

# ML Workshop Day 2

# Recap of yesterday

- Intro to ML
- Classifiers
- p5.js & ml5js
- Training a model with Teachable Machine
- Building stuff

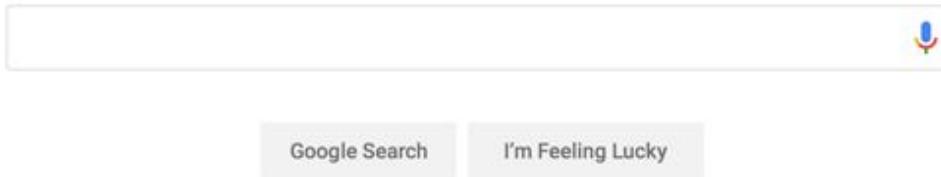
Any issues?

A photograph of a grand, multi-story library. The space is filled with floor-to-ceiling bookshelves, all neatly organized and filled with books. The architecture is classical, with tall ceilings, decorative moldings, and a central spiral staircase that connects the different levels. The lighting is soft, coming from large windows on the upper levels and small openings in the ceiling. The overall atmosphere is one of quiet reverence and historical significance.

# Search and Recommendations

Organizing content with ML

Web search is one of the most successful ML applications



goo·gle

/'goog(ə)l/

*verb*

verb: **google**; 3rd person present: **googles**; past tense: **googled**; past participle: **googled**; gerund or present participle: **googling**

search for information about (someone or something) on the Internet using the search engine Google.

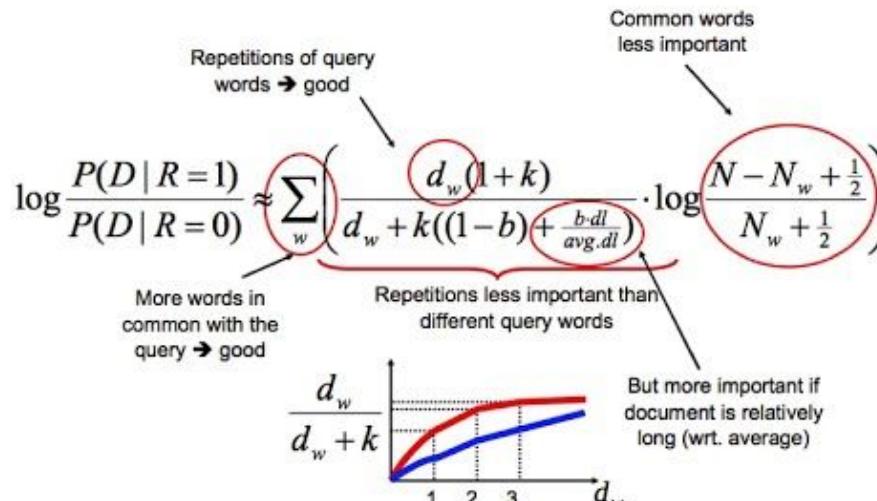
# Billions of users search over trillions of pages

2 trillion  
searches per year

130 trillion  
pages indexed

# Initial search algorithms - keyword search

Term Frequency - Inverse Document Frequency and BM25

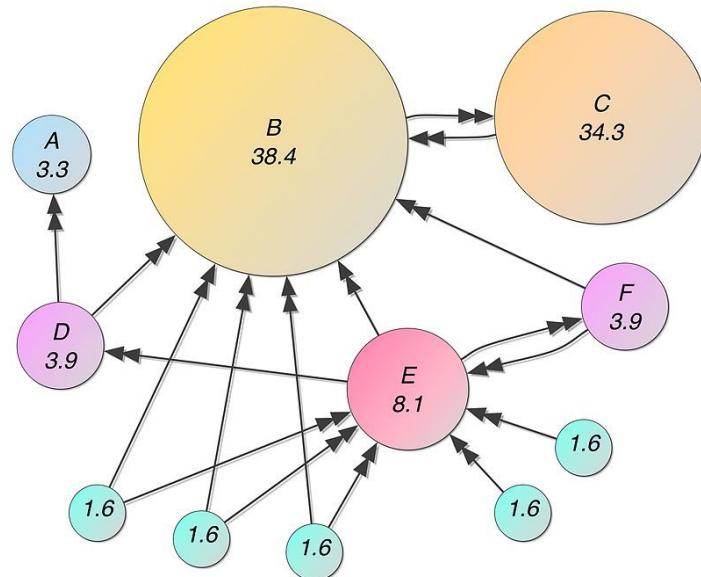


# SEO - Keyword stuffing

Are you looking for **cheap flights**? If so, then you have come too the **cheap flights** specialist. All we have is **cheap flights**. We sold **cheap flights** to your cousin only last week! And she was so happy with her **cheap flights**, that she came back and bought more **cheap flights** from us, the **cheap flights** specialist. So, don't go looking anywhere else for **cheap flights**, because you'll get the best **cheap flights** from us. Remember, we're the **cheap flights** specialist! Where would you like **cheap flights** for? Because we have **cheap flights** to pretty much anywhere you could imaging. We even have **cheap flights** that will take you to **cheap flight central**! Ohhhh, we love our **cheap flights**!

# Main Google innovation

PageRank (1998)



# Google Algorithms

	<b>Launched on Feb 24, 2011</b> "Panda" - Google algorithm that modernized to reduce the prevalence of low-quality and thin content in the search results so that to reward unique, compelling content.	PANDA
	<b>Launched on Apr 24, 2012</b> In 2012, Google officially launched the "Webspam algorithm update (OR) PENGUIN" which specifically targeting to gain greater control over spam tactics and manipulative link building practices of a particular web page.	PENGUIN
	<b>Launched on Aug 22, 2013</b> Hummingbird did not appear to have severe negative impacts on the general web. It was largely understood as having a positive influence on the accuracy of Google's knowledge base known as the "knowledge graph."	HUMMING BIRD
	<b>Launched on July 24, 2014 (US); Dec 22, 2014 (UK, Canada, Australia)</b> The "Pigeon" is a new update in Google algorithm to provide more useful, relevant and accurate local search results that are tied more closely to traditional web search ranking signals of SERP's.	PIGEON
	<b>Launched on Apr 21, 2015</b> Google released a significant algorithm update for a new mobile-friendly ranking parameter that is designed to give a boost to mobile-friendly pages in Google's mobile search results.	MOBILE GEDDON
	<b>Launched on Oct 26, 2015</b> RankBrain integrates with artificial intelligence to embed vast amounts of written language into mathematical entities which making it more effective at handling never-before-seen search queries.	RANK BRAIN
	<b>Launched on Sep 1, 2016</b> "Possum" is the name given to an unconfirmed but documented update that appeared to most significantly impact Google's local pack and local finder results.	POSSUM
	<b>Launched on Mar 8, 2017</b> Google Fred is an algorithm update that targets black-hat tactics tied to aggressive monetization. This includes an overload on ads, low-value content, and little added user benefits	FRED

# Natural language understanding

## PEOPLE ALSO ASK

- What is the difference between AI and machine learning? 
- What is machine learning and its importance? 
- What are the prerequisites for learning machine learning? 
- Is machine learning a scam? 

# BERT (2018)

(Bidirectional Encoder Representations from Transformers)



# BERT (2018)

(Bidirectional Encoder Directions from Transformers)

What is Joe Bidens height?

Joe Biden height

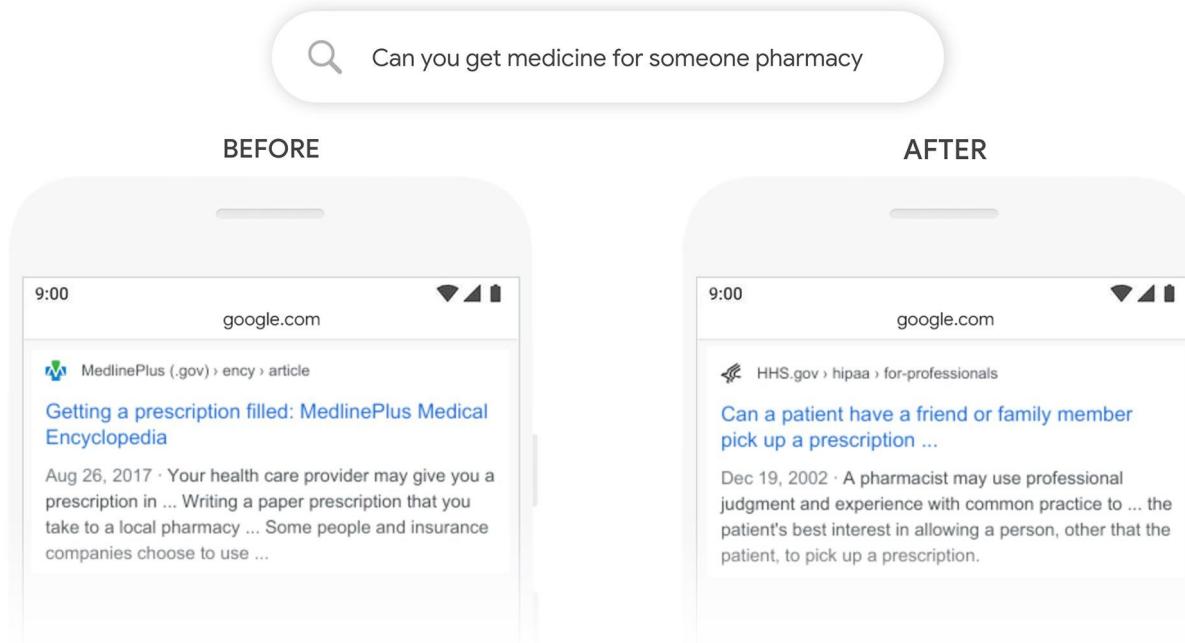
How tall is Joe Biden?

How many meters is Joe Biden?

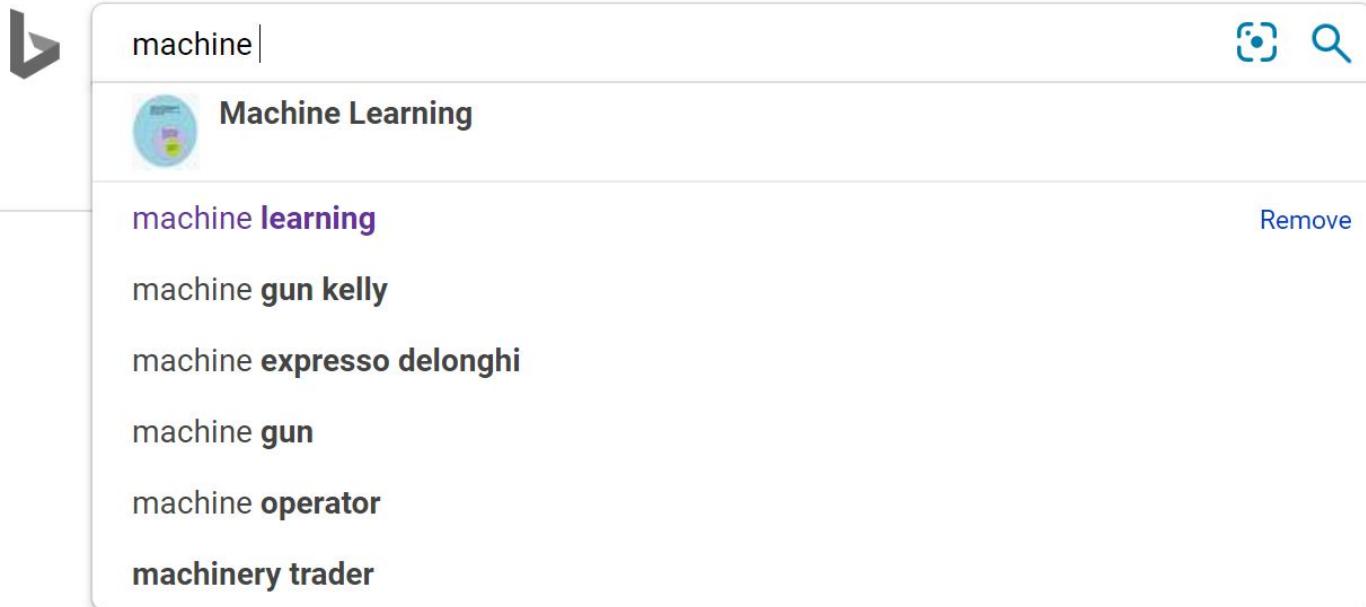
Joe Biden tall

# BERT (2018)

(Bidirectional Encoder Directions from Transformers)



# ML is used to predict what you are searching for



The image shows a screenshot of a search interface, likely from a web browser or a search engine. In the top left corner, there is a logo consisting of a stylized 'b' inside a square. The search bar at the top contains the text "machine". To the right of the search bar are two icons: a magnifying glass and a camera-like symbol. Below the search bar, a list of search suggestions is displayed. The first suggestion, "Machine Learning", is highlighted with a blue circular icon containing a neural network diagram. The other suggestions are listed below it: "machine learning", "machine gun kelly", "machine espresso delonghi", "machine gun", "machine operator", and "machinery trader". On the far right of the list, next to the last suggestion, is a blue "Remove" link.

