Automatisches Bildverstehen

–

Visuelle Bildnavigation

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visual-computing.com

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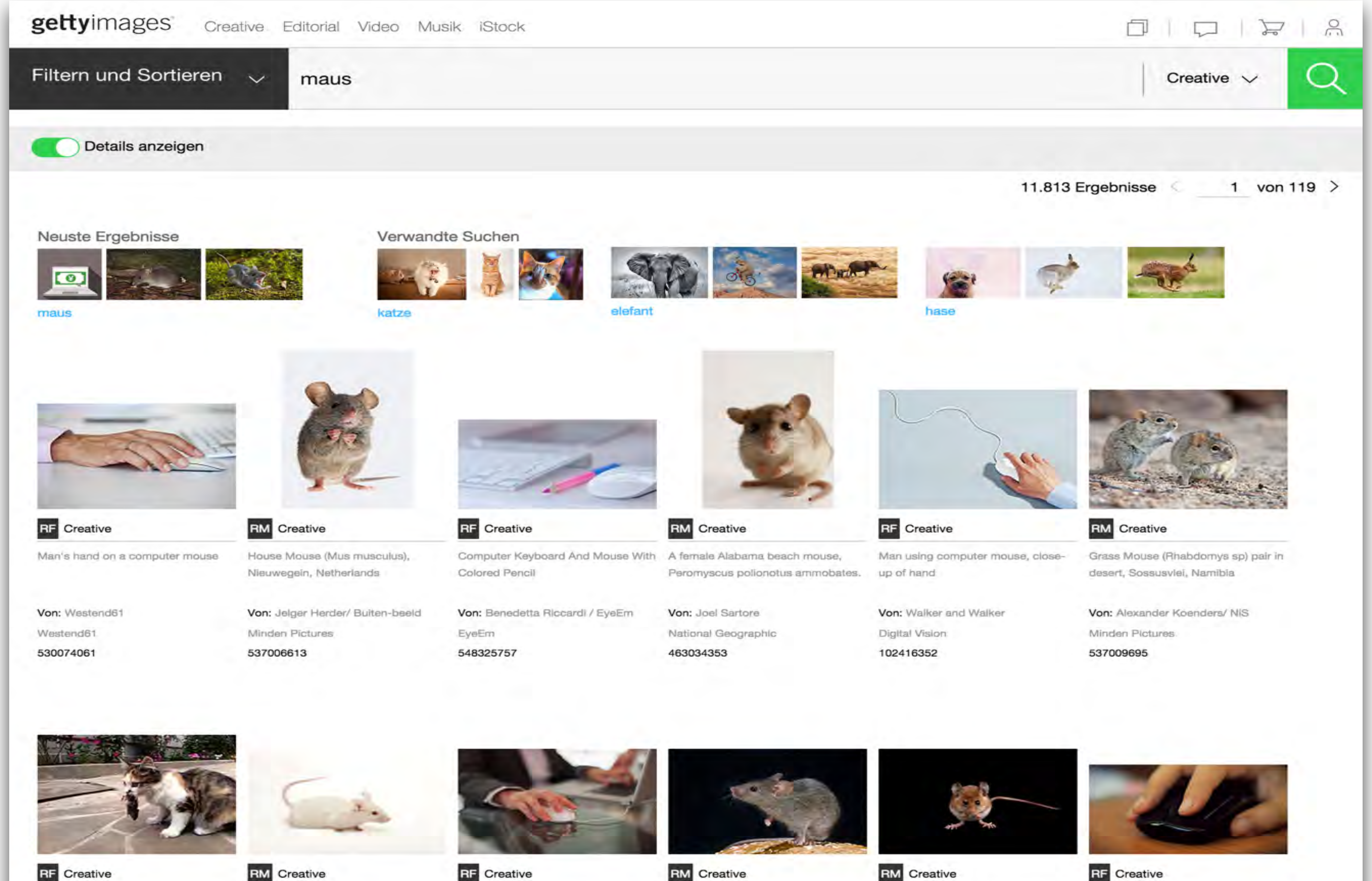
pixolution

There are too many images

- Constantly growing number of images, thousands of results for a search
- Image search is very time consuming
- Only few images can be looked at simultaneously

Image search: The Actual Situation as you all know it …



Keyword search

- Good keywording is expensive, keywords often are incomplete, overloaded or wrongly translated
- Exact keyword matching leads to finding everything or nothing

"meadow"

826,951 results:

"meadow blue sky apple tree clouds flowers family"

3 results:

Low-Level Content based Image Search

- Low-level image search finds similar looking images.

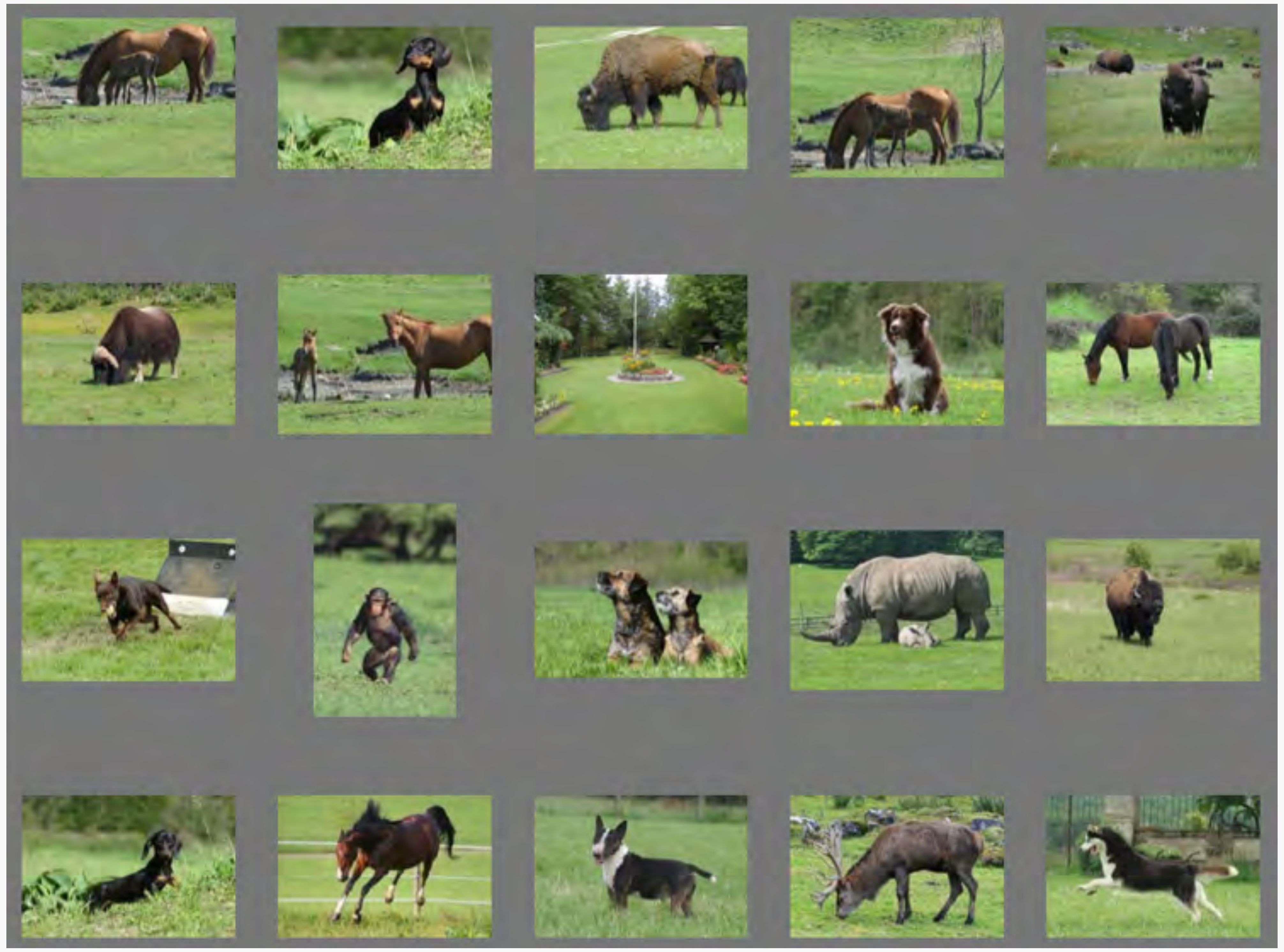

- Does not understand the meaning of the images.


- Cannot find similar images that look different


Problem of visual image search

Visual search finds similar looking images, but does not "understand" the meaning of the image.

Query: 

Result: → 

Visually similar images, context may be different

"More like this" search using image keywords

Query:

(The keywords of the query image)

america amazon animal beak bird brazil era eye feather fuss parrot portrait yellow ...

