

Deep learning for Computer Vision

Beyond classification, segmentation and Detection

**Semantic
Segmentation**



**Classification
+ Localization**



**Object
Detection**



**Instance
Segmentation**



Image style transfer

Learning style from one or more images and applying that style to a new image.

Examples: applying the style of specific famous artworks (e.g. Picasso, Van Gogh) to new photographs.



$$E_L = \sum (G^L - A^L)^2$$

$$\underbrace{G_{ij}^L}_{\text{content}} = \sum_k F_{ik}^L F_{jk}^L.$$

$$\mathcal{L}_{total} = \alpha \mathcal{L}_{content} + \beta \mathcal{L}_{style}$$

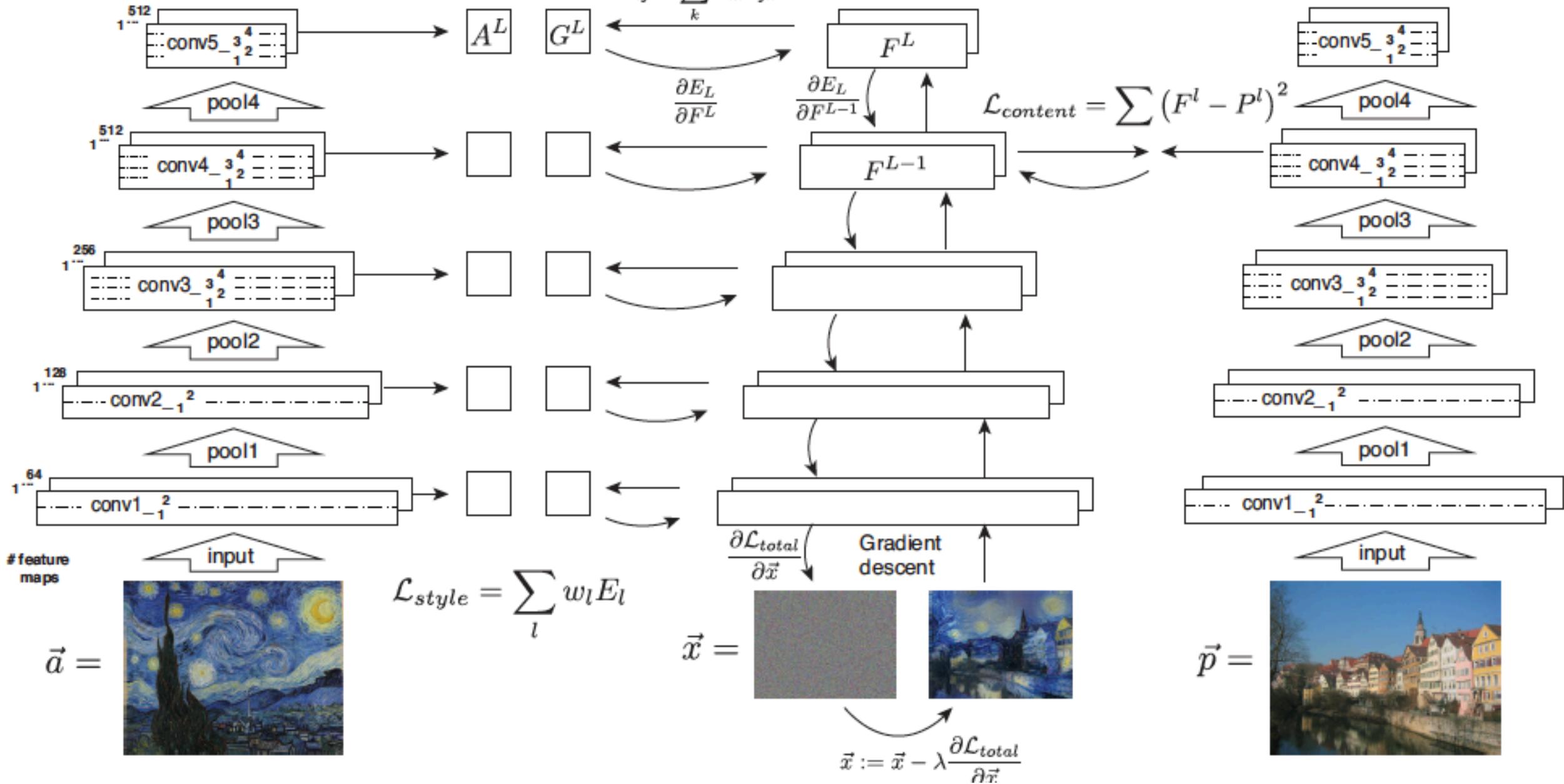
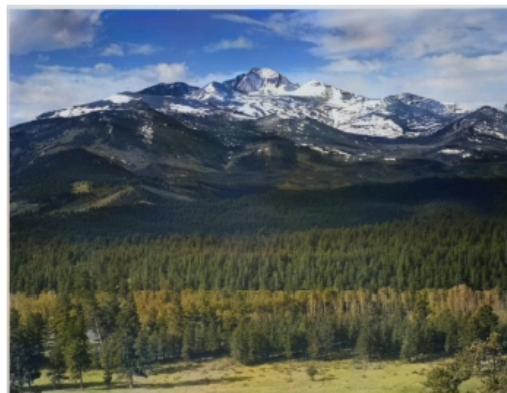
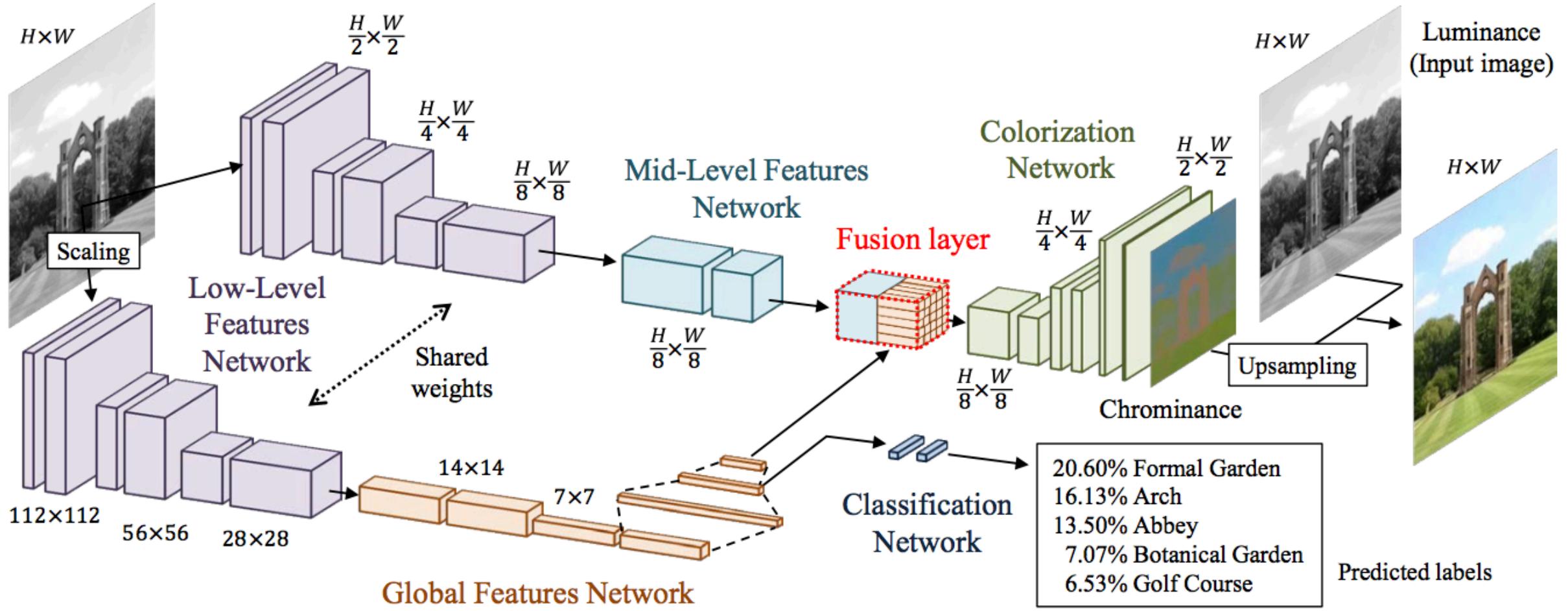


