

Introduction

Elements of Data Science and Artificial Intelligence

Prof. Dr. Jens Dittrich
bigdata.uni-saarland.de

**Why is this lecture&program
named “Data Science and
Artificial Intelligence“?***

***or: how to explain your parents, friends, etc. what you are studying at SIC**

Buzzwords

KI keri **KI!**





Big Data!

Data Lake!

**Data
Science!**

ML!

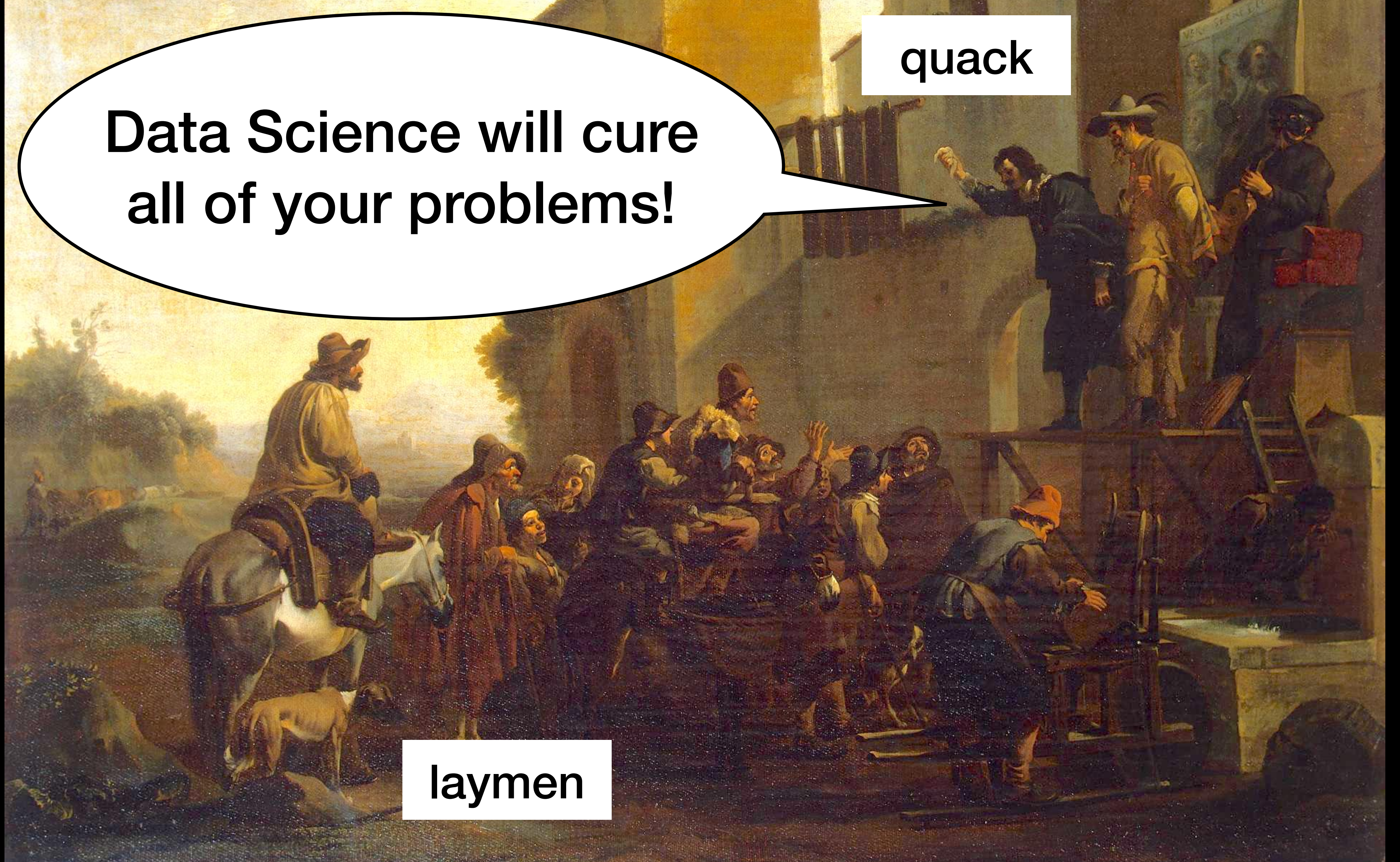
NoSQL!

AI!

quack

Data Science will cure
all of your problems!

laymen

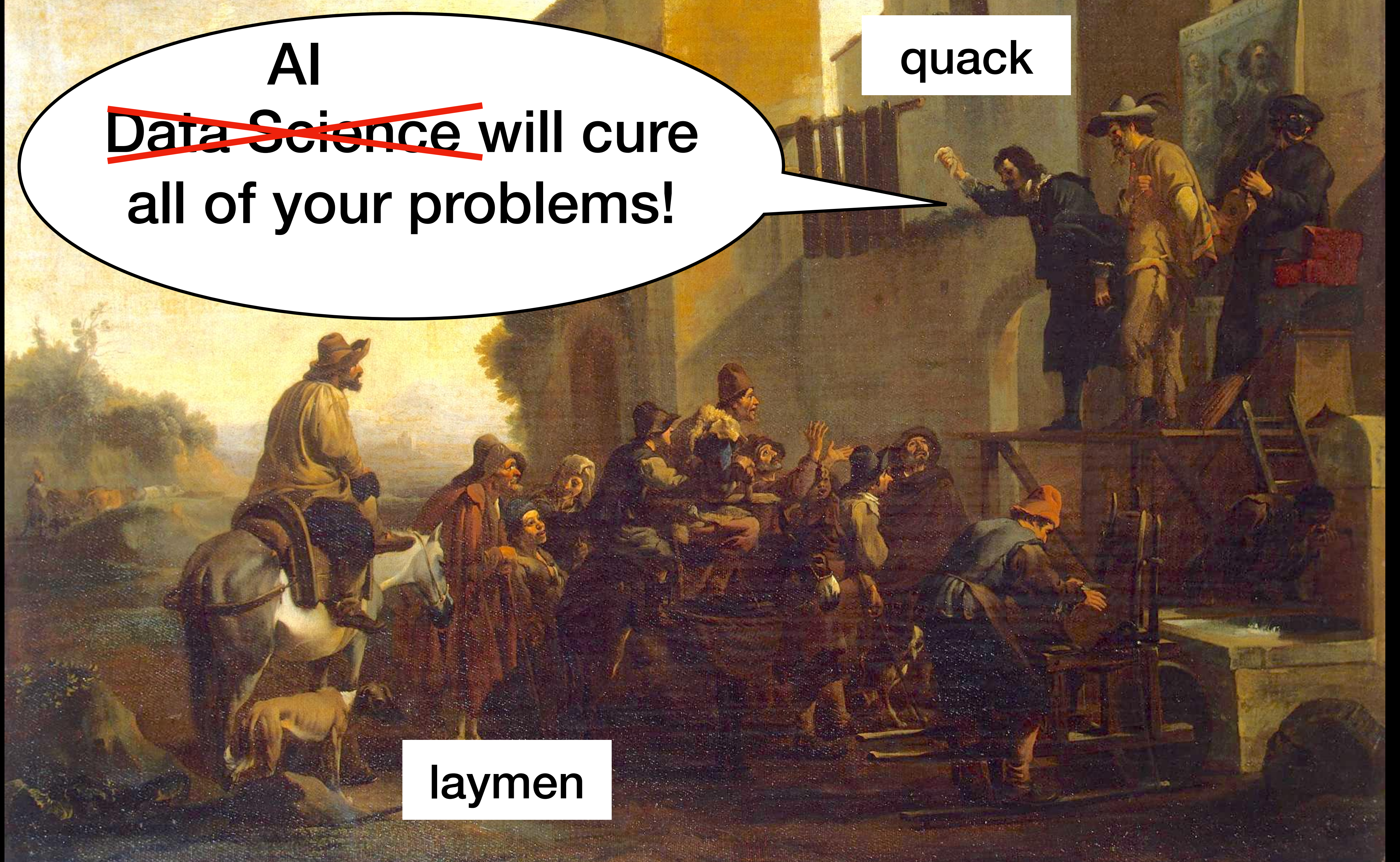


AI

~~Data Science~~ will cure
all of your problems!

quack

laymen



The TV shop:

“TV expert”

**This model even has
HyperRay++Rendering!**

laywoman

“TV expert”

**500Hz rather than
250Hz**

laywoman

“TV expert”

UltraHDMI!

laywoman

The “Big Data” shop:

“TV expert”

laywoman

A man and a woman are standing in an office, engaged in a conversation. The man, on the left, is wearing a light blue blazer over a white shirt and is gesturing with his hands. The woman, on the right, is wearing a red and white striped blazer and is also gesturing. In the background, there are office desks with computer monitors and various items on them. Overlaid on the image is a bar chart with four bars of different heights and colors: purple, red, orange, and blue. The bars are arranged in a row, with the purple bar being the tallest, followed by the red bar, the orange bar, and the blue bar being the shortest. The text 'laywoman' is written in a white box next to the blue bar, and the text '“TV expert”' is written in a white box next to the woman.

laywoman

“TV expert”

layman

The leading NoSQL
Data Lake solution in the
cloud!

“Big Data expert”

layman

Blockchain-enabled

“Big Data expert”

layman

AI-ready

“Big Data expert”

layman

built on the
Lambda-
architecture

“Big Data expert”

layman

IoT

“Big Data expert”

layman

IIoT

“Big Data expert”

layman

IdIoT

“Big Data expert”

Problem:
ambiguous communication

symbol

meaning

Big Data!

large data

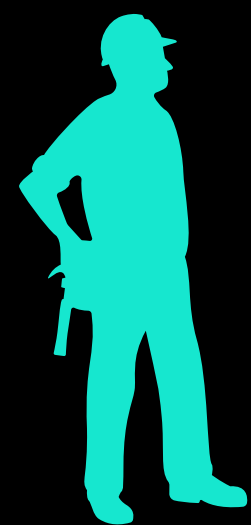
4Vs

NSA

Spark

MapReduce

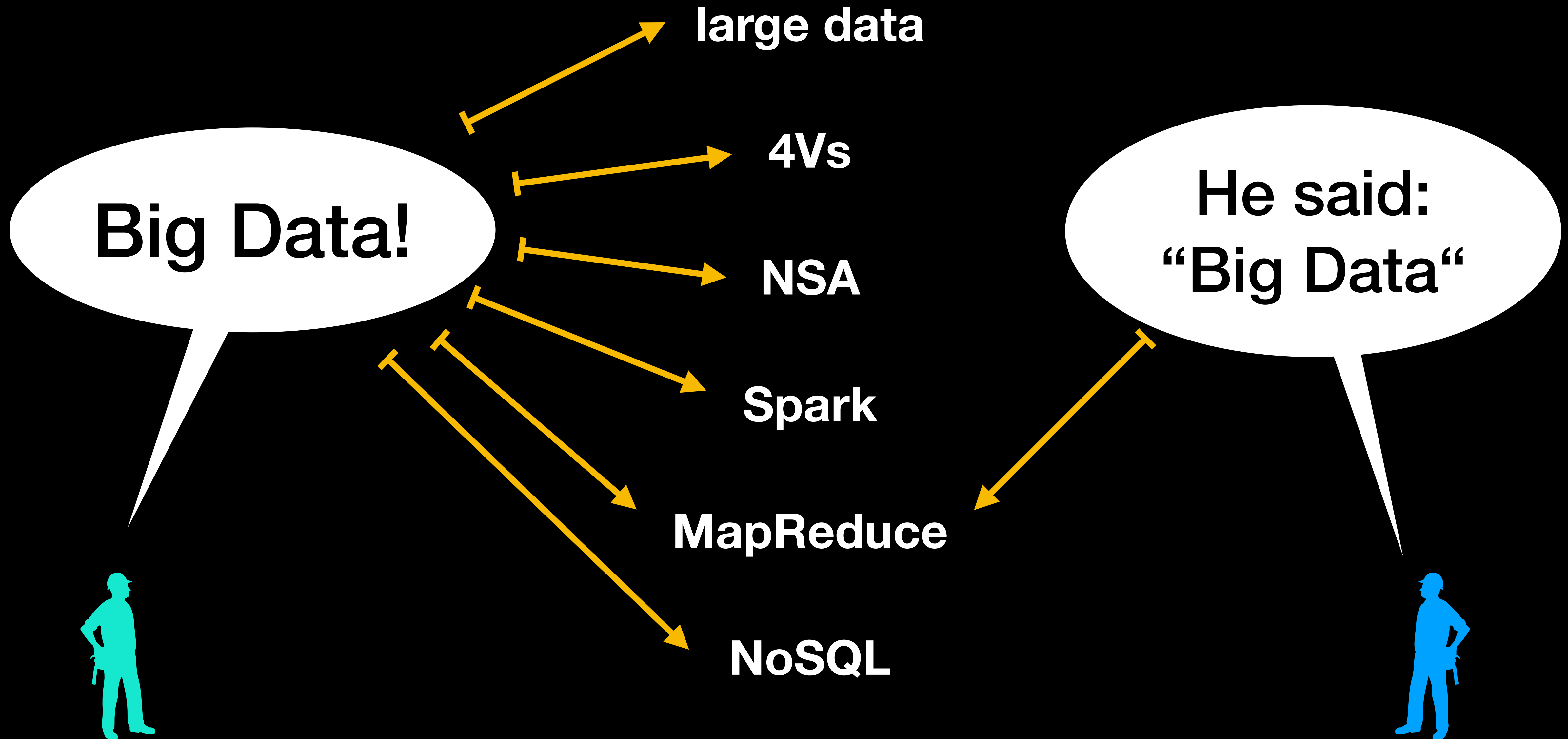
NoSQL



symbol

meaning

symbol



symbol

meaning

symbol

large data

Big Data!

He said:
“Big Data”

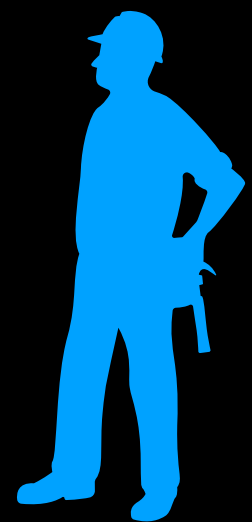
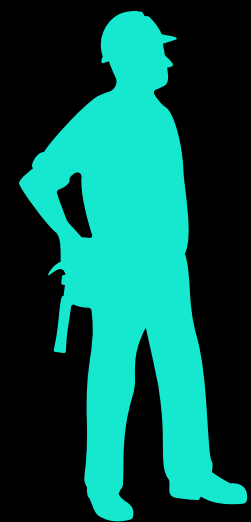
4Vs

NSA

Spark

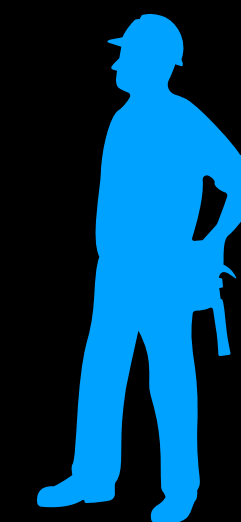
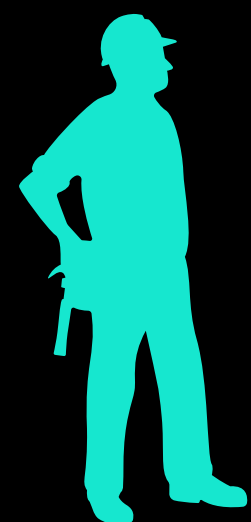
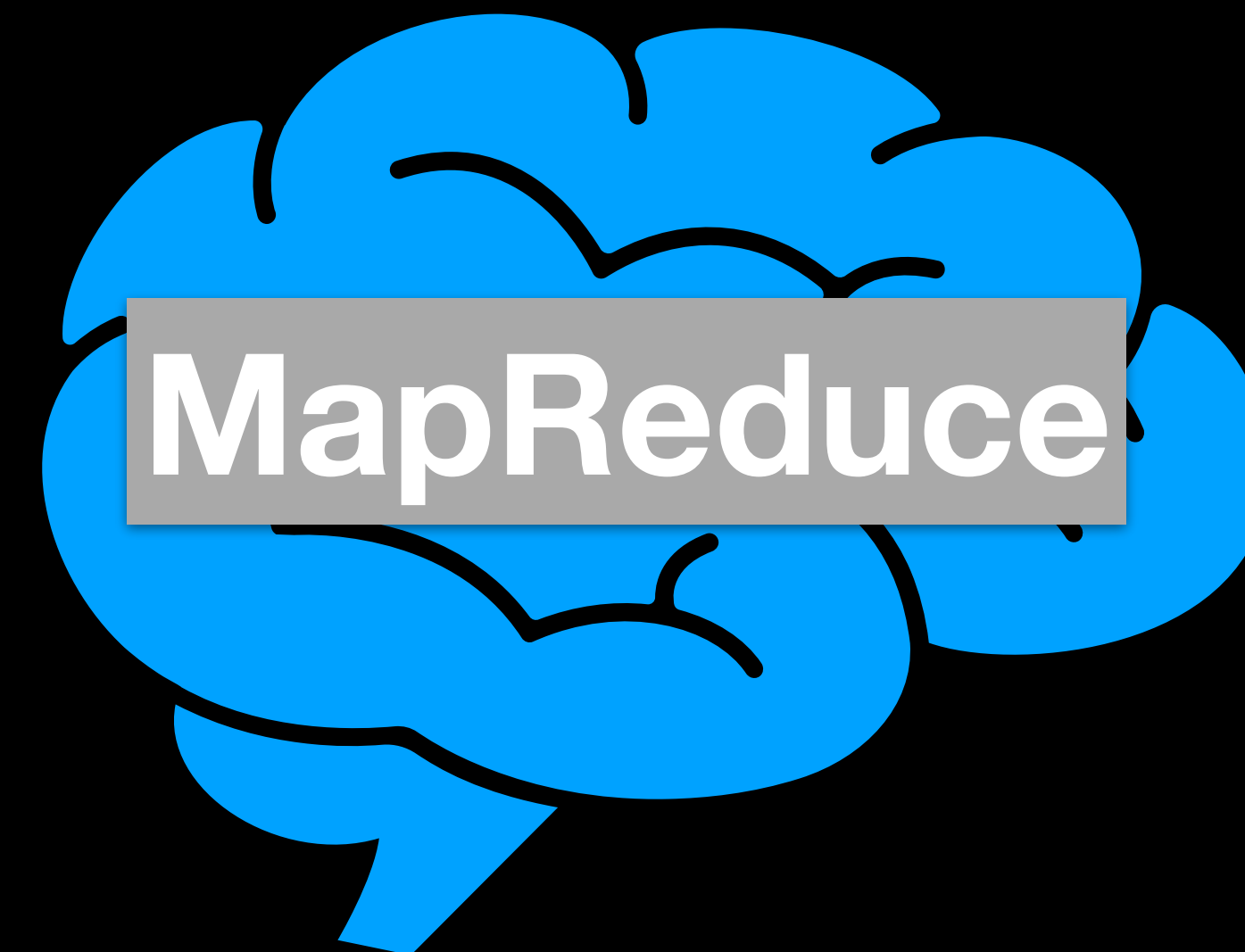
MapReduce

