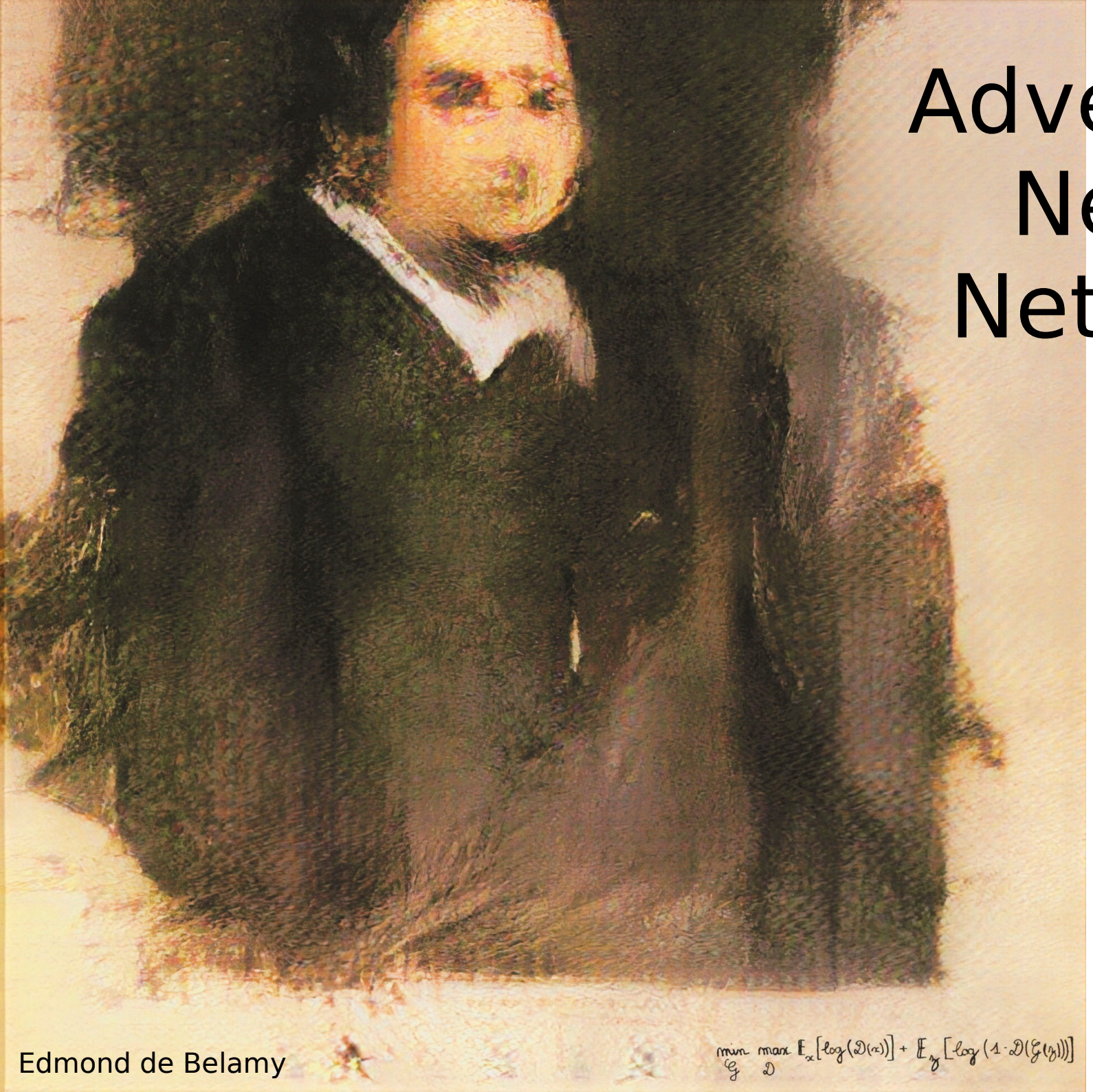


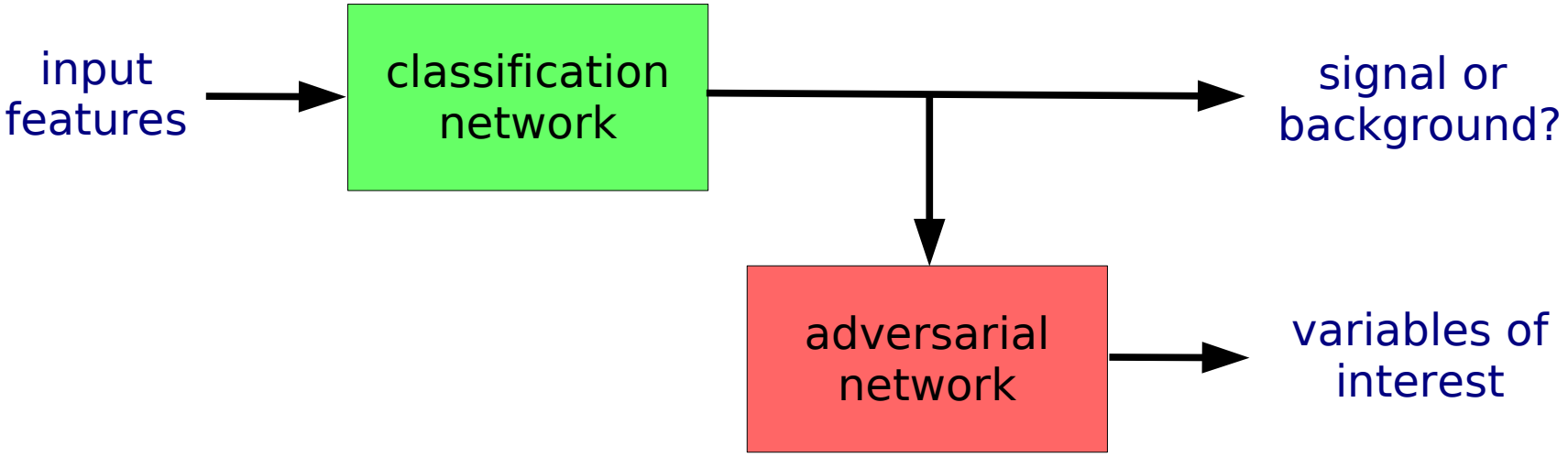
Adversarial Neural Networks

ErUM Data Community Meeting
01.07.2021

Thomas Kuhr
LMU München

Adversarial Neural Network (ANN)