Result:

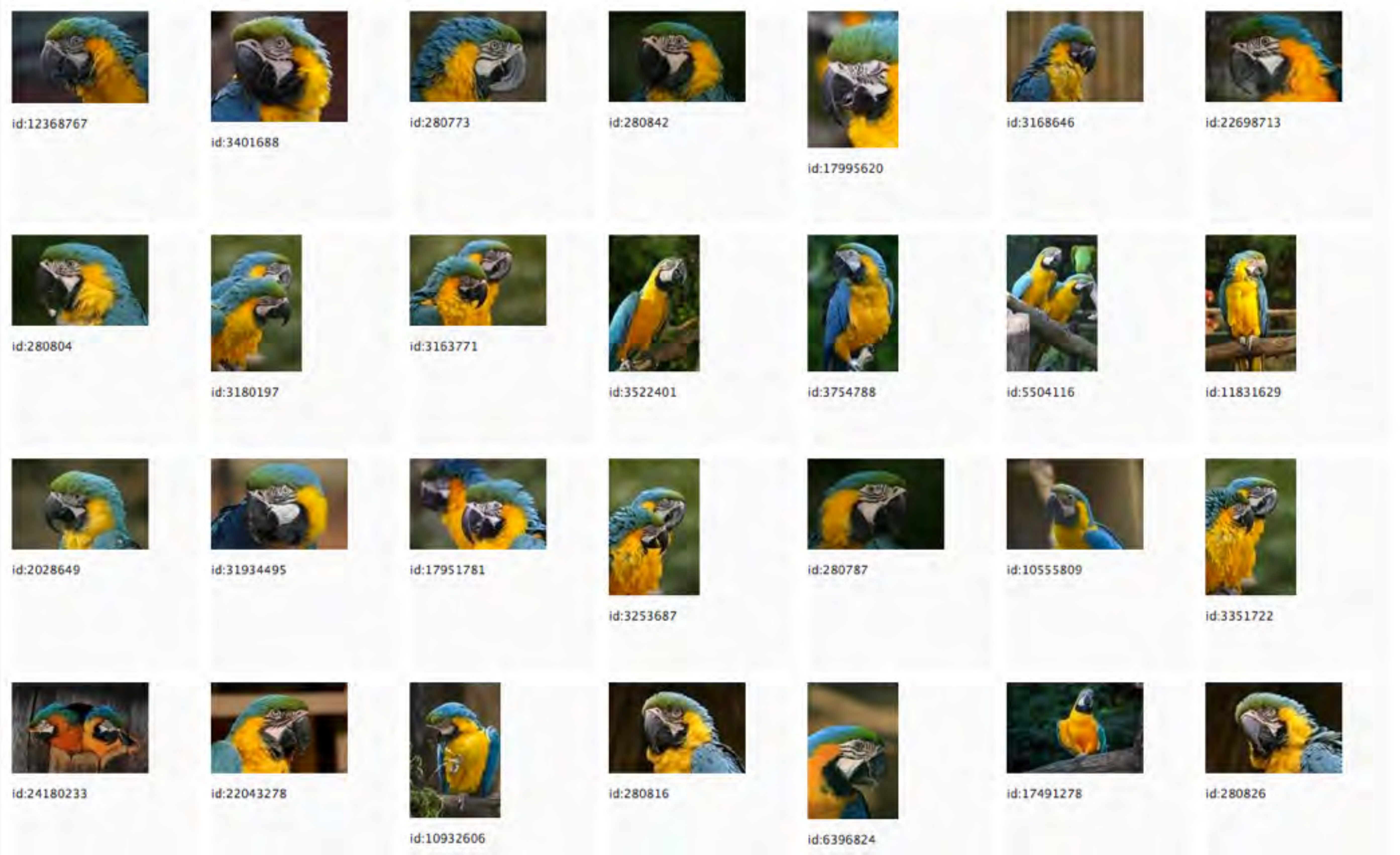
Similar image content, large appearance variations

Fusing visual and keyword search

Query: 

+

america amazon
animal beak bird
brazil era eye
feather fuss parrot
portrait yellow ...

Result: 

+ Visually similar images and (!) + Similar content

Similarity Weighting

query:
image
+
keywords

keywords

visual

What can we do with this?

A fused search allows a unified similarity measure. This paves the way to:

- Improved image search results
- Automatic clustering of images

- But: No solution for untagged images (images without keywords)!


Enter keyword here
pixolution
Images found
ms
by keywords
visually
What's the magic?
fusing visual and keyword search
pixolution

Clustering Image Search Results

Too many different images make it difficult to find images to start a similarity search

Clustering Image Search Results

What do we need to find image more easily?

Most images are untagged!

→ We need **automatic image understanding**

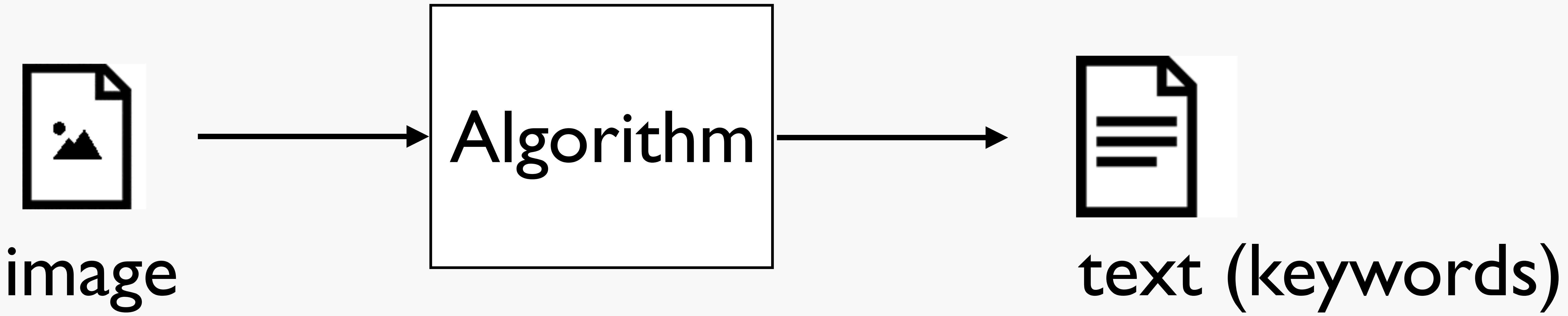
There are far too many images!

→ We need **visual image browsing**

Automatic Image Understanding

Image Understanding

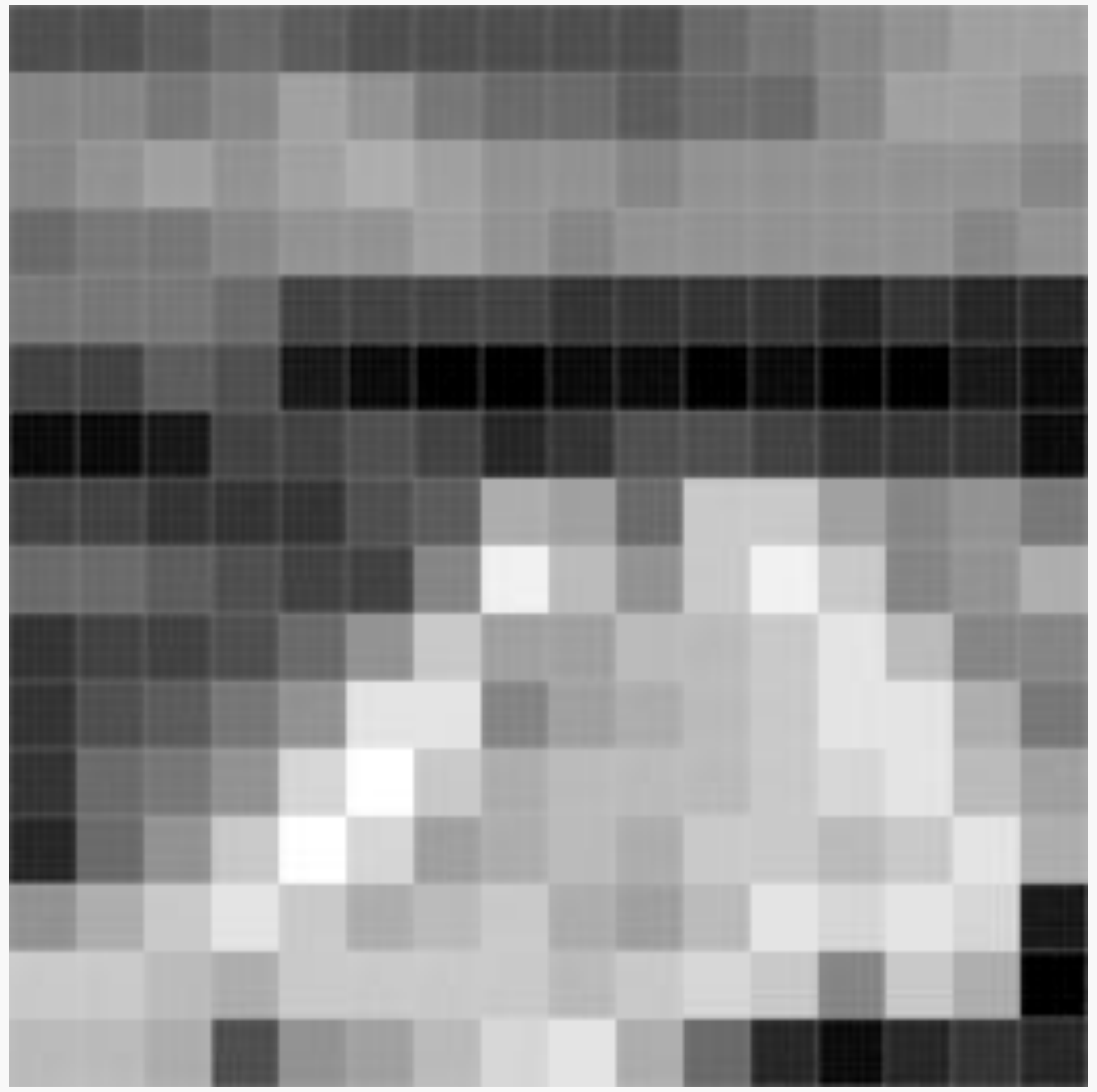
What is shown in this image?