NoSQL





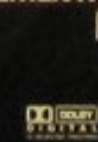
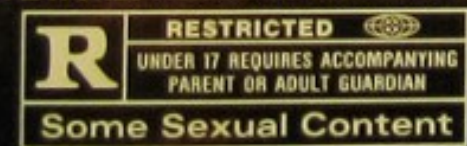
translated to:



BILL MURRAY SCARLETT JOHANSSON

Lost In Translation

FOCUS FEATURES PRESENTS AN AMERICAN ZOETROPE / ELEMENTAL FILMS PRODUCTION "LOST IN TRANSLATION" BILL MURRAY SCARLETT JOHANSSON GIOVANNI RIBISI ANNA FARIS FUMIHIRO HAYASHI MUSIC PRODUCER BRIAN REITZELL COSTUME DESIGNER NANCY STEINER



PRODUCTION DESIGNERS

ANNE ROSS K.K. BARRETT

EDITOR SARAH FLACK

DIRECTOR OF PHOTOGRAPHY LANCE ACORD

LINE PRODUCER CALLUM GREENE

ASSOCIATE PRODUCER MITCH GLAZER

EXECUTIVE PRODUCERS FRANCIS FORD COPPOLA FRED ROOS

PRODUCED BY ROSS KATZ SOFIA COPPOLA

WRITTEN AND DIRECTED BY SOFIA COPPOLA

SOUNDTRACK AVAILABLE ON
emperorNorton

FOCUS
FEATURES
ARTWORK © 2003 FOCUS FEATURES, LLC. ALL RIGHTS RESERVED.

www.lost-in-translation.com

The new film written and directed by Sofia Coppola

clear communication:

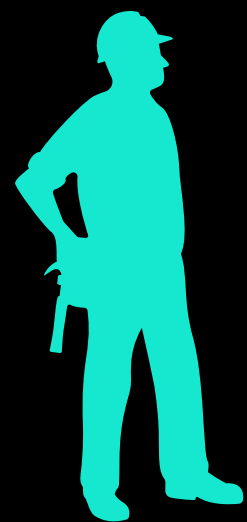
symbol

meaning

relational
algebra



relational
algebra,
i.e. π , σ , \bowtie , ...



symbol

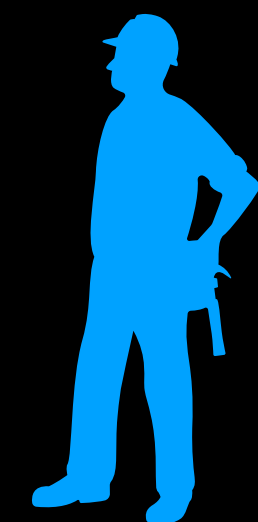
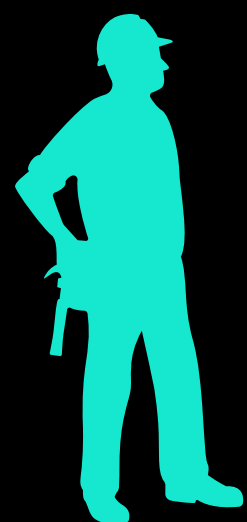
meaning

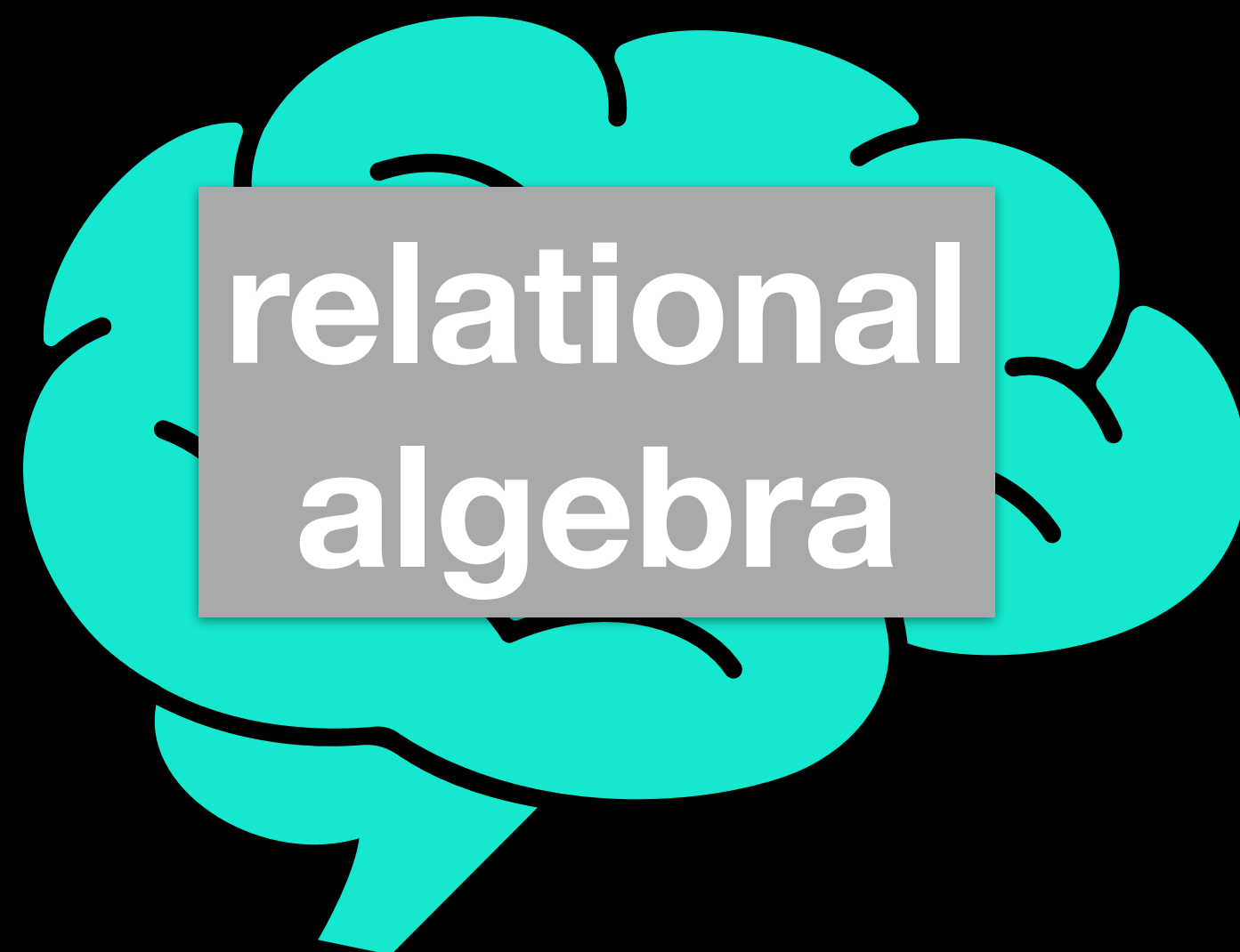
symbol

relational
algebra

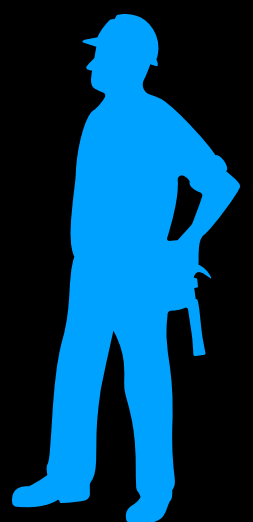
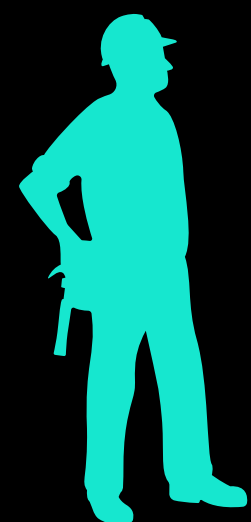
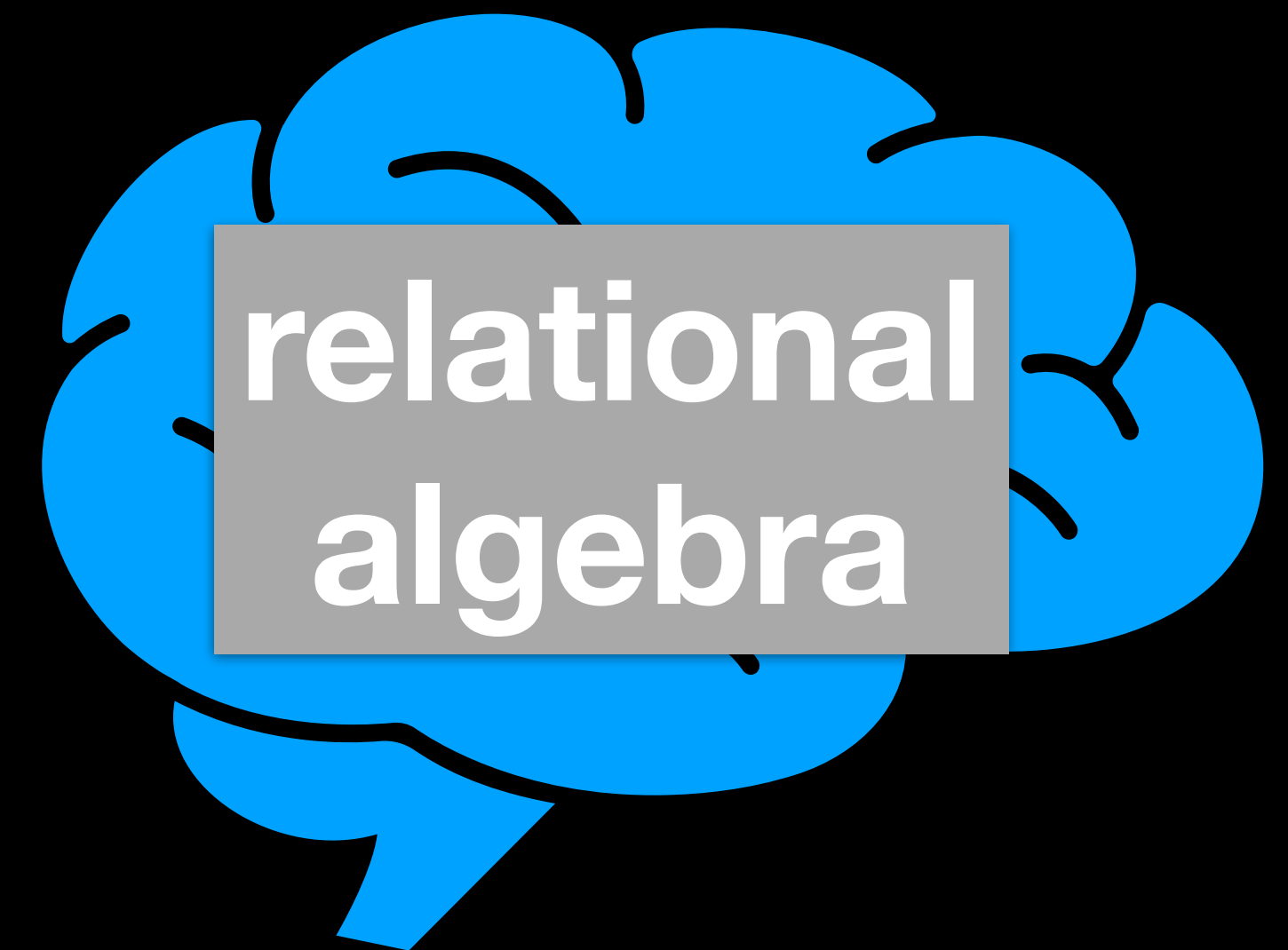
relational
algebra,
i.e. π , σ , \bowtie , ...

He said:
“relational algebra”





translated to:

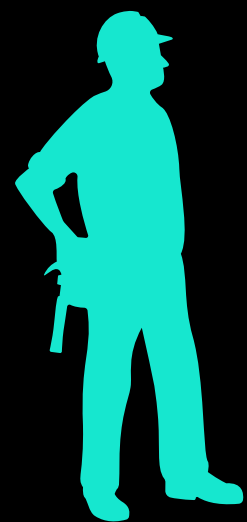


symbol

meaning

AI!

deep learning
knowledge representation
symbolic AI
machine learning
planning
NLP
robots
statistical learning
deductive databases
computer vision
logics



symbol

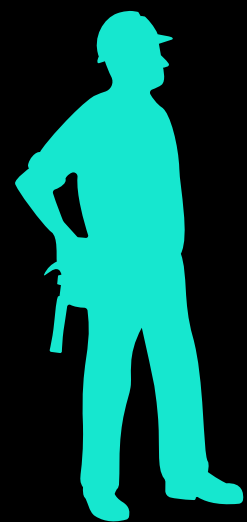
meaning

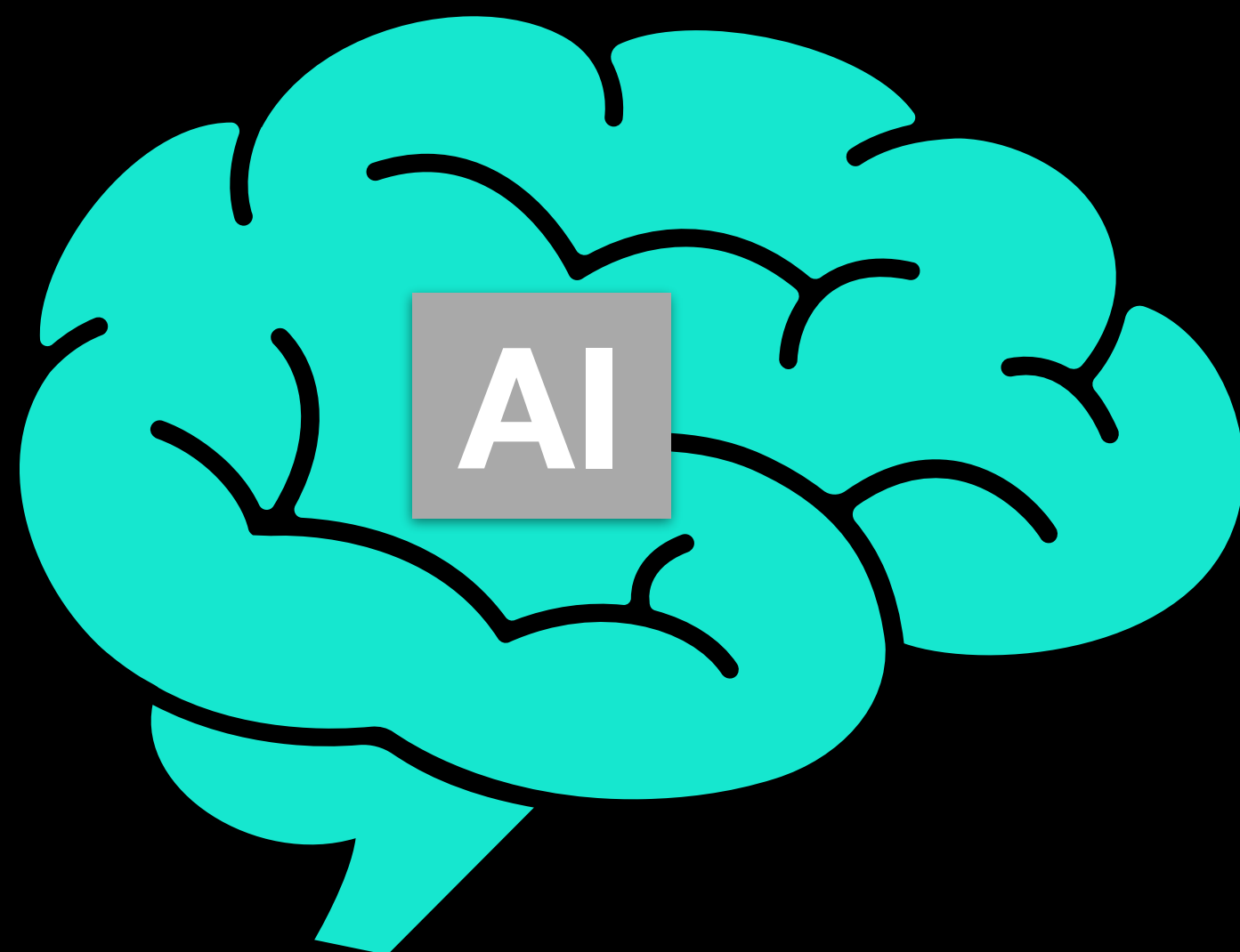
„Company
X wants to solve
problem Z using
an AI.“

