Artificial Intelligence

Budi Rahardjo (@rahard)
https://www.youtube.com/@rahard
2024

VLSI / Security / IoT / AI / Blockchain / Data Science

- Lecturer at ITB
- Head of Microelectronic Center, ITB
- Manage .ID domain (1997-2005)
- Founder & chairman of ID-CERT (1999-now)
  Indonesia Computer Emergency Response Team
- Serial technopreneur – startup mentors

kesamaan dengan dunia IT. Keduanya
sama-sama membutuhkan kreativitas,
tandasnya.
Saya biasa mengisi blog dimana
dan kapan saja. Saat sedang di rumah,
mobil atau kereta. Biasanya, kalau tidak
kreativitas lewat sarana website. Dan kita
tak perlu membayar saat memakainya.
Alias gratisan.
belum kesampaian. Saya akan berusaha
terus untuk mewujudkannya.
Business, IT
& Rock'n Roll
mobile | 25

COLLECT YOUR OWN MUSIC
DIGITAL BEAT STORE
NOW OPEN
AT
blitzmegaplex
PARIS VAN JAVA MALL SUKAJADI,
BANDUNG

Insan Music Store

MP3 LEGAL
INSAN
MUSIC STORE
REGISTRASI

BNI
solidarity forever
12-14 OCTOBER 2018
INSAN MUSIC PROJECT
PLN
HONDA
SASMITA
MANDIRI OIL
PERTAMINA
inalum
PARAGON
BNI ITB ULTRA MARATHON
Marshall

BNI
yayasan solidarity forever
12-14 OCTOBER 2018
MANDIRI OIL
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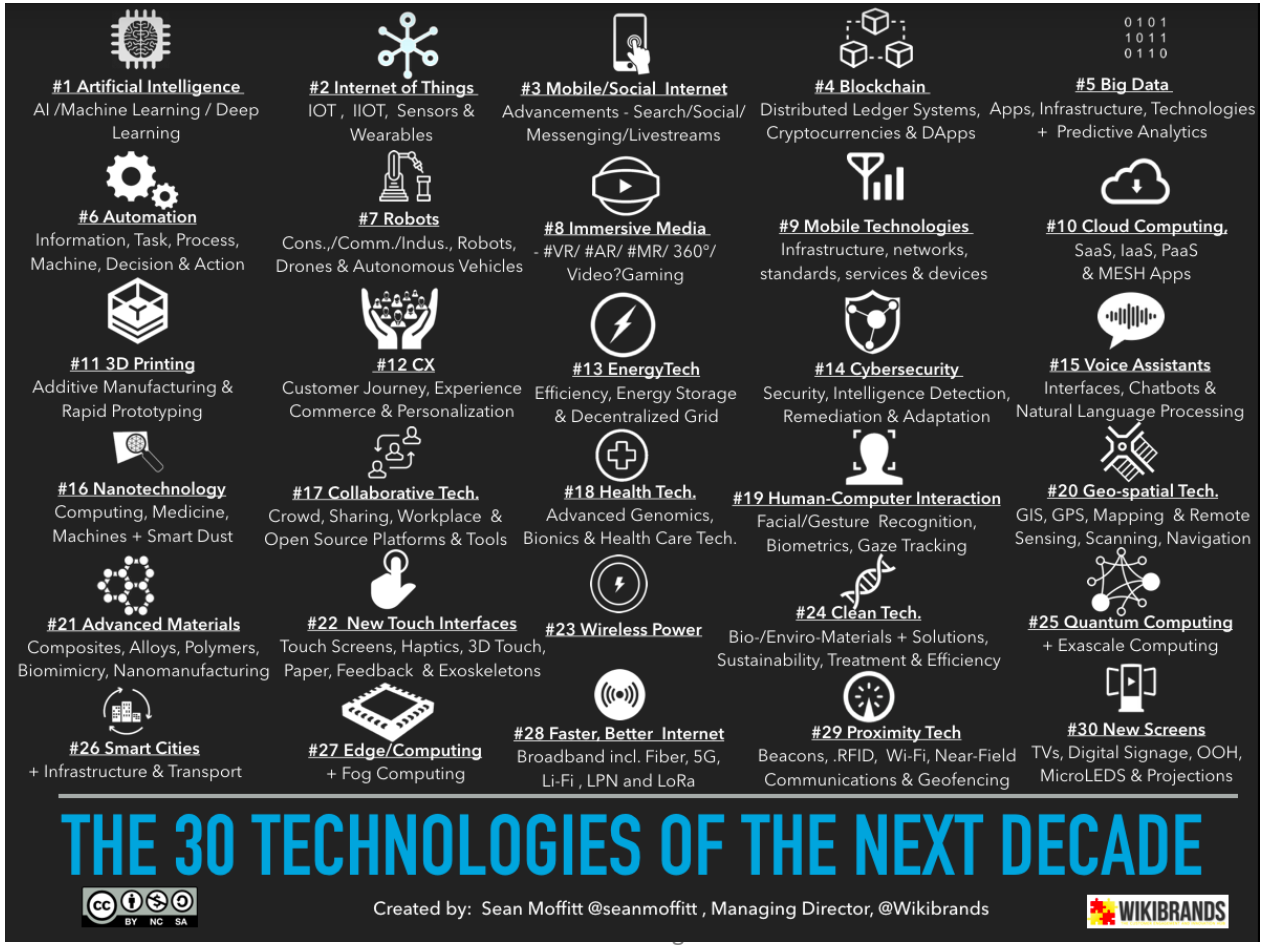
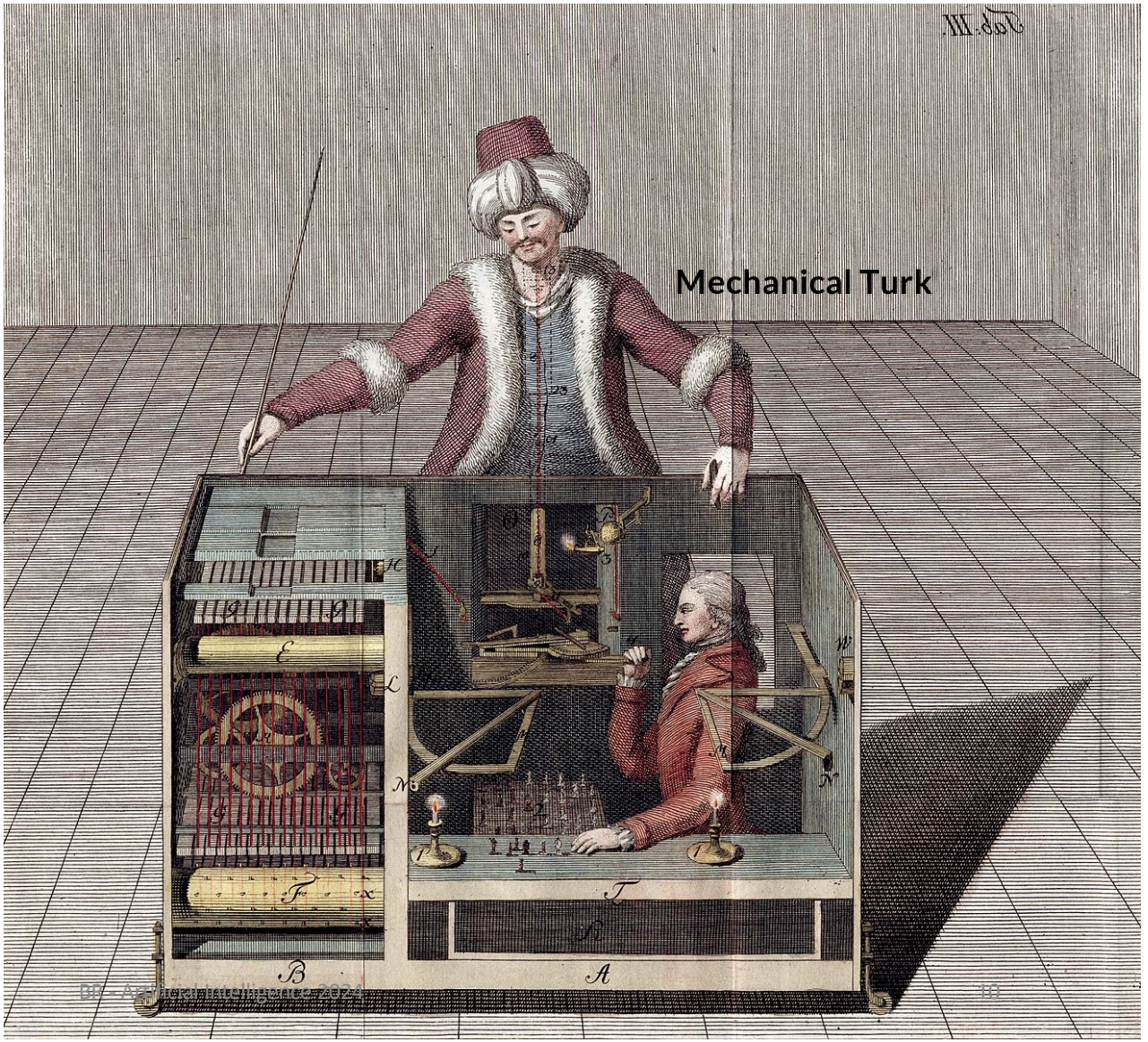
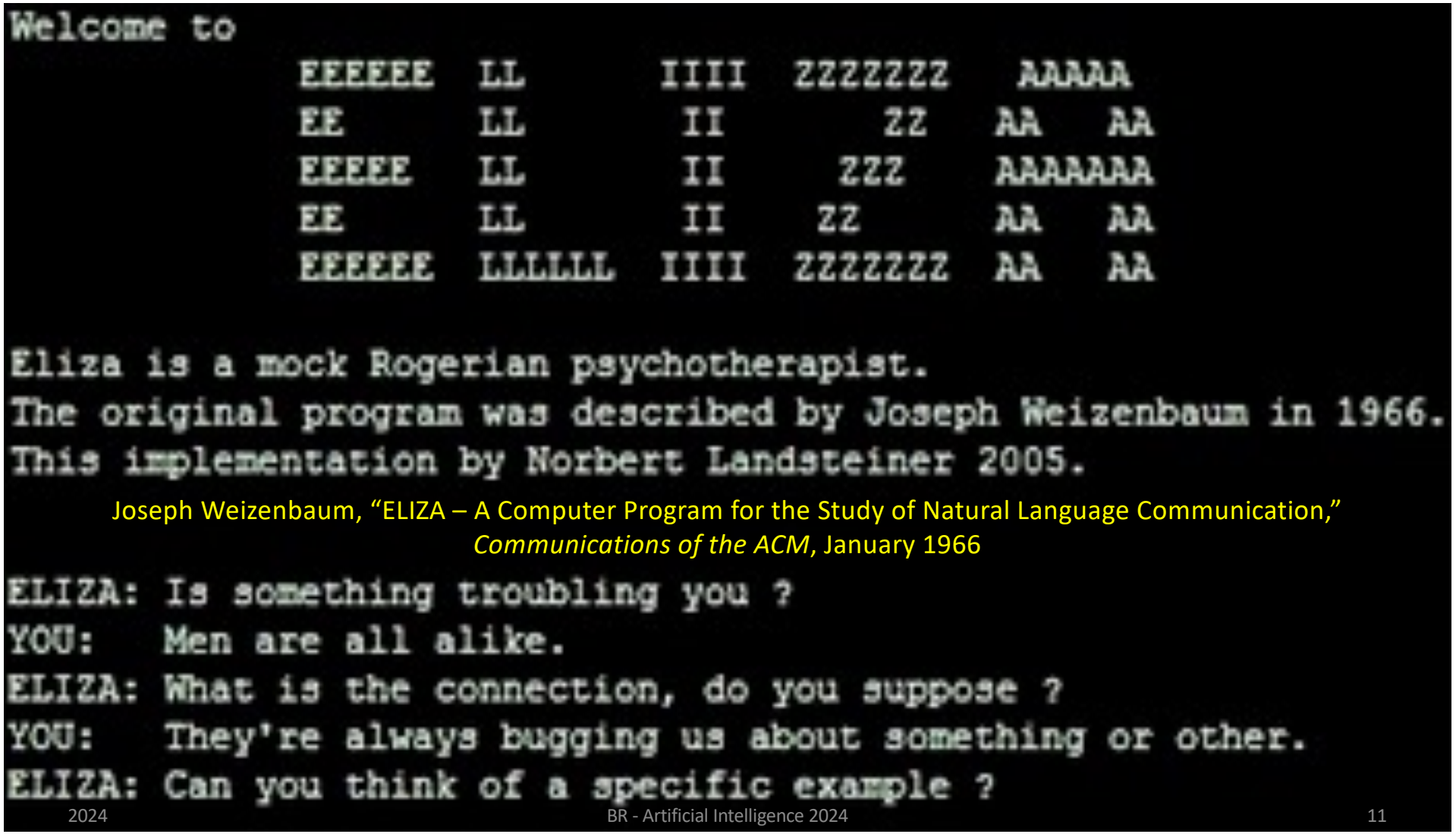
Emerging Technologies

