



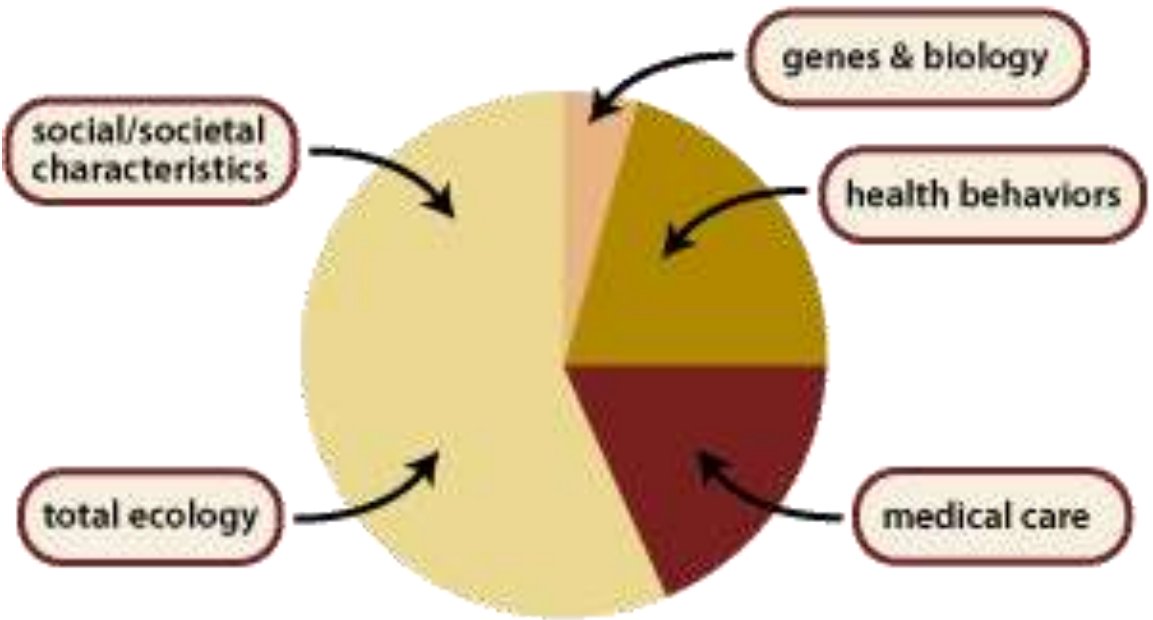
painting artificial intelligence data and  
medicine DALL-E 15.11.2022

# La digitalisation Données et intelligence artificielle

Christian Lovis

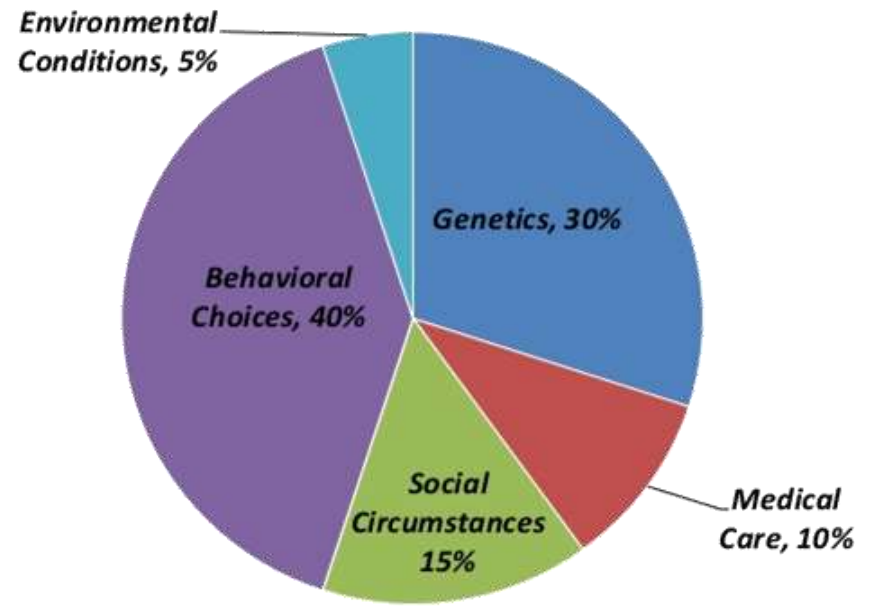
Services des sciences de l'information médicales, HUG  
Département de radiologie et informatique médicale, UNIGE

# DETERMINANTS OF POPULATION HEALTH



Tarlov, A.R., Public Policy Frameworks for Improving Population Health. Annals of the New York Academy of Sciences, 1999. 896(SOCIOECONOMIC STATUS AND HEALTH IN INDUSTRIAL NATIONS: SOCIAL, PSYCHOLOGICAL, AND BIOLOGICAL PATHWAYS): p. 281-293.

## Factors Influencing Health

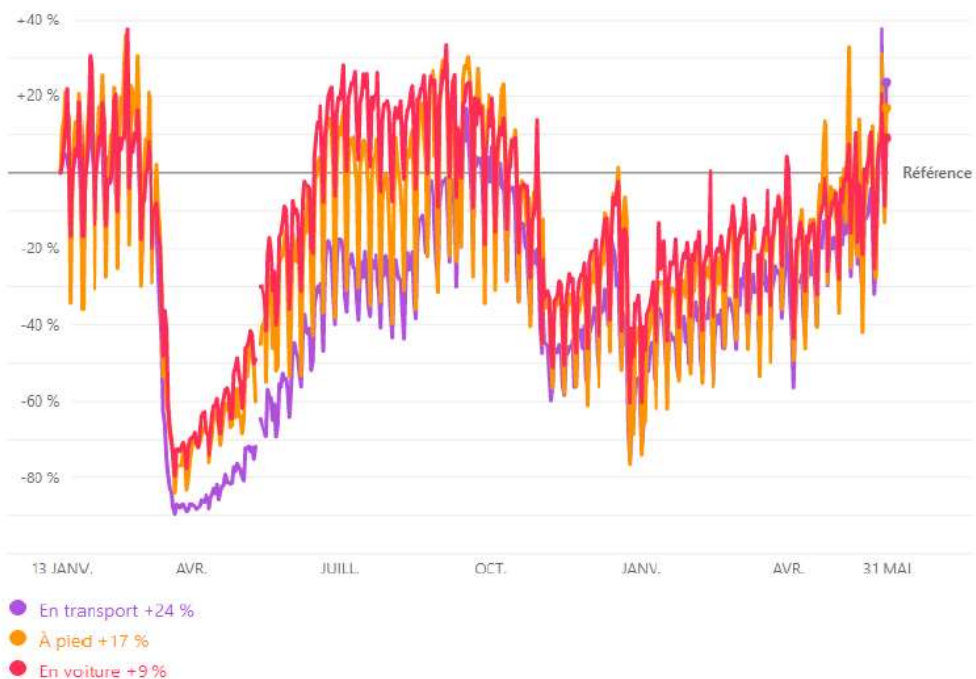


McGinnis et al. Health Affairs, 22 2

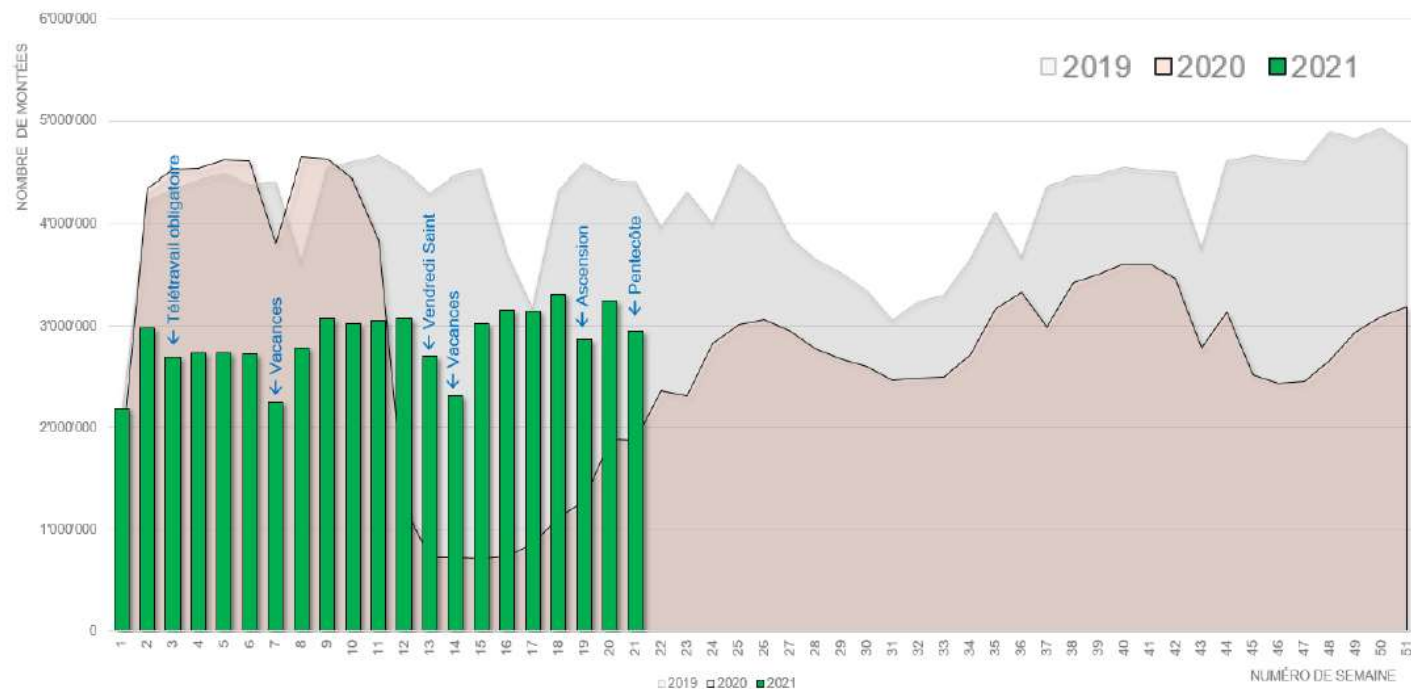




- La semaine 21 compte un jour férié (lundi de Pentecôte), qui rend les comparaisons difficiles.
- Si l'on considère uniquement les jours ouvrables de mardi à vendredi, les chiffres montrent une fréquentation équivalente à environ 74% de la fréquentation 2019.



