

Image Dataset Curation and Art Recommendation Workshop I

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KI Service
Zentrum
by Hasso-Plattner-Institut

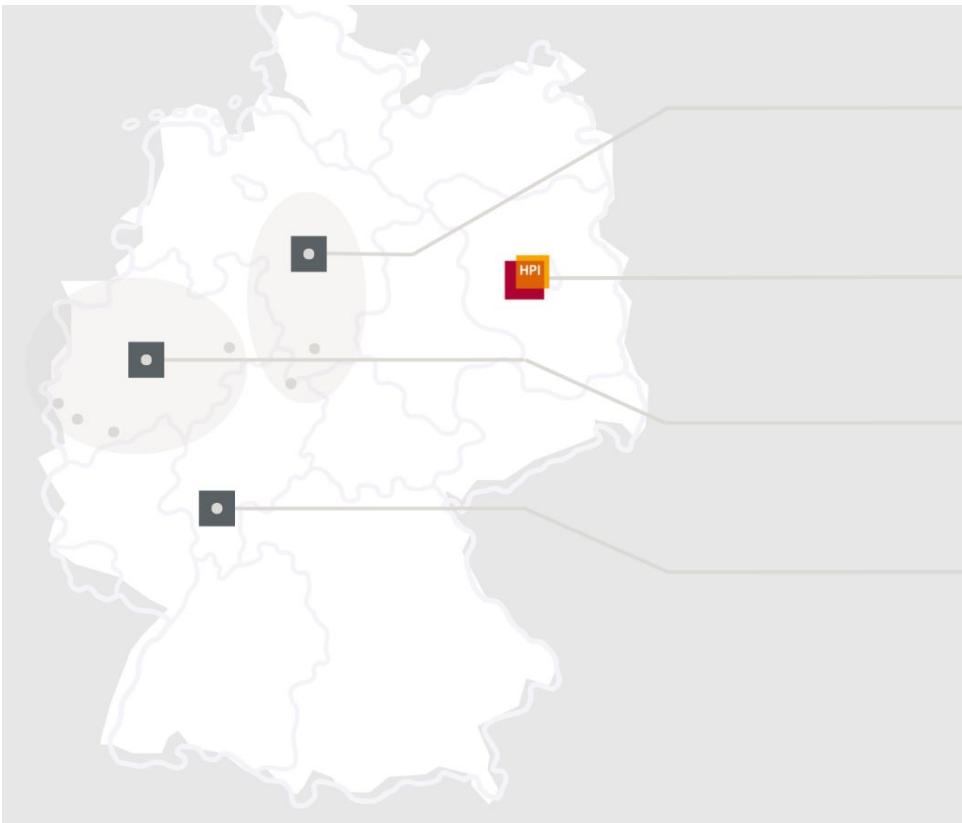


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Agenda

- Brief intro and learning objectives
- Use cases for image similarity
- Understanding image embeddings
- Scraping images from Google Images or Bing
- Setting up Google Colab and Drive
- Using pre-trained networks for image similarity
- Visualizing embeddings with TensorBoard
- Review questions and discussion

What we expect you to have

- Some Python knowledge
- Curiosity :)

Learning objectives

At the end of the first workshop you will be able to:

- Describe use cases for image similarity in dataset curation
- Scrape images from Google Images or Bing
- Generate embeddings for images using a pretrained neural network
- Compare image pairs using cosine similarity
- Visualize embeddings in 3D using Tensorboard

Learning objectives

At the end of the second workshop you will be able to:

- Visualize image neighborhoods with k-nn
- Cluster images using k-medoids
- Select representative images

