

Creativity and Machine Learning

**Mediterranean Machine Learning
Summer School**

Dr Konstantina Palla
Spotify

29th August, 2023





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Creative

When I write: [medium](#)

When I draw:



Source: <https://konstantinapalla.netlify.app/>

What is creativity?

Can computers be creative?

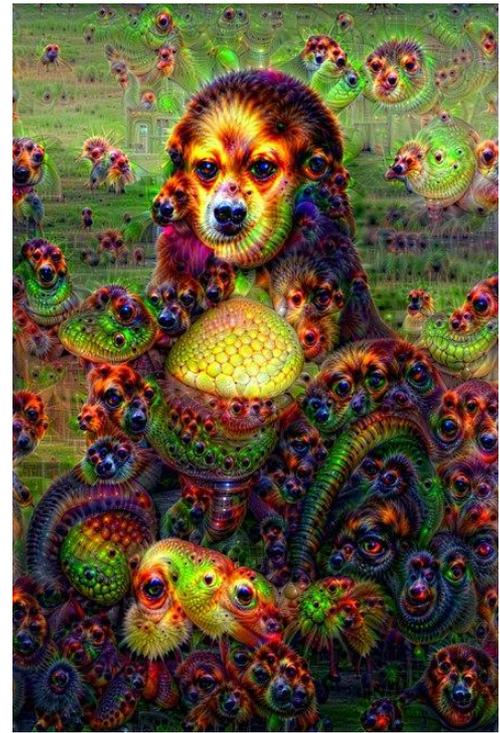
Can AI create art?

How can AI create art?

**What does this mean for the
future of art/creativity?**

Why now?

Exciting era for AI-generated art

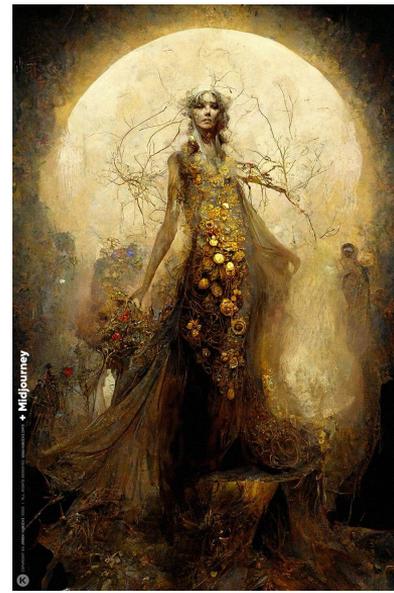


A Vincent van Gogh-inspired painting and The Mona Lisa using Google **Deep Dream**. Image courtesy of Google.

DALL-E 2 (OpenAI)



“A sea otter in the style of Girl With a Pearl Earring by Vermeer”. Credit: DALL-E (OpenAI)



“Augmented Art”, Credit: Midjourney, Jarek Kubicki



“Portrait of an older man sat in a coffee shop, shot through a window”. Credit: Midjourney v5 | Julie Wieland



Billie Eilish. Credits: AI-DA&AIDAN MELLER (2019)



The Impossible Statue (2023). Credits: Swedish National Museum of Science and Technology.



Denim Cape, created using Midjourney, G-Star Raw (2023)

AI-generated music



"Genesis" Symphonic Fantasy in A minor, Op. 21 | Aiva Technologies, 2018

Movies using AI generated images



The Frost. AI-Generated short film. Credits: DALL-E 2, Waymark / Latent Cinema, 2023



Genesis. AI-generated movie trailer. Credits: Midjourney & Runway, 2023

The
Economist

Russian assets: freeze or seize?

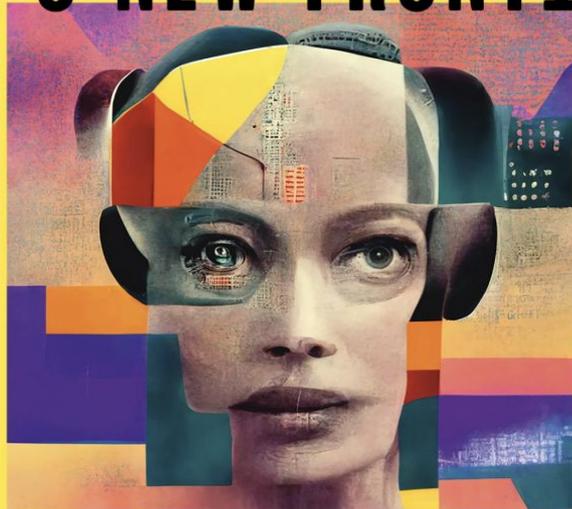
Managing in a time of stagflation

Britain's growth problem

The short-sightedness epidemic

JUNE 11TH-17TH 2022

AI'S NEW FRONTIER



New Articles | Artificial intelligence

How a computer designed this
week's cover



AI Art at Christie's Sells for \$432,500

Share full article



“Portrait of Edmond de Belamy”, GANs & Obvious, print on Canvas (2018). Image credit: Obvious



Exhibition “Faceless Portraits Transcending Time” at Chelsea’s HG Gallery

ML generated art brought into the mainstream

THE SHIFT

An A.I.-Generated Picture Won an Art Prize. Artists Aren't Happy.

"I won, and I didn't break any rules," the artwork's creator says.

Artists Worry About Survival as AI Changes the Game for Creative Work

By Wall Street Journal

Apr 17, 2023 10:33 pm



The threat that technology will replace workers is something more people are grappling with due to the introduction of new tools powered by generative artificial intelligence.

