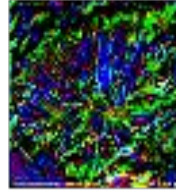
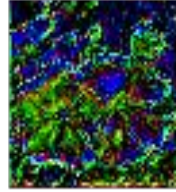
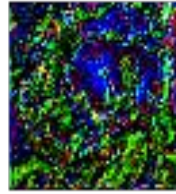
Model Iterations and GANs

Autoencoder with skip connections (concat)

- Blurry
- Inaccurate colours
- Square colour blocks in images

UNet

- Much deeper CNN autoencoder
- Perfect edge detection but poor colourization



Results of Iterations



5-layer Autoencoder



9-layer Autoencoder
w/ skip connection



7-layer Autoencoder



9-layer GAN
w/ skip connection
autoencoder
generator



7-layer Autoencoder
w/ Leaky_ReLU

Discussion on Improvements

- Stacking models with UNet Embedding Detections
- More tuning parameters w GAN:
 - HighwayNet or DenseNet (different types of skip-connections)
 - Adding noise to RGB and grayscale

Thank you for listening!