- Machine Learning
- machine learning
- machine gun kelly
- machine espresso delonghi
- machine gun
- machine operator
- machinery trader

# ML is used to correct your typos

The screenshot shows a search interface with the following elements:

- Search Bar:** Contains the text "machine leaning".
- Search Buttons:** Includes a magnifying glass icon and a camera icon.
- Filter Buttons:** Labeled "All", "Images", "Videos", "Maps", "News", "Shopping", and "My saves".
- Search Statistics:** Shows "14,200,000 Results" and a "Any time" dropdown.
- Text Overlay:** A message indicating the search results include "machine learning" and asking if the user wants results only for "machine leaning".

# Knowledge graph built by mining the Internet

## Machine Learning

 Share



Machine learning is a subfield of computer science that evolved from the study of pattern recognition and computational learning theory in artificial intelligence. In 1959, Arthur Samuel defined machine learning as a "Field of study that gives computers the ability to learn without being explicitly programmed".

### Machine learning - Wikipedia

[https://en.wikipedia.org/wiki/Machine\\_learning](https://en.wikipedia.org/wiki/Machine_learning)

Subdisciplines of: Artificial Intelligence · Computer Science

Subdisciplines: Deep Learning · Supervised Learning

Academic conferences: AAAI 2016 · NIPS 2015 · ICML 2016 · IJCAI 2016 · KDD 2016 · CVPR 2016 · ICASSP 2016 · ICDM 2015 · ACL 2016 · AI 2016 · CHI 2016 +

### Related people

[See all \(20+\)](#)



Arthur  
Samuel



Tom M.  
Mitchell



Andrew Ng



Geoffrey  
Hinton



Michael I.  
Jordan

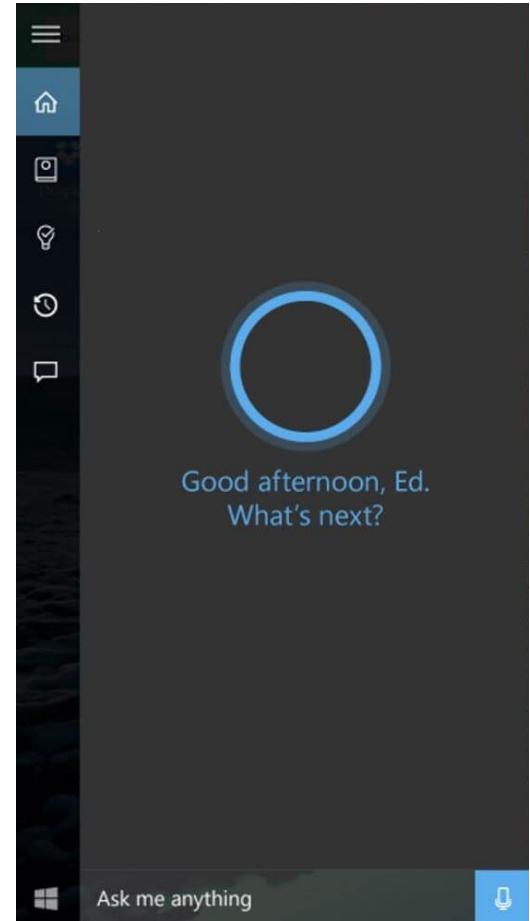
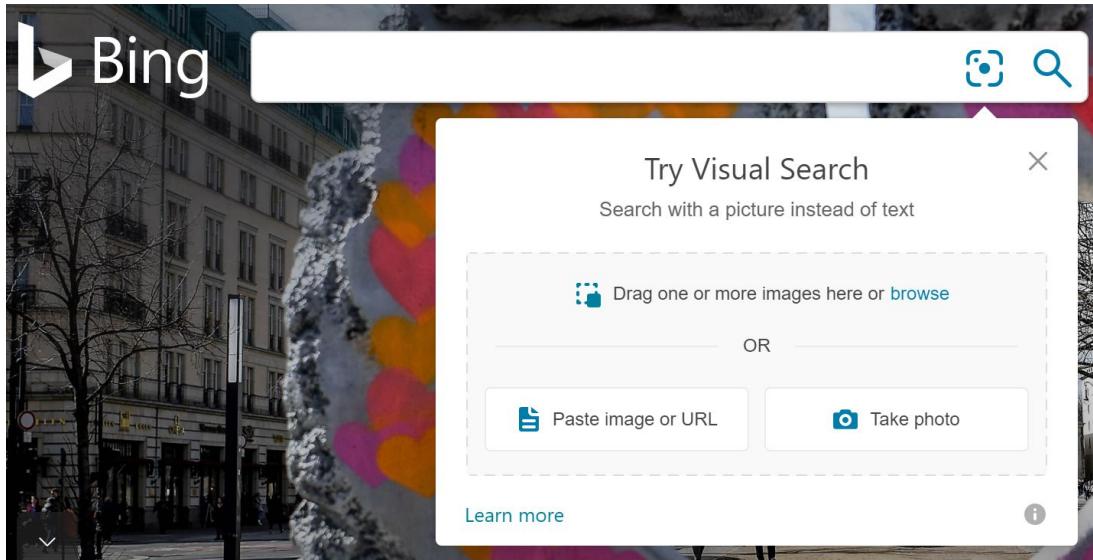


Fei-Fei Li



Leo Breiman

# Image and voice input



# Recommendations

The screenshot shows a Spotify interface with a dark theme. On the left is a sidebar with navigation links: Browse, Radio, Your Library, Made For You, Recently Played, Songs, Albums, Artists, Stations, Local Files, Videos, and Podcasts. Below these are sections for Playlists: Women's March on..., Jeep Stuff, Acoustic Covers, and Songs to Sing in the... The main content area features a "Discover Weekly" playlist titled "MADE FOR KATHLEEN". The cover image shows a woman's face with the text "Your Discover Weekly". The description reads: "Your weekly mixtape of fresh music. Enjoy new discoveries and deep cuts chosen just for you. Updated every Monday, so save your favorites!" It was made for Kathleen Slattery Booth by Spotify, containing 29 songs over 1 hour and 40 minutes. Below the description are three buttons: PLAY, FOLLOW, and more options. The FOLLOW button has 0 FOLLOWERS. The table below lists the first few songs:

TITLE	ARTIST	ALBUM	LAST LISTENED
Watch Me (Whip / Nae Nae)	Silentó	Watch Me (Whip / ...)	2 days ago
Fight Song	Rachel Platten	Wildfire	2 days ago
Scream & Shout	will.i.am, Britney Spe... #willpower (Deluxe)	#willpower (Deluxe)	2 days ago
Gangnam Style - Radio Edit	Opa	Gangnam Style	2 days ago
Ooh La La (from "The Smurfs 2")	Britney Spears	Ooh La La (from "Th...")	2 days ago
Sax	Fleur East	Love, Sax & Flashba...	2 days ago

# Recommendation systems are really important

- 35% of Amazon.com revenue is generated by recommendations
- 80% of what users watch on Netflix is driven by recommendations
- 70% of what users watch on Youtube is driven by recommendations (2018)
- 30% of what users listen to on Spotify is driven by recommendations (2017)
- 68% of Spotify users regularly discover new music from recommendations

# Similarity between users (Collaborative filtering)

What would “similar” users like?

Based on:

- Likes
- Views
- Playlists
- Shares
- ++

					
A					
B					
C					
D					
E				?	

# Similar item recommendation

A screenshot of a social media platform interface showing a user's post and a grid of recommended items.

The main post shows a Japanese paper bowl with intricate floral patterns. The caption reads "Japanese paper" and "Uploaded by Gaynor Laight". Below the post, a "Comments" section is visible.

Below the post, a grid of smaller images shows various pieces of Japanese pottery, labeled "More like this".

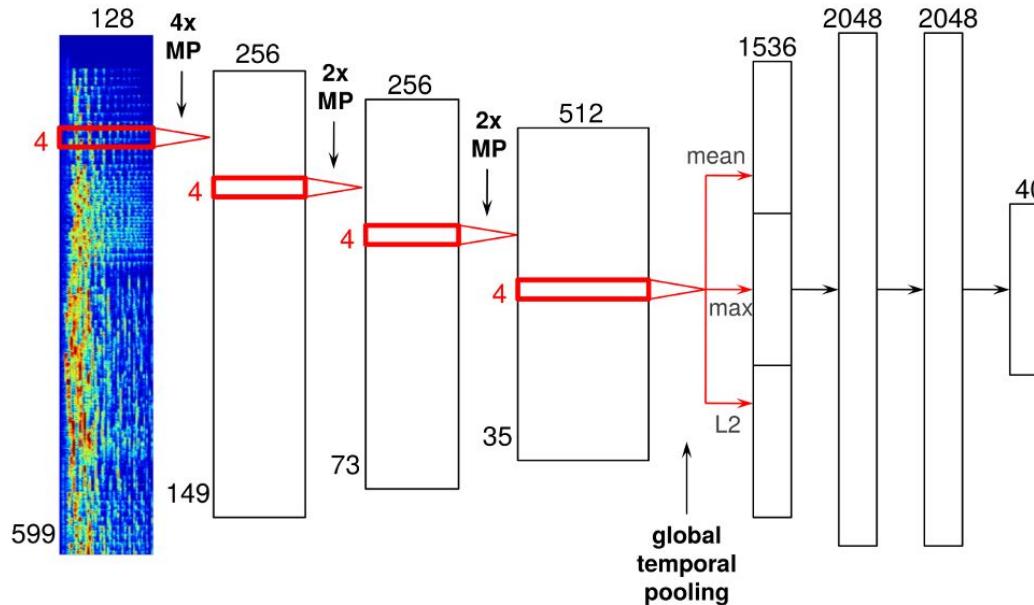
To the right of the grid, a sidebar displays "ideas you might love" with the following categories:

- Decorative boxes
- Vintage suitcases
- Antique jewelry box
- Vintage luggage
- Trinket boxes
- Jewelry casket

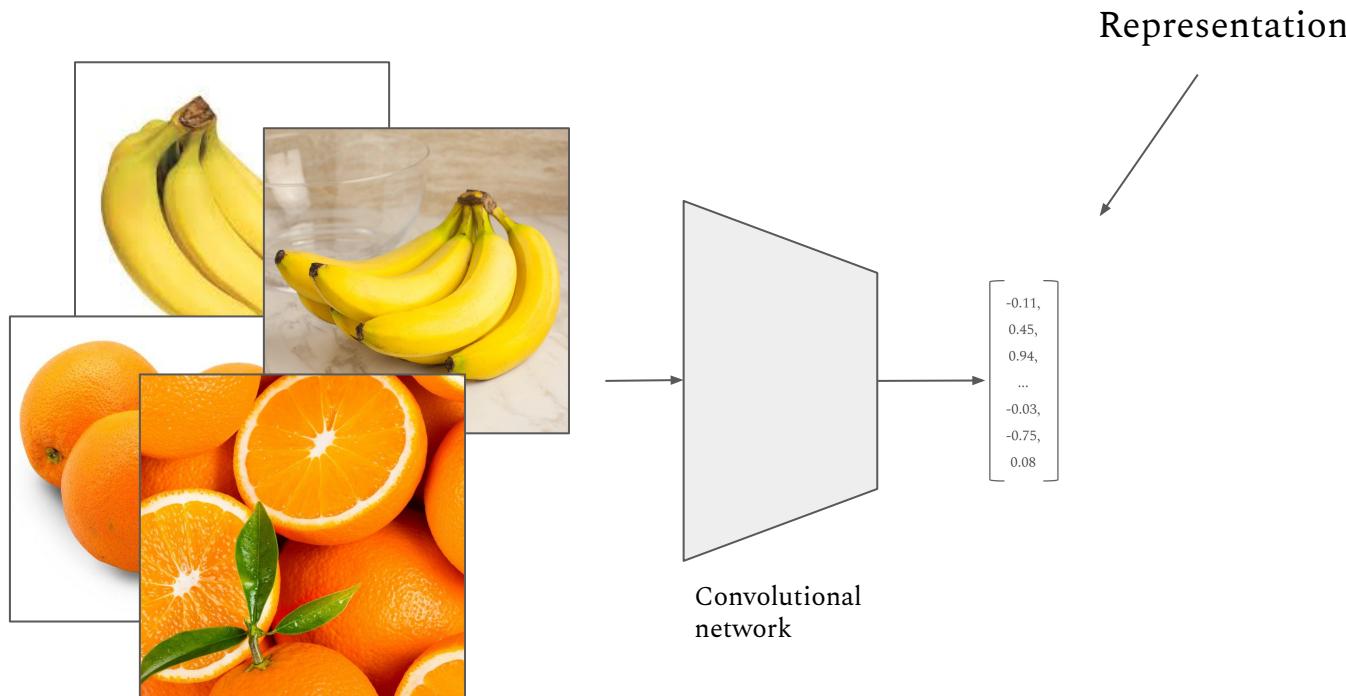
Surrounding the main post are several recommended items:

- Boards like yours**: A collage of vintage-style boards.
- Vintage cups**: A collection of antique cups and saucers.
- Japanese pottery**: A set of traditional Japanese ceramic vessels.
- Tea set**: A collection of tea service pieces.
- Chinese porcelain**: A set of Chinese porcelain items.
- Porcelain painting**: A large piece of porcelain with detailed painted scenes.
- Tableware**: A single piece of colorful, ornate tableware.
- Tea pots**: A collection of various tea pot designs.