**Figure 25** COVID-19, mobilité Apple – évolution des demandes d'itinéraires depuis le 13 janvier 2020 sur Apple Plans, à Genève

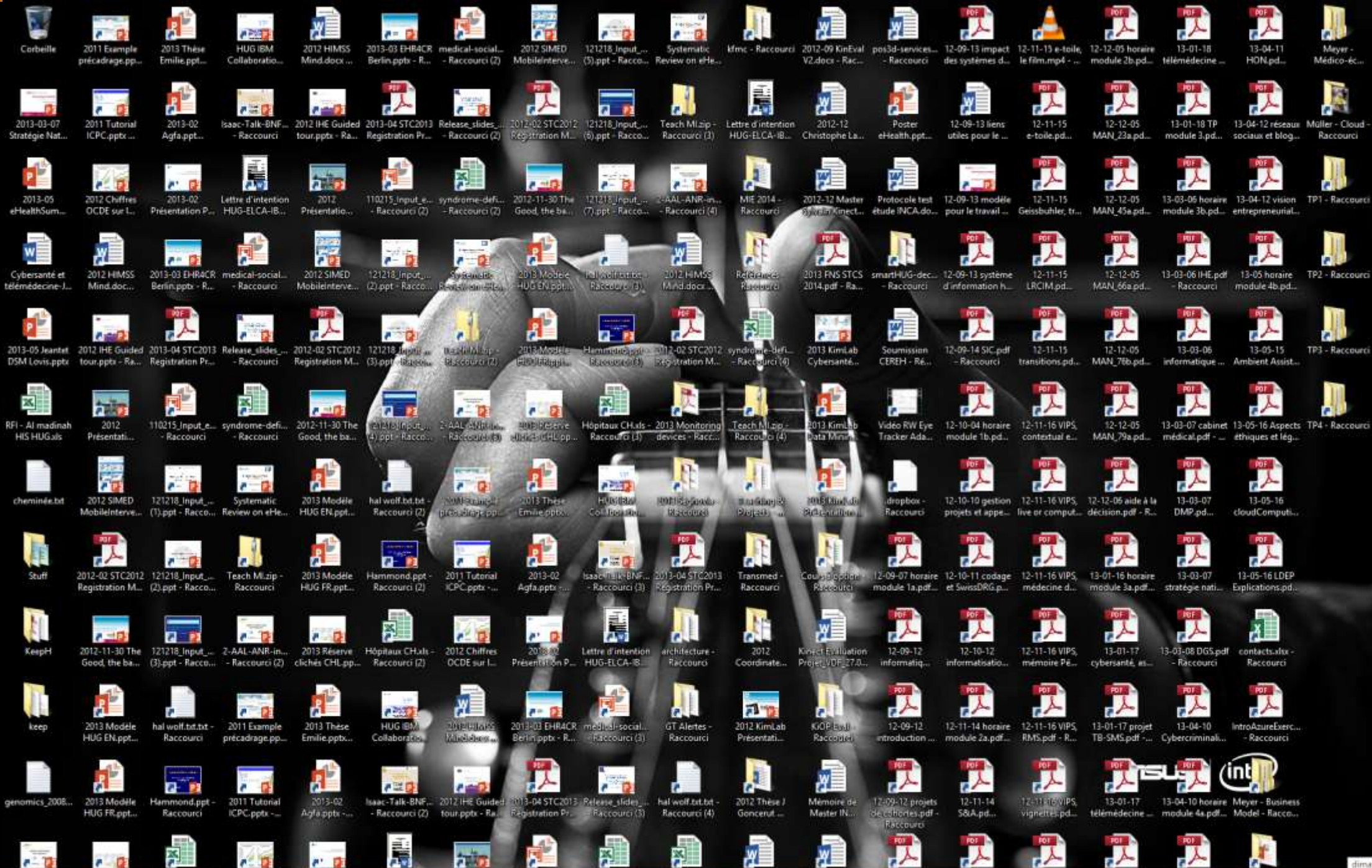


**Figure 24** COVID-19, mobilité TPG – nombre de montées par semaine sur les lignes TPG principales, secondaires et transfrontalières

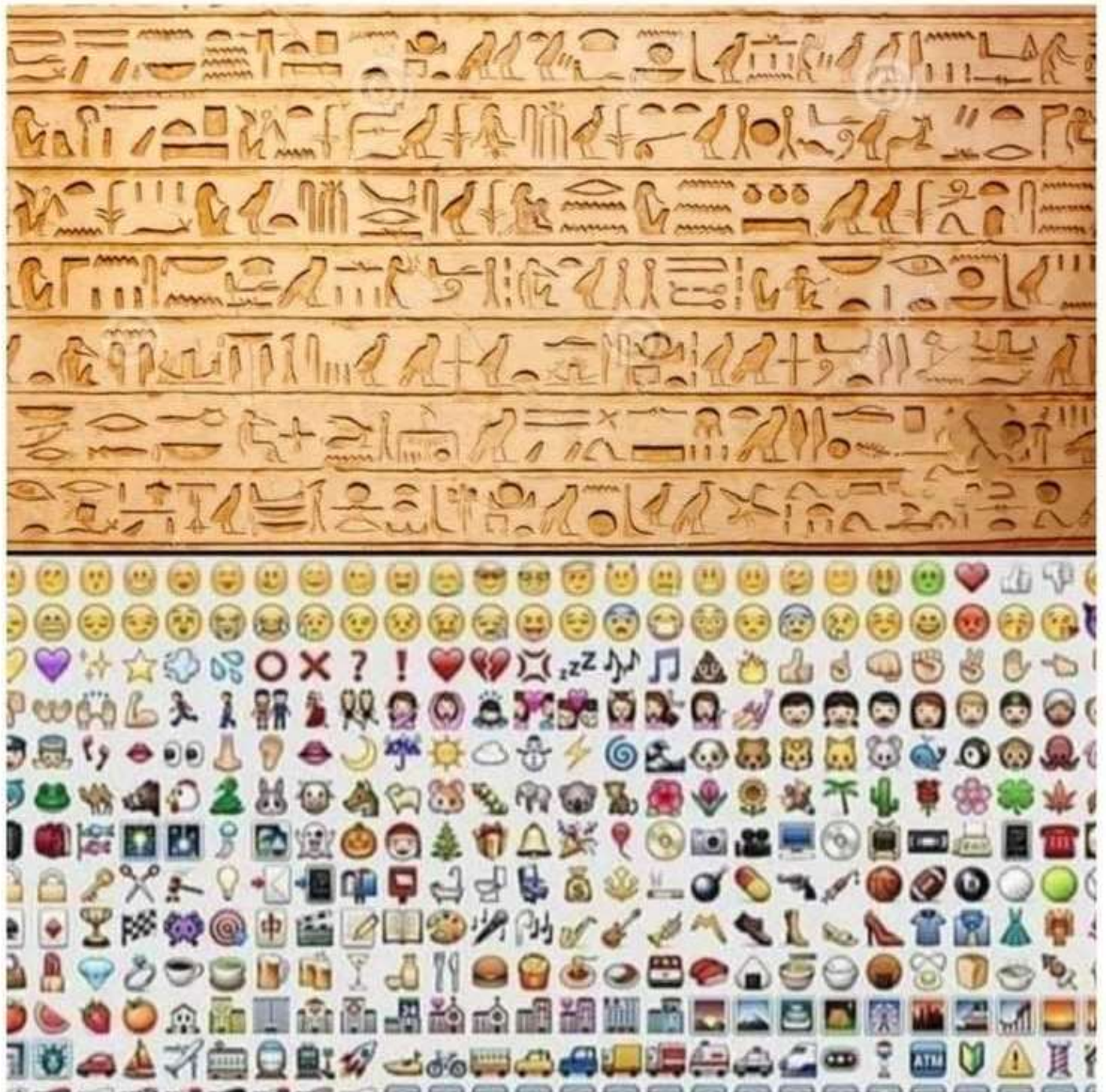
- Sept semaines après les vacances de Pâques, augmentation nette de la mobilité au dessus du seuil de référence.

*Ces données proviennent notamment de sources externes (Apple) sans disponibilité des données brutes.*





# 4'000 and d'évolution ...







TECH

# Epic's CEO is urging hospital customers to oppose rules that would make it easier to share medical info

PUBLISHED WED, JAN 22 2020-7:05 PM EST | UPDATED WED, JAN 22 2020-7:06 PM EST



Christina Farr

SHARE f t in e

## KEY POINTS

- Epic Systems is urging its health system customers to take a stand against the U.S. Department of Health and Human Services' proposed rules to make it easier to share patient data.
- Epic's CEO Judy Faulkner says that patient privacy will be negatively impacted.
- Privately held Epic is one of the leading providers of electronic medical records in the U.S.



