Machine learning introduction
Part II – Deep Neural Networks

2 - The Generative Adversarial Networks
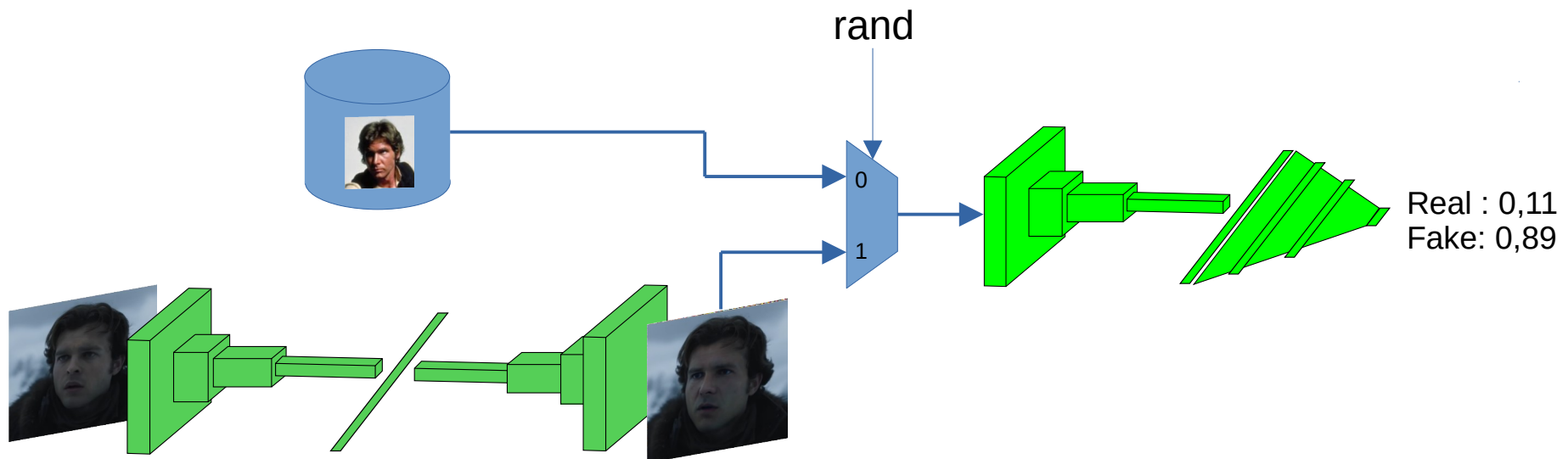
Simon Gay

Part II-2 : the generative adversarial networks

- **GANs**

  - Generative Adversarial Networks

  - Couples of networks
    - A first network learns to mislead the second network
    - The second networks learns to recognize a generated images from real ones

  - The loss functions are opposite: mutual improvements
    - The second networks finds features separating fake and true images
    - First network correct fake images to make them more realistic