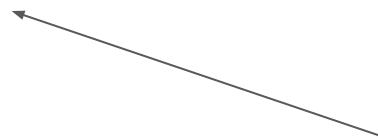
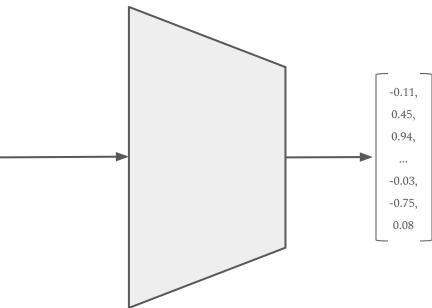
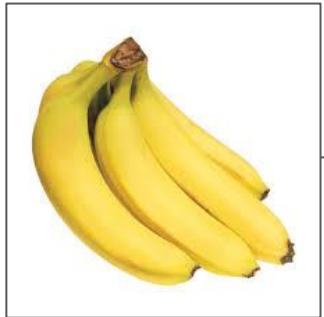
# Spotify audio model (2014)



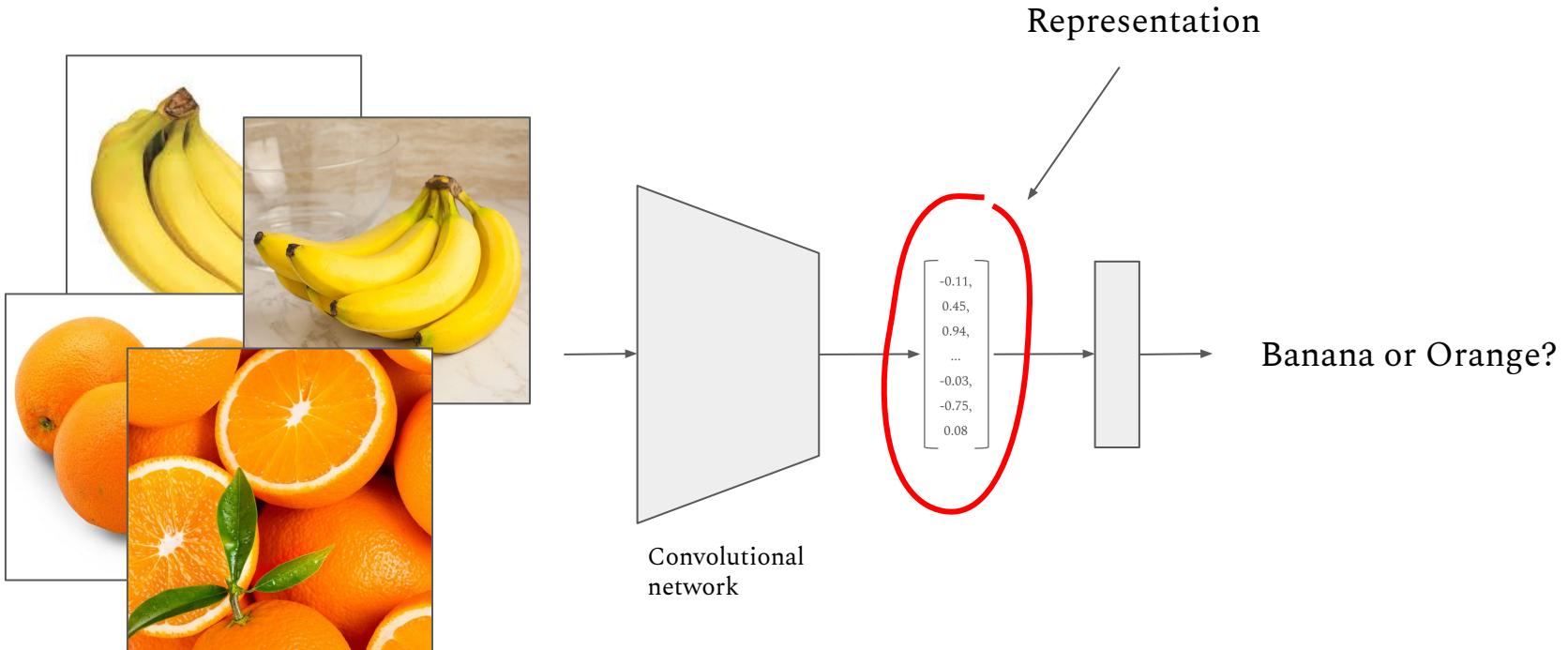
Source : <https://benanne.github.io/2014/08/05/spotify-cnns.html>

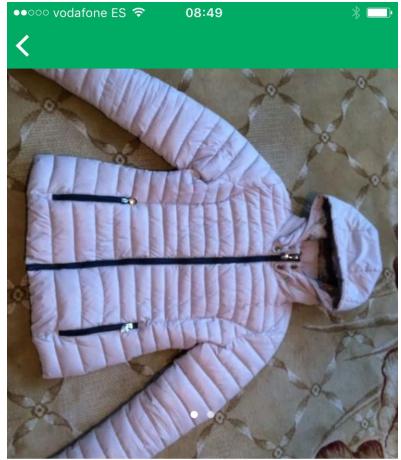


# Similarity



What is the distance  
between these  
representations /  
vectors?





25 р.

Куртка женская

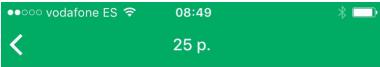
Дзержинск  
Женская одежда

7 мин. назад



Инна

Чат



### Описание

Продам , размер 44-46, хорошее состояние  
без дефектов. Вышлю постой Тел.

80336508674

[Пожаловаться на объявление](#)

### Похожие объявления



50 р.

Пальто на все слу...



30 р.

Куртка ZARA.



50 р.