Automatic Image Understanding

3264x2448 pixels
16.7 million colors

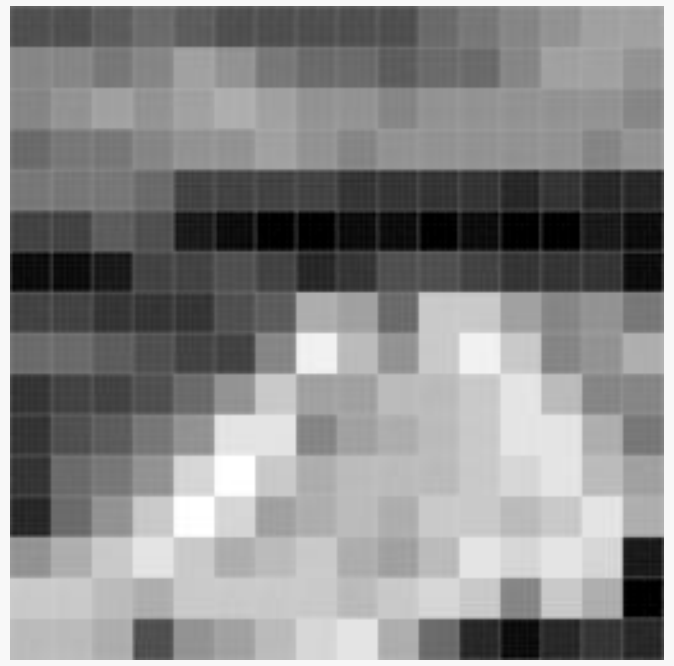
16x16 pixels



16x16 pixels
16 brightness levels

164	229	229	224	219	214	199	192	185	160	77	33	24	28	30	26
170	235	226	209	197	185	170	159	155	138	68	29	25	29	30	29
165	220	213	200	187	173	164	158	161	134	74	62	67	73	79	82
154	189	193	203	207	201	197	187	182	141	104	151	175	177	177	173
184	210	209	215	218	213	208	198	188	140	128	180	202	195	189	185
225	221	221	214	215	214	208	206	199	148	115	158	190	193	189	185
227	221	217	217	213	218	206	203	209	144	113	152	190	193	189	186
221	218	215	215	213	213	209	211	202	146	119	163	196	197	193	189
216	220	219	219	215	216	214	218	186	106	83	131	181	202	198	191
216	214	214	216	215	218	214	186	122	57	49	55	132	185	190	186
218	215	214	217	218	214	200	141	78	47	39	63	118	161	177	180
215	218	217	216	218	220	207	125	73	52	70	152	189	188	191	187

Automatic Image Understanding



16x16 pixels, 16 brightness levels

Number of possible images:

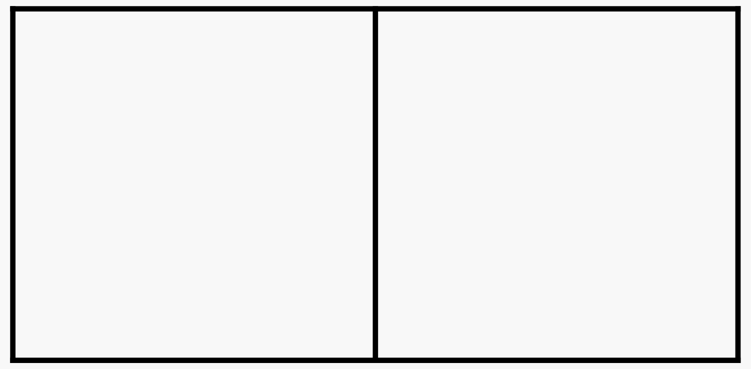
16^{16x16} = $1.79 \cdot 10^{308}$ =

179 769 313 486 231 590 772 930 519 078 902 473 361 797 697 894 230 657 273 430
081 157 732 675 805 500 963 132 708 477 322 407 536 021 120 113 879 871 393 357
658 789 768 814 416 622 492 847 430 639 474 124 377 767 893 424 865 485 276 302
219 601 246 094 119 453 082 952 085 005 768 838 150 682 342 462 881 473 913 110
540 827 237 163 350 510 684 586 298 239 947 245 938 479 716 304 835 356 329 624
224 137 216

More than the number of atoms in the universe: 10^{80}

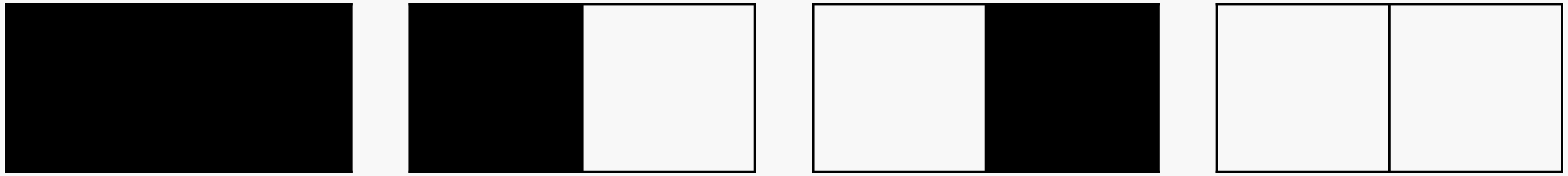
Simple Case

- Image with only 2 pixels



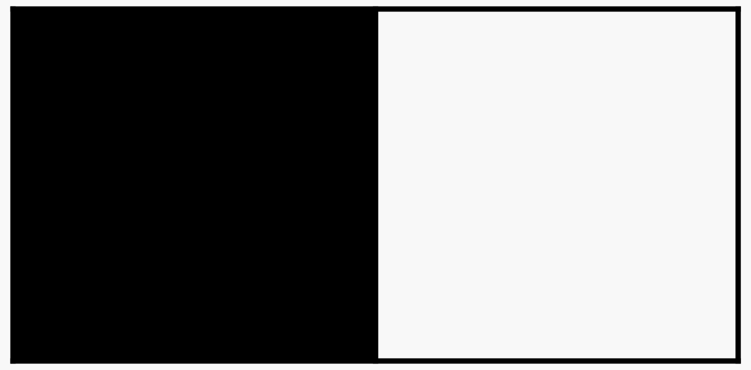
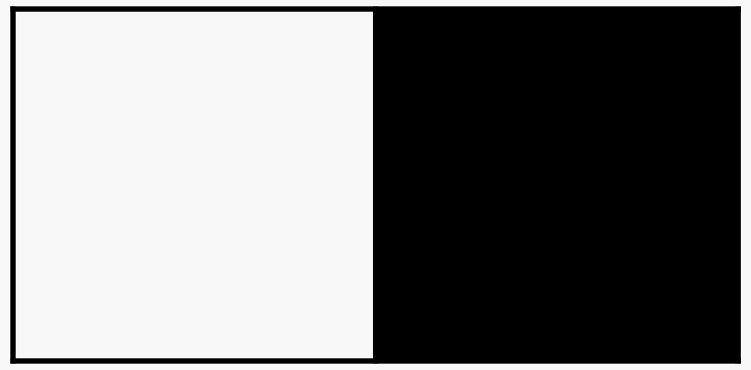
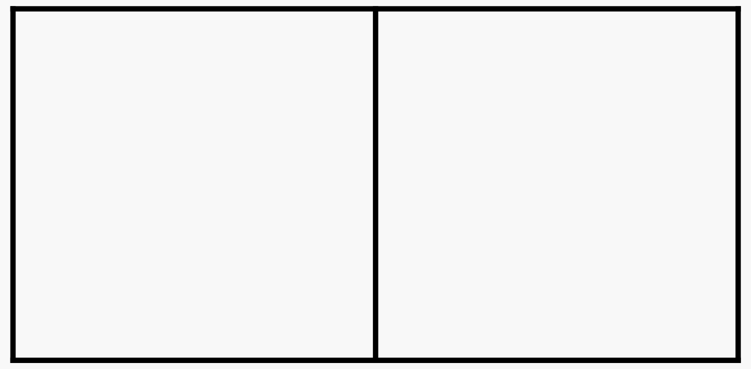
- Only black or white colors

- For possible images:

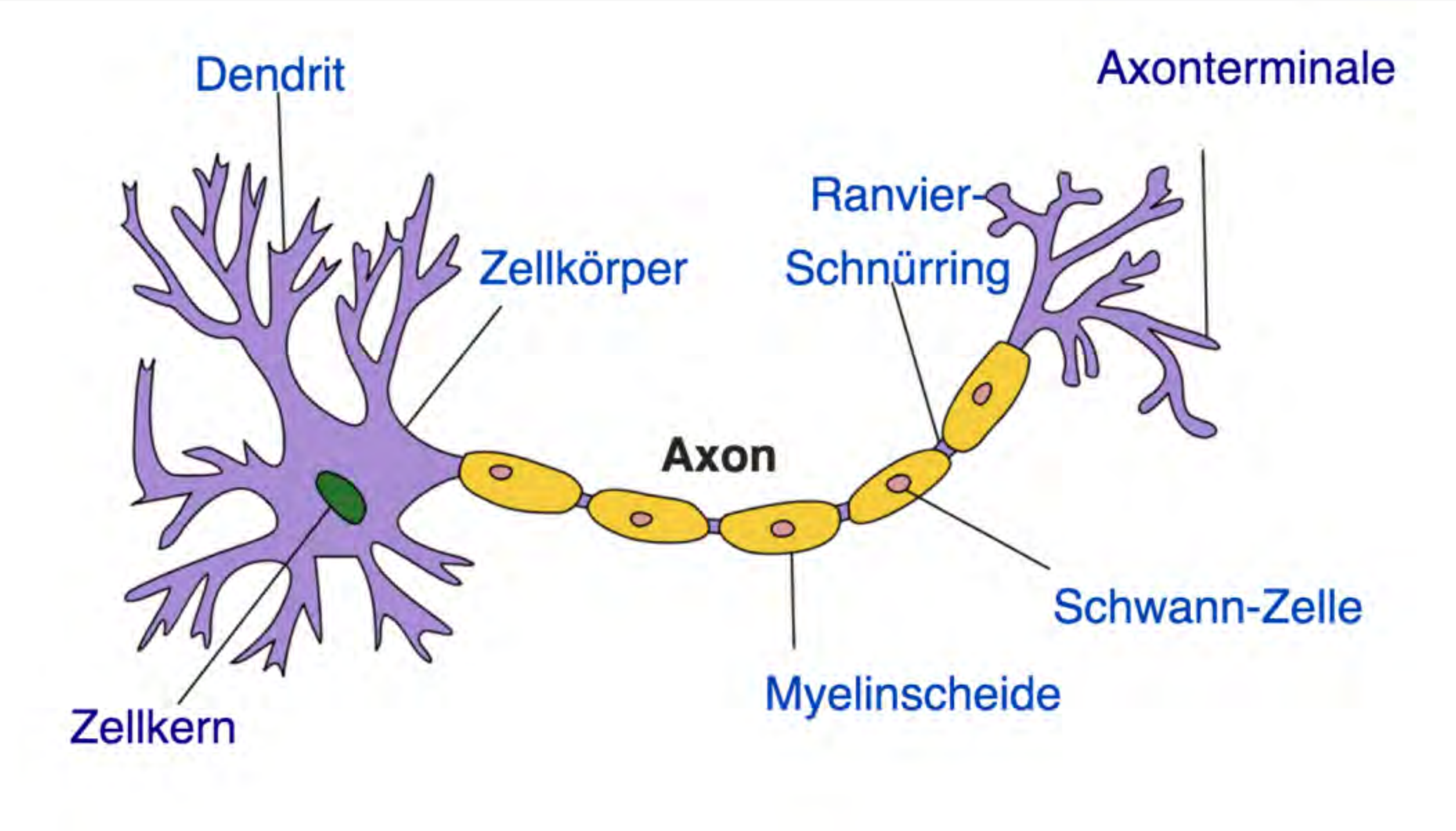


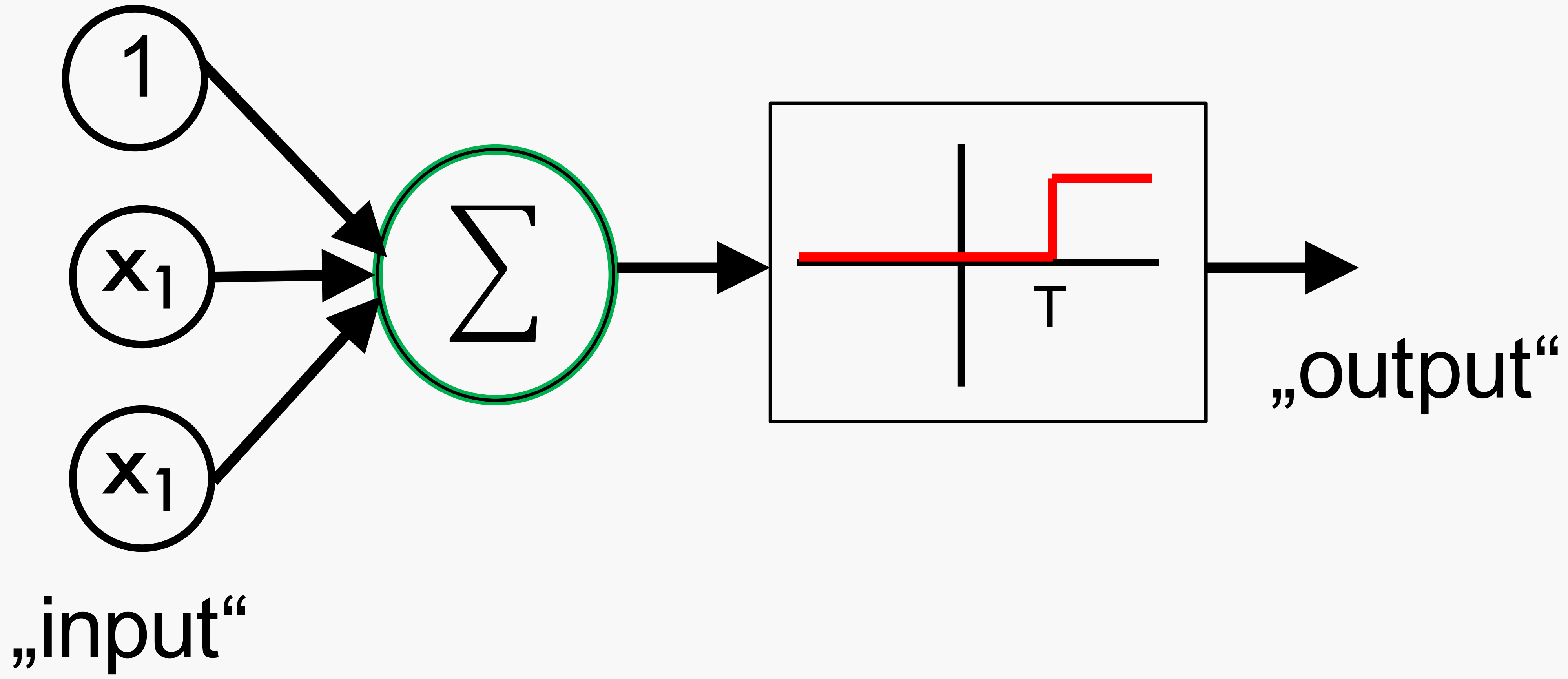
Simple Case

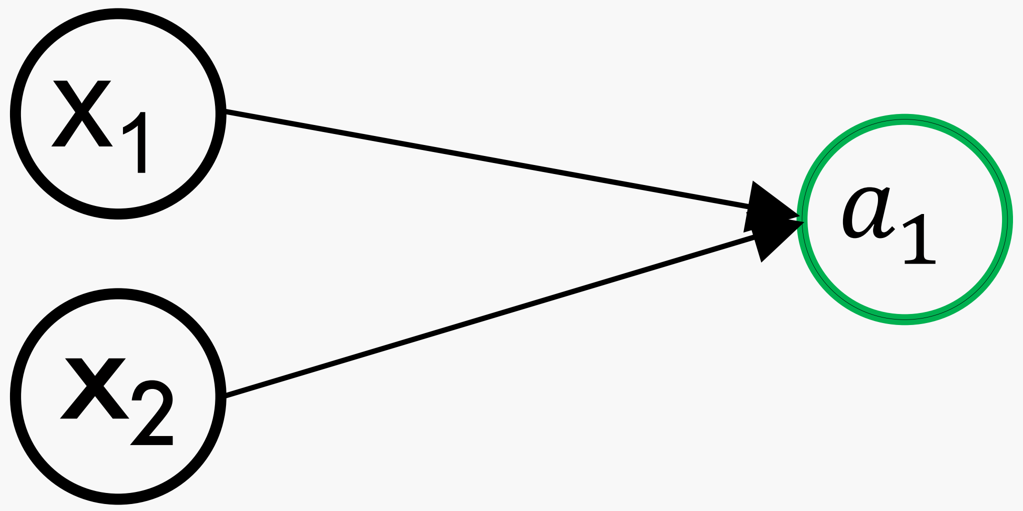
Possible questions: Are the pixels …

	both black?	both white?	both different?
	yes	no	no
	no	no	yes
	no	no	yes
	no	yes	no