Image colorization

Converting a grayscale image to a full color image

Examples: colorizing old black and white photographs and movies



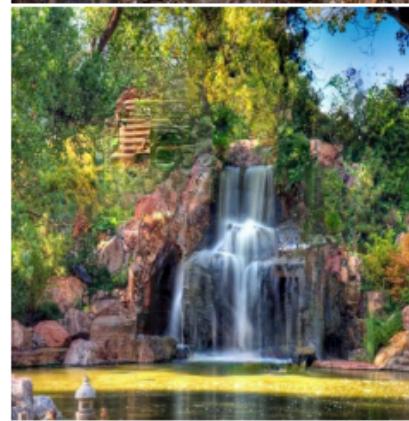
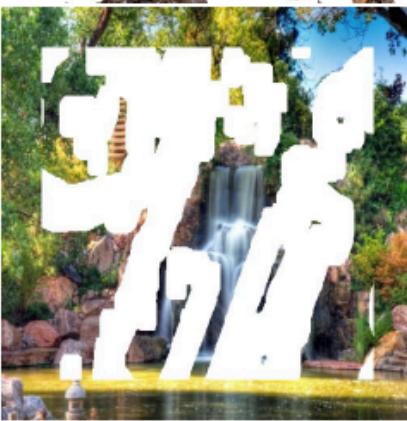