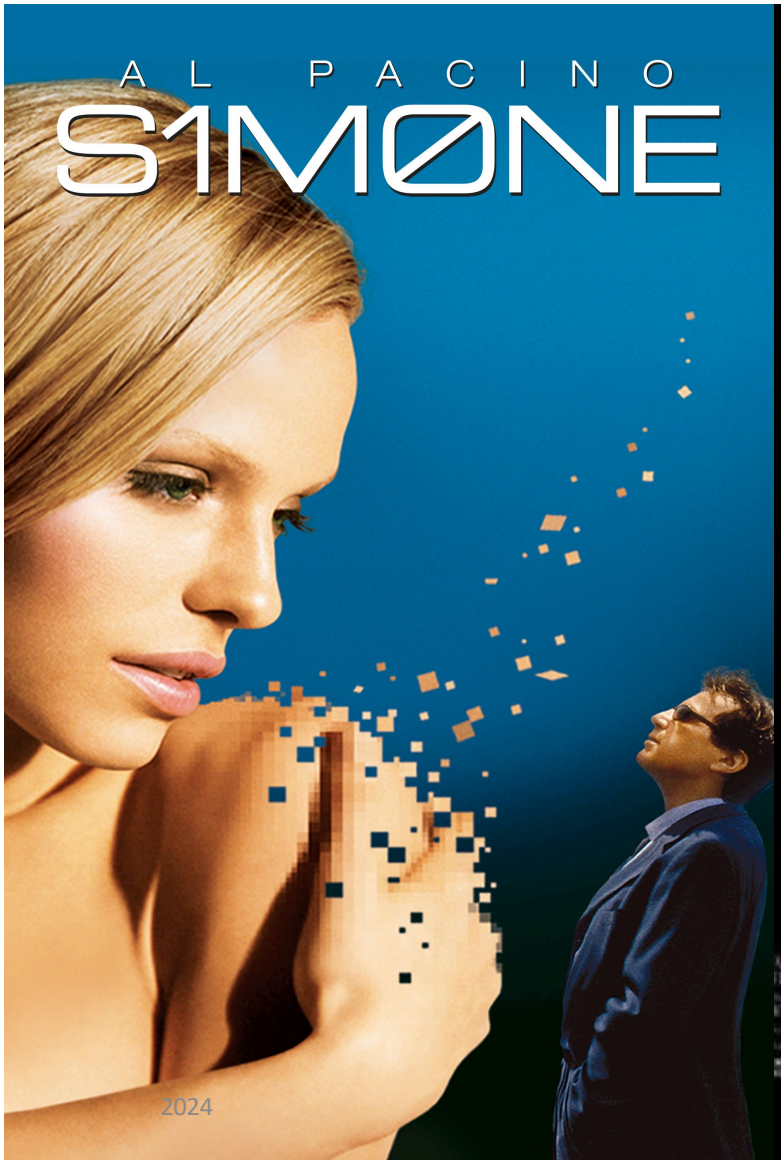


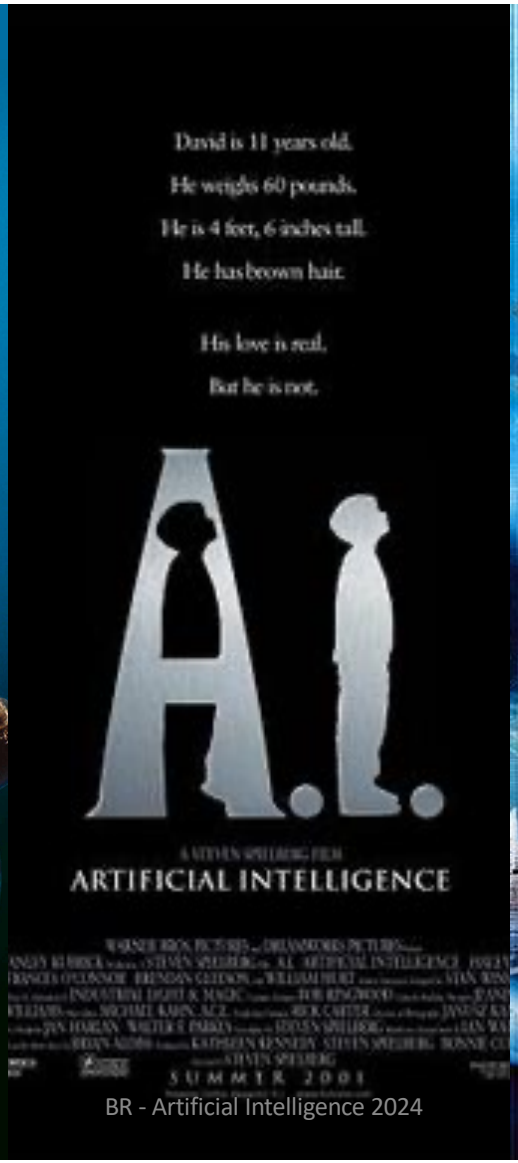
What is Intelligence

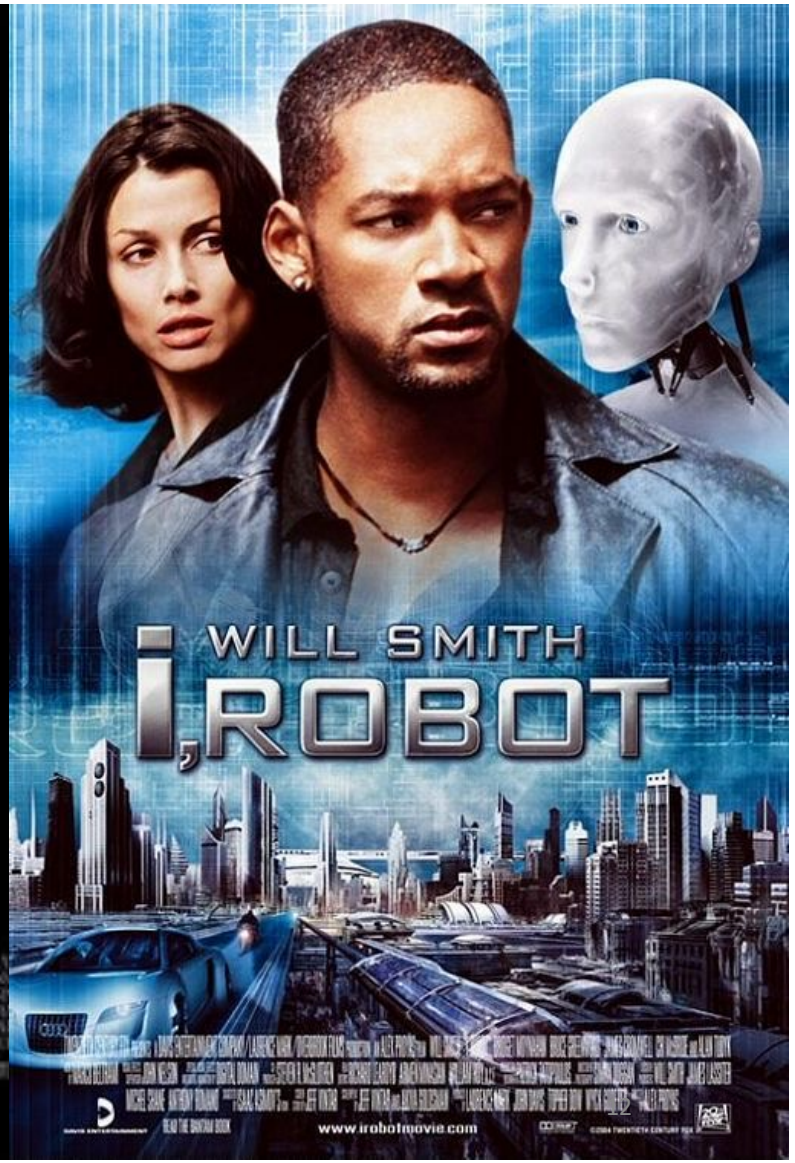




Joseph Weizenbaum, "ELIZA – A Computer Program for the Study of Natural Language Communication," *Communications of the ACM*, January 1966


AL PACINO
S1M0NE


David is 11 years old.
He weighs 60 pounds.
He is 4 feet, 6 inches tall.
He has brown hair.
His love is real.
But he is not.
A.I.
ARTIFICIAL INTELLIGENCE
SUMMER 2001


WILL SMITH
i,ROBOT
www.irobotmovie.com

RYAN REYNOLDS
JODIE COMER
LIL REL HOWERY
UTKARSH AMBUDKAR
JOE KEERY
AND TAIKA WAITITI
LIFE'S TOO SHORT TO BE A BACKGROUND CHARACTER
FREE GUY
ONLY IN THEATERS
AUGUST 13

Current Generative AI Applications

- Text
  - ChatGPT (OpenAI)
  - Gemini (was Bard, Google), idx
  - Bing + Copilot
- Image
  - Dall-e (OpenAI)
  - Midjourney
  - ...
- Music
  - Suno
  - Udio
- Video
  - Sora (OpenAI)
- Specific
  - ...