How are we doing this workshop

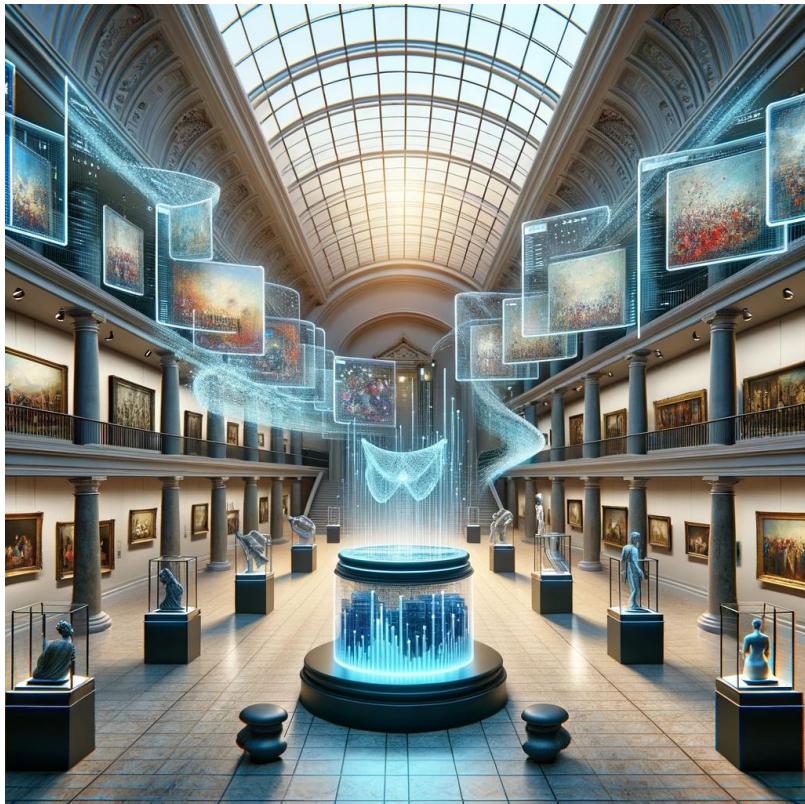
- We **type** most of the Python code from the tutorial notebooks in Google Colab

Repository:<https://github.com/KISZ-BB/image-dataset-curation-workshops>

What you need

- A Google user account
- A Google Drive account with enough free space
- Google Chrome or Firefox

What is dataset curation?



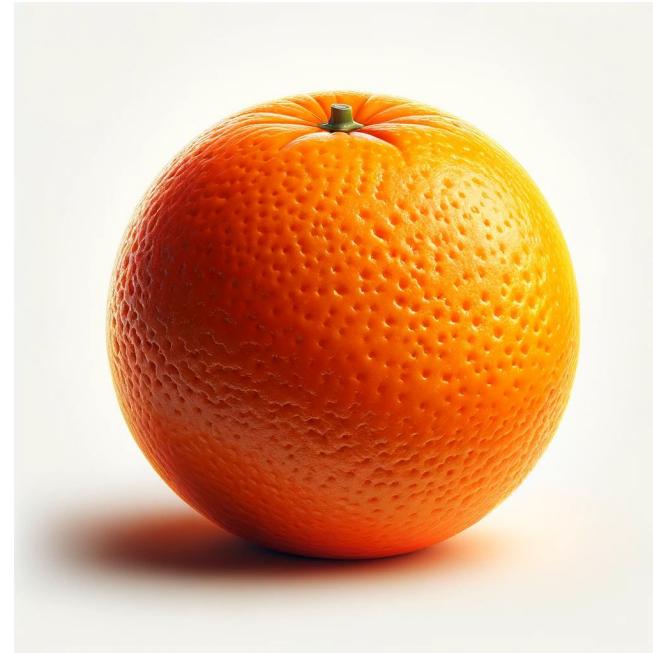
- We want to make data **accurate** and **relevant**
- We clean, deduplicate, and label
- This is similar to what museum curators do

How similar are these two images?



Cosine similarity = 0.91

How similar are these two images?



Cosine similarity = 0.78

How similar are these two images?



Cosine similarity = 0.53

How similar are these two images?



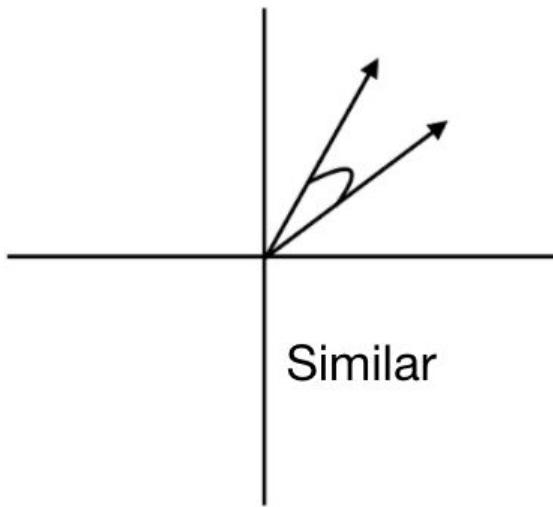
Cosine similarity = 0.65

How similar are these two images?