Part II-2 : the generative adversarial networks

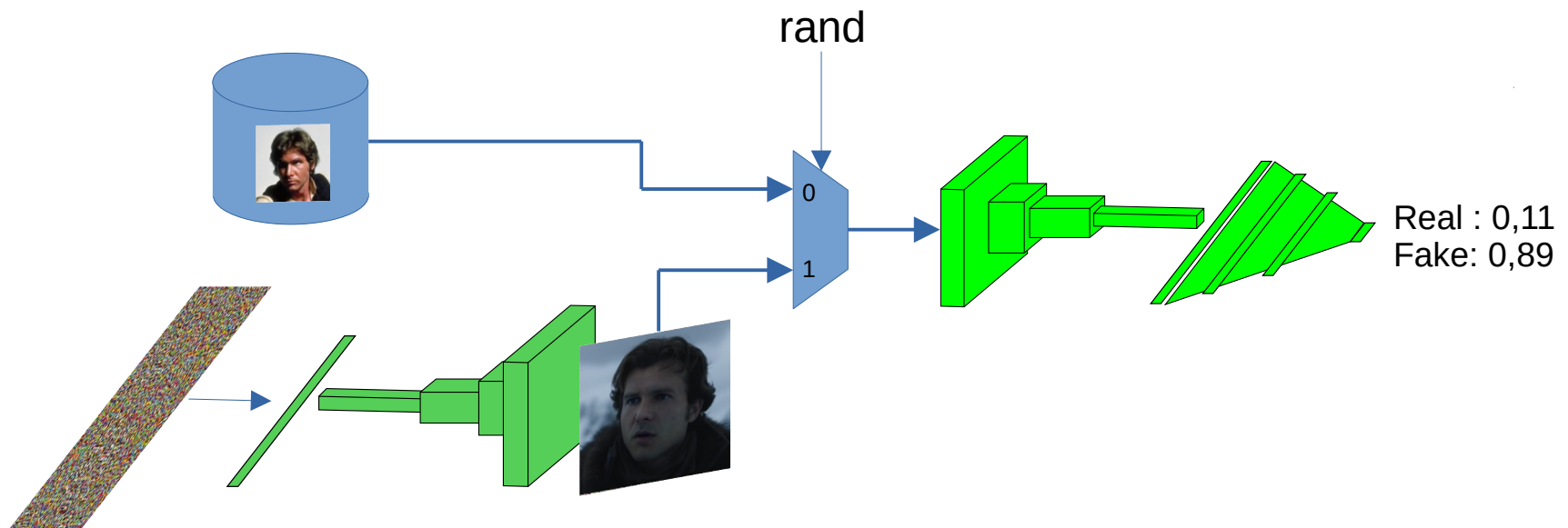- **GANs**

    - GANS to improve an encoder-decoder network
        - An encoder-decoder to improve
        - A database of real images
        - A discriminator network learning to recognize fake from real images

rand

0

1

Real : 0,11
Fake: 0,89

Part II-2 : the generative adversarial networks

- **GANs**

  - GANS to generate original data (images, text, sound...)
    - A decoder (only) network
    - A random vector generator
    - A database of true image
    - A discriminator network

Part II-2 : the generative adversarial networks

- **GANs**

  - Generative GANs: a rapid evolution

Generative Adversarial Networks (GANs): An Overview of Theoretical Model, Evaluation Metrics, and Recent Developments Preprint, Pegah et al., 2020

Part II-2 : the generative adversarial networks

- **GANs**

    - Generative GANs: not always perfect...

No One Can Escape: A General Approach to Detect Tampered and Generated Image,
Zhang et al., 2019
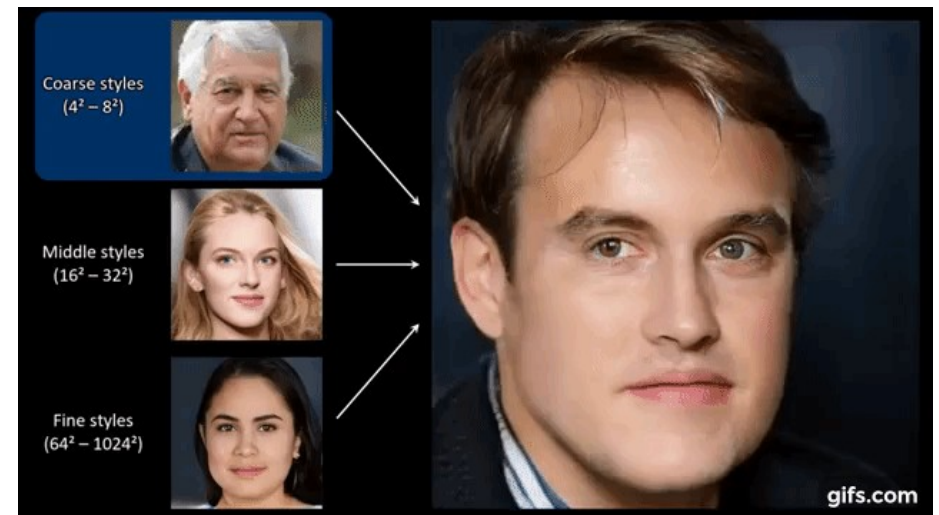
Part II-2 : the generative adversarial networks