circuit

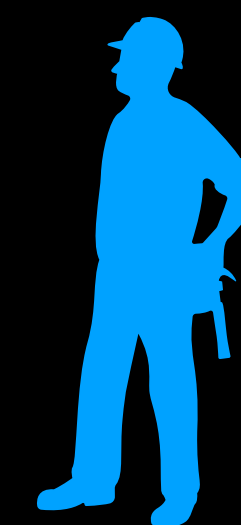
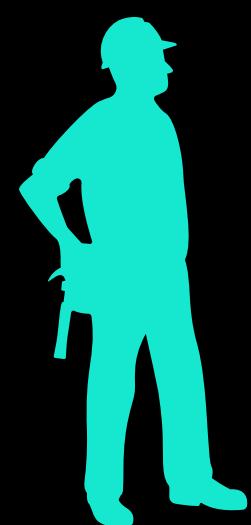
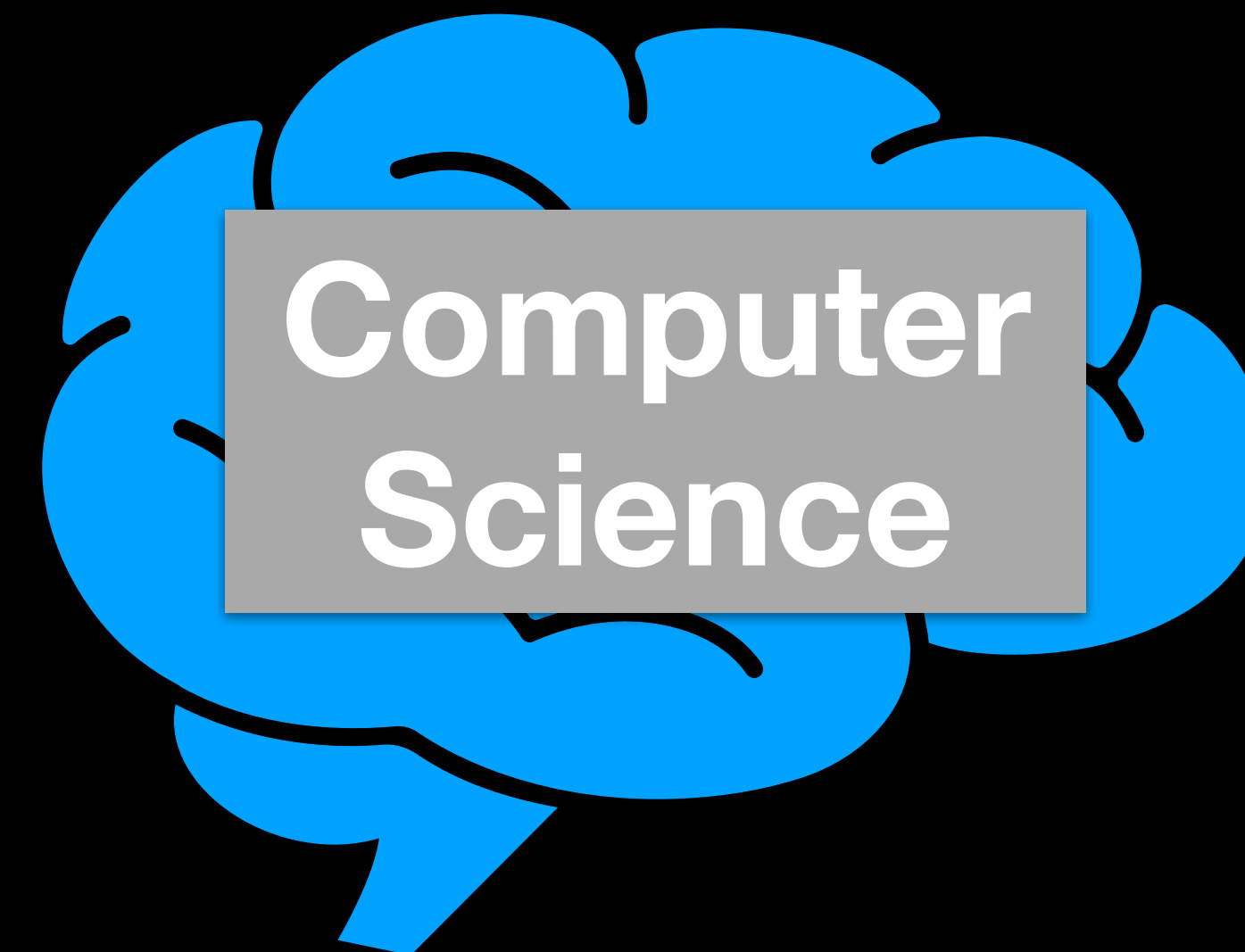
electronics

computer science

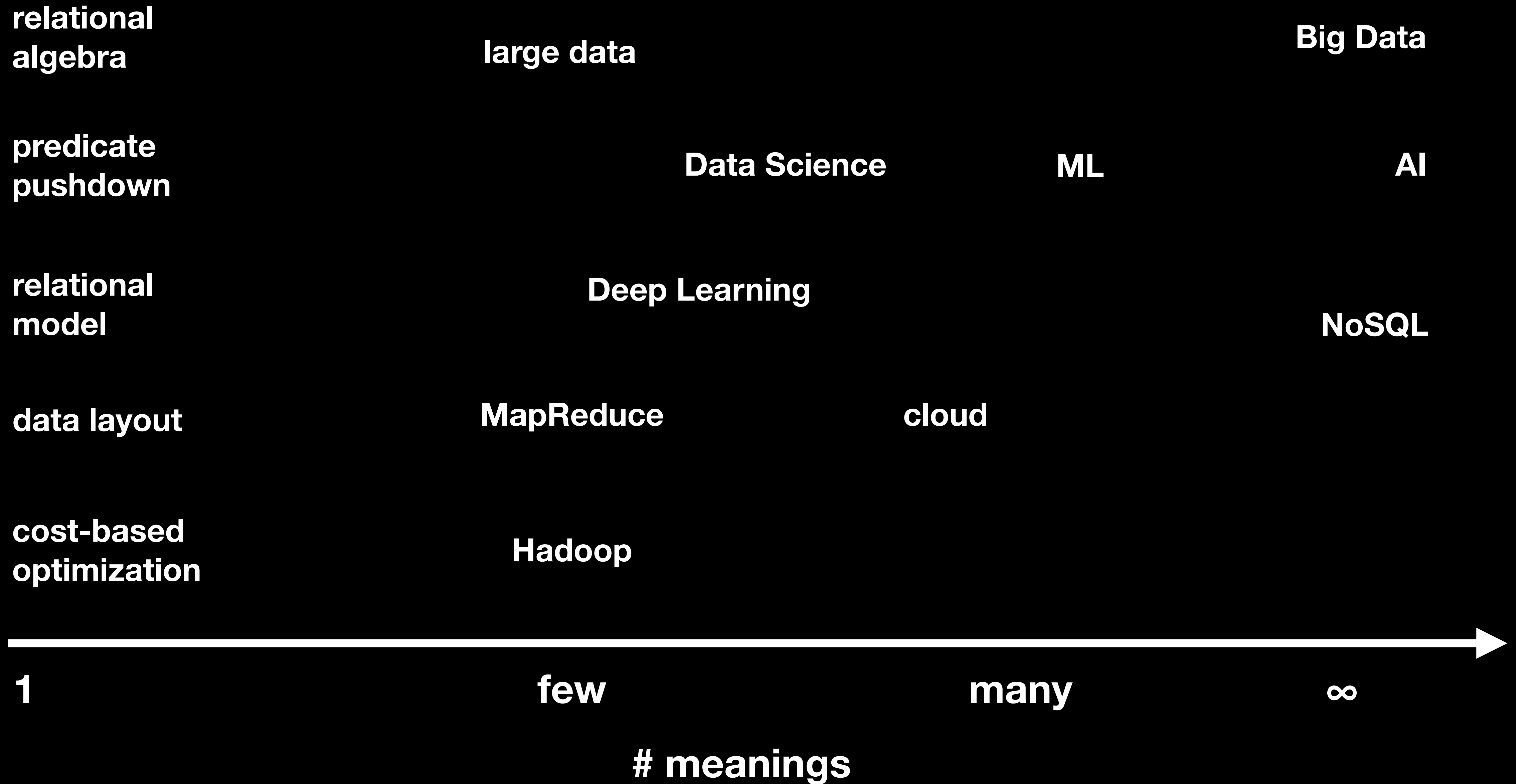




translated to:

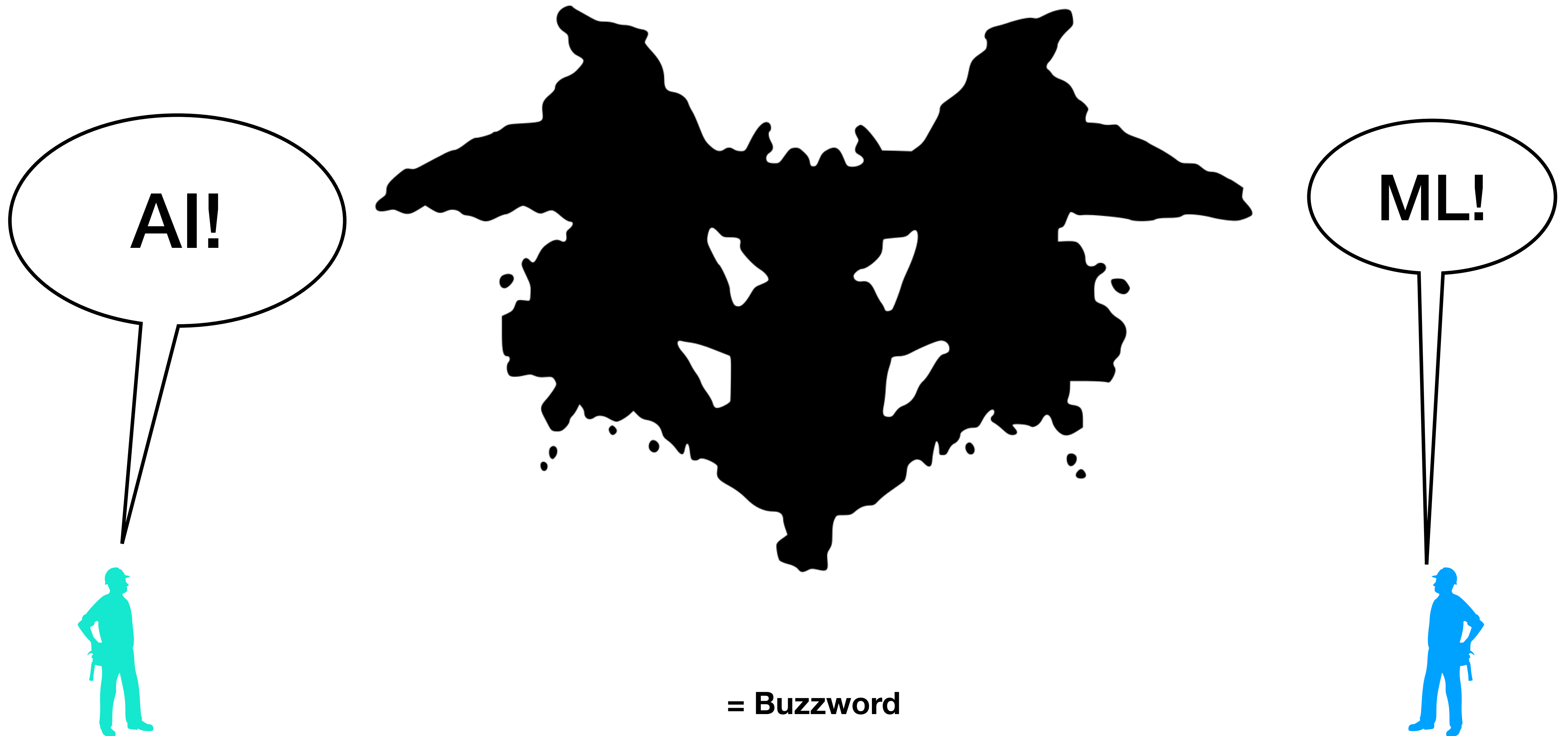


The buzzword bullshit landscape



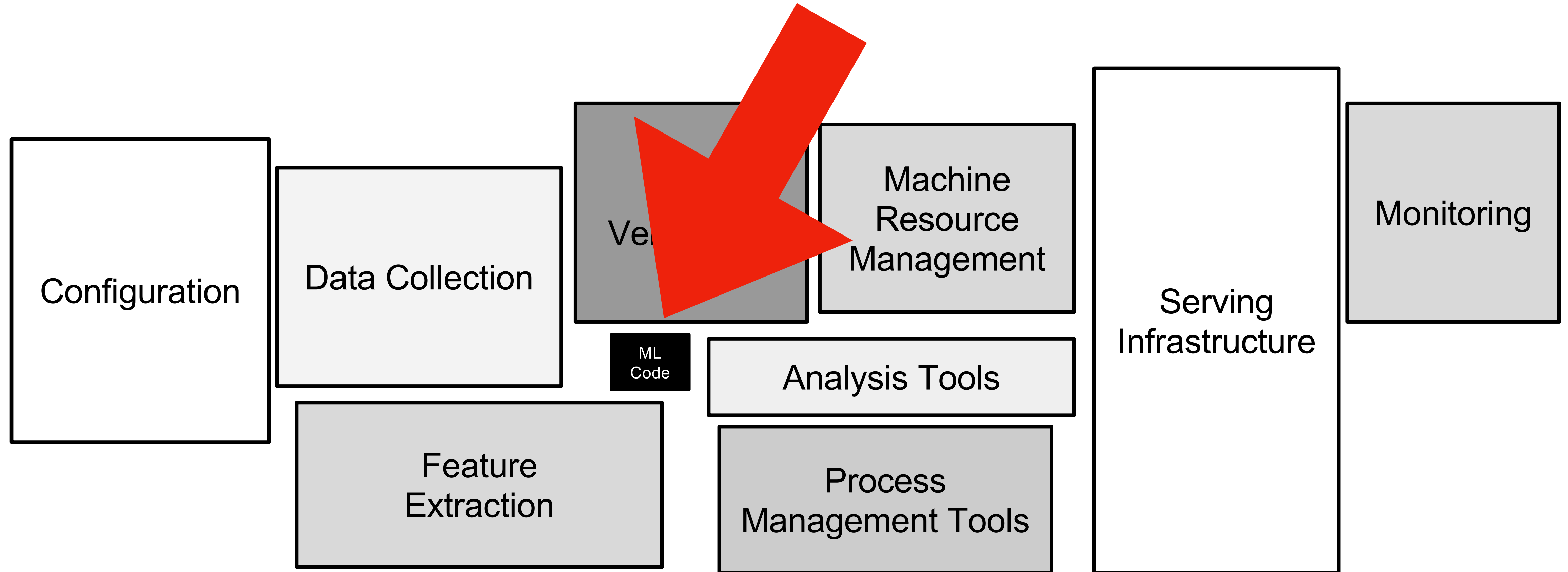
**advice: only use non-ambiguous
terms in communication**

Buzzwords as a Rorschach test



Can you spot the AI?

it's here!



[Sculley et al. Hidden Technical Debt in Machine Learning Systems, NIPS 2015, Figure 1]

**OK, if buzzwords do not
help, what is DSAI about?**

Solution:

Define DSAI by typical
Applications and/or methods
in that space.

DSAI Applications:

nature

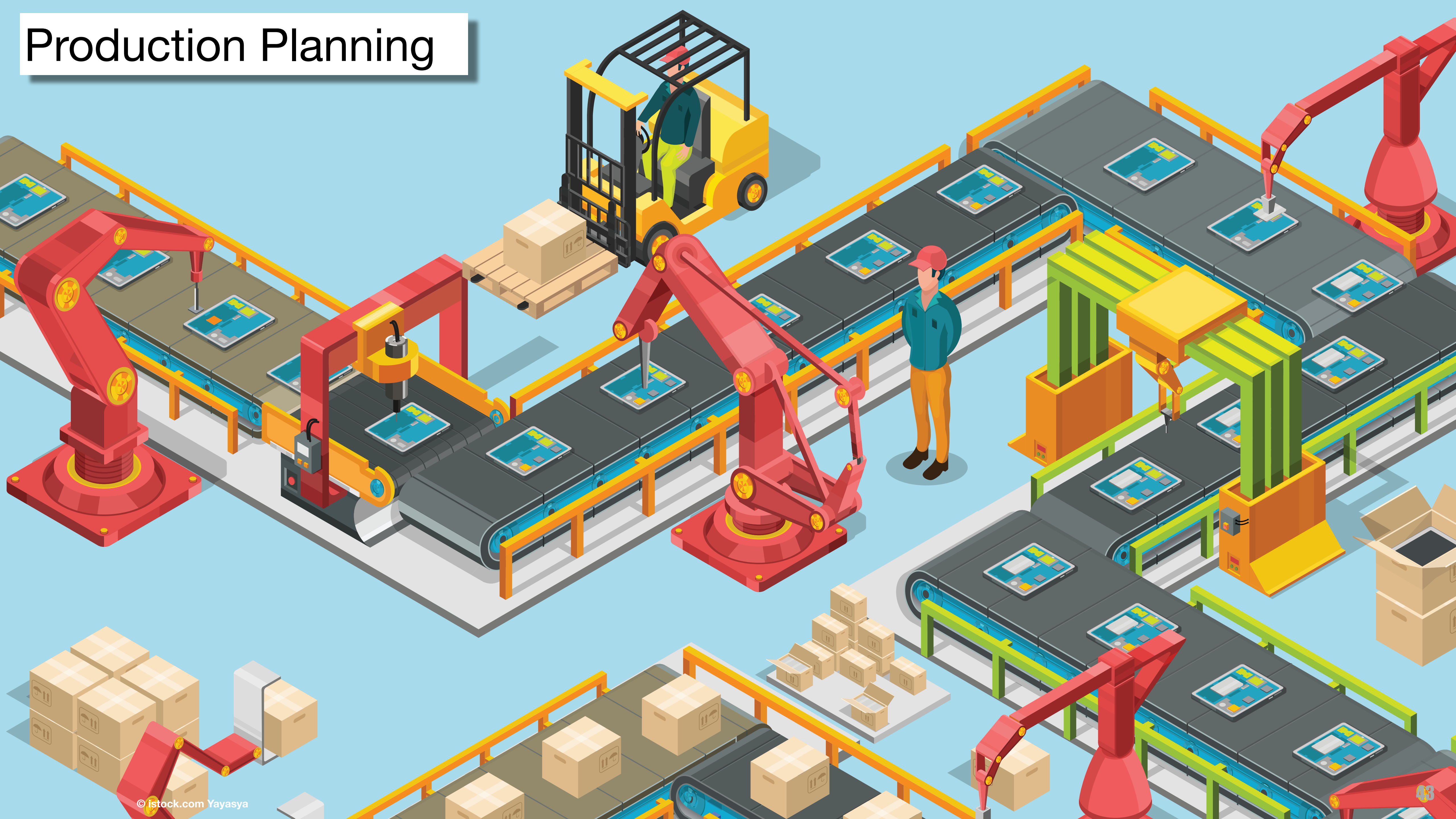


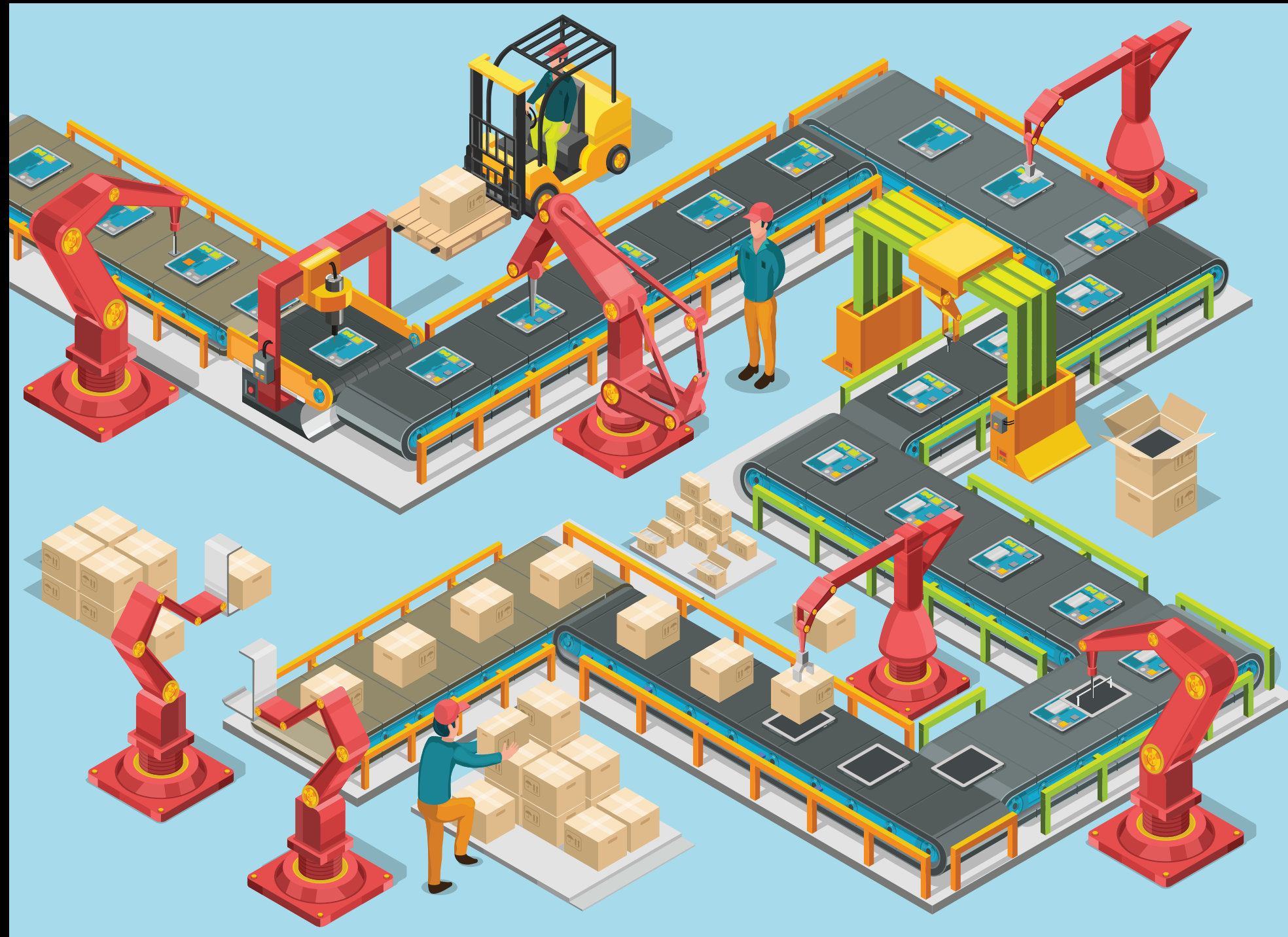
THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE

At last — a computer program that
can beat a champion Go player **PAGE 484**

ALL SYSTEMS GO

Production Planning





+



= d:Al:mond



Style Transfer

Style Transfer

A



B



C



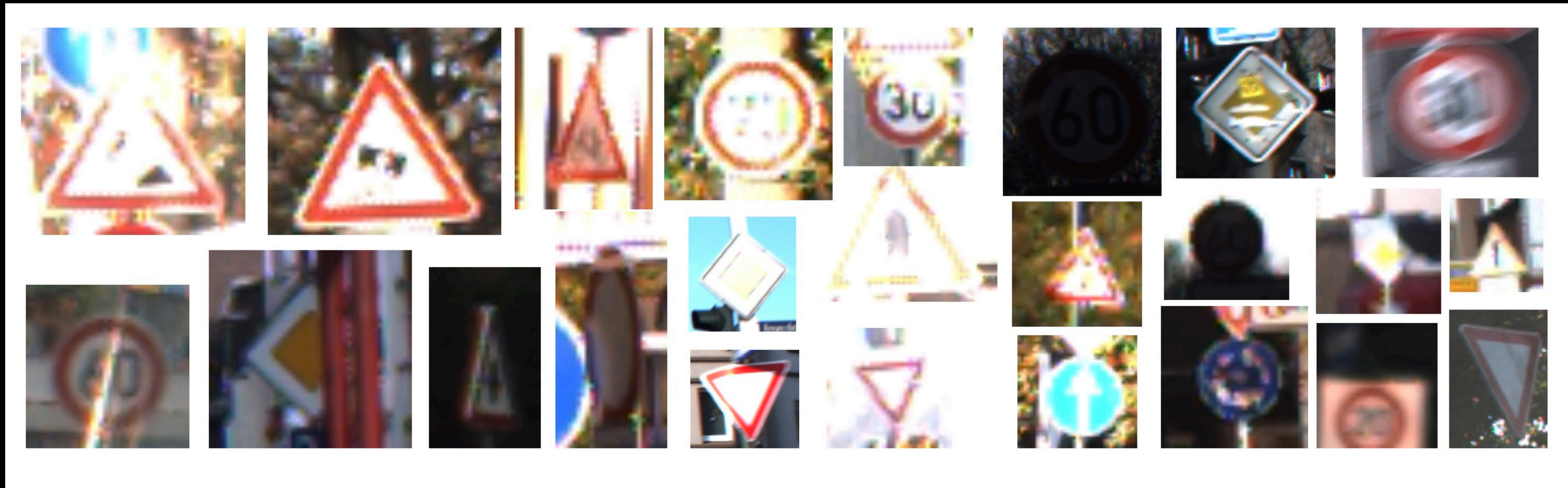
D





Deep Dream

Traffic Sign Recognition Benchmark



[Traffic Sign Recognition with Multi-Scale Convolutional Networks, Pierre Sermanet and Yann LeCun]

Text 2 Image

Text description	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
256x256 StackGAN							

[Han Zhang et al, <https://arxiv.org/abs/1612.03242>]