Judith Faulkner, CEO of healthcare IT giant Epic Systems.  
Source: Epic Systems

## TRENDING NOW



Meet the middle-aged millennial: Homeowner, debt-burdened and turning 40



This 34-year-old mom quit her job to work on her side hustle full-time—and made \$300,000 in one year



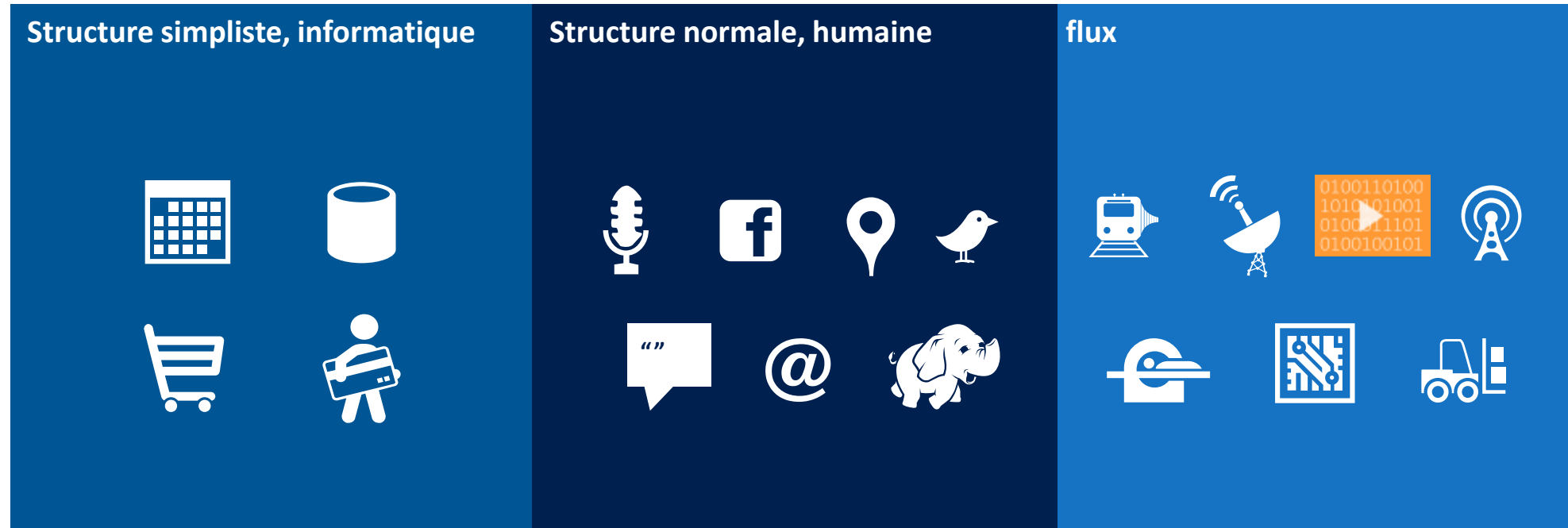
GM unveils electric Hummer SUV topping \$110,000



How much you need to save per month to retire at 45 with \$35,000 in passive income



U.S. companies face boycott threats, mounting pressure to take sides in battle over voting rights



- ▶ Les structures simplistes sont nées avec l'Informatique et sont des simplifications parfois pertinentes
- ▶ Les structures complexes sont les structures naturelles, comme l'image, le son et le texte
- ▶ Les sources du monde réel ne sont jamais figées
- ▶ Les sources sont hétérogènes, multimodales, et superposent de multiples informations





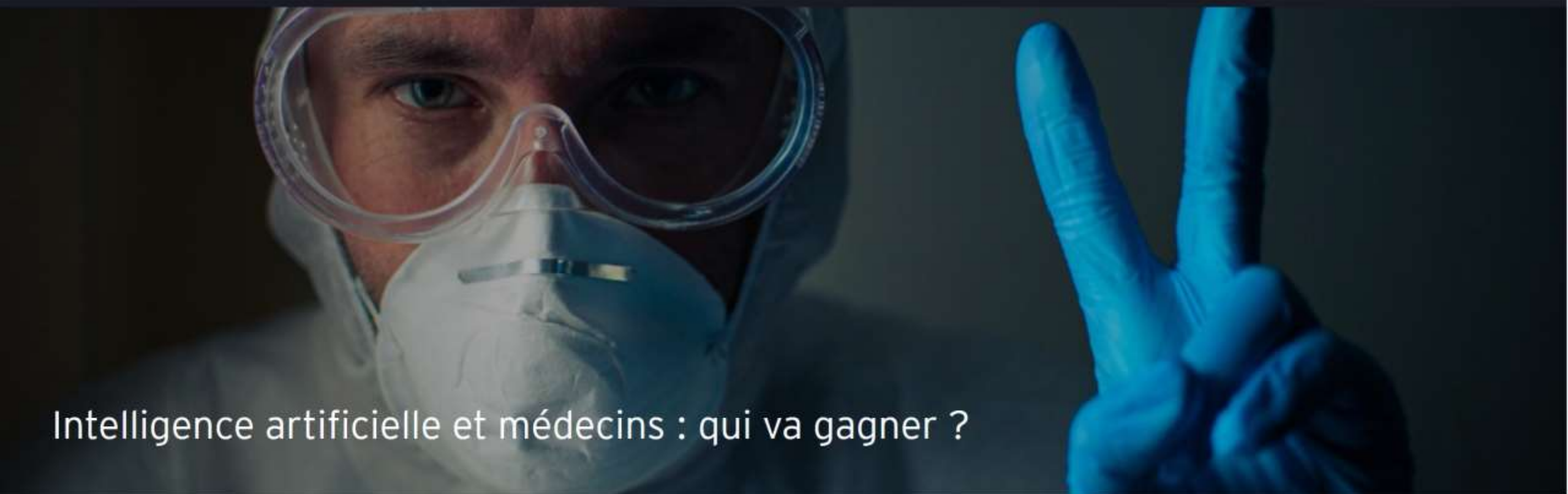
## Business Report

# IBM Aims to Make Medical Expertise a Commodity

Big Blue thinks its *Jeopardy!* champion Watson can make money by offering health-care providers new expertise without hiring new staff.

by Tom Simonite    July 21, 2014





# Intelligence artificielle et médecins : qui va gagner ?

## Auteurs

### Nihal Filali

Associée, Consulting, Digital healthcare leader, France

### Alain Livartowski

Médecin oncologue - Conseiller médical - Direction des data, Institut Curie

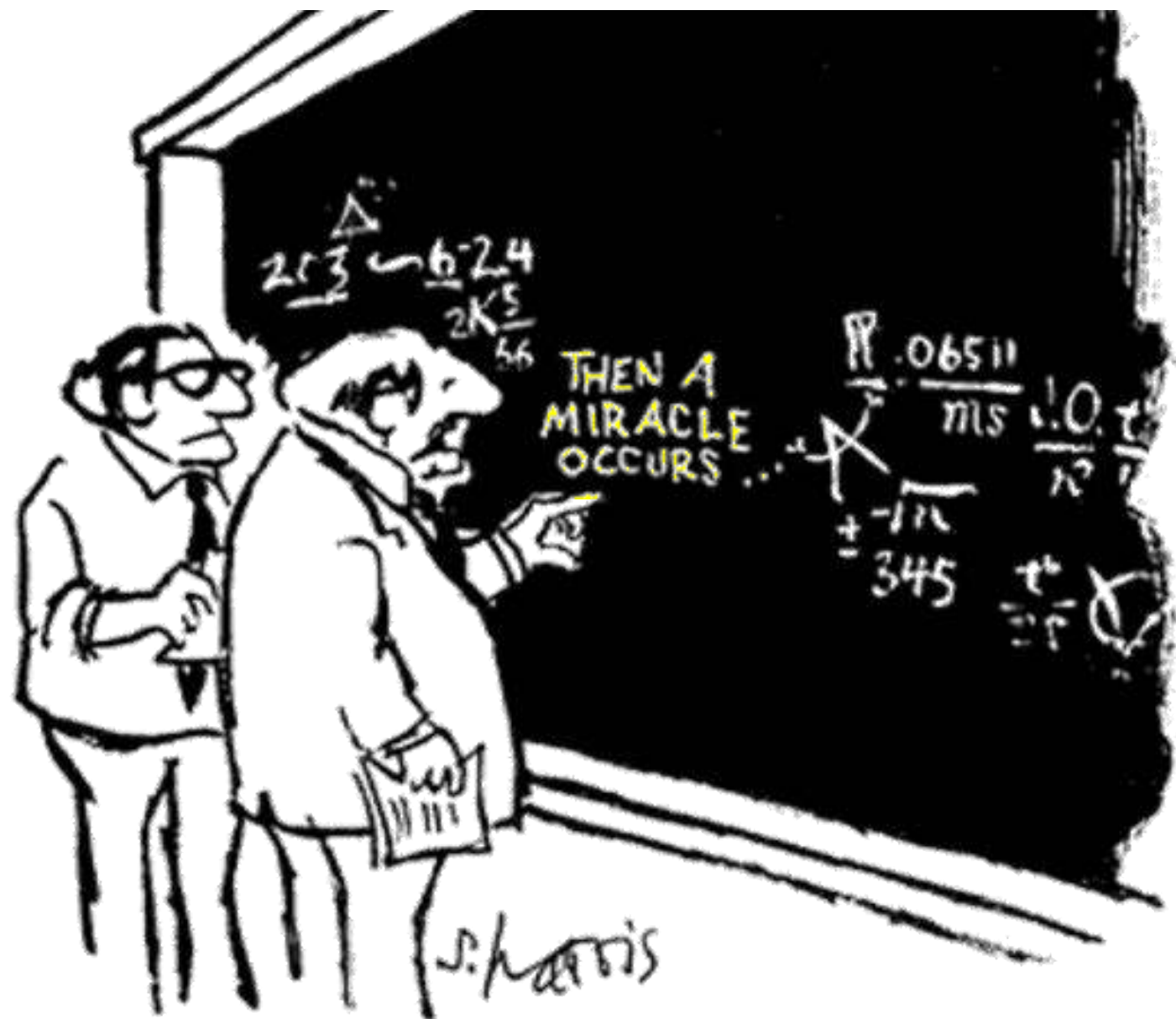
### Loïc Chabanier

Associé, Consulting, Healthcare leader, France et Europe West

L'IA ouvre la voie à une nouvelle médecine, plus prédictive mais va-t-elle pour autant remplacer le médecin ?

## En résumé

- L'IA dispose de capacités supérieures à l'homme mais jusqu'à un certain point
- La dimension humaine ne pourra jamais être apportée par l'intelligence artificielle



"I think you should be more explicit here in step two."



