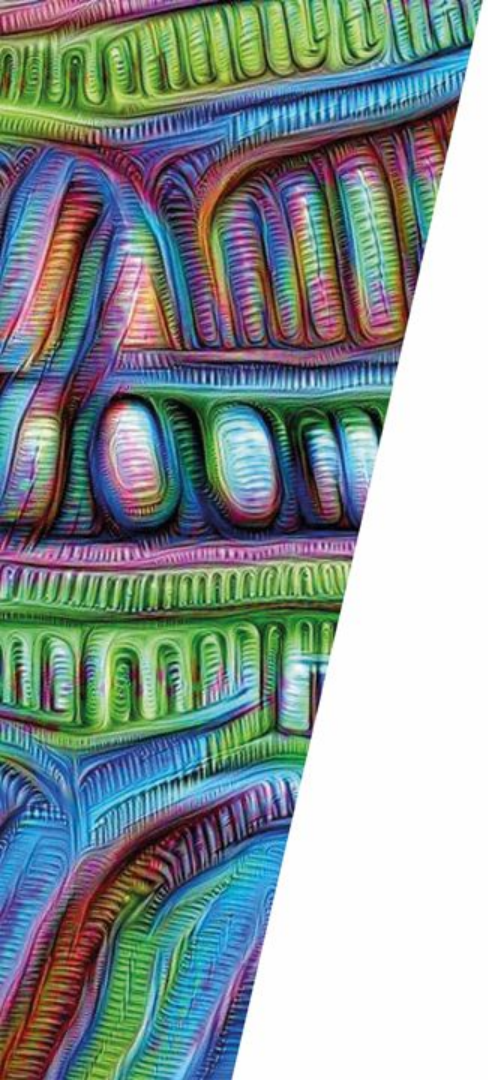


Bienvenue!

ÉCOLE D'ÉTÉ FRANCOPHONE EN APPRENTISSAGE PROFOND

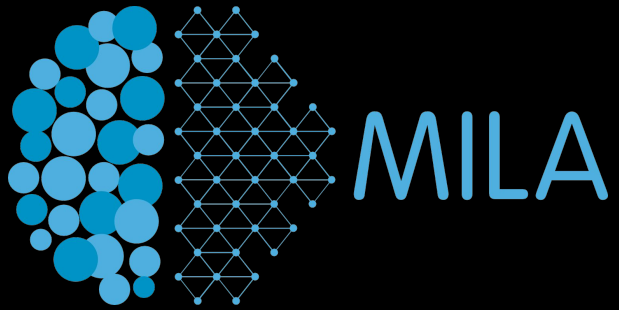
21-25 août 2017

IVADO

HEC Montréal
Polytechnique Montréal
Université de Montréal

MILA

Institut
des algorithmes
d'apprentissage
de Montréal



Modèles génératifs

Mathieu Germain

Qu’est-ce qu’un Modèle Génératif?