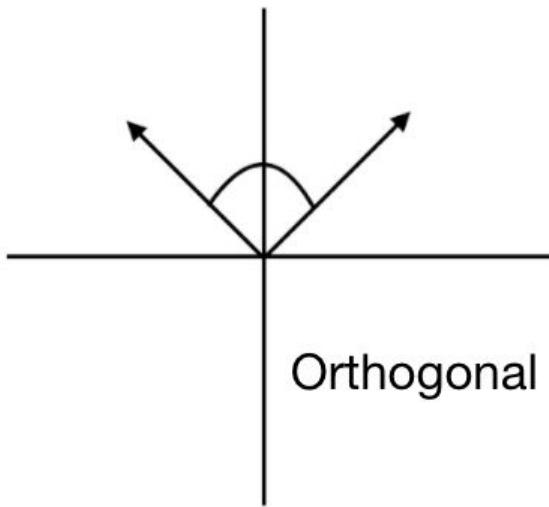


Cosine similarity = 0.84

Cosine Similarity



Similar



Orthogonal

16

$$\text{similarity} = \cos(\theta) = \frac{\mathbf{A} \cdot \mathbf{B}}{\|\mathbf{A}\| \|\mathbf{B}\|}$$

Time for the first notebook

Comparing apples to apples

Use Case: Google's reverse image search

Google

Find image source

Search Text Translate

Related search

Wikimedia
File:Pieter Bruegel d. Ä. 075.jpg - Wikimedia...
See exact matches

Genially
La Tour de Babel par Lila et Suzanne

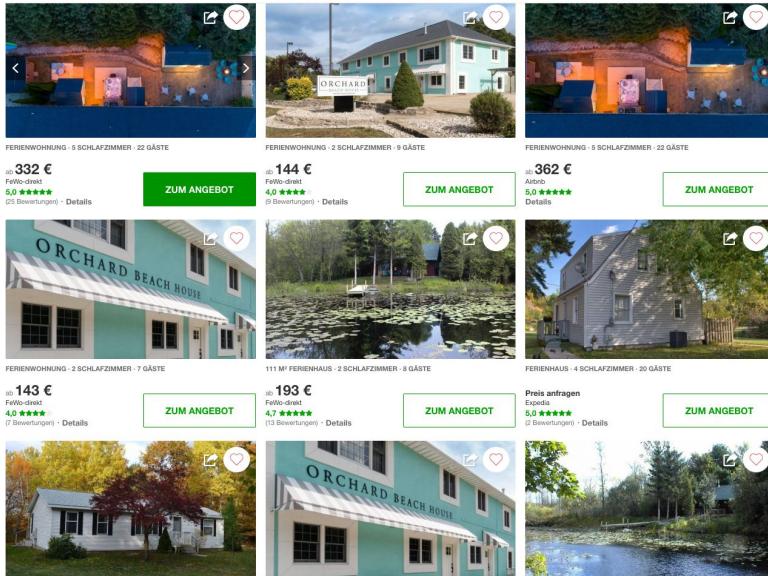
HistoryExtra
Babylon: What Happened To The...

Christian Bible Refe...
The Tower of Babel

<https://images.google.com/>

Use case: image matching at hometogo.com

- Inventory understanding (500 million images)
- Providing the best deals to users (sample use case: strike prices)



3-STAR HOTEL · DOWNTOWN GRAND LAS VEGAS

\$30 ~~\$33~~
Travelocity
4.2 ★★★★★ · Details

[VIEW DEAL](#)