DALL-E

MIDJOURNEY AI

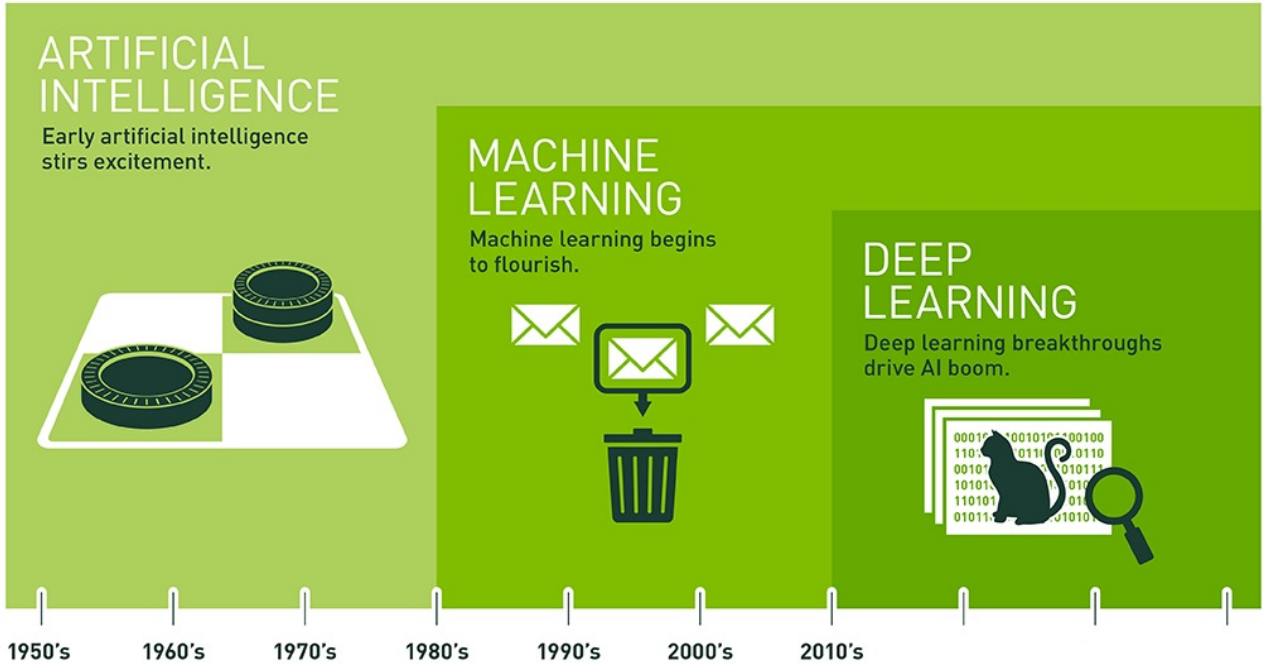
Sejarah Artificial Intelligence

Istilah yang diperkenalkan oleh **John McCarthy** di 1956:

... machines that can perform tasks
that are characteristic of human intelligence ...

General AI vs. Narrow AI (specific task)

AI / Machine Learning / Deep Learning



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

"Pemrograman" AI

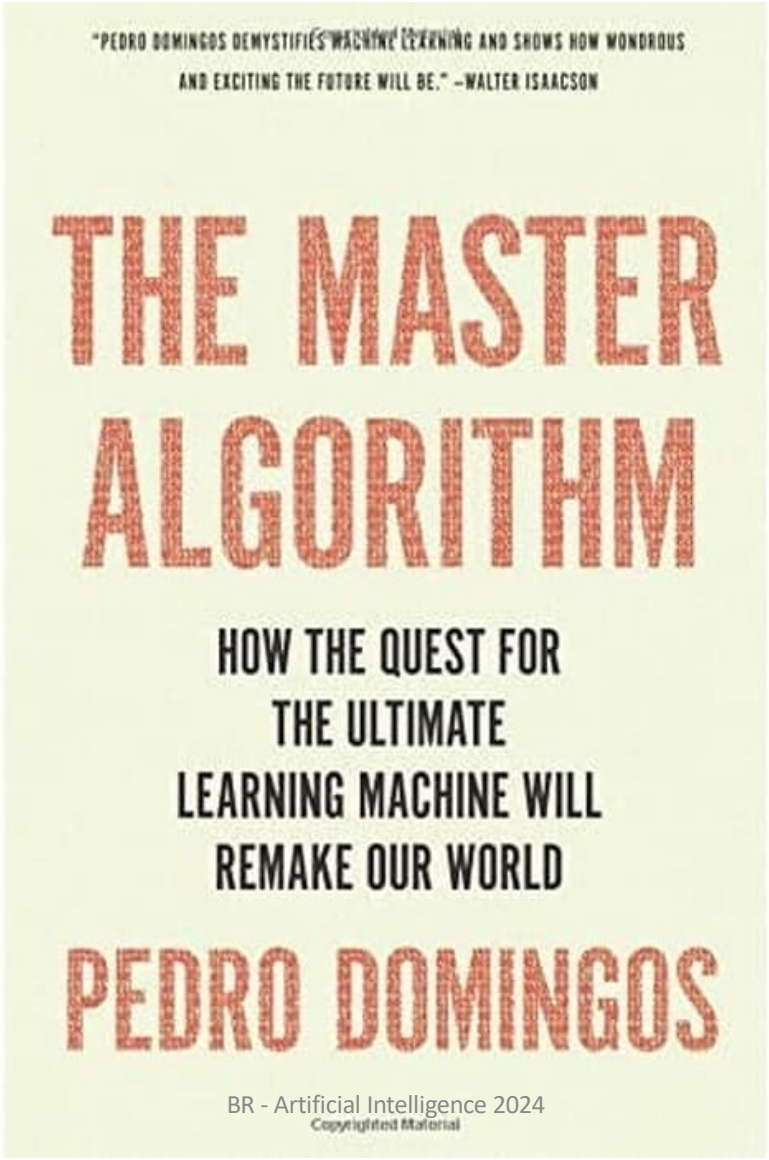
- Tidak dilakukan dengan menggunakan aturan (*rules*) atau urutan perintah, tetapi dilakukan dengan memberikan contoh-contoh
  - Programming by examples
- Mesin akan melakukan proses "pembelajaran" (*learning*) dengan menggunakan contoh-contoh (data set) yang diberikan
- Kualitas dari hasil akhir bergantung kepada kualitas contoh yang diberikan, sehingga **kualitas** dan **kuantitas** dari contoh sangat penting

Bidang-bidang AI

- Image & video analysis: classification, face detection & recognition, image generation
- Natural Language Processing: sentiment analysis, chatbot
- Text analysis: spam detection
- Autonomous Vehicle
- Music
- Fraud detection
- Speech recognition

Deep Learning

- Neural Networks: inspired by the biological of our brain, the interconnection of neurons
- Was difficult to produce “intelligence” due to high computation requirements
  - Now, it is possible due to GPU, networks, large volume data, ...
  - Software tools to make it easier to program
- “Deep”
  - More layers of neural networks


"PEDRO DOMINGOS DEMYSTIFIES MACHINE LEARNING AND SHOWS HOW MONDROUS AND EXCITING THE FUTURE WILL BE." –WALTER ISAACSON
THE MASTER ALGORITHM
HOW THE QUEST FOR THE ULTIMATE LEARNING MACHINE WILL REMAKE OUR WORLD
PEDRO DOMINGOS
Copyrighted Material

Pedro Domingos: 5 Tribes of Machine Learning

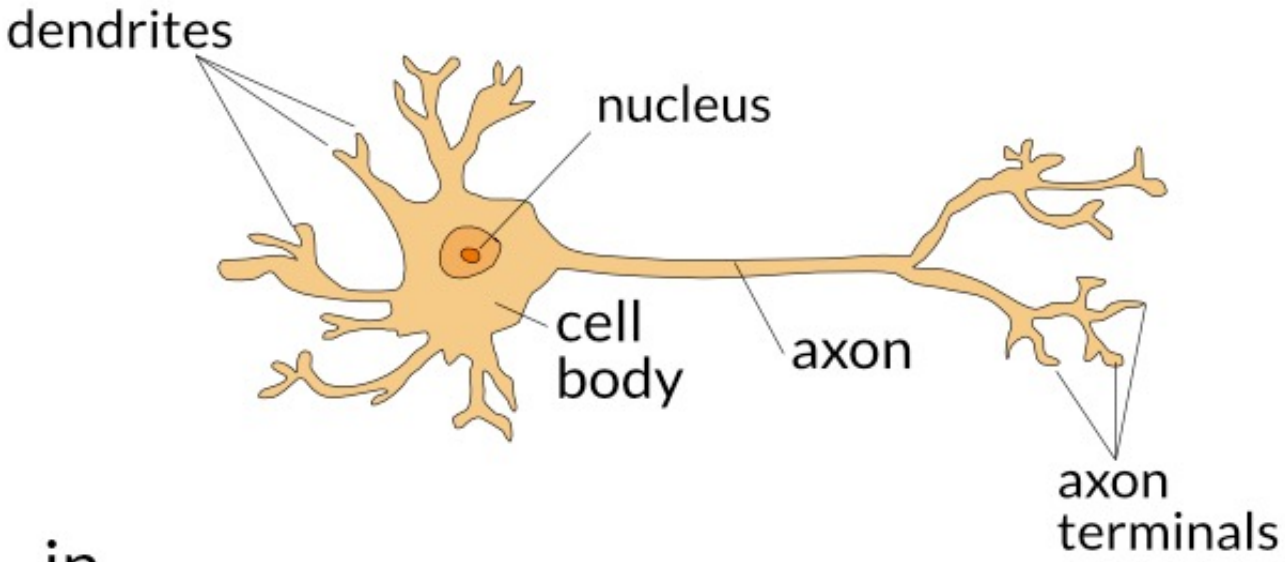
Tribe	Origins	Master Algorithm
Symbolists	Logic, philosophy	Inverse deduction
Connectionists	Neuroscience	Backpropagation
Evolutionaries	Evolutionary biology	Genetic programming
Bayesians	Statistics	Probabilistic inference
Analogizers	Psychology	Kernel machines

