IA et Anesthésie

>>> Speaker : R. Florquin

>>> Modérateur : P. Dony

>>> Société D’Anesthésie de Charleroi

>>> 19 mars 2025

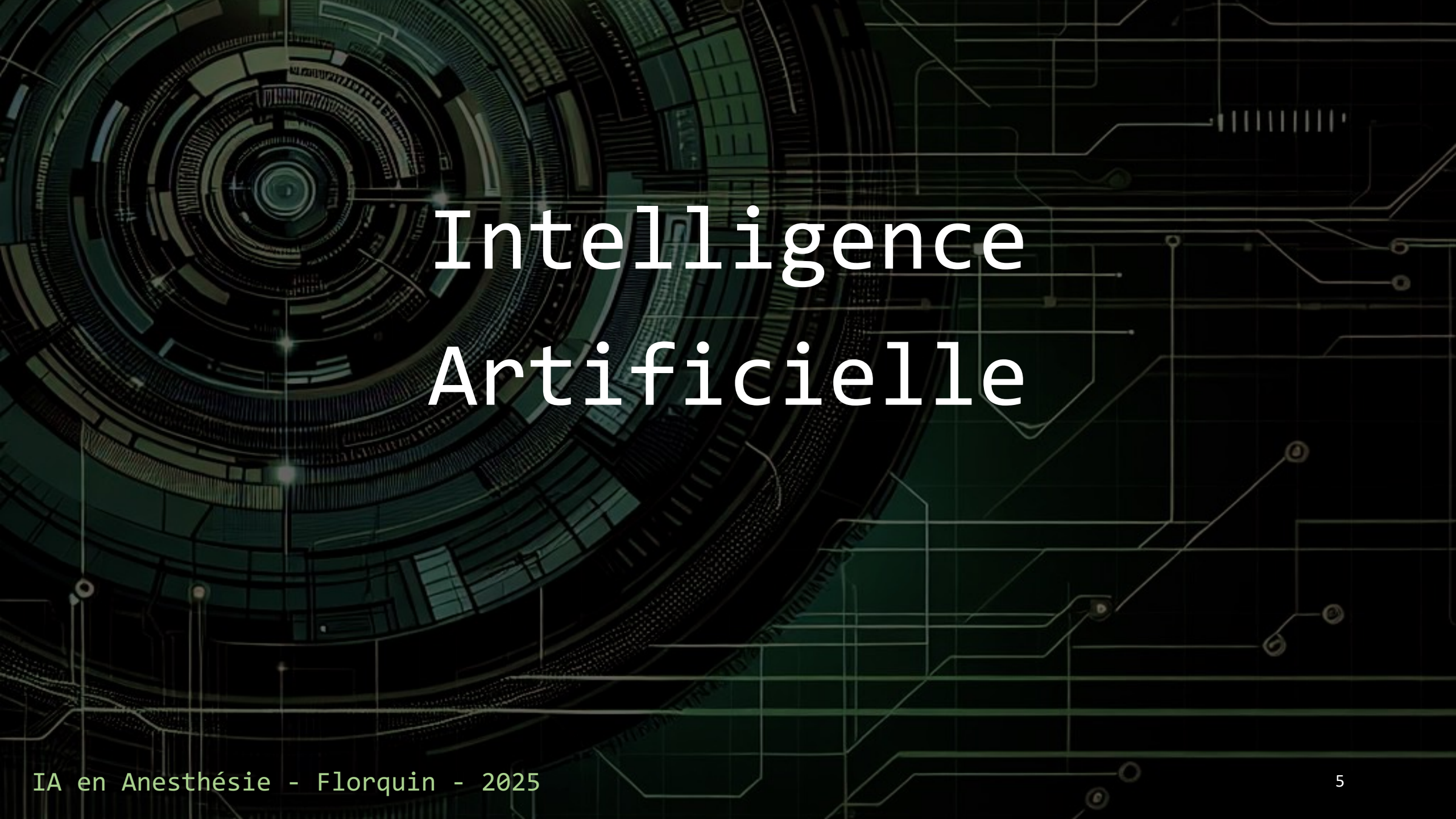
UMONS
Université de Mons

HUman

ULB
UNIVERSITÉ
LIBRE
DE BRUXELLES

CHU Saint-Pierre
UMC Sint-Pieter

>>> Nothing_To_Declare


Intelligence
Artificielle

L’étude des agents qui percoivent leur environnement et effectuent des actions

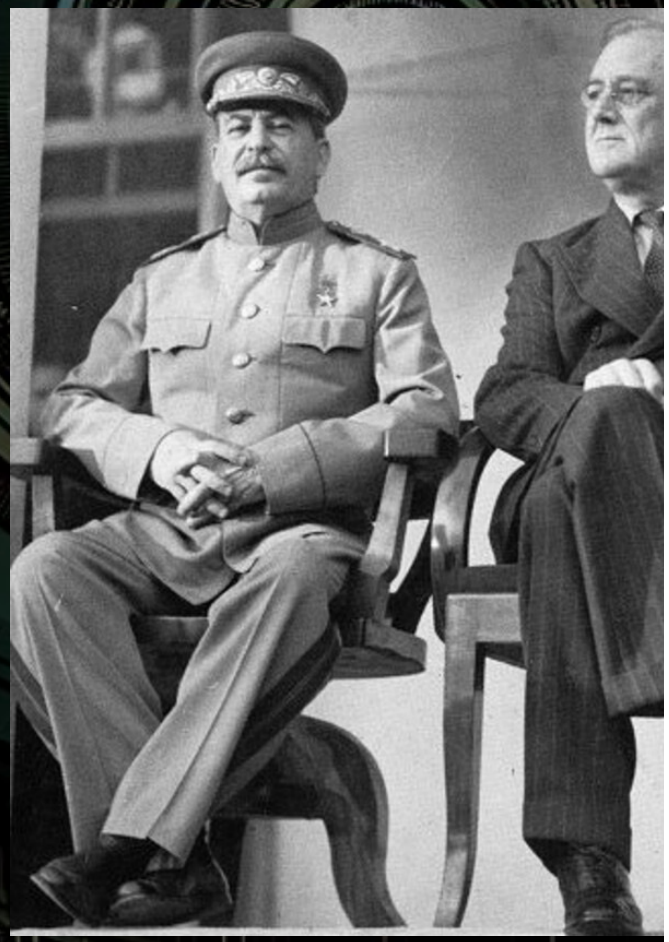
Russell, S. & Norvig, P. (2021). *Artificial Intelligence, Global Edition*. (4th ed.). Pearson Education. https://elibrary.pearson.de/book/99.150005/9781292401171

A = avant 1960

B = 1960 - 1970

C = 1970 – 1980

D = 1980 – 1990



BULLETIN OF
MATHEMATICAL BIOPHYSICS
VOLUME 5, 1943

A LOGICAL CALCULUS OF THE IDEAS IMMANENT IN NERVOUS ACTIVITY

WARREN S. MCCULLOCH AND WALTER PITTS

FROM THE UNIVERSITY OF ILLINOIS, COLLEGE OF MEDICINE,
DEPARTMENT OF PSYCHIATRY AT THE ILLINOIS NEUROPSYCHIATRIC INSTITUTE,
AND THE UNIVERSITY OF CHICAGO

Because of the "all-or-none" character of nervous activity, neural events and the relations among them can be treated by means of propositional logic. It is found that the behavior of every net can be described in these terms, with the addition of more complicated logical means for nets containing circles; and that for any logical expression satisfying certain conditions, one can find a net behaving in the fashion it describes. It is shown that many particular choices among possible neurophysiological assumptions are equivalent, in the sense that for every net behaving under one assumption, there exists another net which behaves under the other and gives the same results, although perhaps not in the same time. Various applications of the calculus are discussed.

I. Introduction

Theoretical neurophysiology rests on certain cardinal assumptions. The nervous system is a net of neurons, each having a soma and an axon. Their adjunctions, or synapses, are always between the axon of one neuron and the soma of another. At any instant a neuron has some threshold, which excitation must exceed to initiate an impulse. This, except for the fact and the time of its occurrence, is determined by the neuron, not by the excitation. From the point of ex-

Global Information Storage Capacity

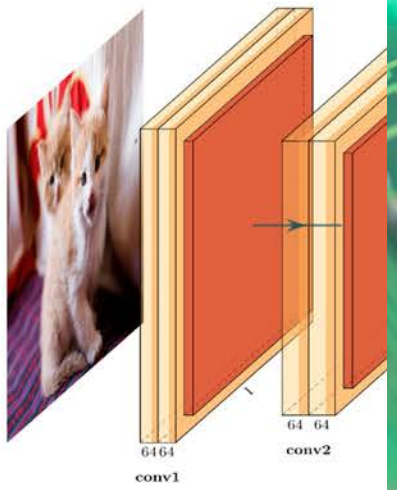
in optimally compressed bytes

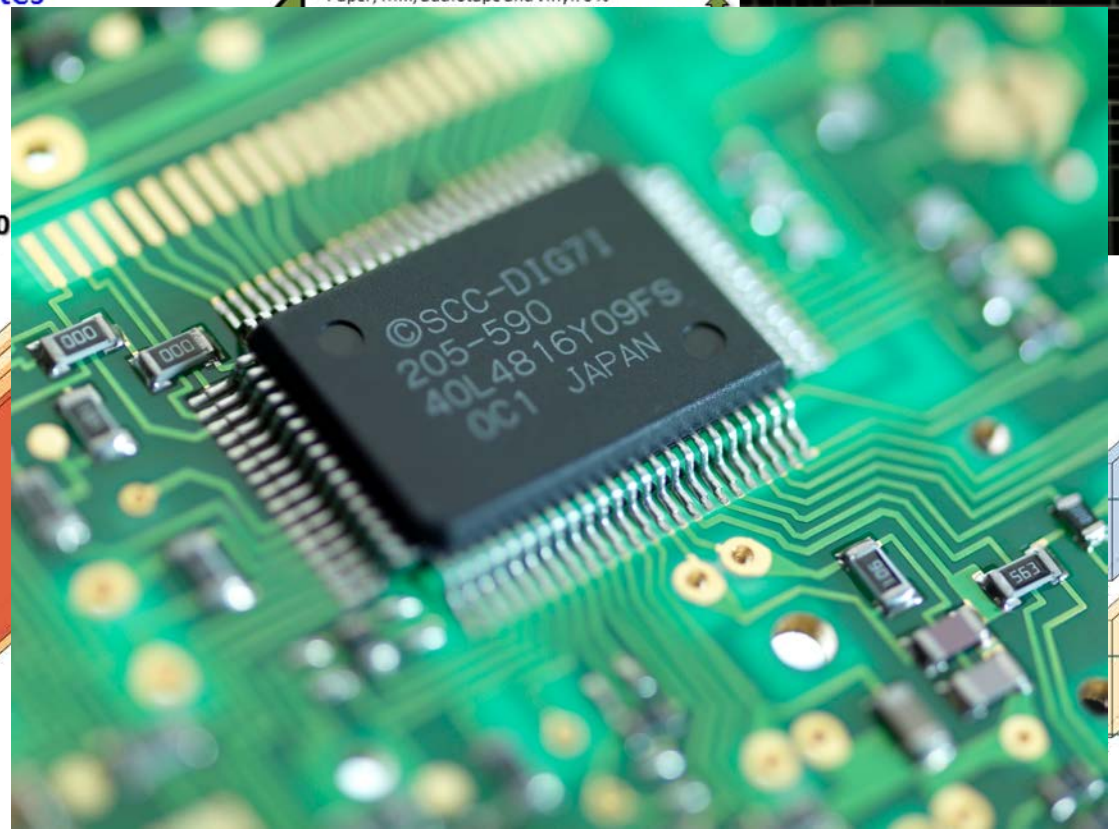
2007 ANALOG
19 exabytes
- Paper, film, audiotape and vinyl: 6 %

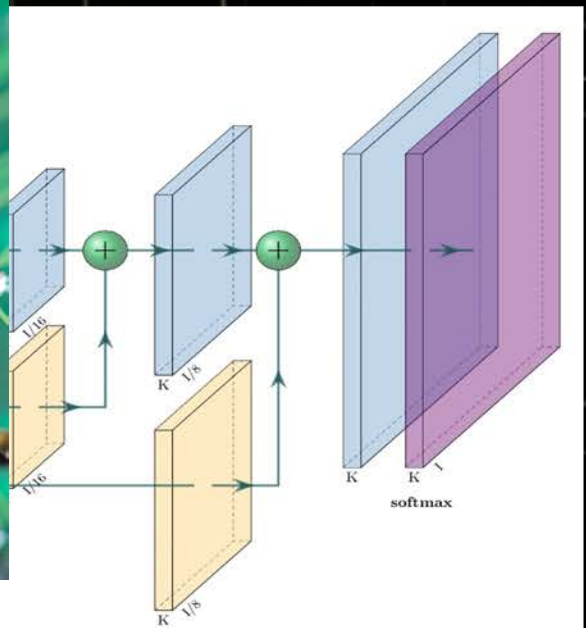
2000

1986
ANALOG
2.6 exabytes

DIGITAL
0.02 exabytes







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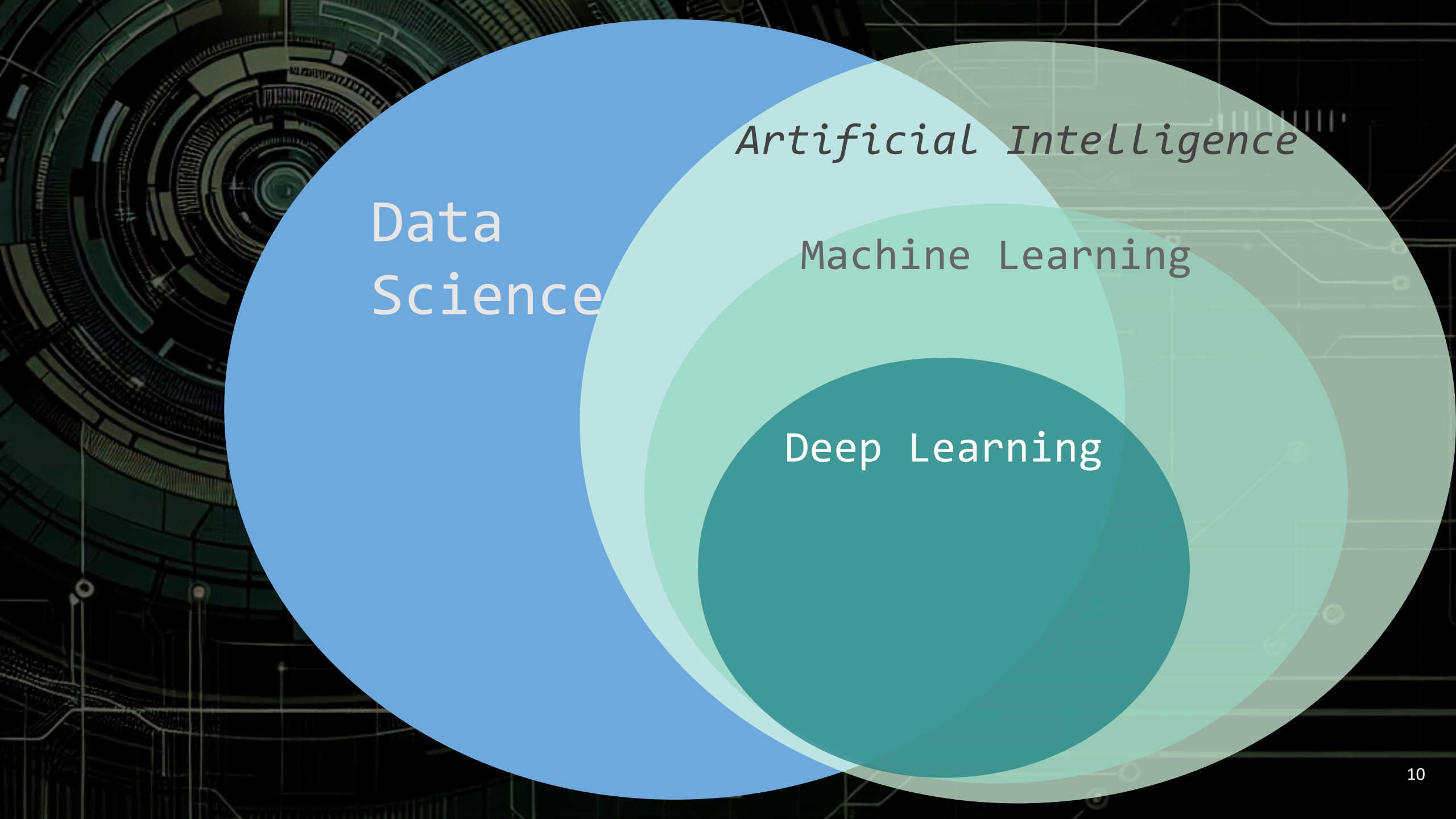
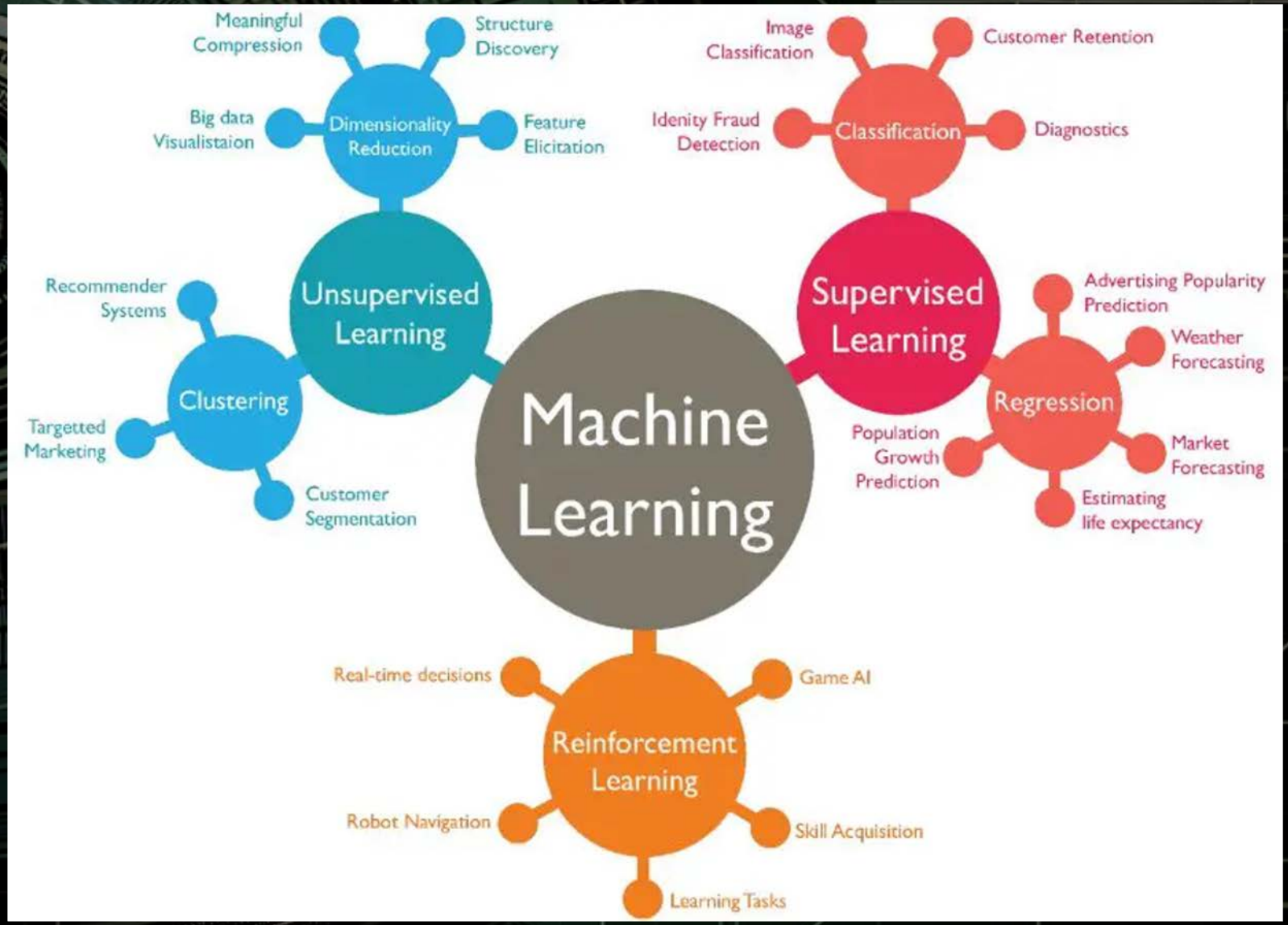
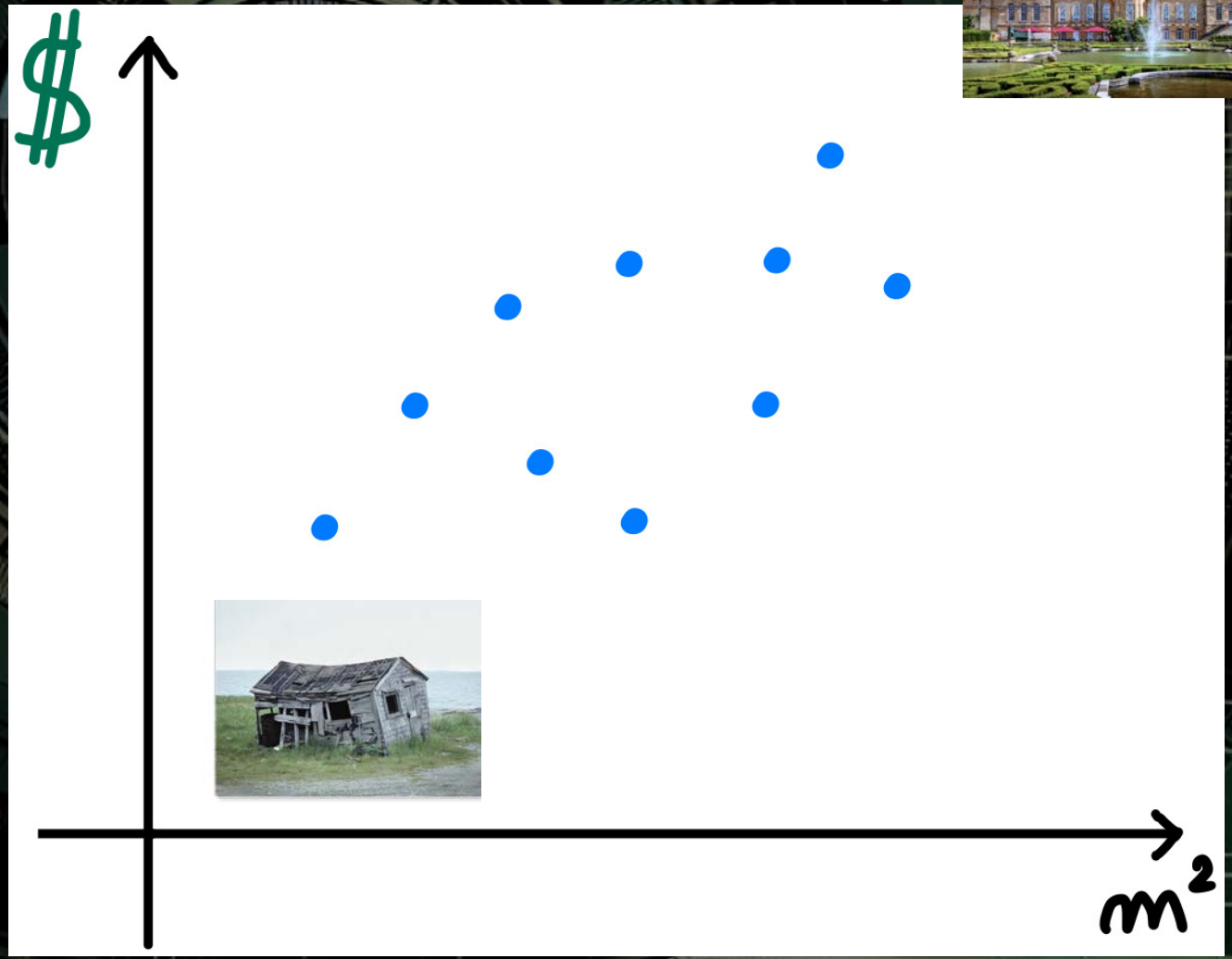
Source: Hilbert, M., & Lópe
Compute Information. *Science*, 332(6025), 60 –65. http://www.martinhilbert.net/WorldInfoCapacity.html