- **GANs**

    - Generative GANs: The latent space

        - The input of the network defines a space of possible input vector. This space is called 'latent space' → each 'point' of this space can generate an image

Unsupervised Representation Learning with Deep
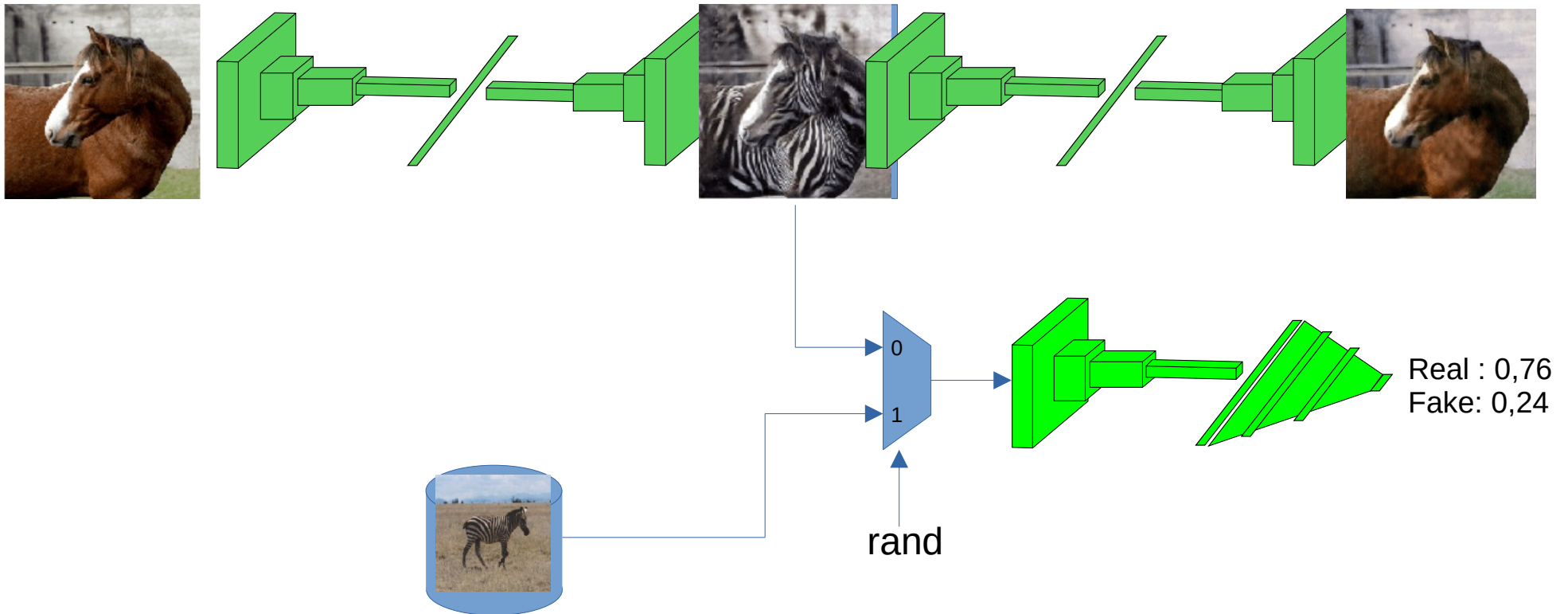Convolutional Generative Adversarial Networks

- It is possible to interpolate between points

- Input vectors can be added added, subtracted, merged...