In order to train the network, we use the Mean Square Error (MSE) criterion. Given a color image for training, we convert the image to grayscale and CIE L*a*b* colorspace. The input of the model is the grayscale image while the target output is the a*b* components of the CIE L*a*b* colorspace.

Image Inpainting

Filling in missing or corrupt parts of an image.

Examples: reconstructing old, damaged black-white photographs and movies (photo restoration)



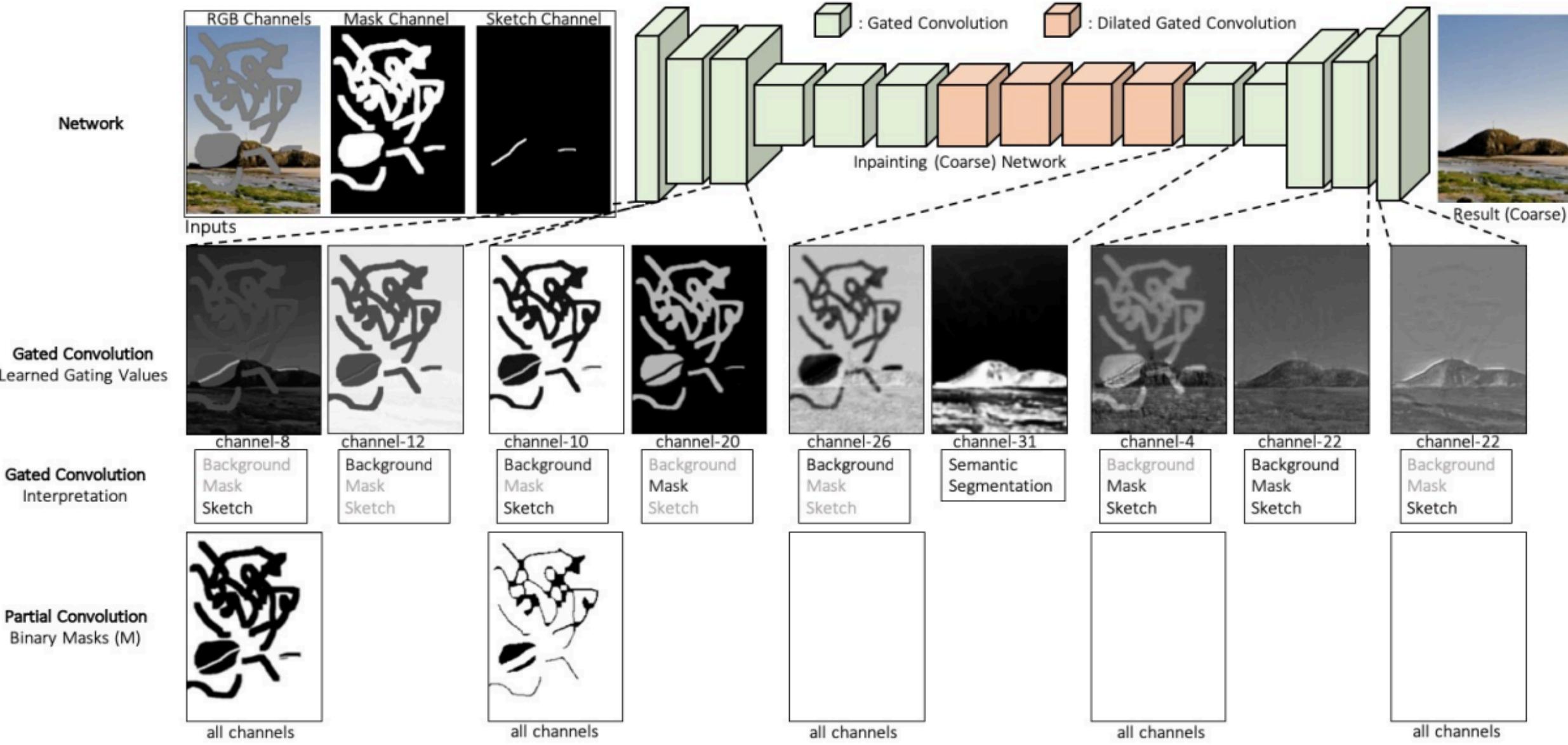
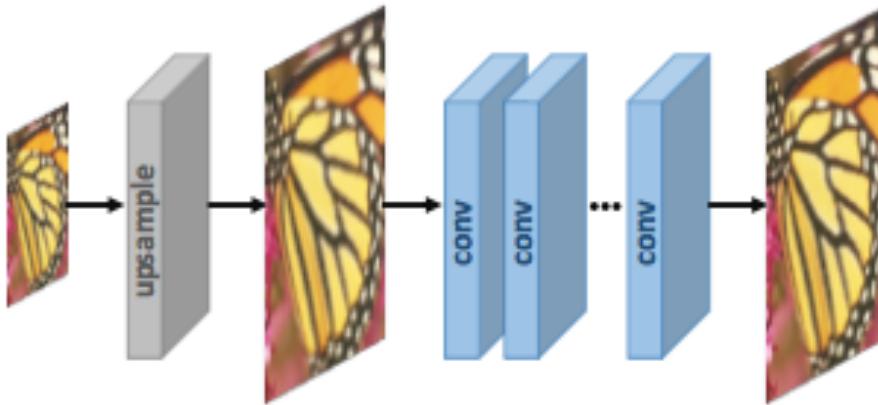