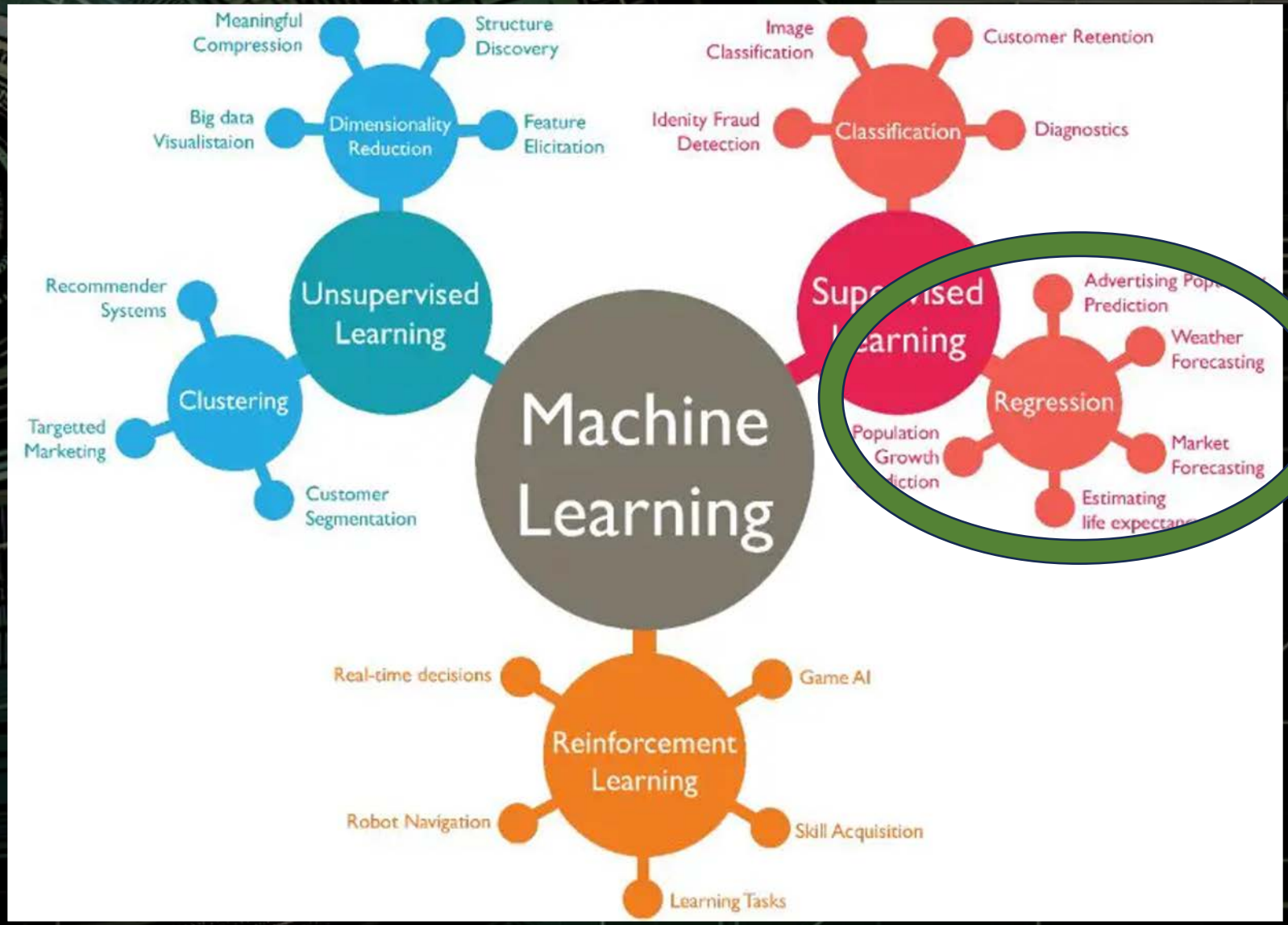

Artificial Intelligence
Data Science
Machine Learning
Deep Learning



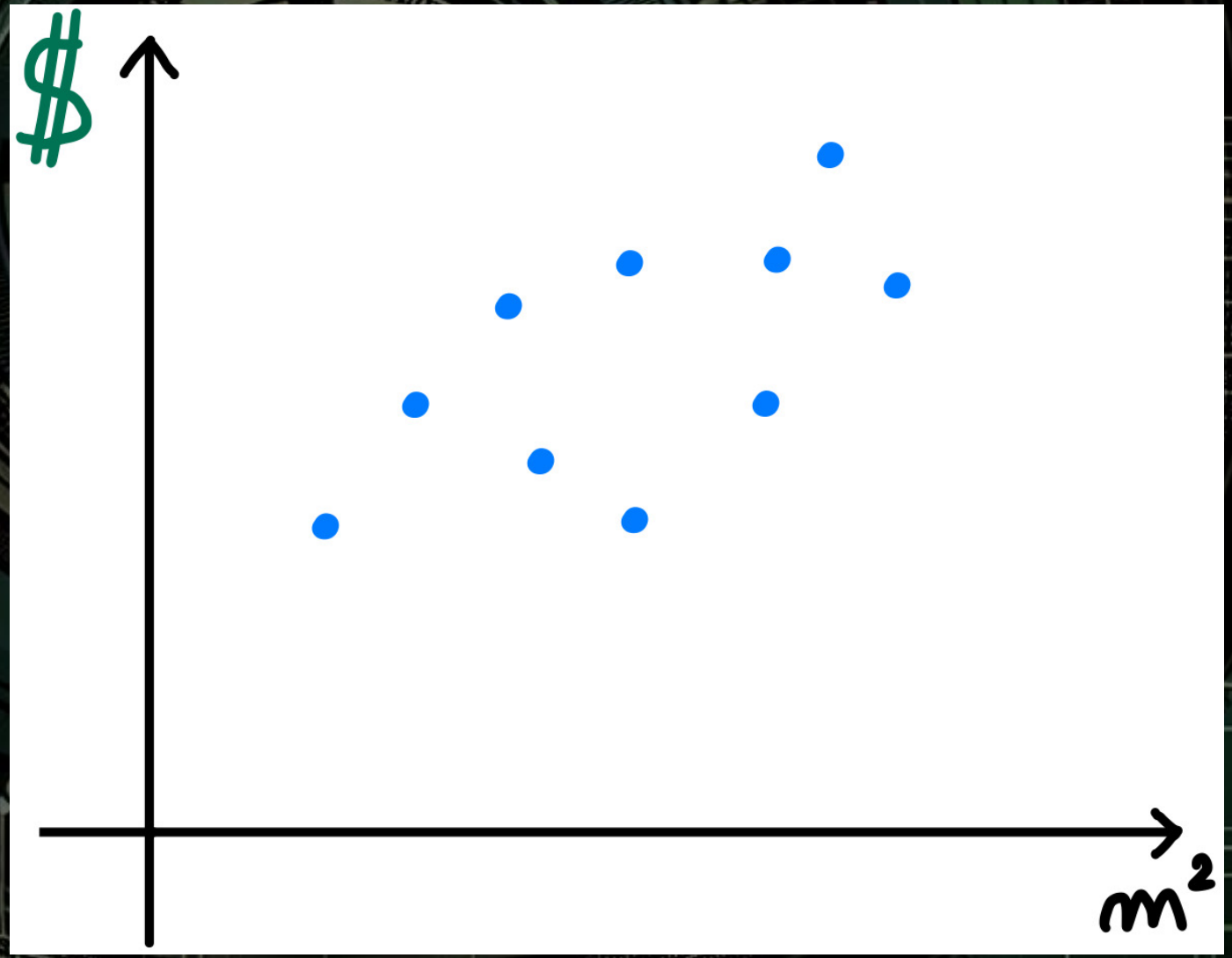
 Source Mactores Data Science team (2022)