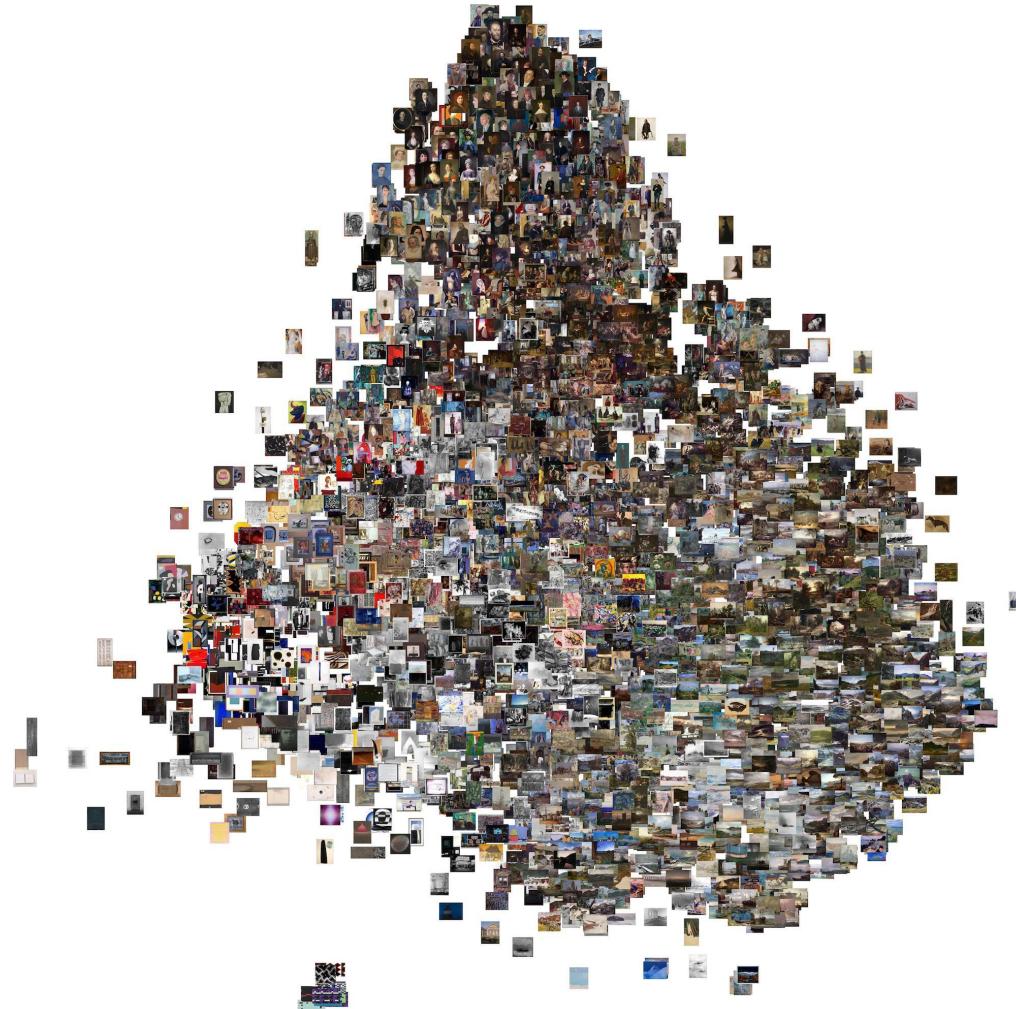
Куртка



Инна

Чат

Similar item recommendations in Schibsted marketplaces

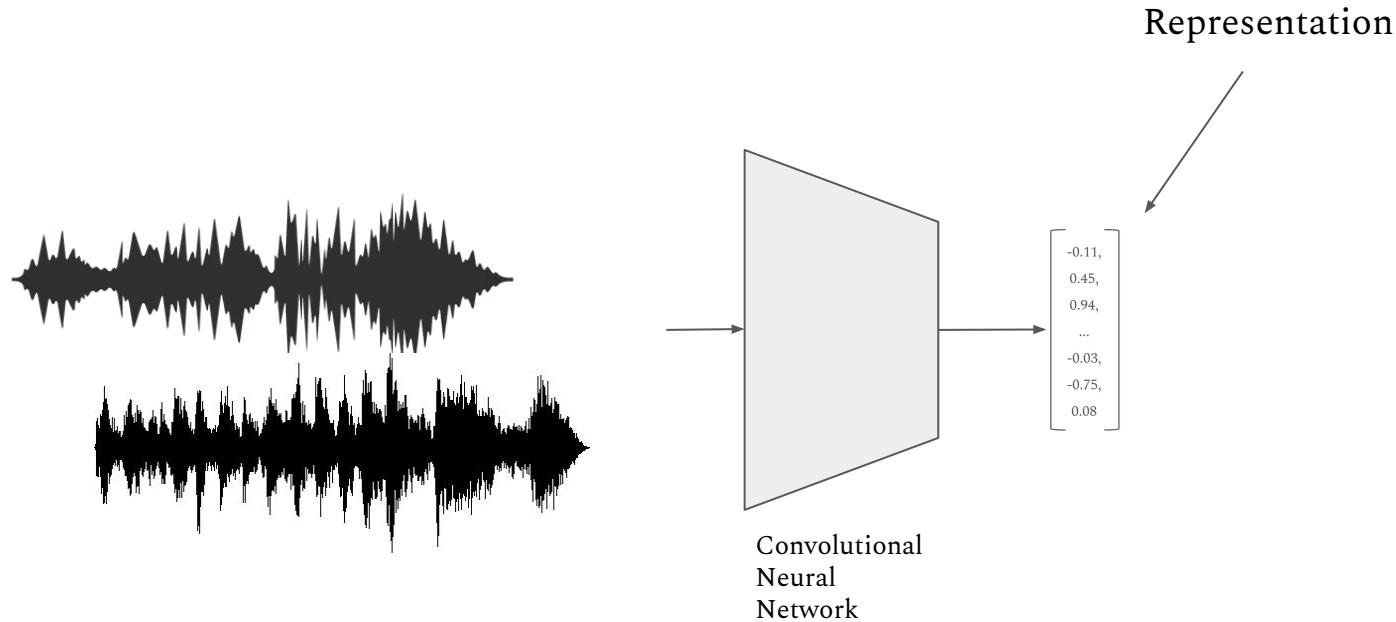


Visualization of learned  
representations of  
Nationalgallery paintings,

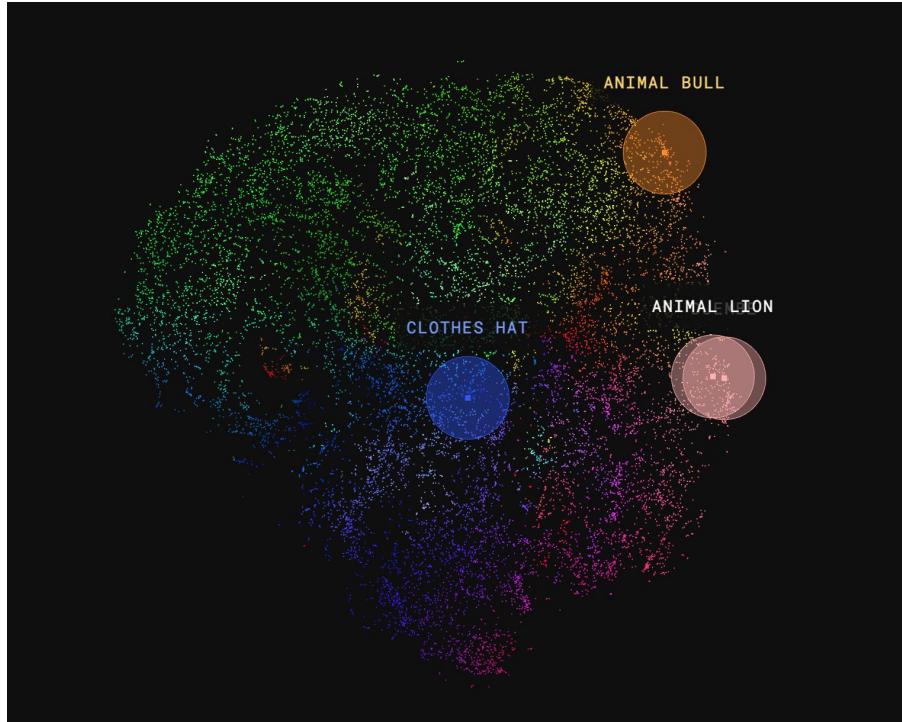
Convolutional network  
trained on genre classes

<http://vy.nasjonalmuseet.no>

# Audio classifier

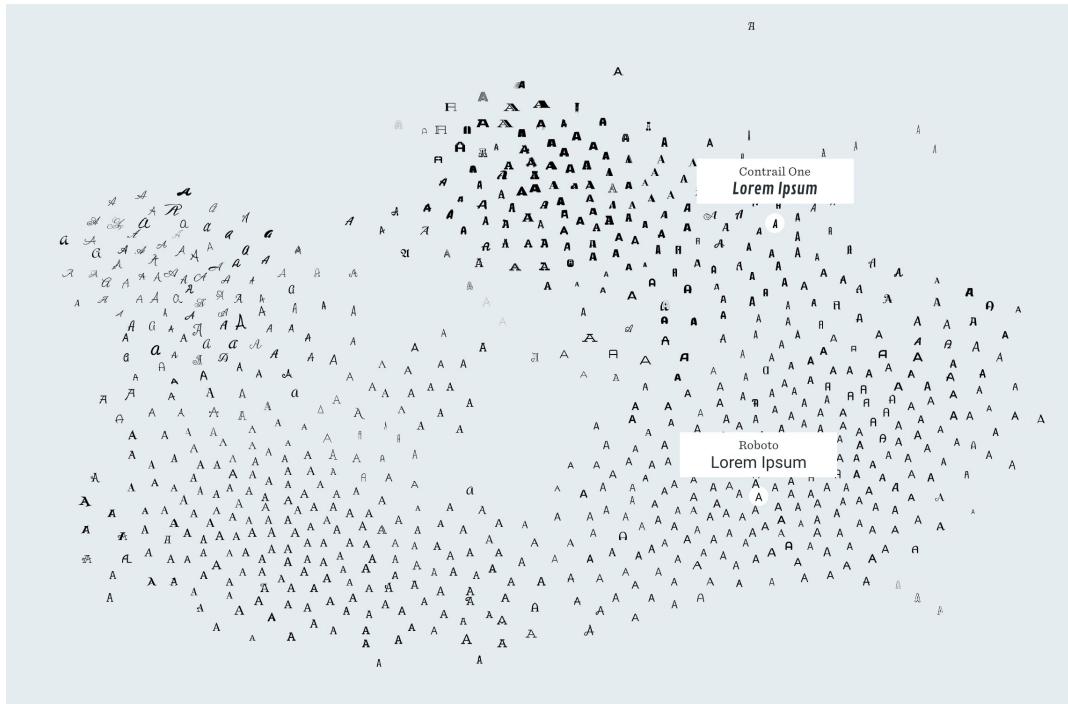


# Similarity in audio



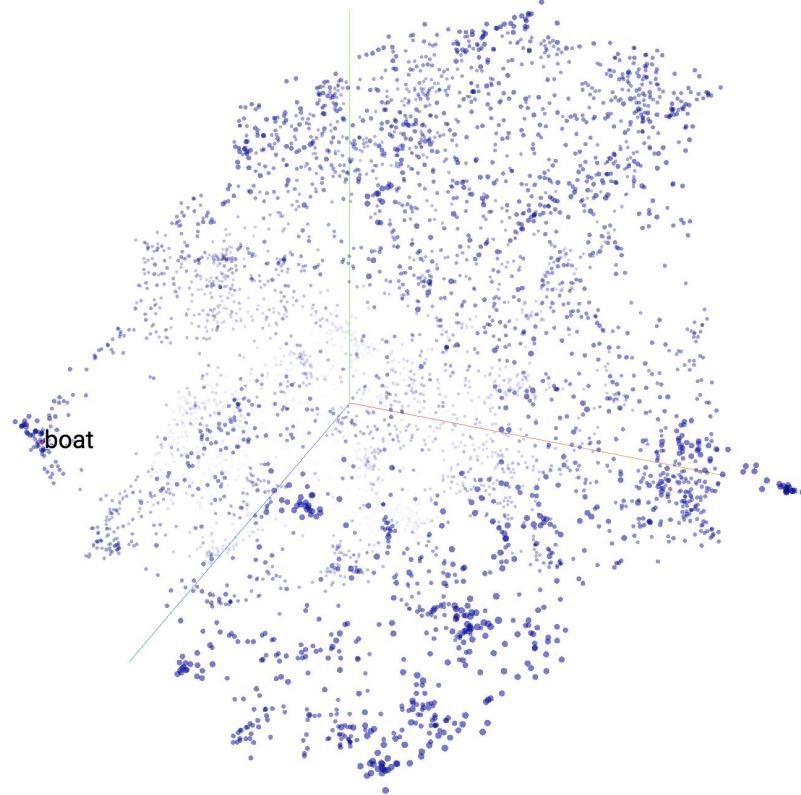
<https://experiments.withgoogle.com/ai/drum-machine/view/>