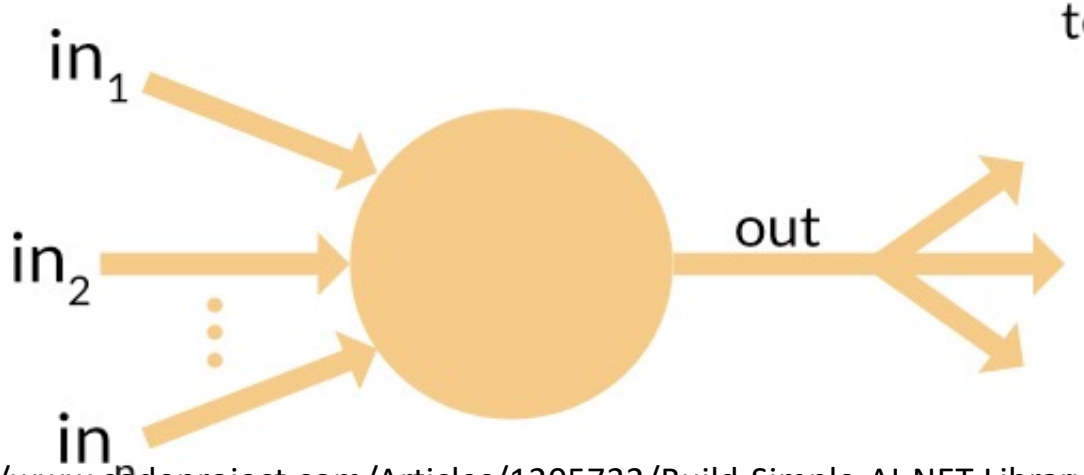
Source: Pedro Domingos – The Five Tribes of Machine Learning

Problems & Solutions

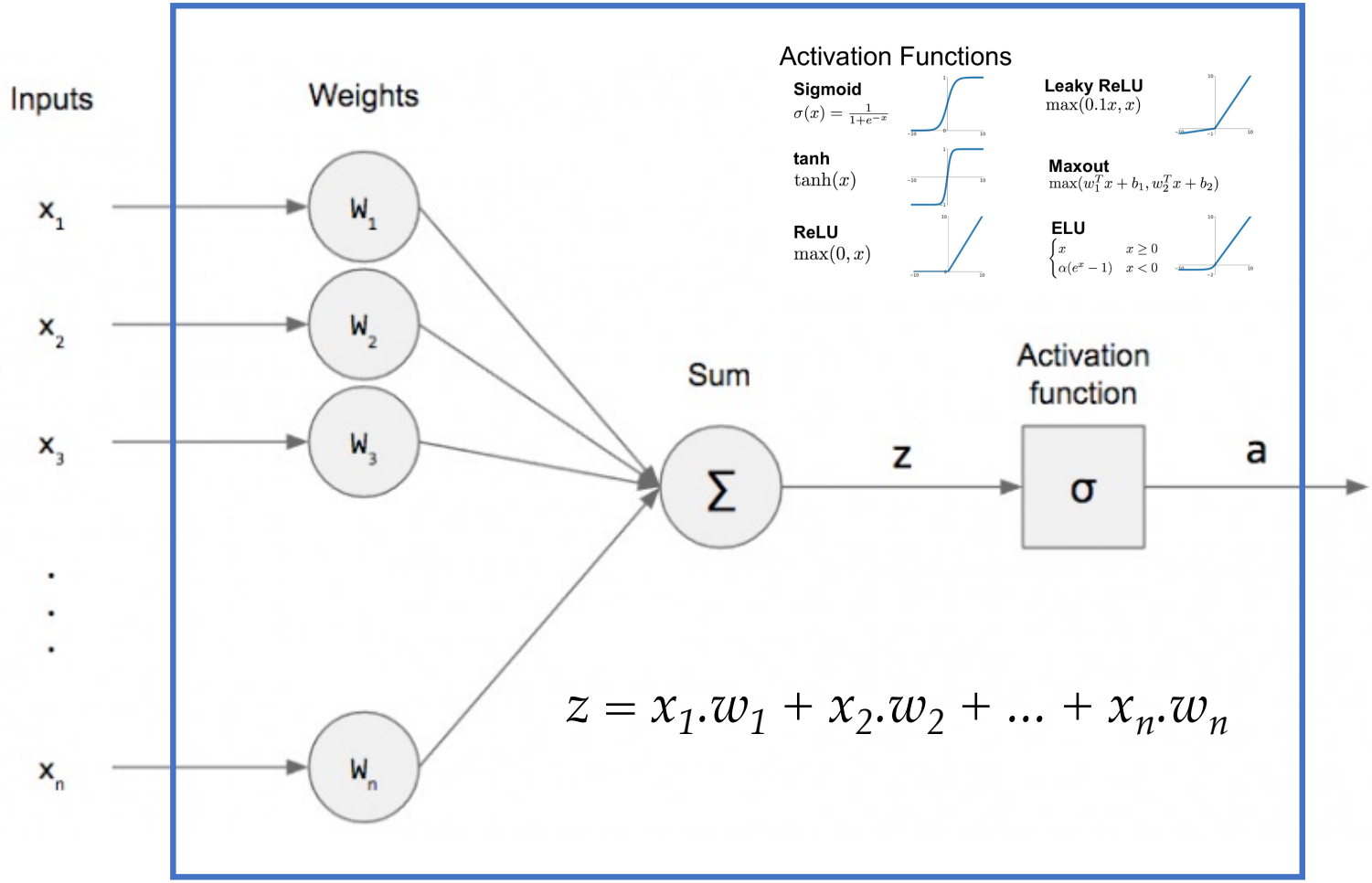
Tribe	Problem	Solution
Symbolists	Knowledge composition	Inverse deduction
Connectionists	Credit assignment	Backpropagation
Evolutionaries	Structure discovery	Genetic programming
Bayesians	Uncertainty	Probabilistic inference
Analogizers	Similarity	Kernel machines

