



ASSOCIAZIONE ITALIANA EMATOLOGIA  
ONCOLOGIA PEDIATRICA

# Introduzione all'Intelligenza Artificiale

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IRCCS ICS Maugeri, Pavia

Università di Pavia

Bologna, 3 Ottobre 2023

# XLVIII

CONGRESSO NAZIONALE

# AIEOP

Bologna

2-4 Ottobre 2023

***Il sottoscritto Riccardo Bellazzi***

*ai sensi dell'art. 3.3 sul Conflitto di Interessi, pag. 17 del Reg. Applicativo dell'Accordo Stato-Regione del 5 novembre 2009,*

dichiara

☐ *che negli ultimi due anni ha avuto rapporti diretti di finanziamento con i seguenti soggetti portatori di interessi commerciali in campo sanitario:*

- *Biomeris s.r.l.*
- *Engenome s.r.l.*

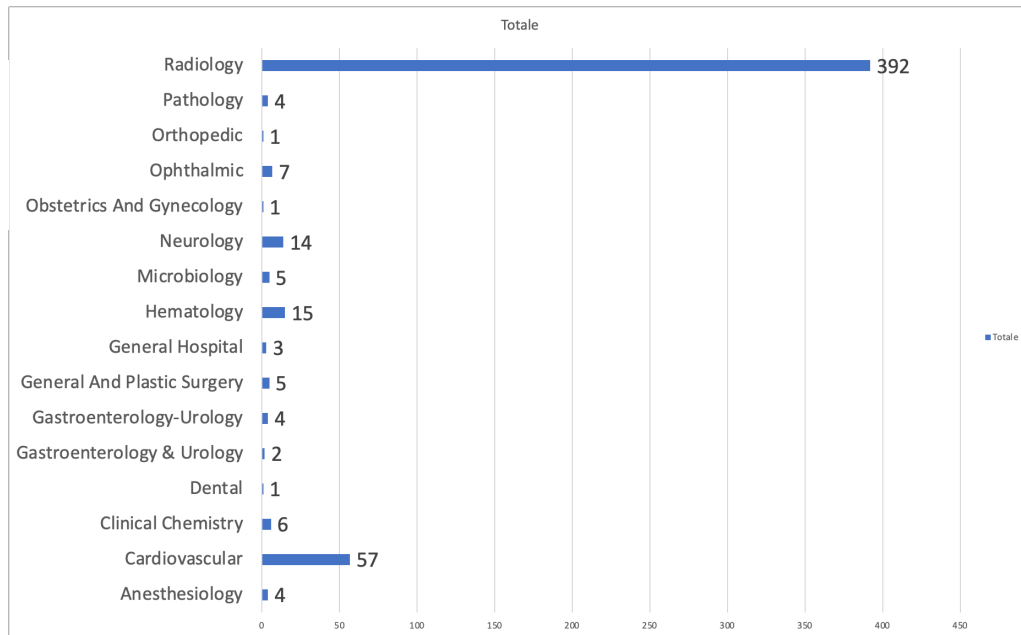
## Artificial Intelligence and Machine Learning (AI/ML)-Enabled Medical Devices

**October 5, 2022 update:** 178 Artificial Intelligence and Machine Learning (AI/ML)-Enabled Medical Devices were added to the list below. With this update, the FDA has also added the ability to download the list as an Excel file.



### Artificial Intelligence/Machine Learning (AI/ML)-Based Software as a Medical Device (SaMD) Action Plan

January 2021





## DOCTOR PENGUIN

Catch the Latest AI + Healthcare Research



Eric Topol  
Professor,  
Molecular  
Medicine, Scripps  
Research



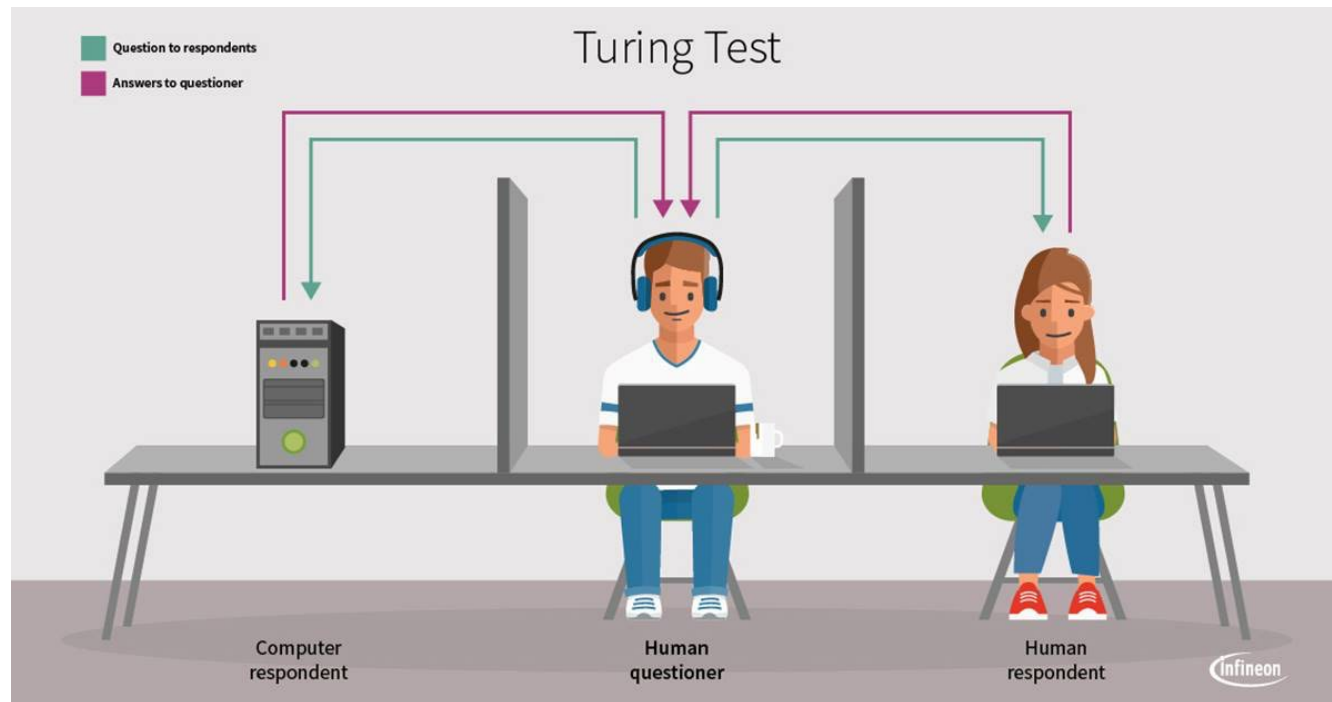
Andrew Ng  
Professor of  
Computer Science,  
Stanford University



Tuesday, September 13, 2022

NIH launches Bridge2AI program to expand the use of  
artificial intelligence in biomedical and behavioral  
research





Nel 2022 il test di Turing è stato superato  
... 2 volte (LaMDA + ChatGPT)

The NEW ENGLAND JOURNAL of MEDICINE

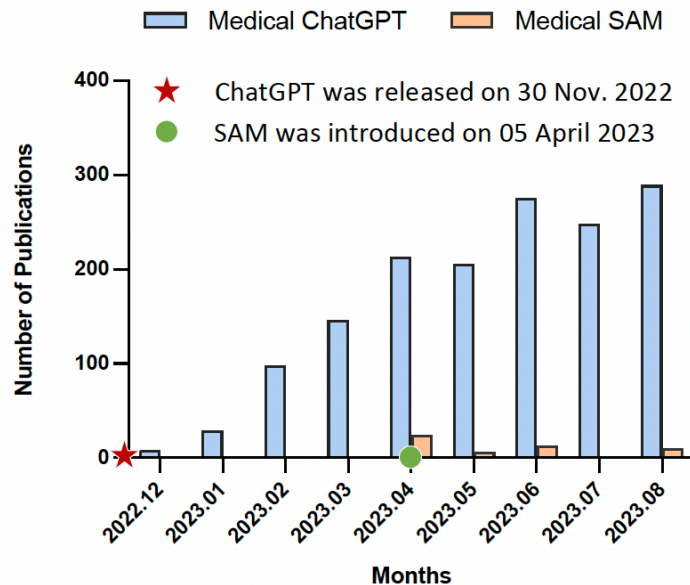
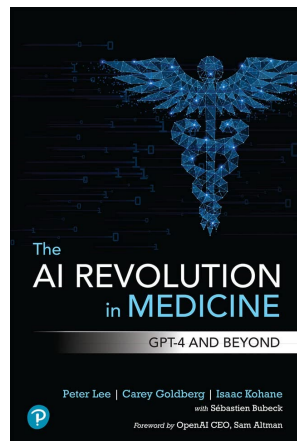
## EDITORIALS



### Artificial Intelligence in Medicine

Andrew L. Beam, Ph.D., Jeffrey M. Drazen, M.D., Isaac S. Kohane, M.D., Ph.D.,  
Tze-Yun Leong, Ph.D., Arjun K. Manrai, Ph.D., and Eric J. Rubin, M.D., Ph.D.