# IDEO Fontmap



<http://fontmap.ideo.com/>

# Word representations / encodings

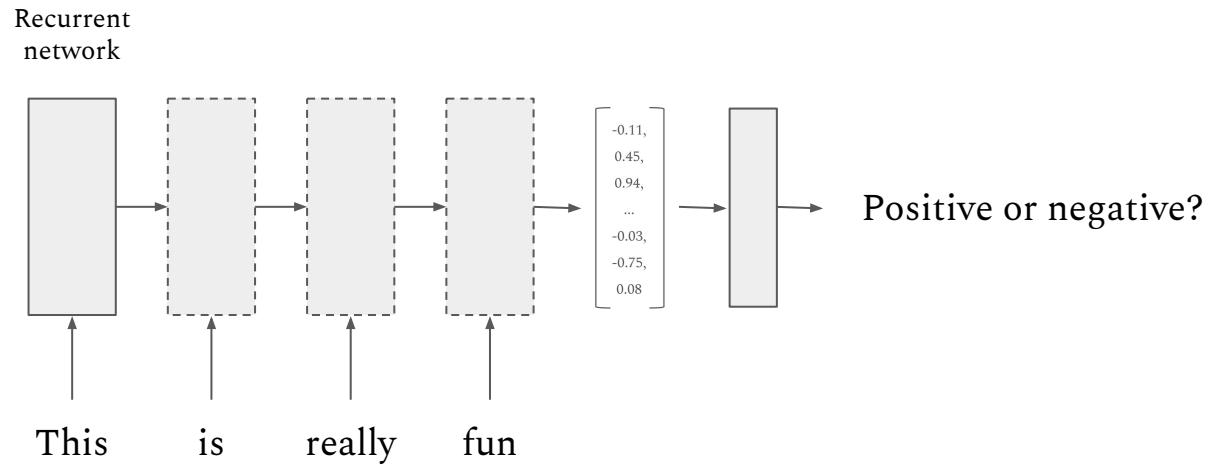


<https://projector.tensorflow.org/>

# Results

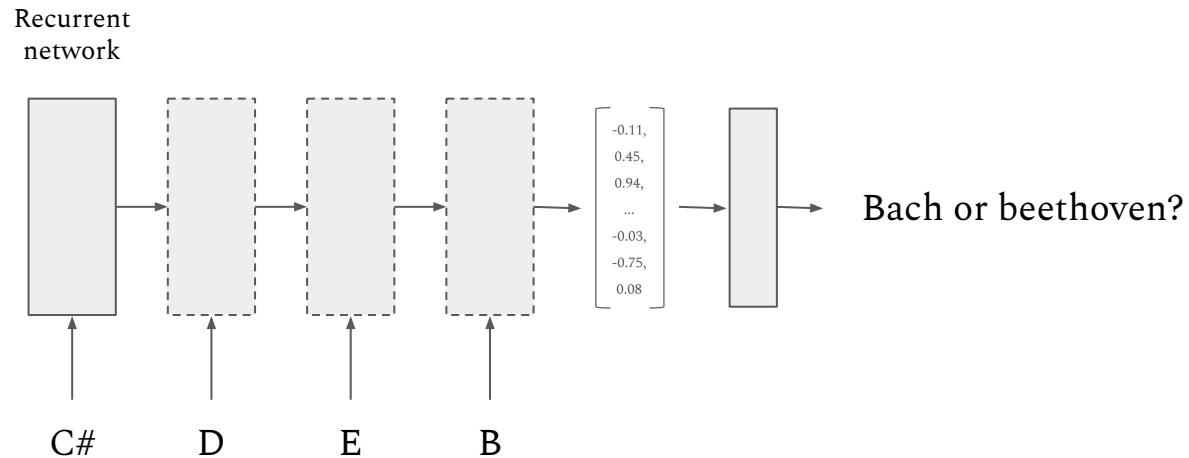
# Generative Machine learning

# Sequential models



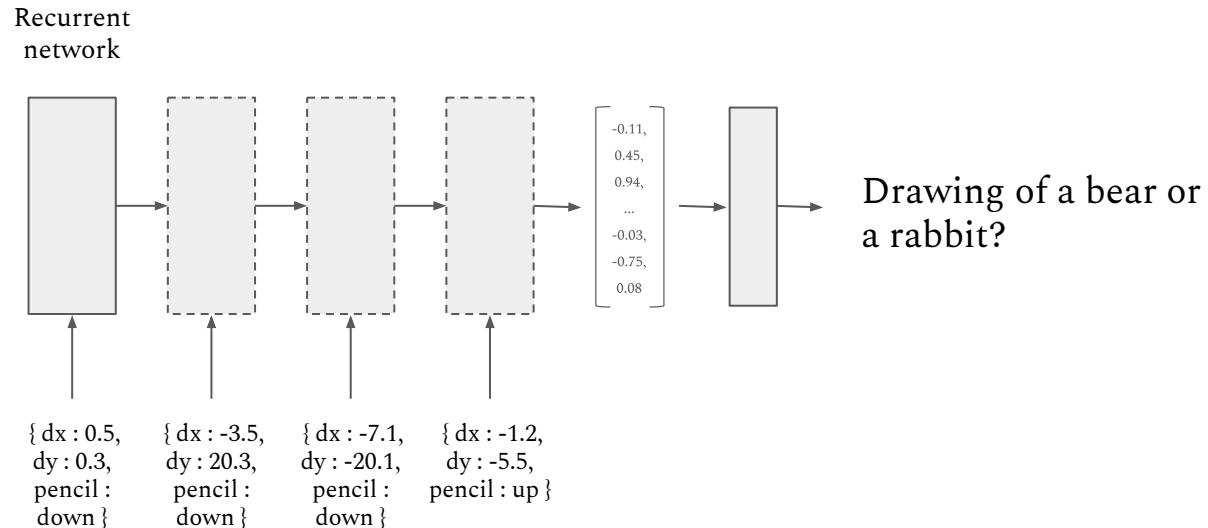
Sentiment recognition

# Sequential models



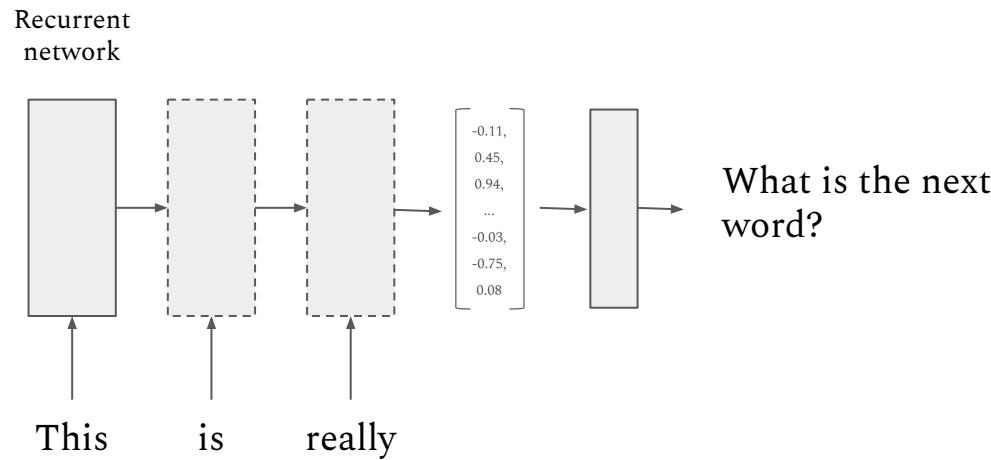
Music recognition

# Sequential models

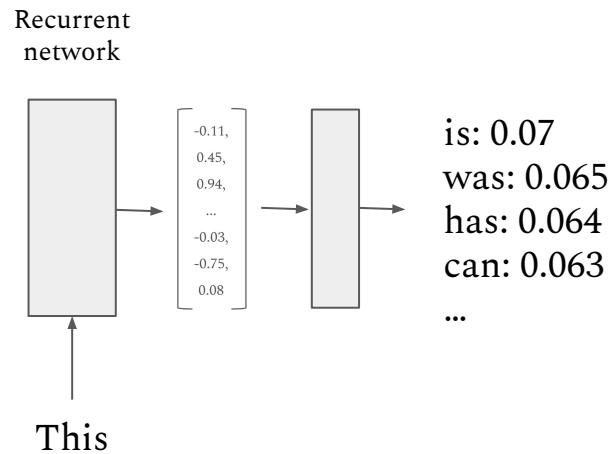


Sketch recognition

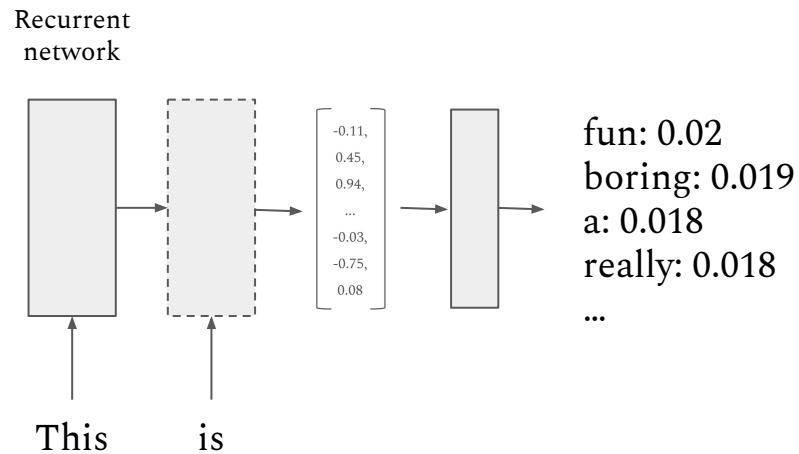
# Generative sequential models



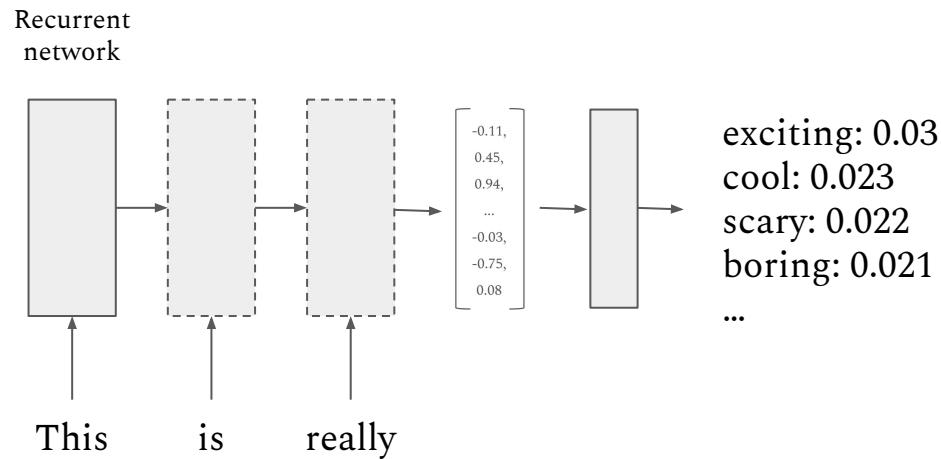
# Generative sequential models



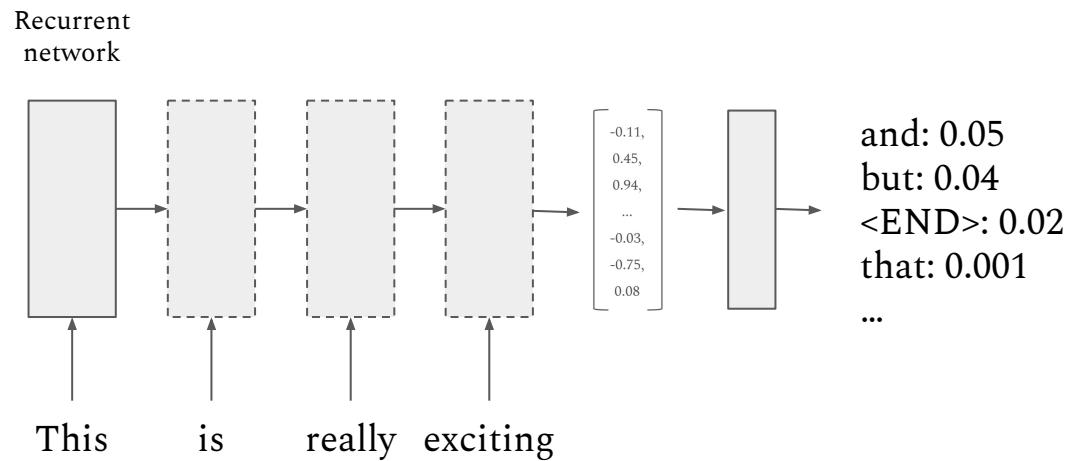
# Generative sequential models



# Generative sequential models



# Generative sequential models



# Model types

- RNN (Recurrent Neural Networks)
- LSTM (Long Short-Term Memory)
- Transformer models

# Hands-on with Generative models

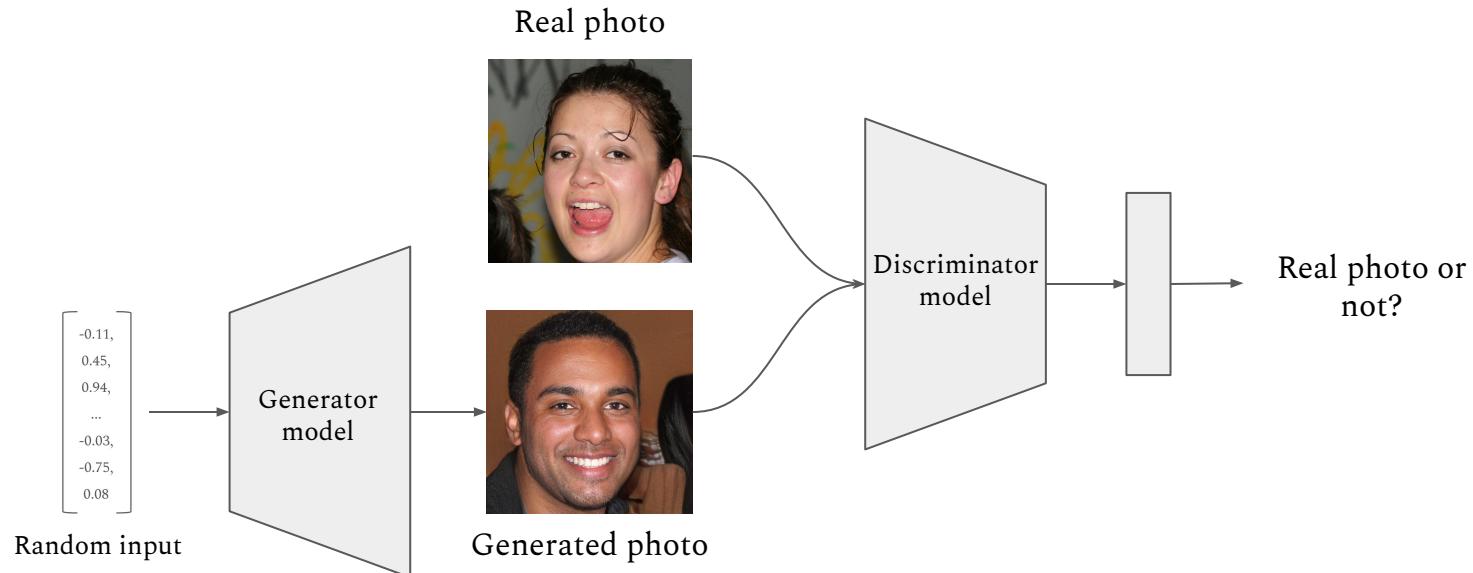
Lunch



thispersondoesnotexist.com

StyleGAN,  
December 2018

# GAN = Generative Adversarial Networks





Ian Goodfellow  
@goodfellow\_ian

4.5 years of GAN progress on face generation.