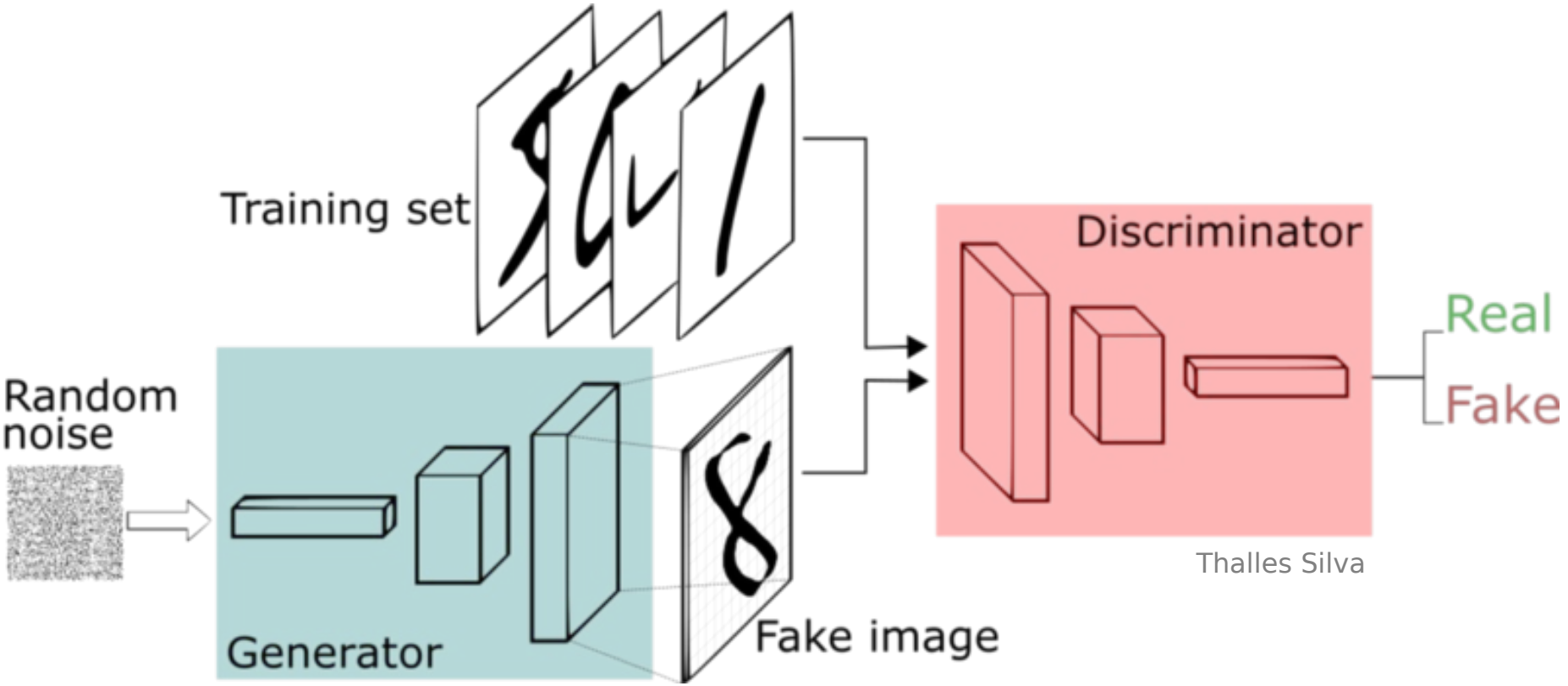
- Common problem: separation of signal and background without biasing the distribution of some variables of interest



- Loss function: $L = L_{classification} - \lambda L_{adversarial}$
- Min-max game

Generative Adversarial Network (GAN)