**COMING SOON**  
**NEJM AI – A NEW JOURNAL**



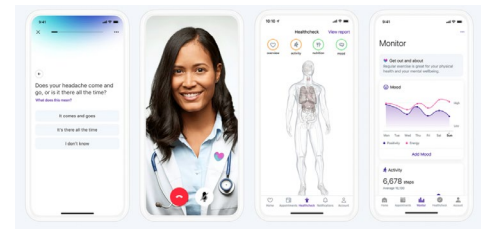
## Intelligenza Artificiale - una definizione

L'intelligenza artificiale (IA) è l'abilità di una macchina di mostrare capacità umane quali il ragionamento, l'apprendimento, la pianificazione e la creatività.



Parlamento europeo

**Software:** assistenti virtuali e sistemi di supporto alle decisioni, software di analisi di immagini, motori di ricerca, sistemi di riconoscimento facciale e vocale



**Embodied intelligence:** robot, veicoli autonomi, droni, l'internet delle cose



L'intelligenza artificiale (IA) è l'abilità di una macchina di mostrare capacità umane quali il **ragionamento**, l'apprendimento, la **pianificazione** e la creatività.

**Pre-AI-winter**

## ARTIFICIAL INTELLIGENCE IN MEDICINE

Proceedings of the International Conference on  
Artificial Intelligence in Medicine  
Pavia, Italy, 13-14 September, 1985

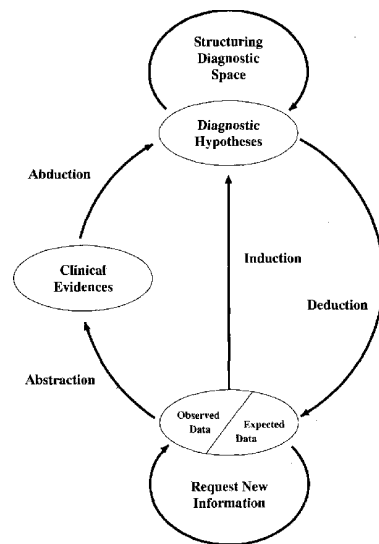


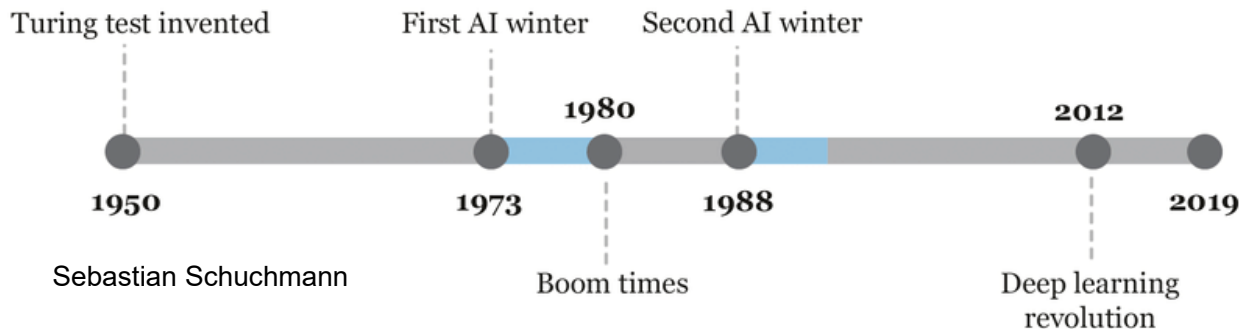
Fig. 3. Specializing the STModel in the diagnostic task.





(H. Simon, 1983):

“Forse la ragione più profonda per le ricerche nel campo dell'apprendimento automatico è che, sul lungo periodo e per grandi basi di conoscenza, **apprendere** risulterà molto **più efficiente** che **esplicitare o programmare la conoscenza stessa**, per quanto il processo di apprendimento possa essere inefficiente.”



L'intelligenza artificiale (IA) è l'abilità di una macchina di mostrare capacità umane quali il ragionamento, l'**apprendimento**, la pianificazione e la **creatività**.

## Post-AI-winter

Artificial Intelligence in Medicine 65 (2015) 61–73



ELSEVIER

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Artificial Intelligence in Medicine

journal homepage: [www.elsevier.com/locate/aiim](http://www.elsevier.com/locate/aiim)



Thirty years of artificial intelligence in medicine (AIME) conferences:  
A review of research themes



Niels Peek<sup>a,\*</sup>, Carlo Combi<sup>b</sup>, Roque Marin<sup>c</sup>, Riccardo Bellazzi<sup>d</sup>

<sup>a</sup> Health e-Research Centre, Institute of Population Health, University of Manchester, Vaughan House, Portsmouth Street, Manchester M13 9GB, UK

<sup>b</sup> Department of Computer Science, University of Verona, Ca'Vignal 2, strada le Grazie 15, 37134 Verona, Italy

<sup>c</sup> Department of Information Engineering and Communications, University of Murcia, Campus de Espinardo, 30100 Espinardo (Murcia), Spain

<sup>d</sup> Dipartimento di Ingegneria Industriale e dell'Informazione, University of Pavia, Via Ferrata 1, 27100 Pavia, Italy

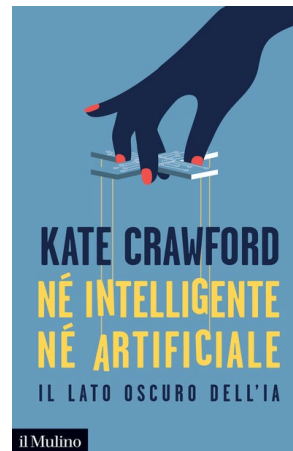


Macchine intelligenti che non ragionano

Capaci di agire autonomamente in modo appropriato (tale da aumentare la probabilità di successo nell'effettuare un compito in un ambiente incerto)

AI: Agere sine  
Intelligere o AI come  
nuova forma dell'agire

Distinzione fra AI  
ingegneristica e AI  
cognitivista



Costo ambientale e  
sociale dell'IA

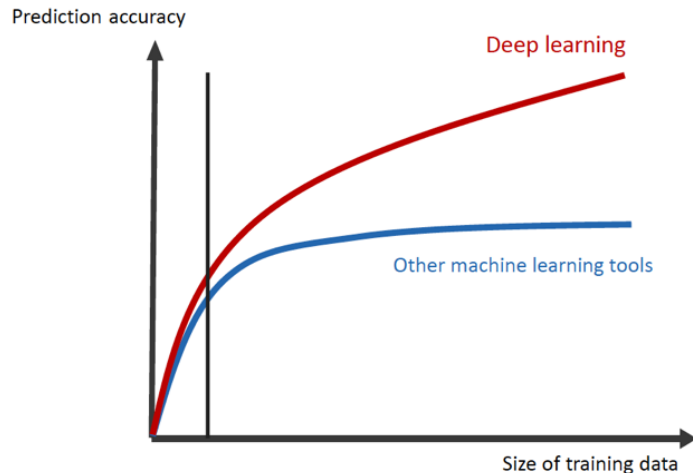
Rischi di una IA  
«proprietaria»

# Come ci siamo arrivati

- Enorme disponibilità di dati raccolti in larga parte grazie alla rete Internet
- Algoritmi adatti
- Infrastrutture computazionali adeguate