[arxiv.org/abs/1406.2661](https://arxiv.org/abs/1406.2661) [arxiv.org/abs/1511.06434](https://arxiv.org/abs/1511.06434)

[arxiv.org/abs/1606.07536](https://arxiv.org/abs/1606.07536) [arxiv.org/abs/1710.10196](https://arxiv.org/abs/1710.10196)

[arxiv.org/abs/1812.04948](https://arxiv.org/abs/1812.04948)



1:40 AM · Jan 15, 2019 · Twitter Web Client

# BigGAN



*Large Scale GAN Training for High Fidelity Natural Image Synthesis*, Andrew Brock et al, 2018

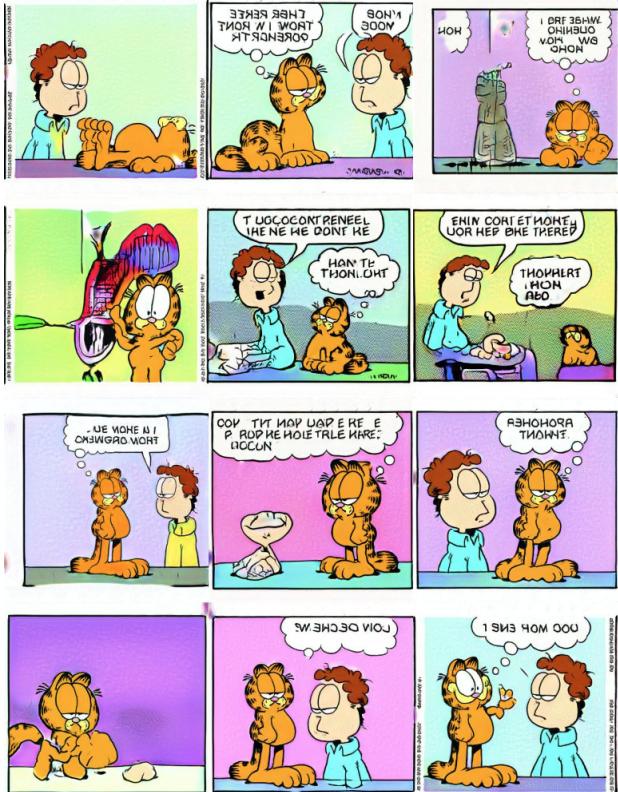


# StyleGAN



*A Style-Based Generator Architecture for Generative Adversarial Networks, Tero Karras et al, 2019*





Michael Friesen  
@MichaelFriesen10

cursed emojis #StyleGAN



Kenji Doi  
@knjcode

約9万枚のラーメン二郎画像で StyleGAN を試しました。

公式の実装を使って、最大解像度を512x512pxに下げて学習しています。

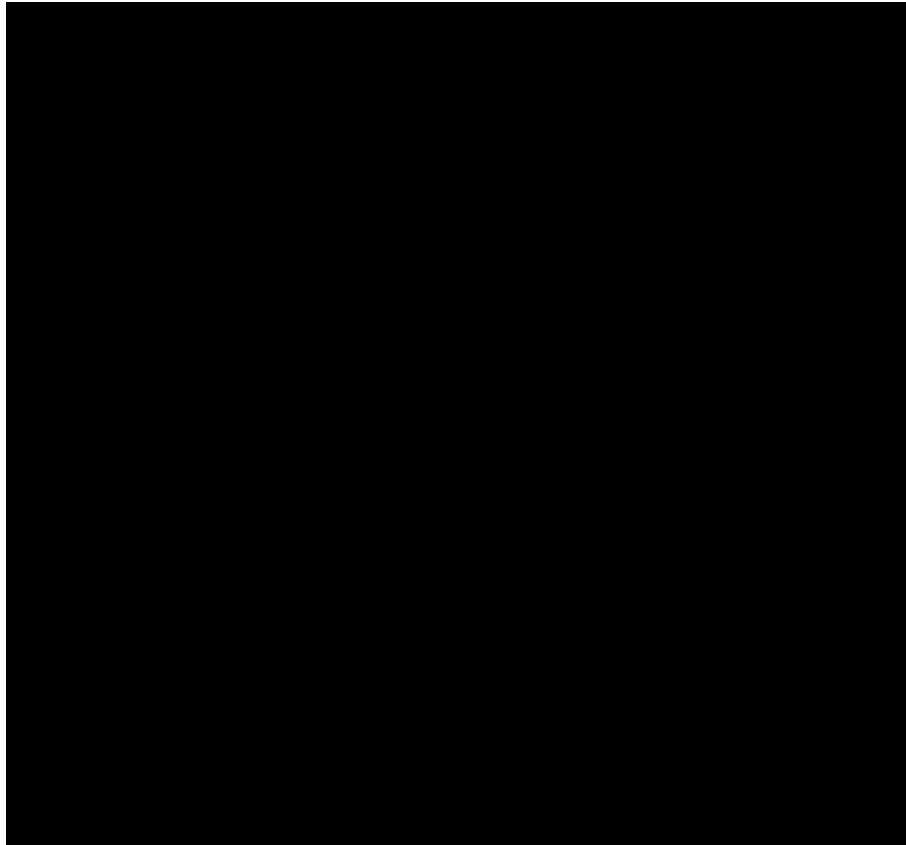
まだ学習途中(50%ぐらい)ですが、以前のPGGANよりもさらにリアルになっているように思います。