FINANCIAL TIMES

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FT Magazine Arts + Add to myFT

The golden age of AI-generated art is here. It's going to get weird

Dall-E 2 'outpainting' of Johannes Vermeer

How software that can create almost any image from a few words will change human creativity



In this talk

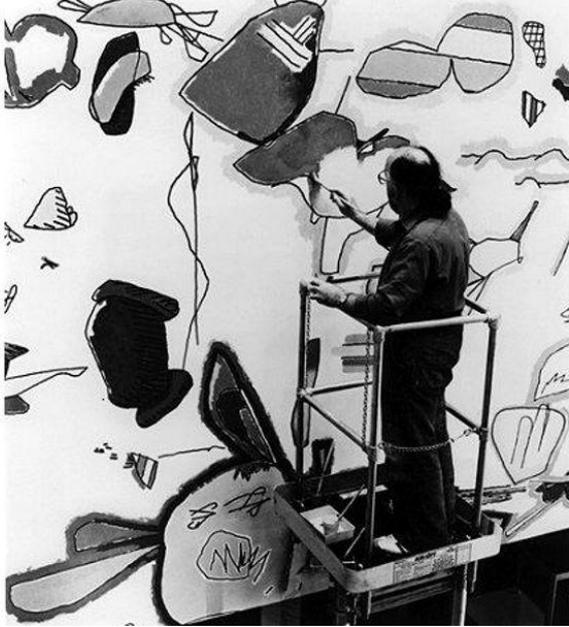
Brief history of ML and the tech that makes this all

The impact on the artist and the creative process

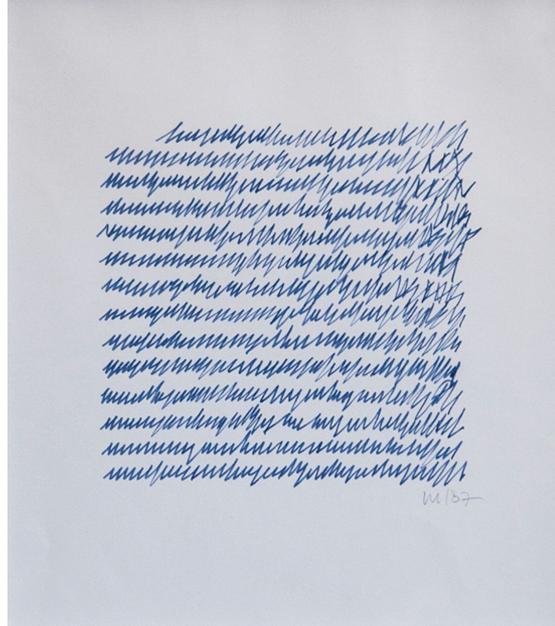
Opportunities and Challenges

Why now?

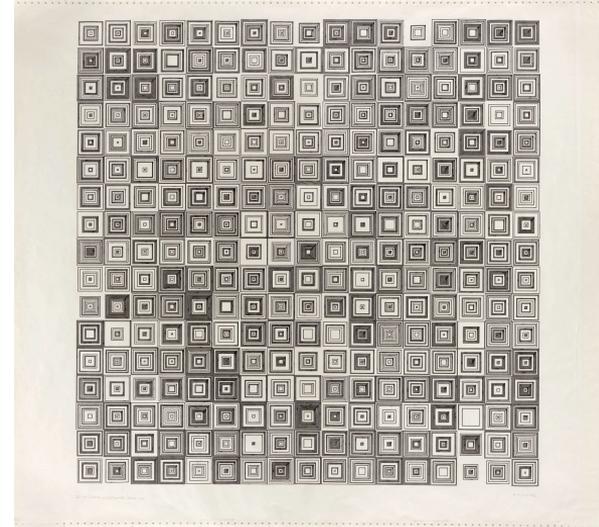
Early developments in AI art



Harold Cohen coloring the drawing produced by the AARON drawing "Turtle", ca. 1982. Collection of the Computer History Museum



Vera Molnar, *Lettres de ma Mère* ("Letter from my Mother"), 1987.



Vera Molnar, *De La Serie (Des) Ordres*, 1974

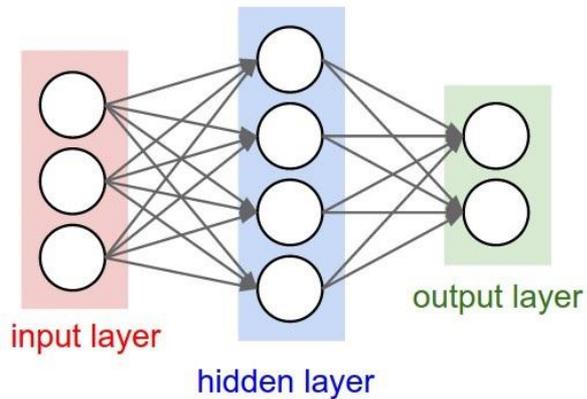


Harold Cohen's "Turtle" drawing machine, 1980

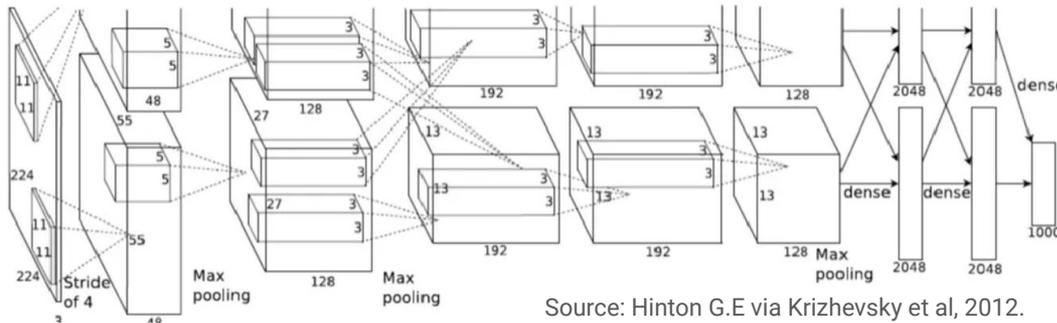
Availability of large datasets

(ImageNet, *Deng et al. 2009*)

Neural Networks



Deep Learning



Source: Hinton G.E via Krizhevsky et al, 2012.

DeepDream

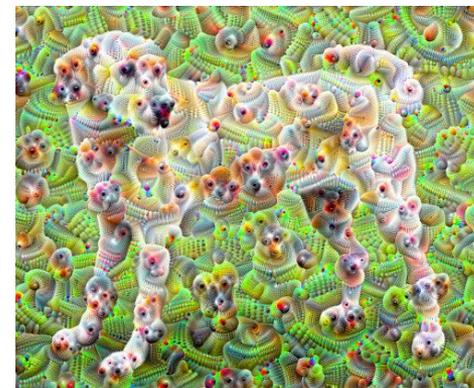
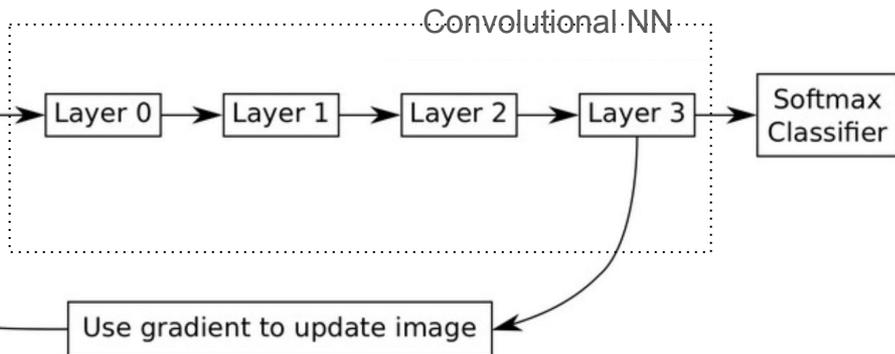
(Mordvintsev et al., 2015)