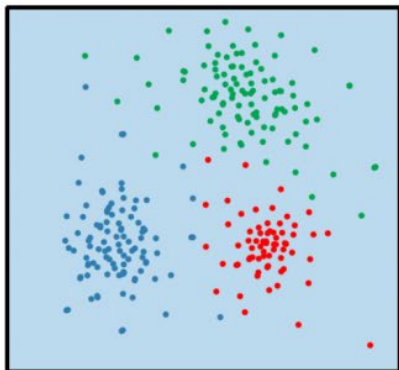


1 Titan X is 20x faster than  
16-core Xeon CPUs

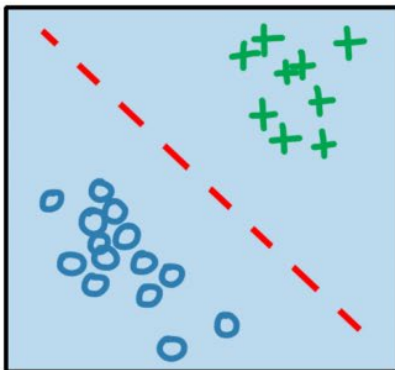


## machine learning

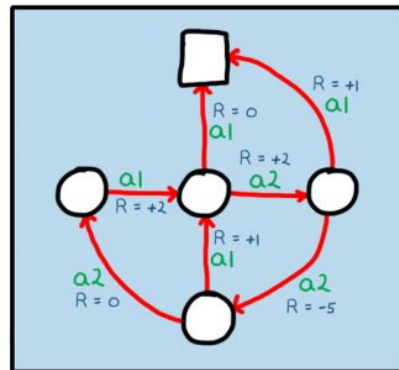
unsupervised  
learning



supervised  
learning



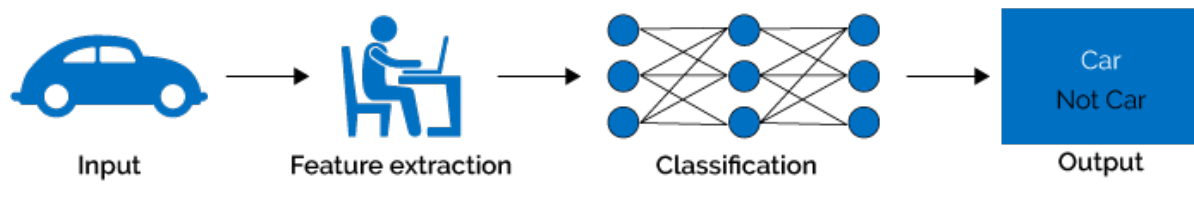
reinforcement  
learning



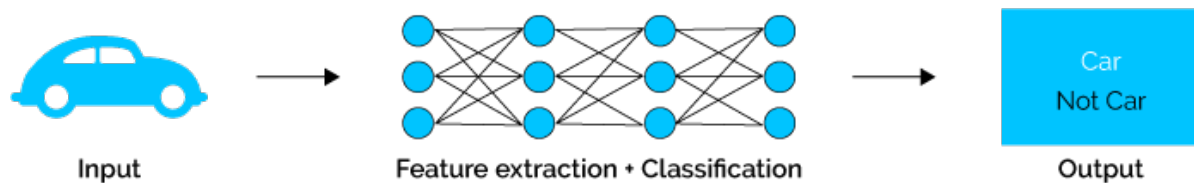


## Algoritmi adatti: Machine & Deep Learning

### Machine Learning

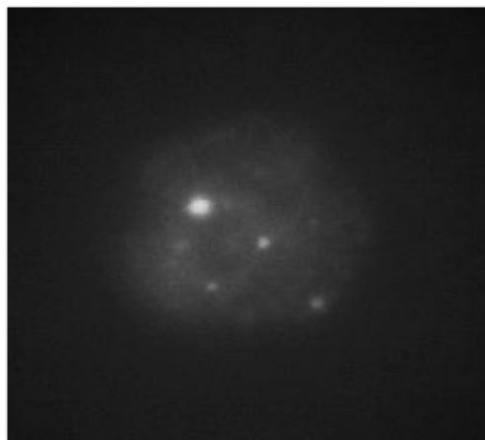


### Deep Learning

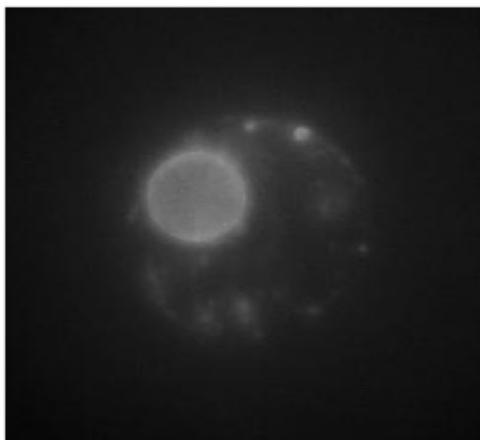


## Ingredienti

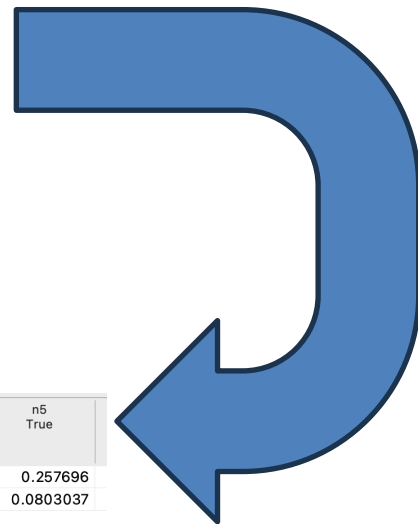
Il deep learning, nelle sue varie architetture, consente di effettuare un «embedding» di oggetti digitali in una rappresentazione matematica conveniente per uno degli obiettivi del machine learning



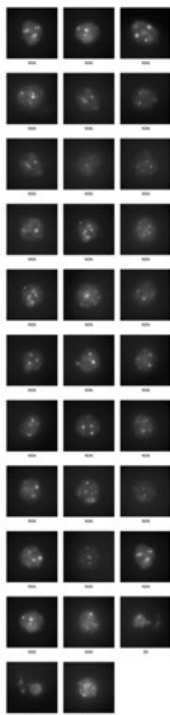
NSN - Not Competent for development



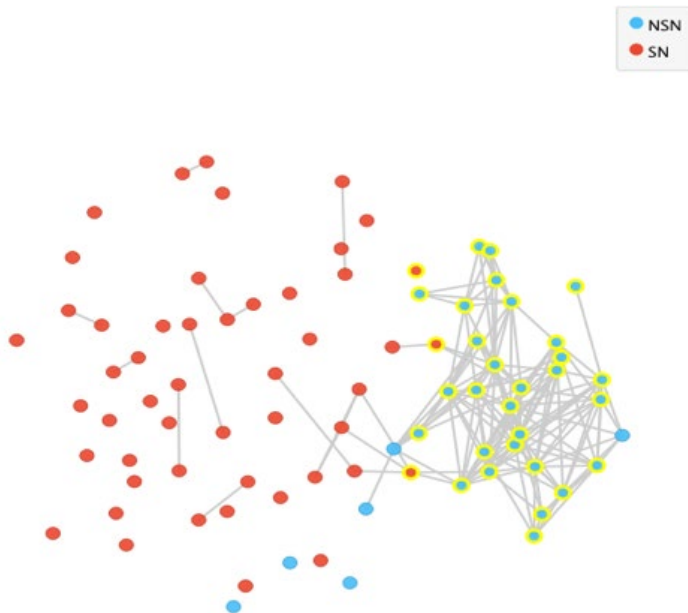
SN - Competent for development



Info		category	image name	image	size	width	height	n0 True	n1 True	n2 True	n3 True	n4 True	n5 True
2 instances (no missing data)		hidden origin type		:s/ricerca/bioinform									
2048 features				image									
Target with 2 values													
5 meta attributes													
Variables	1	NSN	NSN...	NSN/NSN_3...	3301	265	264	1.00116	0.314914	0.037168	0.312784	0.0358623	0.257696
	2	SN	SN_52	SN/SN_52.jpg	4327	265	265	0.969793	0.272101	0.252348	0.192658	0.149291	0.0803037



105 images of cell development



## ARTICLE

<https://doi.org/10.1038/s41467-019-12397-4>

OPEN

**Democratized image analytics by visual programming through integration of deep models and small-scale machine learning**

Primož Godec<sup>1,7</sup>, Matjaž Pančur<sup>1,7</sup>, Nejc Ilenič<sup>1,7</sup>, Andrej Čopar<sup>1</sup>, Martin Stražar<sup>1</sup>, Aleš Erjavec<sup>1</sup>, Ajda Pretnar<sup>1</sup>, Janez Demšar<sup>1</sup>, Anže Starič<sup>1</sup>, Marko Toplak<sup>1</sup>, Lan Žagar<sup>1</sup>, Jan Hartman<sup>1</sup>, Hamilton Wang<sup>2</sup>, Riccardo Bellazzi<sup>3</sup>, Uroš Petrovič<sup>4,5</sup>, Silvia Garagna<sup>6</sup>, Maurizio Zuccotti<sup>6</sup>, Dongsu Park<sup>2</sup>, Gad Shaulsky<sup>2</sup> & Blaž Zupan<sup>1,2\*</sup>

Convolutional Nnets **already learned** on the **ImageNet 2012 Challenge** validation data set.