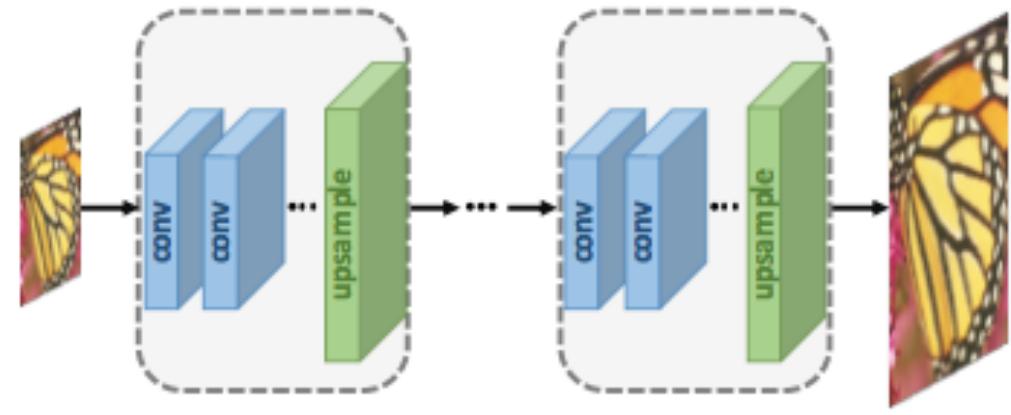
Image Super-resolution

Generating a new version of an image with a higher resolution and detail than the original image.
Usually using for image restoration and inpainting as the solve related problem (filling the holes)