- arXiv:1406.2661 (Goodfellow, et al.)
- → ANN used to train a generative model

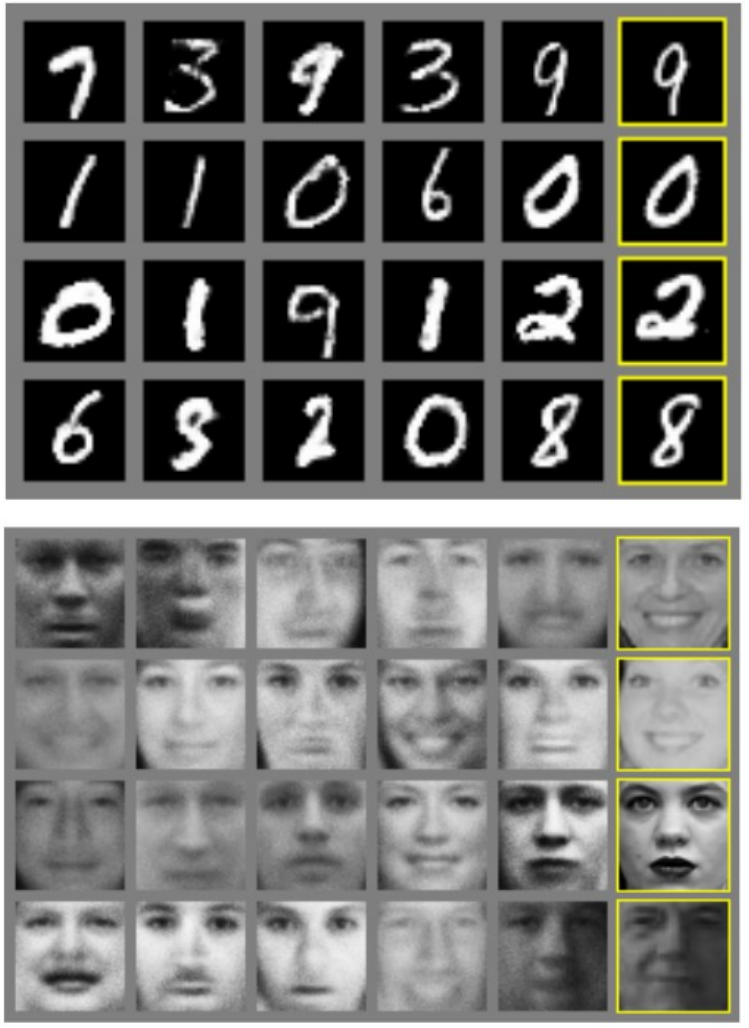


GAN Examples

arXiv:1406.2661

generated images

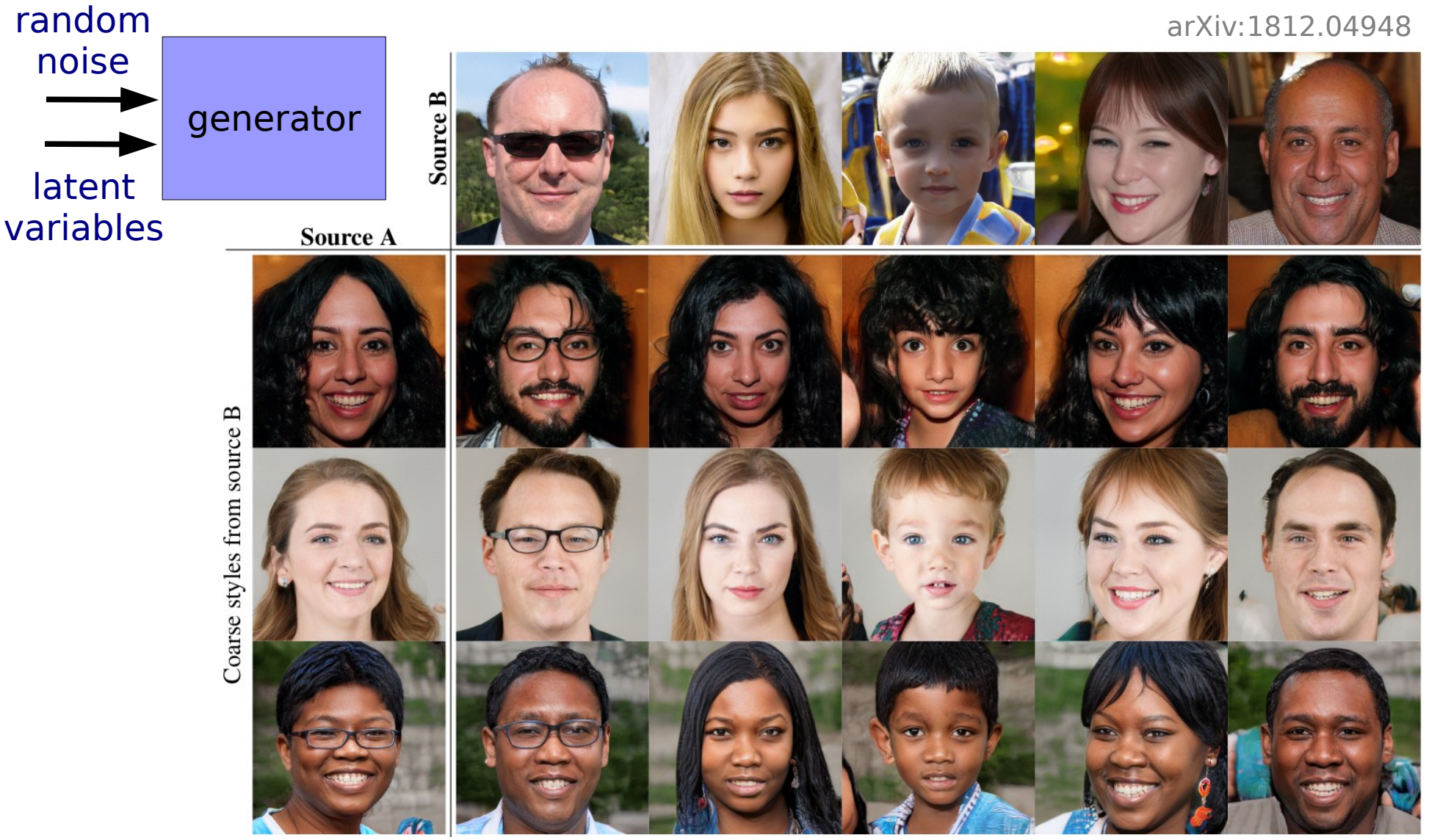
nearest training image



arXiv:1812.04948

StyleGAN

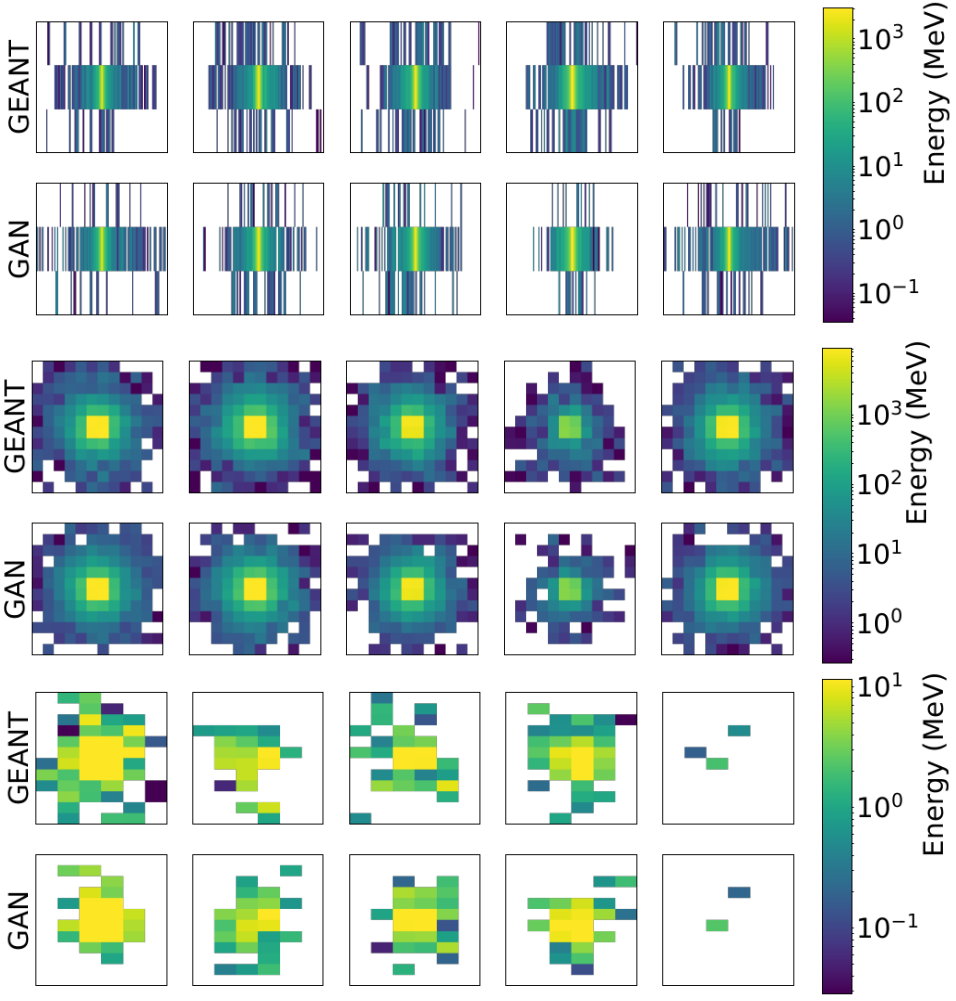
Latent Space

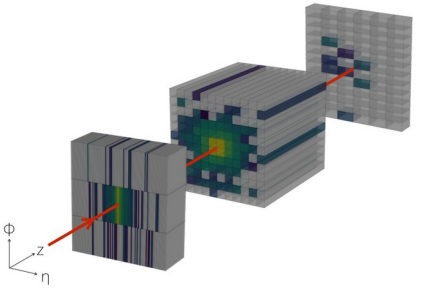