Source: Pedro Domingos – The Five Tribes of Machine Learning

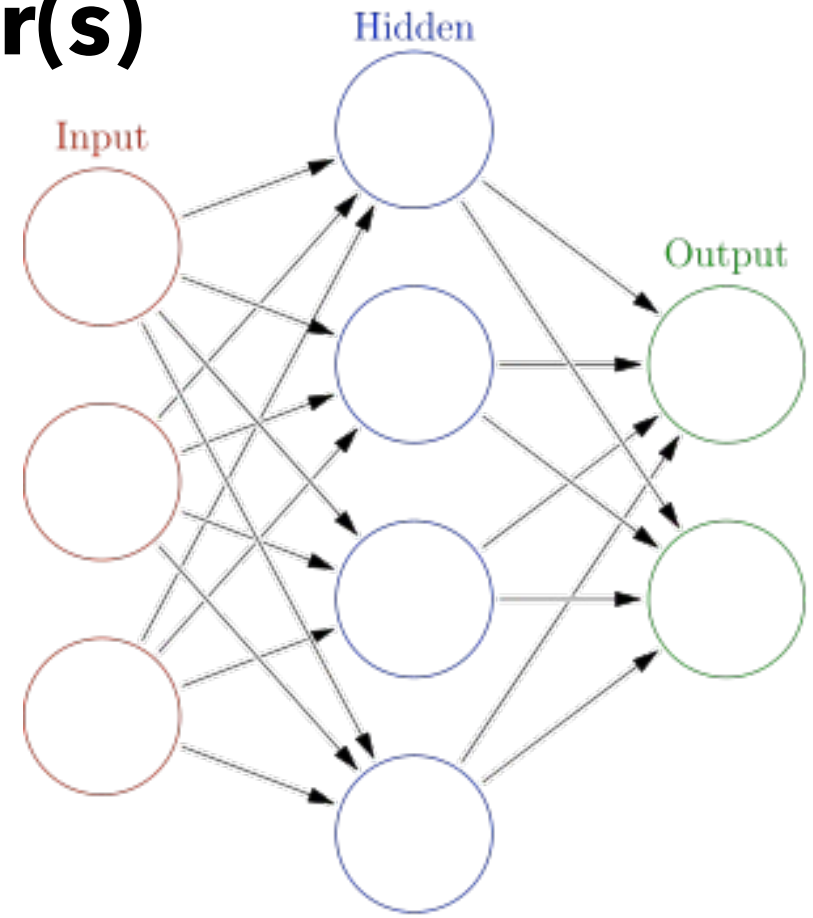


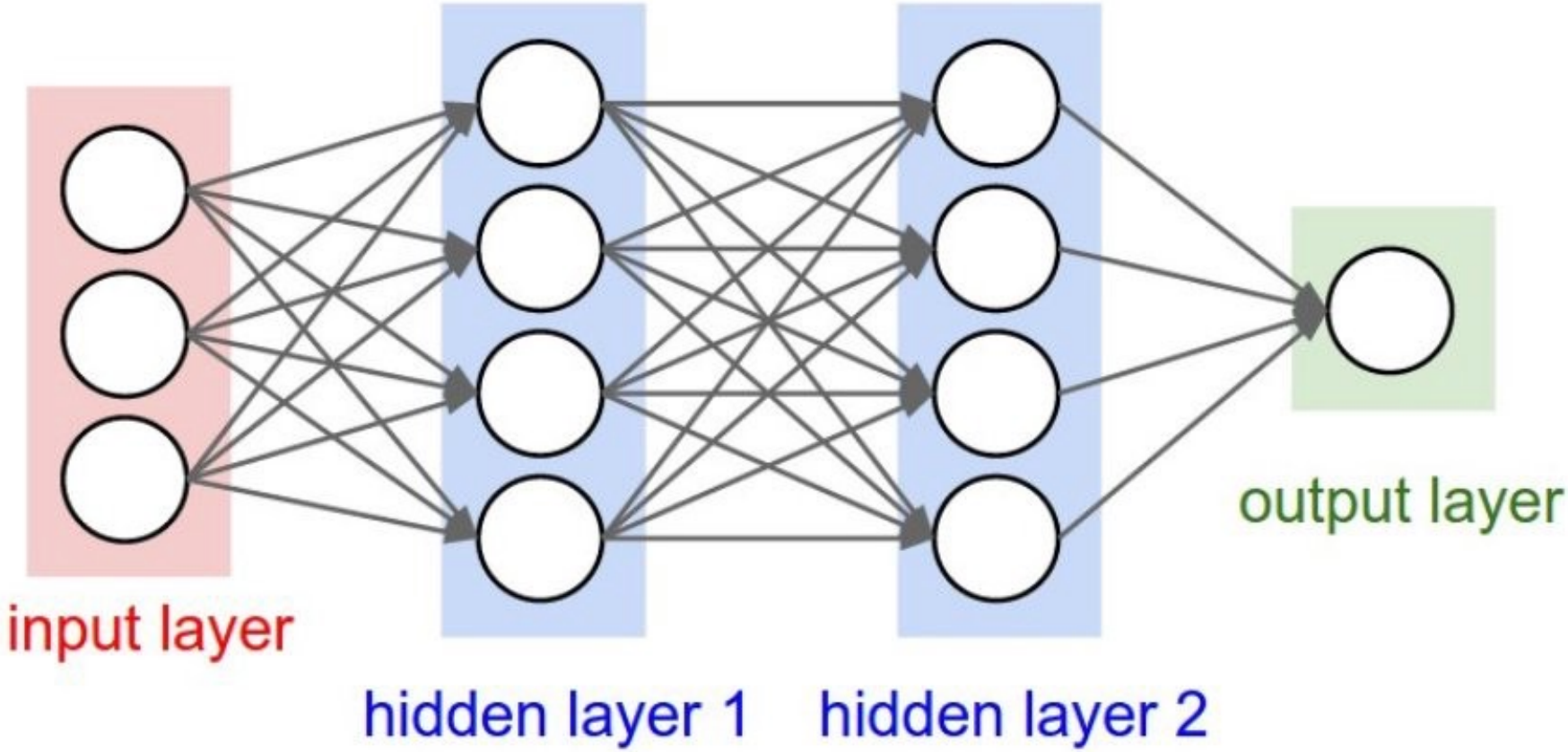


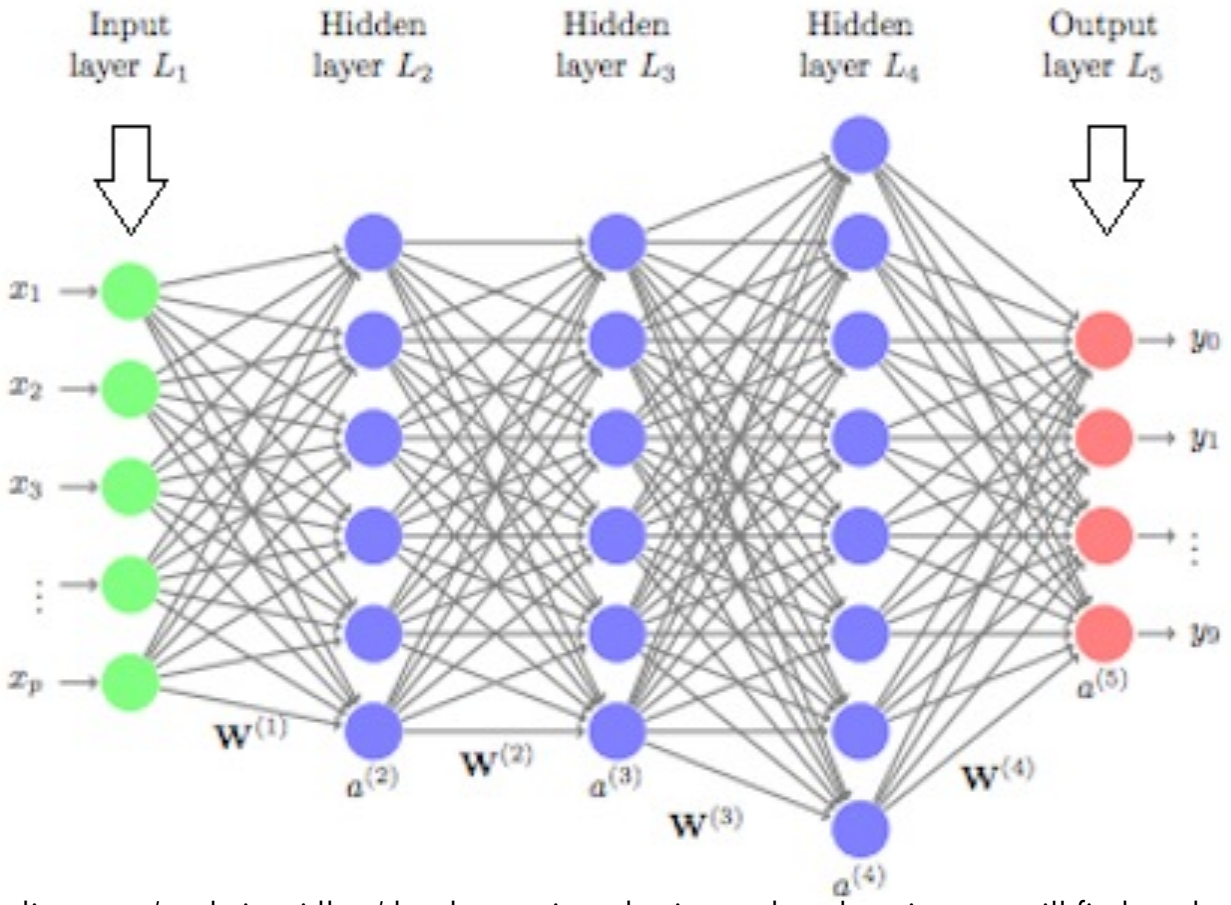
https://www.codeproject.com/Articles/1205732/Build-Simple-AI-NET-Library-Part-Perceptron


Inputs
Weights
x1
x2
x3
xn
W1
W2
W3
Wn
Sum
Σ
z
Activation function
σ
a
Activation Functions
Sigmoid
$\sigma(x) = \frac{1}{1+e^{-x}}$
tanh
$\tanh(x)$
ReLU
$\max(0, x)$
Leaky ReLU
$\max(0.1x, x)$
Maxout
$\max(w_1^T x + b_1, w_2^T x + b_2)$
ELU
$\begin{cases} x & x \geq 0 \\ \alpha(e^x - 1) & x < 0 \end{cases}$
$z = x_1.w_1 + x_2.w_2 + \ldots + x_n.w_n$

Hidden Layer(s)