Entrées

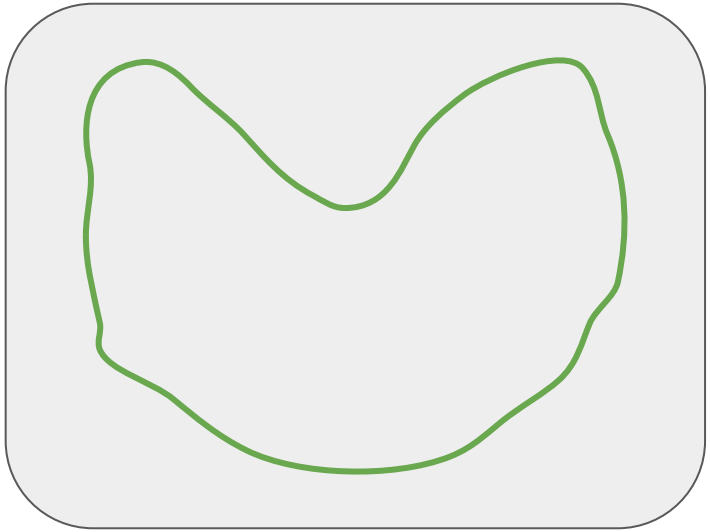
Modèle Génératif

Modèle Génératif

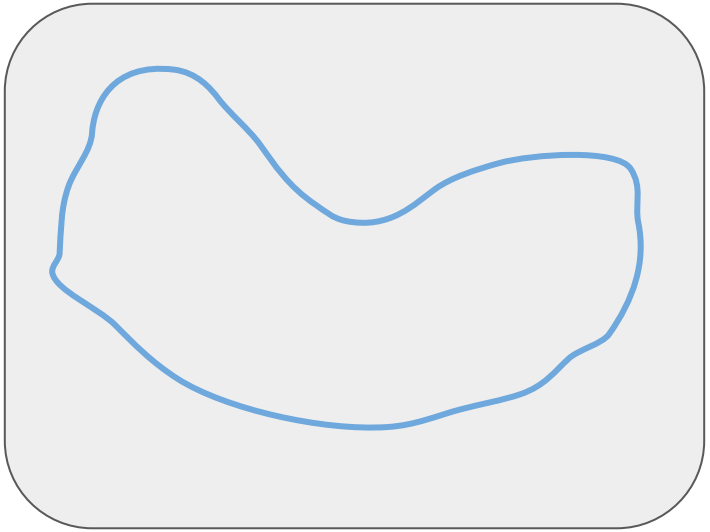
Sorties

MILA

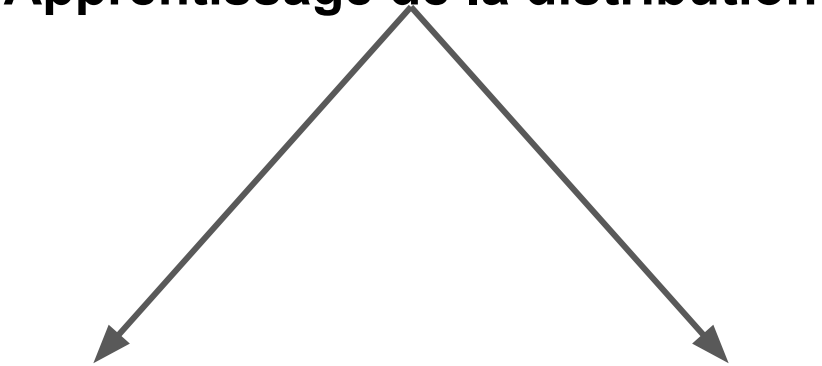
Vraie distribution

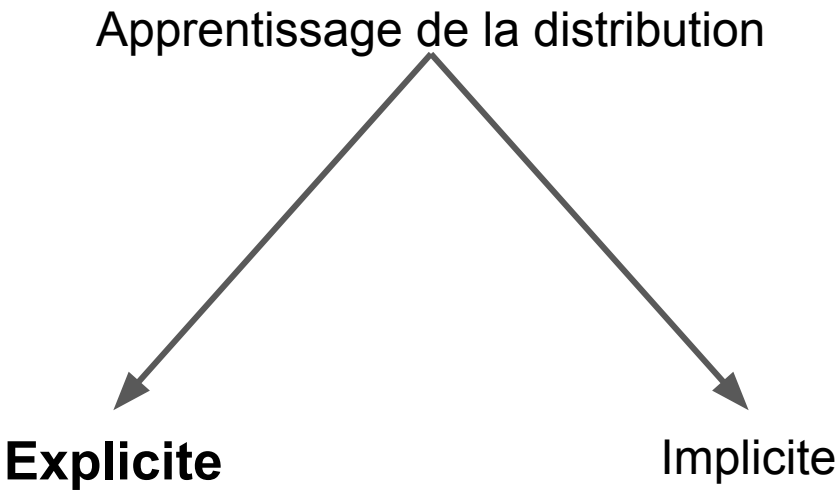


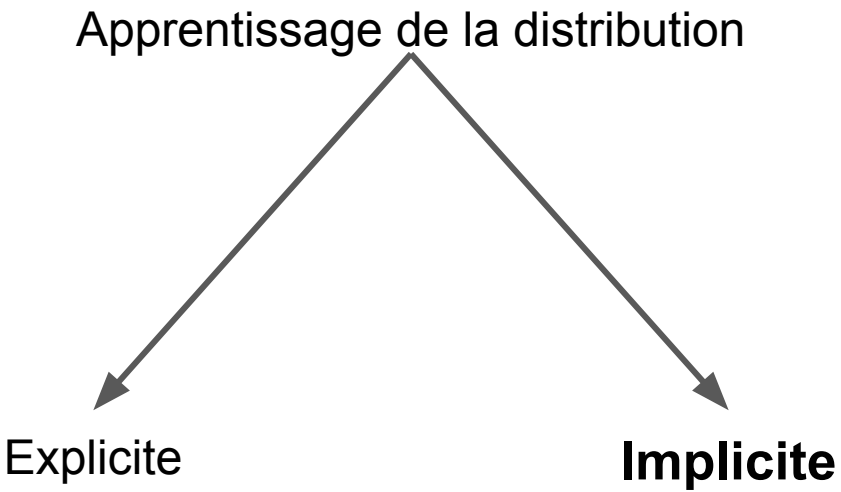
Distribution estimée par le modèle

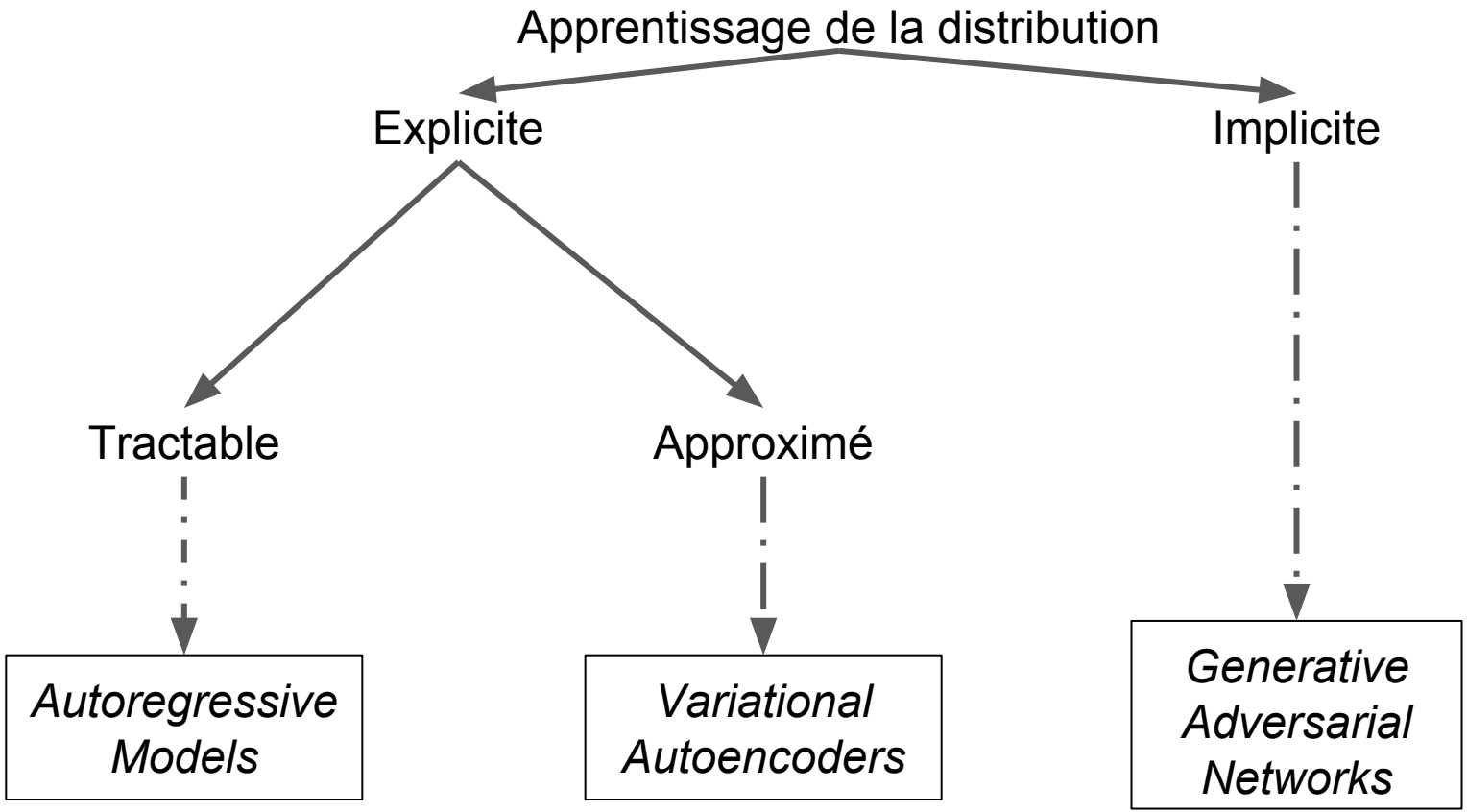


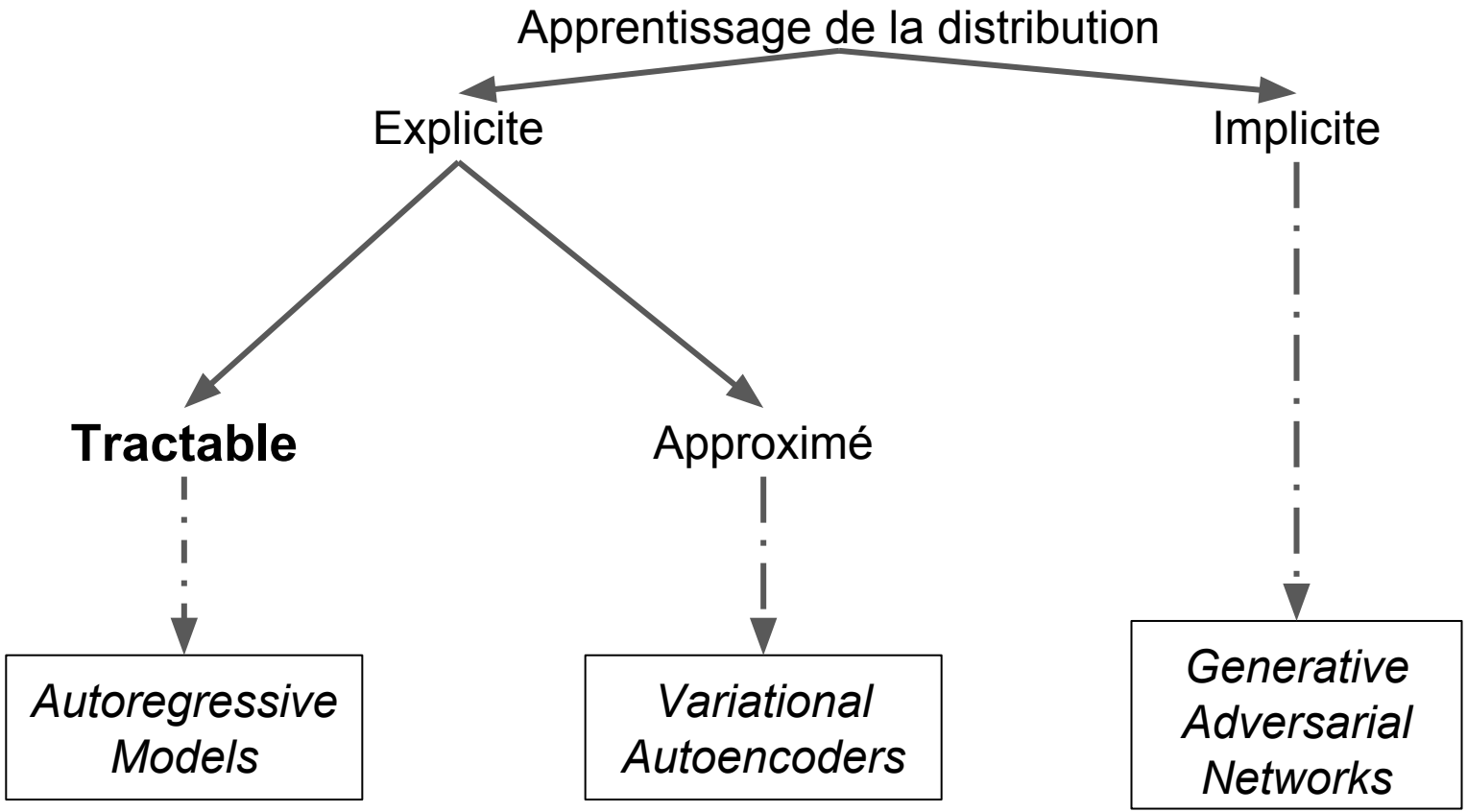
Apprentissage de la distribution




Apprentissage de la distribution
Explicite
Implicite


Apprentissage de la distribution
Explicite
Implicite


Apprentissage de la distribution
Explicite
Implicite
Tractable
Approximé
Autoregressive Models
Variational Autoencoders
Generative Adversarial Networks


Apprentissage de la distribution
Explicite
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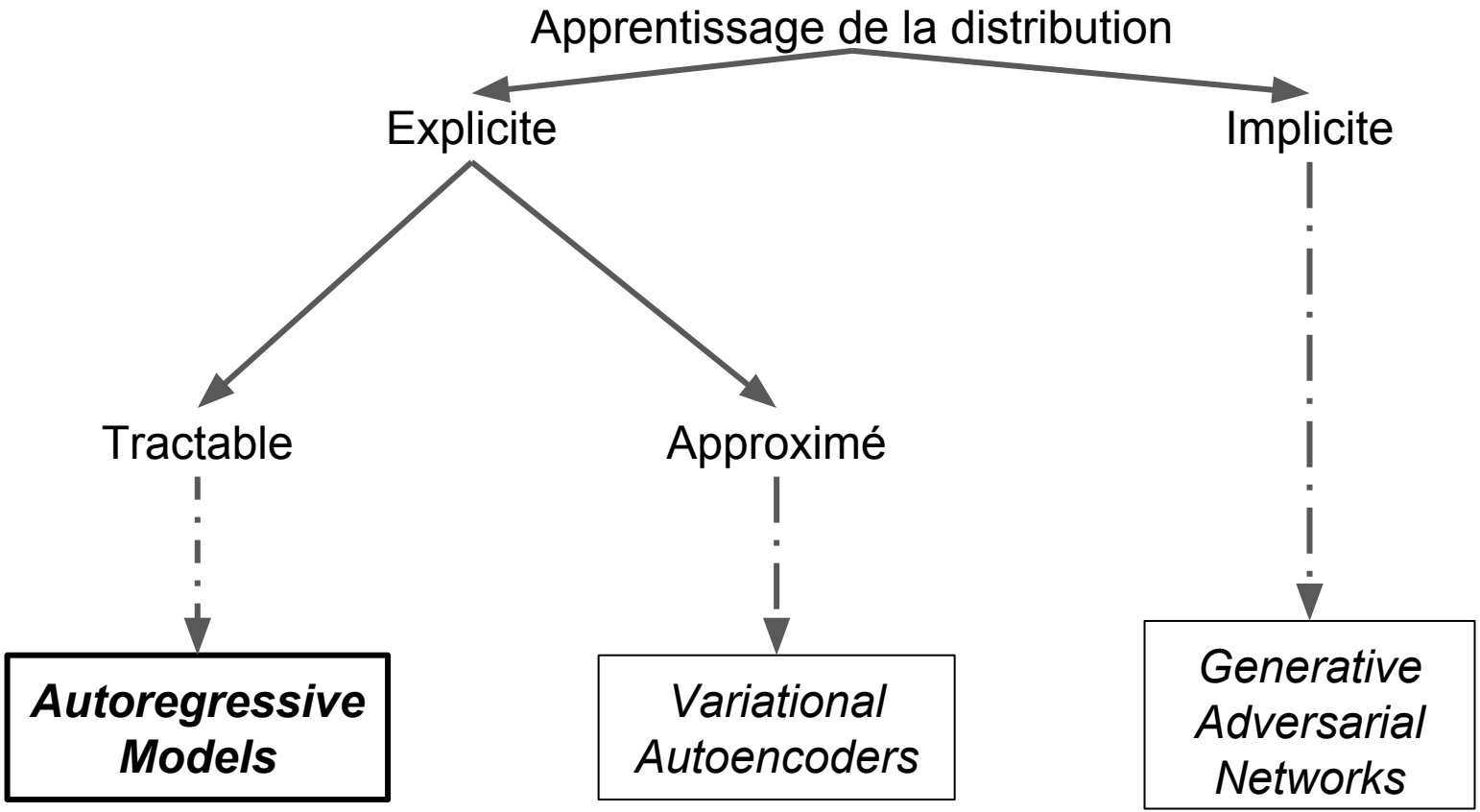
Variational Autoencoders
Generative Adversarial Networks


Apprentissage de la distribution
Explicite
Implicite
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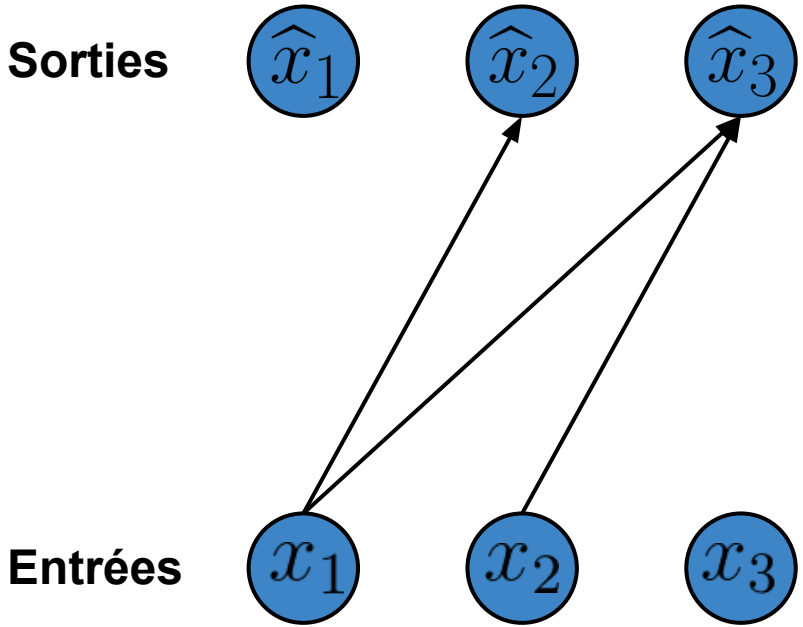
Variational Autoencoders
Generative Adversarial Networks