FACOM


$
m²



 Source Mactores Data Science team (2022)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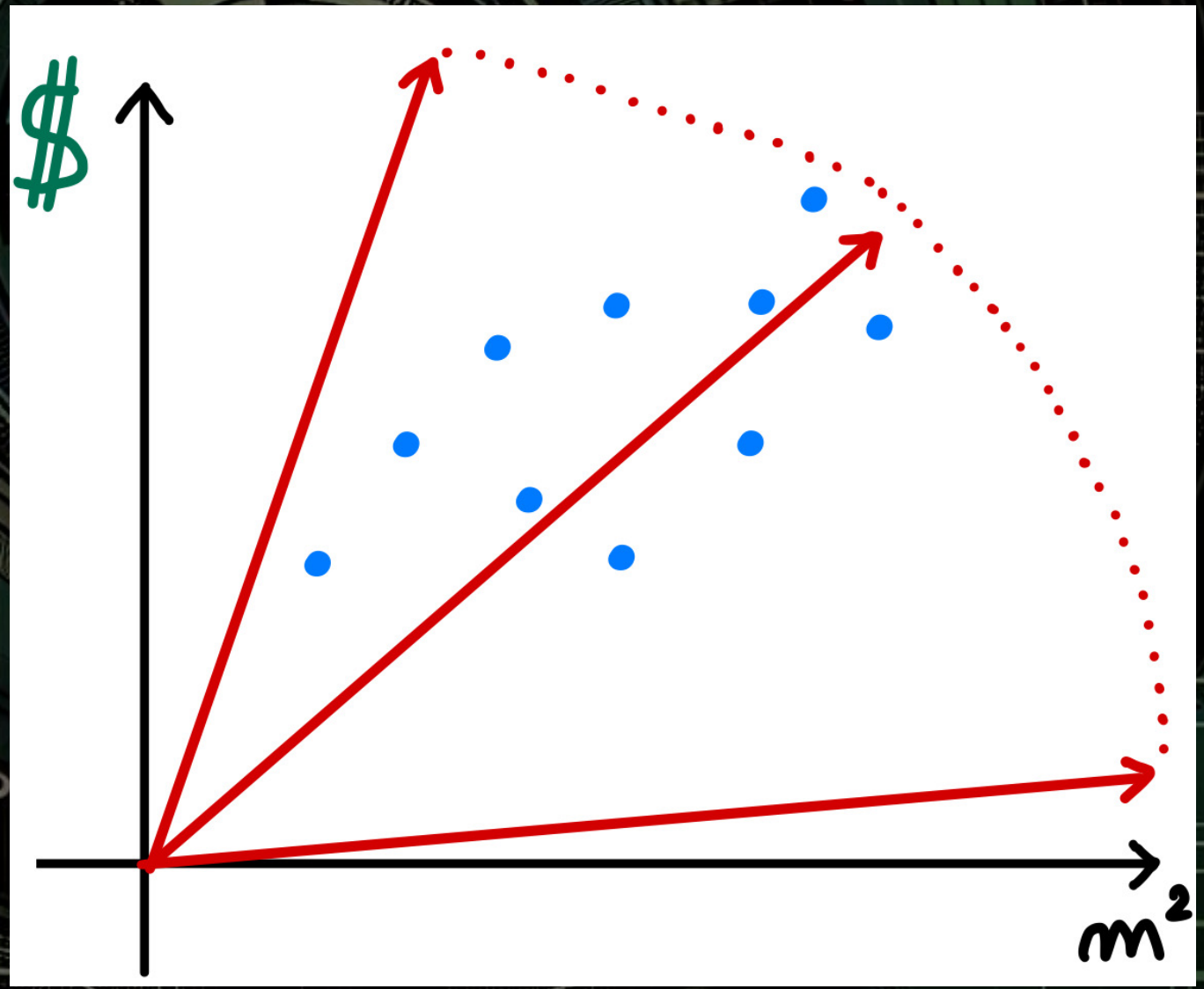
m²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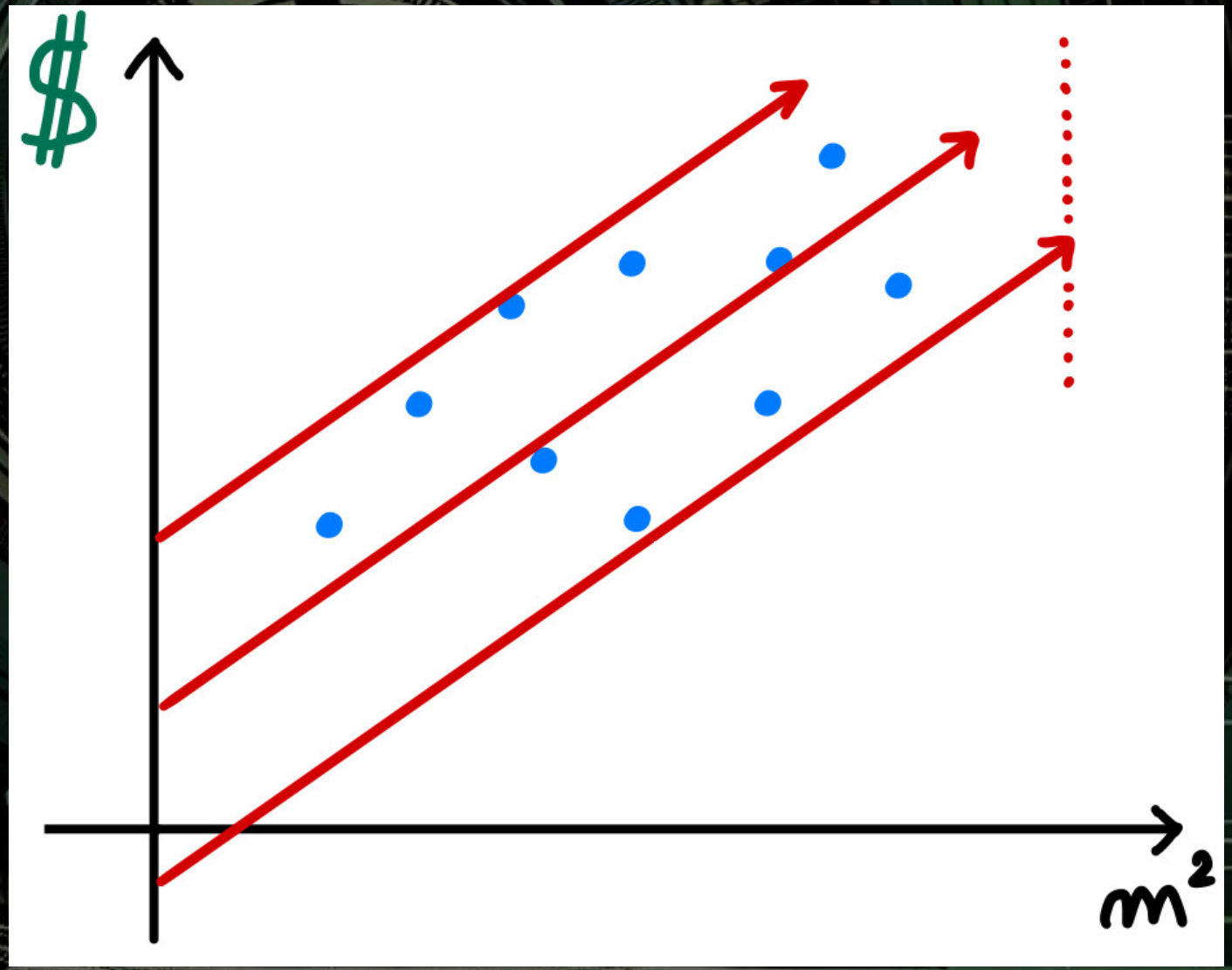
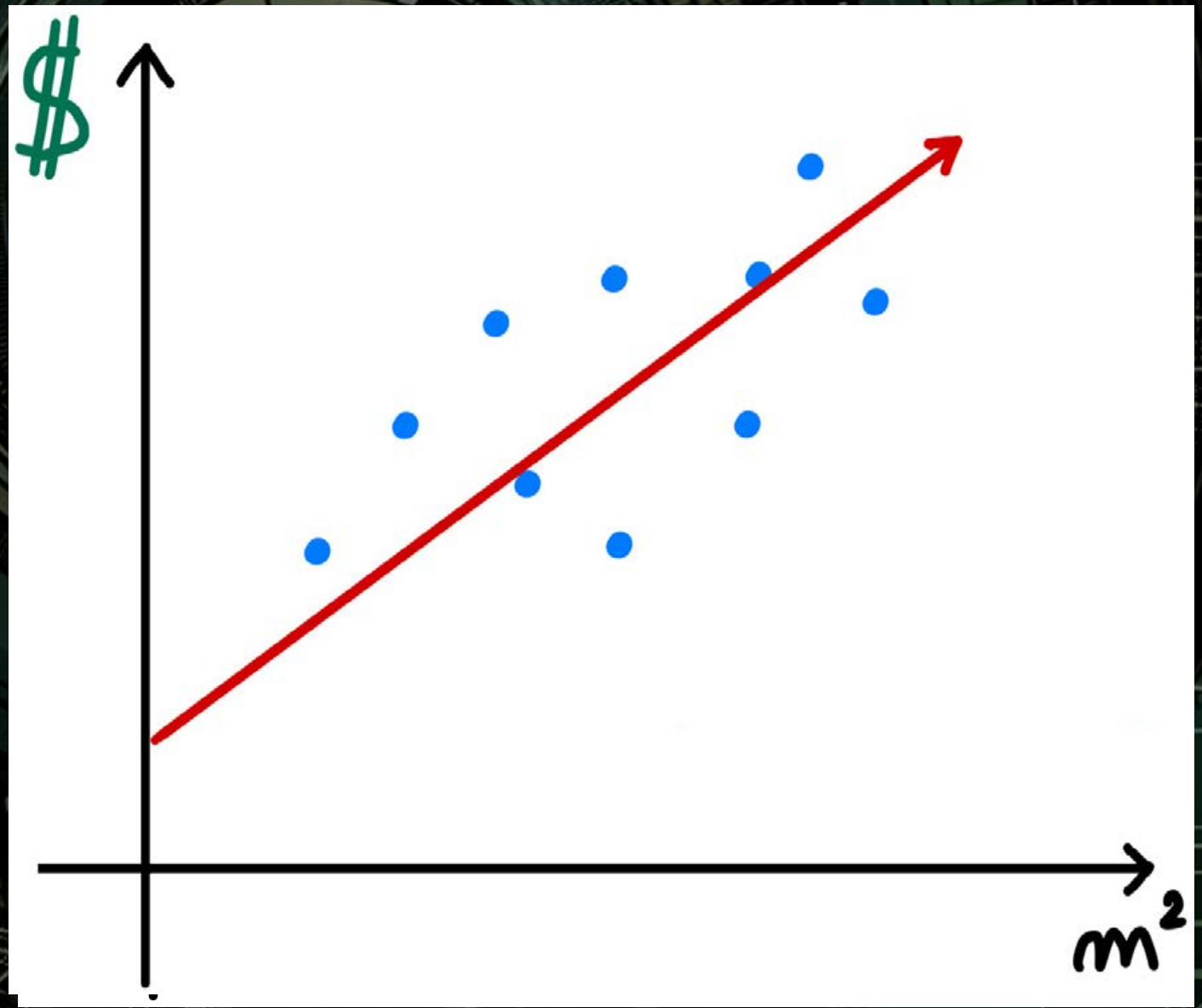
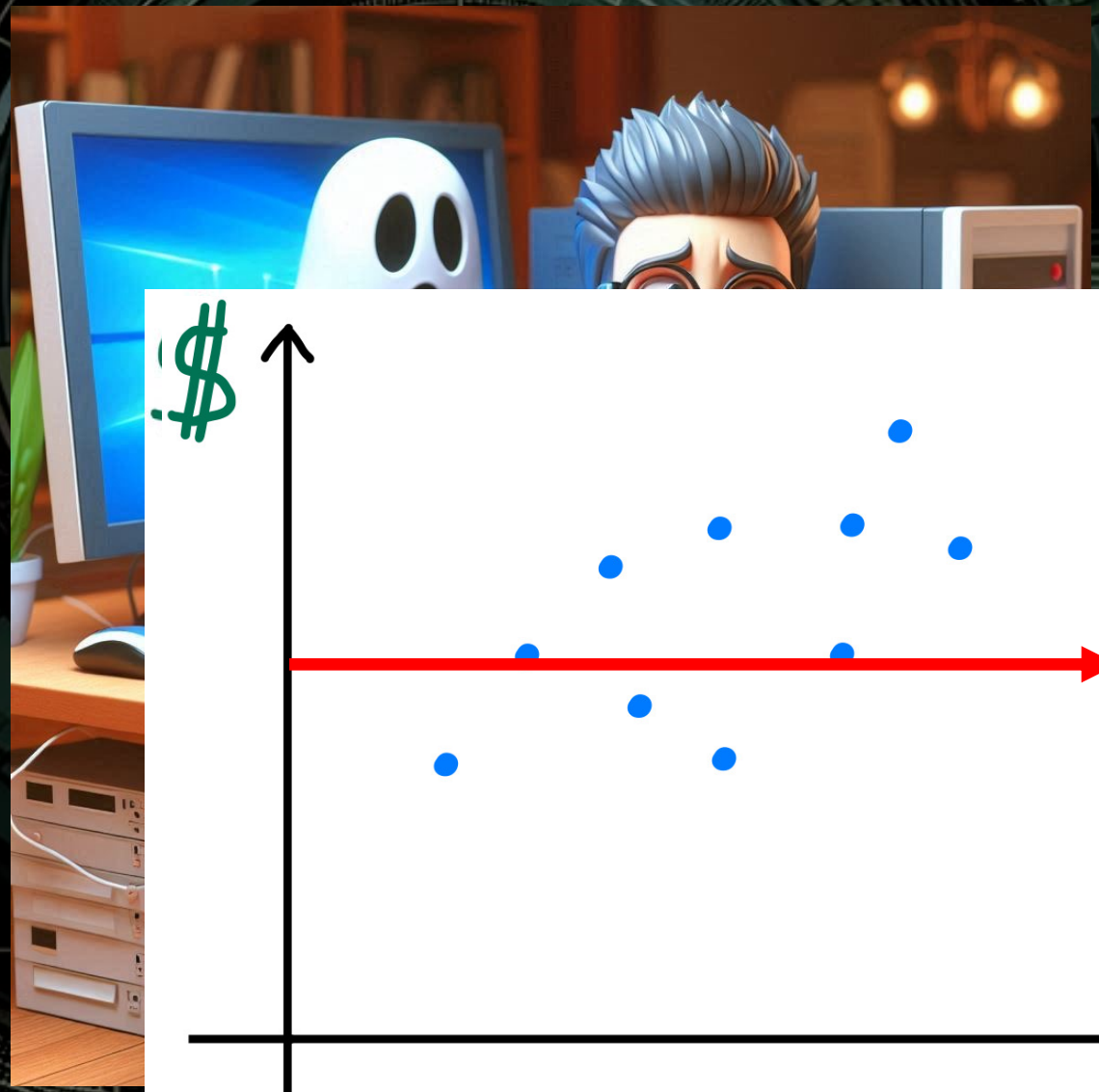

$
m²



$$\$ = a \,.\, m^2 + b$$

>>> Overfitting ("sur appris")



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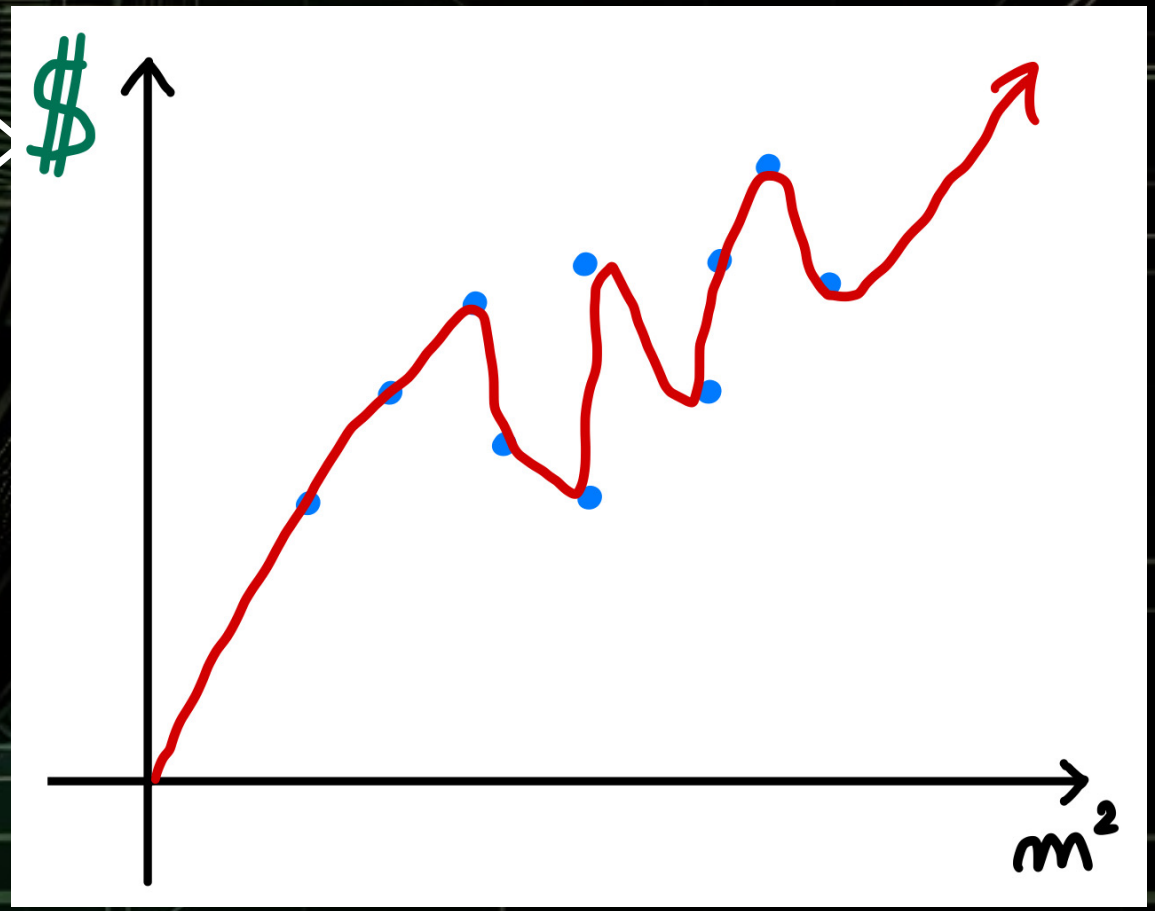
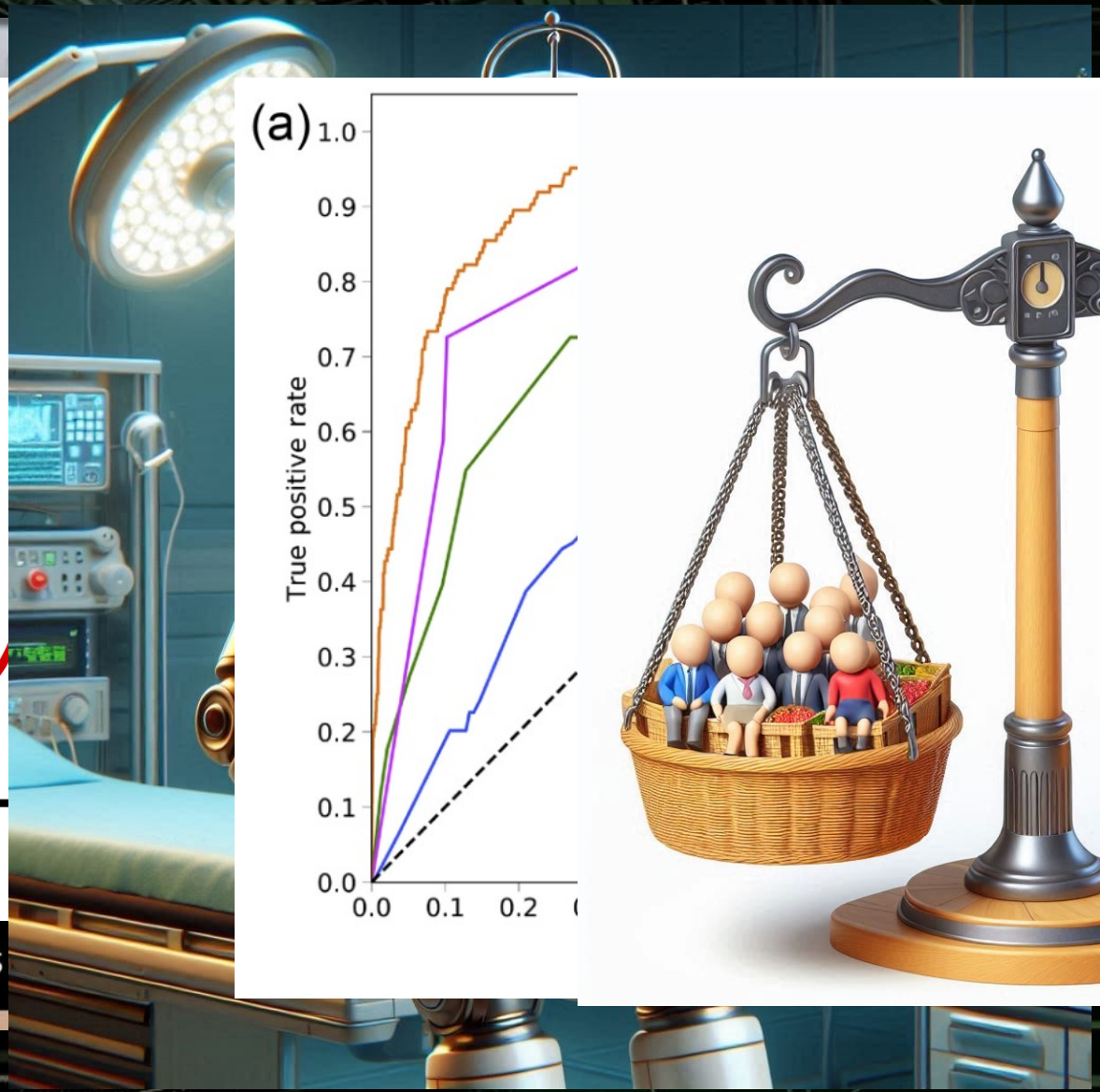
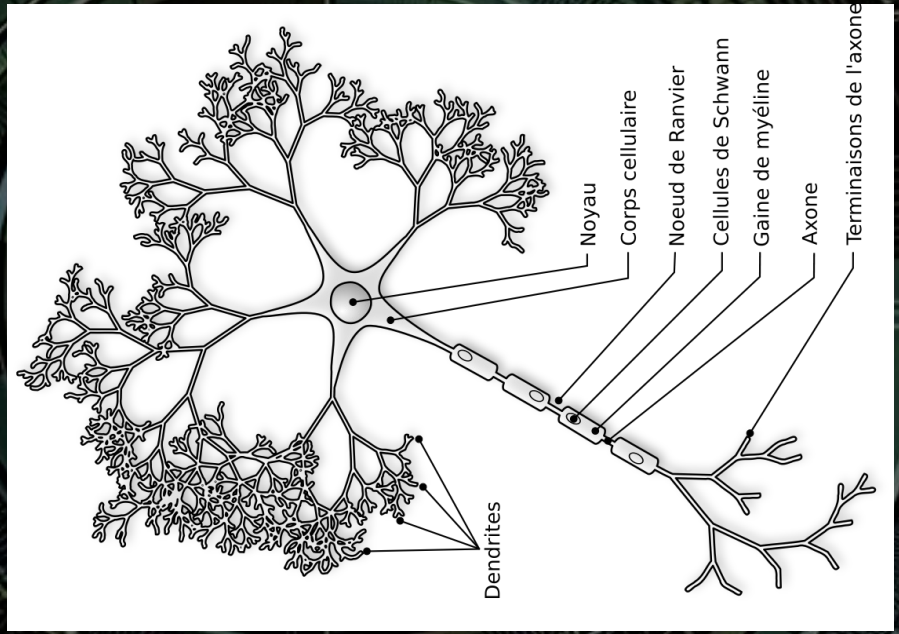