ARTIFICIAL INTELLIGENCE

# Hundreds of AI tools have been built to catch covid. None of them helped.

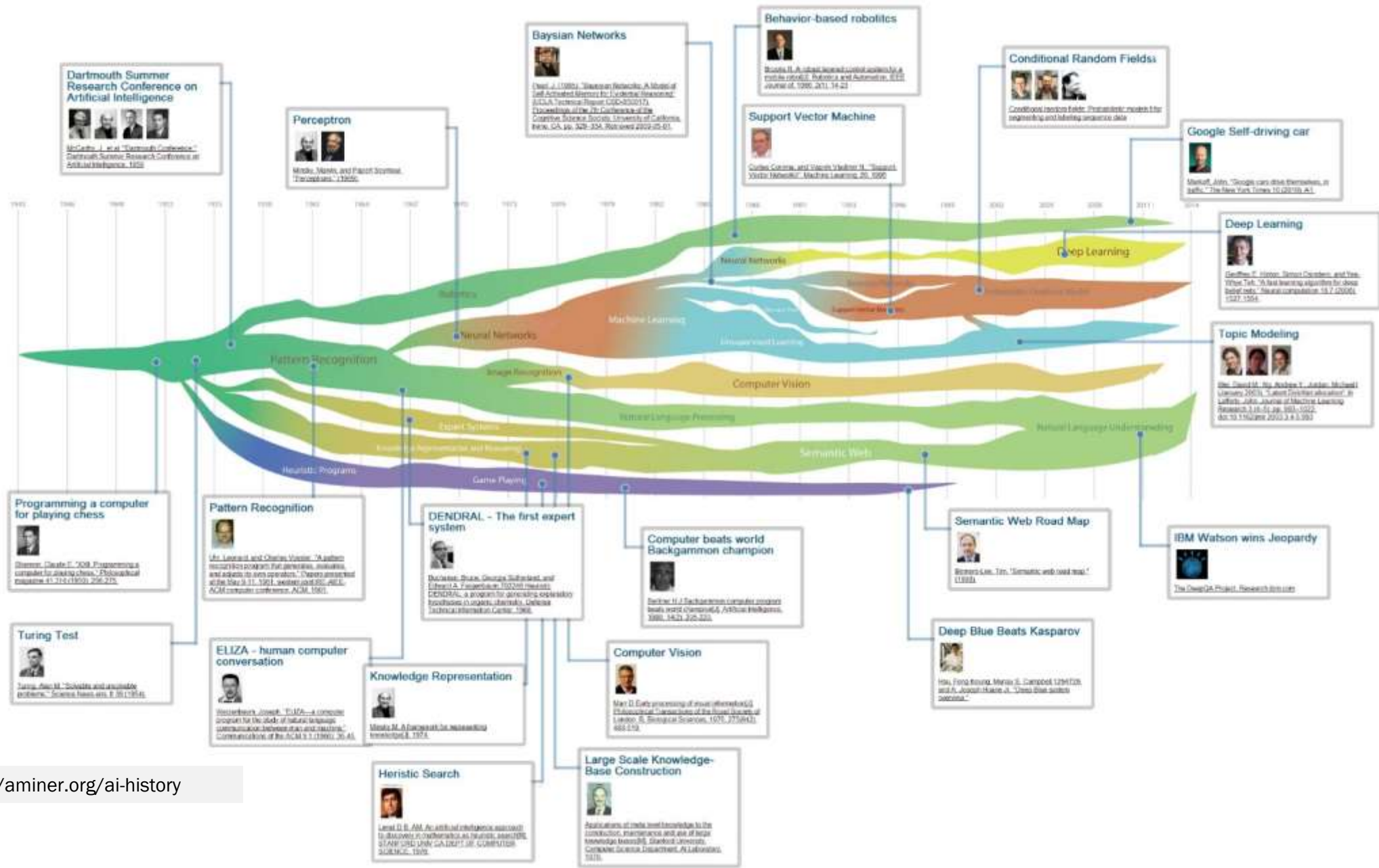
Some have been used in hospitals, despite not being properly tested. But the pandemic could help make medical AI better.

By Will Douglas Heaven

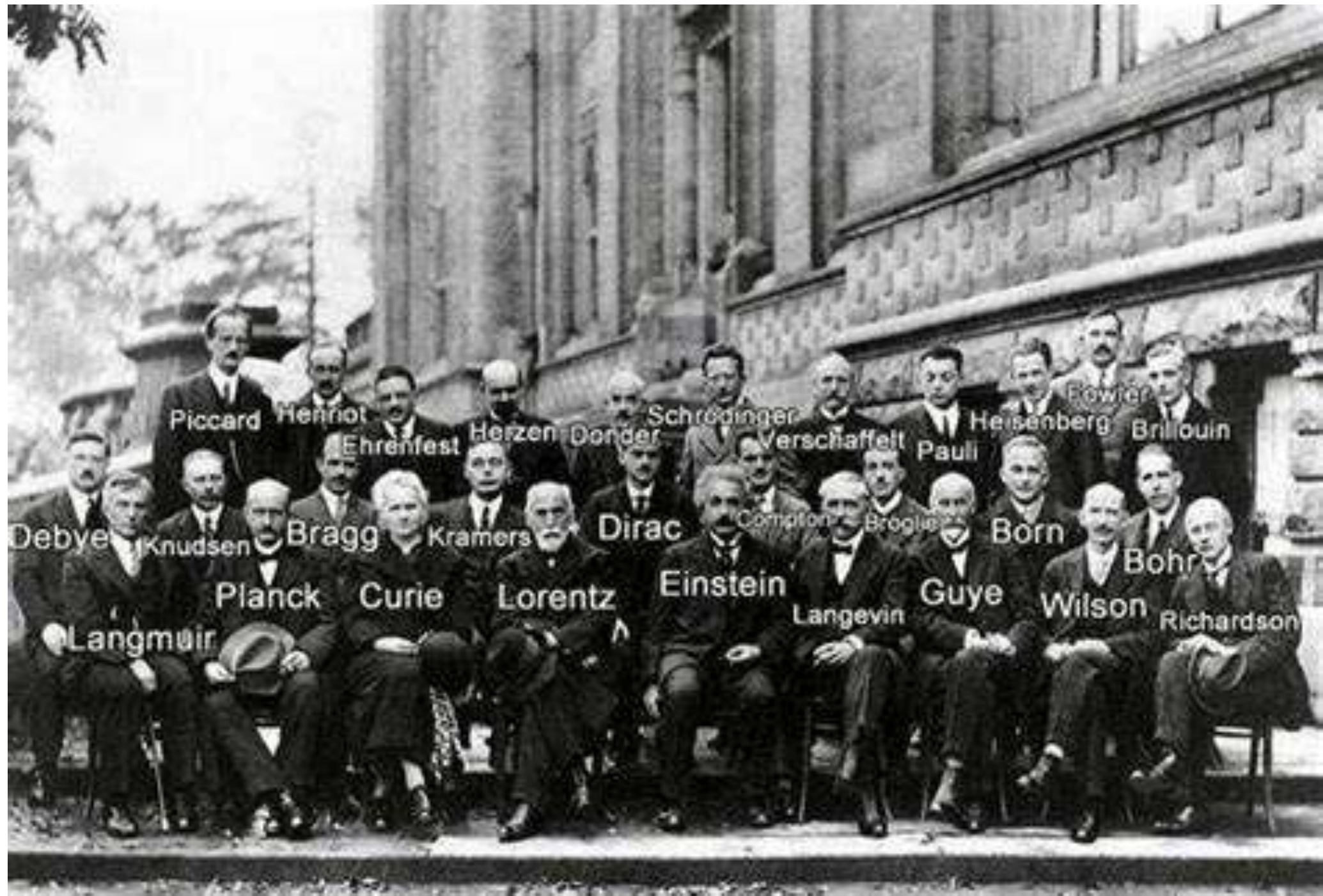
July 30, 2021



<https://www.technologyreview.com/2021/07/30/1030329/machine-learning-ai-failed-covid-hospital-diagnosis-pandemic/>  
Accessed Octobe 24th, 2021