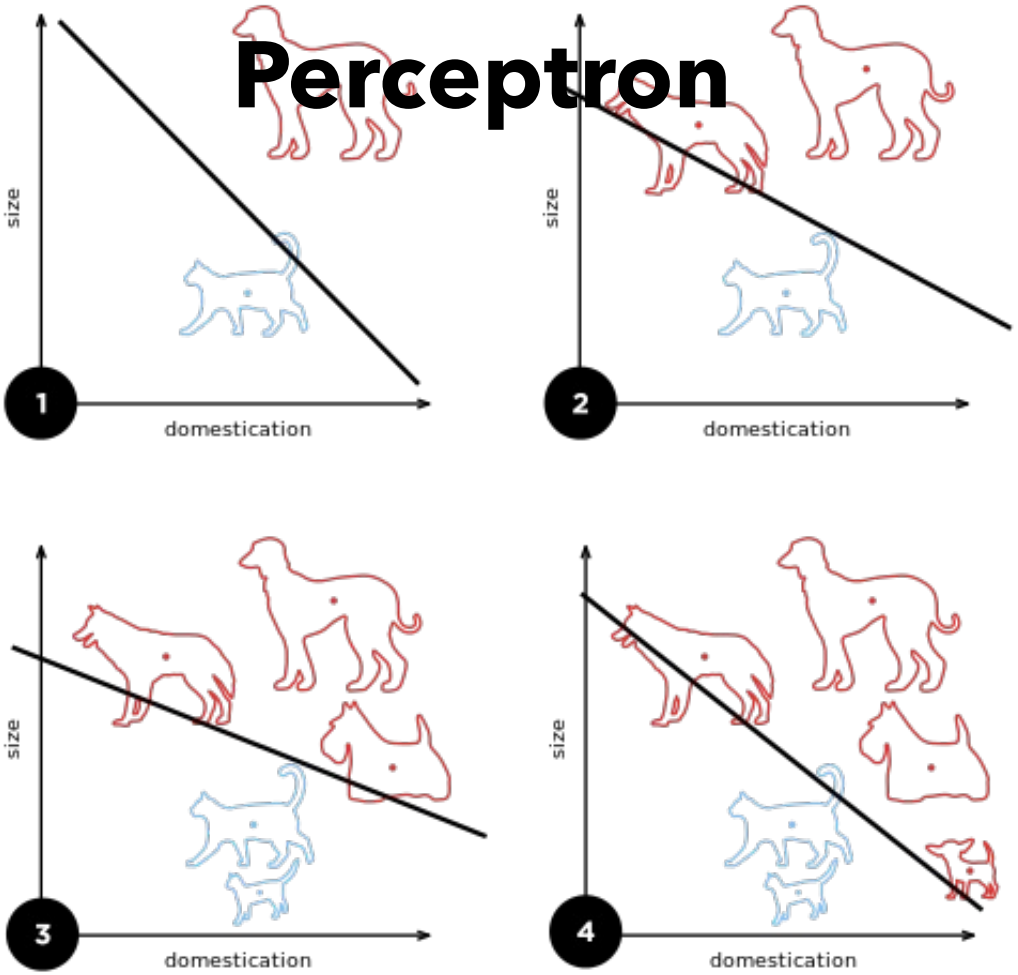



input layer
hidden layer 1
hidden layer 2
output layer

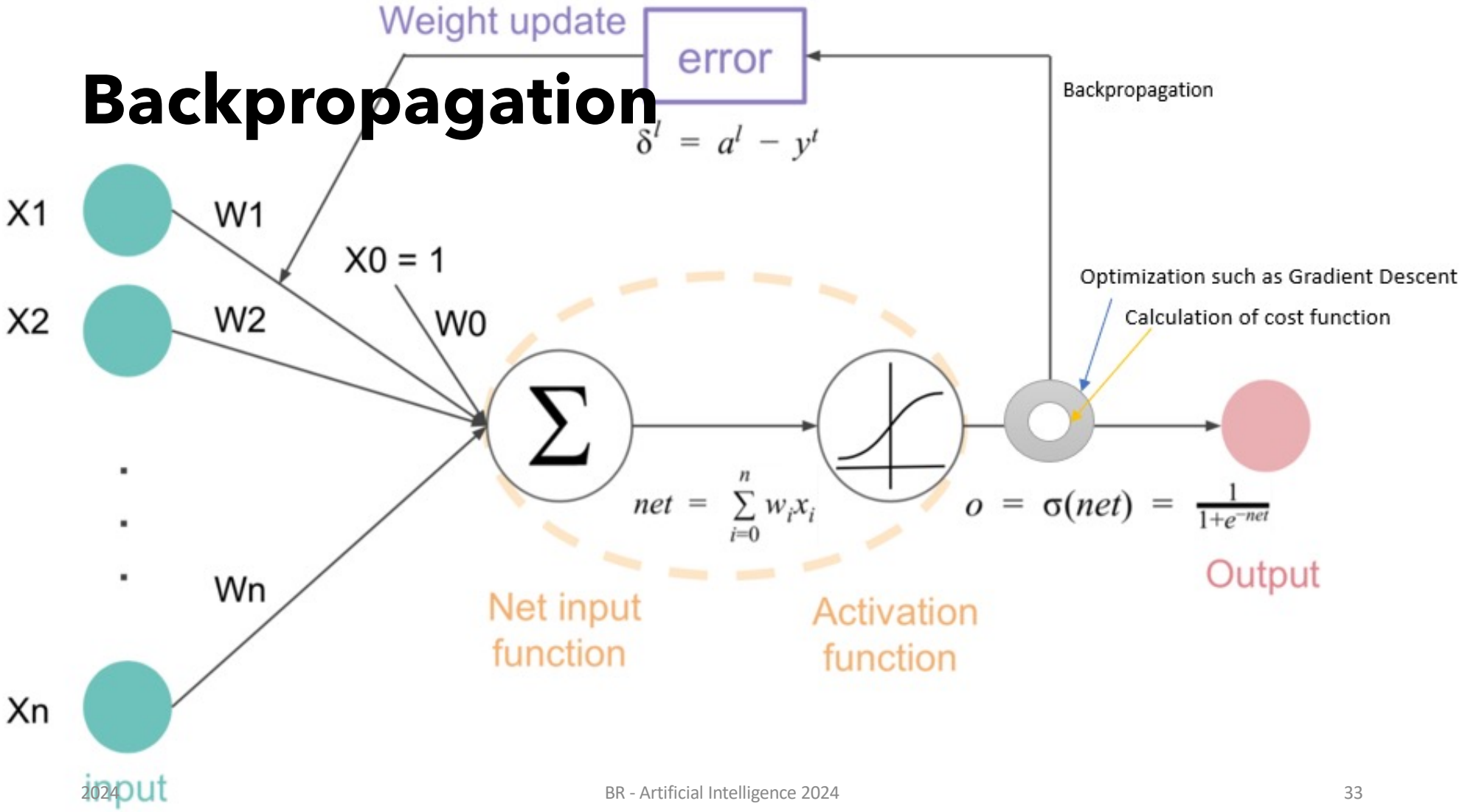


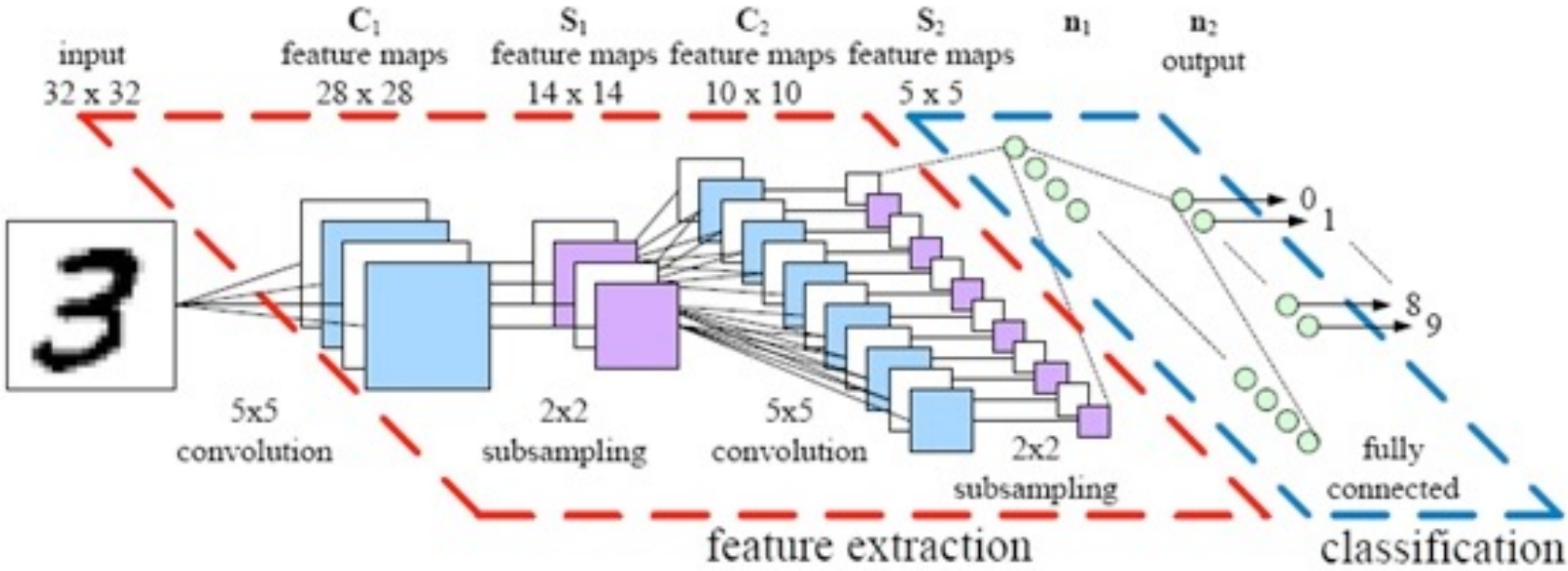
https://medium.com/analytics-vidhya/the-shortest-introduction-to-deep-learning-you-will-find-on-the-web-25a9975bbe1d

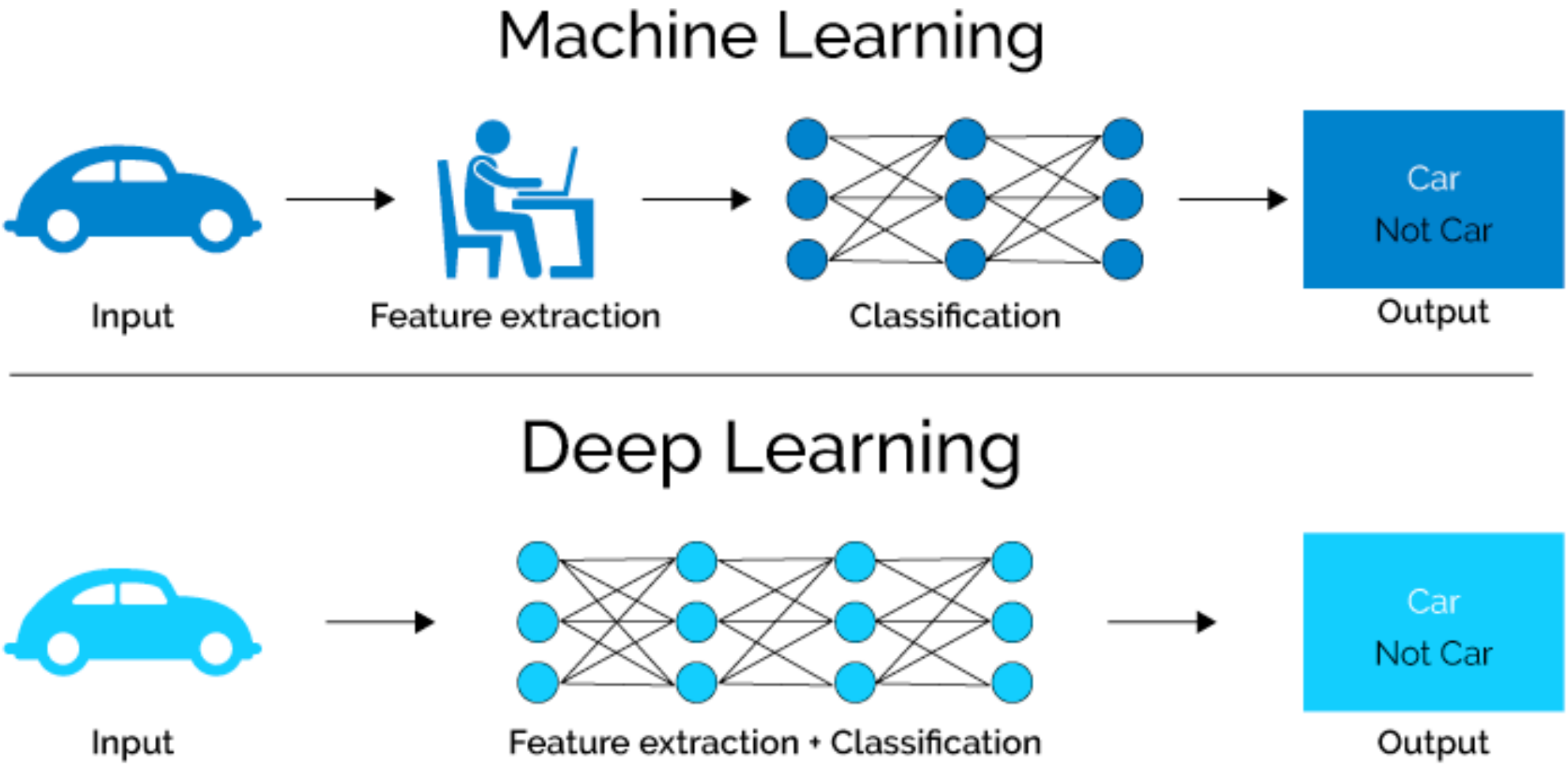
Perceptron

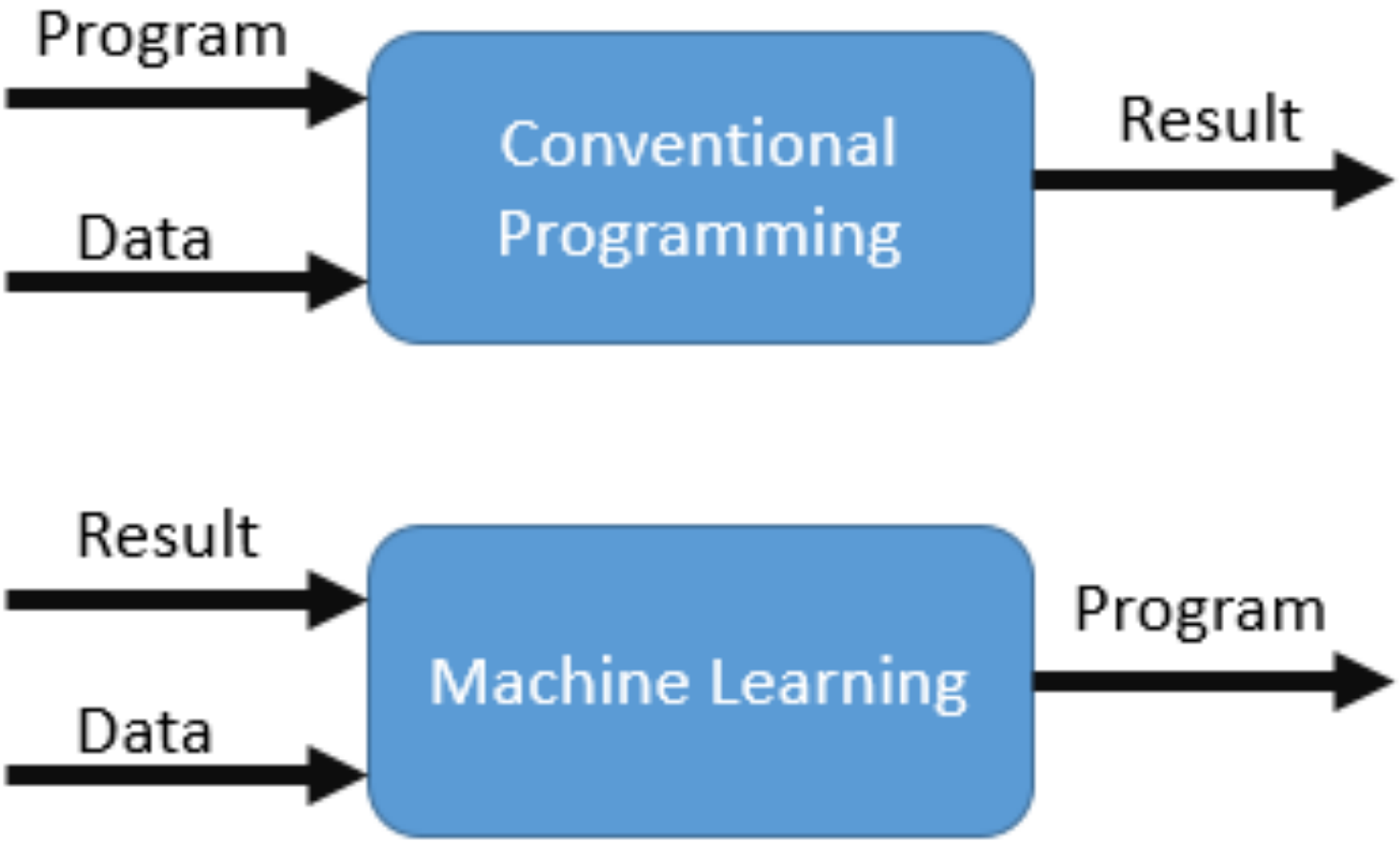

size
1
domestication
size
2
domestication
size
3
domestication
size
4
domestication