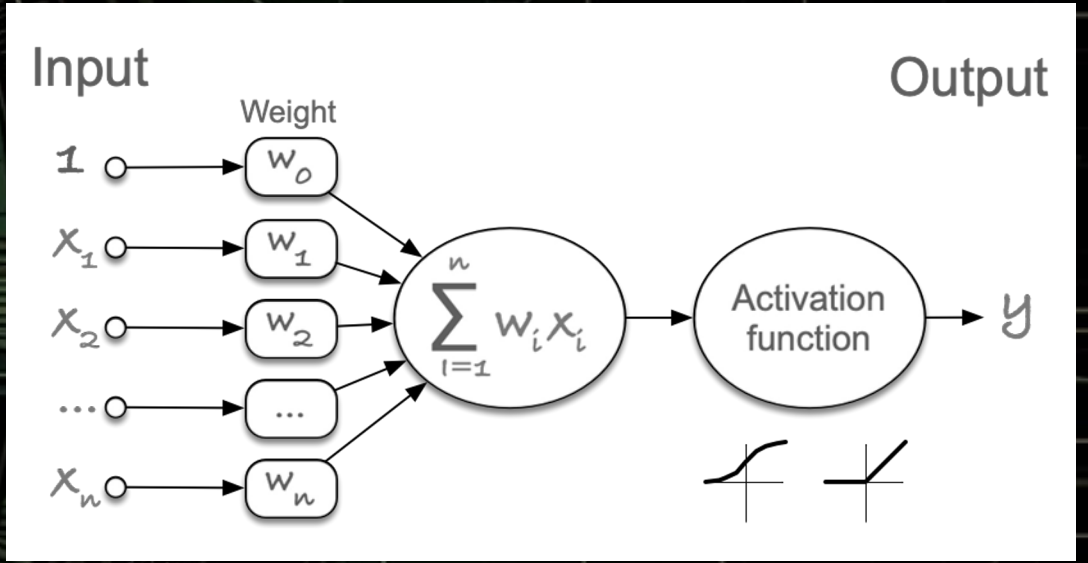

Data S

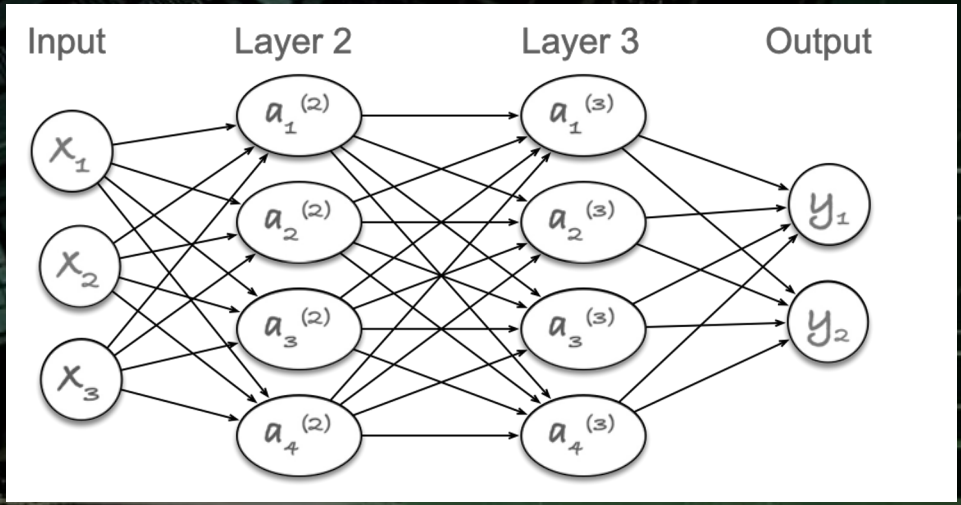
$
Is this

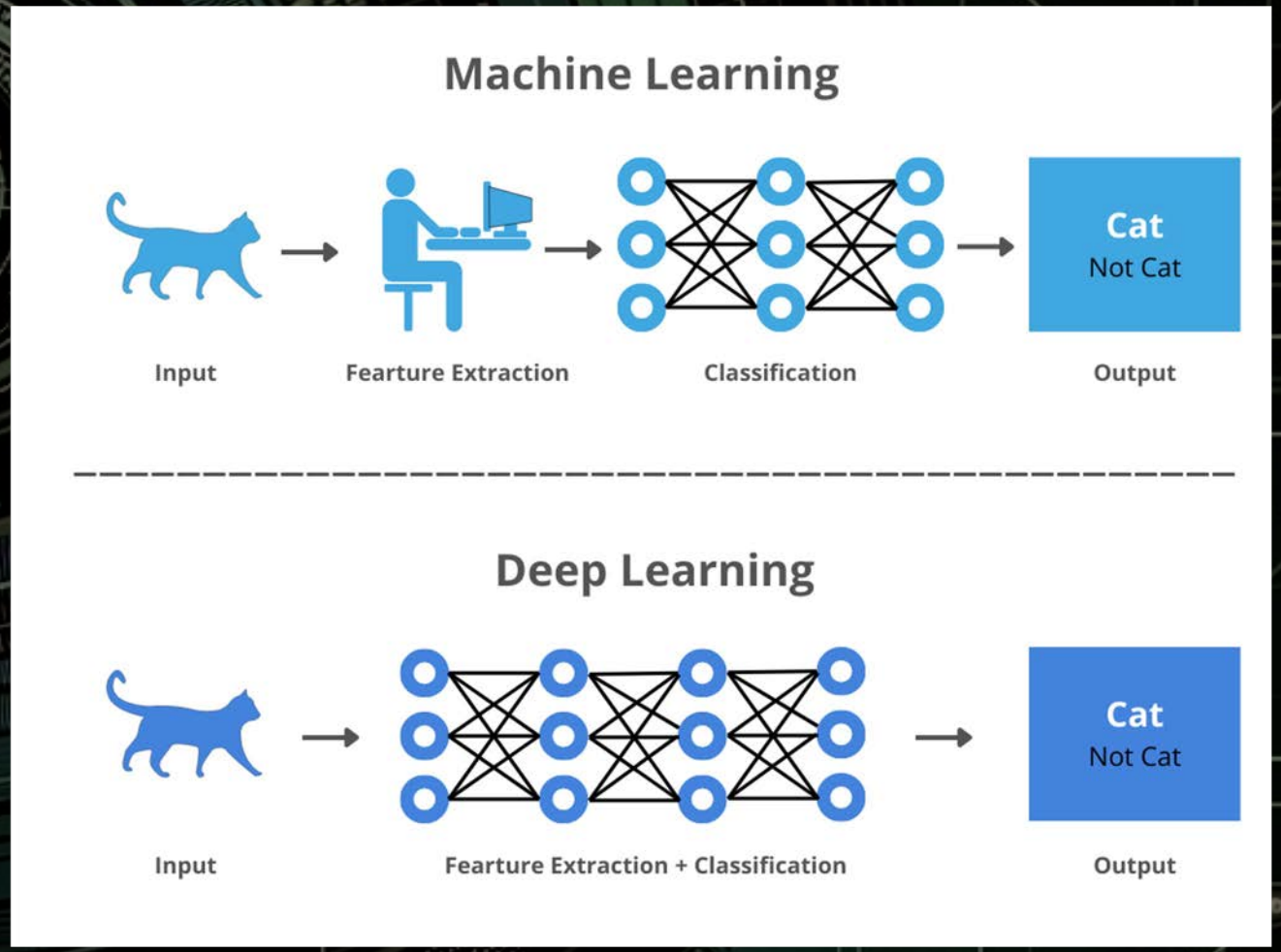


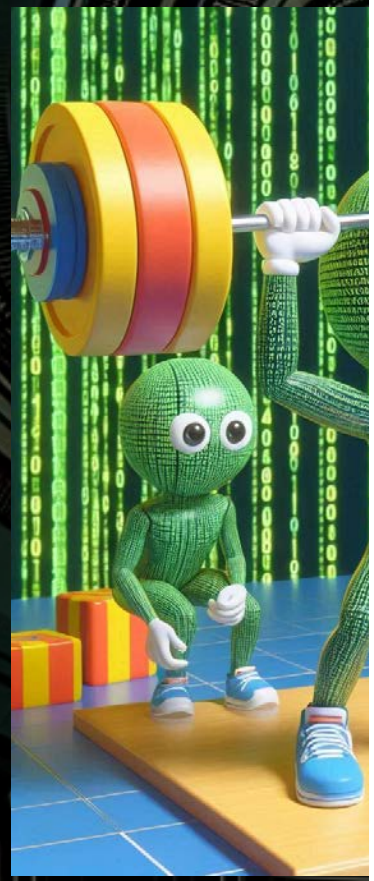
(a)
True positive rate
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.1
0.2

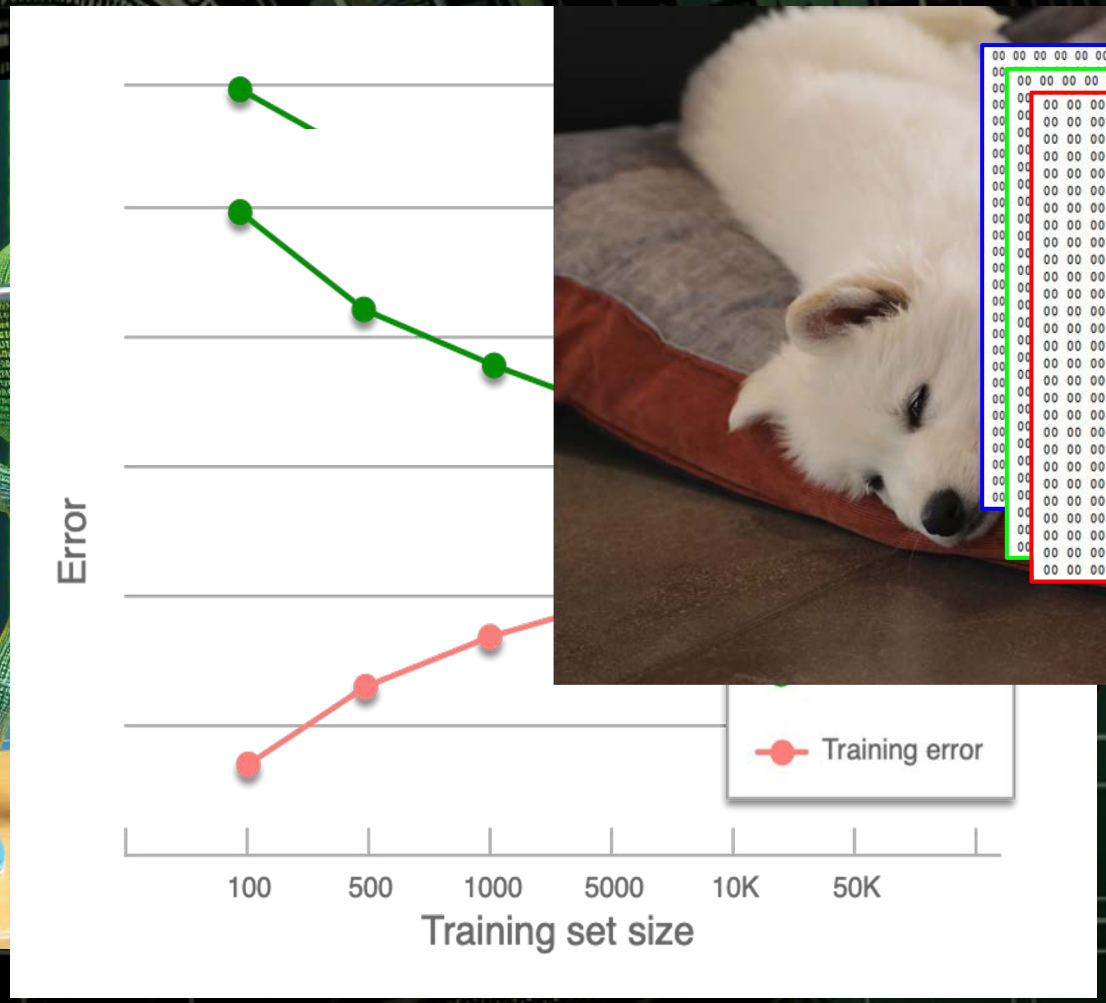

Noyau
Corps cellulaire
Noeud de Ranvier
Cellules de Schwann
Gaine de myéline
Axone
Terminaisons de l'axone
Dendrites

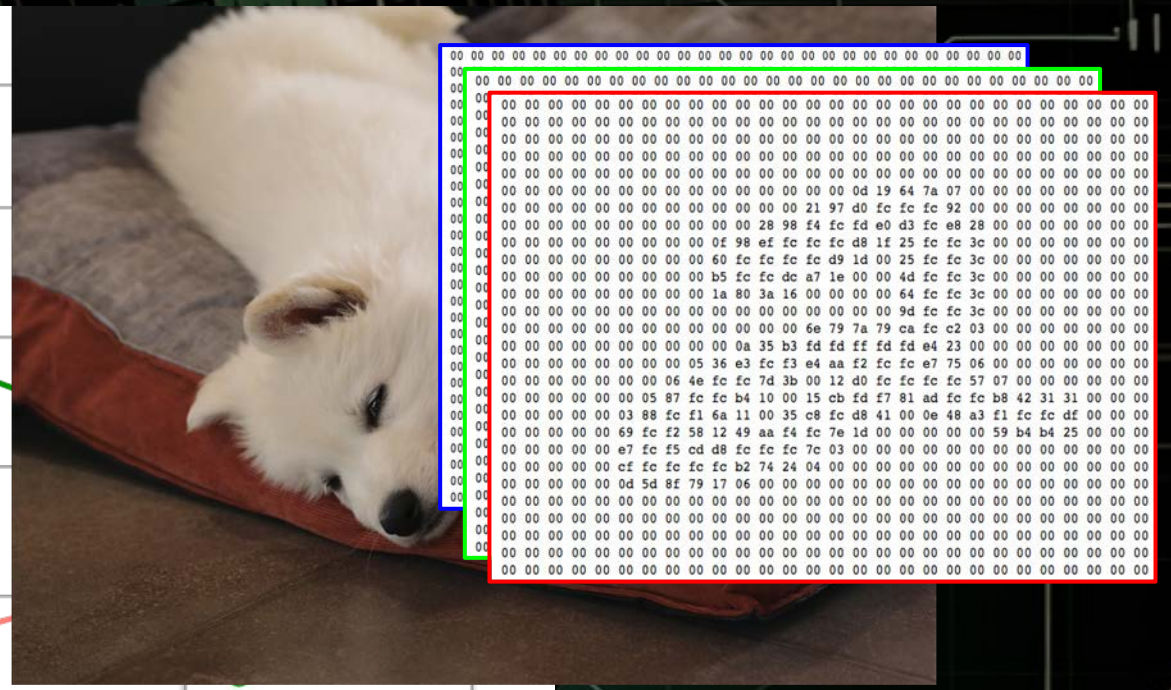

Input
Output
Weight
1
x_1
x_2
...
x_n
w_0
w_1
w_2
...
w_n
$\sum_{i=1}^{n} w_i x_i$
Activation function
y

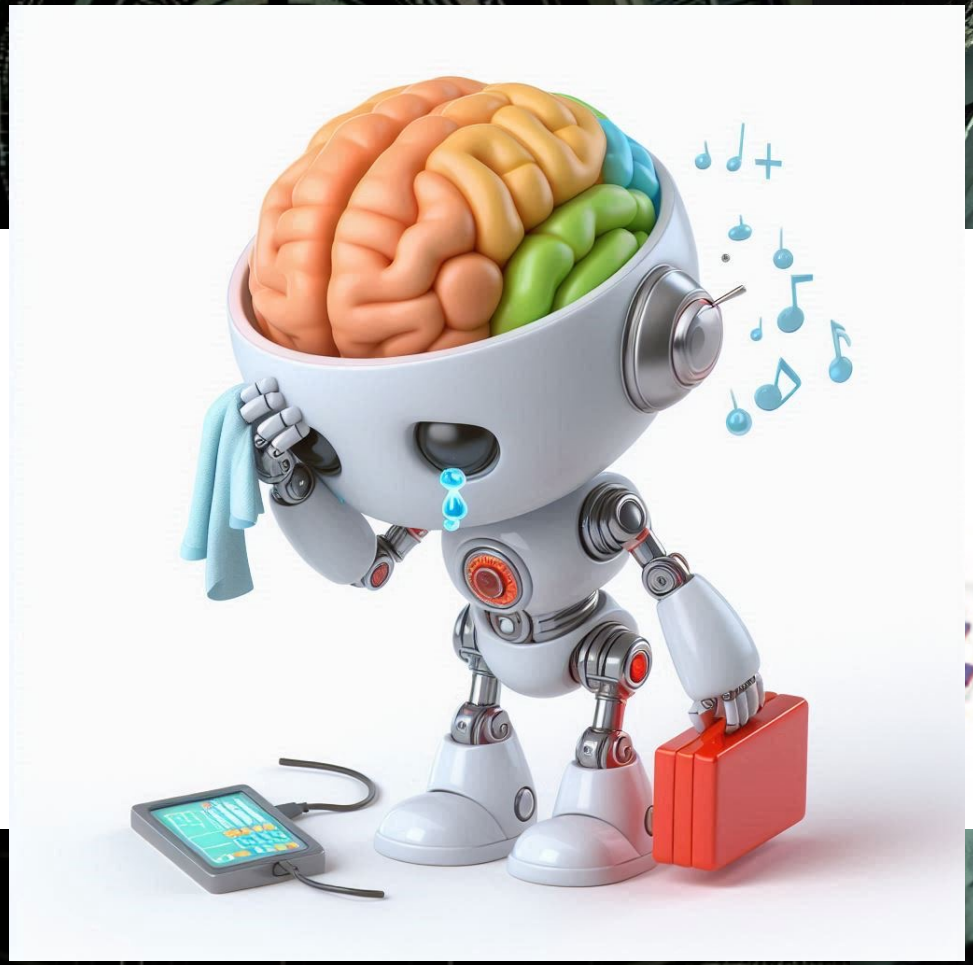

Input
Layer 2
Layer 3
Output
x_1
x_2
x_3
$a_1^{(2)}$
$a_2^{(2)}$
$a_3^{(2)}$
$a_4^{(2)}$
$a_1^{(3)}$
$a_2^{(3)}$
$a_3^{(3)}$
$a_4^{(3)}$
y_1
y_2

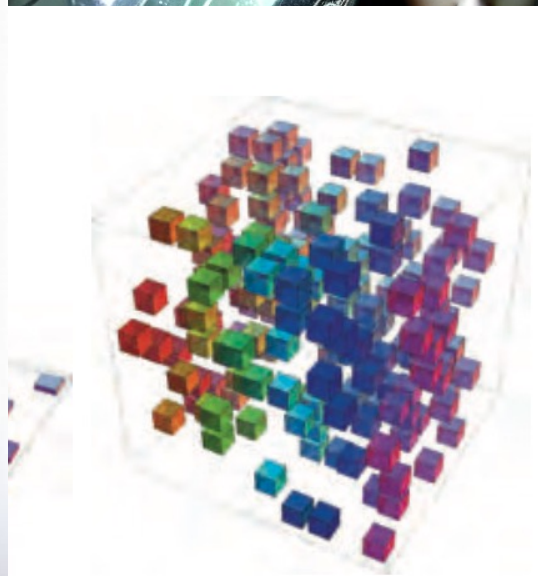

Machine Learning
Cat
Not Cat
Input
Fearture Extraction
Classification
Output
Deep Learning
Cat
Not Cat
Input
Fearture Extraction + Classification
Output