(Artificial) Neural Network



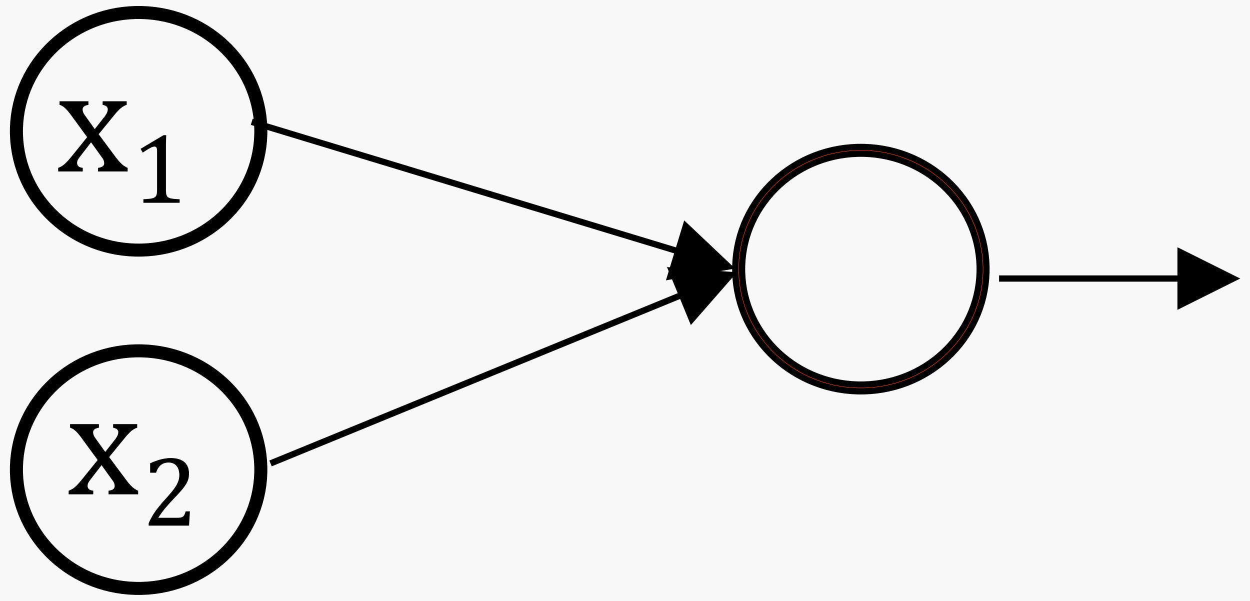




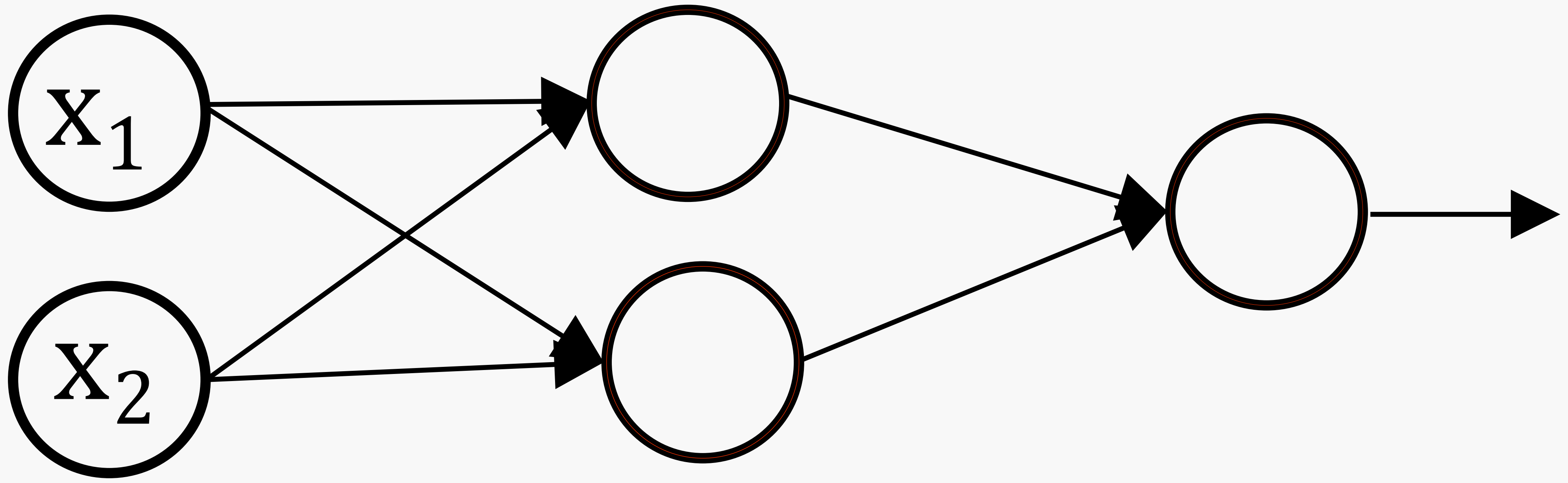
Neural Networks

… can be trained to answer these questions:

Are the pixels all white?

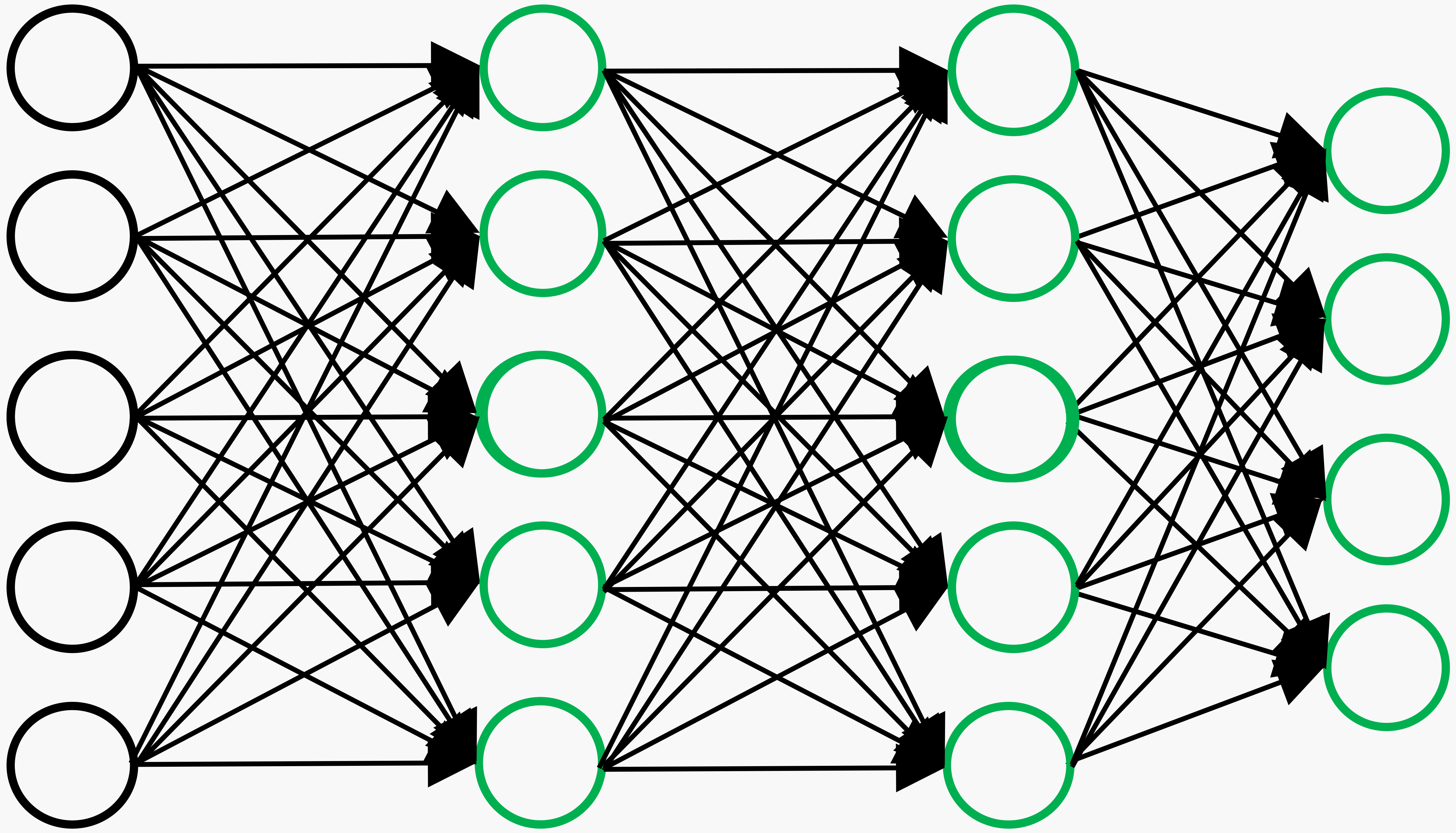


Are the pixels different?