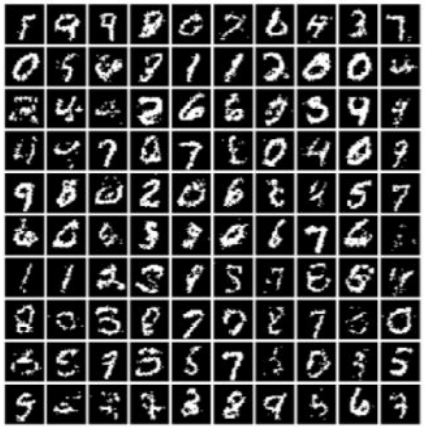
Fully Visible Sigmoid Belief Network



Notable Autoregressive Models

NADE

(Larochelle et al 2011)

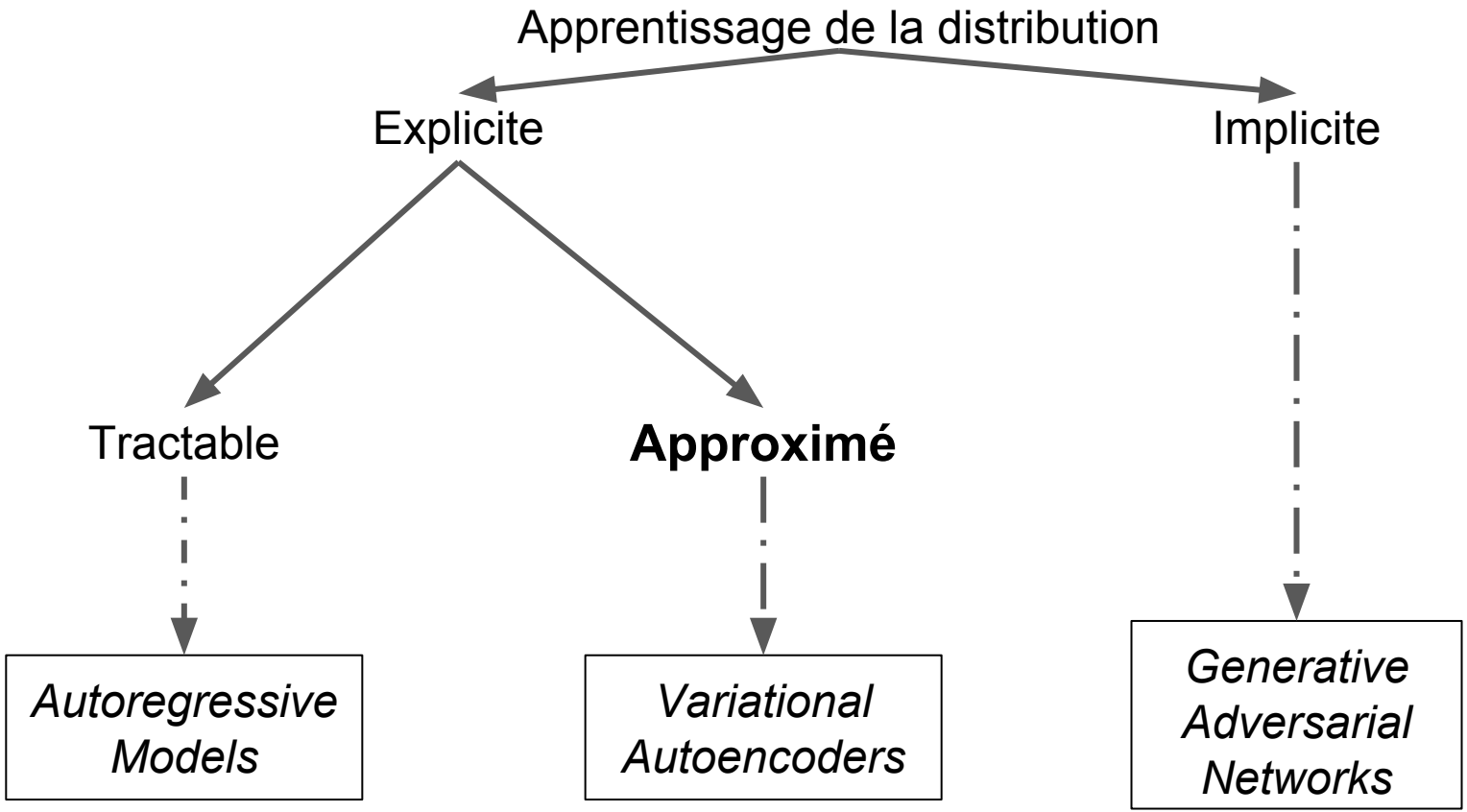


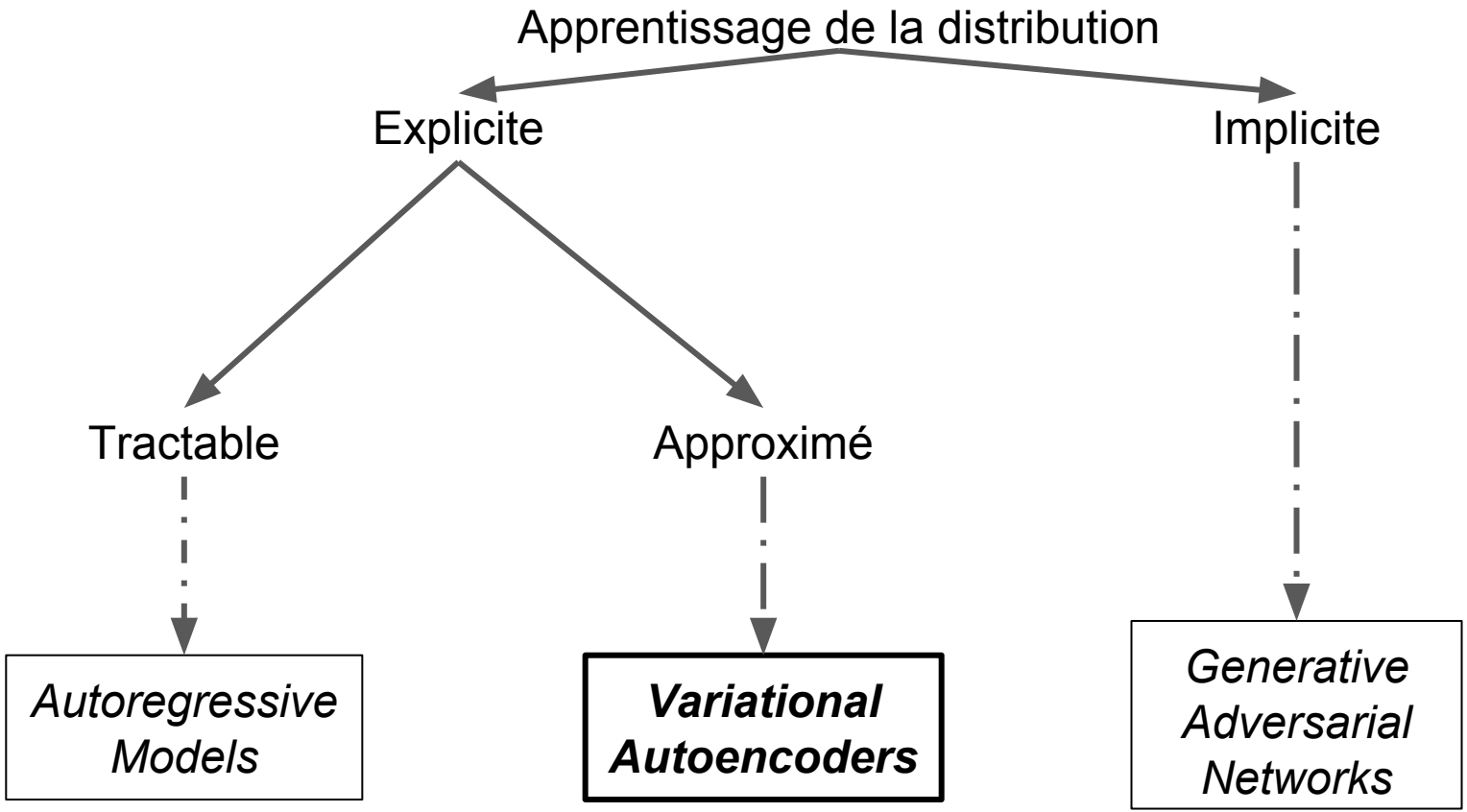
MADE

(Germain et al 2016)

PixelCNN

(van den Ord et al 2016)


Apprentissage de la distribution
Explicite
Implicite
Tractable
Approximé
Autoregressive Models
Variational Autoencoders
Generative Adversarial Networks


Apprentissage de la distribution
Explicite
Implicite
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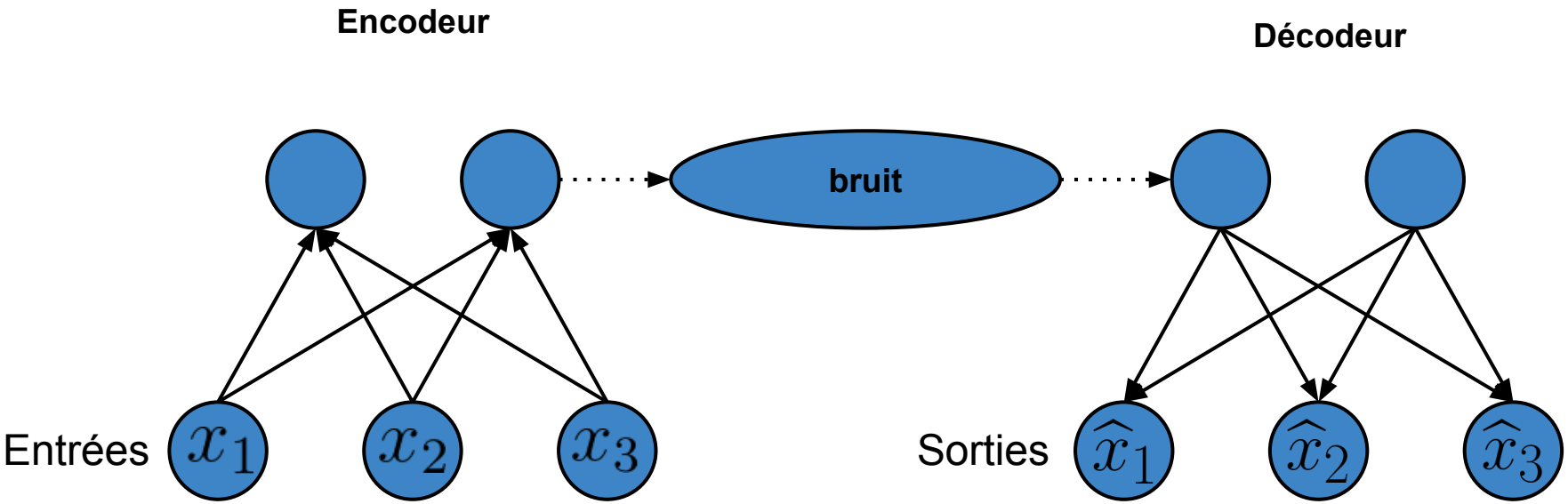
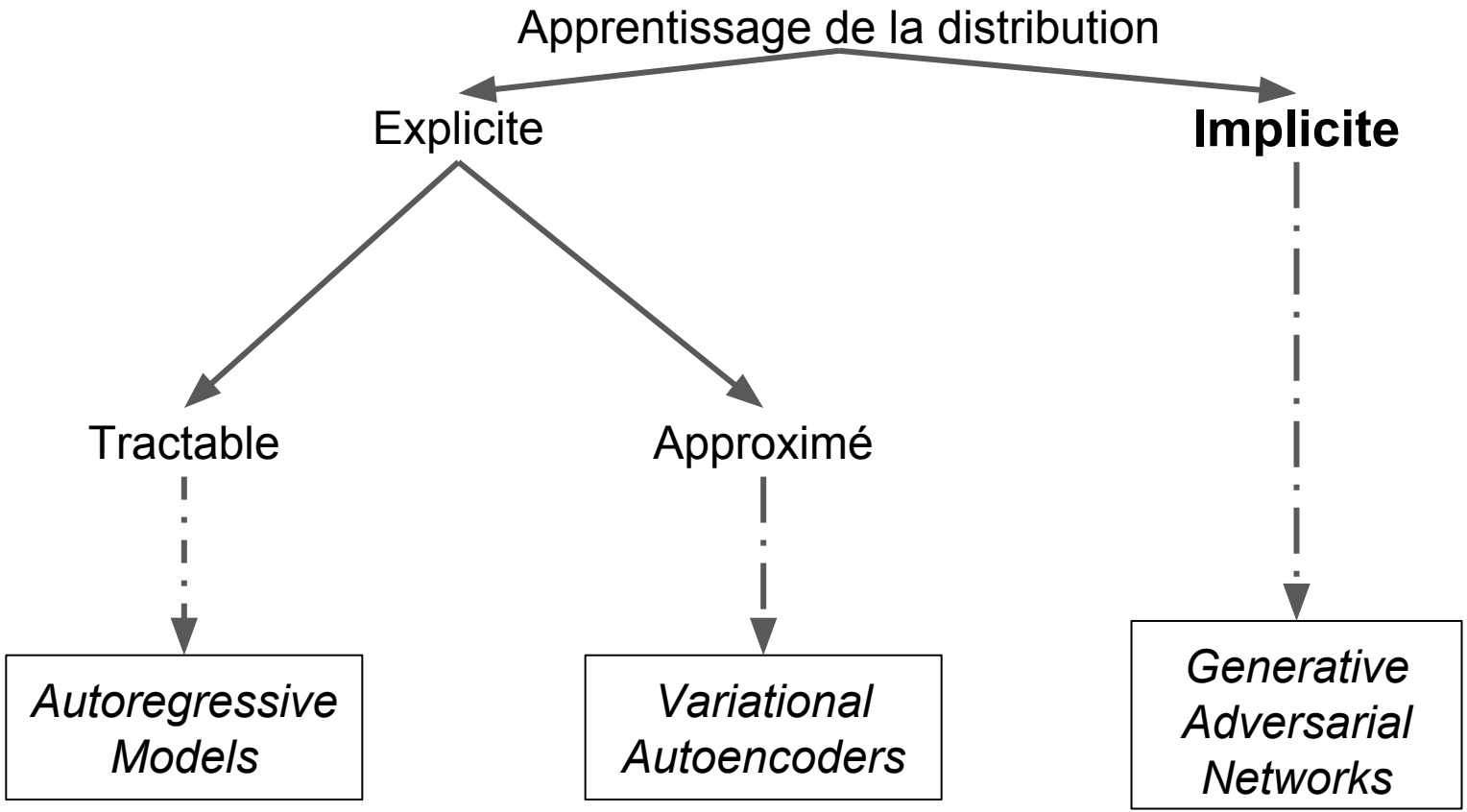
Autoregressive Models
Variational Autoencoders
Generative Adversarial Networks