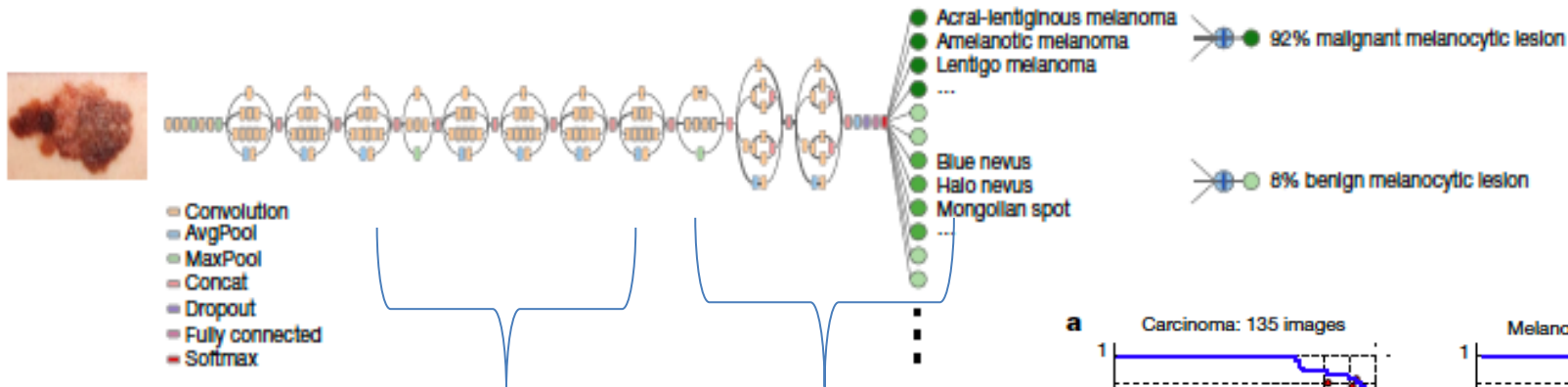
		Predicted		
		NSN	SN	Σ
Actual	NSN	32	3	35
	SN	2	48	50
	Σ	34	51	85

Skin lesion image

Deep convolutional neural network (Inception v3)

Training classes (757)

Inference classes (varies by task)

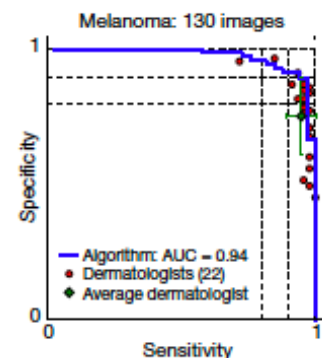
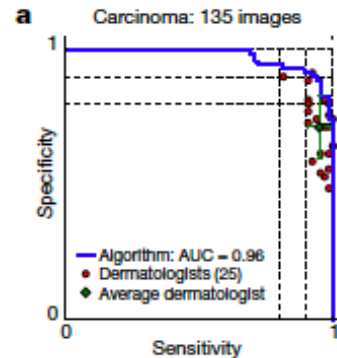


Google inception v3

**1.28 million  
images over 1,000  
generic object  
classes**

Dati dei ricercatori

**129,450 skin  
lesions  
comprising 2,032  
different diseases.**

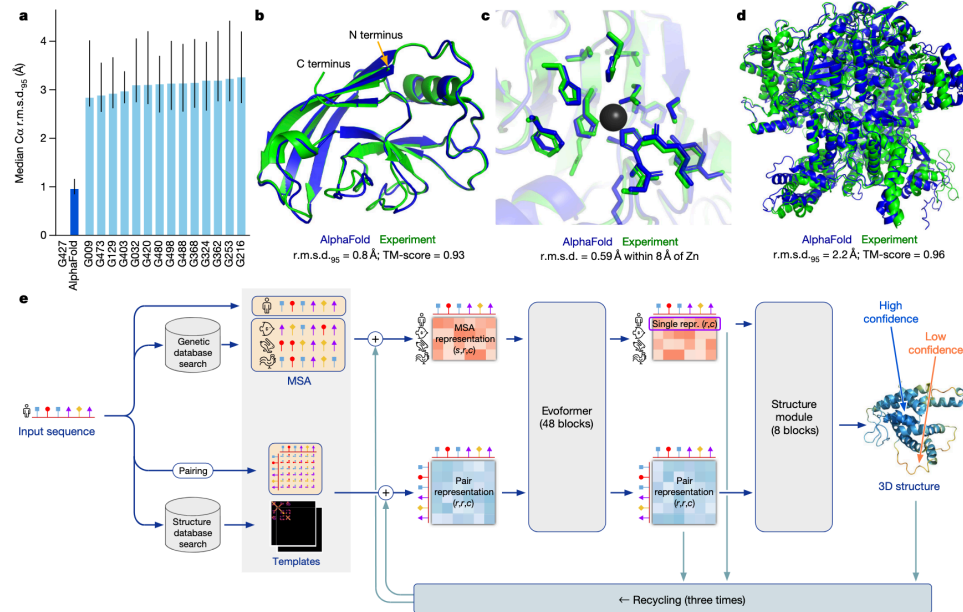


## LETTER

doi:10.1038/nature23056

### Dermatologist-level classification of skin cancer with deep neural networks

Andre Esteve<sup>1\*</sup>, Brett Kuper<sup>1,4</sup>, Roberto A. Novoa<sup>2,3</sup>, Justin Ko<sup>5</sup>, Susan M. Swetter<sup>1,4</sup>, Helen M. Blau<sup>5</sup> & Sebastian Thrun<sup>6</sup>



**Fig. 1 | AlphaFold produces highly accurate structures.** **a**, The performance of AlphaFold on the CASP14 dataset ( $n = 87$  protein domains) relative to the top 15 entries (out of 146 entries), group numbers correspond to the numbers assigned to entrants by CASP. Data are median and the 95% confidence interval of the median, estimated from 10,000 bootstrap samples. **b**, Our prediction of CASP14 target T1049 (PDB 6Y4F, blue) compared with the true experimental structure (green). Four residues in the C terminus of the crystal structure are  $B$ -factor outliers and are not depicted. **c**, CASP14 target T1056 (PDB 6YJ1).

An example of a well-predicted zinc-binding site (AlphaFold has accurate side chains even though it does not explicitly predict the zincion). **d**, CASP target T1044 (PDB 6VR4)—a 2,180-residue single chain—was predicted with correct domain packing (the prediction was made after CASP using AlphaFold without intervention). **e**, Model architecture. Arrows show the information flow among the various components described in this paper. Array shapes are shown in parentheses with  $s$ , number of sequences ( $N_{seq}$  in the main text);  $r$ , number of residues ( $N_{res}$  in the main text);  $c$ , number of channels.