<https://aminer.org/ai-history>



Piccard

Henriot

Ehrenfest

Herzen

Dönder

Schrödinger

Verschaffelt

Pauli

Heisenberg

Brillouin

Debye

Knudsen

Bragg

Kramers

Dirac

Compton

Broglie

Born

Bohr

Planck

Curie

Lorentz

Einstein

Guye

Wilson

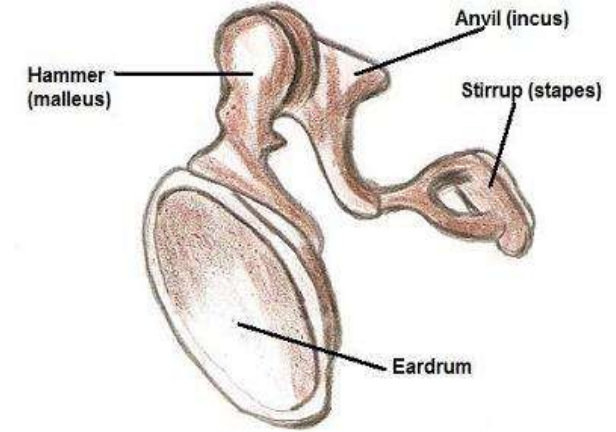
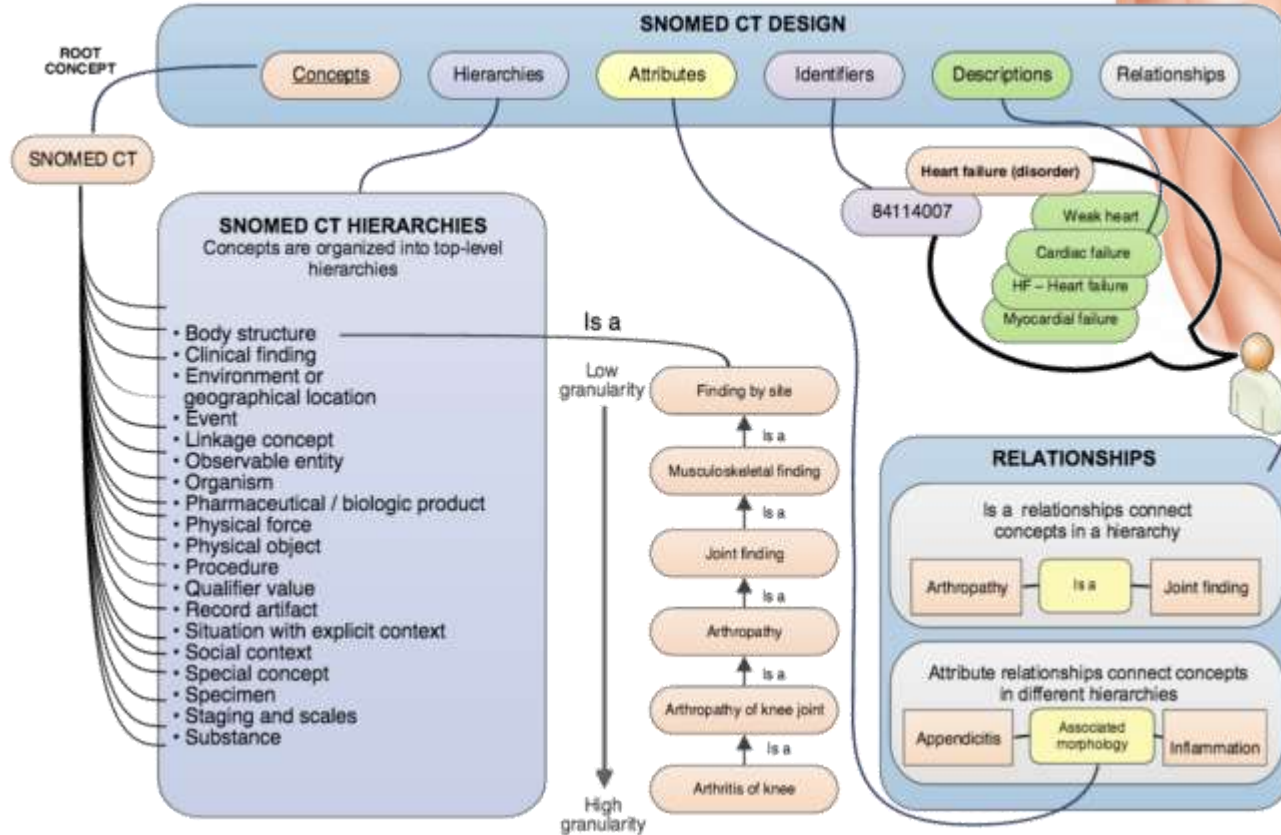
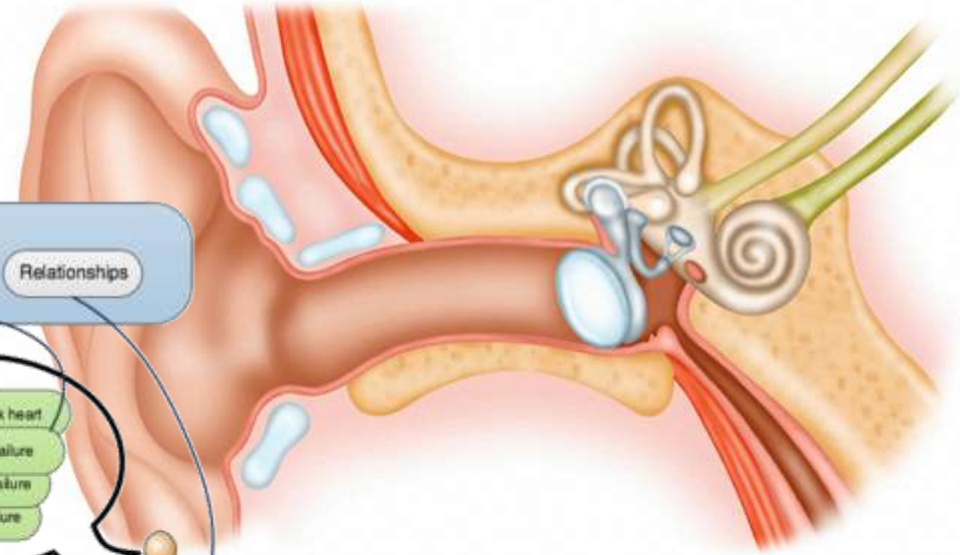
Richardson

Langmuir

Langevin

# SNOMED CT

The global language of healthcare



Sketched By Abhishake Sharma

Lieu	Date	Titre	Source	Résumé	SNOMED-CT
Genève- Anemasse	2020-03-17	Le Léman Express réduit son offre	24 heures	Mesure de prévention - transport public - train - offre diminuée - Genève	169443000   Preventive procedure (procedure)  + 62193008   Railway train, device (physical object)  + 1250004   Decreased (qualifier value)  +
Cugy	2020-03-18	14 personnes contaminées dans un même chœur	24 heures	Cluster - chœur	409520002   Geographical cluster (qualifier value)
Vaud	2020-03-18	Les adolescents vaudois sortent en masse pour profiter du beau temps	24 heures	Comportement à risque - adolescents	112082005   Inappropriate behavior (finding)  + 78648007   At risk for infection (finding)  + 133937008   Adolescent (person)

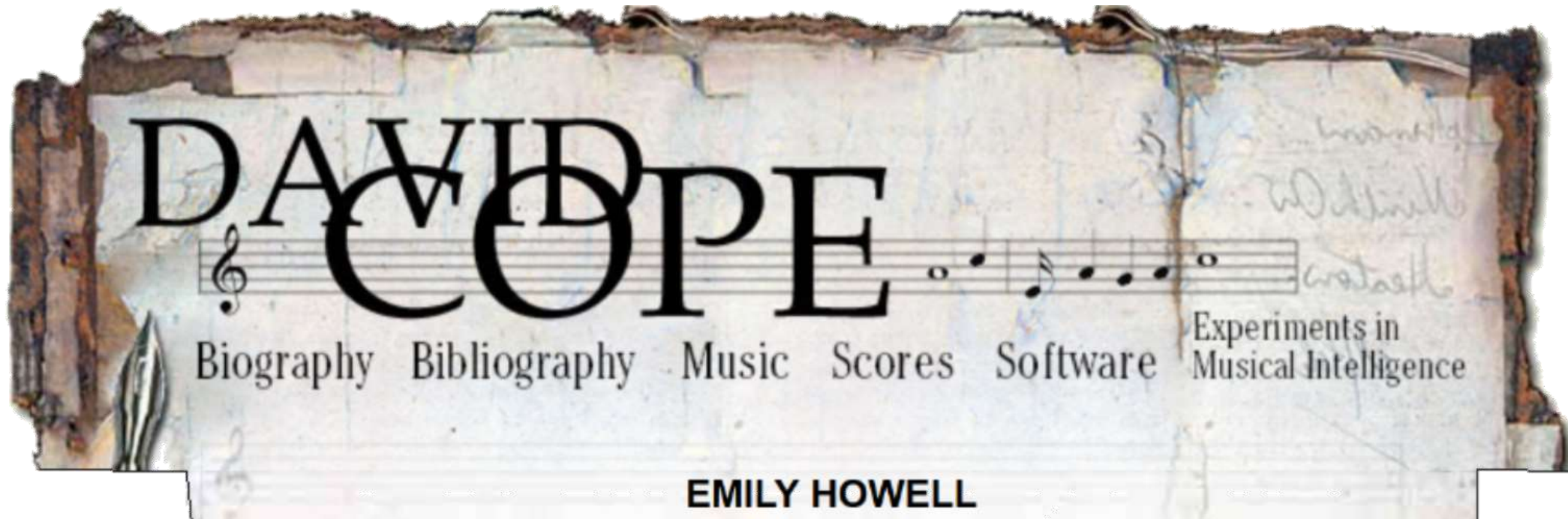


# AI driven publications in medicine (Topol @ twitter)

Prediction	N	AUC	Reference
In-hospital mortality, unplanned readmission, prolonged LOS, final discharge diagnosis	216,221	0.93* 0.75+ 0.85#	Rajkomar et al, Nature NPJ Digital Medicine, 2018
All-cause 3-12 month mortality	221,284	0.93^	Avati et al, arXiv, 2017
Readmission	1,068	0.78	Shameer et al, Pacific Symposium on Biocomputing, 2017
Sepsis	230,936	0.67	Horng et al, PLOS One, 2017
Septic shock	16,234	0.83	Henry et al, Science, 2015
C. Difficile infection	256,732	0.82 <sup>++</sup>	Oh et al, Infection Control and Epidemiology, 2018
Developing diseases	704,587	range	Miotto et al, Scientific Reports, 2018
Diagnosis	18,590	0.96	Yang et al, Scientific Reports, 2018
Dementia	76,367	0.91	Cleret de Langavant et al, J Internet Med Res 2018
Alzheimer's Disease (+ amyloid imaging)	273	0.91	Mathotaarachchi et al, Neurobiology of Aging, 2017
Mortality after cancer chemotherapy	26,946	0.94	Elfiky et al, JAMA Open, 2018
Disease onset for 133 conditions	298,000	range	Razavian et al, arXiv, 2016

AUC-area under the curve, a metric of accuracy, LOS-length of stay, N-Number of patients (training + validation datasets),

\*-in-hospital mortality, +-unplanned readmission, #-prolonged LOS, ^-all patients, ++-for U of Michigan site