Neural Networks

Extension to automatic image understanding

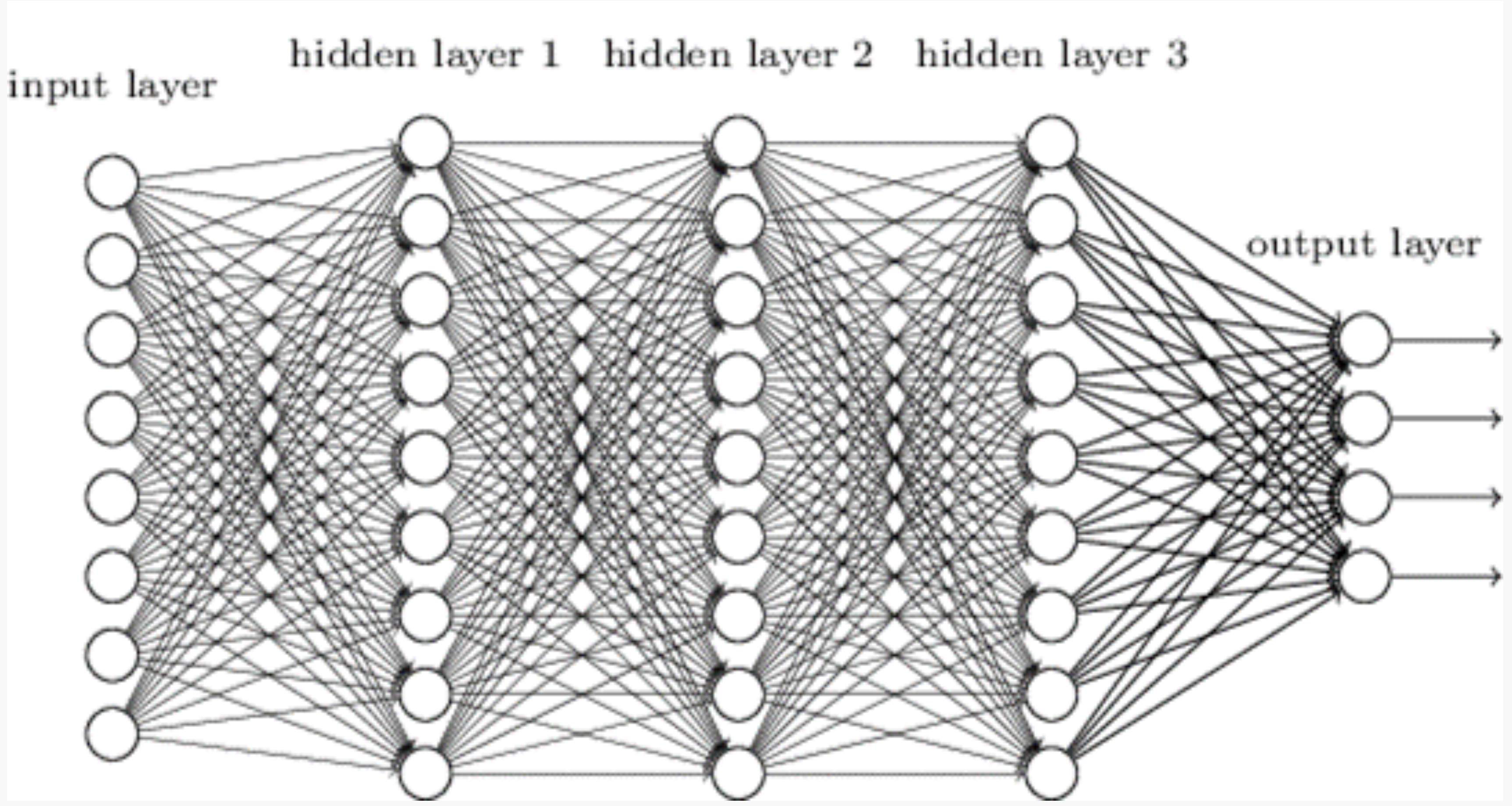


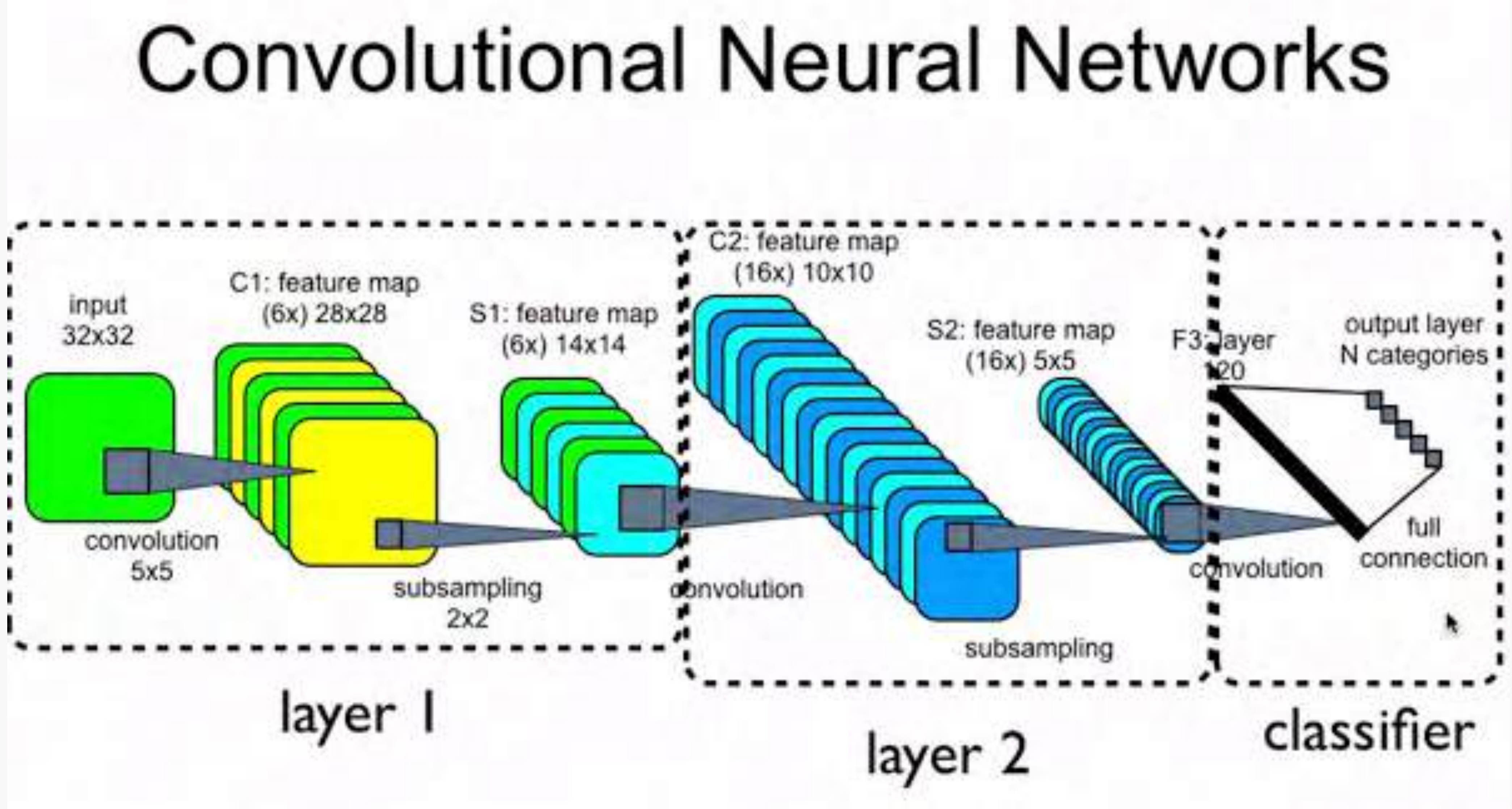
Neural Networks for Image Understanding

Problems:

- Not enough example images
- Computers were too slow
- Too many parameters

All these problems were solved in the last years.
→ Deep Learning / Convolutional Neural Networks





Semi-automatic keywording

Image Browsing / Image Navigation

Instead of scrolling endless image lists:

Explore images!