Interpreter



Self-Driving Cars



Truck drivers



Taxi drivers



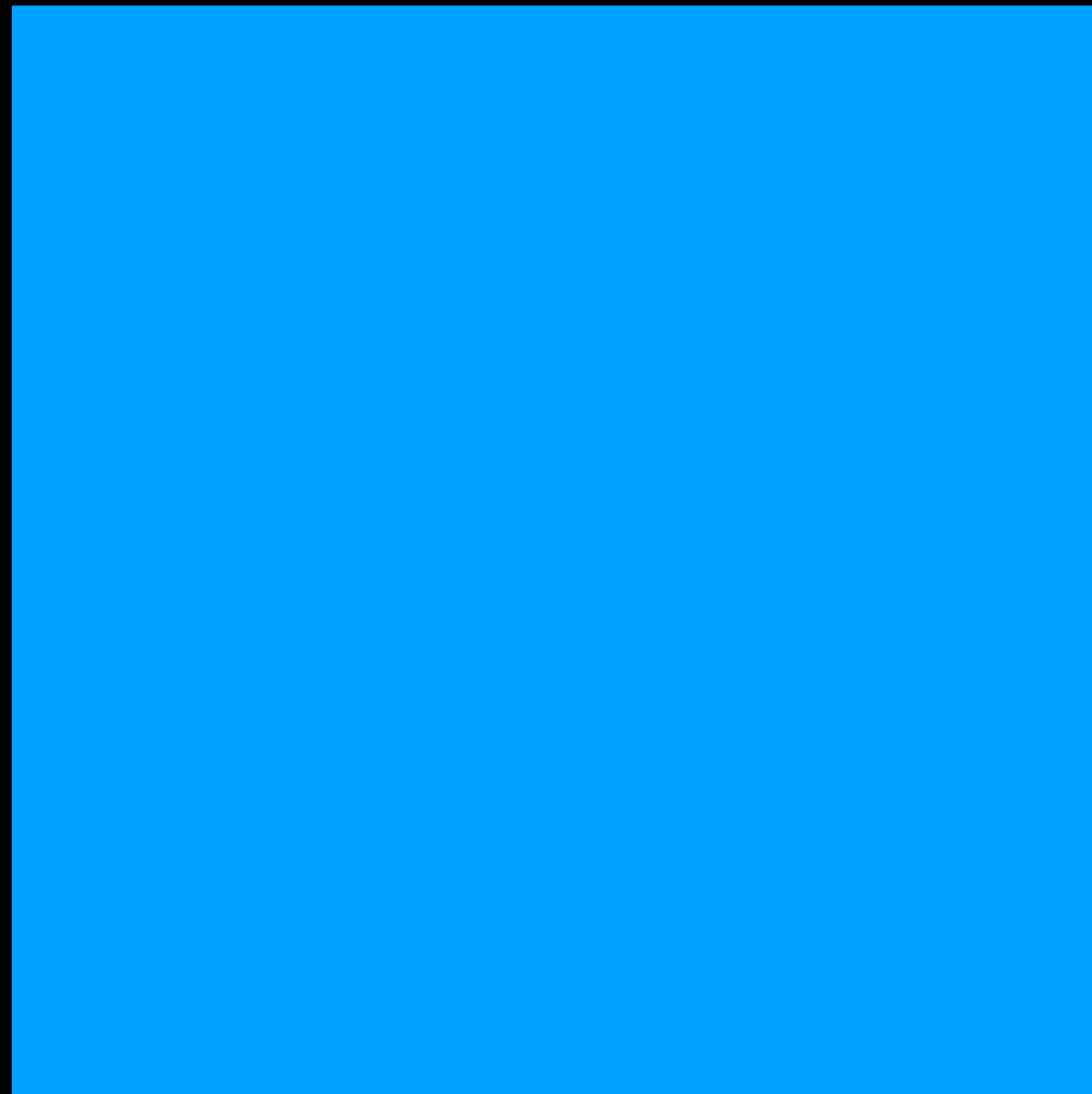
Package deliverers



Cars as selective crowd- sourcers



Software 1.0 vs Software 1.2



Program code



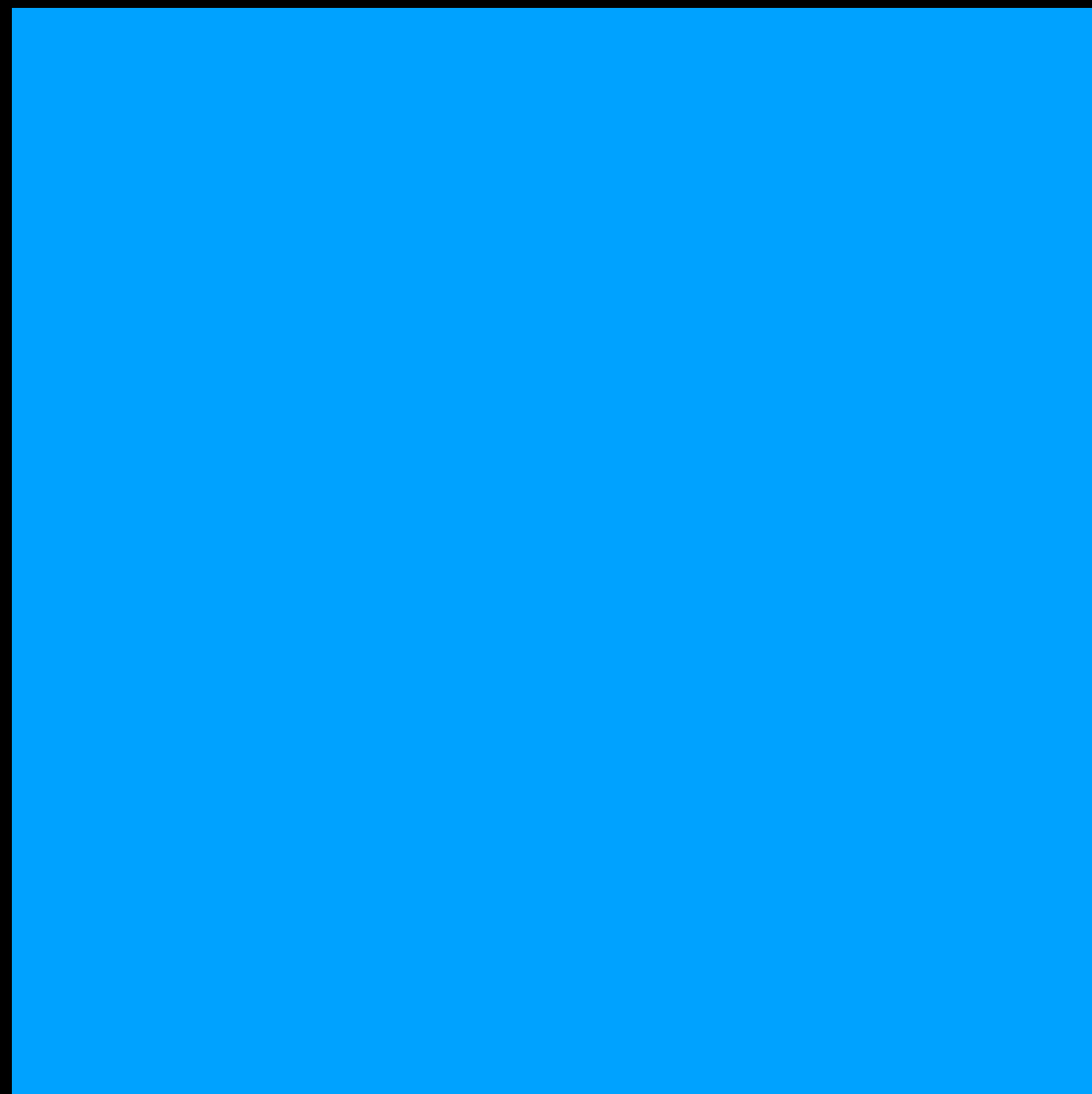
Program code

“Software 2.0”: <https://medium.com/@karpathy/software-2-0-a64152b37c35>

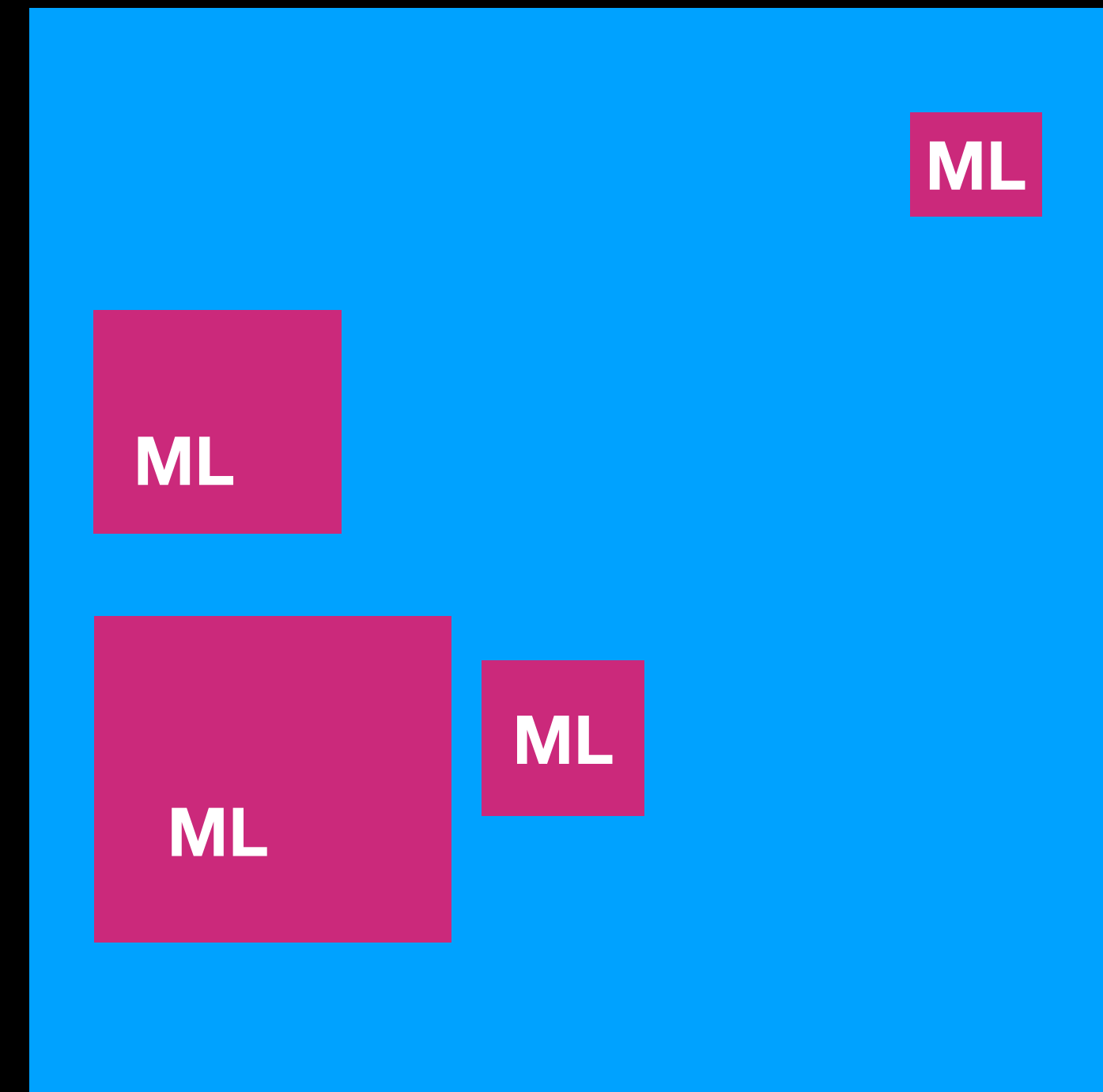
Software 1.0

vs

Software 1.4



Program code

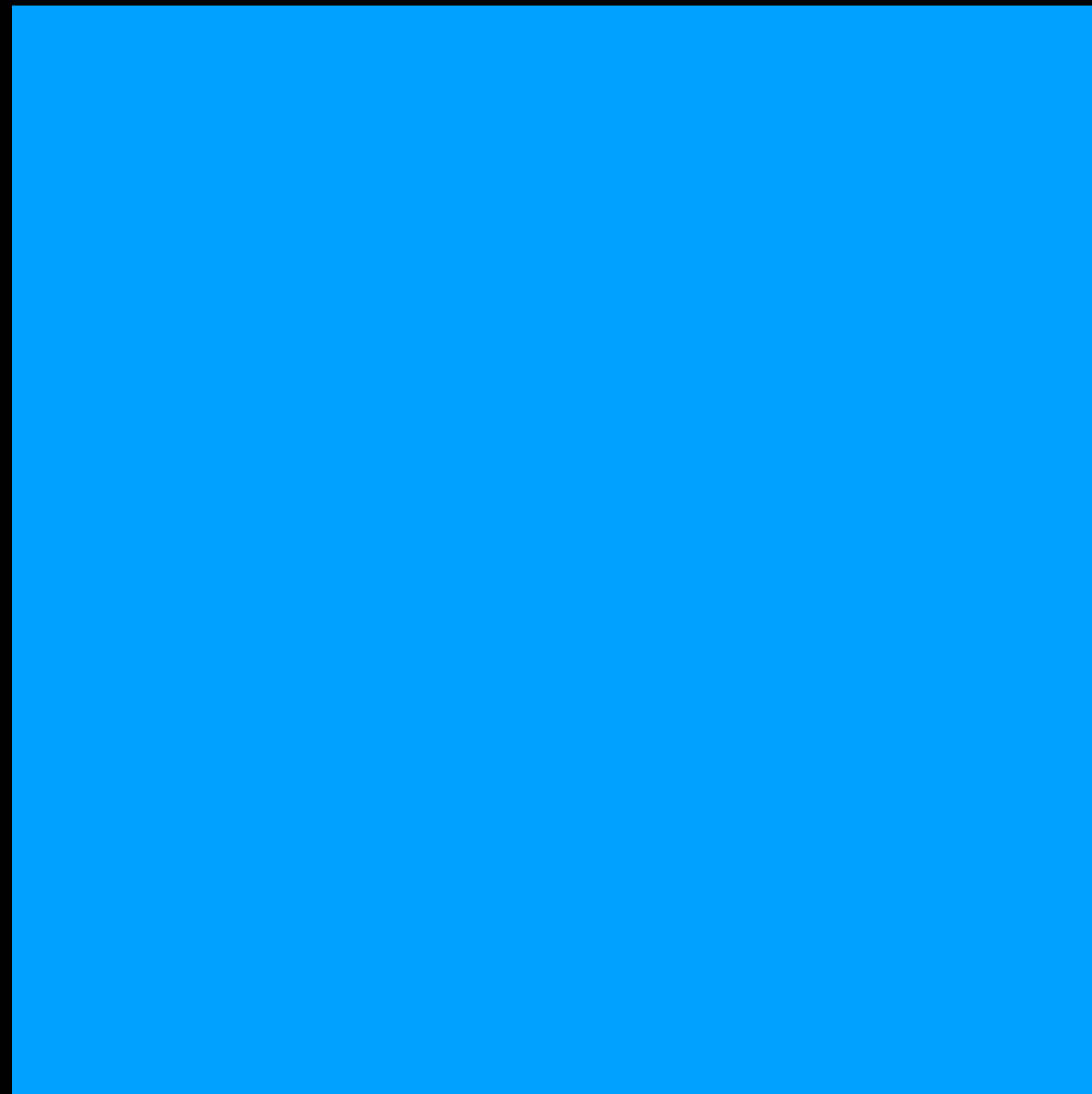


Program code

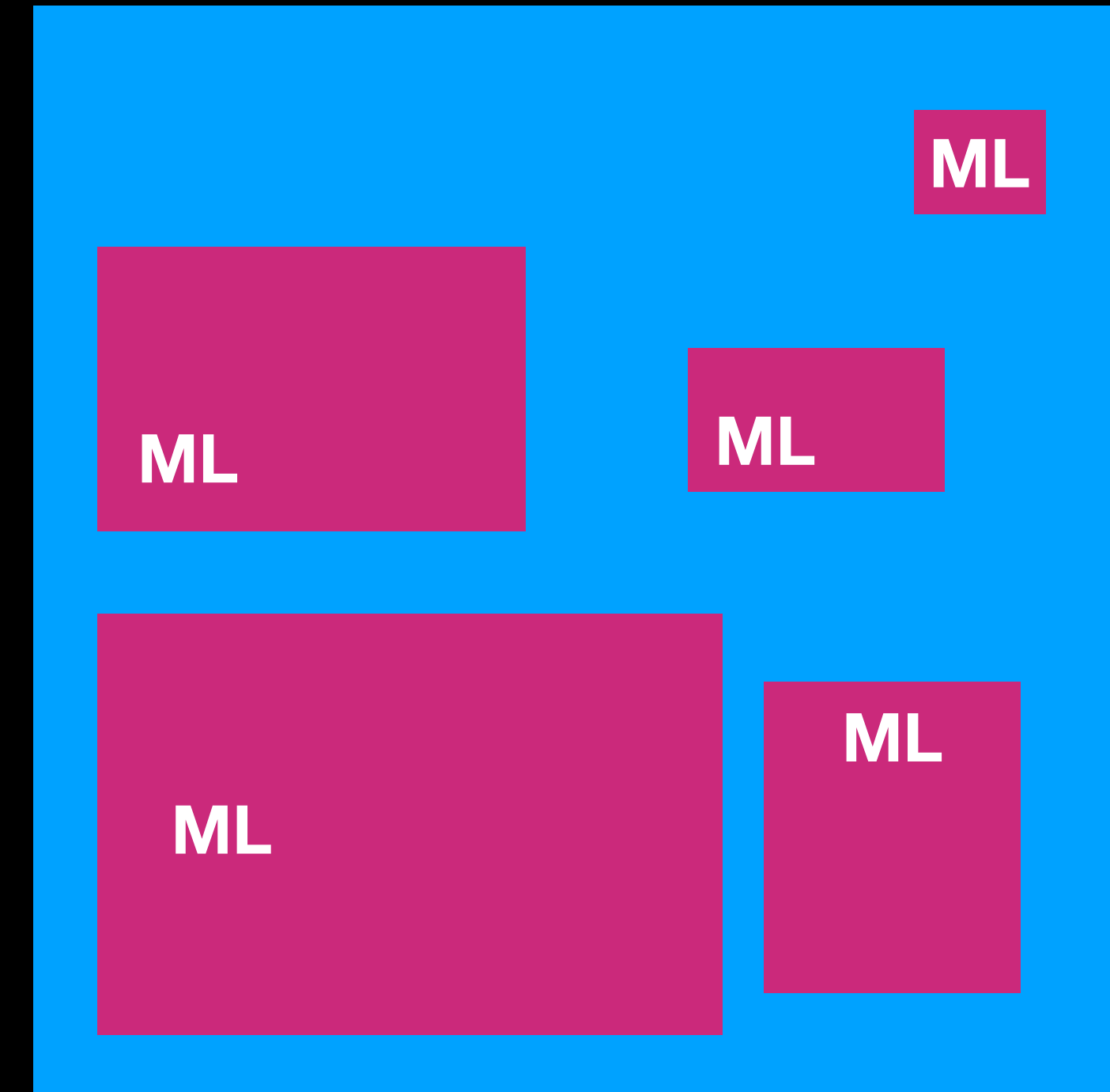
Software 1.0

vs

Software 1.7