Variational Autoencoders




Apprentissage de la distribution
Explicite
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Autoregressive Models
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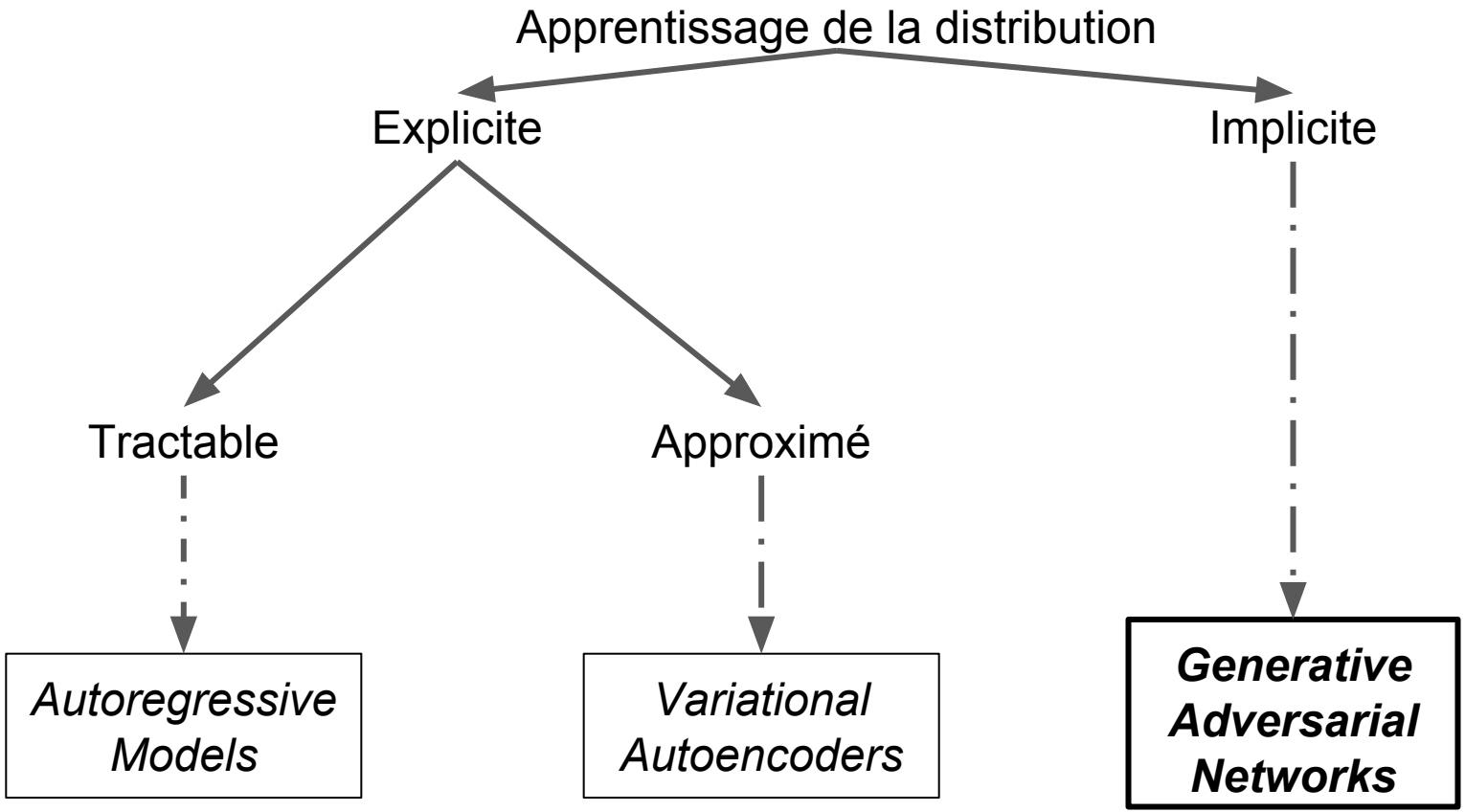
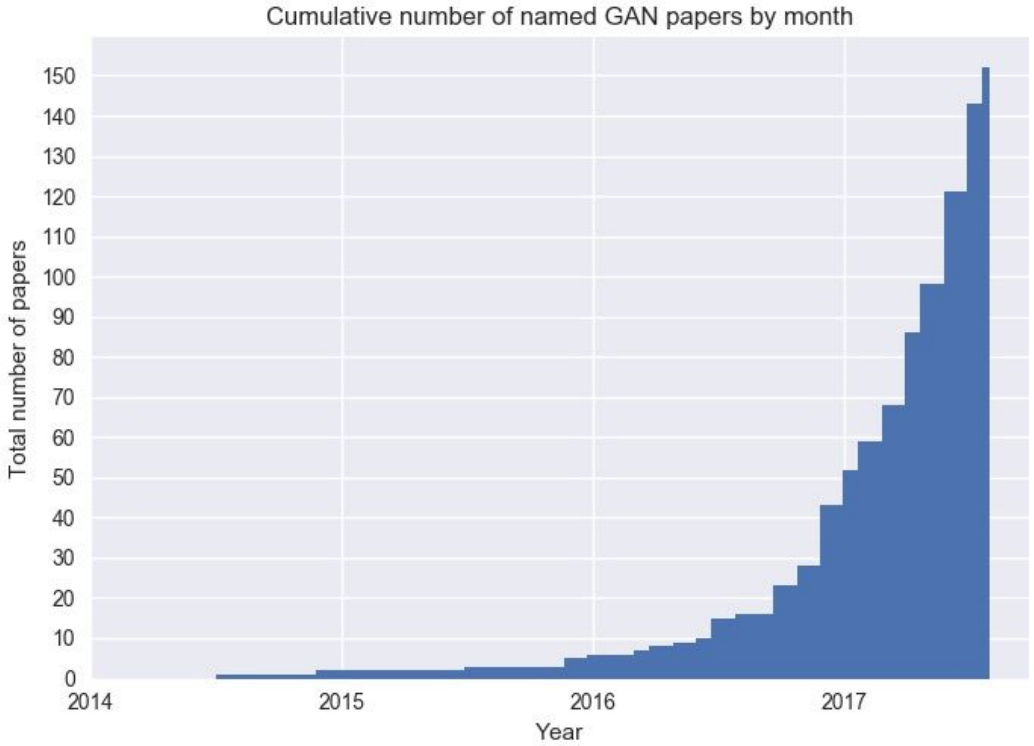
Generative Adversarial Networks


Apprentissage de la distribution
Explicite
Implicite
Tractable
Approximé
Autoregressive Models
Variational Autoencoders
Generative Adversarial Networks