Backpropagation




input
32 x 32
C1
feature maps
28 x 28
S1
feature maps
14 x 14
C2
feature maps
10 x 10
S2
feature maps
5 x 5
n1
n2
output
0
1
8
9
5x5
convolution
2x2
subsampling
5x5
convolution
2x2
subsampling
fully
connected
feature extraction
classification


Machine Learning
Input
Feature extraction
Classification
Car
Not Car
Output
Deep Learning
Input
Feature extraction + Classification
Car
Not Car
Output



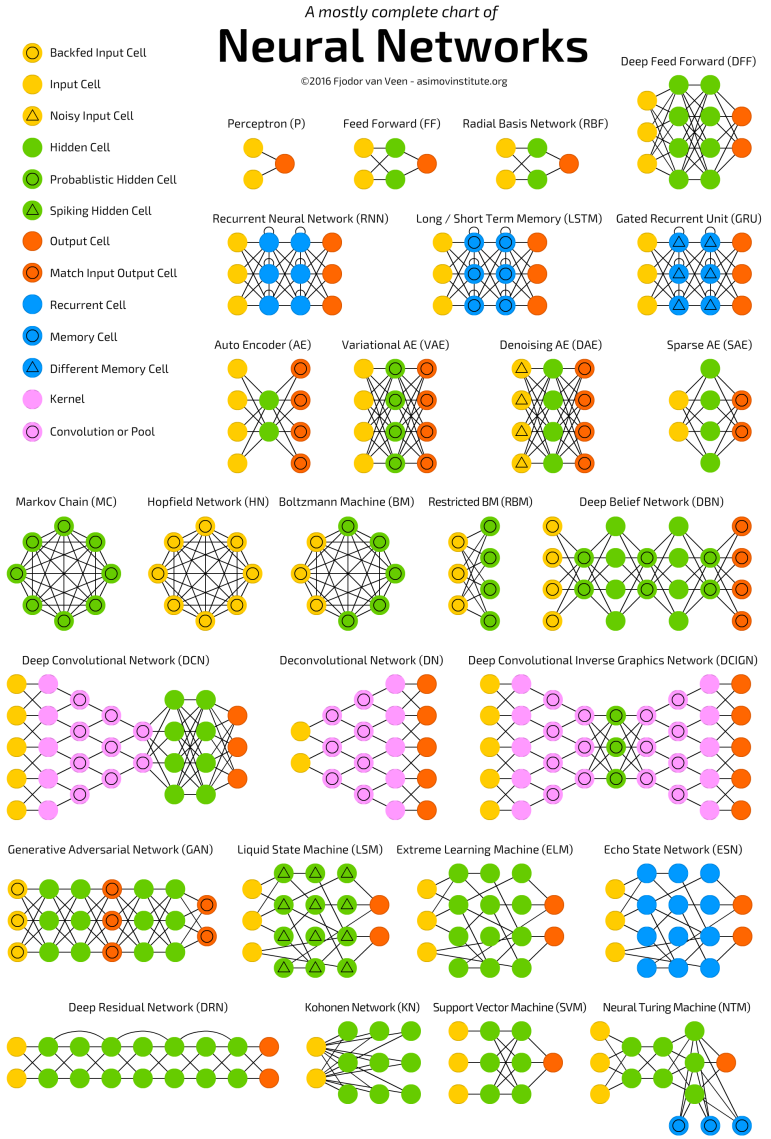
https://medium.com/@rstefanus16/conventional-programming-vs-machine-learning-a3b7b3425531

The Core of Deep Learning

- **Architecture**
  - The connections of neurons, layers, ...
  - Still an art, educated guess
  - Algorithm(s) used for training: back propagation
- **Dataset**
  - The data used for training & testing

Core of AI/ Machine Learning/ Deep Learning

- Architecture
- Data set



Programming Languages: model creation

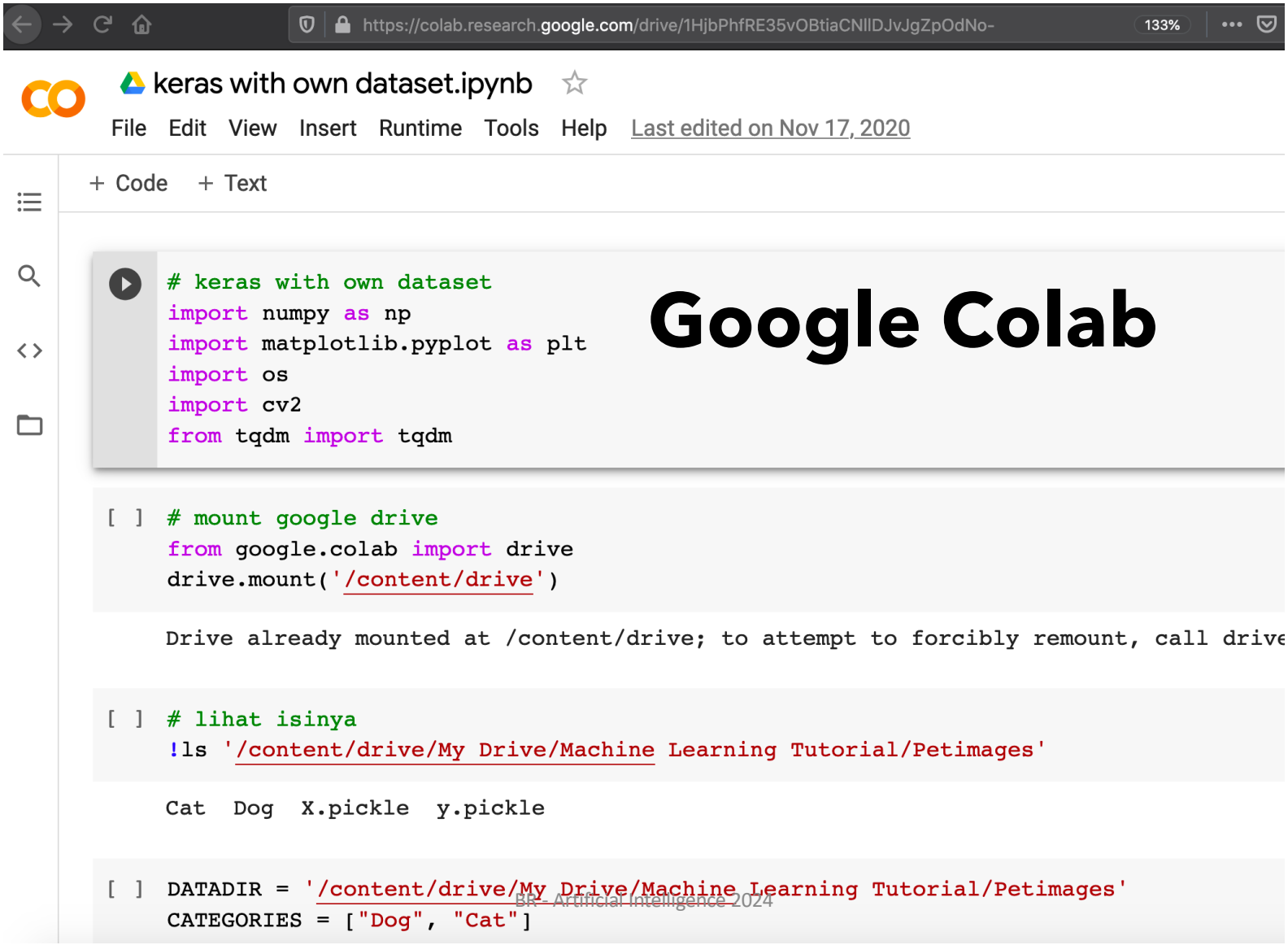
- Lisp
- Prolog
- C/C++
- Java
- **Python**