#ラーメン二郎 #GAN

Translate Tweet



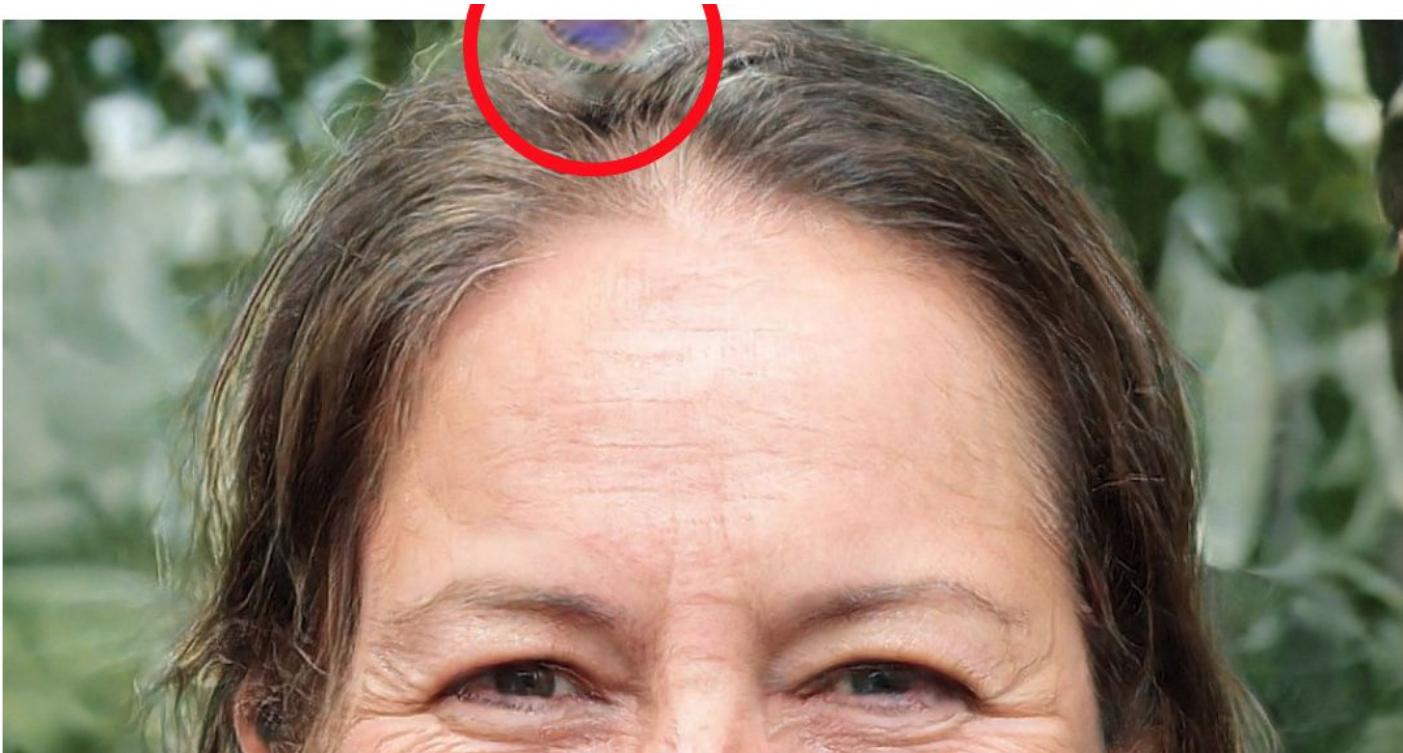
0:08 | 227.6K views



# Artifacts in StyleGAN



# Artifacts in StyleGAN



# StyleGAN2



*Analyzing and Improving the Image Quality of StyleGAN*, Tero Karras et al, 2019

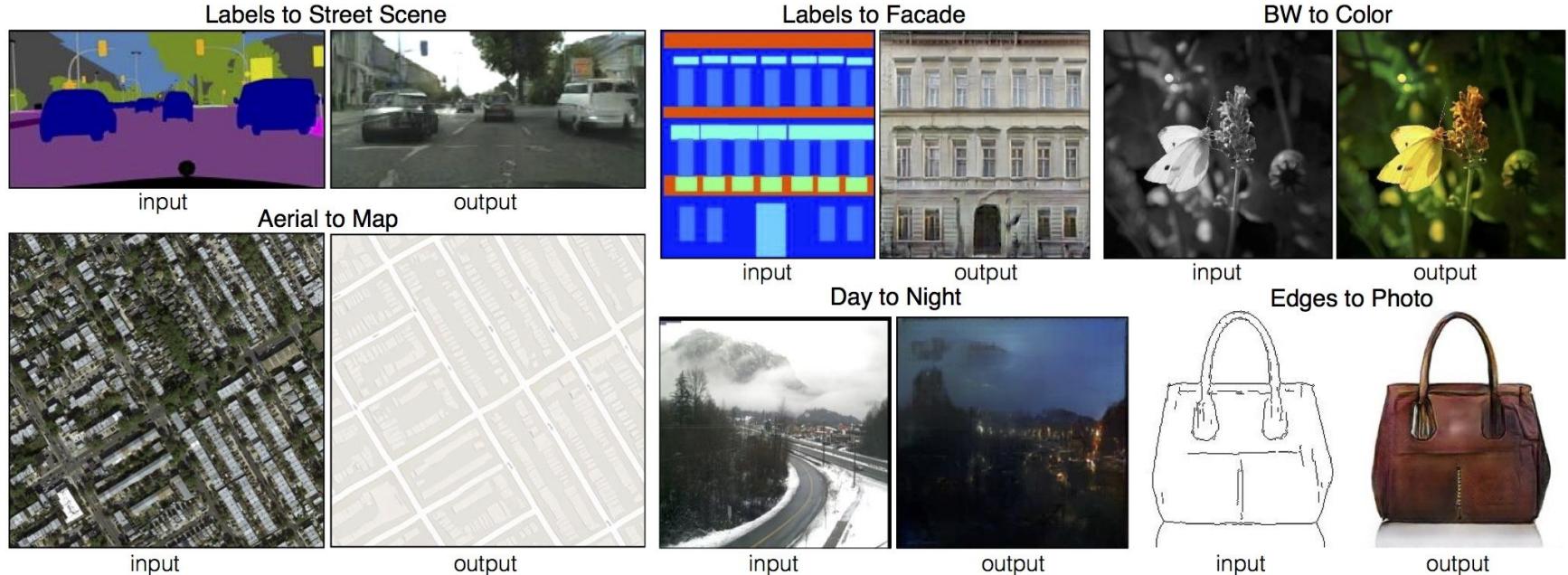
# StyleGAN3



*Alias-free generative adversarial networks*, Tero Karras et al, 2021

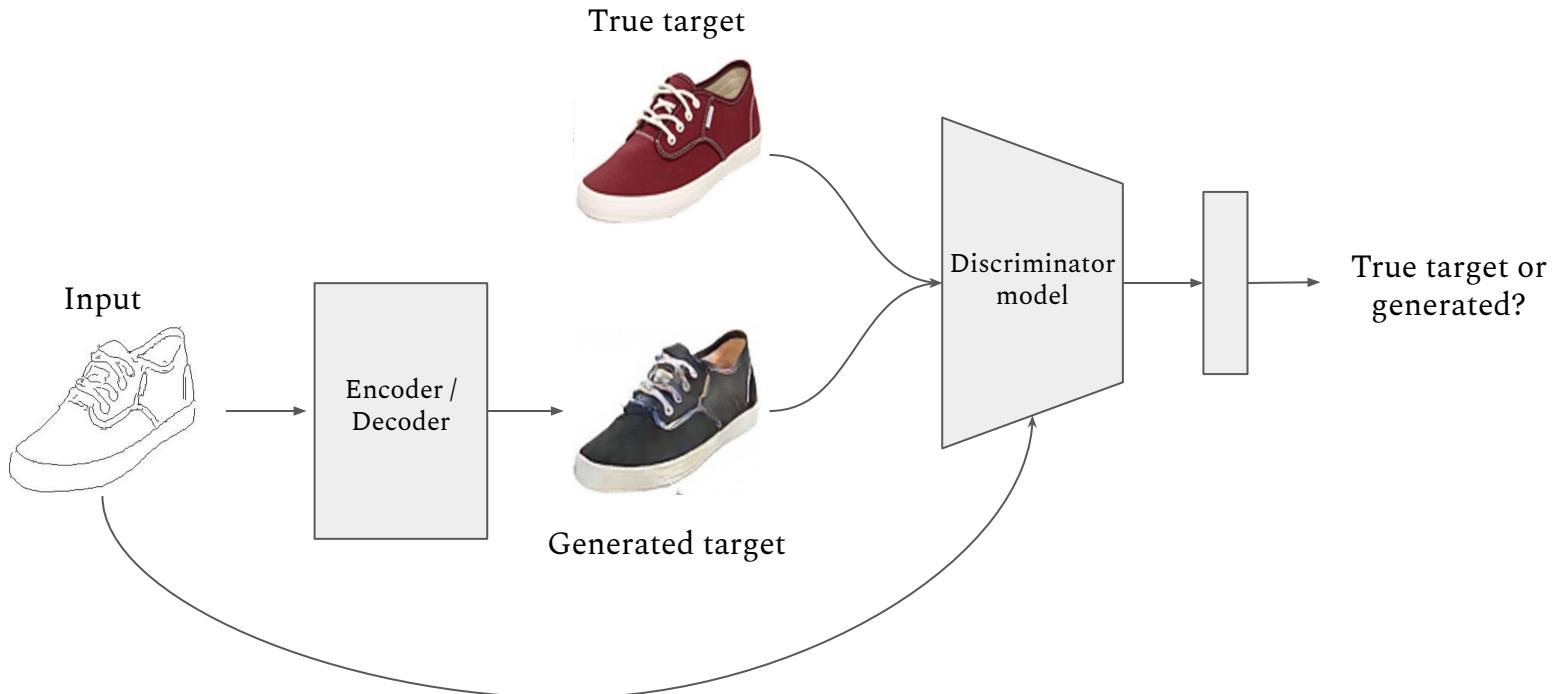
# Conditional GANs

# Pix2Pix

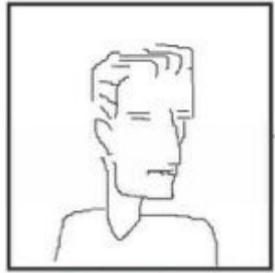


*Image-to-Image Translation with Conditional Adversarial Nets, Philip Isola et al, 2017*

# Pix2Pix



# #fotogenerator

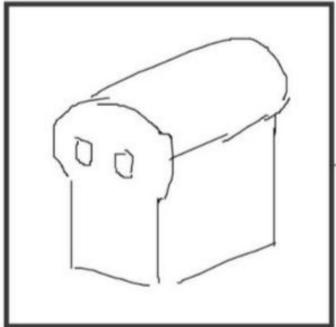


pix2pix  
process



*sketch by Yann LeCun*

#edges2cats by Christopher Hesse



pix2pix  
process



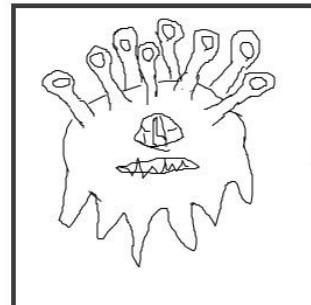
*sketch by Ivy Tsai*

 Mario Klingemann   
@quasimondo

Generating faces from a sketch. I trained a pix2pix net on 1500 #bldigital faces. Left input, right output.



INPUT



pix2pix  
process

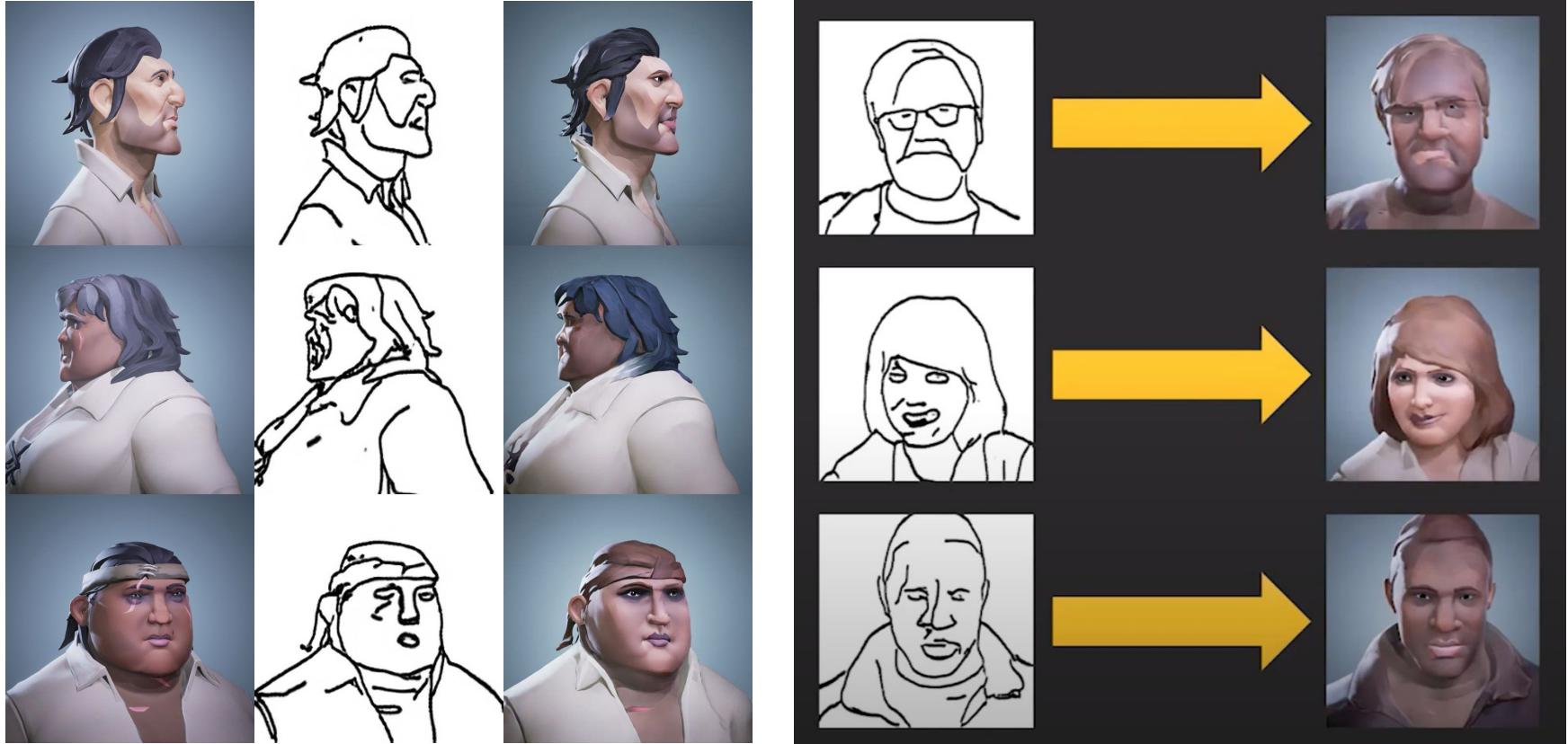
OUTPUT



undo

clear

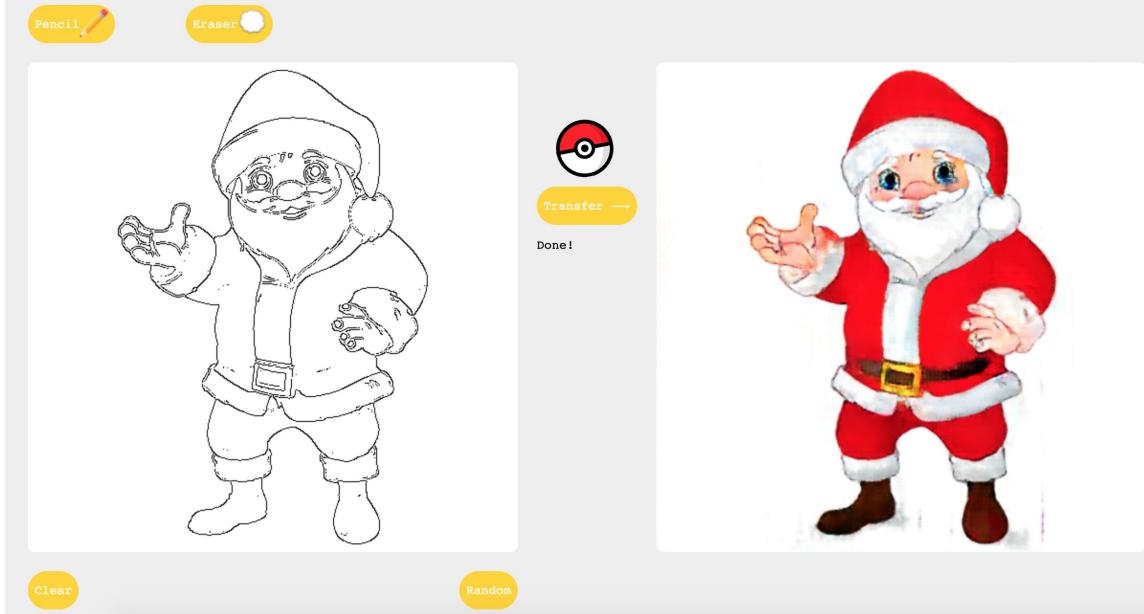
random



*Valentine Kozin, lead technical developer Rare*

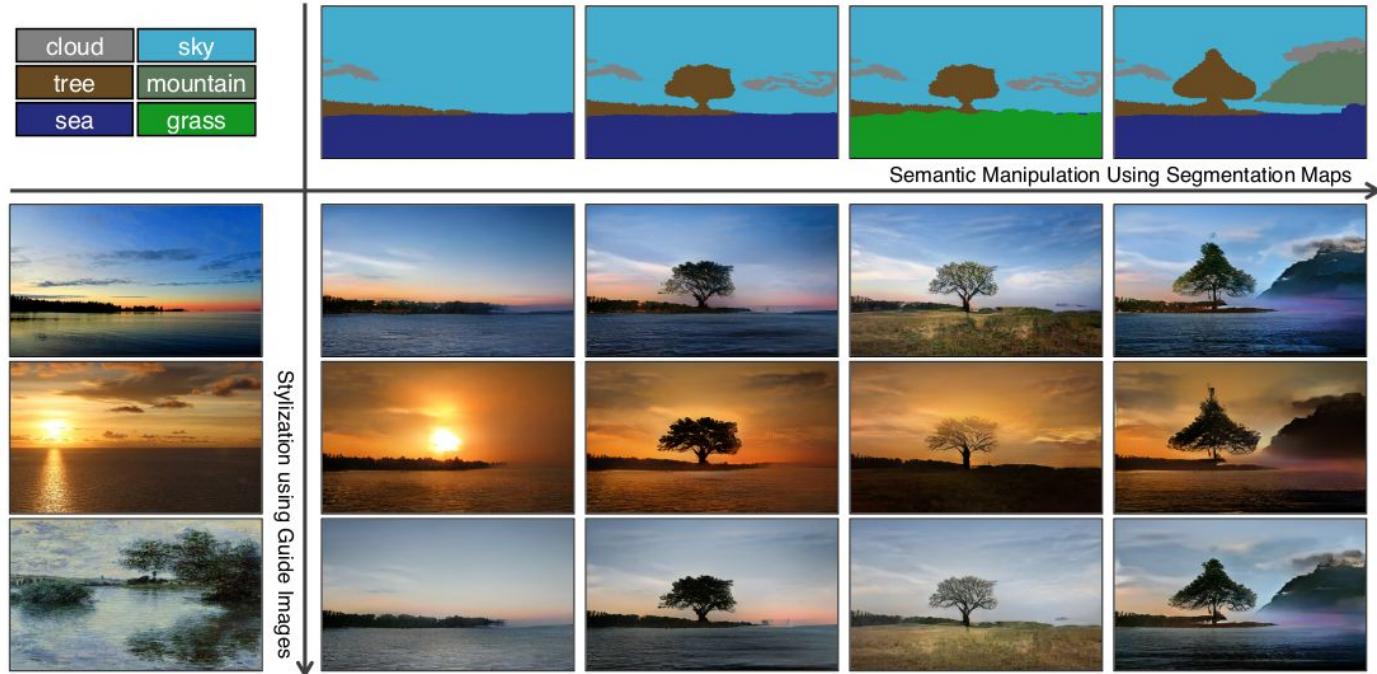
## **Pix2Pix Edges2Santa**

1. Select 'Pencil' tool to draw a Santa on the canvas below.
2. Click the 'Transfer' button.
3. A colored Santa image will appear on the right side in ~5s.
4. Click the 'Clear' button to clear the canvas and draw again.