Bach style chorale



Emmy Vivaldi



Emmy Beethoven beg 2

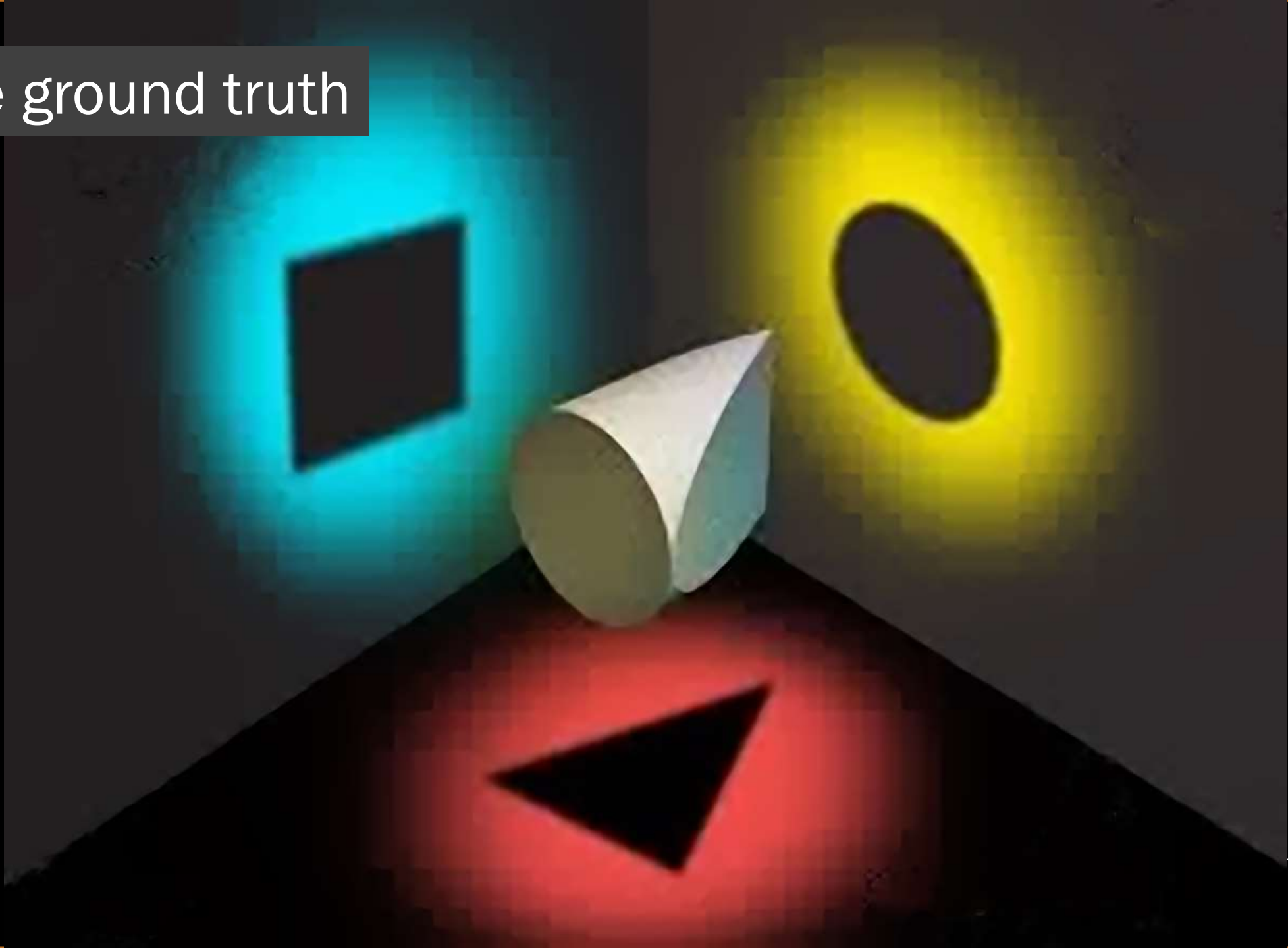


AI in music

David Cope, The Emily Howell project



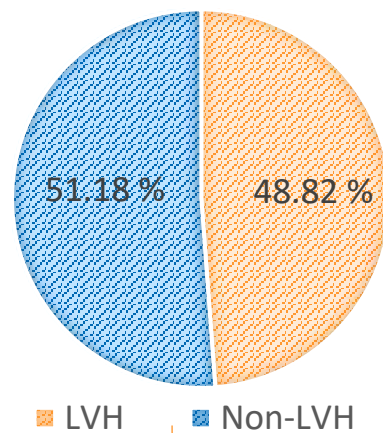
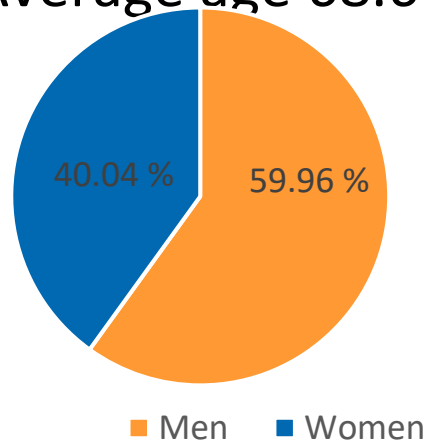
The ground truth



# Dataset Statistics

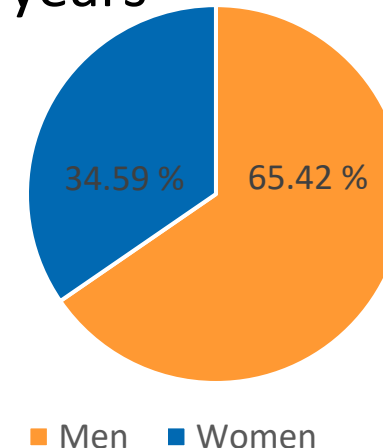
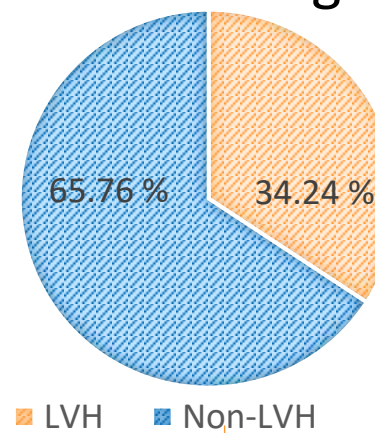
## Annotated based on Echocardiography

- 70'450 annotated ECGs
- Covers 11'969 distinct patients
- Average age 68.6 years



## Annotated based on MRI

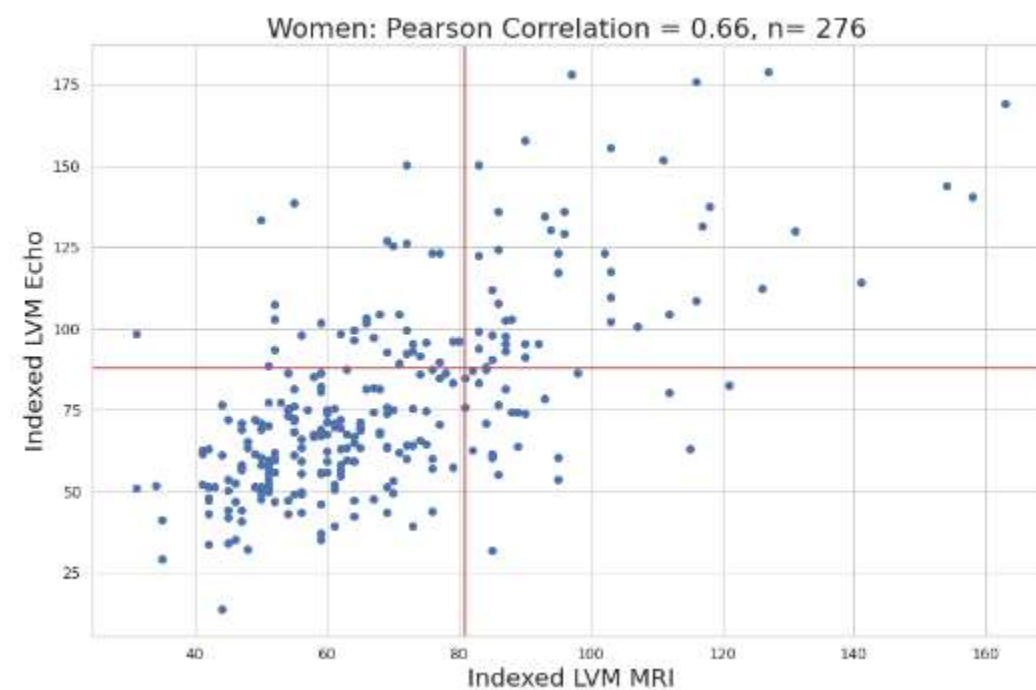
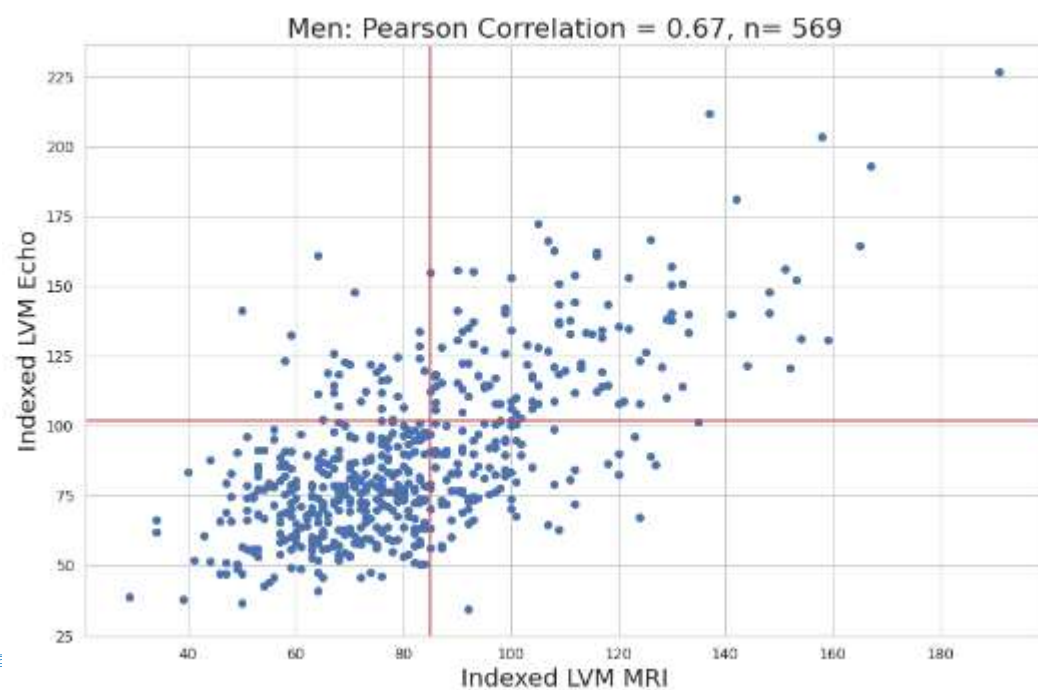
- 6'711 annotated ECGs
- Covers 1020 distinct patients
- Average age 60.3 years



- 4683 ECGs annotated with both modalities
- 65.4% agreement

# Diagnostic agreement

		Echocardiography		Total
		+	-	
MRI	+	1140	553	1693
	-	1067	1923	2990
Total		2207	2476	4683