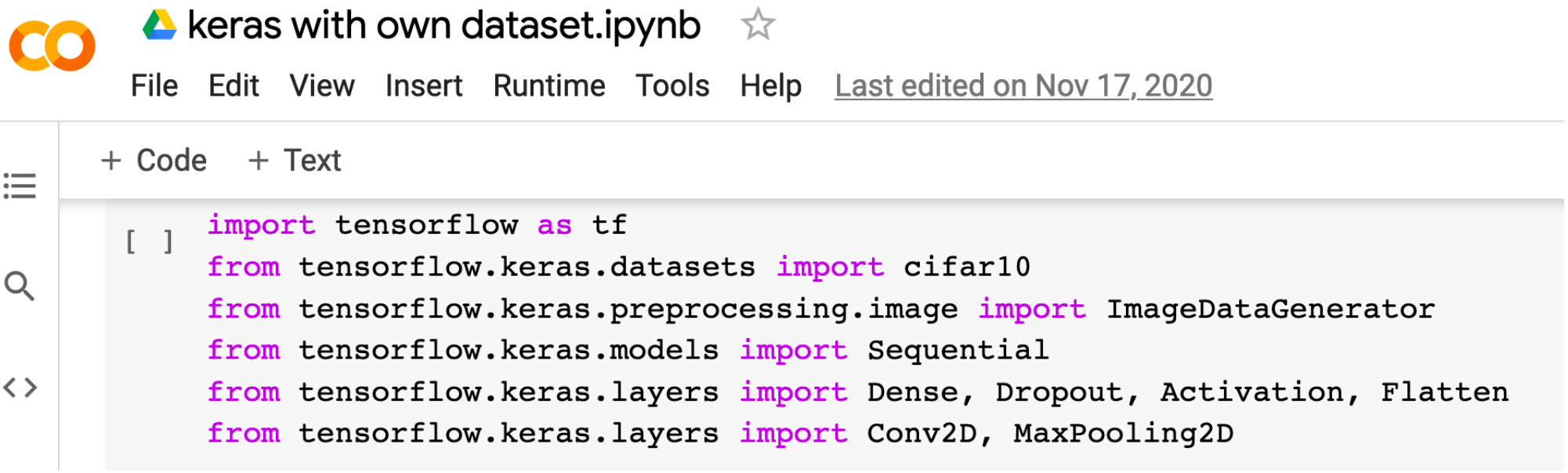
Libraries

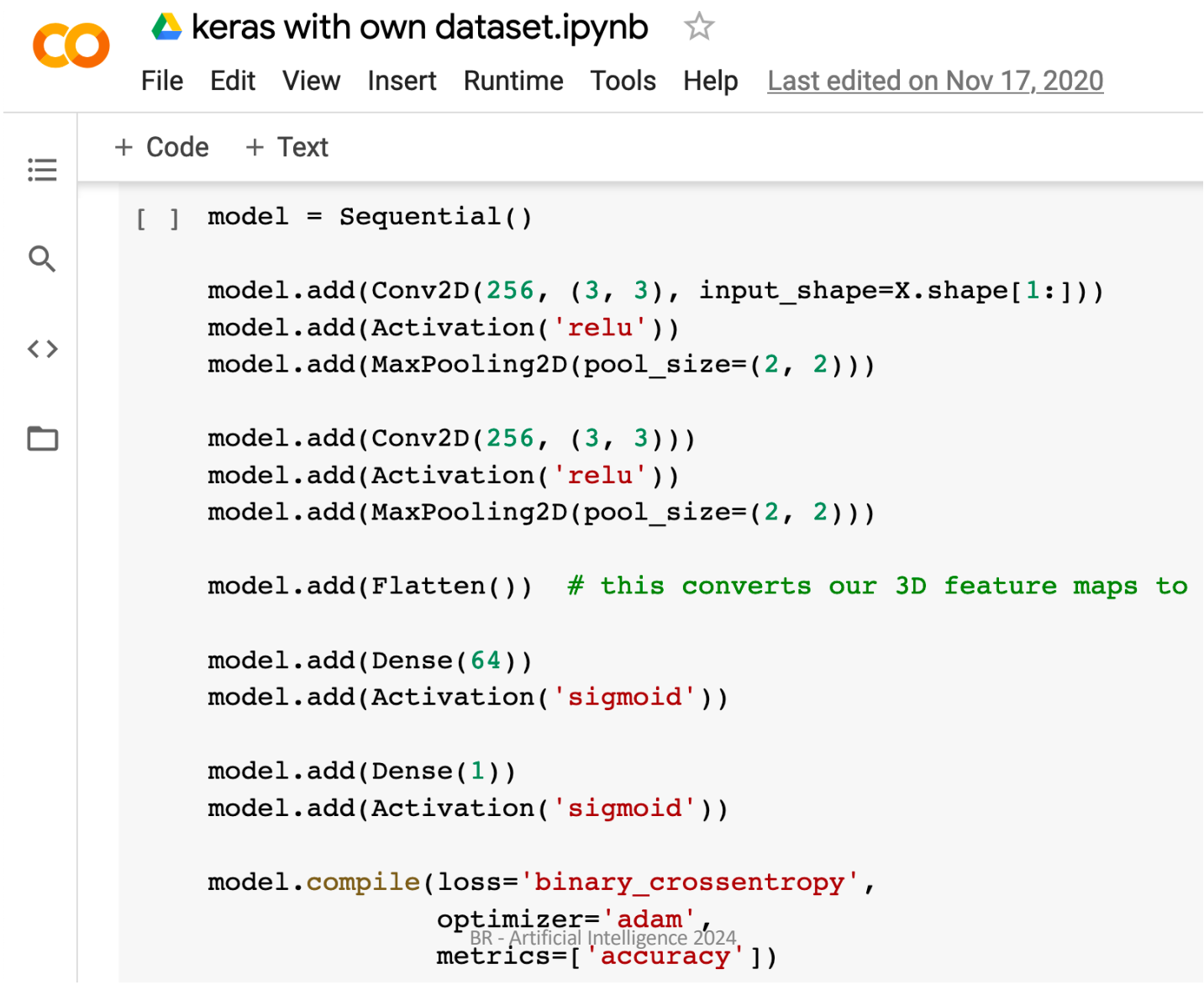
- Tensorflow
- Keras
- Apache MXnet: library for deep learning
- Other libraries ...

Deep learning for humans.

Keras is an API designed for human beings, not machines. Keras follows best practices for reducing cognitive load: it offers consistent & simple APIs, it minimizes the number of user actions required for common use cases, and it provides clear & actionable error messages.


https://colab.research.google.com/drive/1HjbPhfRE35vOBtiaCNllDJvJgZpOdNo-
133%
keras with own dataset.ipynb
File Edit View Insert Runtime Tools Help Last edited on Nov 17, 2020
+ Code + Text
# keras with own dataset
import numpy as np
import matplotlib.pyplot as plt
import os
import cv2
from tqdm import tqdm
Google Colab
[ ] # mount google drive
from google.colab import drive
drive.mount('/content/drive')
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive
[ ] # lihat isinya
!ls '/content/drive/My Drive/Machine Learning Tutorial/Petimages'
Cat Dog X.pickle y.pickle
[ ] DATADIR = '/content/drive/My Drive/Machine Learning Tutorial/Petimages'
CATEGORIES = ["Dog", "Cat"]


keras with own dataset.ipynb
File Edit View Insert Runtime Tools Help Last edited on Nov 17, 2020
+ Code + Text
[ ]
import tensorflow as tf
from tensorflow.keras.datasets import cifar10
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout, Activation, Flatten
from tensorflow.keras.layers import Conv2D, MaxPooling2D


keras with own dataset.ipynb
File Edit View Insert Runtime Tools Help Last edited on Nov 17, 2020
+ Code + Text
[ ] model = Sequential()
model.add(Conv2D(256, (3, 3), input_shape=X.shape[1:]))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Conv2D(256, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Flatten()) # this converts our 3D feature maps to
model.add(Dense(64))
model.add(Activation('sigmoid'))
model.add(Dense(1))
model.add(Activation('sigmoid'))
model.compile(loss='binary_crossentropy',
optimizer='adam',
metrics=['accuracy'])

Data Set (Examples)

- ImageNet (image-net.org)
  - the de facto image datases
- MS COCO
  - generic image understanding captioning

data set creation & management

- crawlers: python
- image processing: python, C++, OpenCV libraries, and also use machine learning libraries
- database: python, golang

Inferencing: Application

- Input: Model + data input
- Output: Prediction
  - Class the input belongs to
  - Probability

Kebutuhan AI

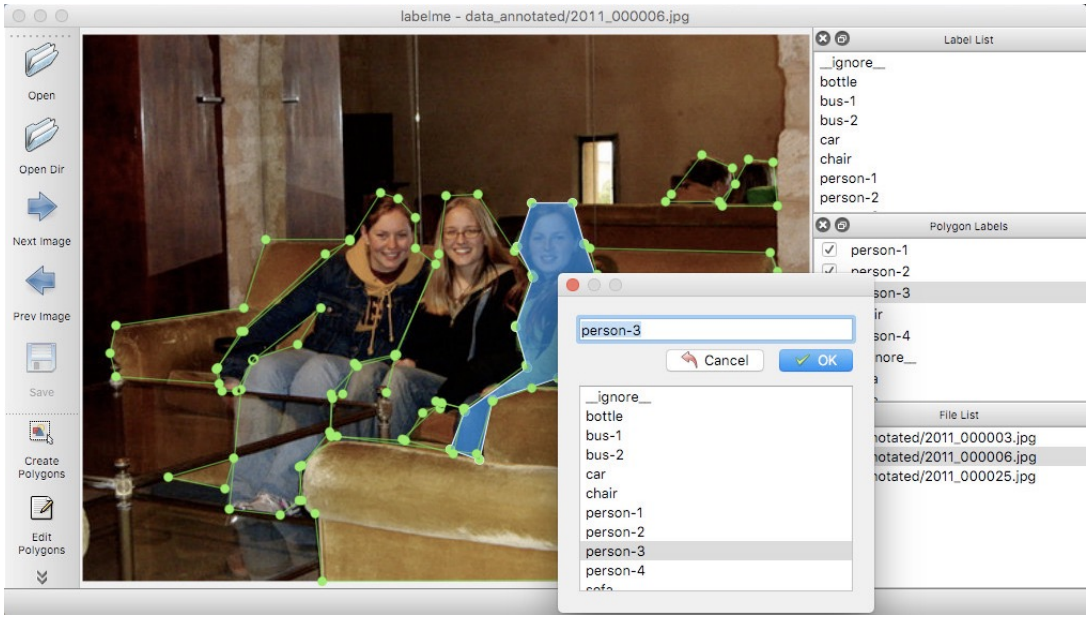
- Infrastruktur komputasi
  - Solusi: Bekerjasama dengan penyedia jasa & produk komputasi
- Data set
  - Peneliti (researcher) @ kampus
  - Perusahaan AI
  - ...
  - SMK AI

Kasus: Image & Video Analysis

Kebutuhan Data Set

- Dalam *image & video analysis*, dibutuhkan data set dalam bentuk video dan foto dalam jumlah yang banyak
- Foto obyek tertentu harus dikumpulkan dan ditandai (tag, label)
- Sudah ada beberapa tempat yang menyediakan data set umum, tetapi untuk dataset yang khusus tidak tersedia
  - Masalah peraturan / hukum, misalnya terkait dengan kerahasiaan / privasi dari data
  - Data karyawan, pelanggan, siswa, ...

Anotasi Data



https://github.com/wkentaro/labelme

Contoh di China

www.xinhuanet.com/english/2019-01/17/c_137752154.htm

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www.news.cn 新华网 NEWS www.xinhuanet.com XINHUANET Thursday, J

China Focus: Data-labeling: the human power behind Artificial Intelligence

Source: Xinhua | 2019-01-17 20:42:21 | Editor: ZX

BEIJING, Jan. 17 (Xinhua) -- In a five-story building on the outskirts of Beijing, 22-year-old Zhang Yusen stares at a computer screen, carefully drawing boxes around cars in street photos.

As artificial voices replace human customer services in call centers and robots replace workers on production lines, Zhang, a vocational school graduate, has found a steady job: data-labeling, a new industry laying the groundwork for the development of AI technologies.

- Contoh yang dapat dilakukan oleh lulusan SMK AI
- *ImageNet is one of the world's largest visual databases designed to train AI systems to see. According to its inventors, it took nearly 50,000 people in 167 countries and regions to clean, sort and label nearly a billion images over more than three years.*

http://www.xinhuanet.com/english/2019-01/17/c_137752154.htm

Kebutuhan Skill Set

- Mengoperasikan komputer
  - Filing: menyimpan berkas dengan tertata, bagaimana mengorganisir foto dalam jumlah ribuan? (penamaan berkas? direktori? database?)
  - Menjalankan program dengan dataset tertentu dan melaporkan hasilnya
  - Melakukan proses backup / archiving
- Internet research
  - Mencari data di internet (misal, mencari foto / video dengan kriteria tertentu)
- Mengambil foto dengan baik
  - Photography

Kebutuhan Skill Set (2)

- Kemampuan image processing/manipulation
  - *Scale*, *crop*, ...
  - *File format conversion*
  - Tools (open source): imagemagick, krita, ...
- Melakukan *tag* / *label* / *annotate* data
- Optional
  - Kemampuan programming
    - membuat skrip / *batch* / otomatisasi untuk memproses data dalam jumlah yang banyak)
    - membuat program (python, tensorflow, ...)

Penutup

- AI memiliki potensi besar dalam berbagai bidang industri
- Masalah di depan bukan ”**Manusia vs. AI**” tapi “**Manusia vs. Manusia + AI**”
- Mampukah kita menjadi salah satu pemain dalam bidang AI ini? Ataukah kita hanya menjadi pasar?