Error
Training error
100
500
1000
5000
10K
50K
Training set size



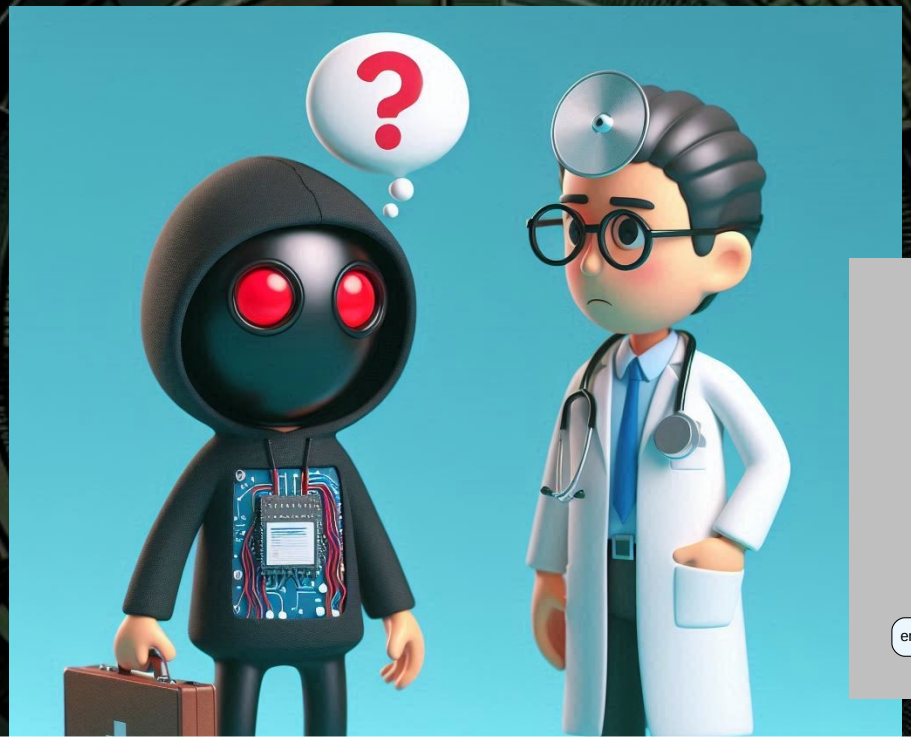


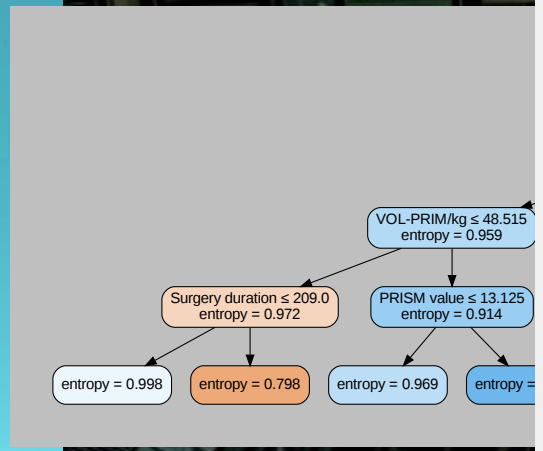


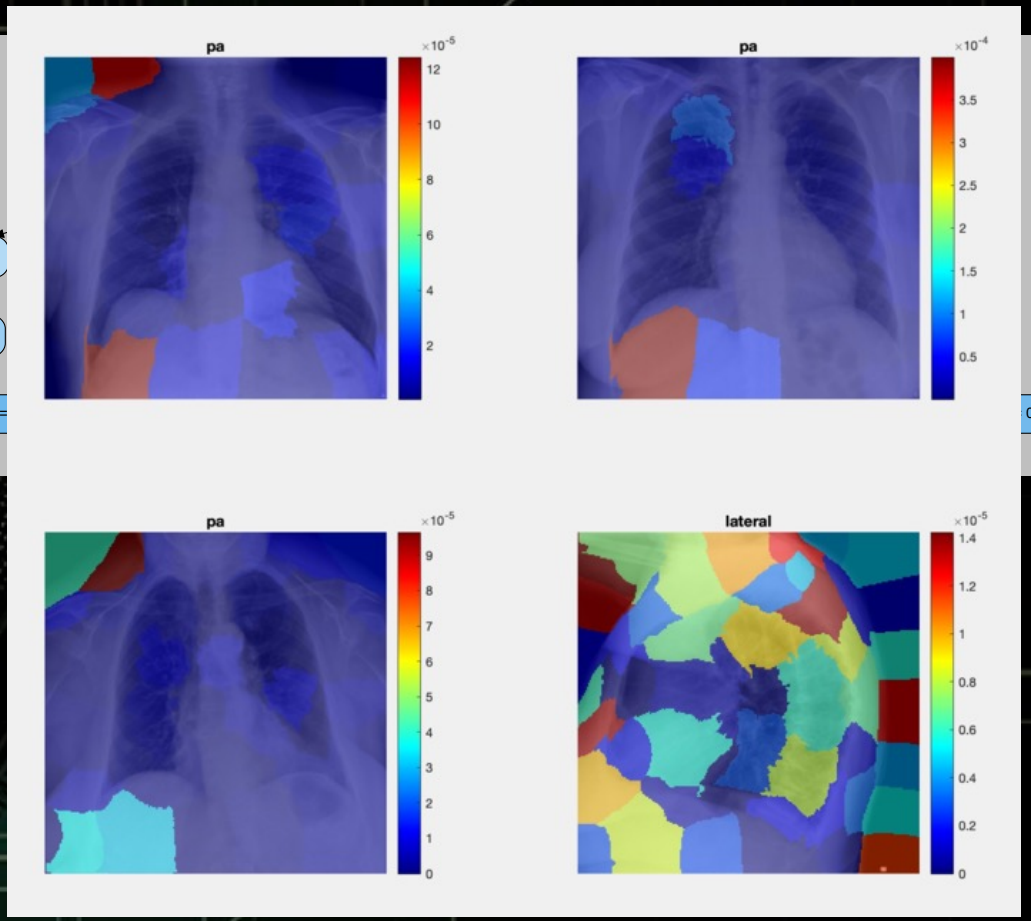
Bengio, Y., Goodfellow, I., & Courville, A. (2017). *Deep learning* (Vol. 1, pp. 23-24). Cambridge, MA, USA: MIT press.

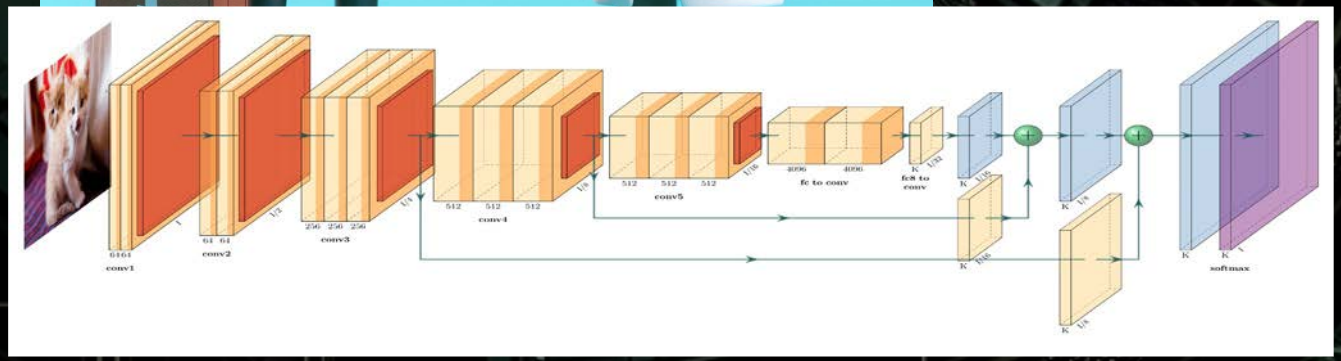

FAILURE

>>> Explainable AI (XAI)





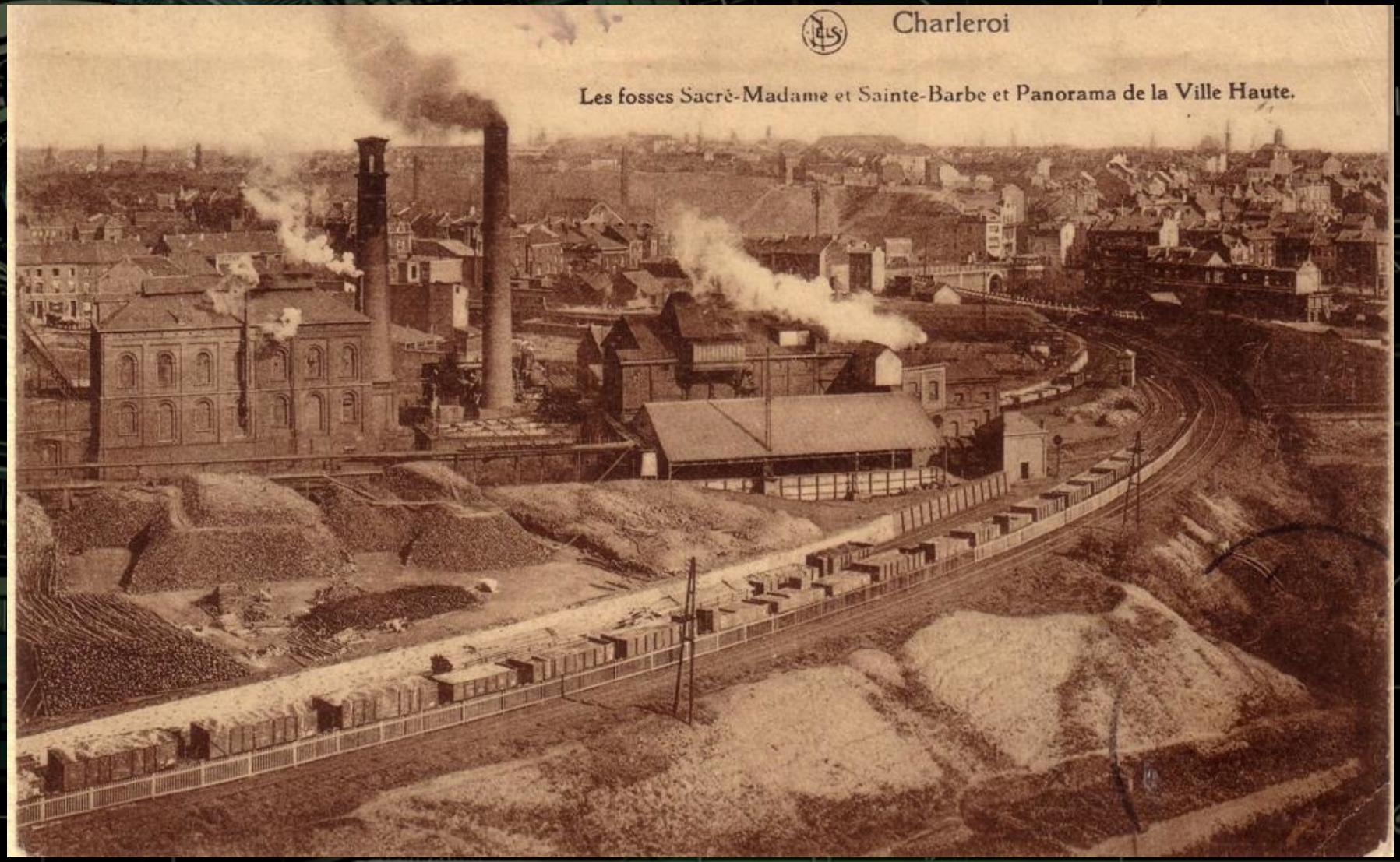




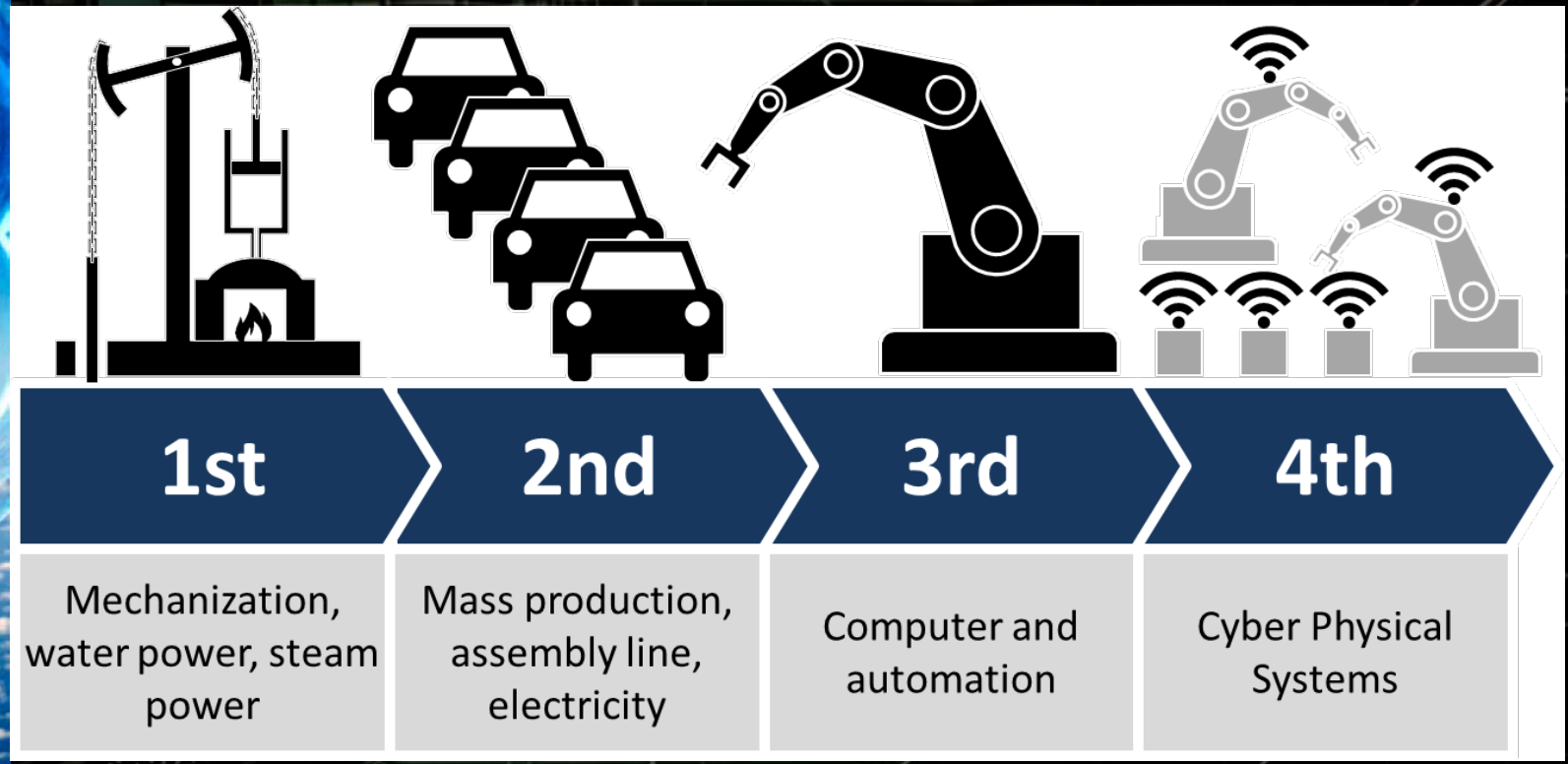
Florquin R, Florquin R, Schmartz D, Dony P, Briganti G. Pediatric cardiac surgery: machine learning models for postoperative complication prediction. J Anesth. 2024 Dec;38(6):747-755. doi: 10.1007/s00540-024-03377-7

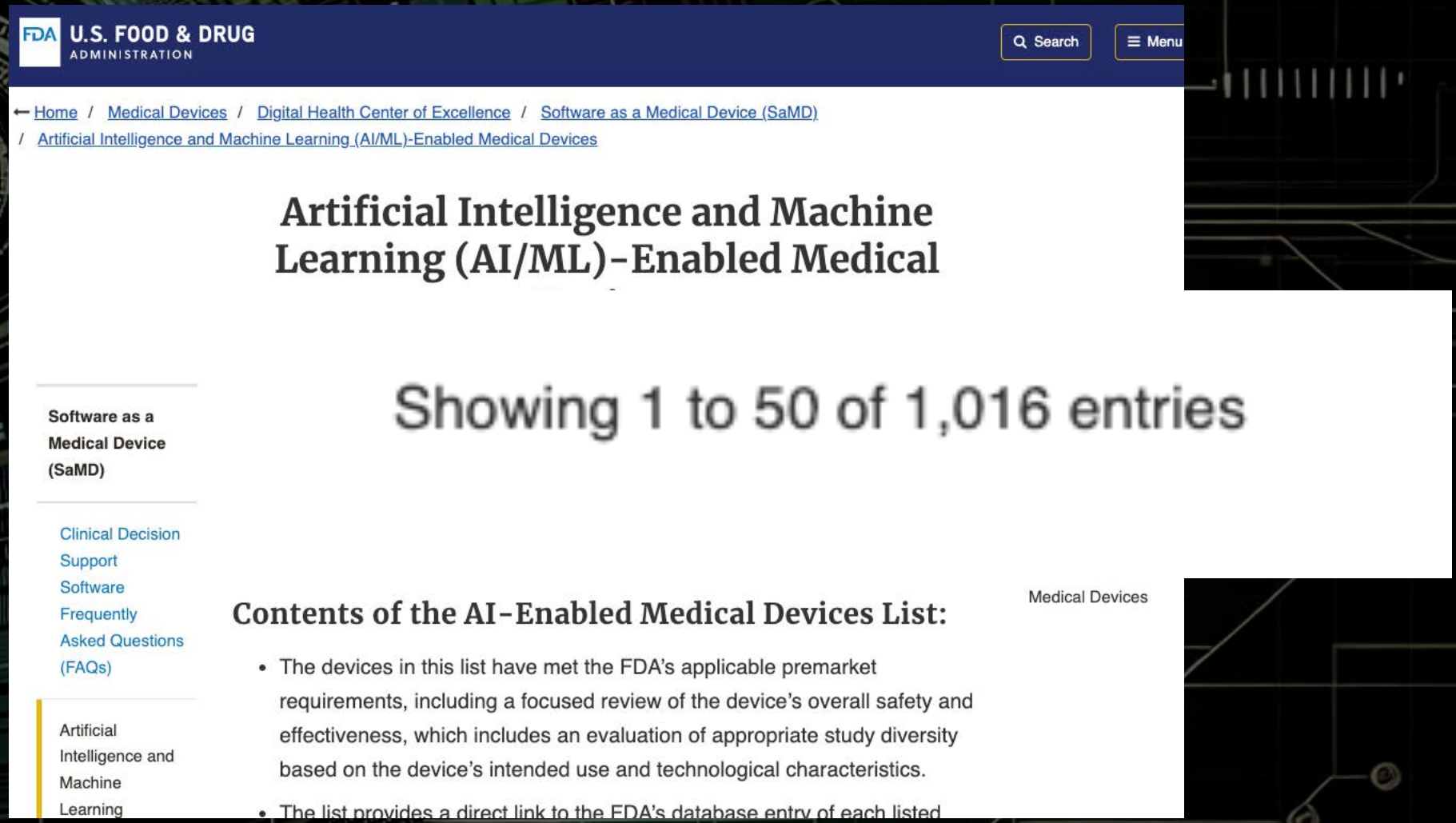
Source: datasciencecentral.com


DIGITAL
REVOLUTION


Charleroi
Les fosses Sacré-Madame et Sainte-Barbe et Panorama de la Ville Haute.

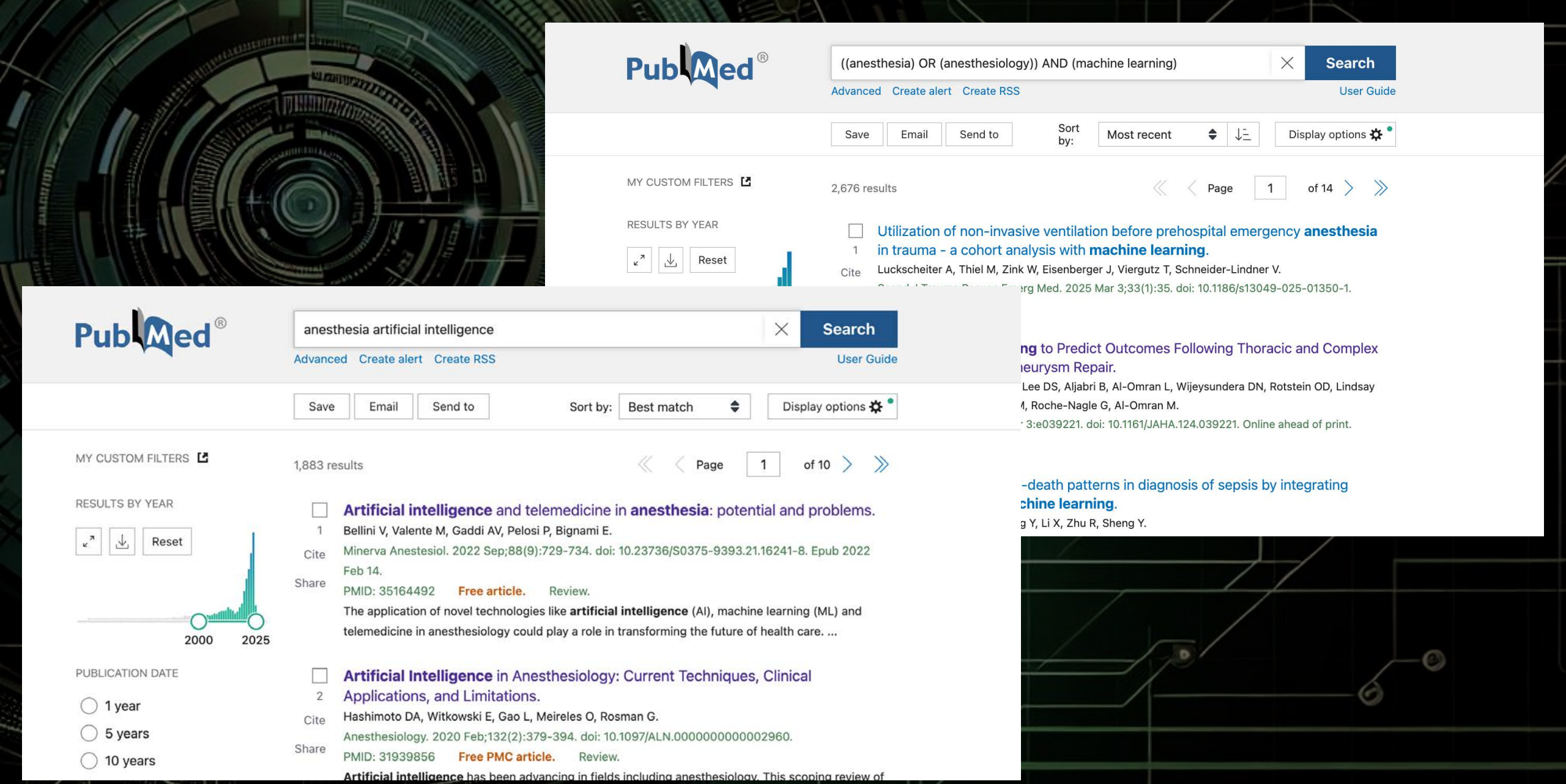

The Fourth Industrial Revolution
Klaus Schwab


1st
2nd
3rd
4th
Mechanization, water power, steam power
Mass production, assembly line, electricity
Computer and automation
Cyber Physical Systems



https://www.fda.gov/medical-devices/software-medical-device-samd/artificial-intelligence-and-machine-learning-aiml-enabled-medical-devices