## Article

# Highly accurate protein structure prediction with AlphaFold

<https://doi.org/10.1038/s41586-021-03819-2>

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Accepted: 12 July 2021

Published online: 15 July 2021

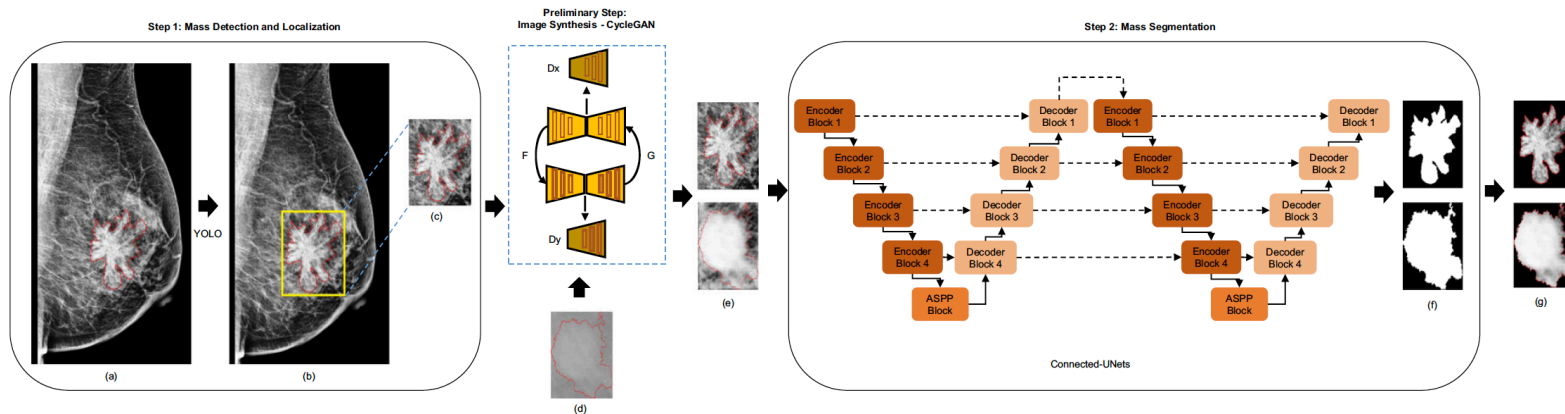
Open access

Check for updates

John Jumper<sup>1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100,101,102,103,104,105,106,107,108,109,110,111,112,113,114,115,116,117,118,119,120,121,122,123,124,125,126,127,128,129,130,131,132,133,134,135,136,137,138,139,140,141,142,143,144,145,146,147,148,149,150,151,152,153,154,155,156,157,158,159,160,161,162,163,164,165,166,167,168,169,170,171,172,173,174,175,176,177,178,179,180,181,182,183,184,185,186,187,188,189,190,191,192,193,194,195,196,197,198,199,200,201,202,203,204,205,206,207,208,209,210,211,212,213,214,215,216,217,218,219,220,221,222,223,224,225,226,227,228,229,230,231,232,233,234,235,236,237,238,239,240,241,242,243,244,245,246,247,248,249,250,251,252,253,254,255,256,257,258,259,260,261,262,263,264,265,266,267,268,269,270,271,272,273,274,275,276,277,278,279,280,281,282,283,284,285,286,287,288,289,290,291,292,293,294,295,296,297,298,299,300,301,302,303,304,305,306,307,308,309,310,311,312,313,314,315,316,317,318,319,320,321,322,323,324,325,326,327,328,329,330,331,332,333,334,335,336,337,338,339,340,341,342,343,344,345,346,347,348,349,350,351,352,353,354,355,356,357,358,359,360,361,362,363,364,365,366,367,368,369,370,371,372,373,374,375,376,377,378,379,380,381,382,383,384,385,386,387,388,389,390,391,392,393,394,395,396,397,398,399,400,401,402,403,404,405,406,407,408,409,410,411,412,413,414,415,416,417,418,419,420,421,422,423,424,425,426,427,428,429,430,431,432,433,434,435,436,437,438,439,440,441,442,443,444,445,446,447,448,449,450,451,452,453,454,455,456,457,458,459,460,461,462,463,464,465,466,467,468,469,470,471,472,473,474,475,476,477,478,479,480,481,482,483,484,485,486,487,488,489,490,491,492,493,494,495,496,497,498,499,500,501,502,503,504,505,506,507,508,509,510,511,512,513,514,515,516,517,518,519,520,521,522,523,524,525,526,527,528,529,530,531,532,533,534,535,536,537,538,539,540,541,542,543,544,545,546,547,548,549,550,551,552,553,554,555,556,557,558,559,560,561,562,563,564,565,566,567,568,569,570,571,572,573,574,575,576,577,578,579,580,581,582,583,584,585,586,587,588,589,590,591,592,593,594,595,596,597,598,599,600,601,602,603,604,605,606,607,608,609,610,611,612,613,614,615,616,617,618,619,620,621,622,623,624,625,626,627,628,629,630,631,632,633,634,635,636,637,638,639,640,641,642,643,644,645,646,647,648,649,650,651,652,653,654,655,656,657,658,659,660,661,662,663,664,665,666,667,668,669,670,671,672,673,674,675,676,677,678,679,680,681,682,683,684,685,686,687,688,689,690,691,692,693,694,695,696,697,698,699,700,701,702,703,704,705,706,707,708,709,710,711,712,713,714,715,716,717,718,719,720,721,722,723,724,725,726,727,728,729,730,731,732,733,734,735,736,737,738,739,740,741,742,743,744,745,746,747,748,749,750,751,752,753,754,755,756,757,758,759,760,761,762,763,764,765,766,767,768,769,770,771,772,773,774,775,776,777,778,779,780,781,782,783,784,785,786,787,788,789,790,791,792,793,794,795,796,797,798,799,800,801,802,803,804,805,806,807,808,809,810,811,812,813,814,815,816,817,818,819,820,821,822,823,824,825,826,827,828,829,830,831,832,833,834,835,836,837,838,839,840,841,842,843,844,845,846,847,848,849,850,851,852,853,854,855,856,857,858,859,860,861,862,863,864,865,866,867,868,869,870,871,872,873,874,875,876,877,878,879,880,881,882,883,884,885,886,887,888,889,890,891,892,893,894,895,896,897,898,899,900,901,902,903,904,905,906,907,908,909,910,911,912,913,914,915,916,917,918,919,920,921,922,923,924,925,926,927,928,929,930,931,932,933,934,935,936,937,938,939,940,941,942,943,944,945,946,947,948,949,950,951,952,953,954,955,956,957,958,959,960,961,962,963,964,965,966,967,968,969,970,971,972,973,974,975,976,977,978,979,980,981,982,983,984,985,986,987,988,989,990,991,992,993,994,995,996,997,998,999,1000,1001,1002,1003,1004,1005,1006,1007,1008,1009,1010,1011,1012,1013,1014,1015,1016,1017,1018,1019,1020,1021,1022,1023,1024,1025,1026,1027,1028,1029,1030,1031,1032,1033,1034,1035,1036,1037,1038,1039,1040,1041,1042,1043,1044,1045,1046,1047,1048,1049,1050,1051,1052,1053,1054,1055,1056,1057,1058,1059,1060,1061,1062,1063,1064,1065,1066,1067,1068,1069,1070,1071,1072,1073,1074,1075,1076,1077,1078,1079,1080,1081,1082,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,1105,1106,1107,1108,1109,1110,1111,1112,1113,1114,1115,1116,1117,1118,1119,1120,1121,1122,1123,1124,1125,1126,1127,1128,1129,1130,1131,1132,1133,1134,1135,1136,1137,1138,1139,1140,1141,1142,1143,1144,1145,1146,1147,1148,1149,1150,1151,1152,1153,1154,1155,1156,1157,1158,1159,1160,1161,1162,1163,1164,1165,1166,1167,1168,1169,1170,1171,1172,1173,1174,1175,1176,1177,1178,1179,1180,1181,1182,1183,1184,1185,1186,1187,1188,1189,1190,1191,1192,1193,1194,1195,1196,1197,1198,1199,1200,1201,1202,1203,1204,1205,1206,1207,1208,1209,1210,1211,1212,1213,1214,1215,1216,1217,1218,1219,1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## AI per image processing e classificazione



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ARTICLE OPEN

## Connected-UNets: a deep learning architecture for breast mass segmentation

Asma Baccouche<sup>1</sup>, Begonya Garcia-Zapirain<sup>2</sup>, Cristian Castillo Olea<sup>2</sup> and Adel S. Elmaghraby<sup>1</sup>



Medical Image Analysis 89 (2023) 102918

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journal homepage: [www.elsevier.com/locate/media](http://www.elsevier.com/locate/media)



Segment anything model for medical image analysis: An experimental study

Maciej A. Mazurowski<sup>a,b,c,d</sup>, Haoyu Dong<sup>b,\*</sup>, Hanxue Gu<sup>b</sup>, Jichen Yang<sup>b</sup>, Nicholas Konz<sup>b</sup>, Yixin Zhang<sup>b</sup>