Use case: primary image matching at Hometogo



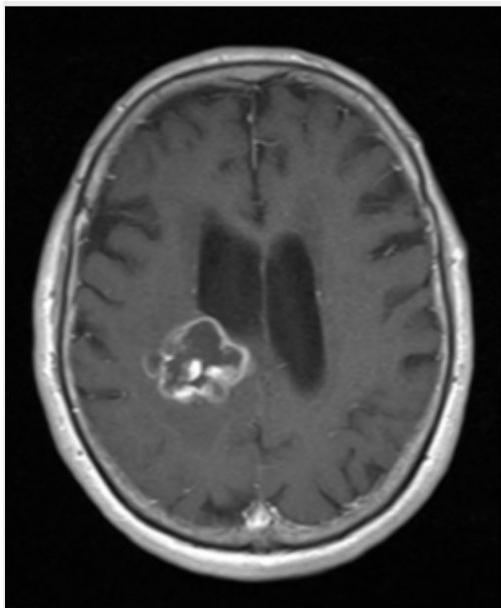
Cosine similarity = 0.65

Use case: primary image matching at Hometogo

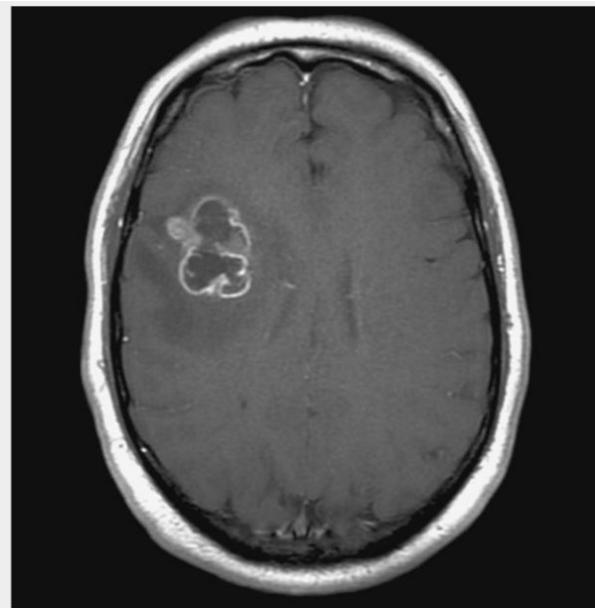


Cosine similarity = 0.99

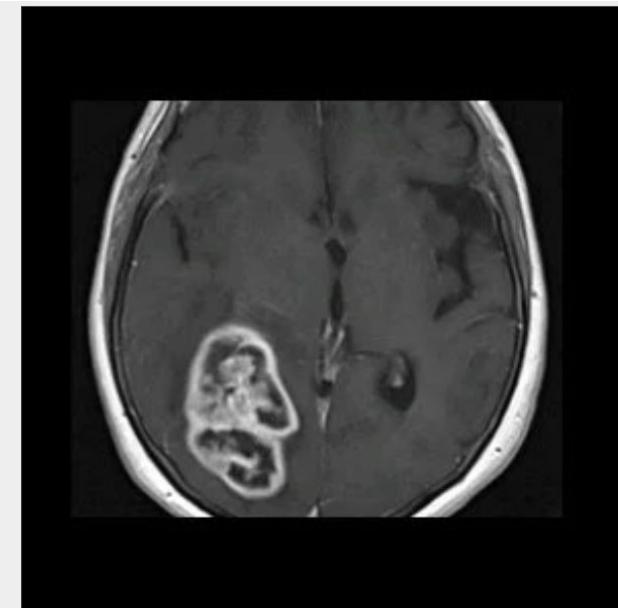
Use case: differential diagnosis



Glioma grade I



Glioma grade I



Glioma grade III

Use case: bike trip routing

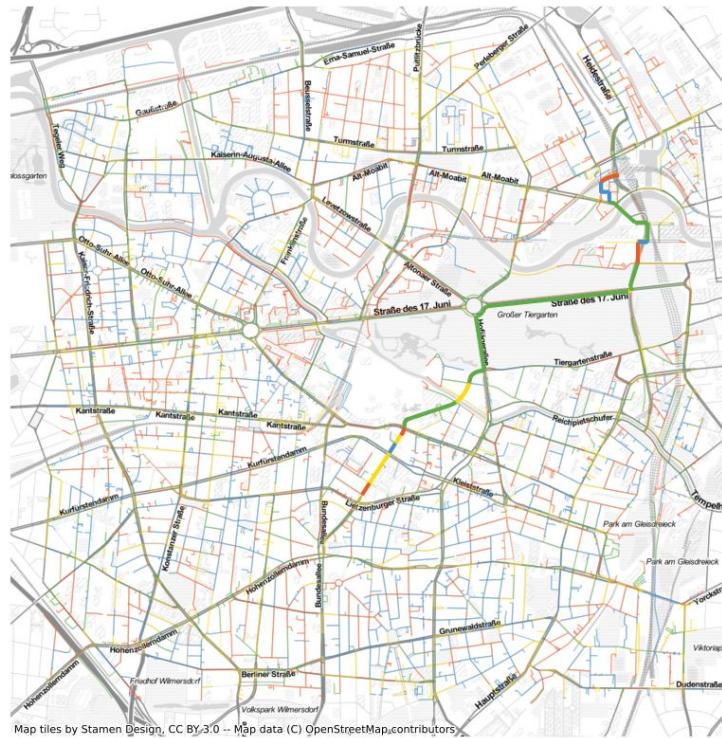
Cluster 0: Safe bike lanes



Cluster 1: Unsafe bike lanes



Use case: bike trip routing



www.github.com/graumannm/Berlin_Bike_CV

Use case: cleaning image datasets



<https://github.com/cleanlab/cleanlab>

Art Recommendation system

This is the repository of a portfolio project at DSR. This project aims to identify similar images using pre-trained computer vision networks. For an explanation of the technology see the [technology section](#).