Part II-2 : the generative adversarial networks

- **Improved GANs:**

    - Cycle GANs :

Part II-2 : the generative adversarial networks

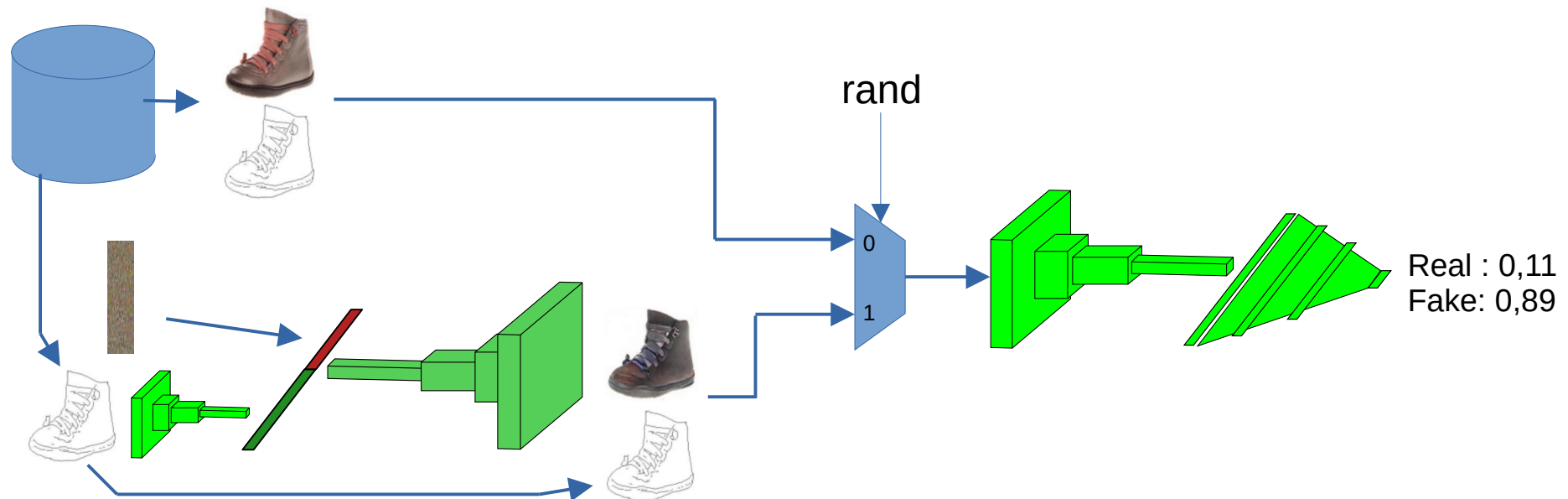- **Improved GANs**

    - Cycle GANs :

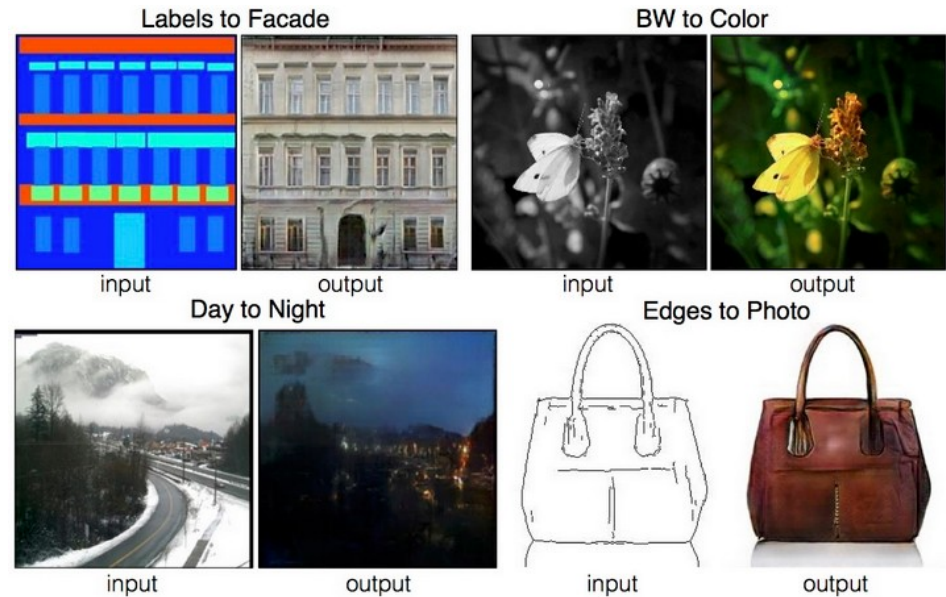# Part II-2 : the generative adversarial networks