Generative Adversarial Networks Explosion



https://github.com/hindupuravinash/the-gan-zoo

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GAN ZOO

* 3D-GAN - [Learning a Probabilistic Latent Space of Object Shapes via 3D Generative-Adversarial Modeling](https://arxiv.org/abs/1610.07584)
* AC-GAN - [Conditional Image Synthesis With Auxiliary Classifier GANs](https://arxiv.org/abs/1610.09585)
* acGAN - [Face Aging With Conditional Generative Adversarial Networks](https://arxiv.org/abs/1702.01983)
* AdaGAN - [AdaGAN: Boosting Generative Models](https://arxiv.org/abs/1701.02386v1)
* AE-GAN - [AE-GAN: adversarial eliminating with GAN](https://arxiv.org/abs/1707.05474)
* AEGAN - [Learning Inverse Mapping by Autoencoder based Generative Adversarial Nets](https://arxiv.org/abs/1703.10094)
* AffGAN - [Amortised MAP Inference for Image Super-resolution](https://arxiv.org/abs/1610.04490)
* AL-CGAN - [Learning to Generate Images of Outdoor Scenes from Attributes and Semantic Layouts](https://arxiv.org/abs/1612.00215)
* ALI - [Adversarially Learned Inference](https://arxiv.org/abs/1606.00704)
* AlignGAN - [AlignGAN: Learning to Align Cross-Domain Images with Conditional Generative Adversarial Networks](https://arxiv.org/abs/1707.01400)
* α-GAN - [Variational Approaches for Auto-Encoding Generative Adversarial Networks](https://arxiv.org/abs/1706.04987)
* AM-GAN - [Generative Adversarial Nets with Labeled Data by Activation Maximization](https://arxiv.org/abs/1703.02000)
* AnoGAN - [Unsupervised Anomaly Detection with Generative Adversarial Networks to Guide Marker Discovery](https://arxiv.org/abs/1703.05921v1)
* ARAE - [Adversarially Regularized Autoencoders for Generating Discrete Structures](https://arxiv.org/abs/1706.04223)
* ARDA - [Adversarial Representation Learning for Domain Adaptation](https://arxiv.org/abs/1707.01217)
* ArtGAN - [ArtGAN: Artwork Synthesis with Conditional Categorial GANs](https://arxiv.org/abs/1702.03410)
* b-GAN - [Generative Adversarial Nets from a Density Ratio Estimation Perspective](https://arxiv.org/abs/1610.02920)
* Bayesian GAN - [Deep and Hierarchical Implicit Models](https://arxiv.org/abs/1702.08896)
* Bayesian GAN - [Bayesian GAN](https://arxiv.org/abs/1705.09558)
* BCGAN - [Bayesian Conditional Generative Adverserial Networks](https://arxiv.org/abs/1706.05477)
* BEGAN - [BEGAN: Boundary Equilibrium Generative Adversarial Networks](https://arxiv.org/abs/1703.10717v2)
* BiGAN - [Adversarial Feature Learning](https://arxiv.org/abs/1605.09782v7)
* BS-GAN - [Boundary-Seeking Generative Adversarial Networks](https://arxiv.org/abs/1702.08431v1)
* C-RNN-GAN - [C-RNN-GAN: Continuous recurrent neural networks with adversarial training](https://arxiv.org/abs/1611.09904)
* CaloGAN - [CaloGAN: Simulating 3D High Energy Particle Showers in Multi-Layer Electromagnetic Calorimeters with Generative Adversarial Networks](https://arxiv.org/abs/1705.02355)
* CAN - [CAN: Creative Adversarial Networks, Generating "Art" by Learning About Styles and Deviating from Style Norms](https://arxiv.org/abs/1706.07068)
* CatGAN - [Unsupervised and Semi-supervised Learning with Categorical Generative Adversarial Networks](https://arxiv.org/abs/1511.06390v2)
* CC-GAN - [Semi-Supervised Learning with Context-Conditional Generative Adversarial Networks](https://arxiv.org/abs/1611.06430v1)
* CGAN - [Conditional Generative Adversarial Nets](https://arxiv.org/abs/1411.1784)
* Chekhov GAN - [An Online Learning Approach to Generative Adversarial Networks](https://arxiv.org/abs/1706.03269)
* CoGAN - [Coupled Generative Adversarial Networks](https://arxiv.org/abs/1606.07536v2)
* Context-RNN-GAN - [Contextual RNN-GANs for Abstract Reasoning Diagram Generation](https://arxiv.org/abs/1609.09444)
* Cramér GAN - [The Cramer Distance as a Solution to Biased Wasserstein Gradients](https://arxiv.org/abs/1705.10743)
* crVAE-GAN - [Channel-Recurrent Variational Autoencoders](https://arxiv.org/abs/1706.03729)
* CS-GAN - [Improving Neural Machine Translation with Conditional Sequence Generative Adversarial Nets](https://arxiv.org/abs/1703.04887)
* CVAE-GAN - [CVAE-GAN: Fine-Grained Image Generation through Asymmetric Training](https://arxiv.org/abs/1703.10155)
* CycleGAN - [Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks](https://arxiv.org/abs/1703.10593)
* Conditional CycleGAN - [Conditional CycleGAN for Attribute Guided Face Image Generation](https://arxiv.org/abs/1705.09966)
* DAN - [Distributional Adversarial Networks](https://arxiv.org/abs/1706.09549)
* DCGAN - [Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks](https://arxiv.org/abs/1511.06434)

GAN ZOO - Suite

* DeLiGAN - [DeLiGAN : Generative Adversarial Networks for Diverse and Limited Data](https://arxiv.org/abs/1706.02071)
* DiscoGAN - [Learning to Discover Cross-Domain Relations with Generative Adversarial Networks](https://arxiv.org/abs/1703.05192v1)
* DistanceGAN - [One-Sided Unsupervised Domain Mapping](https://arxiv.org/abs/1706.00826)
* DR-GAN - [Representation Learning by Rotating Your Faces](https://arxiv.org/abs/1705.11136)
* DRAGAN - [How to Train Your DRAGAN](https://arxiv.org/abs/1705.07215)
* DSP-GAN - [Depth Structure Preserving Scene Image Generation](https://arxiv.org/abs/1706.00212)
* DTN - [Unsupervised Cross-Domain Image Generation](https://arxiv.org/abs/1611.02200)
* DualGAN - [DualGAN: Unsupervised Dual Learning for Image-to-Image Translation](https://arxiv.org/abs/1704.02510v1)
* Dualing GAN - [Dualing GANs](https://arxiv.org/abs/1706.06216)
* EBGAN - [Energy-based Generative Adversarial Network](https://arxiv.org/abs/1609.03126v4)
* EGAN - [Enhanced Experience Replay Generation for Efficient Reinforcement Learning](https://arxiv.org/abs/1705.08245)
* f-GAN - [f-GAN: Training Generative Neural Samplers using Variational Divergence Minimization](https://arxiv.org/abs/1606.00709)
* FF-GAN - [Towards Large-Pose Face Frontalization in the Wild](https://arxiv.org/abs/1704.06244)
* Fila-GAN - [Synthesizing Filamentary Structured Images with GANs](https://arxiv.org/abs/1706.02185)
* Fisher GAN - [Fisher GAN](https://arxiv.org/abs/1705.09675)
* Flow-GAN [Flow-GAN: Bridging implicit and prescribed learning in generative models](https://arxiv.org/abs/1705.08868)
* GAN - [Generative Adversarial Networks](https://arxiv.org/abs/1406.2661)
* GANCS - [Deep Generative Adversarial Networks for Compressed Sensing Automates MRI](https://arxiv.org/abs/1706.00051)
* GAWWN - [Learning What and Where to Draw](https://arxiv.org/abs/1610.02454)
* GeneGAN - [GeneGAN: Learning Object Transfiguration and Attribute Subspace from Unpaired Data](https://arxiv.org/abs/1705.04932)
* Geometric GAN - [Geometric GAN](https://arxiv.org/abs/1705.02894)
* GMAN - [Generative Multi-Adversarial Networks](http://arxiv.org/abs/1611.01673)
* GMM-GAN - [Towards Understanding the Dynamics of Generative Adversarial Networks](https://arxiv.org/abs/1706.09884)
* GoGAN - [Gang of GANs: Generative Adversarial Networks with Maximum Margin Ranking](https://arxiv.org/abs/1704.04865)
* GP-GAN - [GP-GAN: Towards Realistic High-Resolution Image Blending](https://arxiv.org/abs/1703.07195)
* GRAN - [Generating images with recurrent adversarial networks](https://arxiv.org/abs/1602.05110)
* IAN - [Neural Photo Editing with Introspective Adversarial Networks](https://arxiv.org/abs/1609.07093)
* IcGAN - [Invertible Conditional GANs for image editing](https://arxiv.org/abs/1611.06355)
* ID-CGAN - [Image De-raining Using a Conditional Generative Adversarial Network](https://arxiv.org/abs/1701.05957v3)
* iGAN - [Generative Visual Manipulation on the Natural Image Manifold](https://arxiv.org/abs/1609.03552v2)
* Improved GAN - [Improved Techniques for Training GANs](https://arxiv.org/abs/1606.03498)
* InfoGAN - [InfoGAN: Interpretable Representation Learning by Information Maximizing Generative Adversarial Nets](https://arxiv.org/abs/1606.03657v1)
* IRGAN - [IRGAN: A Minimax Game for Unifying Generative and Discriminative Information Retrieval Models](https://arxiv.org/abs/1705.10513v1)
* IWGAN - [On Unifying Deep Generative Models](https://arxiv.org/abs/1706.00550)
* l-GAN - [Representation Learning and Adversarial Generation of 3D Point Clouds](https://arxiv.org/abs/1707.02392)
* LAGAN - [Learning Particle Physics by Example: Location-Aware Generative Adversarial Networks for Physics Synthesis](https://arxiv.org/abs/1701.05927)
* LAPGAN - [Deep Generative Image Models using a Laplacian Pyramid of Adversarial Networks](https://arxiv.org/abs/1506.05751)
* LR-GAN - [LR-GAN: Layered Recursive Generative Adversarial Networks for Image Generation](https://arxiv.org/abs/1703.01560v1)
* LS-GAN - [Loss-Sensitive Generative Adversarial Networks on Lipschitz Densities](https://arxiv.org/abs/1701.06264v5)
* LSGAN - [Least Squares Generative Adversarial Networks](https://arxiv.org/abs/1611.04076v3)

GAN ZOO - Suite 2

* MAD-GAN - [Multi-Agent Diverse Generative Adversarial Networks](https://arxiv.org/abs/1704.02906)
* MAGAN - [MAGAN: Margin Adaptation for Generative Adversarial Networks](https://arxiv.org/abs/1704.03817v1)
* MalGAN - [Generating Adversarial Malware Examples for Black-Box Attacks Based on GAN](https://arxiv.org/abs/1702.05983v1)
* MaliGAN - [Maximum-Likelihood Augmented Discrete Generative Adversarial Networks](https://arxiv.org/abs/1702.07983)
* MARTA-GAN - [Deep Unsupervised Representation Learning for Remote Sensing Images](https://arxiv.org/abs/1612.08879)
* McGAN - [McGan: Mean and Covariance Feature Matching GAN](https://arxiv.org/abs/1702.08398v1)
* MDGAN - [Mode Regularized Generative Adversarial Networks](https://arxiv.org/abs/1612.02136)
* MedGAN - [Generating Multi-label Discrete Electronic Health Records using Generative Adversarial Networks](https://arxiv.org/abs/1703.06490v1)
* MGAN - [Precomputed Real-Time Texture Synthesis with Markovian Generative Adversarial Networks](https://arxiv.org/abs/1604.04382)
* MIX+GAN - [Generalization and Equilibrium in Generative Adversarial Nets (GANs)](https://arxiv.org/abs/1703.00573v3)
* MMD-GAN - [MMD GAN: Towards Deeper Understanding of Moment Matching Network](https://arxiv.org/abs/1705.08584)
* MoCoGAN - [MoCoGAN: Decomposing Motion and Content for Video Generation](https://arxiv.org/abs/1707.04993)
* MPM-GAN - [Message Passing Multi-Agent GANs](https://arxiv.org/abs/1612.01294)
* MV-BiGAN - [Multi-view Generative Adversarial Networks](https://arxiv.org/abs/1611.02019v1)
* ORGAN - [Objective-Reinforced Generative Adversarial Networks (ORGAN) for Sequence Generation Models](https://arxiv.org/abs/1705.10843)
* PAN - [Perceptual Adversarial Networks for Image-to-Image Transformation](https://arxiv.org/abs/1706.09138)
* Perceptual GAN - [Perceptual Generative Adversarial Networks for Small Object Detection](https://arxiv.org/abs/1706.05274)
* pix2pix - [Image-to-Image Translation with Conditional Adversarial Networks](https://arxiv.org/abs/1611.07004)
* PixelGAN - [PixelGAN Autoencoders](https://arxiv.org/abs/1706.00531)
* Pose-GAN - [The Pose Knows: Video Forecasting by Generating Pose Futures](https://arxiv.org/abs/1705.00053)
* PPGN - [Plug & Play Generative Networks: Conditional Iterative Generation of Images in Latent Space](https://arxiv.org/abs/1612.00005)
* PrGAN - [3D Shape Induction from 2D Views of Multiple Objects](https://arxiv.org/abs/1612.05872)
* PSGAN - [Learning Texture Manifolds with the Periodic Spatial GAN](http://arxiv.org/abs/1705.06566)
* RankGAN - [Adversarial Ranking for Language Generation](https://arxiv.org/abs/1705.11001)
* RCGAN - [Real-valued (Medical) Time Series Generation with Recurrent Conditional GANs](https://arxiv.org/abs/1706.02633)
* RenderGAN - [RenderGAN: Generating Realistic Labeled Data](https://arxiv.org/abs/1611.01331)
* ResGAN - [Generative Adversarial Network based on Resnet for Conditional Image Restoration](https://arxiv.org/abs/1707.04881)
* RPGAN - [Stabilizing GAN Training with Multiple Random Projections](https://arxiv.org/abs/1705.07831)
* RNN-WGAN - [Language Generation with Recurrent Generative Adversarial Networks without Pre-training](https://arxiv.org/abs/1706.01399)
* RTT-GAN - [Recurrent Topic-Transition GAN for Visual Paragraph Generation](https://arxiv.org/abs/1703.07022v2)
* RWGAN - [Relaxed Wasserstein with Applications to GANs](https://arxiv.org/abs/1705.07164)
* S^2GAN - [Generative Image Modeling using Style and Structure Adversarial Networks](https://arxiv.org/abs/1603.05631v2)
* SAD-GAN - [SAD-GAN: Synthetic Autonomous Driving using Generative Adversarial Networks](https://arxiv.org/abs/1611.08788v1)
* SalGAN - [SalGAN: Visual Saliency Prediction with Generative Adversarial Networks](https://arxiv.org/abs/1701.01081v2)
* SBADA-GAN - [From source to target and back: symmetric bi-directional adaptive GAN](https://arxiv.org/abs/1705.08824)
* SD-GAN - [Semantically Decomposing the Latent Spaces of Generative Adversarial Networks](https://arxiv.org/abs/1705.07904)
* SegAN - [SegAN: Adversarial Network with Multi-scale L1 Loss for Medical Image Segmentation](https://arxiv.org/abs/1706.01805)
* SeGAN - [SeGAN: Segmenting and Generating the Invisible](https://arxiv.org/abs/1703.10239)
* SEGAN - [SEGAN: Speech Enhancement Generative Adversarial Network](https://arxiv.org/abs/1703.09452v1)
* SeqGAN - [SeqGAN: Sequence Generative Adversarial Nets with Policy Gradient](https://arxiv.org/abs/1609.05473v5)