Contributors

- Catarina Ferreira
- Gargi Maheshwari

<https://github.com/gargimaheshwari/Wikiart-similar-art>

Motivation: enhancing Wikiart's recommendations



The Painter and the Art Lover - Pieter Bruegel the Elder

Pieter Bruegel the Elder

Pieter Brueghel de Oude

Born: c.1525; Breda, Netherlands (i)

Died: September 9, 1569; Brussels, Belgium (i)

Nationality: Flemish

Art Movement: Northern Renaissance

Painting School: Flemish School, Antwerp School

Genre: genre painting

Field: [painting](#), printmaking

Influenced by: Hieronymus Bosch

Influenced on: Tobias Verhaecht, Peter Paul Rubens, Jan Miense Molenaer, Hendrick Avercamp

Art institution: Guild of Saint Luke

Friends and Co-workers: Maarten de Vos, Giulio Clovio

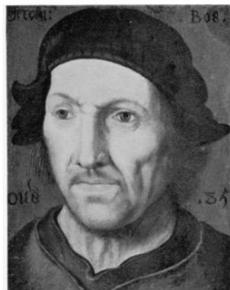
Family and Relatives: Jan Brueghel the Elder, Pieter Brueghel the Younger

Wikipedia: en.wikipedia.org/wiki/Pieter_Bruegel_the_Elder ↗

<https://www.wikiart.org/en/pieter-bruegel-the-elder>

Motivation: improving Wikiart's art recommendation

RELATED ARTISTS i



Hieronymus Bosch

c.1450 - 1516



Gregorio Lopes

c.1490 - 1550



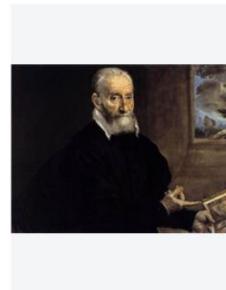
**Marinus van
Reymerswaele**

c.1490 - c.1546



**Hans Holbein the
Younger**

c.1497 - 1543



Giulio Clovio

1498 - 1578



Jan van Hemessen

c.1500 - c.1566



**Cristovao de
Figueiredo**

c.1500 - c.1543

<https://www.wikiart.org/en/pieter-bruegel-the-elder>

Motivation: improving Wikiart's art recommendation

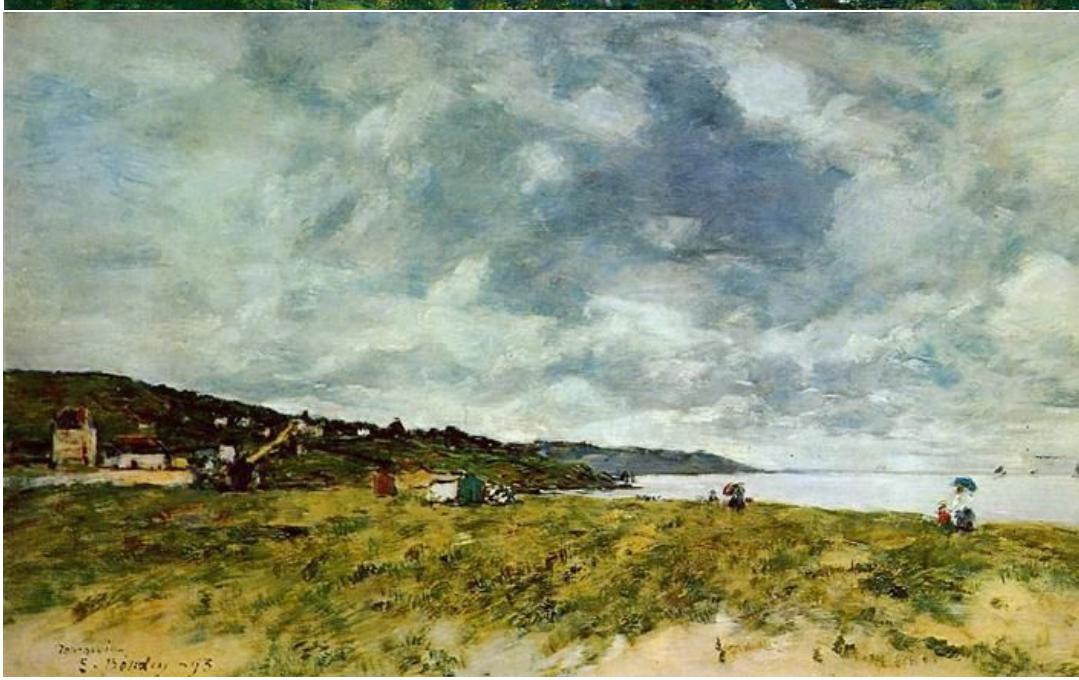
ARTISTS BY ART MOVEMENT

Art historians employ a number of ways to group world arts into systems of classification. They subdivide the continuous flow of artworks through time and space into groupings. These groupings are defined by the perception that the artworks within them share a single quality or a set of qualities that are significant. Significant qualities reflect a specific approach of an artist; they can include the formal, stylistic, iconographic, thematic, or other aspects of art. The definition of a grouping reflects judgments about the nature of meaningful connections between artworks, and between art and its larger context. Western arts are usually structured by art movements, using mostly cultural and aesthetic criteria, while Eastern arts are subdivided into periods according to political-dynastic markers.

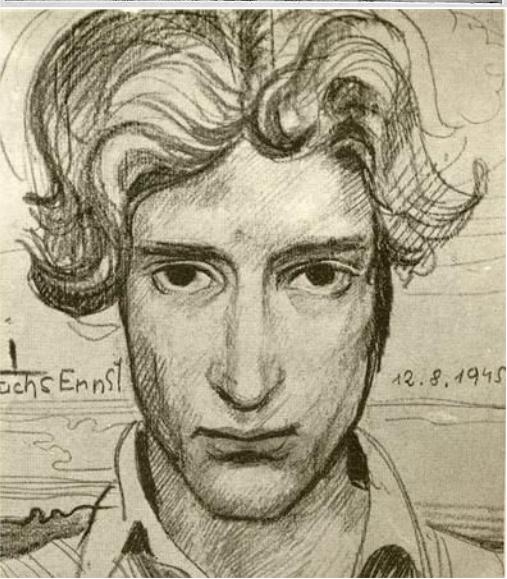
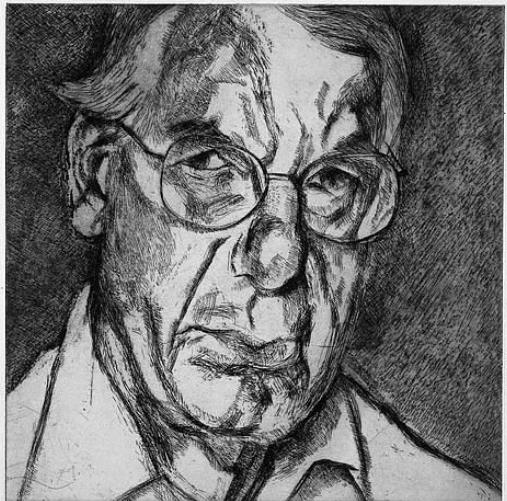
by time