Date of Final Decision	Submission Number	Device	Company	Panel (lead)	Primary Product Code	
09/13/2024	K240929	Sleep Apnea Notification Feature (SANF)	Apple Inc.	Anesthesiology	QZW	Pneumo
07/15/2024	K240285	Huxley SANSA Home Sleep Apnea Test (1000-00)	Huxley Medical	Anesthesiology	MNR	Pneumo
07/02/2024	K240555	Tyto Insights for Crackles Detection	Tyto Care Ltd.	Anesthesiology	PHZ	Pneumo
02/09/2024	K231355	Aurora	EnsoData	Anesthesiology	MNR	Pneumo
02/06/2024	DEN230041	Sleep Apnea Feature	Samsung Electronics Co., Ltd	Anesthesiology	QZW	Pneumo
12/13/2023	K232237	Tyto Insights for Wheeze Detection	Tyto Care Ltd.	Anesthesiology	PHZ	Pneumo
10/06/2023	K232787	ScanNav Anatomy Peripheral Nerve Block	Intelligent Ultrasound Limited	Anesthesiology	QRG	ALR
03/31/2023	DEN200011	Masimo SafetyNet	Masimo Corporation	Anesthesiology	QVT	Desat Opioïden
02/23/2023	K222579	Belun Sleep System BLS-100	Belun Technology Company Limited	Anesthesiology	MNR	Pneumo
02/17/2023	DEN210022	PMD-200	Medasense Biometrics Ltd.	Anesthesiology	QVE	Reponse Nociceptive
10/05/2022	K221892	VISIONAIR	PacificMD Biotech Llc	Anesthesiology	BXQ	Pneumo
01/02/2020	K183089	Air Next	NuvoAir AB	Anesthesiology	BZG	Pneumo
02/04/2019	K181916	d-Nav System	Hygieia, Inc	Anesthesiology	NDC	Insulinothérapie
05/05/2017	K163665	MATRx plus	Zephyr Sleep Technologies	Anesthesiology	MNR	Pneumo
11/05/2015	K150102	SnoreSounds	APPIAN MEDICAL, INC.	Anesthesiology	MNR	Pneumo
04/24/2015	K142918	EndoTool SubQ	MONARCH MEDICAL TECHNOLOGIES	Anesthesiology	NDC	Insulinothérapie
03/11/1997	K955841	SLEEP SYSTEM FOR CLINICS & RESEARCH	COMPUMEDICS PTD LTD.	Anesthesiology	MNR	Pneumo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((anesthesia) OR (anesthesiology)) AND (machine learning)
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2,676 results
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RESULTS BY YEAR
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1
Cite
Utilization of non-invasive ventilation before prehospital emergency anesthesia in trauma - a cohort analysis with machine learning.
Luckscheiter A, Thiel M, Zink W, Eisenberger J, Viergutz T, Schneider-Lindner V.
Med. 2025 Mar 3;33(1):35. doi: 10.1186/s13049-025-01350-1.
ng to Predict Outcomes Following Thoracic and Complex
eurysm Repair.
Lee DS, Aljabri B, Al-Omran L, Wijeysundera DN, Rotstein OD, Lindsay
, Roche-Nagle G, Al-Omran M.
3:e039221. doi: 10.1161/JAHA.124.039221. Online ahead of print.
-death patterns in diagnosis of sepsis by integrating
chine learning.
g Y, Li X, Zhu R, Sheng Y.
PubMed®
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RESULTS BY YEAR
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1
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Artificial intelligence and telemedicine in anesthesia: potential and problems.
Bellini V, Valente M, Gaddi AV, Pelosi P, Bignami E.
Minerva Anestesiol. 2022 Sep;88(9):729-734. doi: 10.23736/S0375-9393.21.16241-8. Epub 2022 Feb 14.
PMID: 35164492 Free article. Review.
The application of novel technologies like artificial intelligence (AI), machine learning (ML) and telemedicine in anesthesiology could play a role in transforming the future of health care. ...
PUBLICATION DATE
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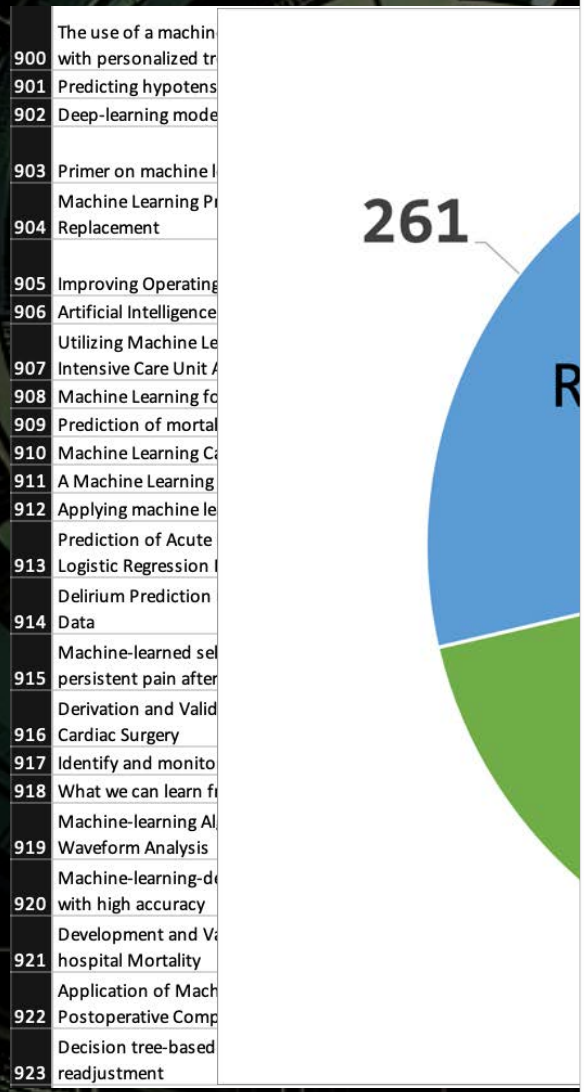
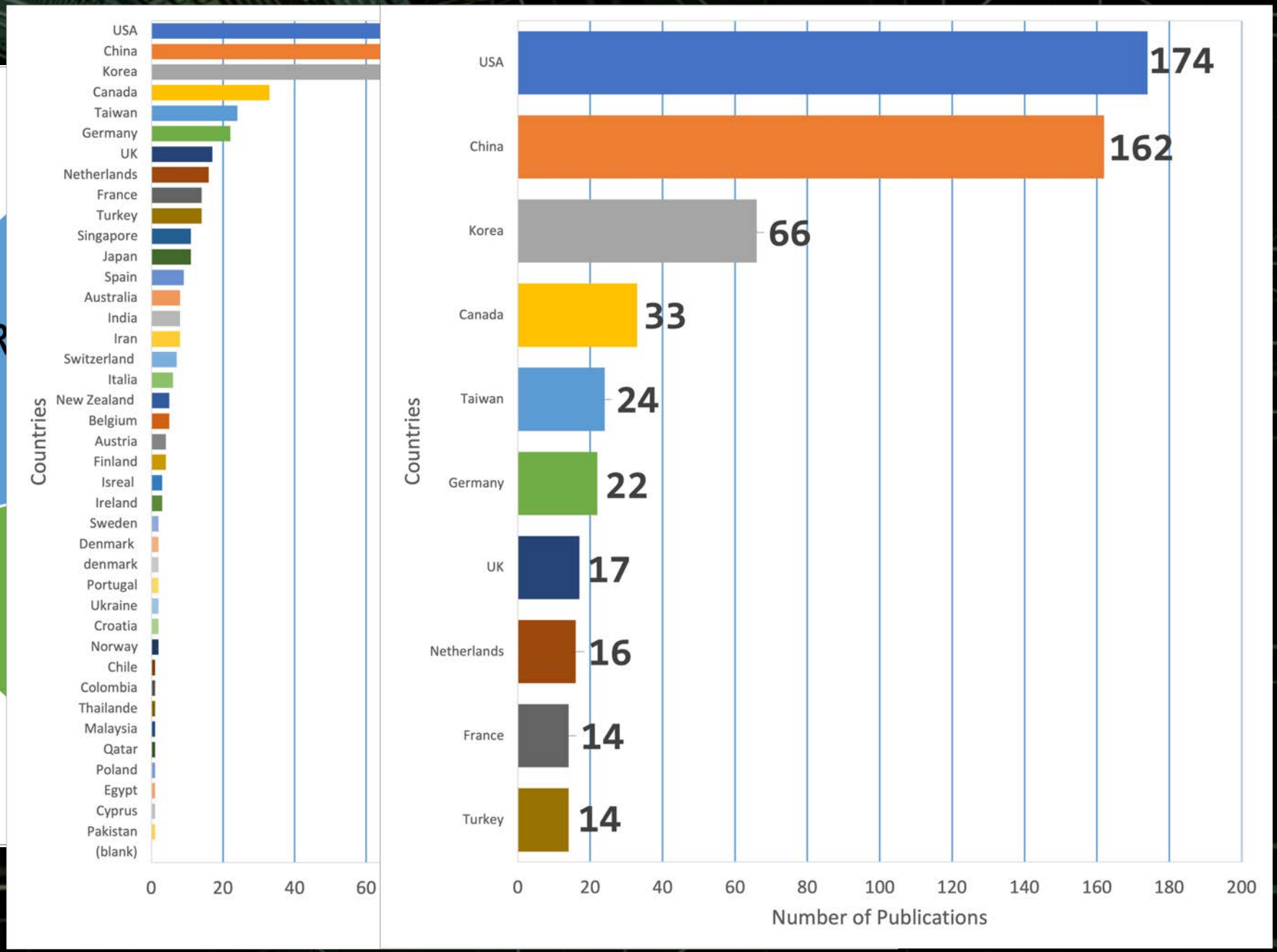
Artificial Intelligence in Anesthesiology: Current Techniques, Clinical Applications, and Limitations.
Hashimoto DA, Witkowski E, Gao L, Meireles O, Rosman G.
Anesthesiology. 2020 Feb;132(2):379-394. doi: 10.1097/ALN.0000000000002960.
PMID: 31939856 Free PMC article. Review.
Artificial intelligence has been advancing in fields including anesthesiology. This scoping review of


900 The use of a machin with personalized tr
901 Predicting hypotens
902 Deep-learning mode
903 Primer on machine l
904 Machine Learning Pr Replacement
905 Improving Operating
906 Artificial Intelligence
907 Utilizing Machine Le Intensive Care Unit A
908 Machine Learning fo
909 Prediction of mortal
910 Machine Learning Ca
911 A Machine Learning
912 Applying machine le
913 Prediction of Acute Logistic Regression
914 Delirium Prediction Data
915 Machine-learned sel persistent pain after
916 Derivation and Valid Cardiac Surgery
917 Identify and monito
918 What we can learn fr
919 Machine-learning Al Waveform Analysis
920 Machine-learning-de with high accuracy
921 Development and Va hospital Mortality
922 Application of Mach Postoperative Comp
923 Decision tree-based readjustment
261
R


USA
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India
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Austria
Finland
Isreal
Ireland
Sweden
Denmark
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Portugal
Ukraine
Croatia
Norway
Chile
Colombia
Thailande
Malaysia
Qatar
Poland
Egypt
Cyprus
Pakistan
(blank)
Countries
0
20
40
60
USA
174
China
162
Korea
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Canada
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Taiwan
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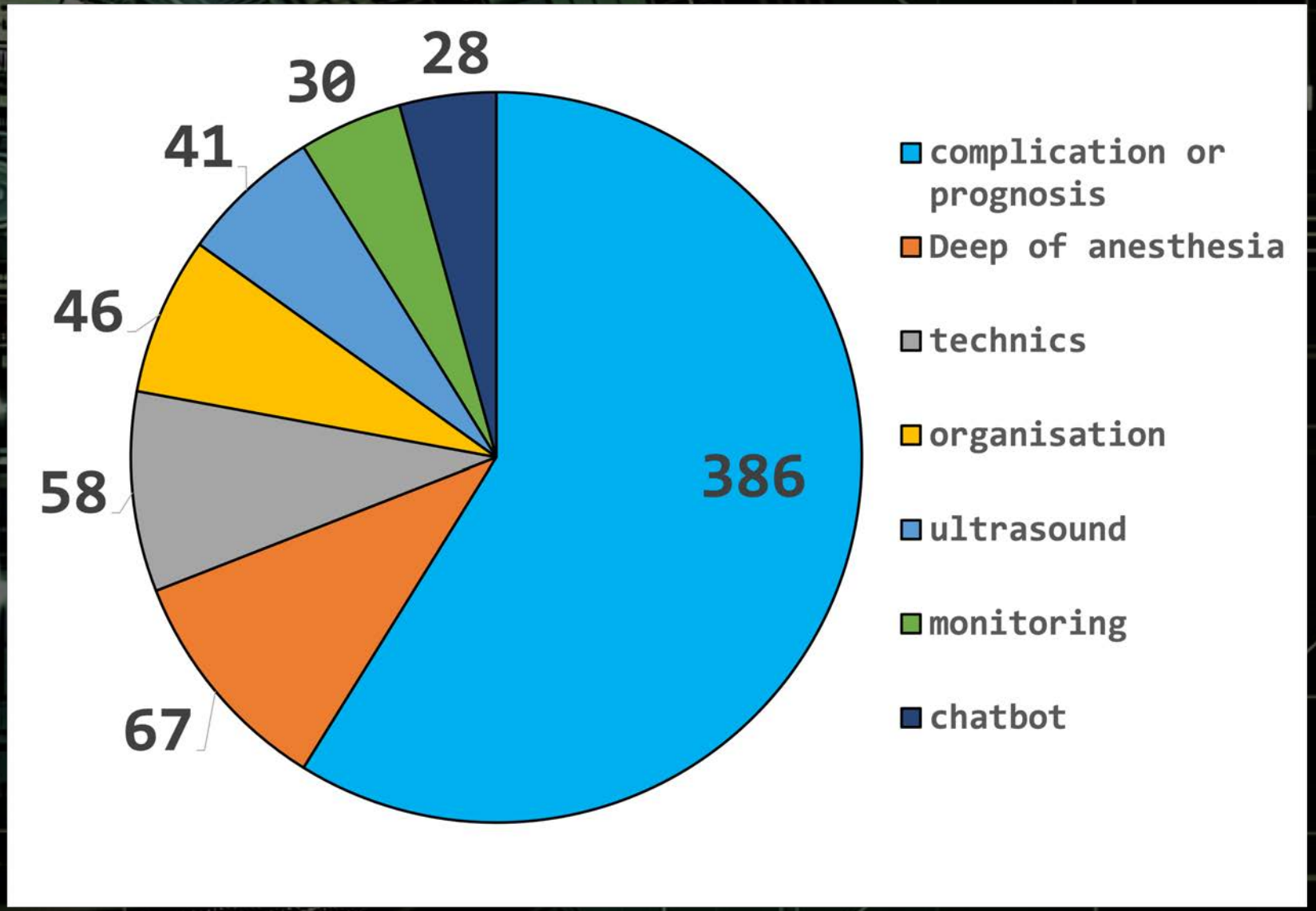
Number of Publications


28
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58
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386
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technics
organisation
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chatbot

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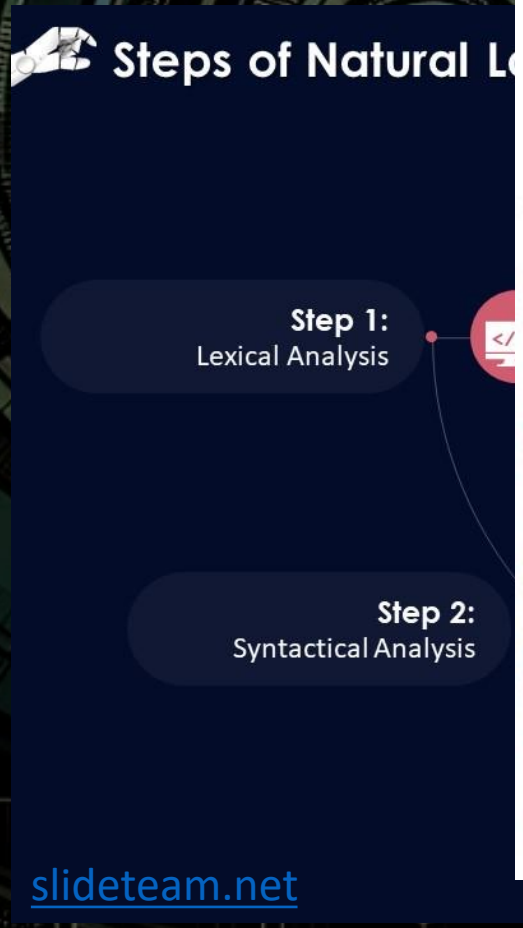