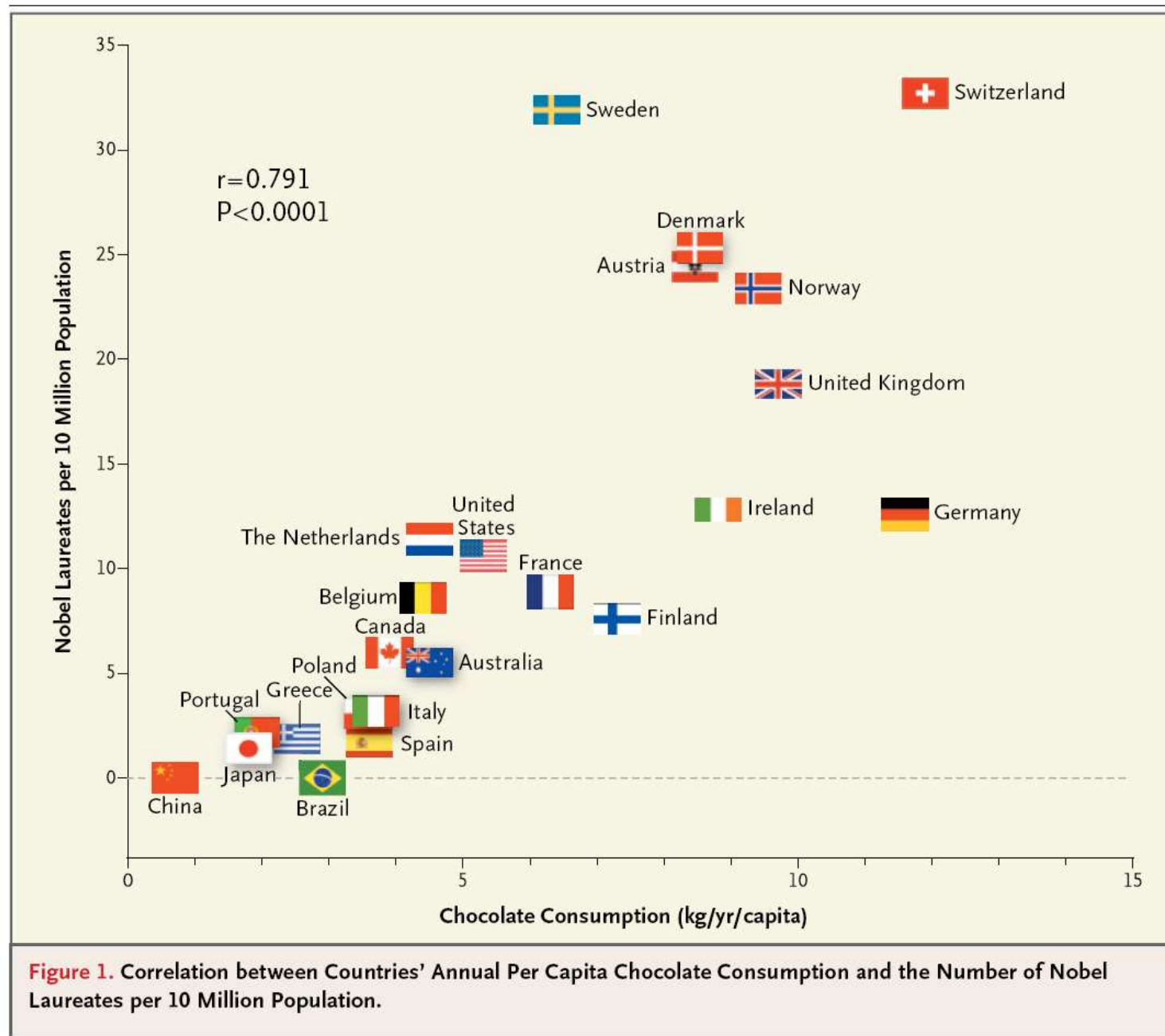


Messerli FH.

Chocolate consumption, cognitive function, and Nobel laureates.

N Engl J Med. 2012  
Oct 18 367(16):1562-4.

PubMed PMID: 23050509



**Figure 1.** Correlation between Countries' Annual Per Capita Chocolate Consumption and the Number of Nobel Laureates per 10 Million Population.

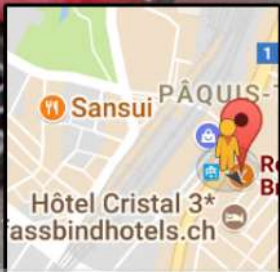
Place de Cornavin

Genève

Google, Inc.

Street View - août 2014

26.05.2018

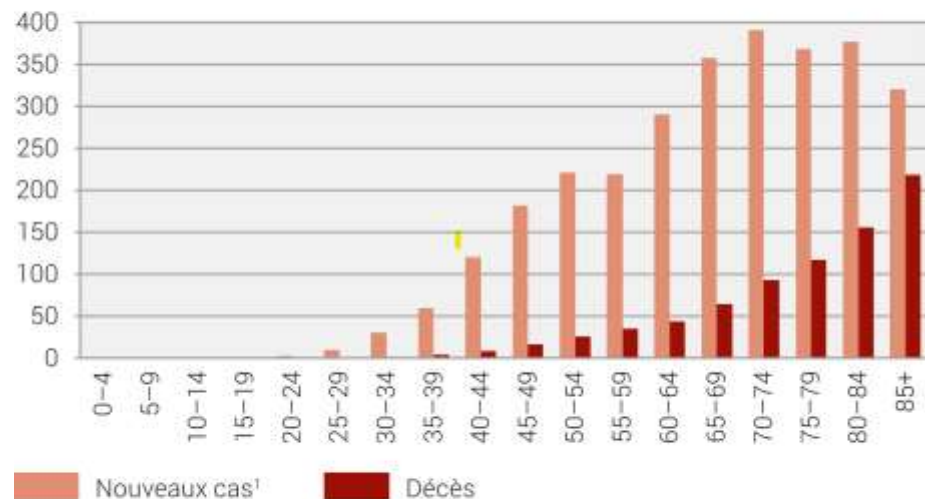


Google

## Cancer du sein selon l'âge, de 2013 à 2017

Taux spécifique par âge, pour 100 000 habitantes

Femmes



<sup>1</sup> nouveaux cas estimés sur la base des données des registres des tumeurs

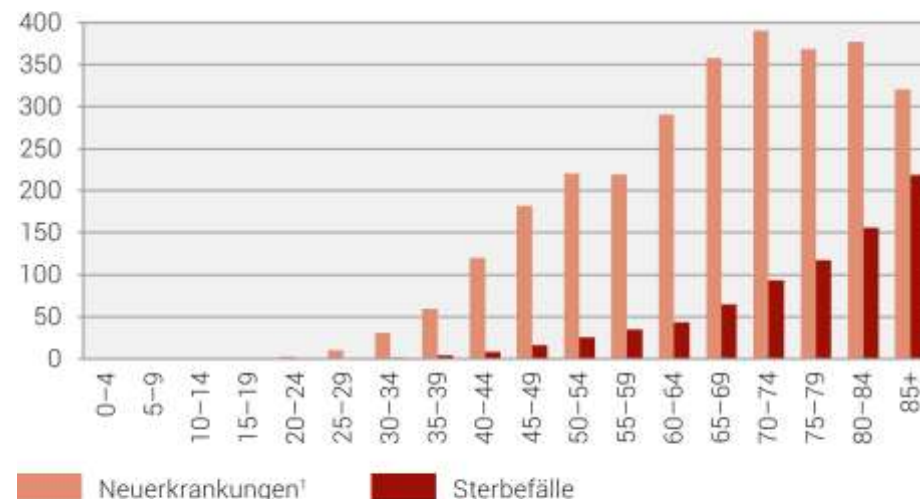
Sources: ONEC – Nouveaux cas; OFS – Décès

© OFS 2020

## Brustkrebs nach Alter, 2013–2017

Altersspezifische Rate, pro 100 000 Einwohnerinnen

Frauen



<sup>1</sup> Neuerkrankungen geschätzt aufgrund der Daten der Krebsregister

Quellen: NKRS – Neuerkrankungen; BFS – Sterbefälle

© BFS 2020

	Radiologist	Radiologist + AI
<b>Specificity</b>	88%	95%
<b>Sensitivity</b>	86%	95%
<b>Prevalence</b>	1%	1%
<b>PPV=</b>	6%	16%

$$\Pr(D|+) = \frac{\Pr(+|D) \Pr(D)}{\Pr(+)} = \frac{\Pr(+|D) \Pr(D)}{\Pr(+|D) \Pr(D) + \Pr(+|\sim D) \Pr(\sim D)}$$

$$= \frac{\text{sensitivity} \times \text{prevalence}}{\text{sensitivity} \times \text{prevalence} + (1 - \text{specificity}) \times (1 - \text{prevalence})}$$



SHARE

IN DEPTH COMPUTER SCIENCE



0



0

# Artificial intelligence faces reproducibility crisis

Matthew Hutson

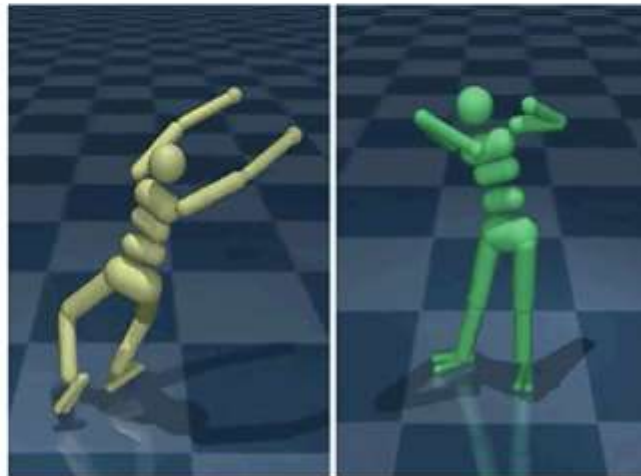
[+ See all authors and affiliations](#)*Science* 16 Feb 2018:

Vol. 359, Issue 6377, pp. 725-726

DOI: 10.1126/science.359.6377.725

**Article**[Figures & Data](#)[Info & Metrics](#)[eLetters](#)[PDF](#)

Last year, computer scientists at the University of Montreal (U of M) in Canada were eager to show off a new speech recognition algorithm, and they wanted to compare it to a benchmark, an algorithm from a well-known scientist. The only problem: The benchmark's source code wasn't published. The researchers had to recreate it from the published description. But they couldn't get their version to match the benchmark's claimed performance, says Nan Rosemary Ke, a Ph.D. student in the U of M lab. "We tried for 2 months and we couldn't get anywhere close."



The same algorithm can learn to walk in wildly different ways.