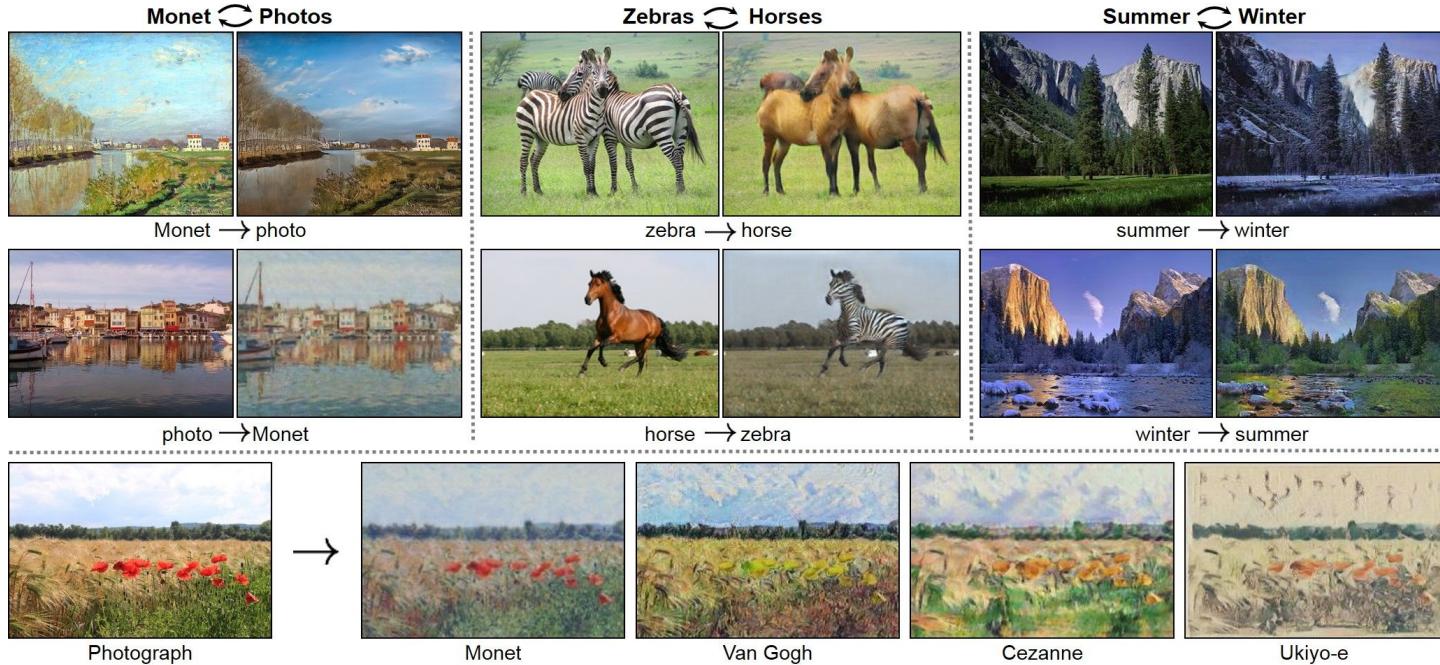
[https://github.com/auduno/pix2pix\\_tensorflowjs\\_lite](https://github.com/auduno/pix2pix_tensorflowjs_lite)

# GauGAN / SPADE



*Semantic Image Synthesis with Spatially-Adaptive Normalization, Taesung Park et al, 2019*

# CycleGAN



*Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks, Jun-Yan Zhu et al, 2017*

# Hands-on with GANs

## Runway ML

# Collecting images

# Flickr-Faces High Quality (FFHQ) (2018)



# Flickr-Faces High Quality (FFHQ) (2018)

- 70000 1024 x 1024 images of faces collected by Nvidia Research
- Photos crawled from Flickr, only creative commons licensed photos
- Faces rotated, cropped and centered to have uniform shape
- More info : <https://github.com/NVlabs/ffhq-dataset>
- See examples at <https://thispersonexists.net>





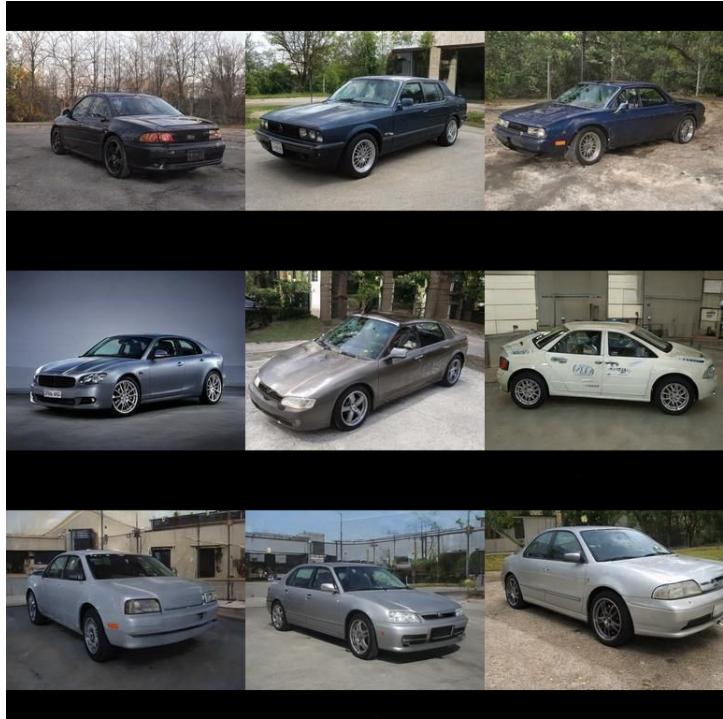






# LSUN Car (2015)

- 5.5 million 512 x 384 images of cars, large variation
- Photos scraped from Google Image search

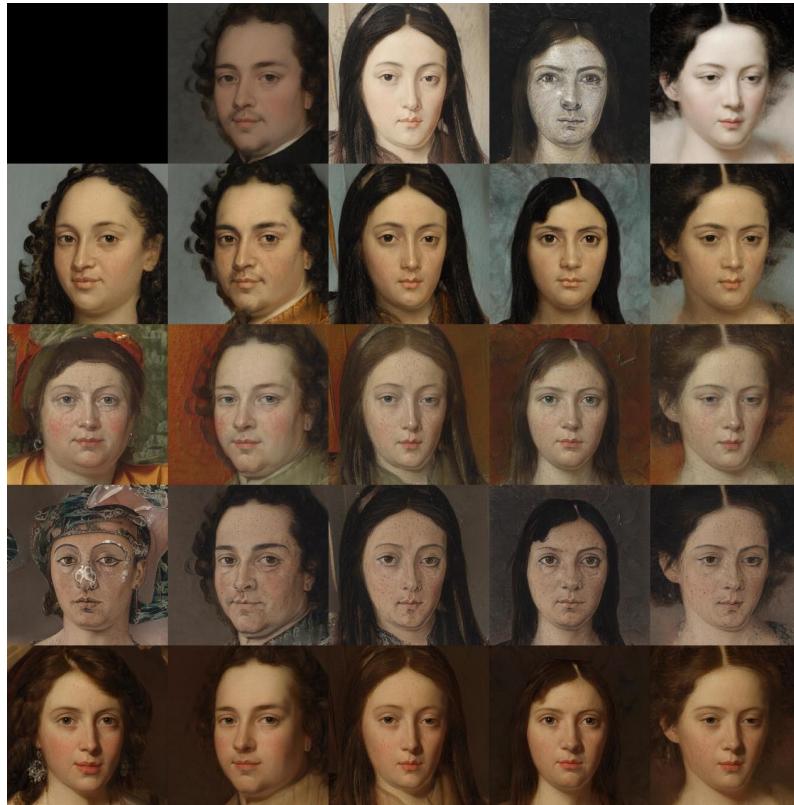


# Metfaces (2019)

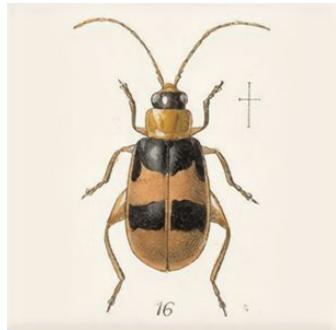


- 1336 1024x1024 images of faces from Metropolitan Museum of Art
- <https://github.com/NVlabs/metfaces-dataset>

# Metfaces (2019)



# Beetles

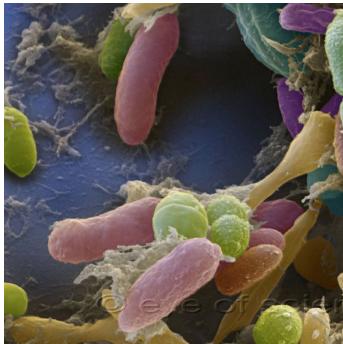


- 1075 1024x1024 images of beetles from old botanical illustrations

# Beetles

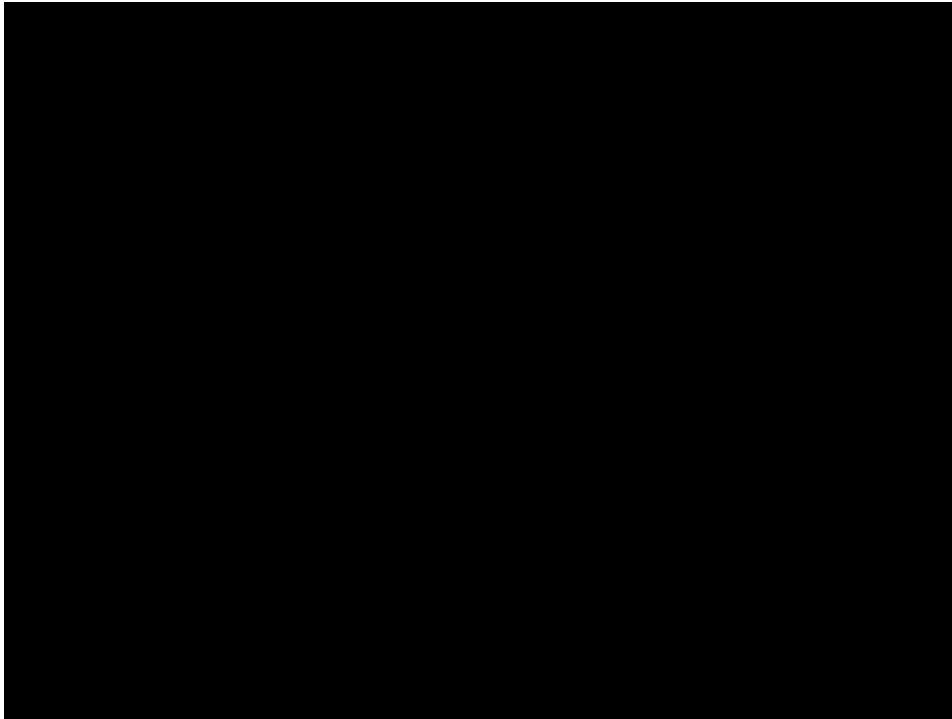


# Microscopy photos



- Collected by me
- ~600 microscopy images of various proportions from google image search

# Microscopy photos



# Recommended sources

- Flickr
- Google images
- Nasjonalbiblioteket
- Digitalt museum
- Shopping sites
- ++

# Tools

- “Download all images” extension
  - <https://chrome.google.com/webstore/detail/download-all-images/ifipmflagepipjokmbdecpmjbibjnakm?hl=en>

End