- **Improved GANs**

  - Conditional GANs : add constraints to generated images

    - Additional information is added to images (ex. drawing of a picture, numerical values…)

    - The discriminator recognizes couples image/information

    - The GAN must consider additional information to generate images
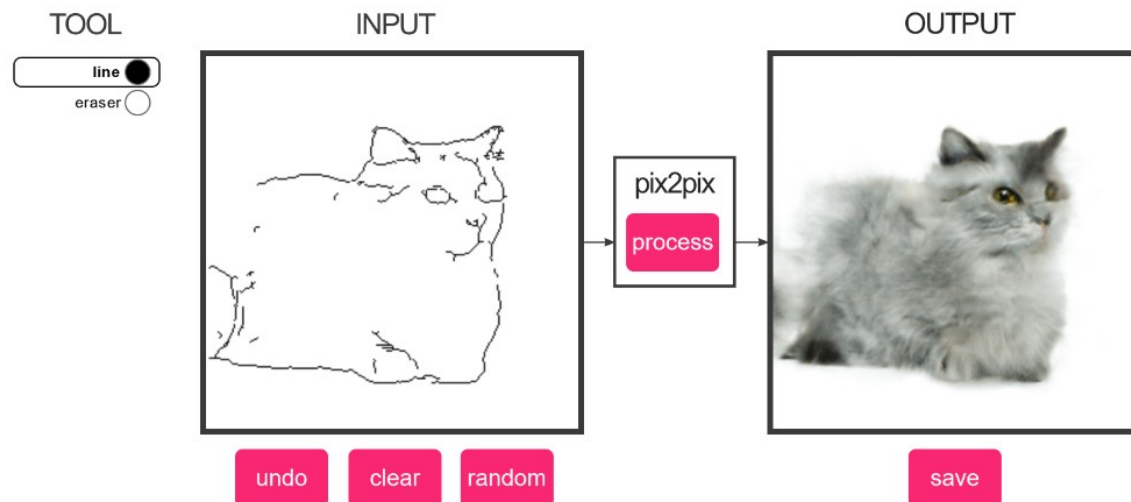

rand

Real : 0,11
Fake: 0,89

Part II-2 : the generative adversarial networks

- **Improved GANs**

    - Conditional GANs :