2015



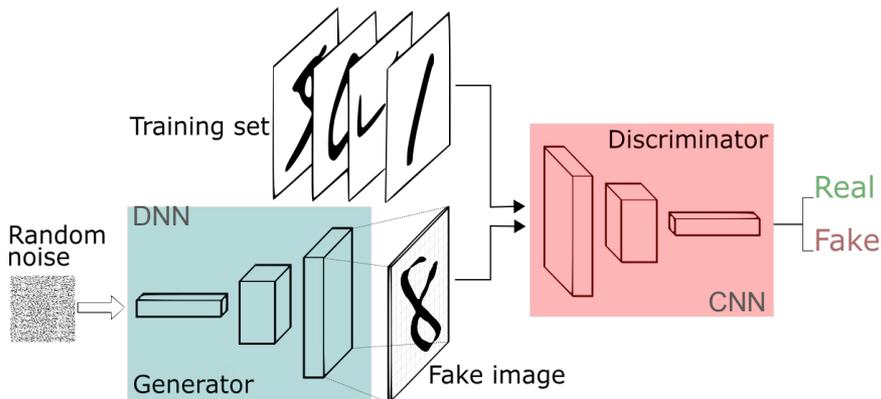
Video credit: [charlesleflamand](#)

what patterns do you see in this image? Now amplify it.



The birth of Generative AI

Generation of new, never-before-seen content



Source: blog, <https://sthalles.github.io/intro-to-gans/>

GAN loss

$$E_x[\log(D(x))] + E_z[\log(1 - D(G(z)))]$$

“Adversarial training is the coolest thing since sliced bread.”

— Yann LeCun

Generative Adversarial Networks

(Goodfellow et al., 2014)

Generative AI

Generation of new, never-before-seen
content

PyTorch (Facebook, 2016)
TensorFlow (Google, 2015)

The birth of GANism (ca 2017)

CycleGAN (Zhu et al., 2017), BigGAN (Brock et al., 2018)
StyleGAN (Karras et al., 2019,)...



"Memories of Passersby I", Mario Klingemann Image: ONKAOS

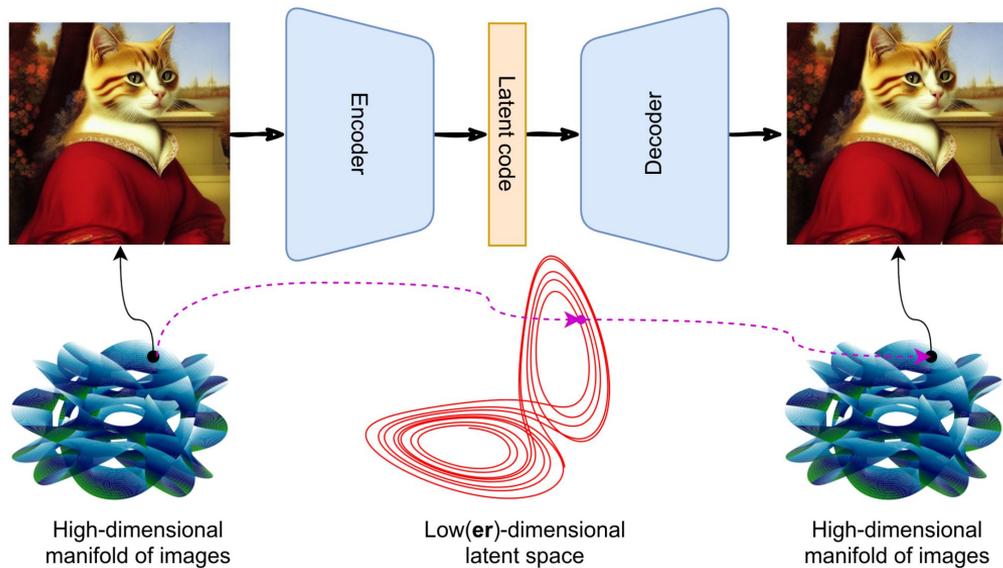


GAN generated art, Memo Akten



"AI portraits", GAN generated art, Mauro Martino, 2019

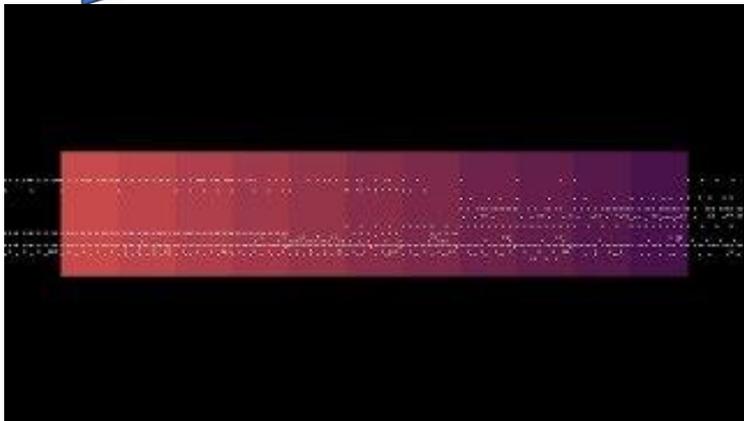
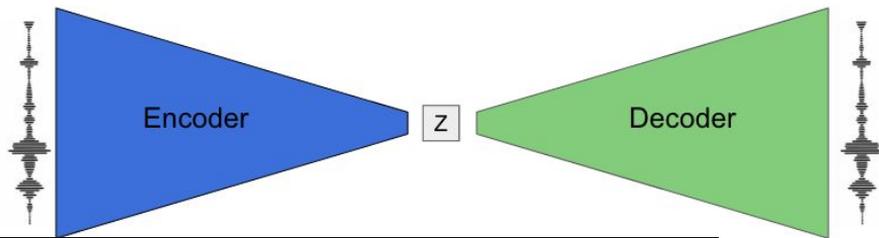
(Kingma et al., 2014)