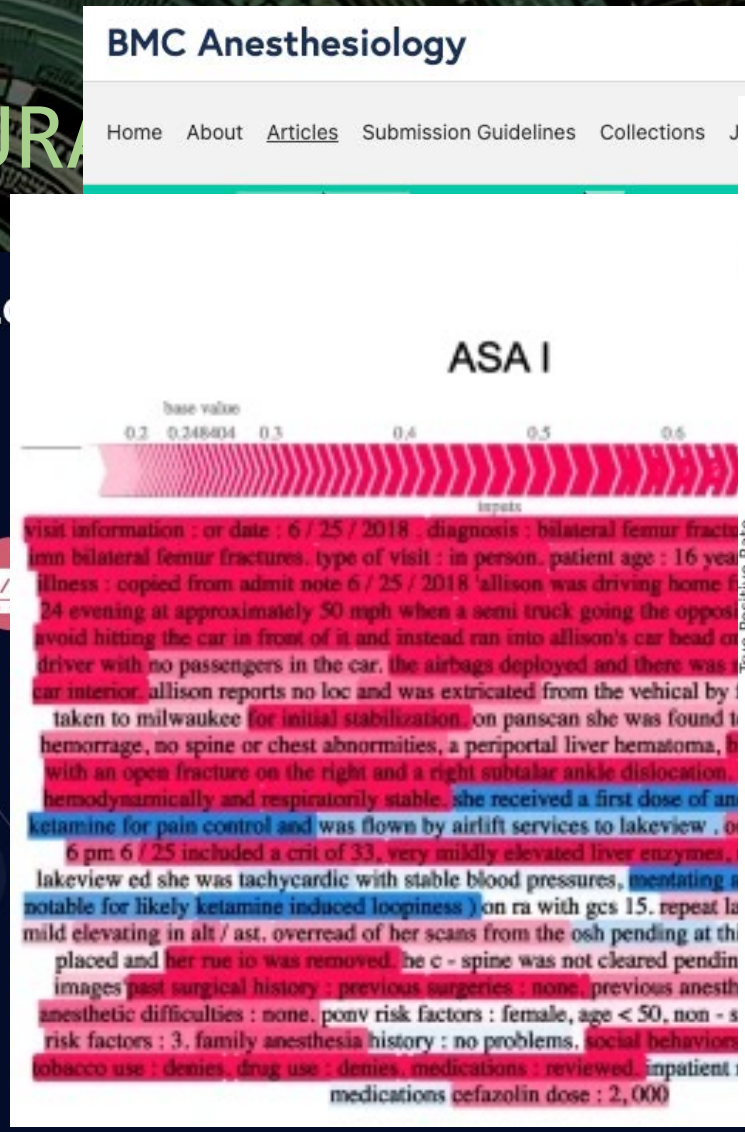

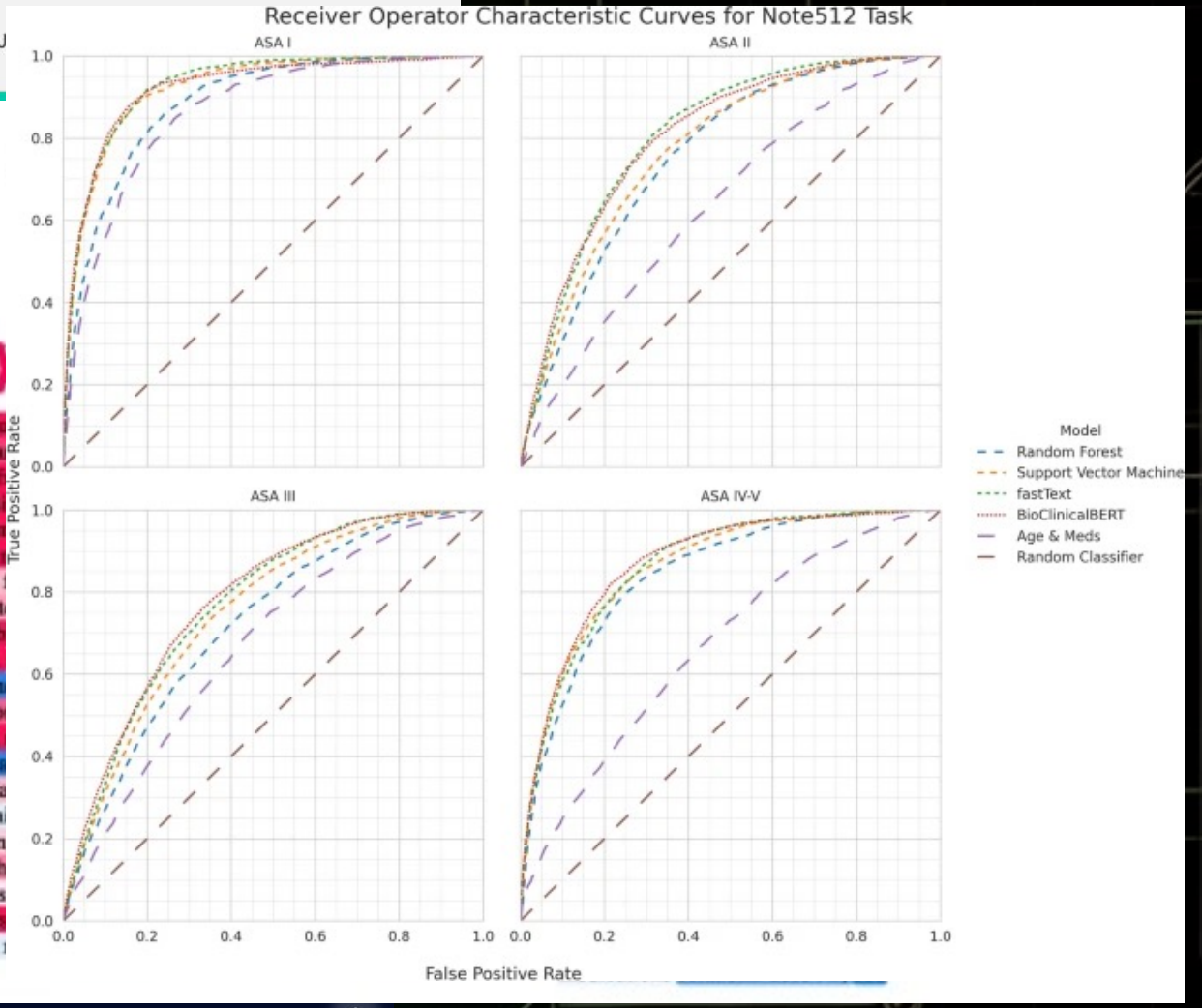

slideteam.net

Chung, P., Fong, C.T., Walters, A.M. *et al.* Prediction of American Society of Anesthesiologists Physical Status Classification from preoperative clinical text narratives using natural language processing. *BMC Anesthesiol* **23**, 296 (2023). https://doi.org/10.1186/s12871-023-02248-0

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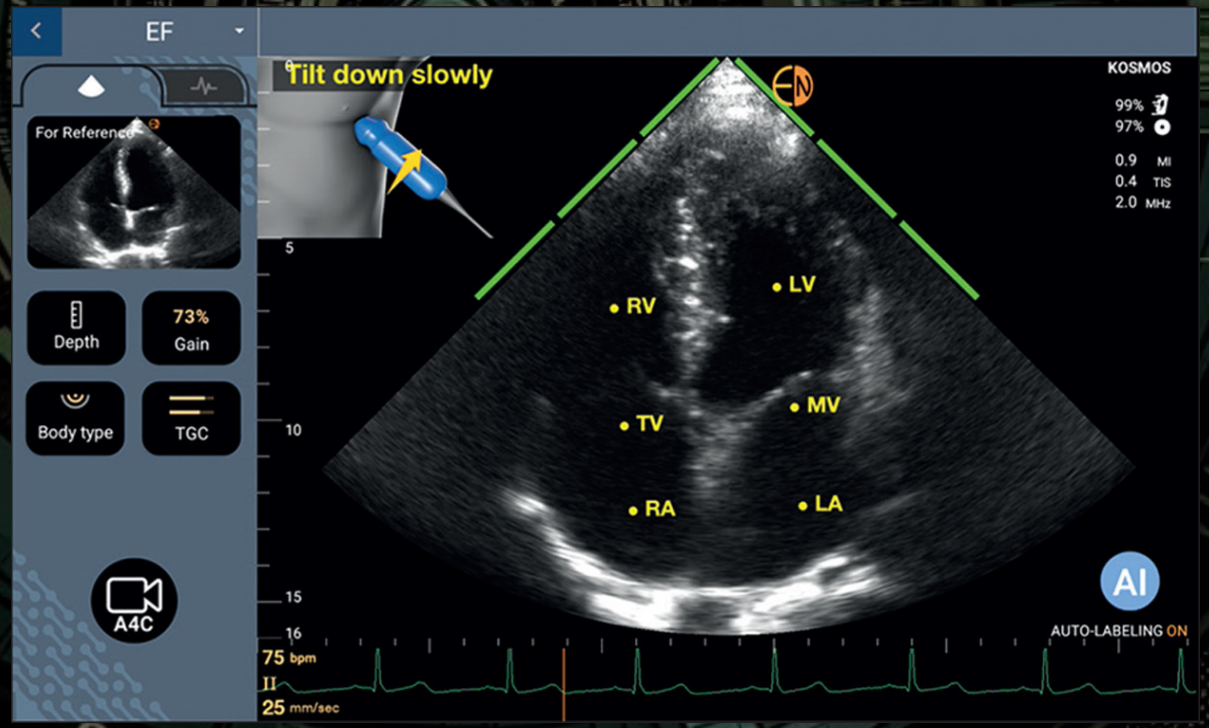

https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)31875-4/abstract
https://www.ecotowndiagnostics.com/the-future-of-ultrasound-ai-and-machine-learning-innovations/

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Evaluation ultrasound

James S. Bowness
Simeon West [7] · J
Affiliations & Note

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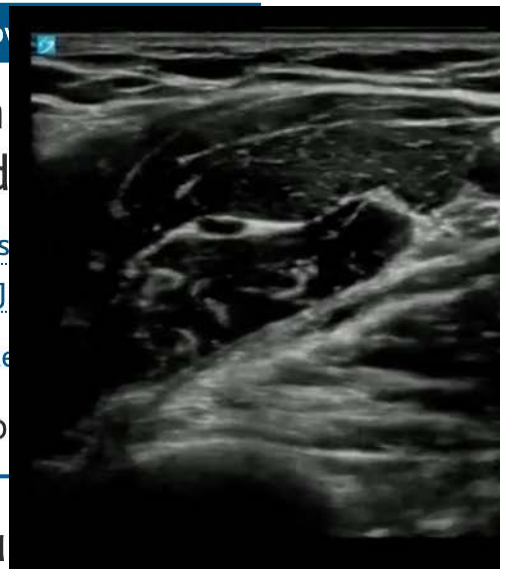

Abstra

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Background

Ultrasound-guided regional anaesthesia relies o
and safety structures on ultrasound. However, this can be challenging, particularly for
inexperienced practitioners. Artificial intelligence (AI) is increasingly being applied to medical
image interpretation, including ultrasound. In this exploratory study, we evaluated

	Scanning with AI assistive device	Scanning without AI assistive device	Alpha (*P*-value)
Correct block view, *n* (%)	56/62 (90.3)	47/62 (75.1)	0.031
Correct structure identification, *n* (%)	188/212 (88.8)	161/208 (77.4)	0.002
Median confidence (IQR)	8 (6–10)	7 (6–10)	0.155
Median global rating score (IQR)	7 (6–9)	7 (4–9)	0.225
Mean scan time (SD), s	75.9 (69.6)	74.5 (65.6)	0.881

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Machine learning approach to identification for spinal anest

Jason Ju In Chan, Jun Ma, Yusong Leng, Kok Kiong Tan, Heng Sia & Ban Leong Sng

BMC Anesthesiology **21**, Article number: 246 (2021)

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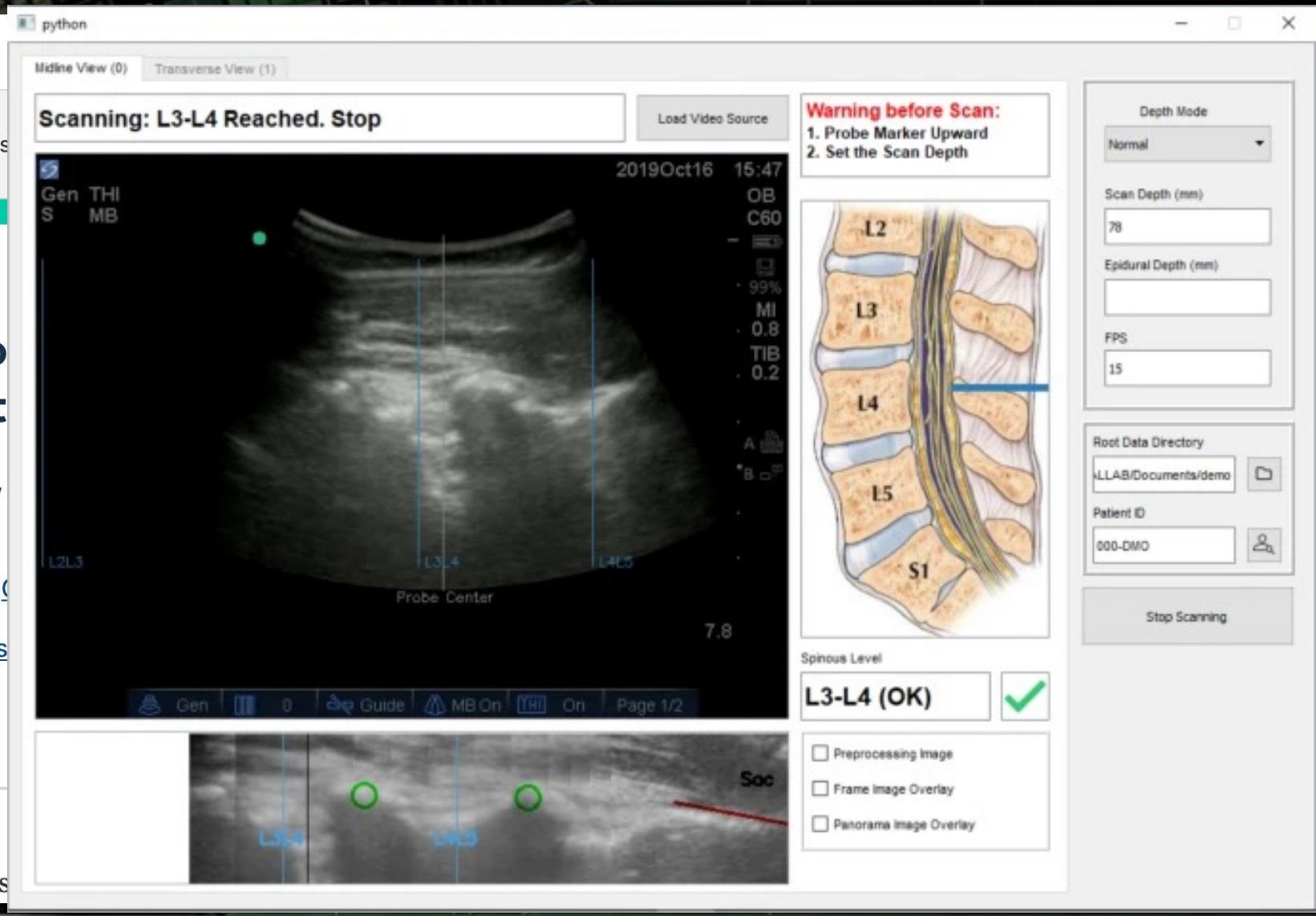
Abstract

Background

Ultrasonography for neuraxial anesthesia is increas



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Convolution neural networks for real-time needle detection and localization in 2D ultrasound

Original Article | Published: 06 March 2018

Volume 13, pages 647–657, (2018) Cite this article

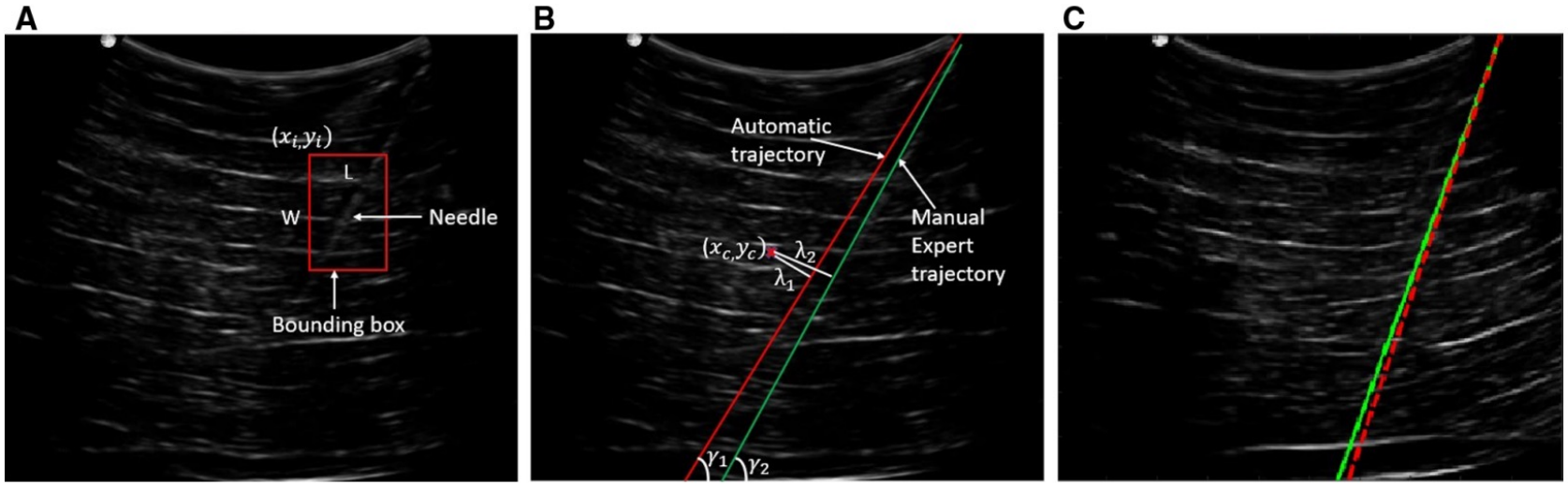

Fig. 6 **a** Estimation of needle insertion side and trajectory. Initial estimate of the trajectory is obtained from the diagonal of the needle bounding box. **b** Parameters used in calculating needle trajectory error. (x_c, y_c) is the center of the image. The automatically determined parameters are subtracted from the parameters obtained manually by an expert. Here, the difference between the two trajectories is exaggerated for illustration purposes. **c** Trajectory from proposed method (green) and expert-labeled (red, dashed) overlaid on US image. The proposed method gives an accurate prediction of the trajectory

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David Ouyang ✉, Bryan He, Amirata Ghorbani, Ne
Heidenreich, Robert A. Harrington, David H. Liang,

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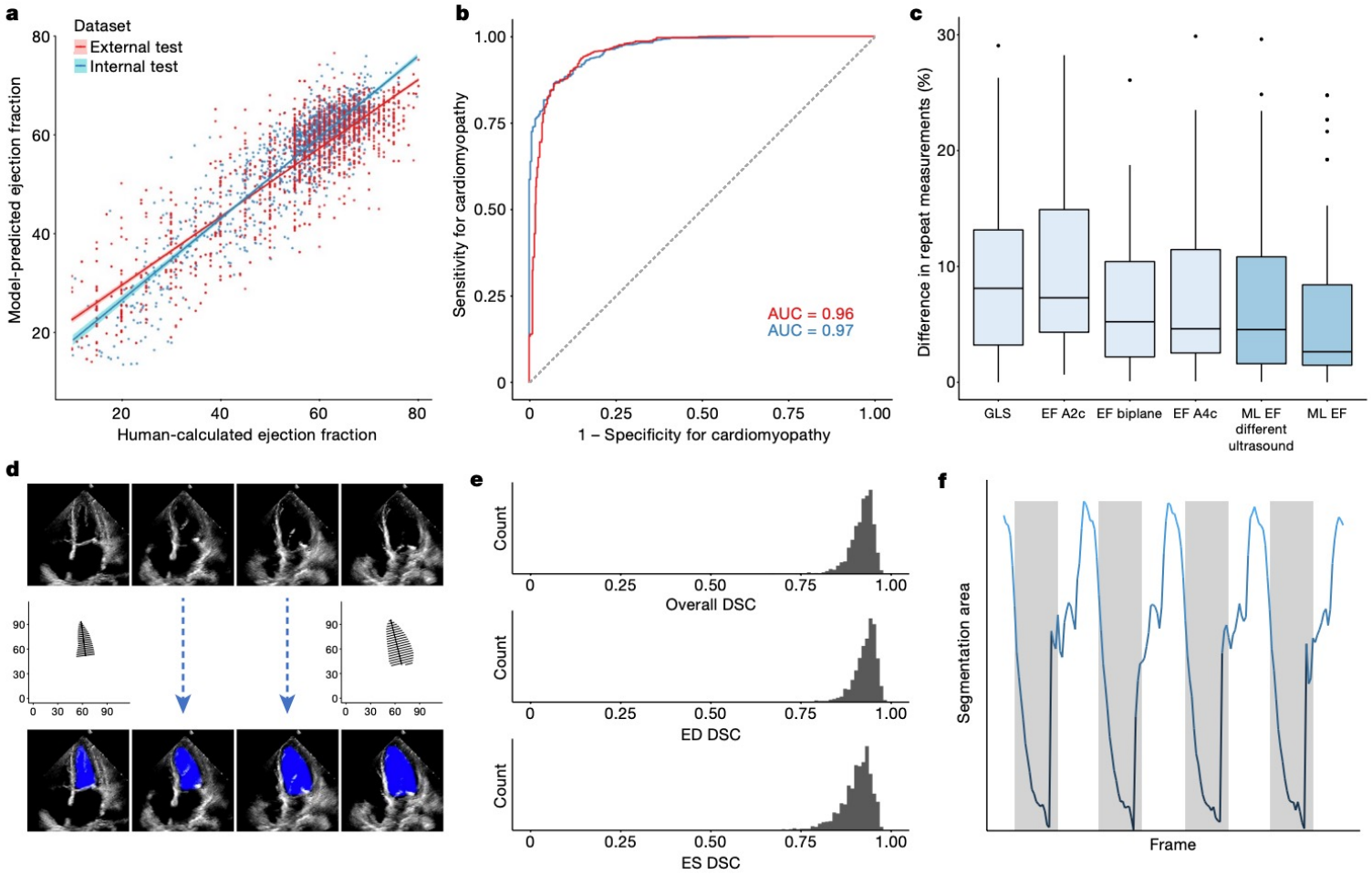