        - Pix2pix

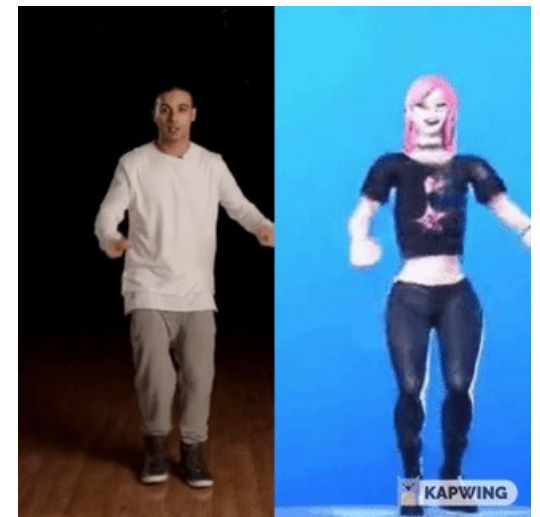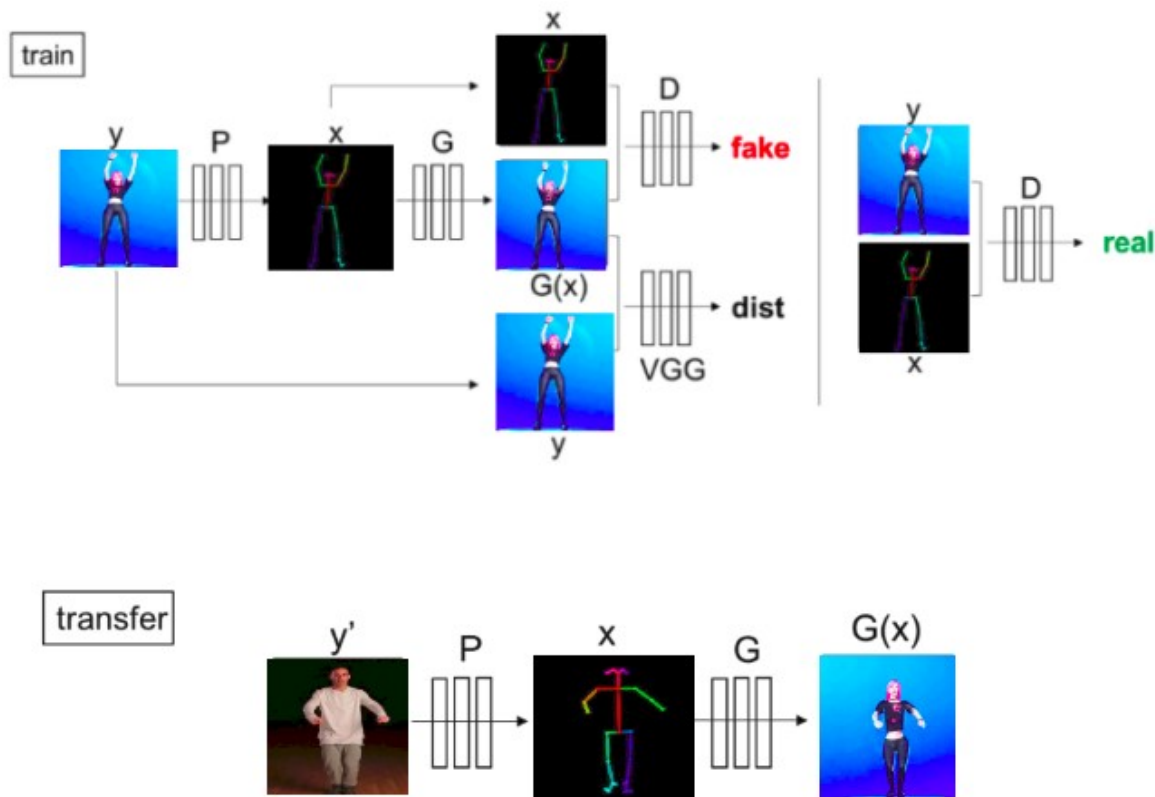   - Edges2cats

        - Edges2shoes

        - Edges2handbag

https://phillipi.github.io/pix2pix/

https://affinelayer.com/pixsrv/index.html

Part II-2 : the generative adversarial networks

- **Improved GANs**

    - Conditional GANs :