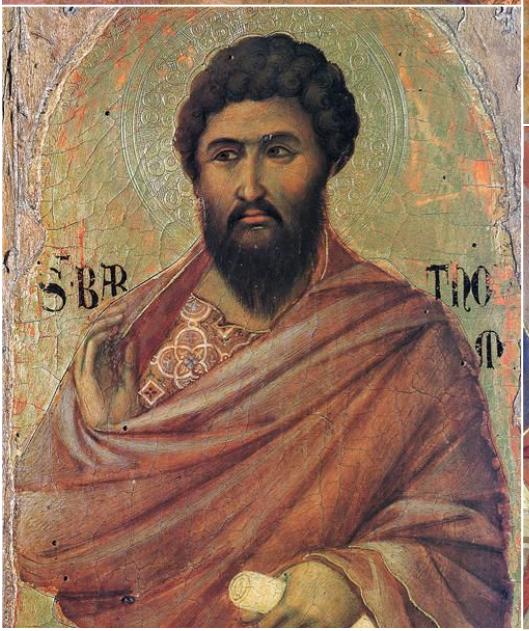
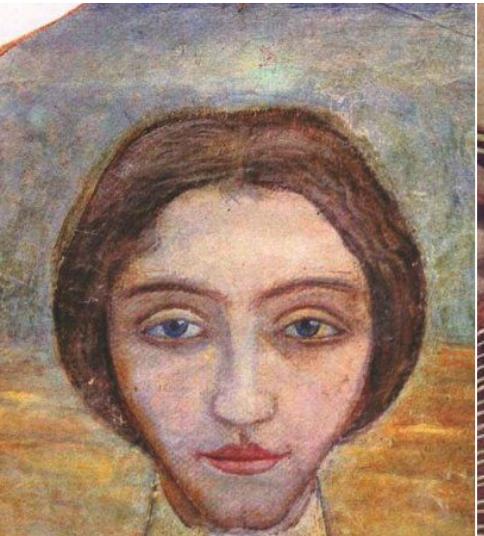
by name