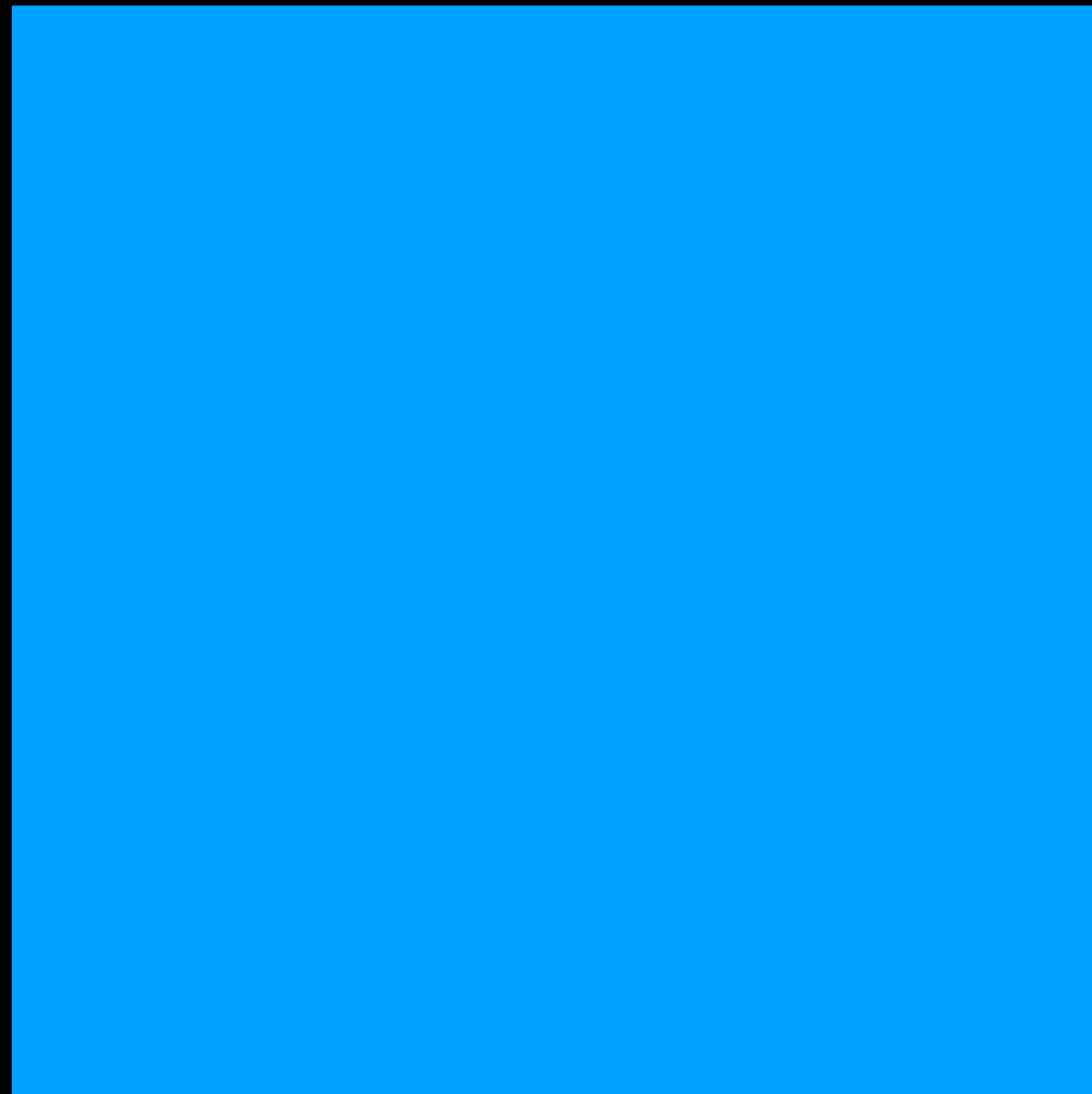


Program code

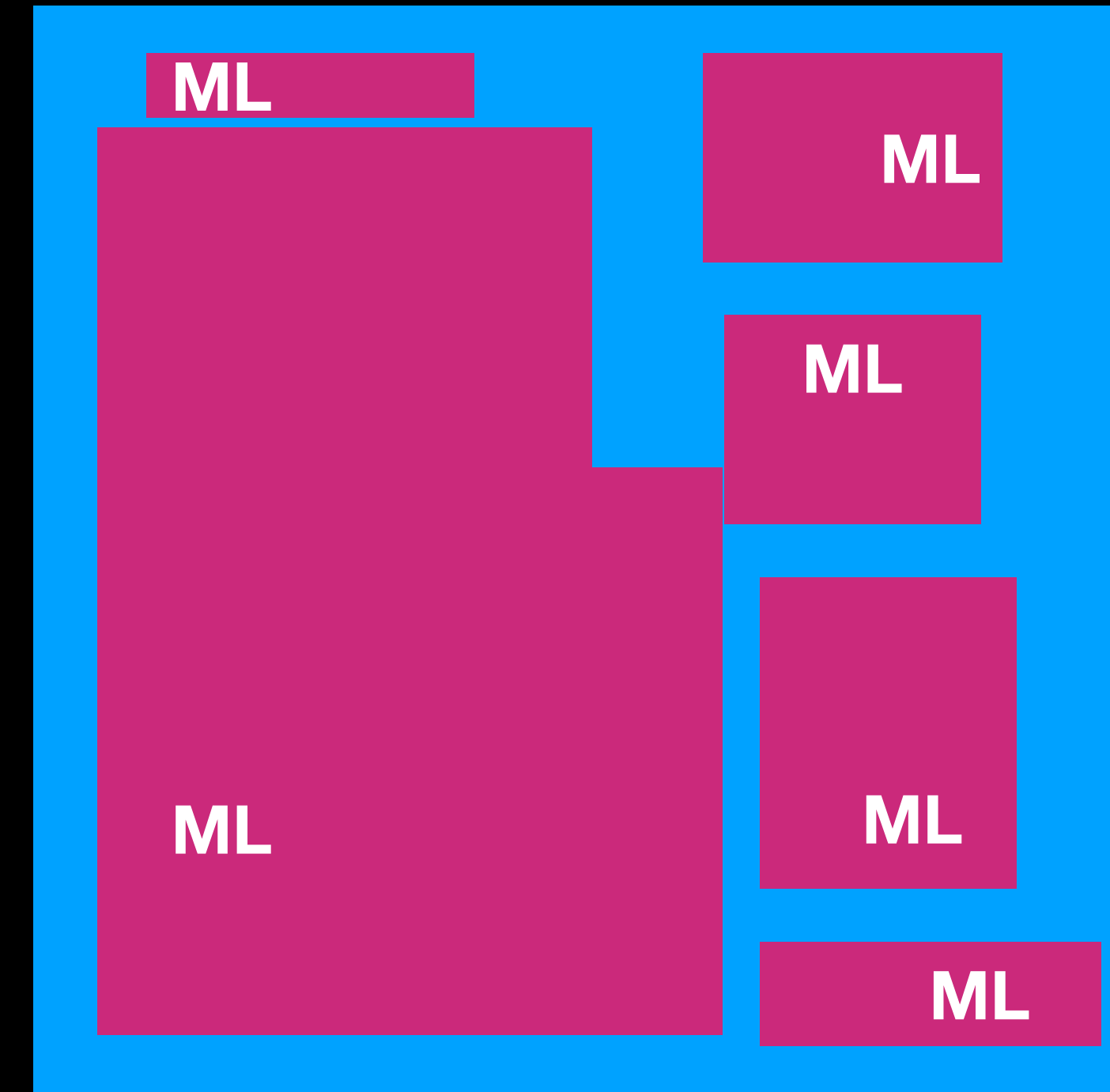


Program code

Software 1.0 vs Software 2.0



Program code

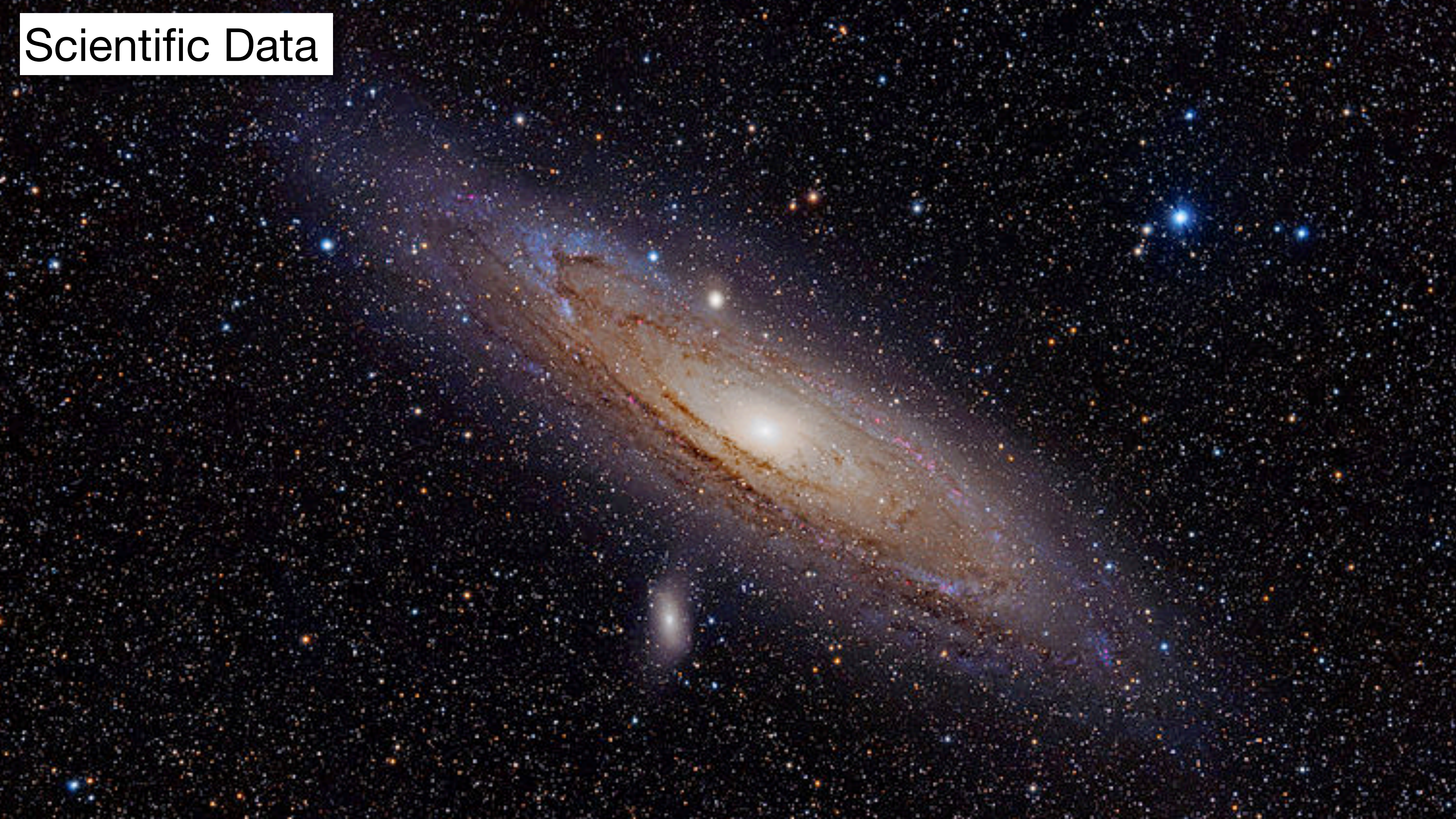


Program code

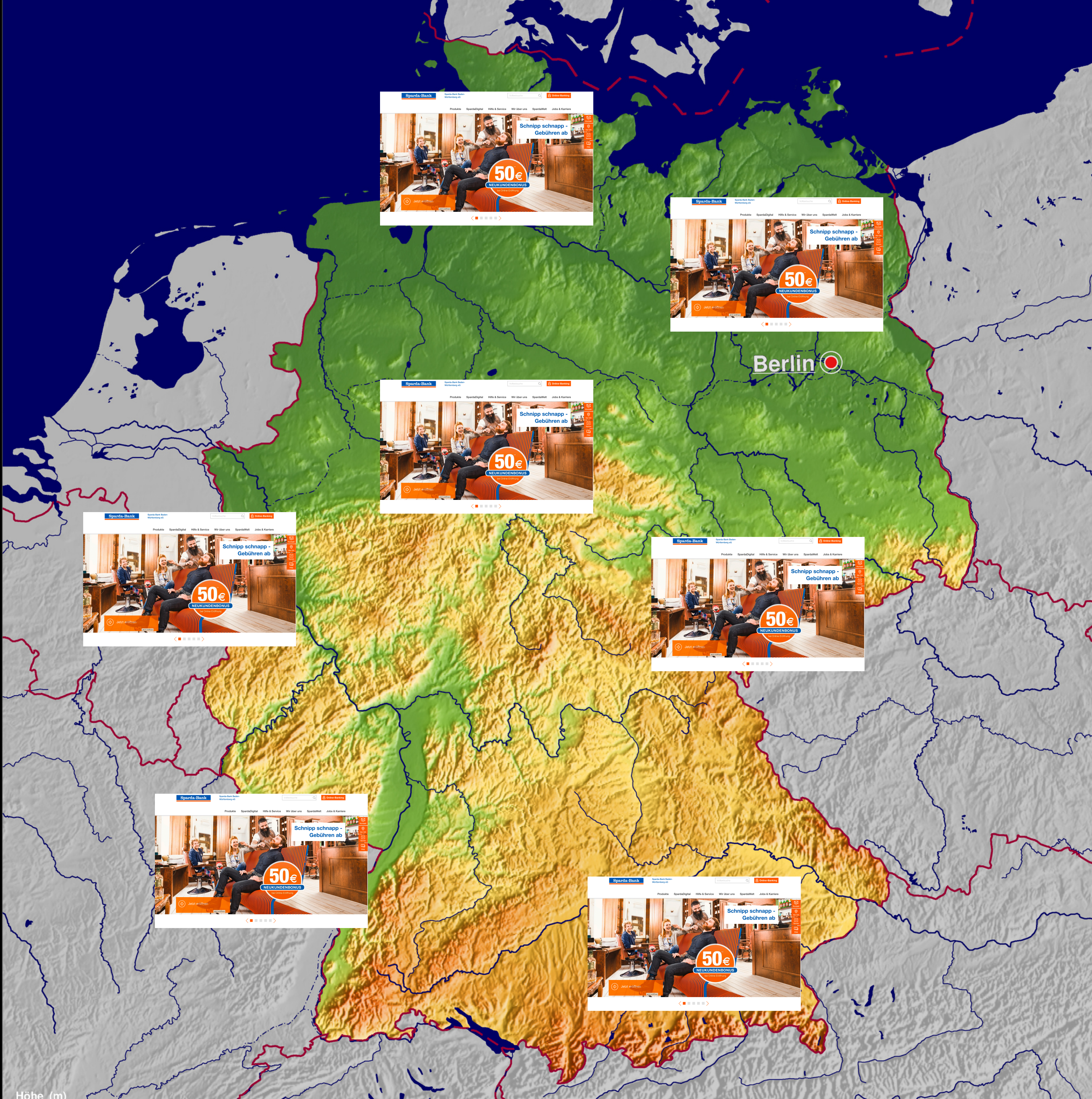
Scientific Data



Scientific Data

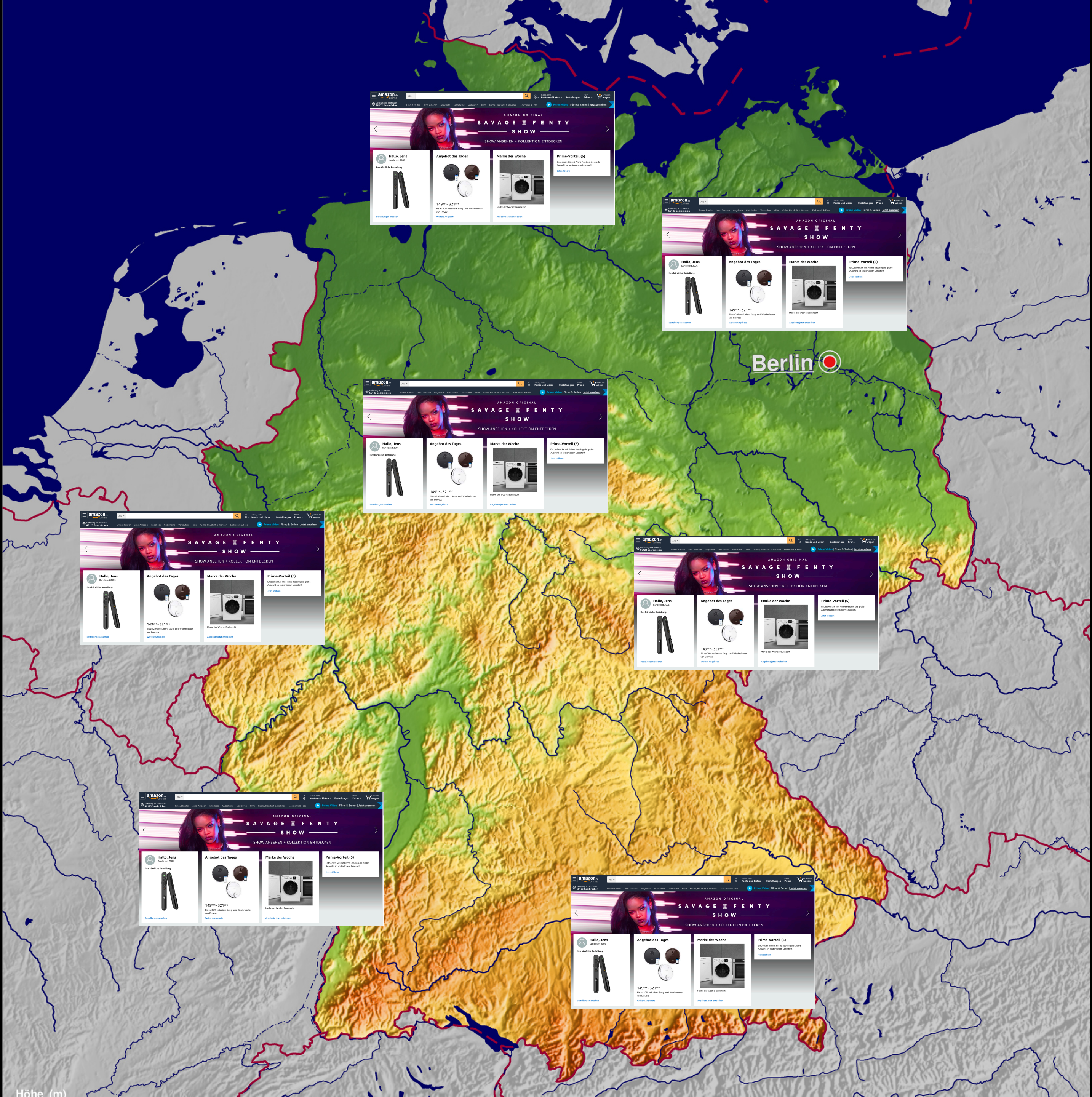


Banking



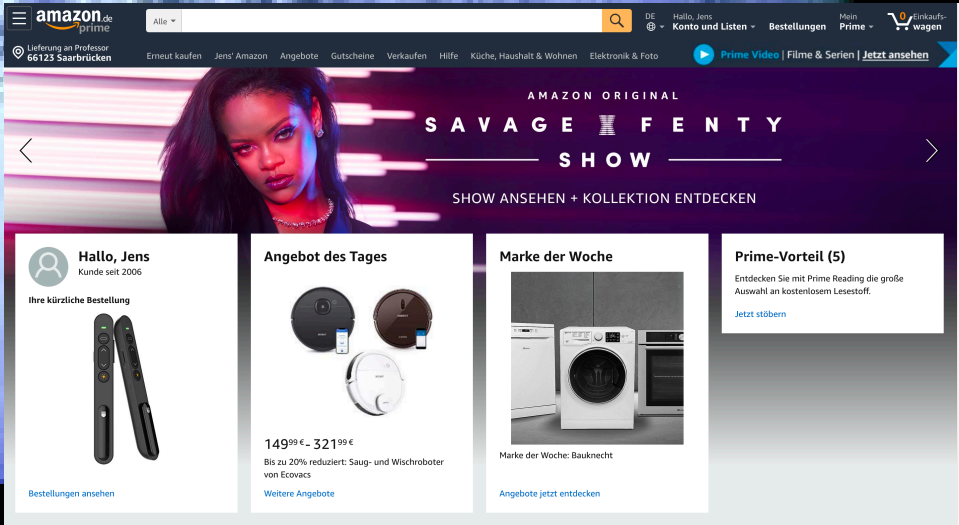
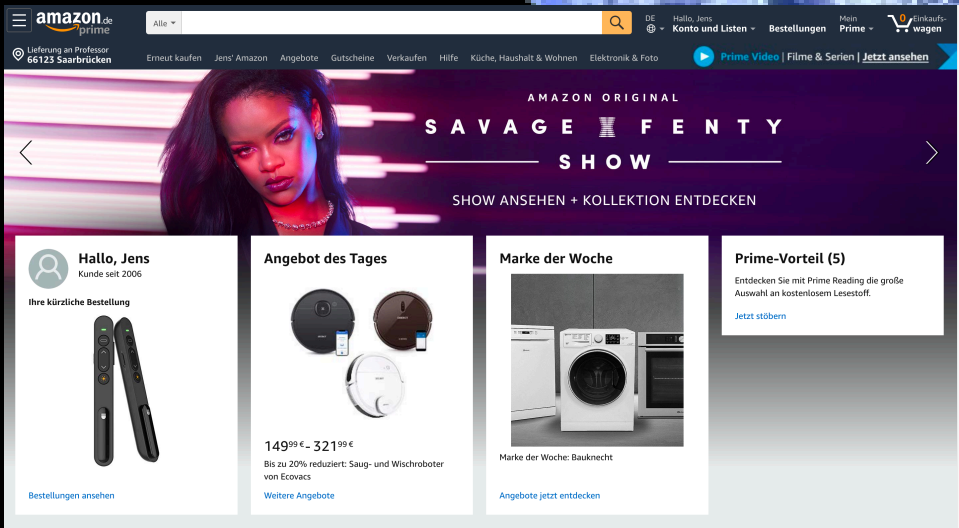
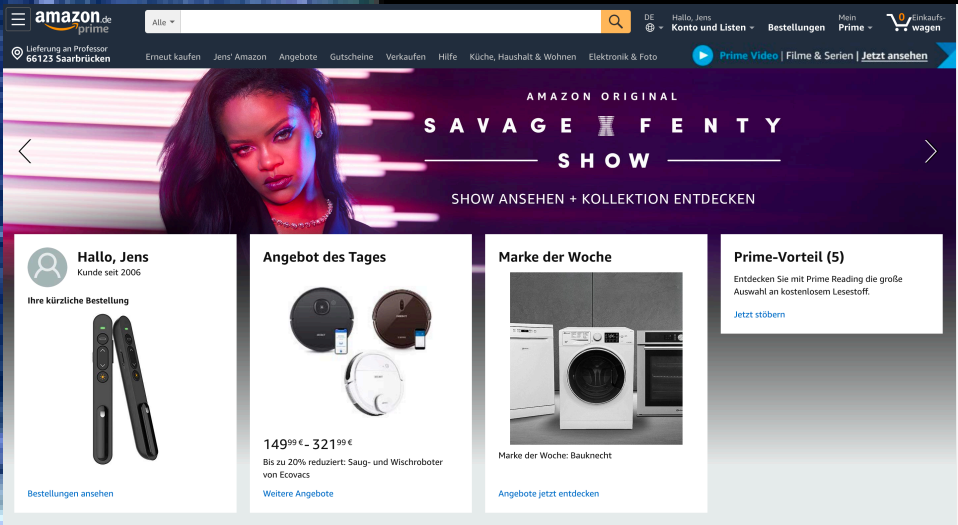
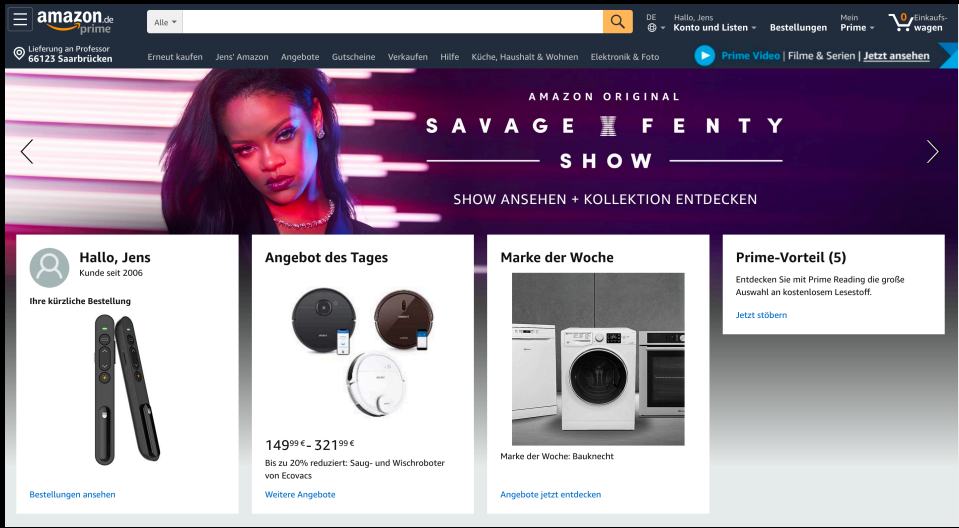
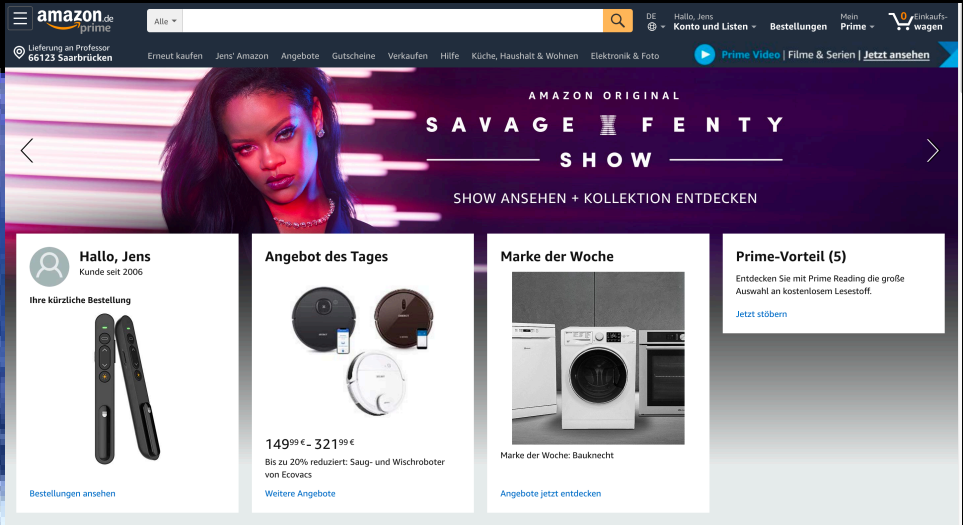
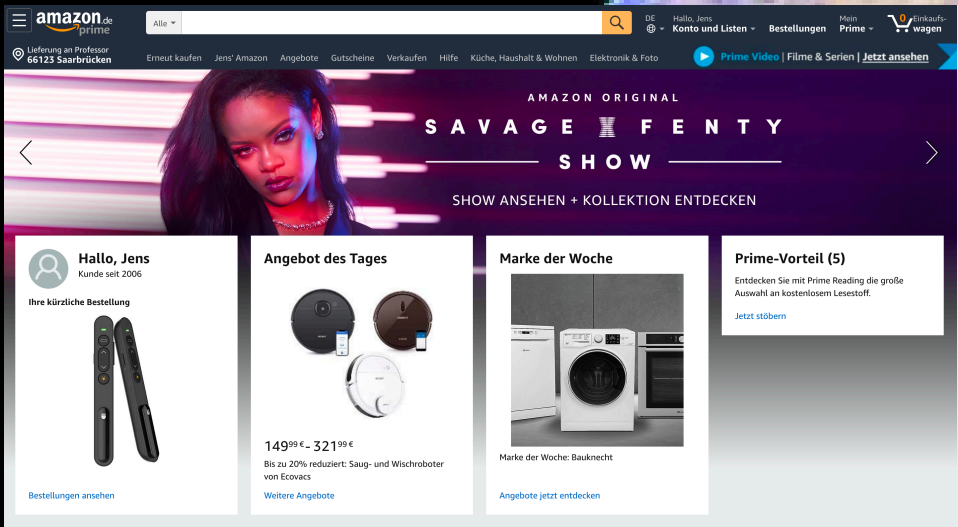
Shopping