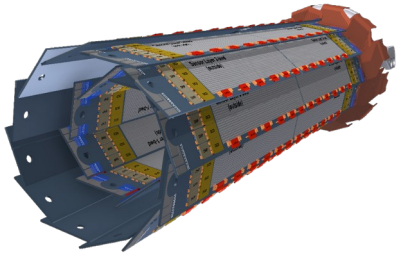
Physics Examples

CaloGAN

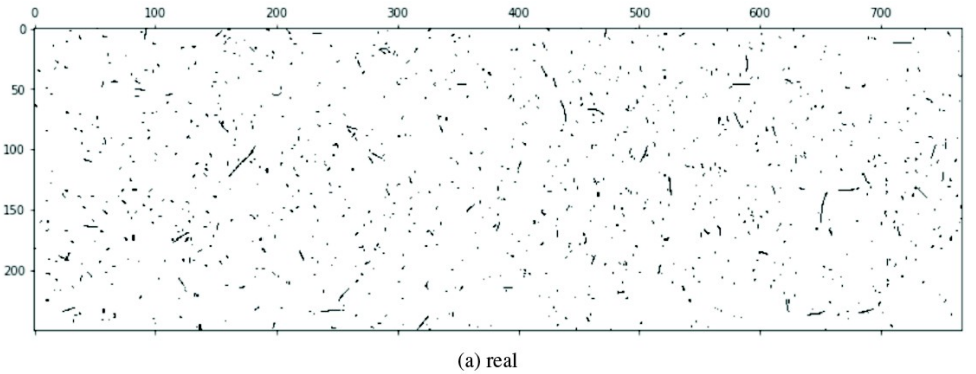
arXiv:1712.10321



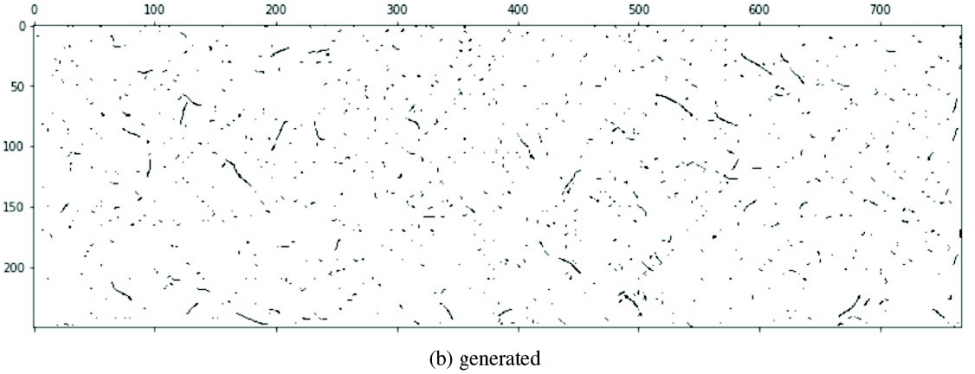




https://doi.org/10.1051/epjconf/202024502010



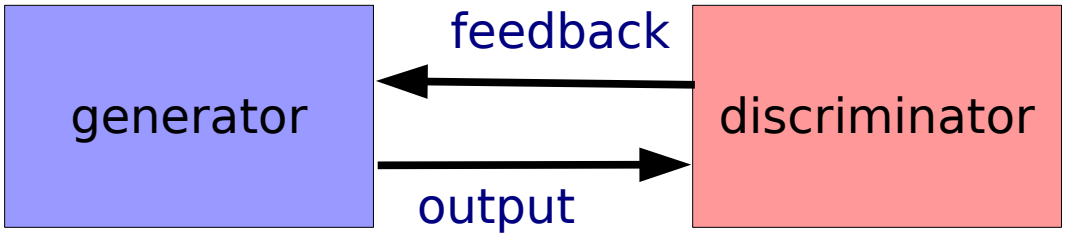
(a) real



(b) generated

Challenges and Opportunities

- Assessment of output quality and variety
- Common training problems:
  - Mode collapse
  - Vanishing gradients
  - Failing convergence



- Alternative approach: Variational autoencoders

- Huge potential to replace resource demanding Monte-Carlo simulations or calculations
- Conditional GANs for physics parameter dependent generations
- Your use cases?