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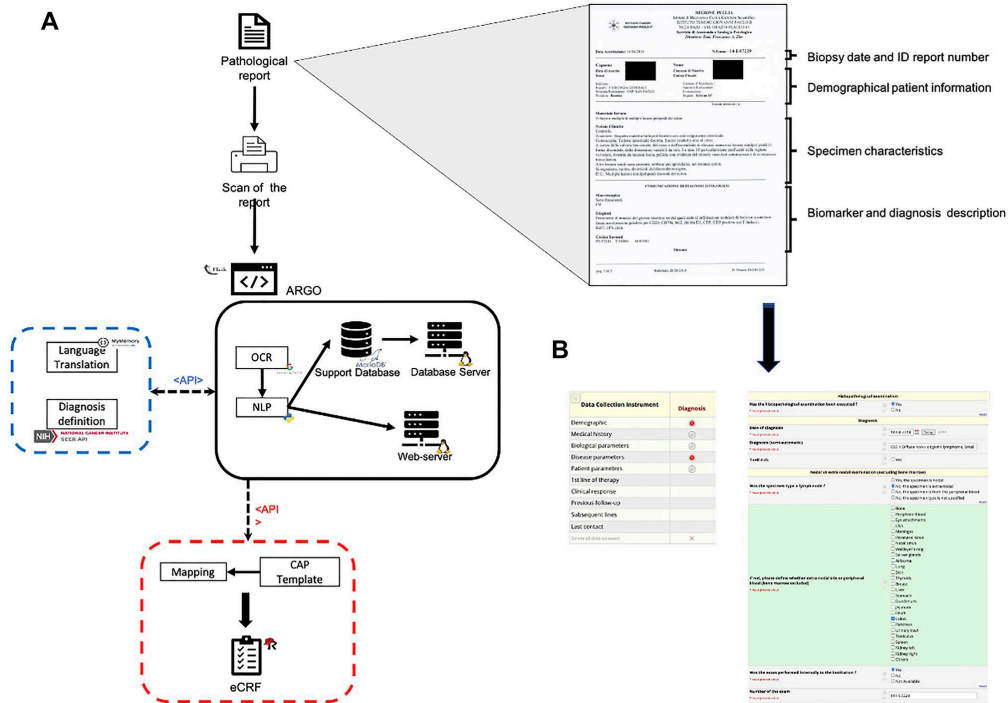
## scientific reports

OPEN

### Electronic case report forms generation from pathology reports by ARGO, automatic record generator for onco-hematology

Gian Maria Zaccaria<sup>1,2,3</sup>, Vito Colella<sup>2</sup>, Simona Colucci<sup>2</sup>, Felice Clemente<sup>1</sup>, Fabio Pavone<sup>1</sup>, Maria Carmela Vegliante<sup>1</sup>, Flavia Esposito<sup>1,3</sup>, Giuseppina Opinto<sup>1</sup>, Anna Scattone<sup>4</sup>, Giacomo Loseto<sup>1</sup>, Carla Minoia<sup>1</sup>, Bernardo Rossini<sup>1</sup>, Angela Maria Quinto<sup>1</sup>, Vito Angiulli<sup>1,5</sup>, Luigi Alfredo Grieco<sup>2</sup>, Angelo Fama<sup>1,6</sup>, Simone Ferrero<sup>1,6</sup>, Riccardo Moia<sup>1</sup>, Alice Di Rocco<sup>1,6</sup>, Francesca Maria Quaglia<sup>1,1</sup>, Valentina Tabanelli<sup>1,2</sup>, Attilio Guarini<sup>1</sup> & Sabino Ciavarella<sup>1</sup>

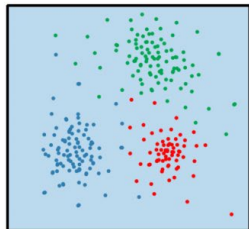
Check for updates



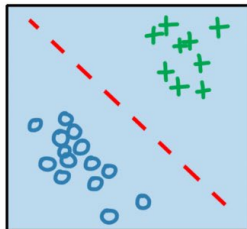
Un'ulteriore dimensione

## machine learning

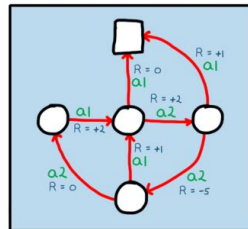
unsupervised  
learning



supervised  
learning



reinforcement  
learning



### **Self-supervised learning:**

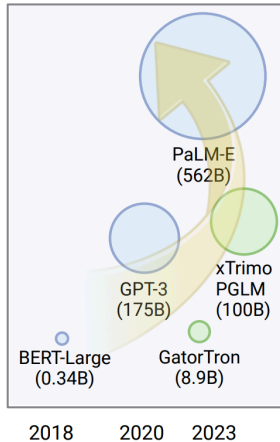
- *Dati con poche o nessuna etichetta preassegnata manualmente*
- *Adatto ad analizzare sequenze (di parole, di immagini, di eventi, ...)*
- *Modelli «generativi»*

## Large AI Models: Key Features and New Paradigm Shift

### A. Model Size

There has been a trend of increasing the number of parameters of a model (tens of billions is common for LLMs)

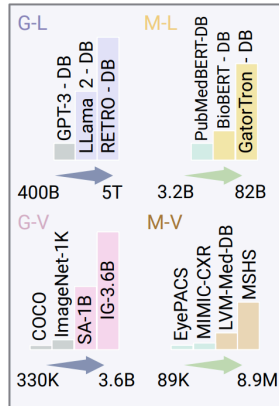
- : Large AI Models in General Domain
- : Large AI Models in Health Informatics



### B. Data Scale

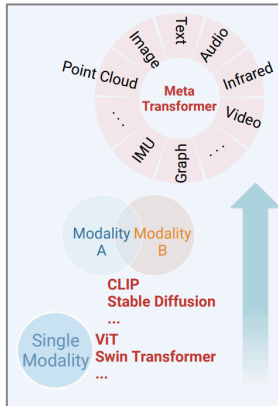
Data has been scaled up, but the medical data scale is much smaller than that of general domain data

- G-L : General Lang. M-L : Medical Lang.
- G-V : General Vision M-V : Medical Vision



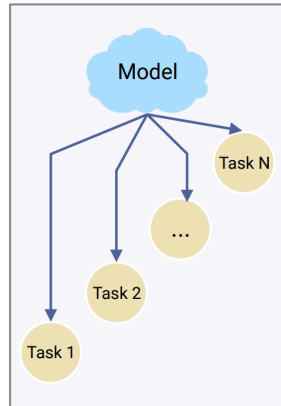
### C. Number of Modalities

With increased model capacity, and advances in multi-modal learning, the number of modalities a large AI model can process is expanding



### D. Versatility on Downstream Tasks

As often called foundation models, large AI models can exhibit generalist / emergent intelligence, and show impressive performance in multiple downstream tasks, esp. **zero-shot**, **one-shot**, and **few-shot** tasks



> [IEEE J Biomed Health Inform.](#) 2023 Sep 22;PP. doi: 10.1109/JBHI.2023.3316750.  
Online ahead of print.

## Large AI Models in Health Informatics: Applications, Challenges, and the Future

Jianing Qiu, Lin Li, Jiankai Sun, Jiachuan Peng, Peilun Shi, Ruiyang Zhang, Yinzhaoh Dong, Kyle Lam, Frank P-W Lo, Bo Xiao, Wu Yuan, Ningli Wang, Dong Xu, Benny Lo

PMID: 37738186 DOI: [10.1109/JBHI.2023.3316750](#)

### Paradigm Shift

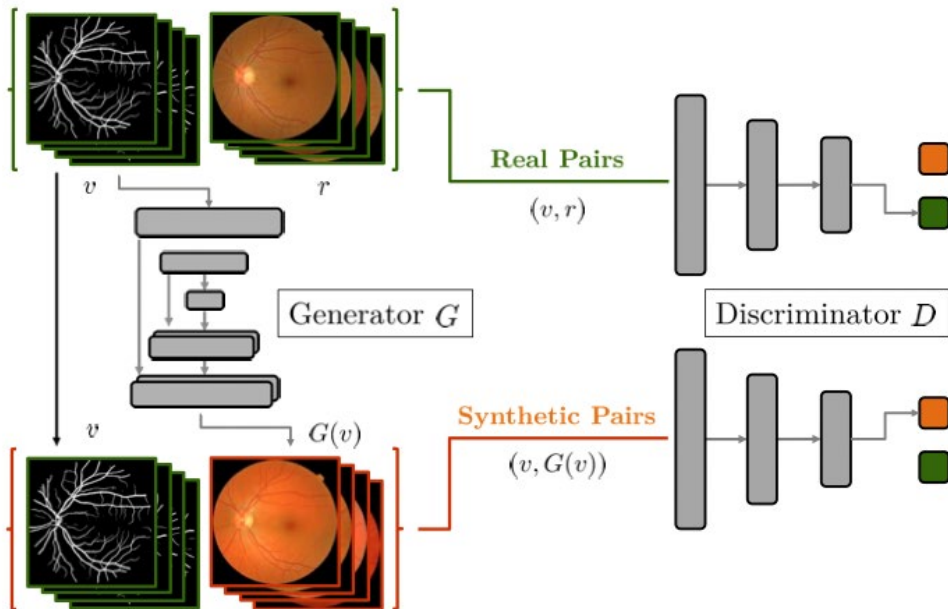
Before:

- 1) Limited-scale model size; 3) Limited generalization.
- 2) Limited-scale training/pre-training;

Large AI Models:

- 1) Large-scale model size; 3) Large generalization.
- 2) Large-scale training/pre-training;

# Generazione dei dati



## Medical Image Generation

19 papers with code • 2 benchmarks • 3 datasets

### Towards Adversarial Retinal Image Synthesis

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## Foundation models for generalist medical artificial intelligence

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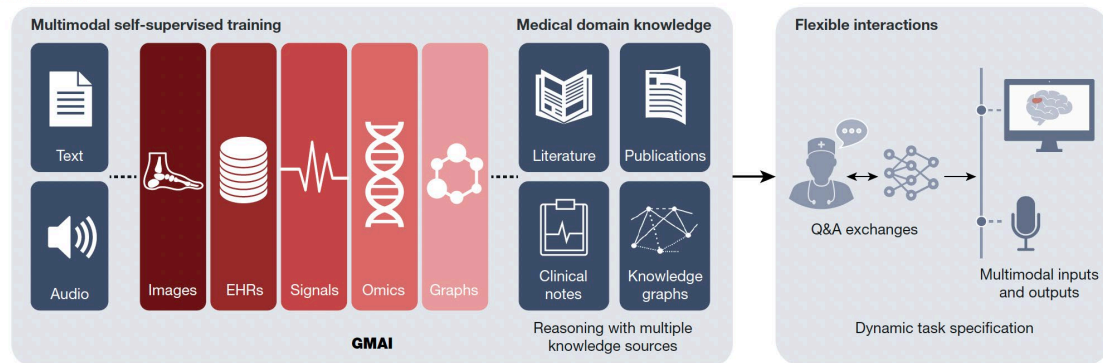
Accepted: 22 February 2023

Published online: 12 April 2023

Check for updates

Michael Moor<sup>1\*</sup>, Oishi Banerjee<sup>2,6</sup>, Zahra Shakeri Hossein Abad<sup>3</sup>, Harlan M. Krumholz<sup>4</sup>, Jure Leskovec<sup>1</sup>, Eric J. Topol<sup>5,7,8</sup> & Pranav Rajpurkar<sup>2,7,9</sup>

The exceptionally rapid development of highly flexible, reusable artificial intelligence (AI) models is likely to usher in newfound capabilities in medicine. We propose a new paradigm for medical AI, which we refer to as generalist medical AI (GMAI). GMAI



**b**

Applications



Chatbots for patients



Interactive note-taking



Augmented procedures

...



Grounded radiology reports



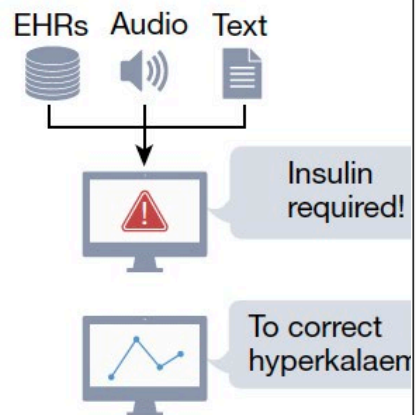
Text-to-protein generation



Bedside decision support

**Regulations:** Application approval; validation; audits; community-based challenges; analyses of biases, fairness and diversity

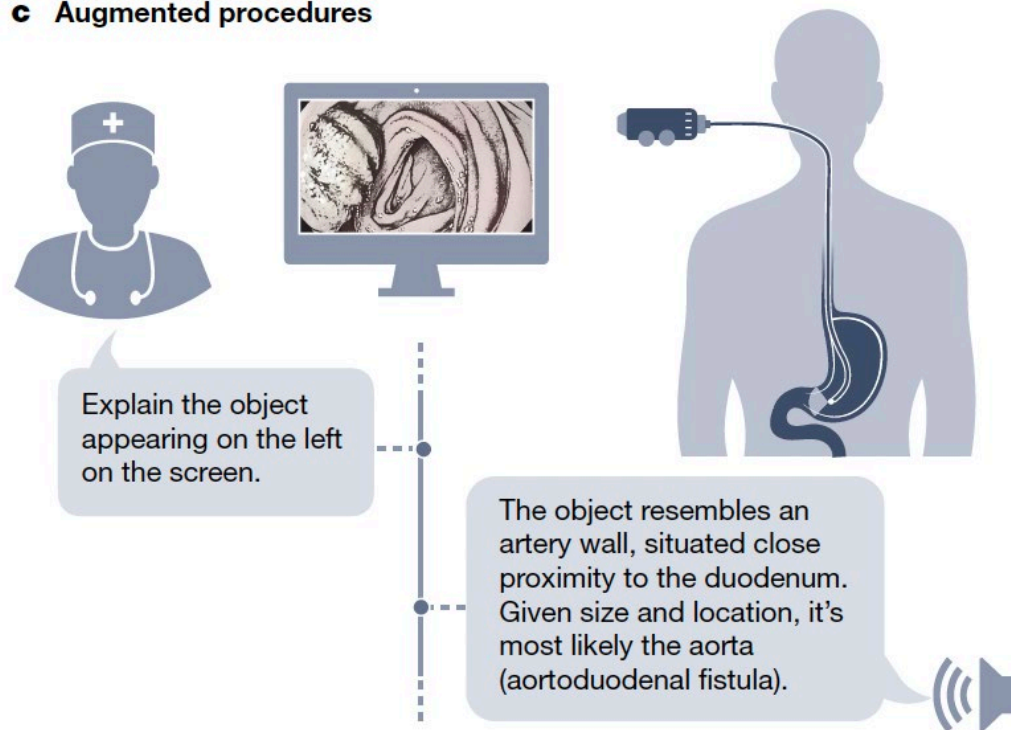
## a Bedside decision support



## b Ground



## c Augmented procedures





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Original Research

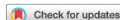
Language models are an effective representation learning technique for electronic health record data

Ethan Steinberg<sup>a</sup>, Ken Jung, Jason A. Fries, Conor K. Corbin, Stephen R. Pfohl, Nigam H. Shah

<sup>a</sup>Stanford University, 450 Serra Mall, Stanford, CA 94305, USA



## scientific reports



## OPEN EHR foundation models improve robustness in the presence of temporal distribution shift

Lin Lawrence Guo<sup>1</sup>, Ethan Steinberg<sup>2</sup>, Scott Lanyon Fleming<sup>3</sup>, Jose Posada<sup>3</sup>, Joshua Lemmon<sup>1</sup>, Stephen R. Pfohl<sup>2</sup>, Nigam Shah<sup>2</sup>, Jason Fries<sup>2,5</sup> & Lillian Sung<sup>1,4,5</sup>

### Clinical Language Model-based Representation (CLMBR)

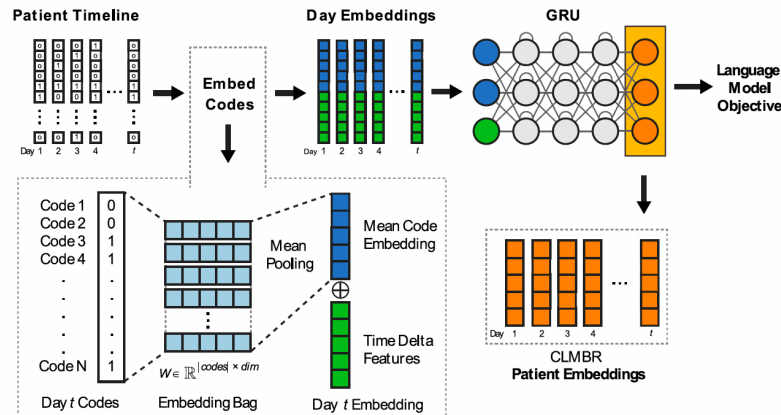


Fig. 4. The figure shows how patient representations were constructed using the CLMBR language model. Representations for individual patients were created by extracting fixed length vectors generated by the linear layer after the GRU.

Table 3

Difference in AUROC of clinical prediction models trained on different representations.