GAN ZOO - Fin

* SGAN - [Stacked Generative Adversarial Networks](https://arxiv.org/abs/1612.04357)
* SGAN - [Texture Synthesis with Spatial Generative Adversarial Networks](https://arxiv.org/abs/1611.08207)
* SGAN - [Steganographic Generative Adversarial Networks](https://arxiv.org/abs/1703.05502)
* SimGAN - [Learning from Simulated and Unsupervised Images through Adversarial Training](https://arxiv.org/abs/1612.07828)
* SketchGAN - [Adversarial Training For Sketch Retrieval](https://arxiv.org/abs/1607.02748)
* SL-GAN - [Semi-Latent GAN: Learning to generate and modify facial images from attributes](https://arxiv.org/abs/1704.02166)
* Softmax-GAN - [Softmax GAN](https://arxiv.org/abs/1704.06191)
* SRGAN - [Photo-Realistic Single Image Super-Resolution Using a Generative Adversarial Network](https://arxiv.org/abs/1609.04802v3)
* ss-InfoGAN - [Guiding InfoGAN with Semi-Supervision](https://arxiv.org/abs/1707.04487)
* SSGAN - [SSGAN: Secure Steganography Based on Generative Adversarial Networks](https://arxiv.org/abs/1707.01613)
* SSL-GAN - [Semi-Supervised Learning with Context-Conditional Generative Adversarial Networks](https://arxiv.org/abs/1611.06430v1)
* ST-GAN - [Style Transfer Generative Adversarial Networks: Learning to Play Chess Differently](https://arxiv.org/abs/1702.06762)
* StackGAN - [StackGAN: Text to Photo-realistic Image Synthesis with Stacked Generative Adversarial Networks](https://arxiv.org/abs/1612.03242)
* SteinGAN - [Learning Deep Energy Models: Contrastive Divergence vs. Amortized MLE](https://arxiv.org/abs/1707.00797)
* TAC-GAN - [TAC-GAN - Text Conditioned Auxiliary Classifier Generative Adversarial Network](https://arxiv.org/abs/1703.06412)
* TAN - [Outline Colorization through Tandem Adversarial Networks](https://arxiv.org/abs/1704.08834)
* TextureGAN - [TextureGAN: Controlling Deep Image Synthesis with Texture Patches](https://arxiv.org/abs/1706.02823)
* TGAN - [Temporal Generative Adversarial Nets](https://arxiv.org/abs/1611.06624v1)
* TP-GAN - [Beyond Face Rotation: Global and Local Perception GAN for Photorealistic and Identity Preserving Frontal View Synthesis](https://arxiv.org/abs/1704.04086)
* Triple-GAN - [Triple Generative Adversarial Nets](https://arxiv.org/abs/1703.02291v2)
* Unrolled GAN - [Unrolled Generative Adversarial Networks](https://arxiv.org/abs/1611.02163)
* VAE-GAN - [Autoencoding beyond pixels using a learned similarity metric](https://arxiv.org/abs/1512.09300)
* VariGAN - [Multi-View Image Generation from a Single-View](https://arxiv.org/abs/1704.04886)
* VAW-GAN - [Voice Conversion from Unaligned Corpora using Variational Autoencoding Wasserstein Generative Adversarial Networks](https://arxiv.org/abs/1704.00849)
* VEEGAN - [VEEGAN: Reducing Mode Collapse in GANs using Implicit Variational Learning](https://arxiv.org/abs/1705.07761)
* VGAN - [Generating Videos with Scene Dynamics](https://arxiv.org/abs/1609.02612)
* VGAN - [Generative Adversarial Networks as Variational Training of Energy Based Models](https://arxiv.org/abs/1611.01799)
* ViGAN - [Image Generation and Editing with Variational Info Generative Adversarial Networks](https://arxiv.org/abs/1701.04568v1)
* WaterGAN - [WaterGAN: Unsupervised Generative Network to Enable Real-time Color Correction of Monocular Underwater Images](https://arxiv.org/abs/1702.07392v1)
* WGAN - [Wasserstein GAN](https://arxiv.org/abs/1701.07875v2)
* WGAN-GP - [Improved Training of Wasserstein GANs](https://arxiv.org/abs/1704.00028)
* WS-GAN - [Weakly Supervised Generative Adversarial Networks for 3D Reconstruction](https://arxiv.org/abs/1705.10904)

GAN ZOO - Fin?

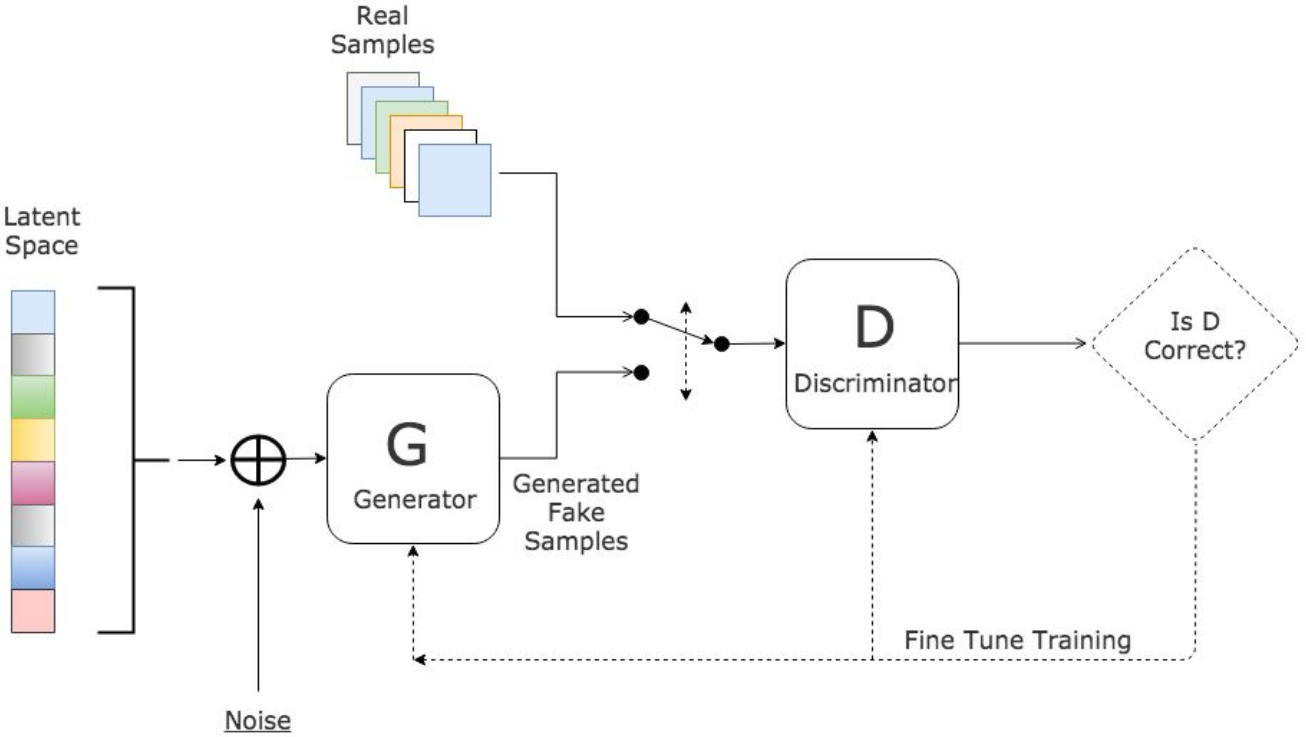
Ian Goodfellow
@goodfellow_ian

Follow

"We use the Greek α prefix for α-GAN, as AEGAN and most other Latin prefixes seem to have been taken" arxiv.org/pdf/1706.04987...
:D

MILA

Generative Adversarial Network



http://www.kdnuggets.com/2017/01/generative-adversarial-networks-hot-topic-machine-learning.html

MILA

Mais à quoi ça sert?

- Simulation
  - Environnement
  - Données d'entraînement

- Données manquantes
  - Inpainting
  - Débruitage
  - Super-résolution

- Génération
  - Texte vers Parole
  - Texte vers Image
  - Image vers Image
  - Art

- **Simulation**
  - Environnement
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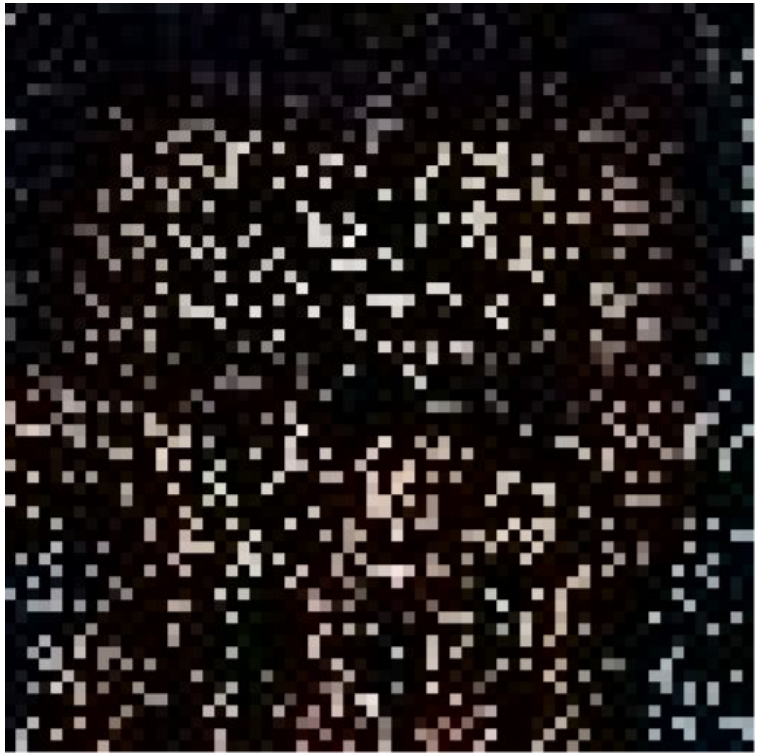
Qu’est-ce que c’est?