by count

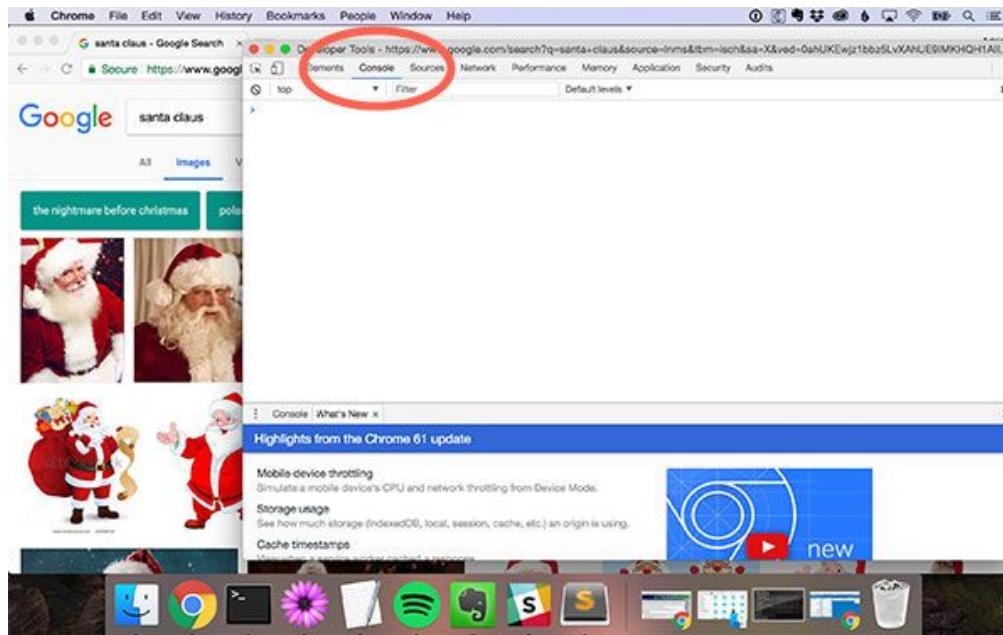






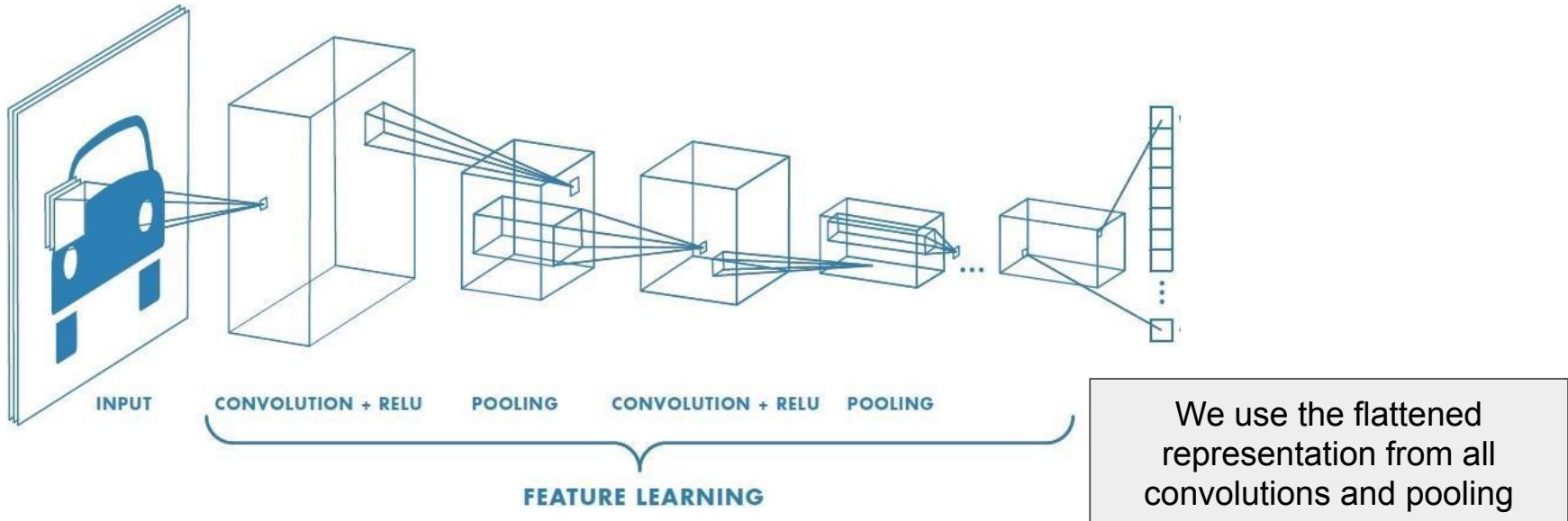


Scraping a dataset from Google Images

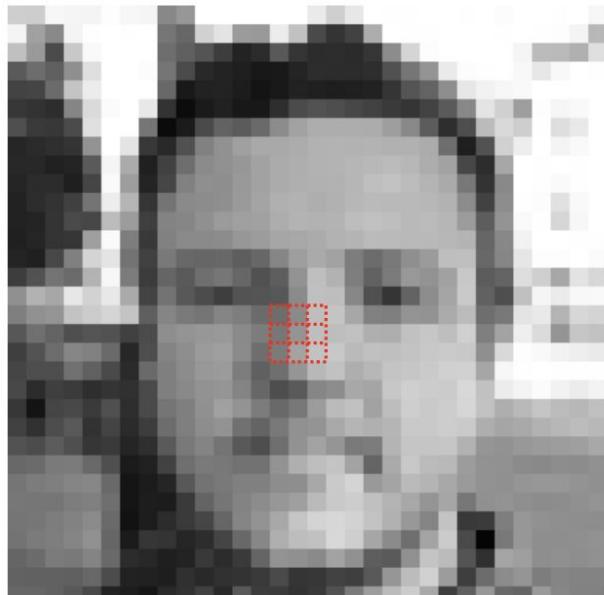


[PylImageSearch guide](#)

Image Embeddings from Convolutional Networks



Intuitions about convolutions



input image

$$\left(\begin{array}{ccc} 110 & + & 139 & + & 191 \\ \times 0 & & \times -1 & & \times 0 \\ \\ + & 120 & + & 149 & + & 191 \\ \times -1 & & \times 5 & & \times -1 \\ \\ + & 124 & + & 164 & + & 195 \\ \times 0 & & \times -1 & & \times 0 \\ \\ = & 131 \end{array} \right)$$

kernel:



output image

<https://setosa.io/ev/image-kernels/>

The ImageNet dataset



14,197,122 images, 21841 synsets indexed

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ImageNet is an image database organized according to the **WordNet** hierarchy (currently only the nouns), in which each node of the hierarchy is depicted by hundreds and thousands of images. The project has been **instrumental** in advancing computer vision and deep learning research. The data is available for free to researchers for non-commercial use.

<https://www.image-net.org/>

Visualizing embeddings in TensorBoard



Image neighborhoods

1.0



0.73



0.73



0.72



0.7



0.7



Review questions

- How can we access an image array from its file's url?
- What is an embedding?
- What is maximum possible value of cosine similarity between two vectors?
- What's the cosine similarity between two orthogonal vectors?
- What is Imagenet?
- Would changing the Resnet change the cosine similarity that we obtain from an image pair?

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Next topics:

- Image clustering
- Fine tuning models for image classification
- Image analysis with CLIP
- Meta's Segment Anything
- Segmentation and object detection with Detectron2
- Using Qdrant as a vector database for images
- Deployment of recommendation system with FastAPI and Docker