Control over the latent space



Creation interactive and adaptive artworks



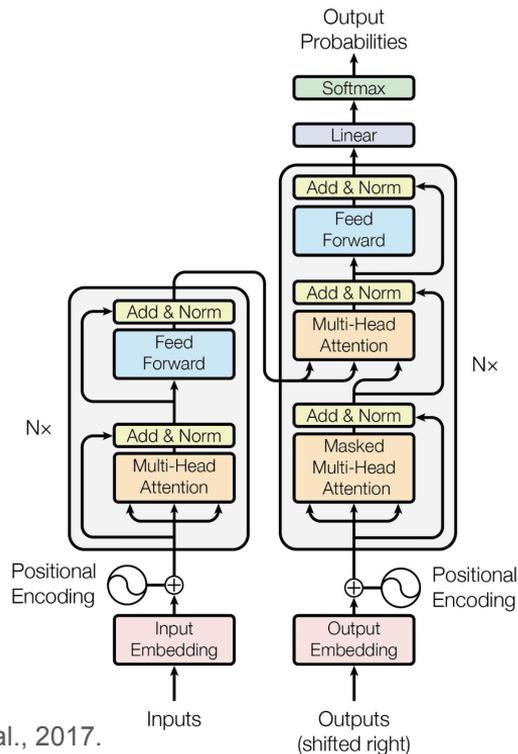
Drum 2-bar "Performance", made with MusicVAE, Credit: Magenta, 2018

Generating lyrics with variational autoencoder and multi-modal artist embeddings

Olga Vechtomova, Hareesh Bahuleyan, Amirpasha Ghabussi, Vineet John
University of Waterloo, ON, Canada
{ovechtom, hpallika, aghabuss, vineet.john}@uwaterloo.ca

Elevating Textual Understanding

(Vaswani et al., 2017)



Powerful training of larger models

Attention based, process sequential data holistically

GPT 1 (openai 2018), BERT (Devlin et al., 2018)

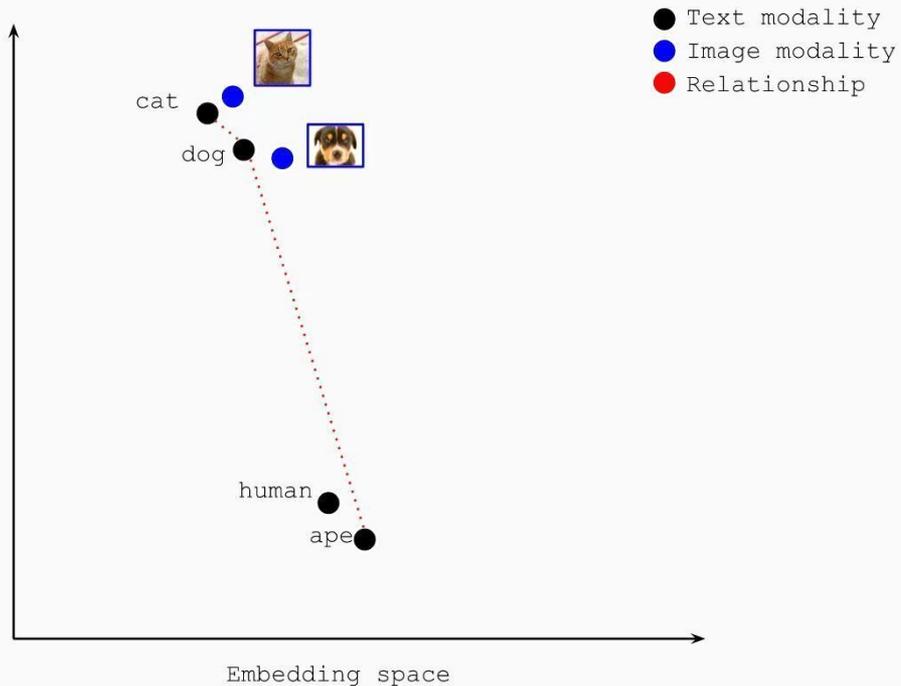
Generative AI

Elevating Textual Understanding



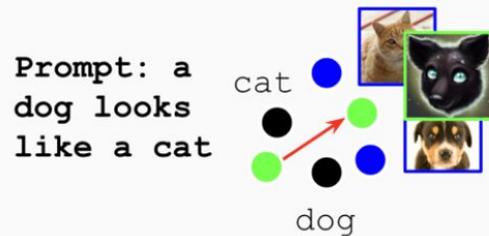
Image generation from text

The rise of AI art generated from text prompts



The ascent of multimodal models

Make new data (generative)



DALL-E

OpenAI (Ramesh et al, 2022)

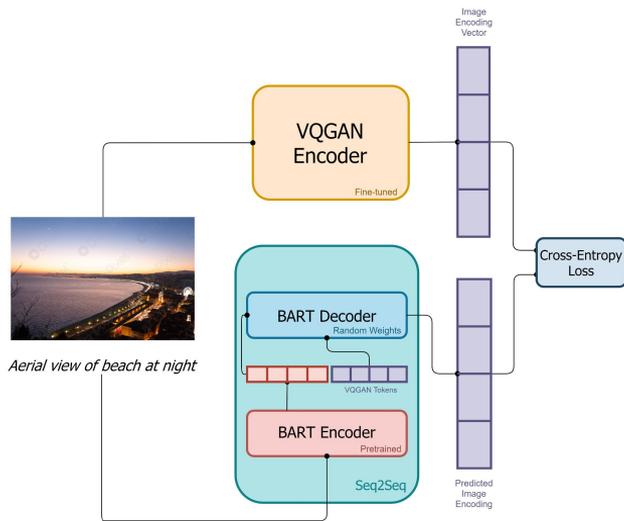


DALL-E API

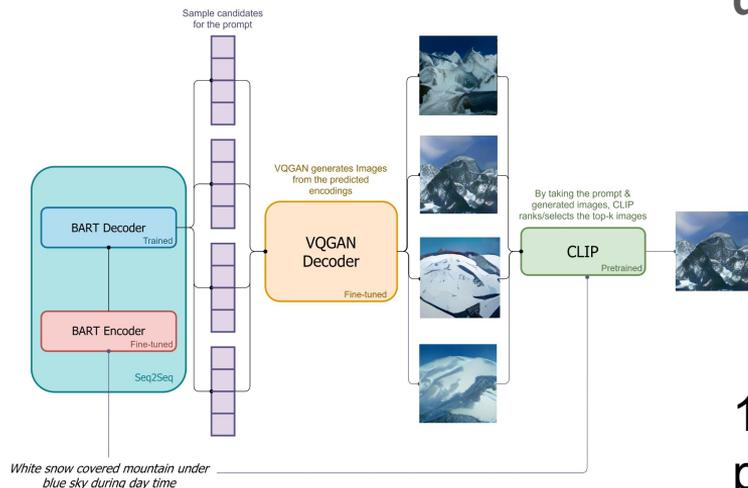
DALL-E

OpenAI (Ramesh et al, 2022)