country-scale



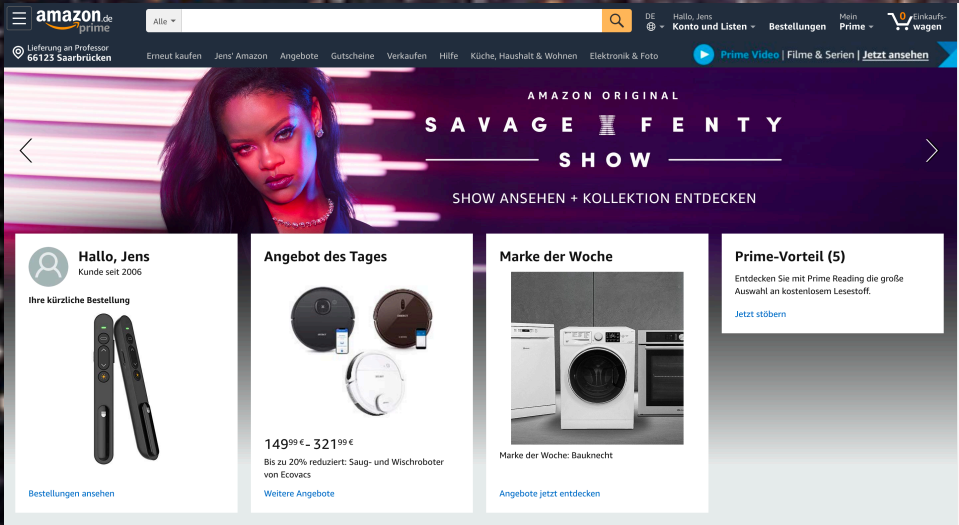
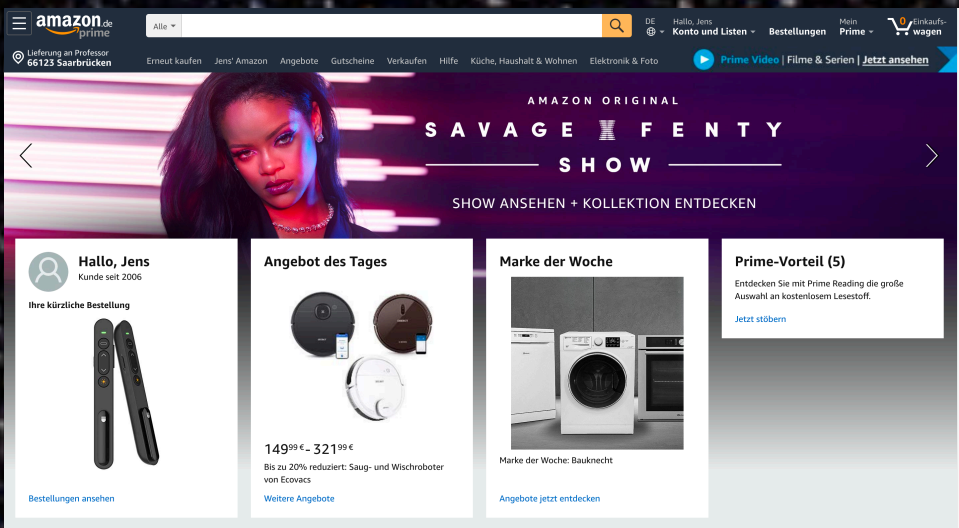
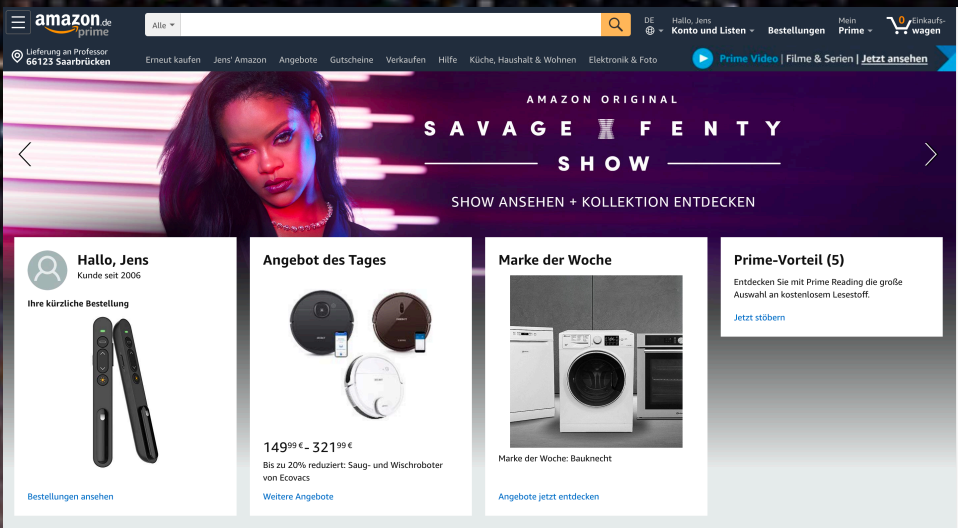
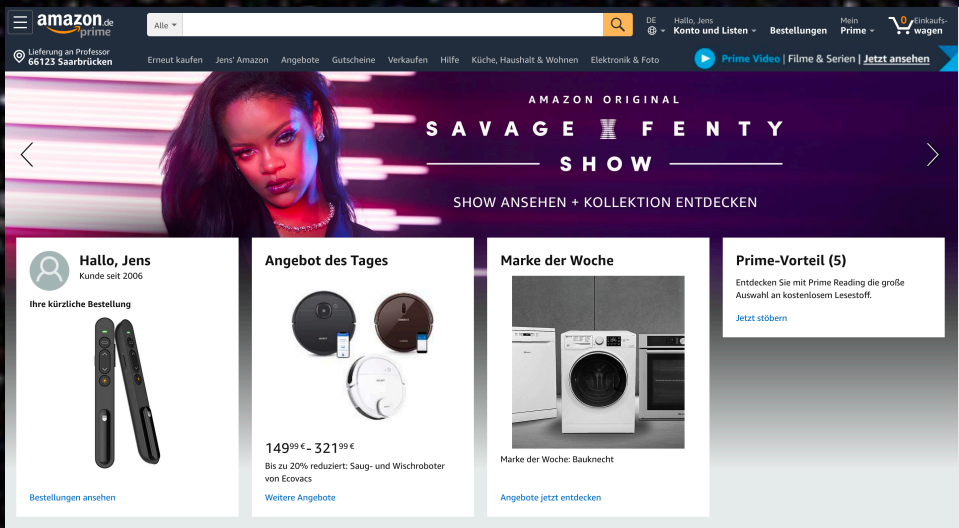
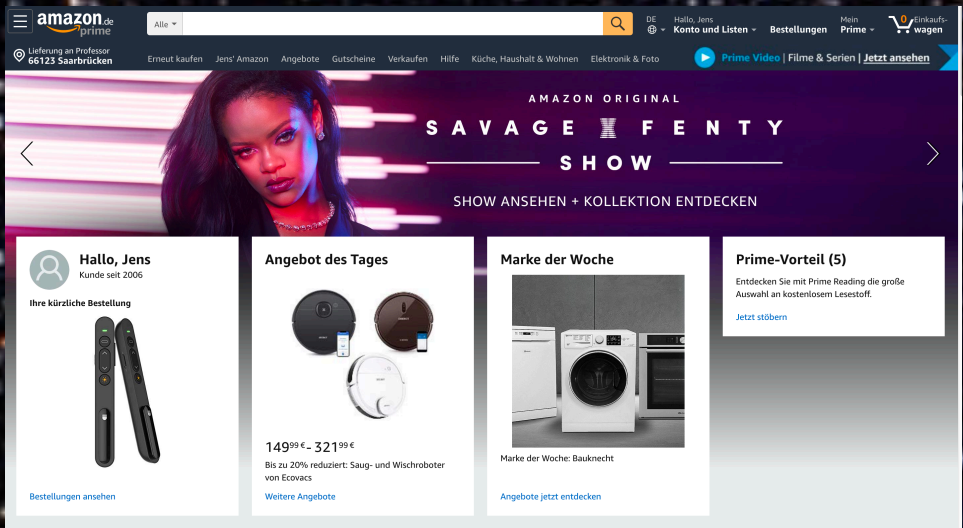
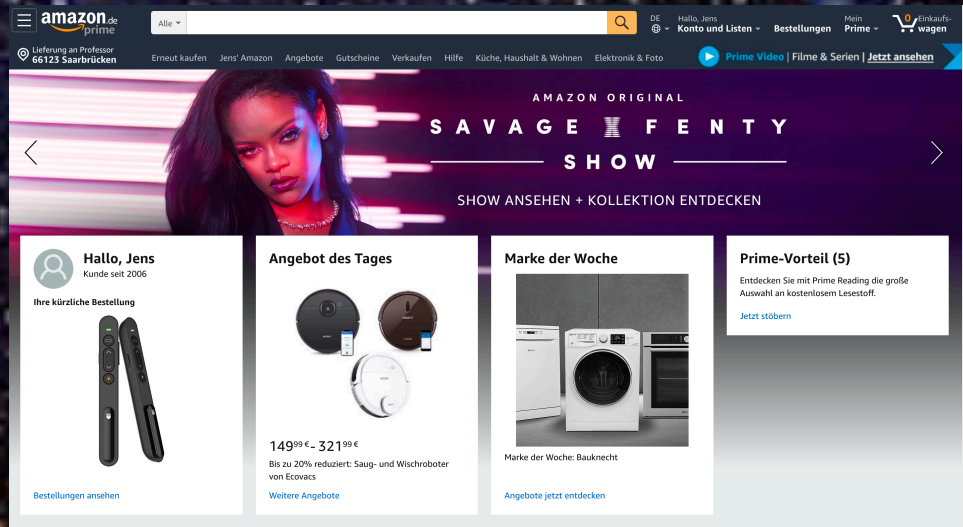
Shopping

planet-scale

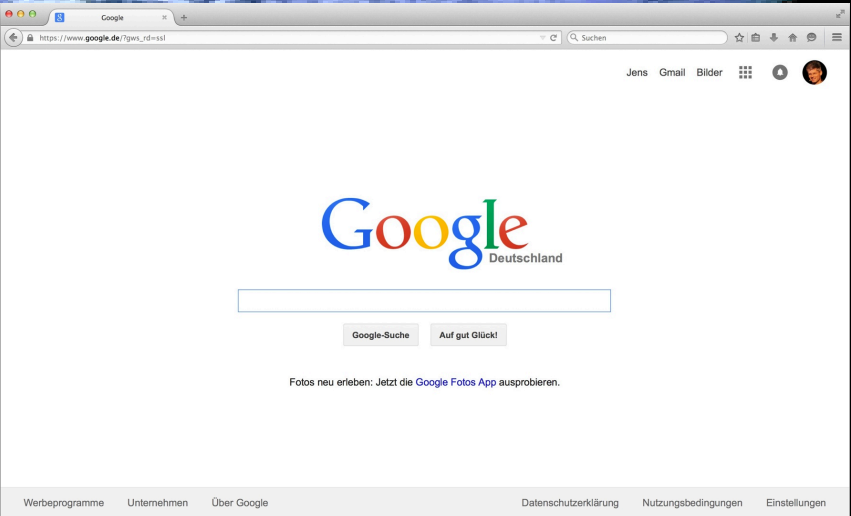
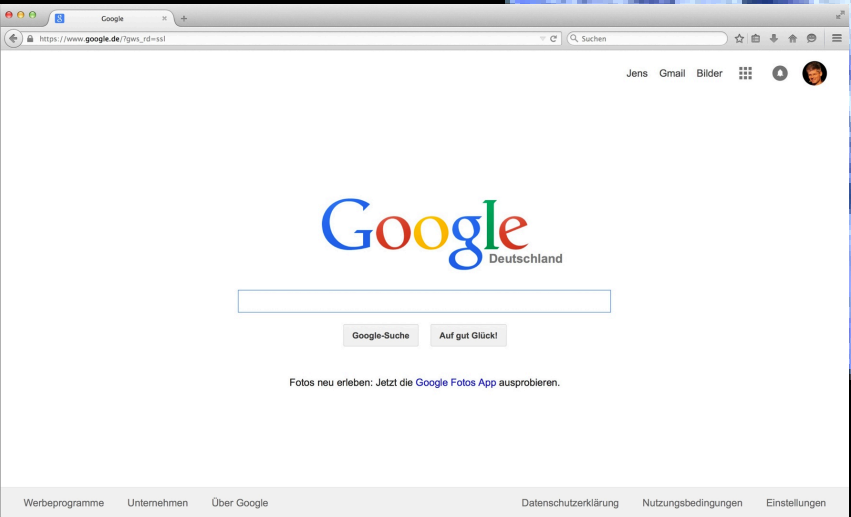
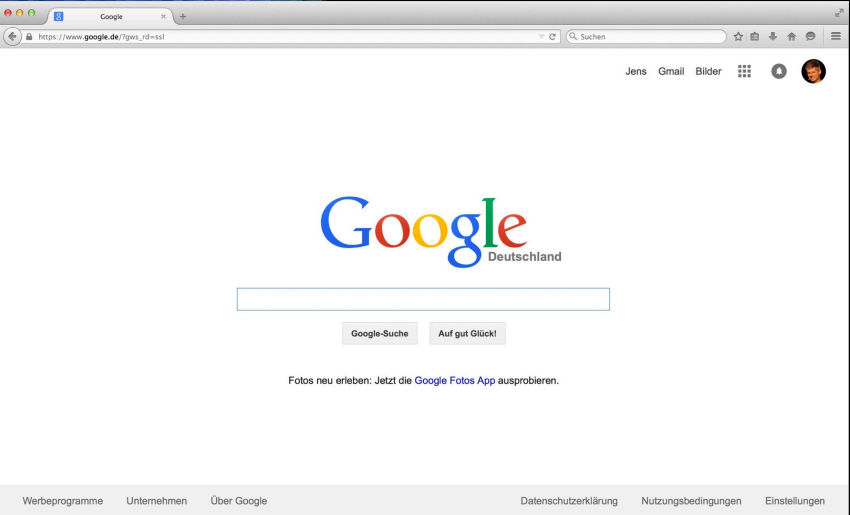
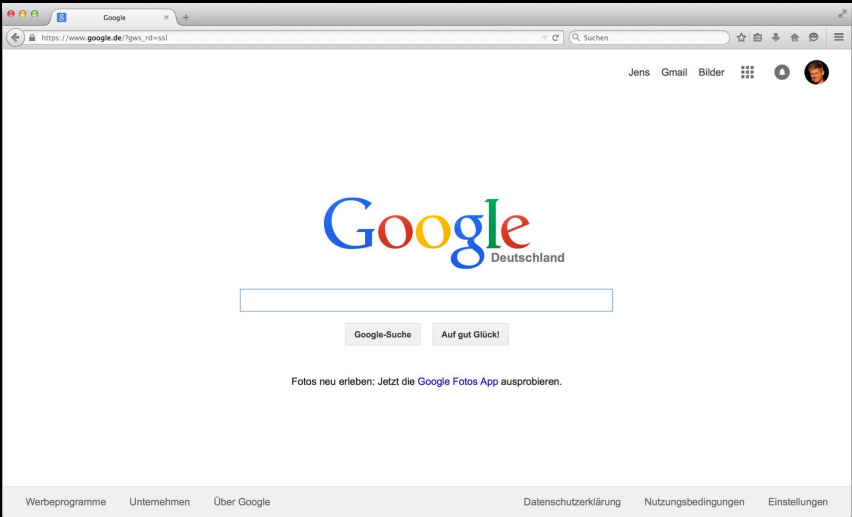
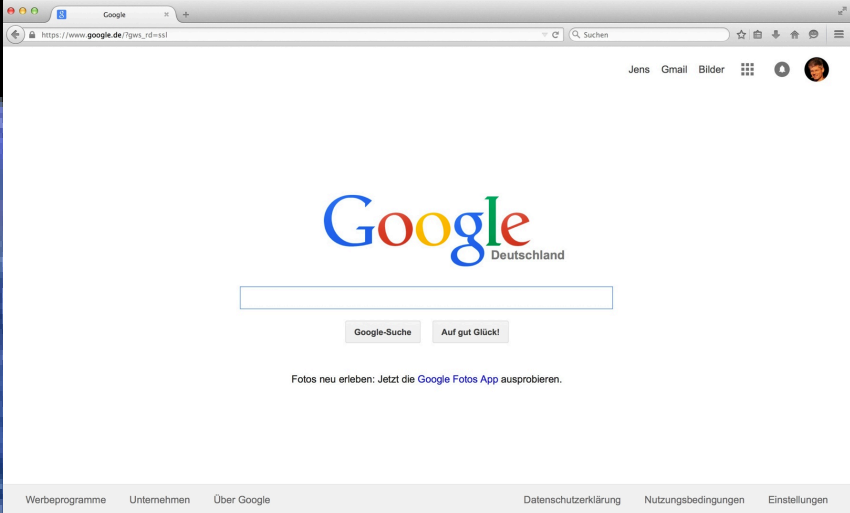
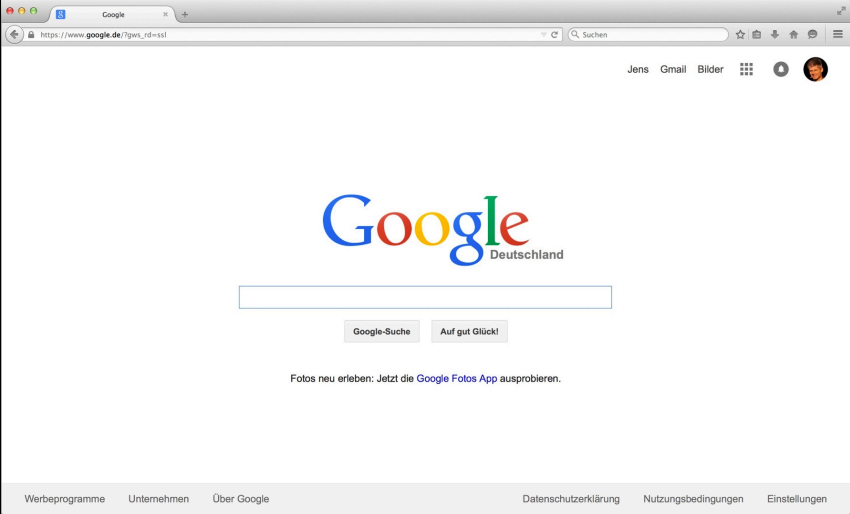