Yeh et al. 2016

Un visage!

Yeh et al. 2016

Restoration de document

Yeh et al. 2016

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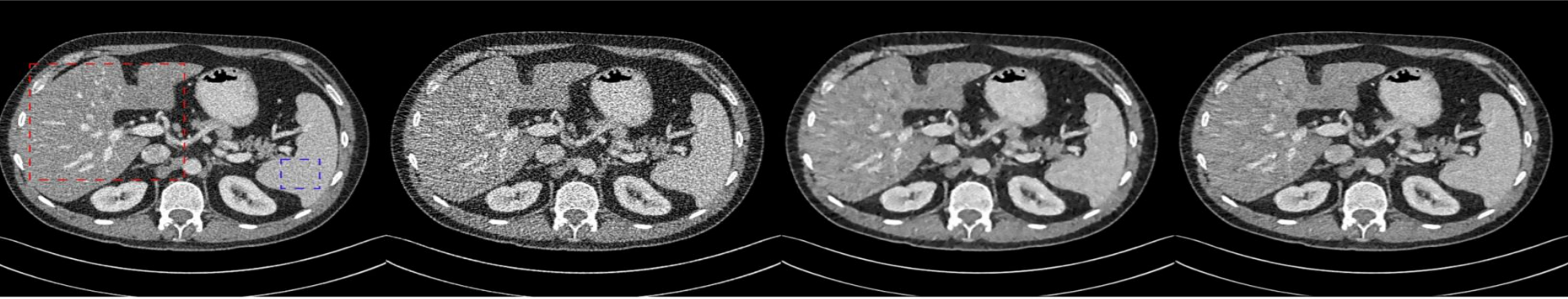
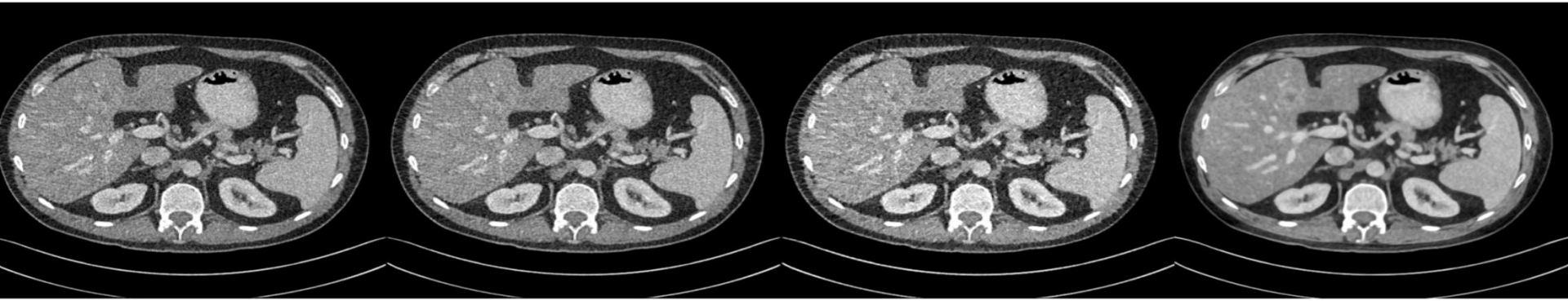


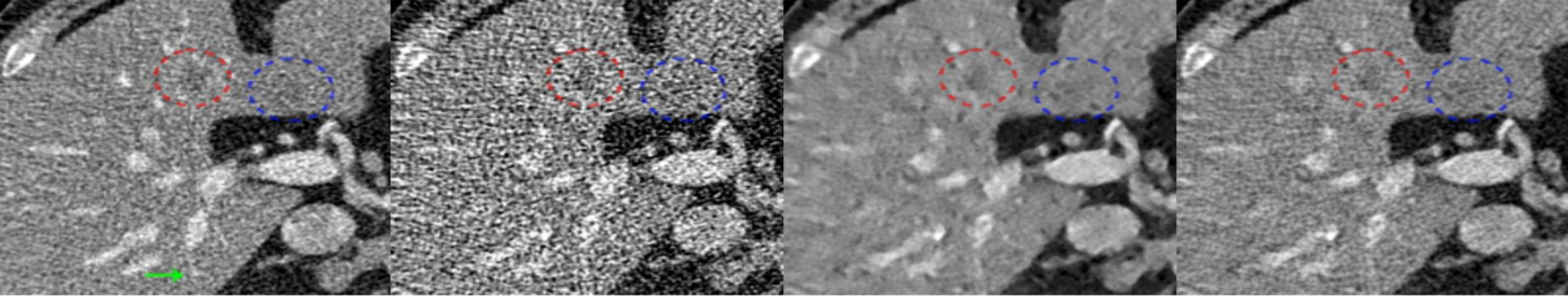
(a) Full Dose FBP Recon (b) Quarter Dose FBP Recon (c) CNN-MSE (d) WGAN-MSE



(e) CNN-VGG (f) WGAN-VGG (g) WGAN (h) DictRecon

Yang et al. 2017

MILA



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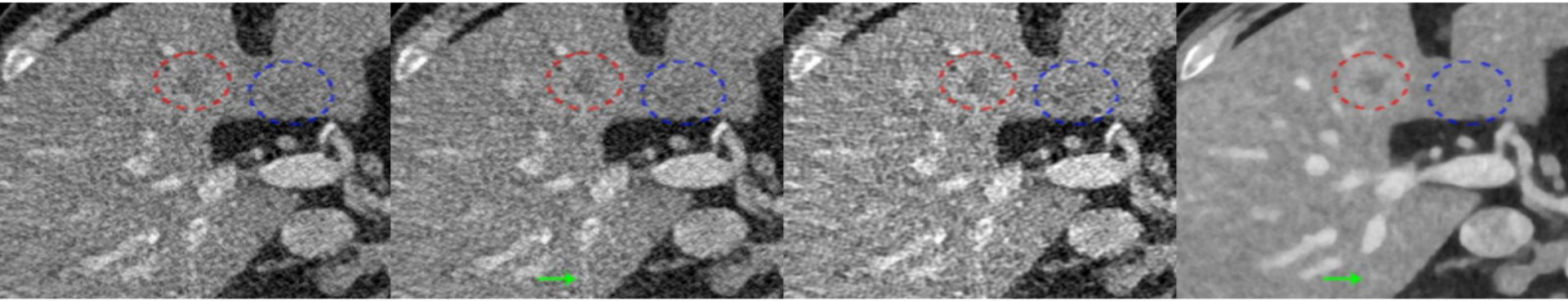

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Yang et al. 2017

MILA

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CSI:
CRIME SCENE INVESTIGATION
See if you can enhance that license plate.
First in Flight
WYW-1747
NORTH CAROLINA
Got him.
Wait, zoom in on that screw

MILA

bicubic
(21.59dB/0.6423)

SRResNet
(23.53dB/0.7832)

SRGAN
(21.15dB/0.6868)

original

[Ledig et al. 2017]

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Wavenet

lyrebird.ai

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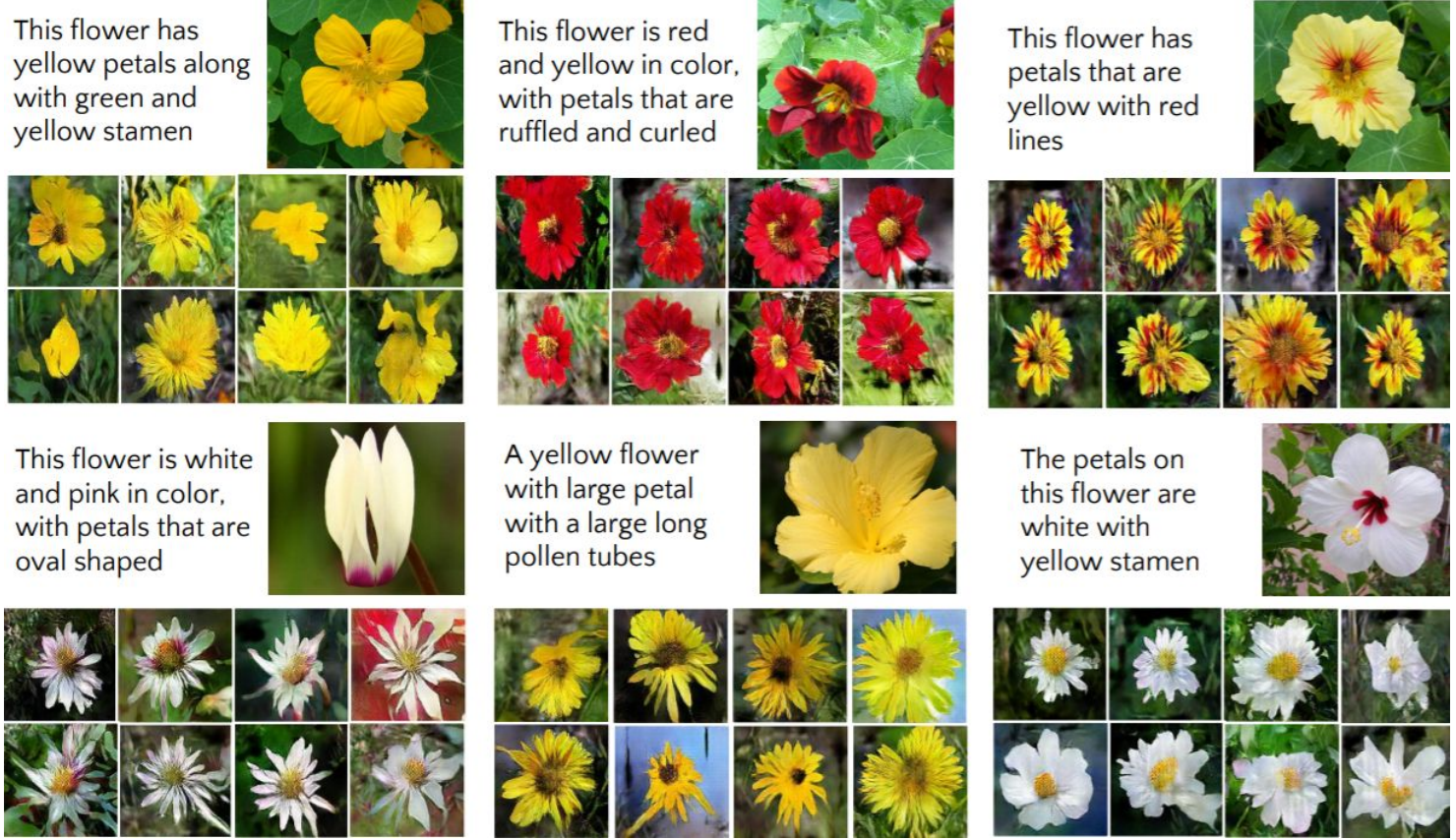
This bird is red and brown in color, with a stubby beak	The bird is short and stubby with yellow on its body	A bird with a medium orange bill white body gray wings and webbed feet	This small black bird has a short, slightly curved bill and long legs	A small bird with varying shades of brown with white under the eyes	A small yellow bird with a black crown and a short black pointed beak	This small bird has a white breast, light grey head, and black wings and tail