a single model to handle both modalities; text + image



Training pipeline of DALL-E mini, Credits: Weights&Biases



Inference pipeline of DALL-E mini, Credits: Weights&Biases

Huge amount of training data!

12-billion parameters

Transformers (BART, for text) + GAN (for image)

Image generation from text

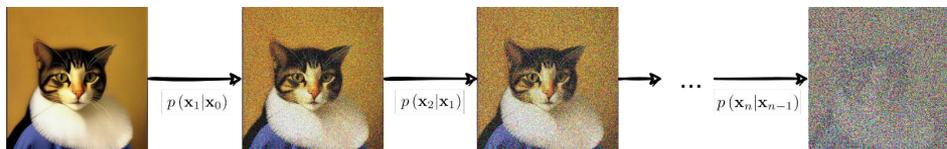
DALL-E 2 (OpenAI)

2022

Ramesh et al. (2022)

The rise of AI art generated from text prompts

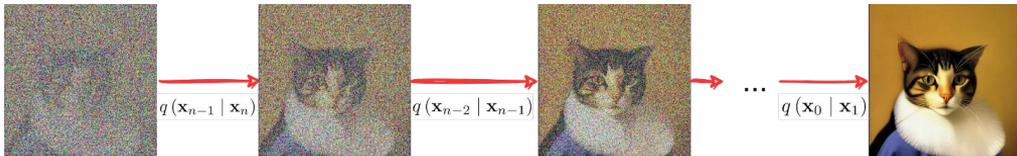
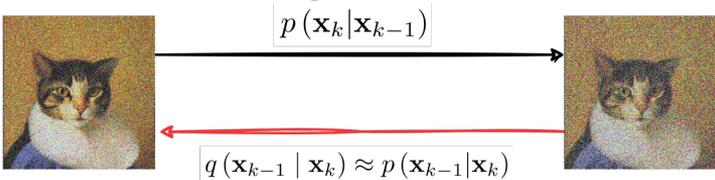
Gradual noising



Diffusion models

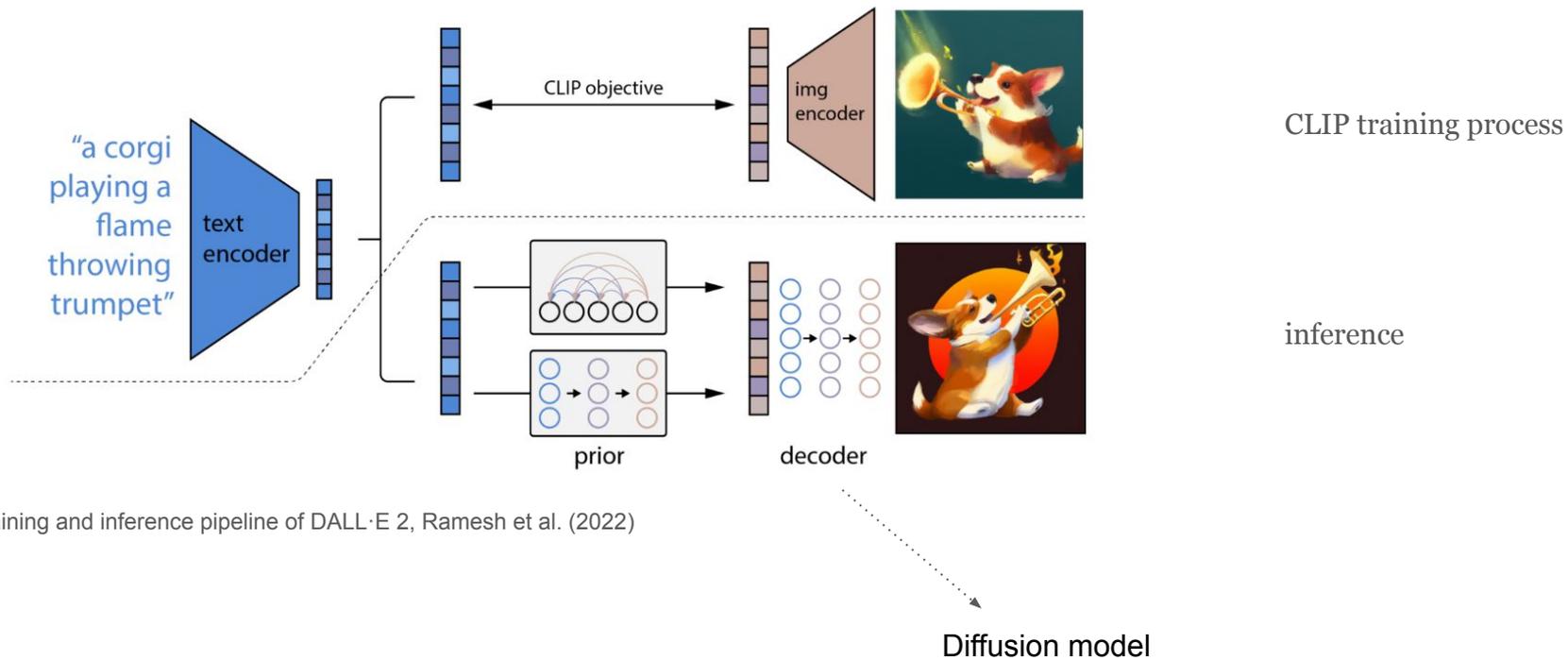
Fine grained control
High quality outputs

Gradual de-noising



regenerate crisp images from random noise

DALL-E 2



Training and inference pipeline of DALL-E 2, Ramesh et al. (2022)