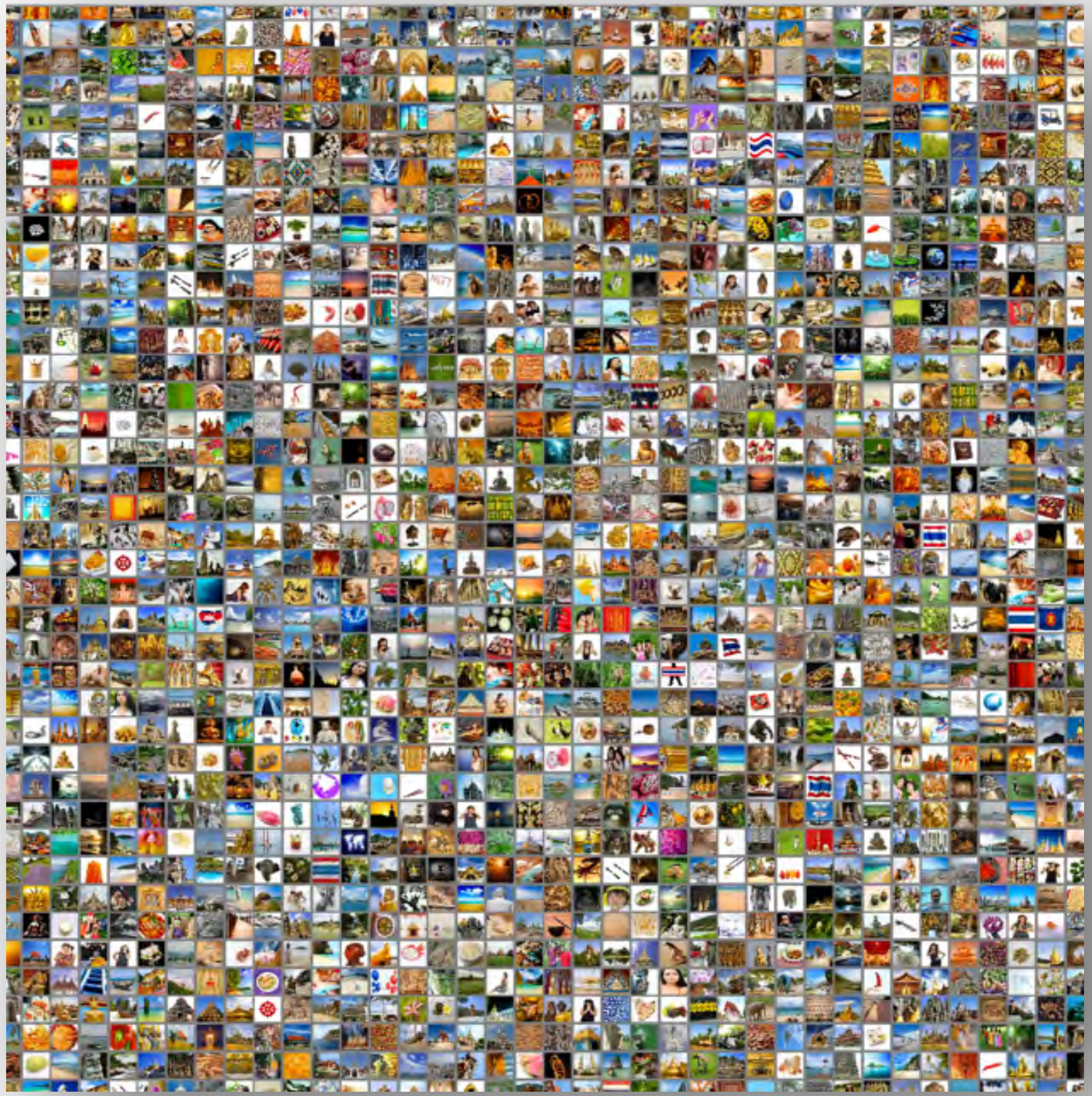
Google Maps

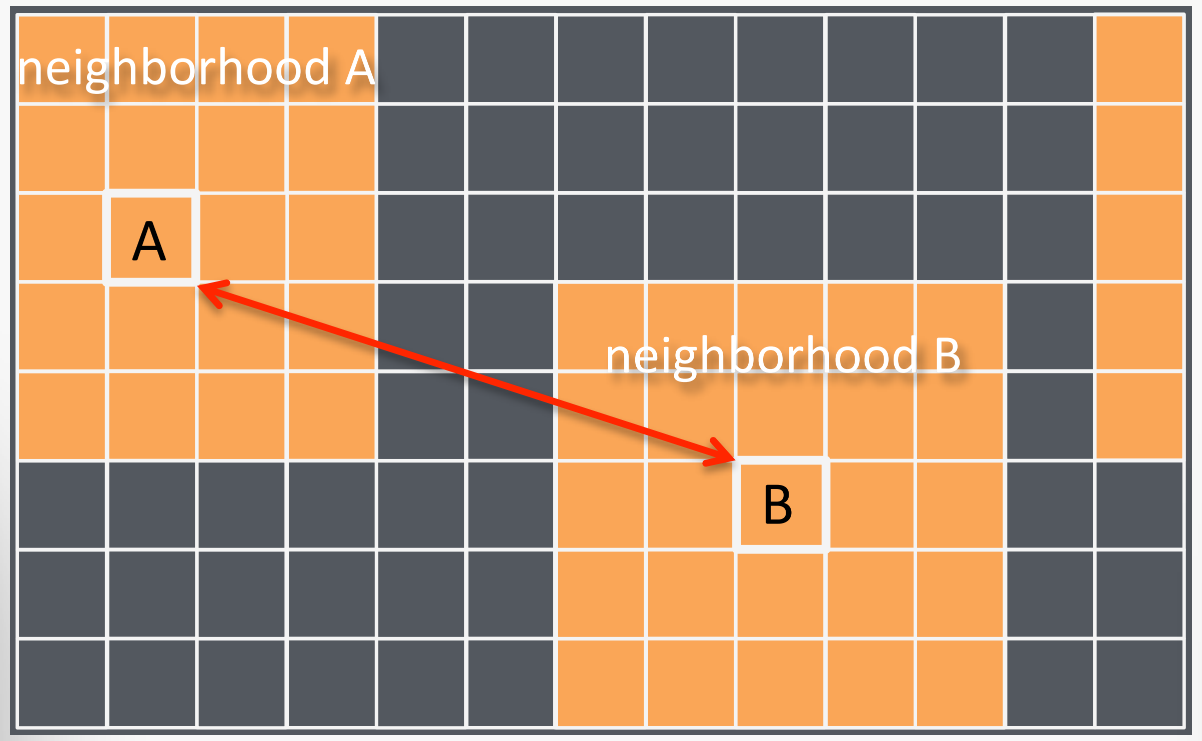

HTW Berlin - Gebäude C, Wilhelminenhofstraße 75A, 1:
HTW Berlin - Gebäude C
Street View · In der Nähe suchen
Kai
Griechischer Park
Griechische Allee
Kilianistraße
Goethestraße
Schillerpromenade
Großstraße
Firlstraße
Grundschule an der Wuhlheide
An der Wuhlheide
Kottmeierstraße
Eichgestell
Städtischer Friedhof
Verlängerte Rathenaustraße
Haus Natur und Umwelt
Feldbahn Wuhlheide
Kindl-
Wilhelminenhofstraße
Lidl
Klarastraße
Plönzeile
Marienstraße
Mathildenstraße
Rathenaustraße
Keplerstraße
Hallenbad Kleine Schwimmhalle...
Platz am Kaisersteg
Rathenauplatz
Slabystraße
Gaußstraße
Waldowstraße
Scharnweberstraße
Parkstraße
Weiskopffstraße
Hochschule für Technik und Wirtschaft Berlin - Campus Wilhelminenhof
HTW Motorsport
HTW Berlin - Gebäude C
Ostendstraße
Essentis Biohotel
Spree
Hasselwerderstraße
Fennstraße
Hainstraße
Mensa HTW Wilhelminenhof
Peter-Behrens-Straße
First Sensor
Schnellerstraße
Hochschule für Schauspielkunst Ernst...
Dokumentationszentrum NS-Zwangsarbeit Berlin
Gaststätte Artemis
BMW Autohaus Graubaum
Köllnische Str.
TC Berlin-Oberspree
Autohaus Dinnebier
Freie Waldorfschule Berlin-Südost
S Oberspree (Berlin)
Earth
Google
Kartendaten © 2015 GeoBasis-DE/BKG (©2009), Google
Bedingungen
Datenschutz
Problem melden
100 m