Shopping

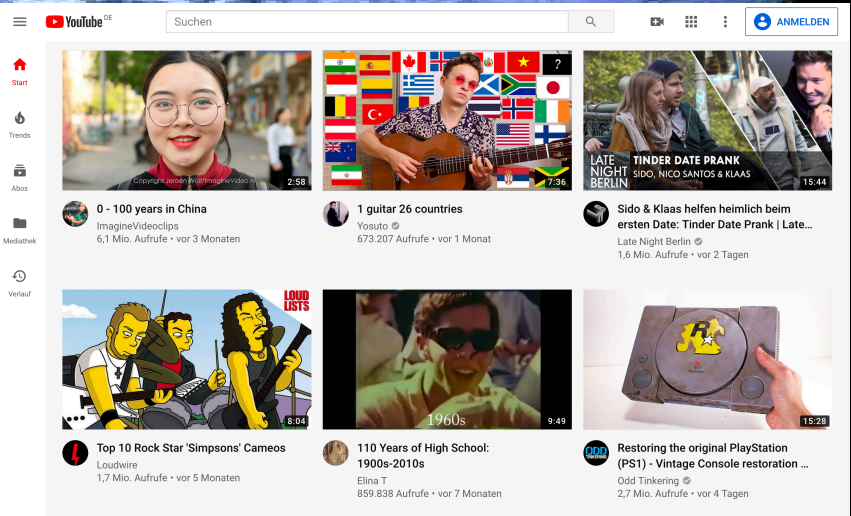
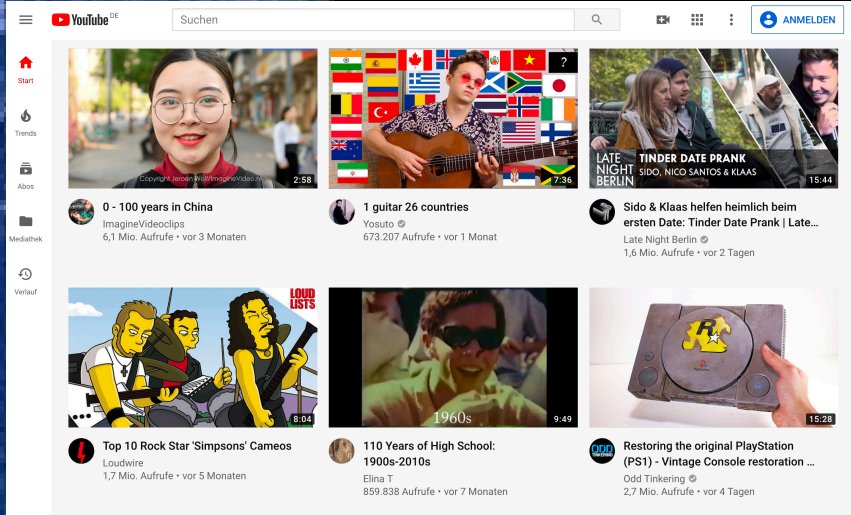
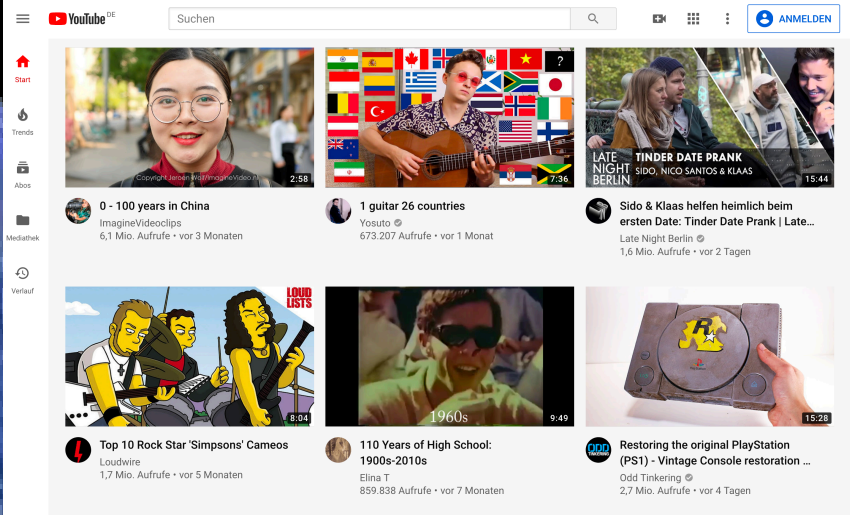
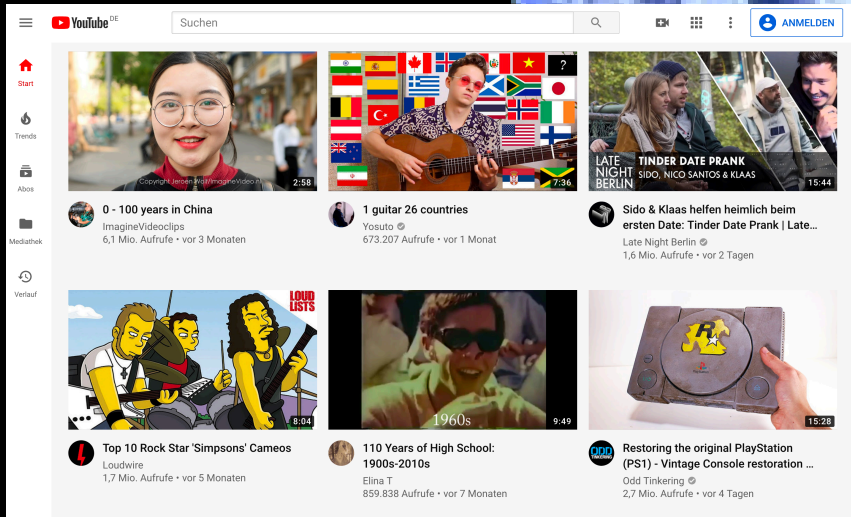
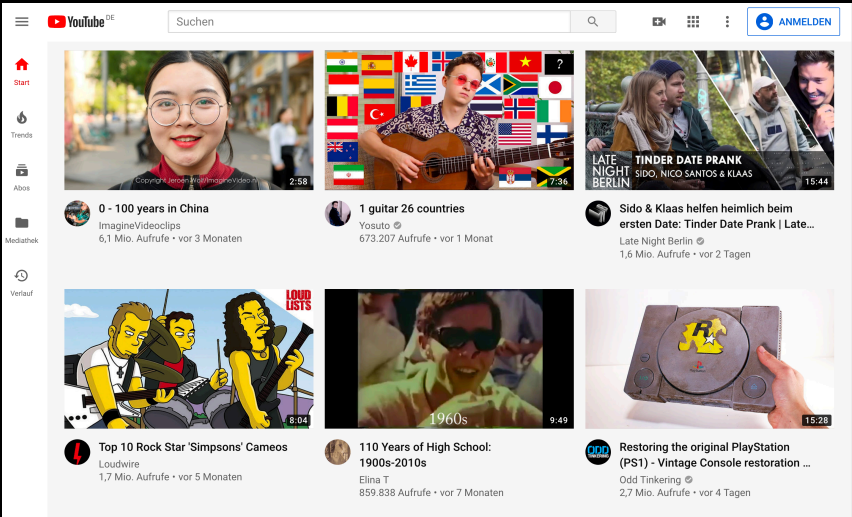
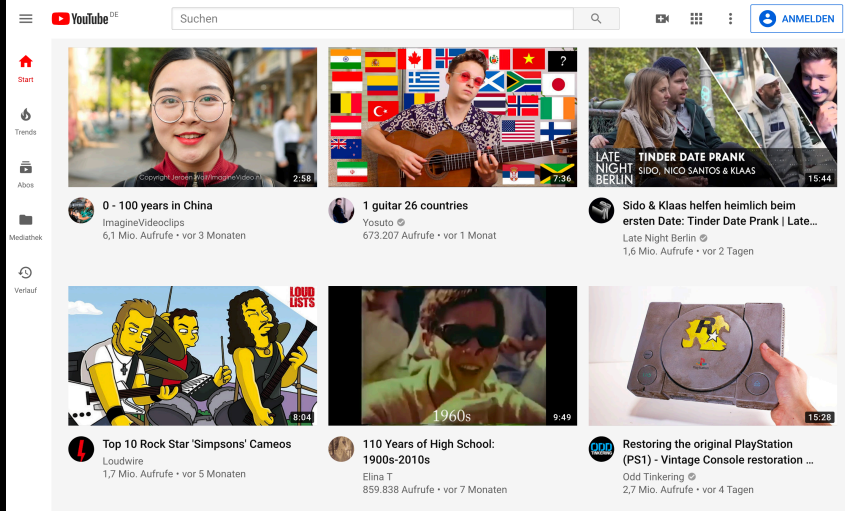
galaxy-scale



Search



Content Delivery





Data Science & AI



**“traditional”
Computer Science**

Radiology



AI can differentiate between tuberculous, pyogenic spondylitis as well as radiologists

September 10, 2018 | [Michael Walter](#) | [Artificial Intelligence](#)



AI algorithm spots abnormal chest X-rays with 90 percent accuracy

September 19, 2018

by [Thomas Dworetzky](#), Contributing Reporter

Artificial intelligence can determine lung cancer type

Tool also IDs genetic changes in each patient's tumor

Spending for machine learning in radiology expected to soar



DIAGNOSTIC IMAGING

Enter your keywords

Topics

Image IQ

Case Studies

Blog

Conferences

Machine Outperforms Radiologists for Staging Liver Fibrosis Using CT

By Diagnostic Imaging Staff

Sep 19, 2018



Dermatologist

Cardiologist

Pathologist

Laboratory physician

Surgeon

AI predicts risk of death from heart disease more accurately than experts

The machine learning model uses 600 variables with patient's data whereas human-constructed models made predictions based on 27, researchers say.

PUBLIC RELEASE: 21-SEP-2018

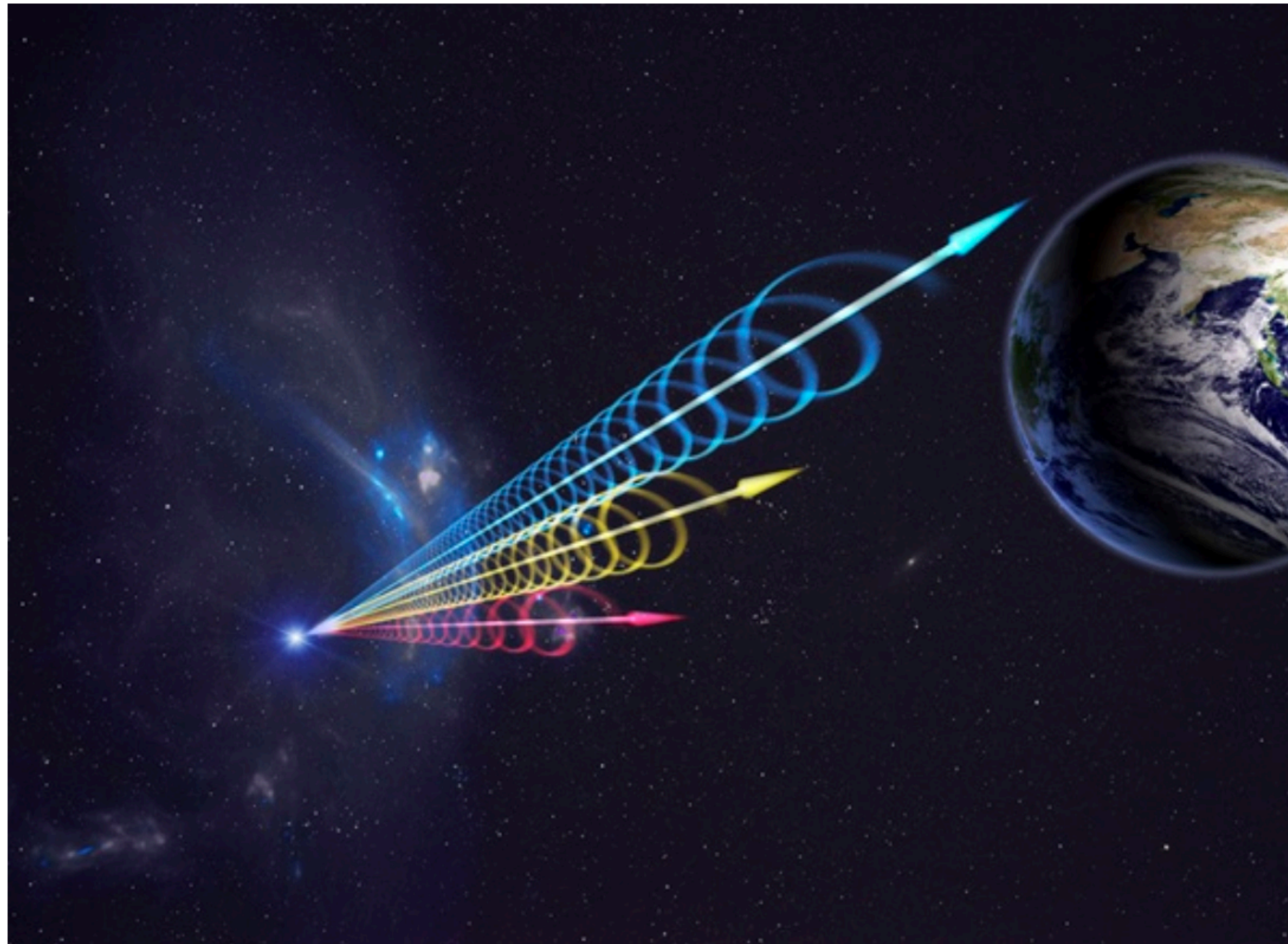
AI used to detect fetal heart problems

Sounding the Alarm: How Deep Learning Helps Doctors Detect Pediatric Sepsis

AI detects 72 fast radio bursts from a distant, unknown source

Machine learning technology can help astronomers identify signals amidst the noise of the universe.

By Amber Jorgenson | Published: Tuesday, September 11, 2018



An artist's illustration shows the signal from a fast radio burst zooming its way toward Earth.

Jingchuan Yu, Beijing Planetarium

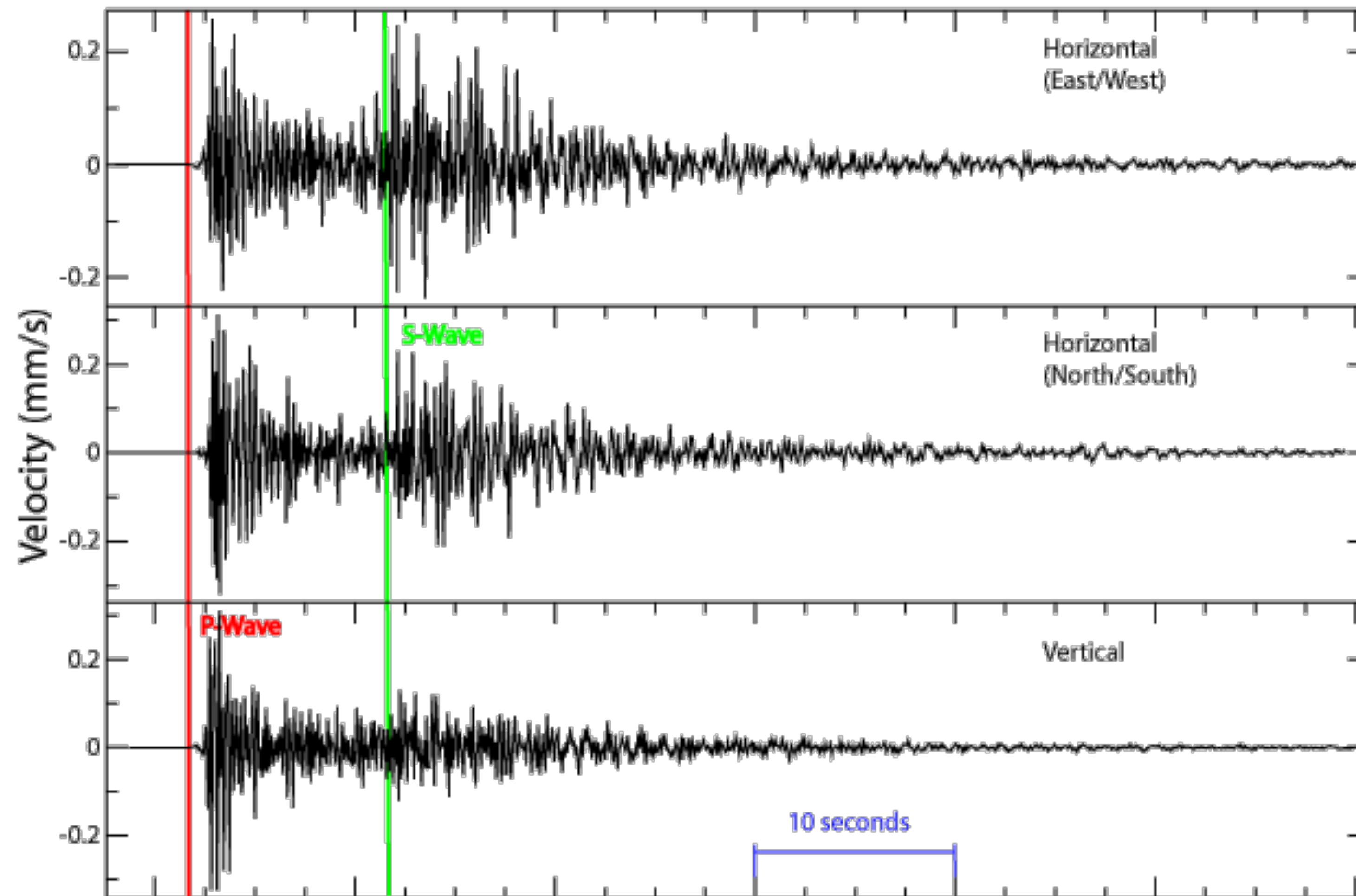
physics

Lightning Prediction



[Schön Christian, Dittrich Jens, Müller Richard. The Error is the Feature:
how to Forecast Lightning using a Model Prediction Error. SIGKDD 2019.]

Seismology



Seismology

Forecasting earthquake aftershock locations with AI-assisted science

Detecting earthquakes over a seismic network using single-station similarity measures

[Karianne J Bergen](#) ✉, [Gregory C Beroza](#)

Breaking Cascadia's Silence: Machine Learning Reveals the Constant Chatter of the Megathrust

Authors: Bertrand Rouet-Leduc^{1*}, Claudia Hulbert^{1*}, Paul A. Johnson¹

¹Affiliation: Los Alamos National Laboratory, Geophysics Group, Los Alamos, New Mexico, USA

Locality-Sensitive Hashing for Earthquake Detection: A Case Study of Scaling Data-Driven Science

Kexin Rong*, Clara E. Yoon†, Karianne J. Bergen‡, Hashem Elezabi*,
Peter Bailis*, Philip Levis*, Gregory C. Beroza†

Stanford University

The dark side:

Automatic warfare





Social Scoring

Global Mass-Surveillance





Data Science & AI



“traditional”
Computer Science



“traditional”
Sciences

BSc Beispielstudienplan

6	Bachelorarbeit	Bachelorarbeit	Vertiefung	
5	Vertiefung	Vertiefung	Vertiefung	Vertiefung
	DSAI Projektseminar			
4	Vertiefung	Big Data Engineering	Vertiefung	Anwendungsfach
3	Mathematik für Informatiker 3	Elements of Machine Learning	Theoretische Informatik	Algorithmen und Datenstrukturen
2	Mathematik für Informatiker 2	Statistics LAB	Programmieren 2	Anwendungsfach
1	Mathematik für Informatiker 1	Einführung Data Science and Artificial Intelligence	Programmieren 1	Ringvorlesung

Anwendungsfächer im Bachelor

- (a) Computerlinguistik
- (b) Materialwissenschaften
- (c) Psychologie
- (d) Physik
- (e) Chemie
- (f) Quantum Engineering
- (g) Human und Molekularbiologie
- (h) Jura
- (i) Systems Engineering
- (j) Medizin/Lebenswissenschaften
- (k) Kunstliche Intelligenz (sic!), mit HBK
- (l) ...

bereits möglich

geplant

**Wann müssen Sie sich
entscheiden?**

Frühjahr 2021!