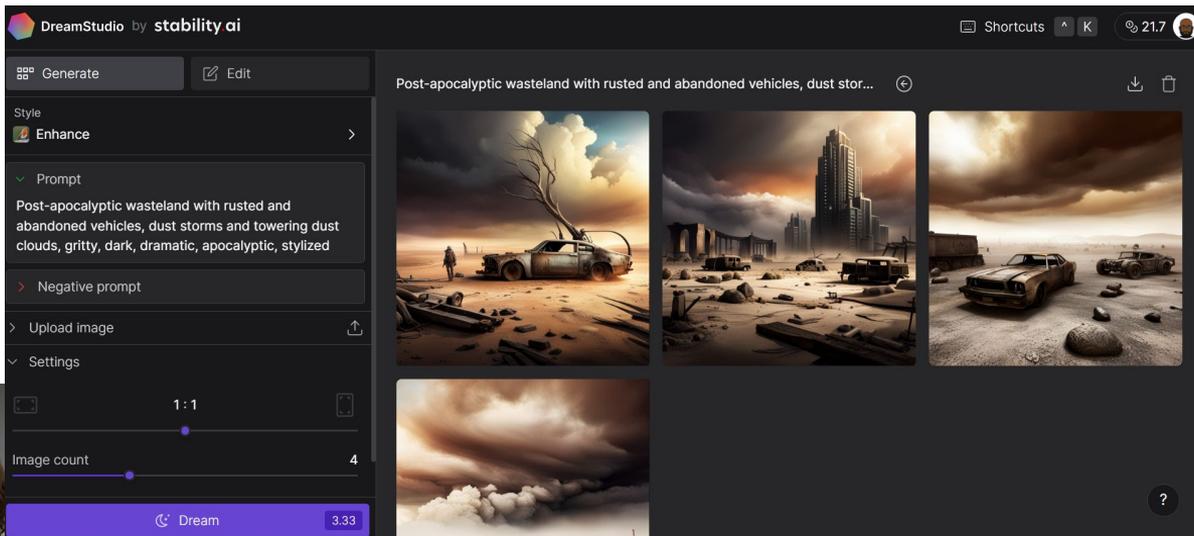
Diffusion model

Image generation from text

The rise of AI art generated from text prompts



Prompt: "A Greek Statue made from clay"
" image using Stable Diffusion, Credits: Reddit



2021

DALL-E (*openAI*)

2022

Diffusion models

DALL-E 2 (*openAI*)

Imagen (*Google*)

Midjourney

Stable Diffusion (*stability.ai*)

Why now?

data + algorithms + computing power

GANs, VAEs,
Transformers,
multimodal
architectures, Diffusion
models ...

Creativity and the artist

Creativity reimagined (... or rather evolved?)



Artist Ghanshyam Sharma in his studio, Image credit: Hashim Badani



Image credit: Maja Dabek.

AI - a new medium for creating art

Creativity reimagined (... or rather evolved?)

Art has always been a reflection of the tools available at every given moment.



"Beyond the light", Artechose

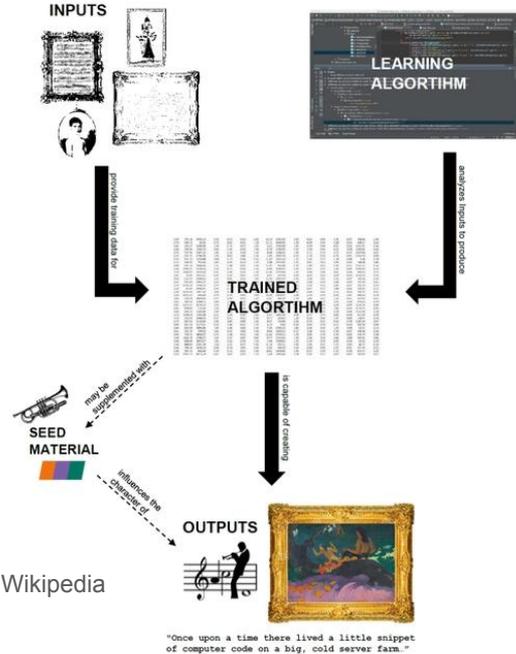


"Adam", Michelangelo



Image: Steve McCurry

The role of the artist is recast.



"The Venus de Milo", Source: Wikipedia

Image source: Fjeld et al, 2017

Co-creation



Sougwen Chung (Mutations of Presence, 2021)

“The interface is not simply a mediating apparatus for creation, but a speculative agent of co-creation.” – Sougwen Chung



Sougwen Chung & D.O.U.G._1 (Drawing Operations, 2015)



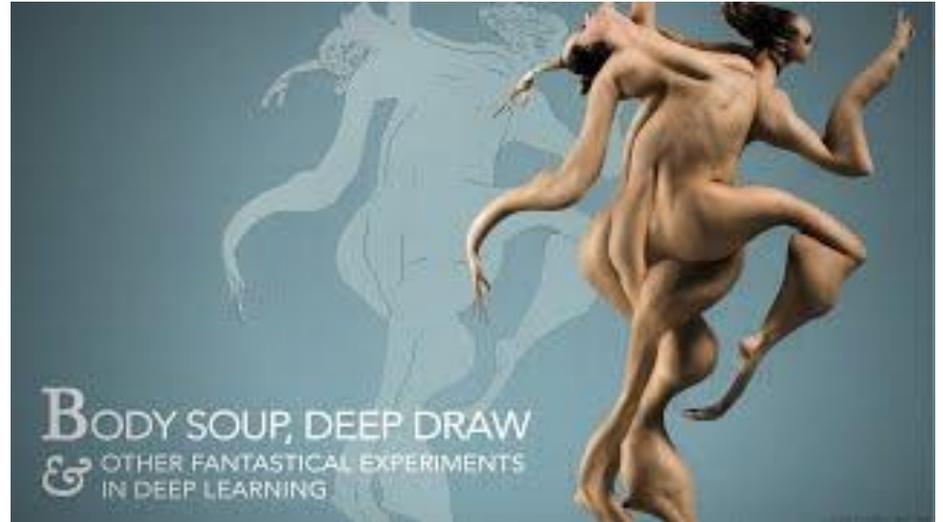
Collaboration

(part of the creative process)

“I have a “working” relationship with AI and use it as a tool, albeit a sophisticated, technically complex tool” – Scott Eaton