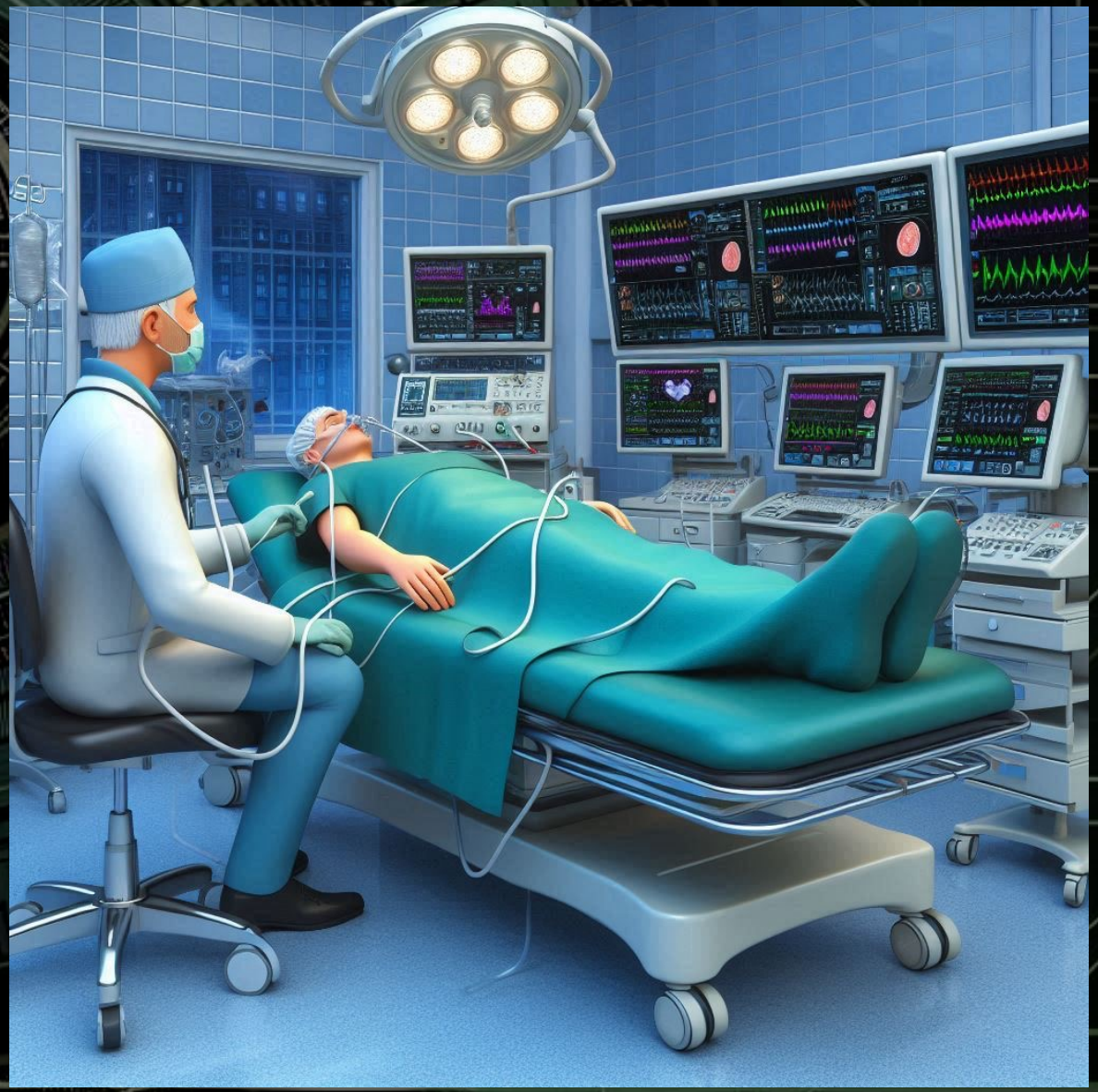

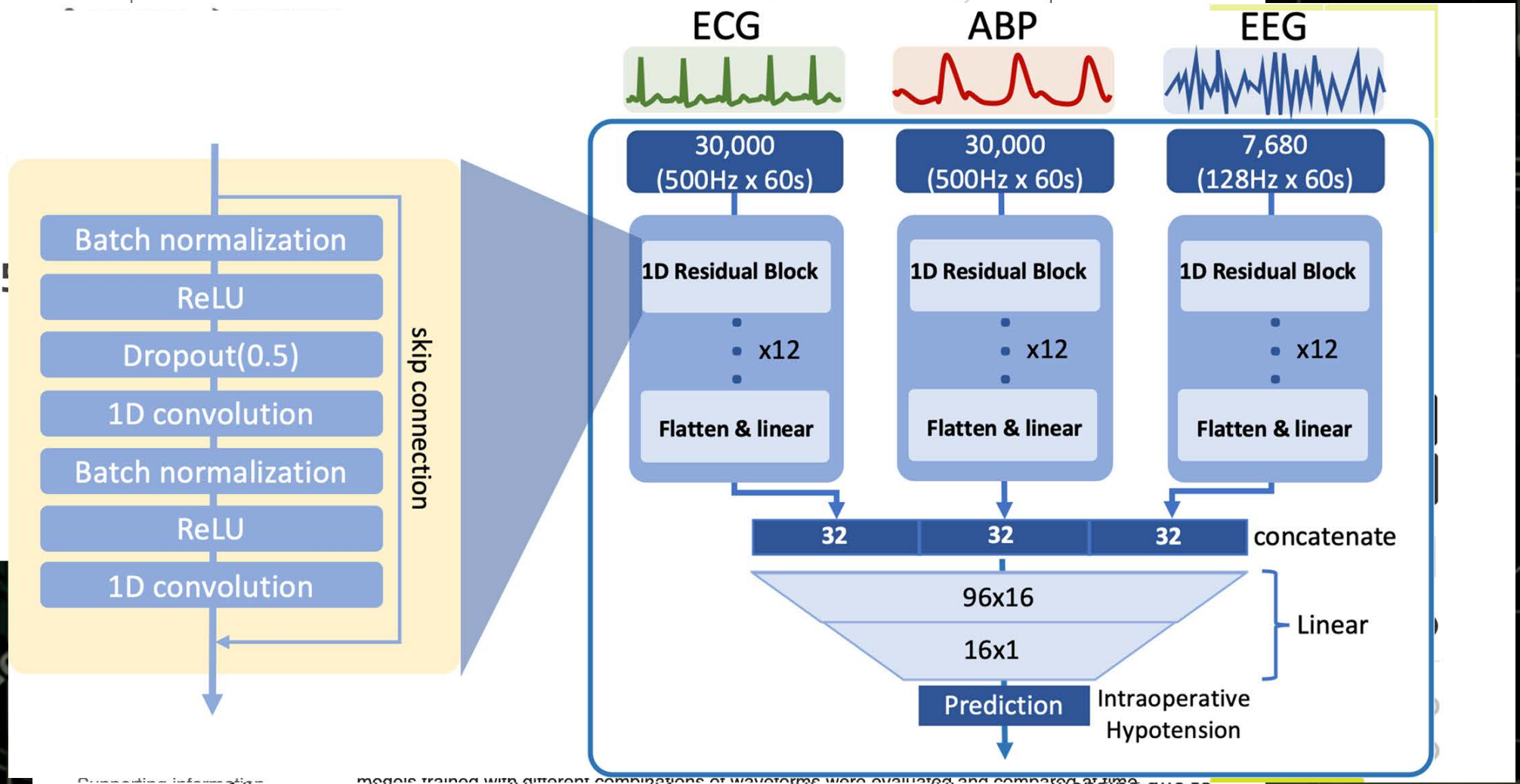
ECG
ABP
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(500Hz x 60s)
7,680
(128Hz x 60s)
1D Residual Block
x12
Flatten & linear
1D Residual Block
x12
Flatten & linear
1D Residual Block
x12
Flatten & linear
32
32
32
concatenate
96x16
16x1
Linear
Prediction
Intraoperative
Hypotension
Batch normalization
ReLU
Dropout(0.5)
1D convolution
Batch normalization
ReLU
1D convolution
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postoperative mortality using readil
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Brian L. Hill [1,†] · Robert Brown [1,†] · Eilon Gabel [2] · ... · Srira
Ira Hofer [2,‡] · Eran Halperin [1,2,7,8,‡] ... Show more

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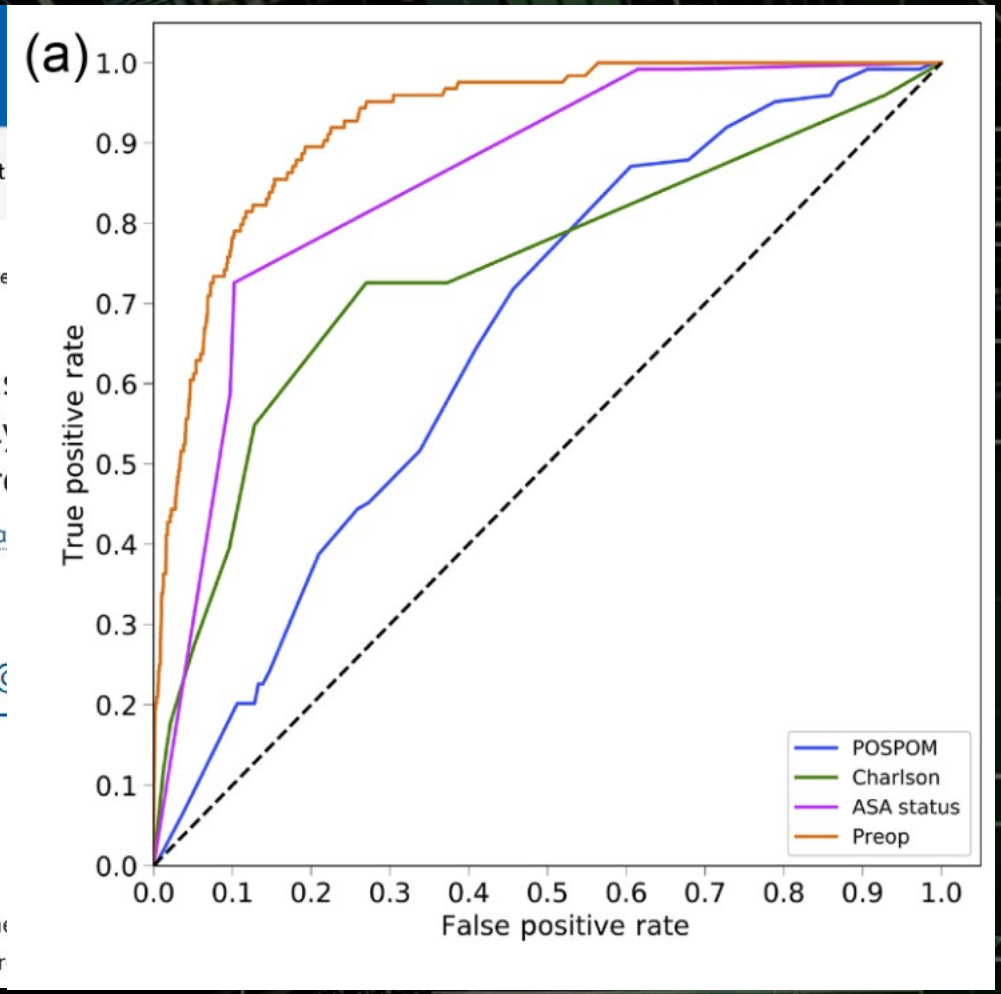
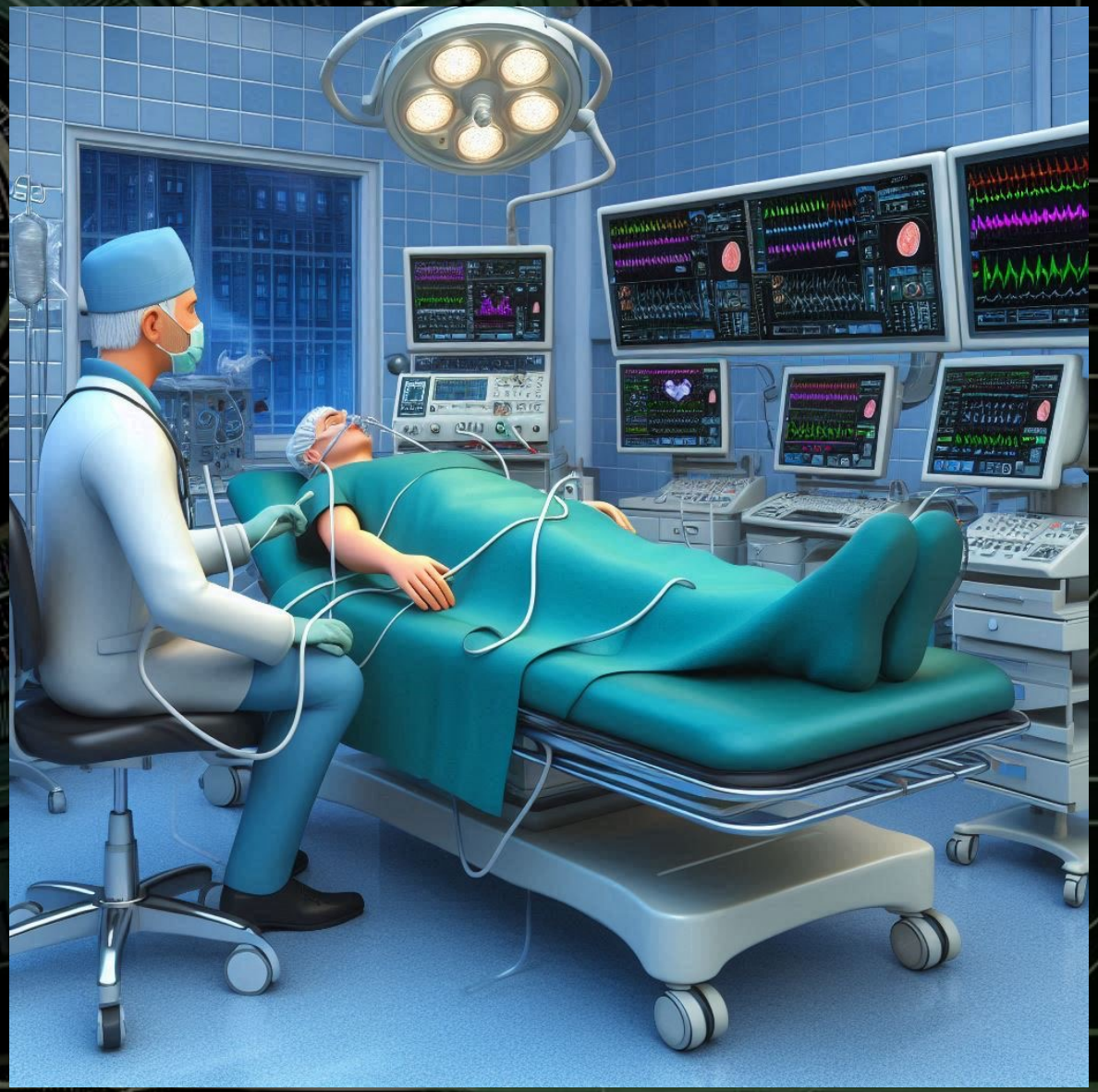
Abstract

Background

Rapid, preoperative identification of patients with the
complications is necessary to ensure that limited infr



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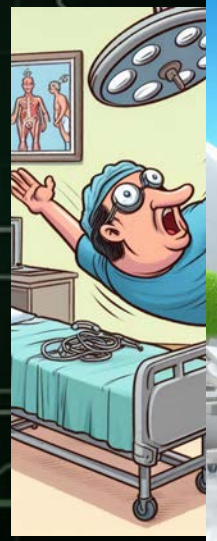

```
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  ('select_numerical_features', FunctionTransformer(lambda df: df[binary_fe
```

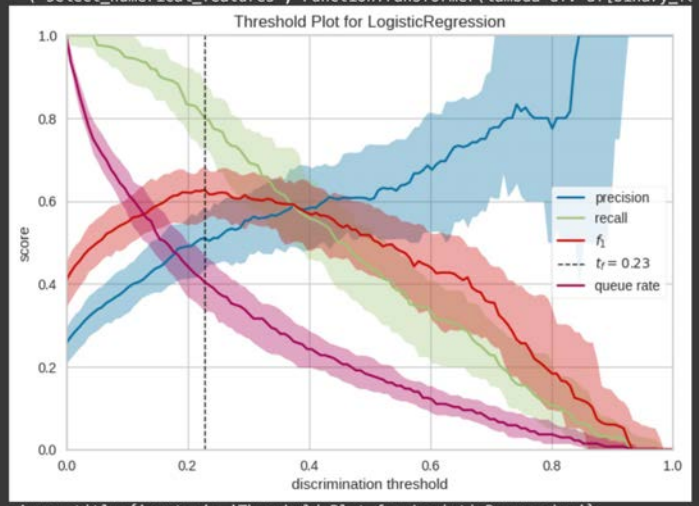


```
<Axes: title={'center': 'Threshold Plot for LogisticRegression'},
xlabel='discrimination threshold', ylabel='score'>
```

FPM1.ipynb | exercicepythonULB.py | *M6 hyperparameter tuning.ipynb*

M6 hyperparameter tuning.ipynb

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```python
from scipy.stats import loguniform
from sklearn.ensemble import HistGradientBoostingRegressor

param_distributions = {
    "max_iter": [3, 10, 30, 100, 300, 1000],
    "max_leaf_nodes": [2, 5, 10, 20, 50, 100],
    "learning_rate": loguniform(0.01, 1),
}
search_cv = RandomizedSearchCV(
    HistGradientBoostingRegressor(),
    param_distributions=param_distributions,
    scoring="neg_mean_absolute_error",
    n_iter=20,
    random_state=0,
    n_jobs=2,
)
search_cv.fit(data_train, target_train)

columns = [f"param_{name}" for name in param_distributions.keys()]
columns += ["mean_test_error", "std_test_error"]
cv_results = pd.DataFrame(search_cv.cv_results_)
cv_results["mean_test_error"] = -cv_results["mean_test_score"]
cv_results["std_test_error"] = cv_results["std_test_score"]
cv_results[columns].sort_values(by="mean_test_error")
```

[5]

	param_max_iter	param_max_leaf_nodes	param_learning_rate	mean_test_error	std_test_error

PROBLEMS 16 | OUTPUT | DEBUG CONSOLE | TERMINAL | PORTS | JUPYTER | COMMENTS


Conclusion

DEEP LEARNING > MACHINE LEARNING

Complexe > Simple

Overfitting – Non-Validation

Si c’est trop beau pour être vrai, c’est que ca l’est probablement pas