Google Earth

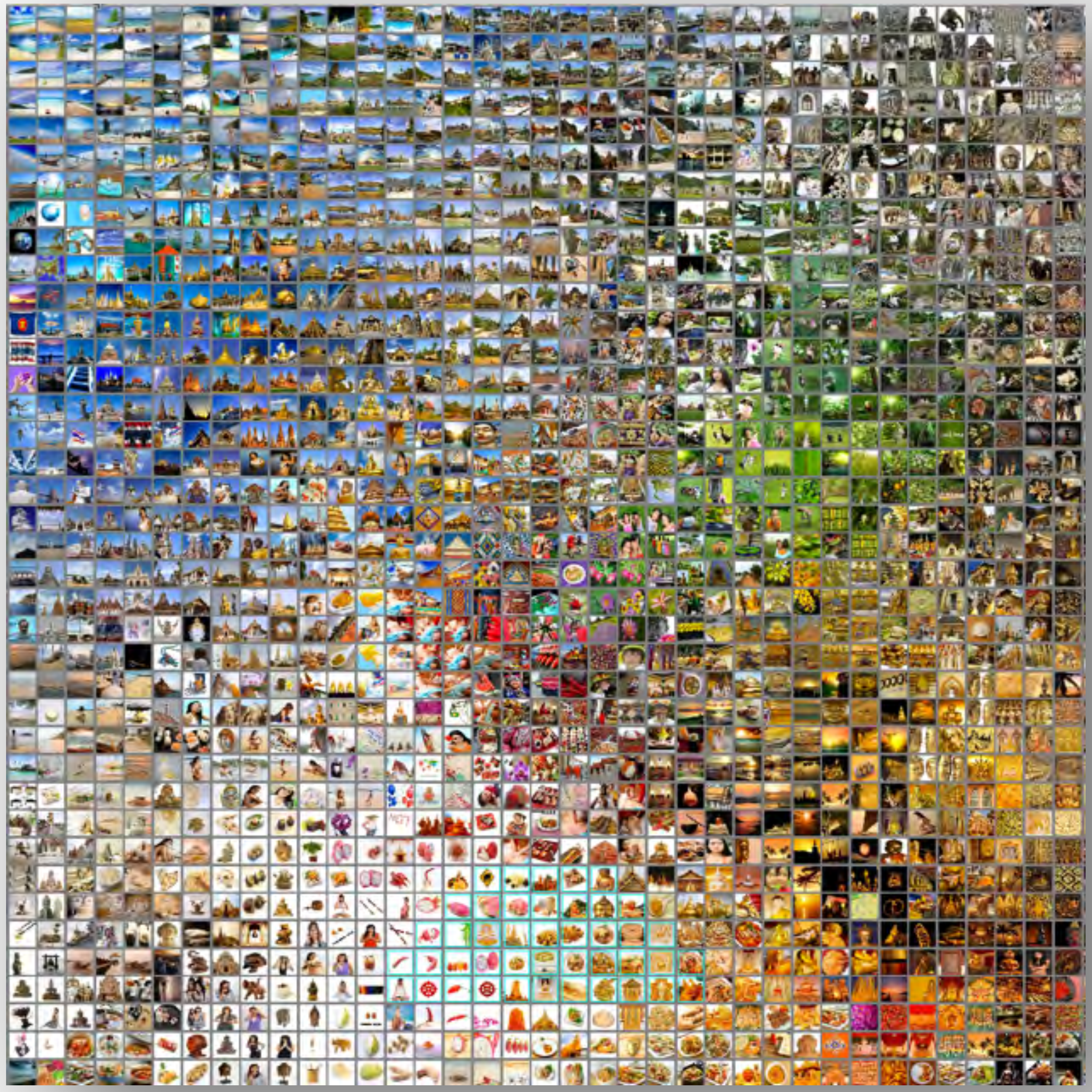
2D-Sorting by image swapping

unsorted





sorted



Visual image browsing

picsbuffet.com


picsbuffet

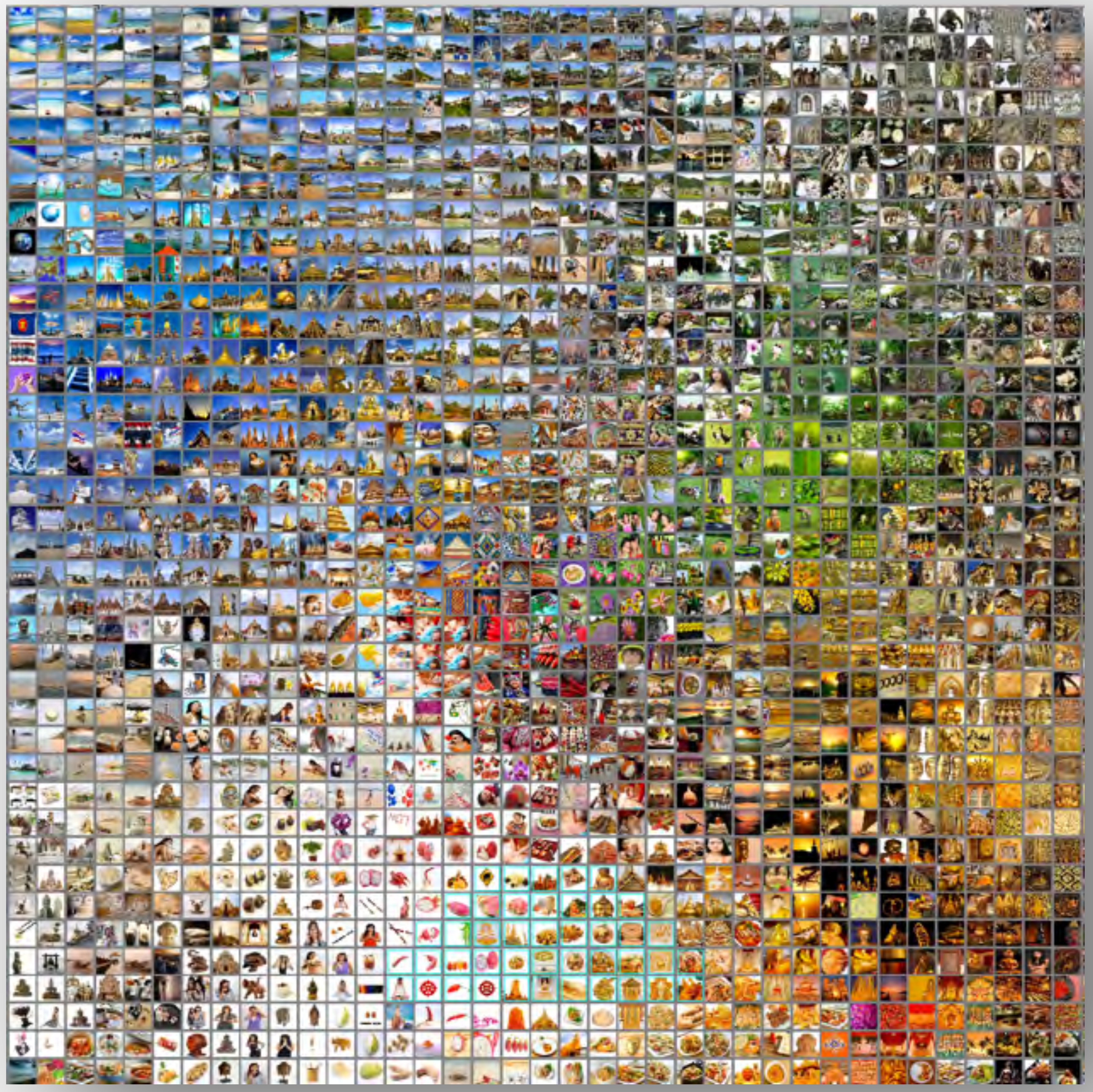
Extension

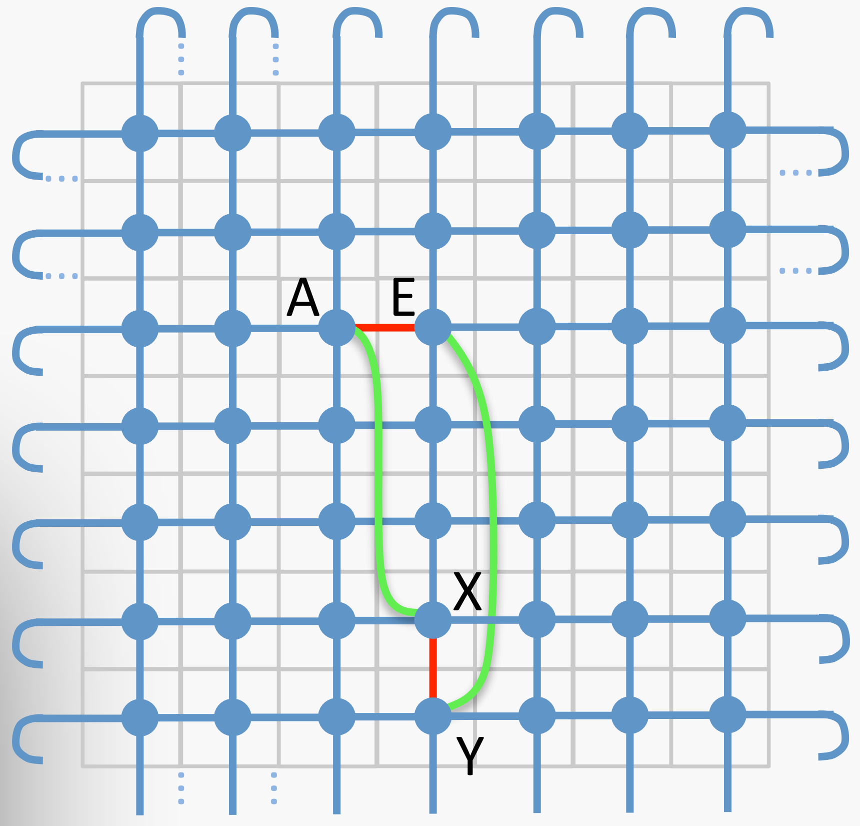
- Image relationships are too complex to be perfectly mapped on a 2D map.
- Idea: Use a high dimensional graph instead of a 2D map.
- Problems:
  1. How to construct a useful graph with millions of images?

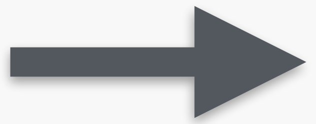
     A distance map of 1 million images has 1 trillion entries (10^{12})
  2. How to navigate the graph?

Graph-building by edge swapping

2D sorting







Graph

Graph Navigation

- Project fractions of the graph to a 2D map and perform instant 2D sorting
- Moving the map retrieves new images from the graph.


Rice

Thank you

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