Figures & Forms, Scott Eaton, 2019



Harvard Business Review



July-August
2023



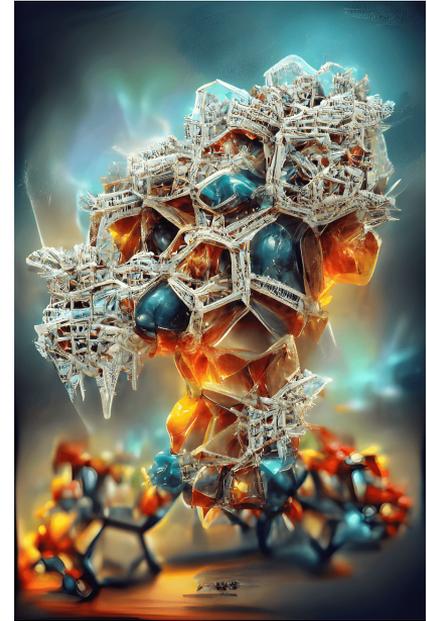
Gen AI and the New Age of Human Creativity

How revolutionary
technology can
enhance, rather than
replace, our powers
of imagination

PAGE 56

Amplifying Creativity

Amplifying Creativity



Xander Steenbrugge, *My ideas are twisting*, 2021.
Courtesy of the artist



Vadim Epstein, (Still from) *Saga*, 2021. Courtesy of the artist

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Technology

Artificially intelligent painters invent new styles of art

By Chris Barantuk

29 June 2017

f t i w v



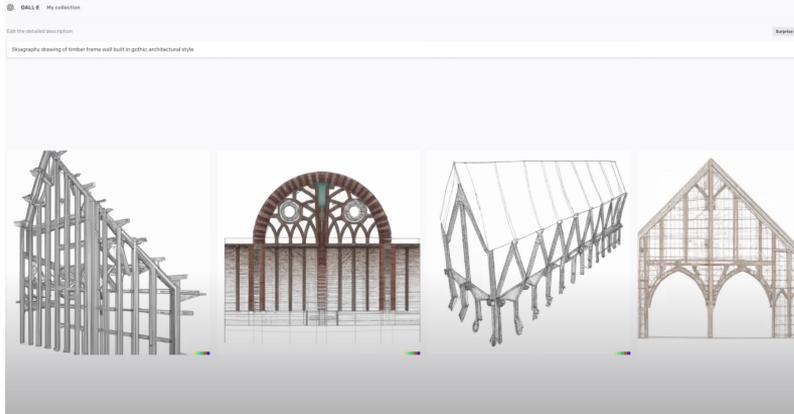
Art for the AI generation
Art and Artificial Intelligence Laboratory, Rutgers University

Inspire new creations, unconventional combinations,
new aesthetics

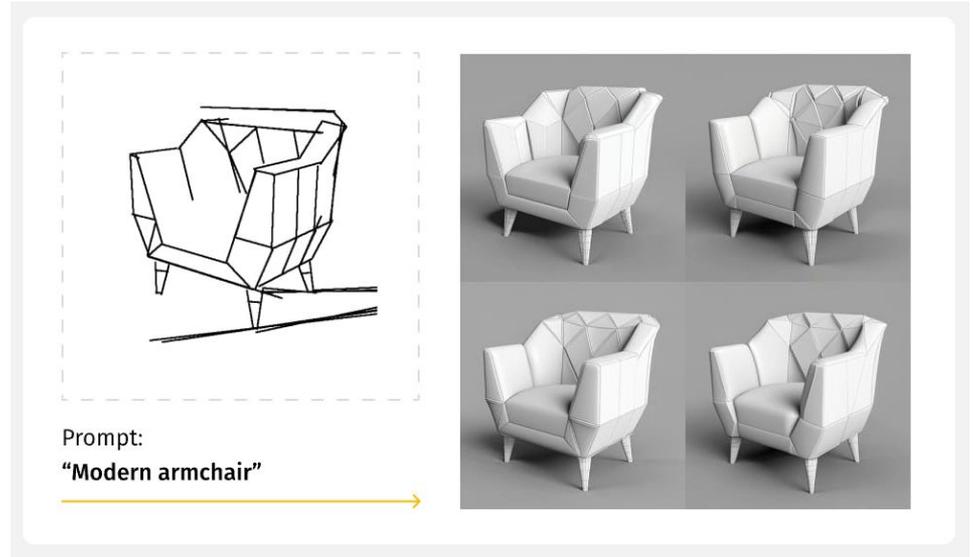
more experimentation and exploration of
different styles, techniques, and mediums.

Amplifying Creativity

Acceleration of the creative process



“Skiagraphy drawing of timber frame wall built in gothic architectural style”, built using DALL-E 2



AI generated product design concepts, built using diffusion models, Credit: Grid Dynamics

Amplifying Creativity

Democratisation of art



- Overcomes geographical barriers, fostering a globally inclusive artistic community.
- Diverse art production leads to increased representation and inclusion.
- Reduced barriers to entry: User-friendly generative AI tools require minimal technical expertise.
- Accessibility Enhancement

Sheds light into human creativity (future)

> [Front Psychol.](#) 2019 Jun 19;10:1401. doi: 10.3389/fpsyg.2019.01401. eCollection 2019.

How Artificial Intelligence Can Help Us Understand Human Creativity

[Fernand Gobet](#) ¹, [Giovanni Sala](#) ²

DOI: 10.48550/arXiv.2205.01605 • Corpus ID: 248506151

Toward Modeling Creative Processes for Algorithmic Painting

[Aaron Hertzmann](#) • Published in International Conference on... 3 May 2022 • Art

- AI a new medium for creation
- Evolution of relationship artist (creator) - technology (creative medium)
- A powerful to enhance creativity, expand boundaries for creation, test new ideas fast and effective
- Democratize creative process
- A powerful tool to provide feedback to human creativity and shed light to its intrinsic processes

Challenges

Challenges

...but also the responsibility?