        - Everybody Dance Now
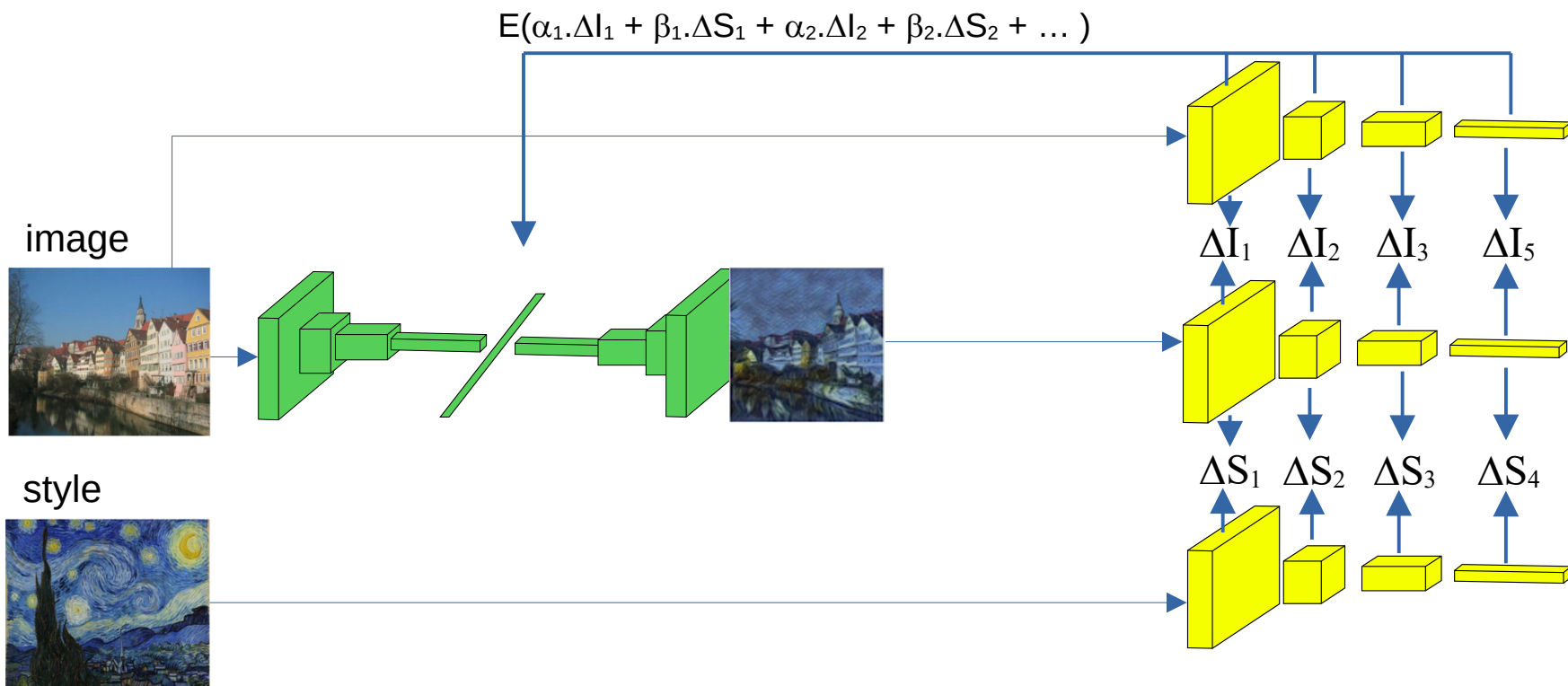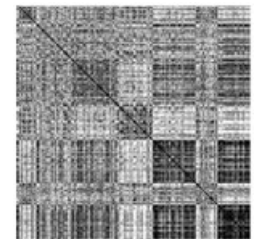

https://github.com/Vishwesh4/Everybody-dance-now

Part II-2 : the generative adversarial networks

- **Improved GANs**
  - Transfert style GAN :
    - Trained encoder networks (without fully connected)
    - Minimize image and style differences (Gram matrix)

$$g_{k_1,k_2} = Y_{k_1} \times Y_{k_2}$$

$E(\alpha_1.\Delta I_1 + \beta_1.\Delta S_1 + \alpha_2.\Delta I_2 + \beta_2.\Delta S_2 + \dots)$

image

style

$\Delta I_1 \quad \Delta I_2 \quad \Delta I_3 \quad \Delta I_5$

$\Delta S_1 \quad \Delta S_2 \quad \Delta S_3 \quad \Delta S_4$

Part II-2 : the generative adversarial networks

- **Improved GANs**

  - Transfert style GAN

https://www.tensorflow.org/lite/examples/style_transfer/overview