IMAGES: YUVAL TASSA

## MATHEMATICS

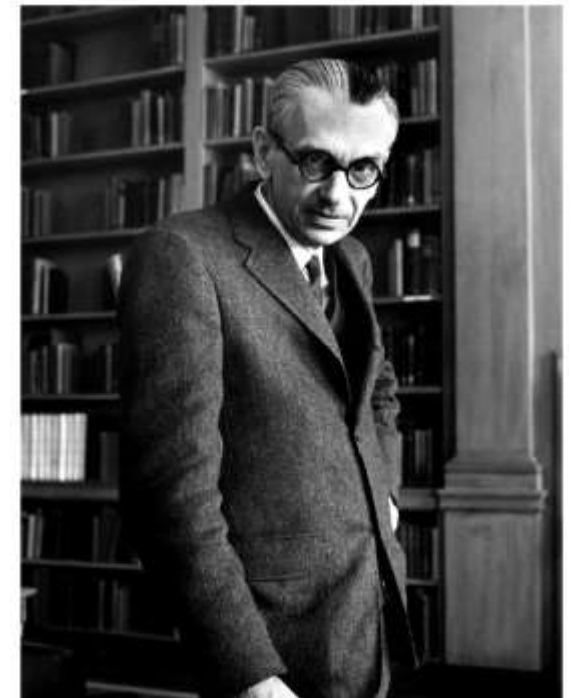
# Machine learning comes up against unsolvable problem

*Researchers run into a logical paradox discovered by famed mathematician Kurt Gödel.*

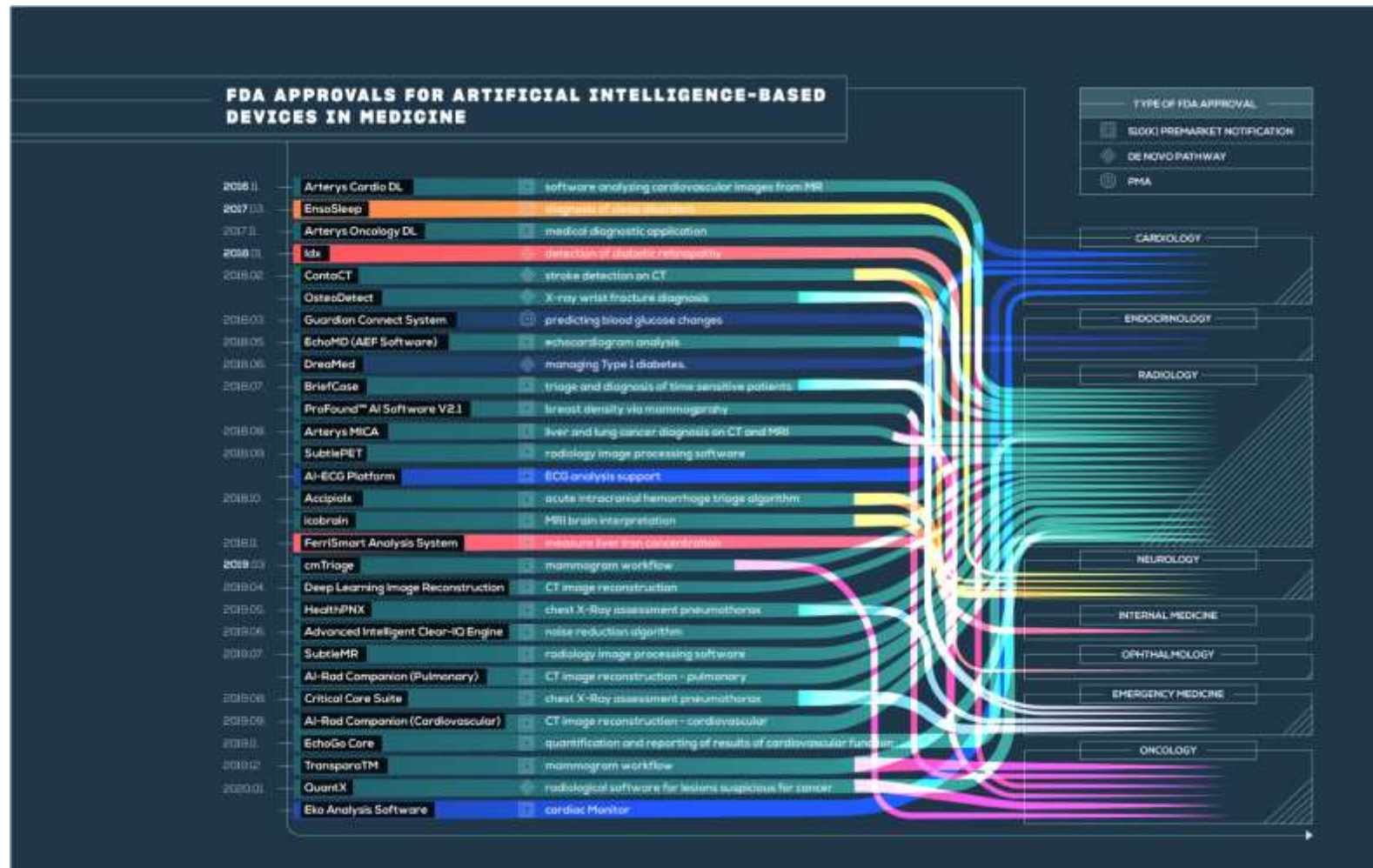
Castelvecchi D. Machine learning leads mathematicians to unsolvable problem. Nature. 2019 Jan 8;565:277–277.

17 JANUARY 2019 | VOL 565 | NATURE | 277

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Benjamins, Stan, Pranavsinh Dhunnoo, and Bertalan Meskó. 'The State of Artificial Intelligence-Based FDA-Approved Medical Devices and Algorithms: An Online Database'. *Npj Digital Medicine* 3, no. 1 (December 2020): 118. <https://doi.org/10.1038/s41746-020-00324-0>.

# THE LANCET

## Digital Health

FEATURE

"Deep learning advances in health care ultimately has to be driven by clinicians and has to be patient-centred...We need to know this is not magic."

<https://www.thelancet.com/journals/landig/home>  
Accessed Sept 11th, 2019

# THE LANCET

Volume 392 | Number 10142 | Pages 95-186 | July 14-20, 2018

[www.thelancet.com](http://www.thelancet.com)

“Continuing to argue for digital exceptionalism and failing to robustly evaluate digital health interventions presents the greatest risk for patients and health systems.”

See Editorial page 95

## Editorial

Food security in the Middle East and north Africa  
See page 96

## Articles

Pembrolizumab versus paclitaxel for advanced gastric or gastro-oesophageal junction cancer  
See page 122

## Articles

Continuing versus withdrawing adjuvant trastuzumab in non-metastatic breast cancer: a randomised controlled trial  
See page 134

## Articles

Community-acquired serious infections among young children in south Asia  
See page 141

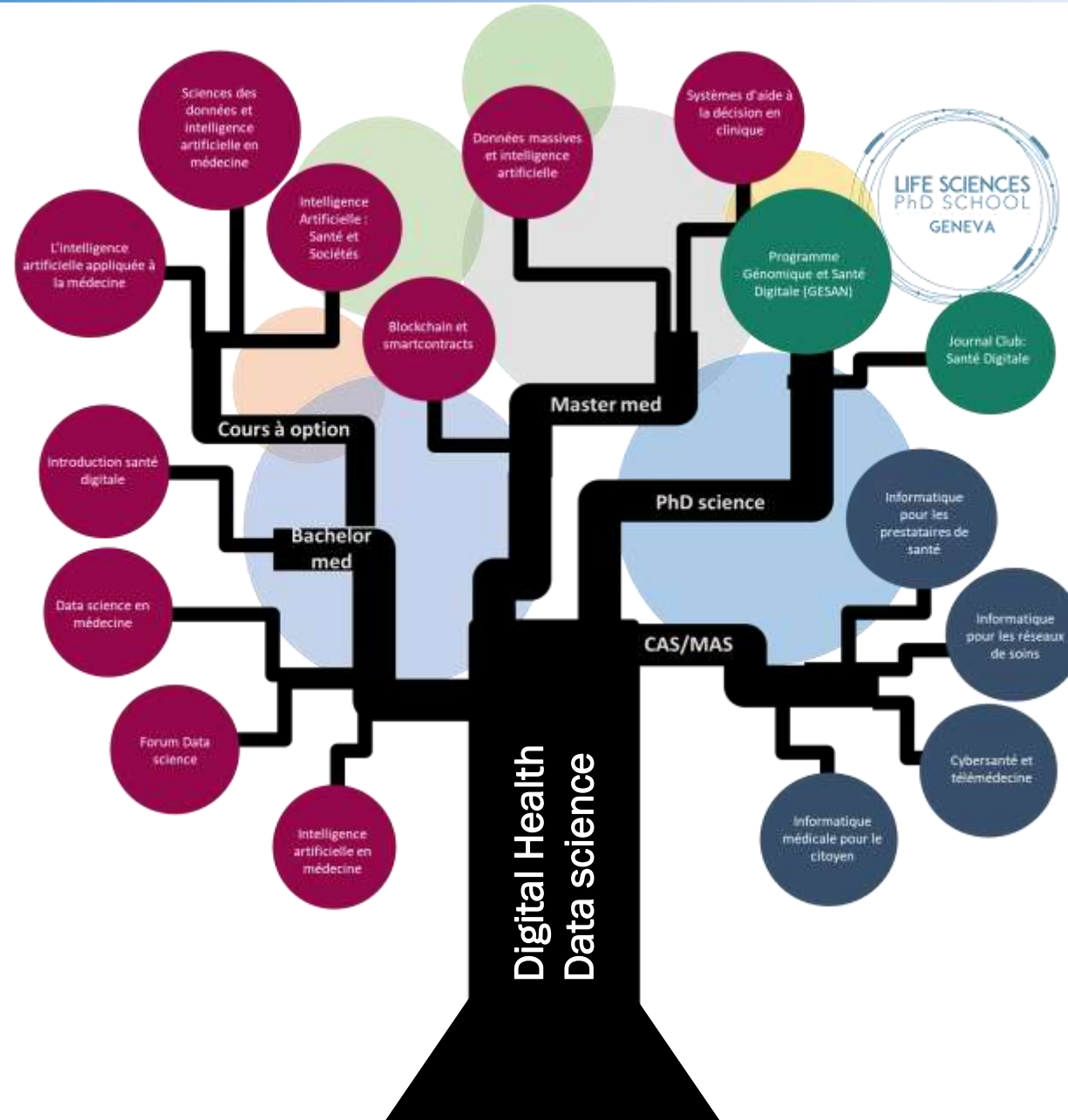
## Seminar

Adult rheumatic fever  
See page 143

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14 July 2018  
Volume 392, Issue 10142

# Formation, formation, formation !!



GÉNOMIQUE ET SANTÉ NUMÉRIQUE