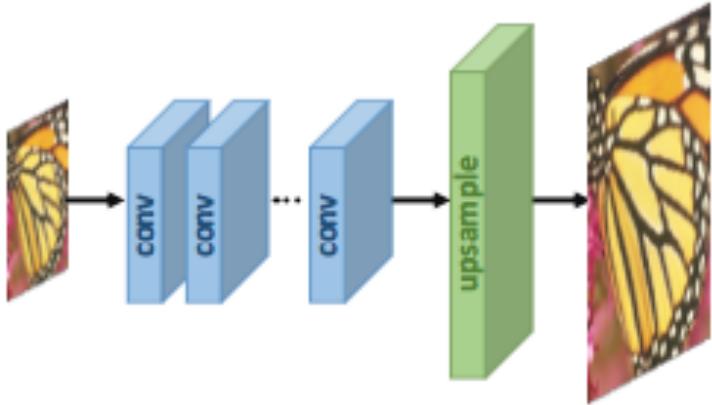




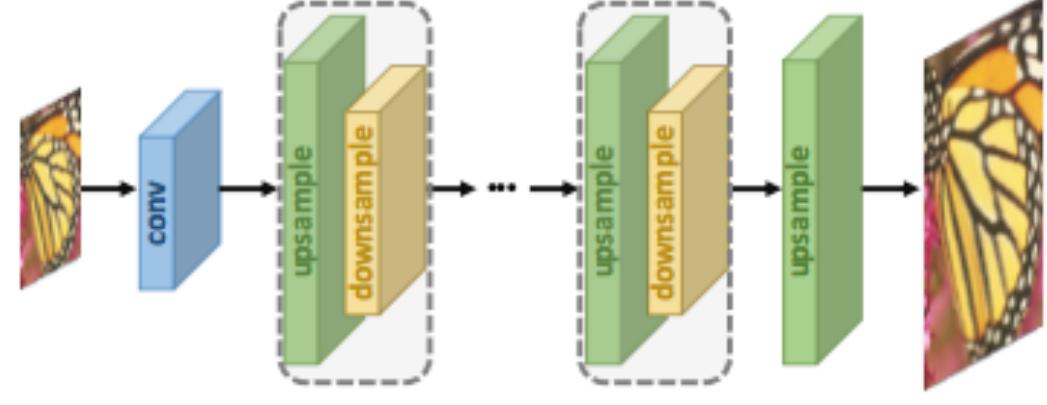
(a) Pre-upsampling SR



(c) Progressive upsampling SR



(b) Post-upsampling SR



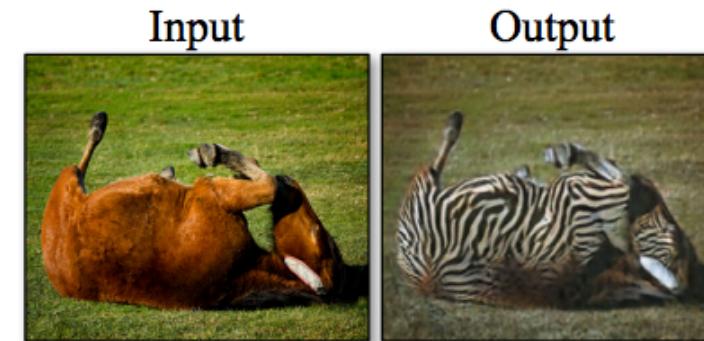
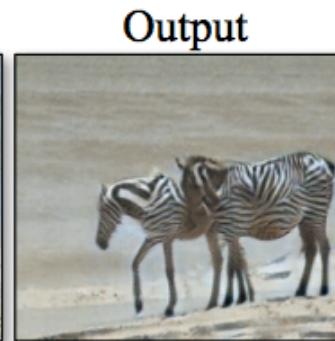
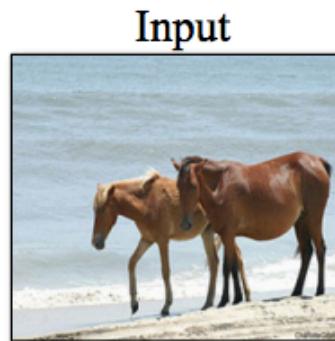
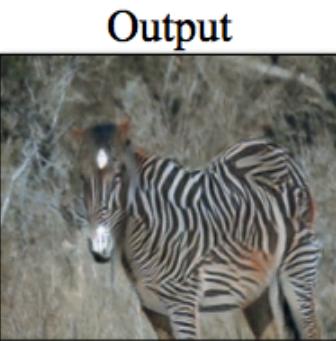
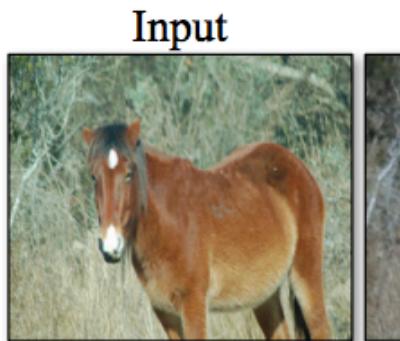
(d) Iterative up-and-down Sampling SR

Image Synthesis

Generating targeted modifications of existing images or entirely new images.

Example: image-to-image translation (SAR to optical, etc.), changing the objects style.

Close to style transfer !



horse → zebra



zebra → horse

Evaluation (14/12/2021)

- Work in pair. A random topic (paper) is distributed.
- Read, highlight and analyze the paper to prepare 5-6 slides to summarize:
 - research topic & applications,
 - dataset (location, sensor, number, band, resolution, date, etc.)
 - methodology (network, loss function, how to train),
 - evaluate metrics, results,
 - pros and cons
- Present your slides within 10 minutes
- 5 minutes of questions/answers
- *Free discussion and remark on the paper.*

4 papers

1. Edge-Enhanced GAN for Remote Sensing Image Super-resolution
2. A SAR-to-Optical Image Translation Method Based on Conditional Generation Adversarial Network
3. Cloud removal in Sentinel-2 imagery using a deep residual neural network and SAR-optical data fusion
4. Self-Supervised Learning of Remote Sensing Scene Representations Using Contrastive Multi-view Coding