[Zhang et al. 2017]

MILA



[Dash et al. 2017]

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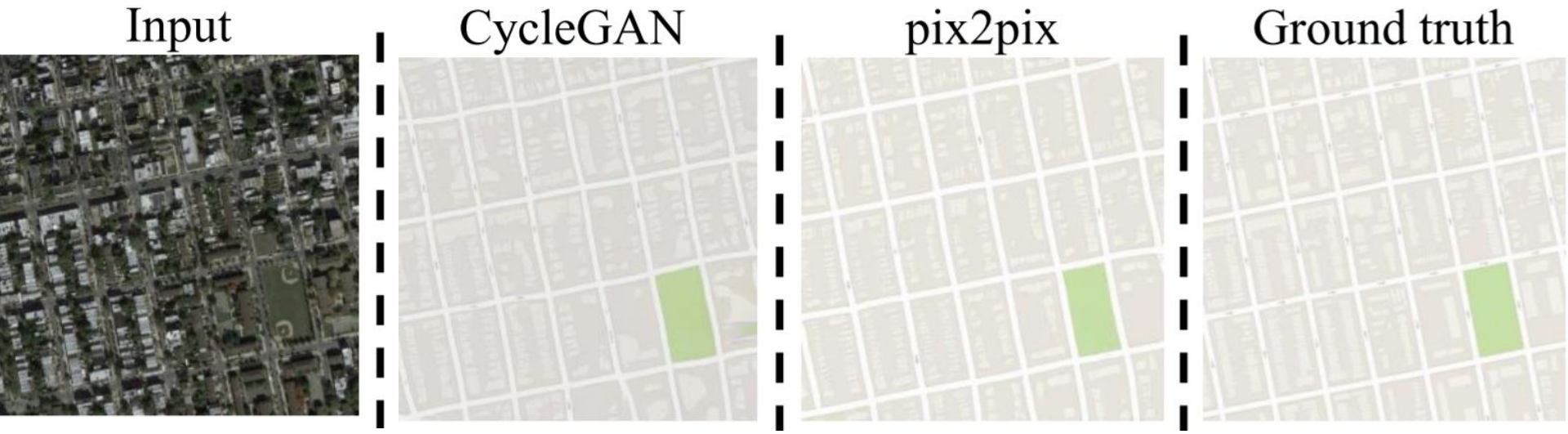
pix2pix

Colorisation de photo historique

Lucy Li

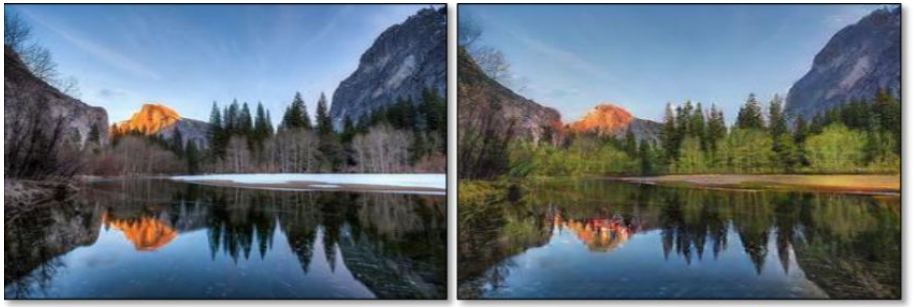
MILA

Création de carte à partir d'image satellite



Zhu et al. 2017

Changement de saison dans une photo



winter Yosemite → summer Yosemite

summer Yosemite → winter Yosemite

[Zhu et al. 2017]

Transfiguration d'animaux

https://github.com/tatsuyah/CycleGAN-Models

https://twitter.com/jointentropy/status/867148895457091584

MILA

Transfiguration d’animaux en vidéo

Zhu et al. 2017

MILA

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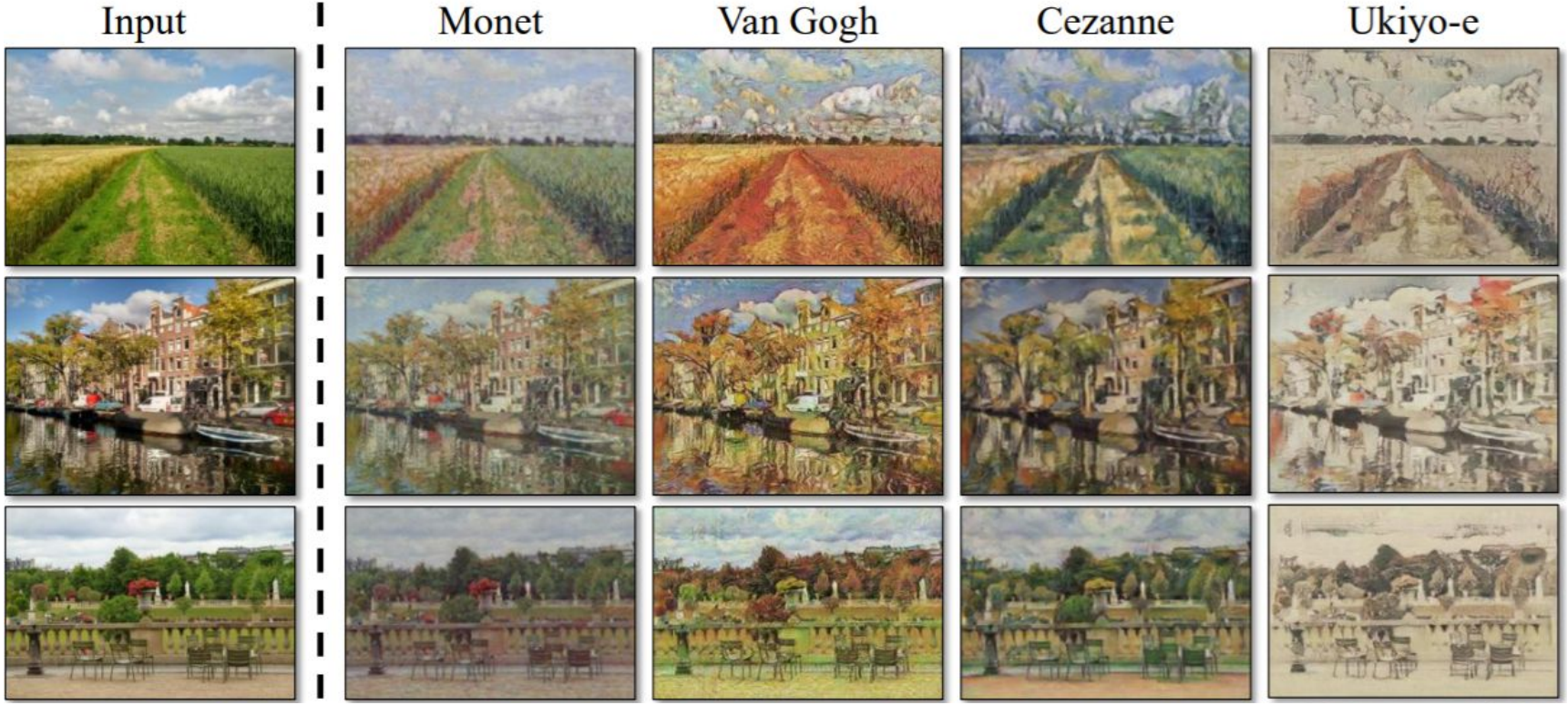
Transfert de style



[Zhu et al. 2017]

Aide à la création d'art

[Zhu et al. 2016]

Création d’art semi-automatisée

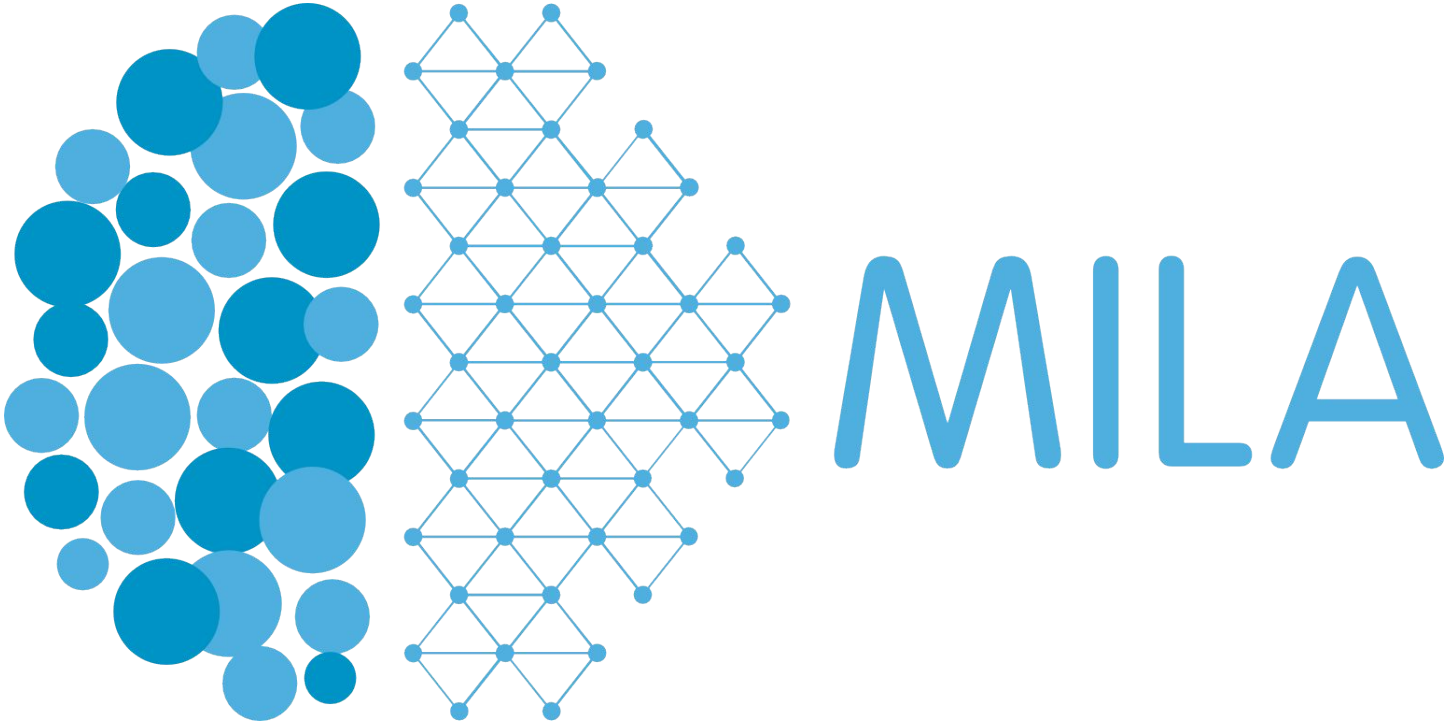
Mario Klingemann

Création d'art !?

SampleRNN - Mozart

Mehri et al. 2017

Merci!


MILA