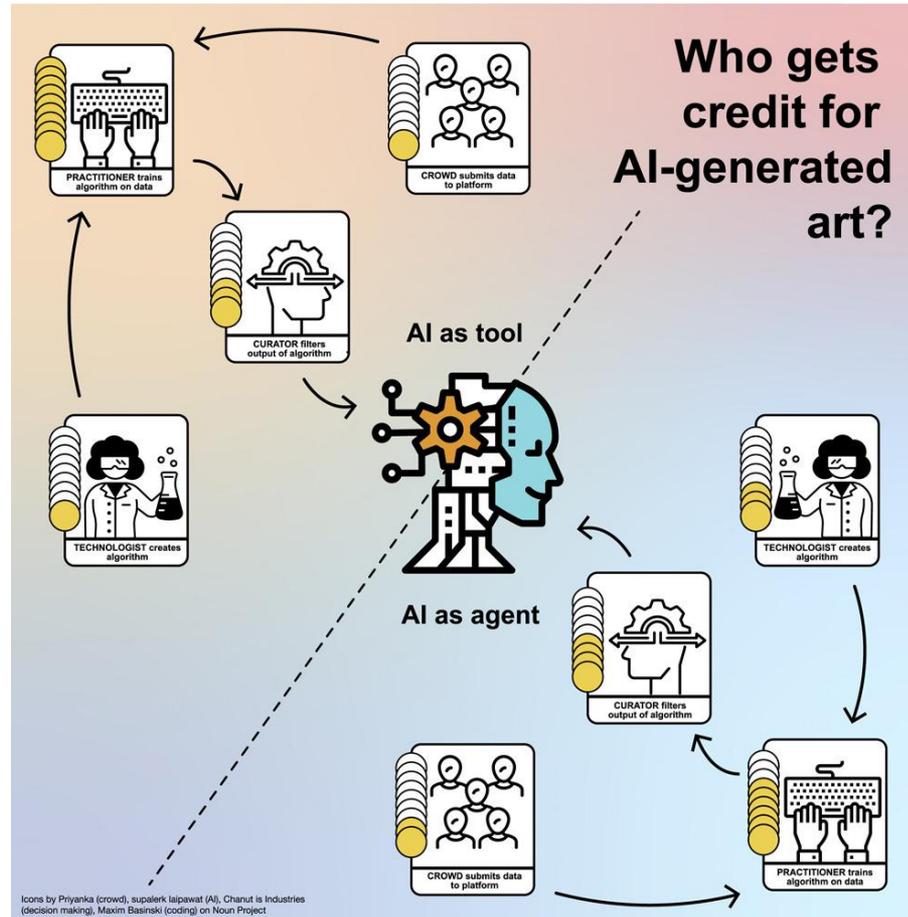


Image credit: Epstein et al. 2014

Challenges

Copyrighting an AI model's output should depend on the degree of human involvement?

Legal treatment of data
(Copyrights)

The output question(s):
can you copyright what an
AI model creates?

AI-generated art ineligible for
traditional copyright

if so, who owns it?

if you own the copyright to the *input*
used to train an AI, does that give you
any legal claim over the model or the
content it creates?

Legal treatment of data (Copyrights)

The input question: can you use copyright-protected data to train AI models?

Forbes

Getty Images Sues AI Company Over Hideous Frankenphotos

Matt Novak Senior Contributor 
FOIA reporter and founder of Paleofuture.com, writing news and opinion on every aspect of...

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 0 Feb 6, 2023, 01:46pm EST







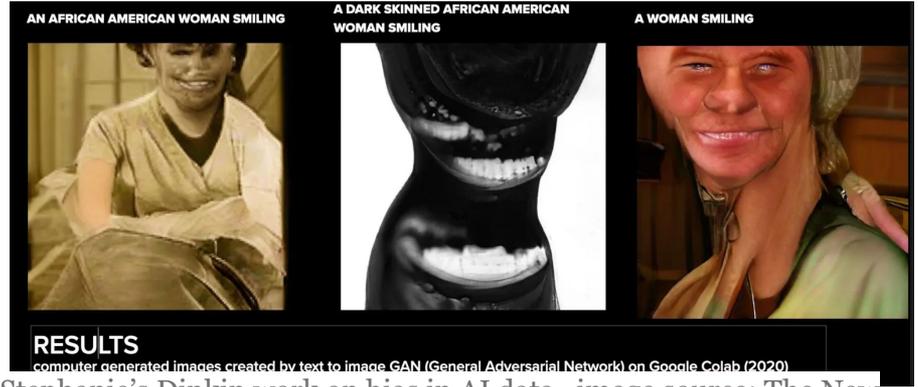
An example of an image made by Stable Diffusion, included in the lawsuit brought by Getty Images. UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE

Bias

Challenges



Example of facial distortion on DALL-E 2 program to the prompt “Black woman smiling,” including a five o'clock shadow. Source: The New York Times.



Stephanie's Dinkin work on bias in AI data, image source: The New York Times



Bias in DALL-E 2 generations. Source: Unknown

Challenges

Harmful content



AI-generated photo faking Donald Trump's possible arrest, Credit: @EloptHiggins

W B D

This Uncensored AI Art Tool Can Generate Fantasies—and Nightmares

Open source project Stable Diffusion allows anyone to conjure images with algorithms, but some fear it will be used to create unethical horrors.



AI-generated photo faking Bill's Clinton possible arrest, Credit: @EloptHiggins on Twitter using Midjourney v5.



Erosion of
trust



Image credit: DIETER KLEIN / TENEUES

What do the creators say?



Can we learn from the past?

Navigating historical parallels: Photography and portrait painting



Jabez Hogg Making a Portrait in Richard Beard's Studio, 1843 | Source: Wikipedia



"Portrait of Grand Duchess Anna", George Dawe (1824–1825)

Reshaping traditions, Paving new paths: the rise of a new genre of art

Van Gogh abandoned accurate visual depiction, since that's just photography

"You must boldly exaggerate the effects of either harmony or discord which colors produce. It is the same thing in drawing – accurate drawing, accurate color, is perhaps not the essential thing to aim at, because the reflection of reality in a mirror, if it could be caught, color and all, would not be a picture at all, no more than a photograph." – Van Gogh



"Gauguin's Chair", Vincent van Gogh. Source: Aaron Hertzmann, "How photography became an art form"

Machine Learning may not be creativity's downfall afterall

Can Machine Learning
create art?



The danger of AI
anthropomorphism



Can
computers
be
creative?

ML technological advancements introduced a new era in the creative industries.

(Generative) AI technologies are yet another artistic tool, with their own distinct affordances and in constant evolution.

Limitless potential in redefining the boundaries of artistic expression.

Continuing research, thought and inclusive discussion among stakeholders is needed to ensure the use of these technologies are beneficial.

Thank you

konstantinap@spotify.com

 @konstantina_pll



Prompt: “Mediterranean summer school in Thessaloniki”, AI generated image, image credits: Konstantina Palla created using *imagine.art*

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