Outcome name	Counts	Relative compared to counts baseline			
		Word2Vec	LSI	CLMBR	End-to-end GRU
Inpatient mortality	0.834	-0.010 ± 0.006	-0.046 ± 0.007	<b>0.018 ± 0.006</b>	-0.030 ± 0.008
Long admission	0.783	-0.020 ± 0.002	-0.055 ± 0.002	<b>0.009 ± 0.002</b>	-0.013 ± 0.002
ICU transfer	0.792	-0.041 ± 0.006	-0.086 ± 0.007	<b>0.045 ± 0.005</b>	0.039 ± 0.006
30-day readmission	0.809	-0.018 ± 0.002	-0.051 ± 0.003	<b>0.005 ± 0.002</b>	-0.001 ± 0.002
Abnormal HbA1c	0.700	0.015 ± 0.015	-0.011 ± 0.016	<b>0.056 ± 0.013</b>	-0.019 ± 0.017

## ATTENZIONE AL PIFFERAIO MAGICO





Correspondence | [Published: 13 April 2023](#)

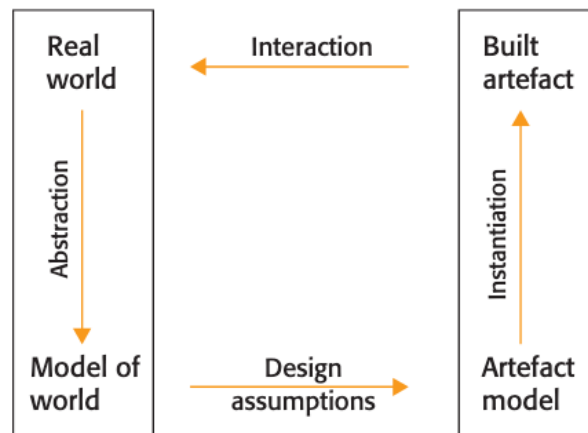
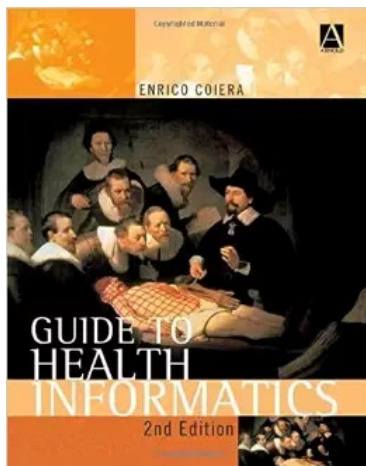
## Potential pitfalls in the use of real-world data for studying long COVID

[Harrison G. Zhang](#), [Jacqueline P. Honerlaw](#), [Monika Maripuri](#), [Malarkodi Jebathilagam Samayamuthu](#),  
[Brendin R. Beaulieu-Jones](#), [Huma S. Baig](#), [Sehi L'Yi](#), [Yuk-Lam Ho](#), [Michele Morris](#), [Vidul Ayakulangara](#)  
[Panickan](#), [Xuan Wang](#), [Griffin M. Weber](#), [Katherine P. Liao](#), [Shyam Visweswaran](#), [Bryce W. Q. Tan](#), [William](#)  
[Yuan](#), [Nils Gehlenborg](#), [Sumitra Muralidhar](#), [Rachel B. Ramoni](#), [The Consortium for Clinical](#)  
[Characterization of COVID-19 by EHR \(4CE\)](#), [Isaac S. Kohane](#), [Zongqi Xia](#), [Kelly Cho](#), [Tianxi Cai](#) &  
[Gabriel A. Brat](#) ✉

[Nature Medicine](#) (2023) | [Cite this article](#)

We are an international consortium that has operationalized definitions of long COVID using health-agency guidelines, and established a chart-review procedure based on these definitions<sup>5</sup>. During this process, we identified three major challenges in using real-world data to study long COVID: ambiguity and heterogeneity in clinical coding of long COVID; inadequacy of diagnostic codes in capturing the constellation of symptoms; and biases in EHR data arising from variability in the number and kind of contacts with the healthcare system. These challenges warrant special attention if the clinical community wishes to arrive at a robust understanding of long COVID using evidence derived from real-world data.

*I sistemi informativi contengono dati, sono basati su modelli della realtà e dei processi decisionali che supportano, e sono quindi arbitrari e costruiti per uno scopo (E. Coiera)*

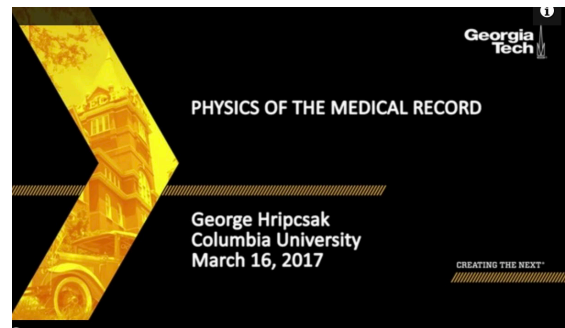




Se una cartella clinica elettronica  
deve supportare il processo di  
cura dovrebbe contenere solo i  
dati necessari alle decisioni



Potrò apprendere solo modelli di  
AI che descrivono il processo di  
cura e le sue caratteristiche



La mancanza di chiarezza nelle impostazioni progettuali dei sistemi informativi e nelle cartelle cliniche elettroniche genera insuccesso e frustrazione

Scarsa distinzione fra

- Obiettivi di controllo di gestione (SDO)
- Obiettivi di supporto decisionale clinico
- Obiettivi di ricerca (registri, eCRF)
- Ogni raccolta dati consente l'impiego di modelli AI differenti per rispondere a domande diverse

Non esistono sistemi ONE-FITS-ALL anche con infiniti dati



**News**  
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## AI Act: a step closer to the first rules on Artificial Intelligence

Press Releases [IMCO](#) [LIBE](#) 11-05-2023 - 09:34

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## Guidelines for clinical trial protocols for interventions involving artificial intelligence: the SPIRIT-AI extension

Samantha Cruz Rivera<sup>1,2,3</sup>, Xiaoxuan Liu<sup>3,4,5,6,7</sup>, An-Wen Chan<sup>8</sup>, Alastair K. Denniston<sup>3,4,5,6,9</sup>,  
Melanie J. Calvert<sup>3,4,5,6,10,11,12</sup>, The SPIRIT-AI and CONSORT-AI Working Group\*, SPIRIT-AI and  
CONSORT-AI Steering Group and SPIRIT-AI and CONSORT-AI Consensus Group

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doi: 10.1093/jamia/ocaa088  
Advance Access Publication Date: 28 June 2020  
Perspective

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Perspective

## MINIMAR (MINimum Information for Medical AI Reporting): Developing reporting standards for artificial intelligence in health care

Tina Hernandez-Boussard<sup>1,2,3\*</sup>, Selen Bozkurt<sup>1</sup>, John P.A. Ioannidis<sup>1,4–6</sup> and  
Nigam H. Shah<sup>1,2</sup>

<sup>1</sup>Department of Medicine, Stanford University, Stanford, California, USA, <sup>2</sup>Department of Biomedical Data Science, Stanford University, Stanford, California, USA, <sup>3</sup>Department of Surgery, Stanford University, Stanford, California, USA, <sup>4</sup>Department of Statistics, Stanford University, Stanford, California, USA, and <sup>5</sup>Meta-Research Innovation Center at Stanford, Stanford University, Stanford, California, USA

## CONSENSUS STATEMENT

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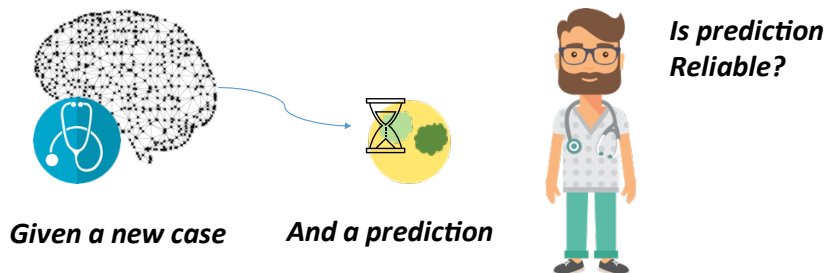
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## Reporting guidelines for clinical trial reports for interventions involving artificial intelligence: the CONSORT-AI extension

Xiaoxuan Liu<sup>1,2,3,4,5</sup>, Samantha Cruz Rivera<sup>5,6,7</sup>, David Moher<sup>8,9</sup>, Melanie J. Calvert<sup>3,4,5,6,7,10,11,12</sup>,  
Alastair K. Denniston<sup>3,4,5,6,9</sup> and The SPIRIT-AI and CONSORT-AI Working Group\*

Validate, validate, validate

# Reliability & Explainability



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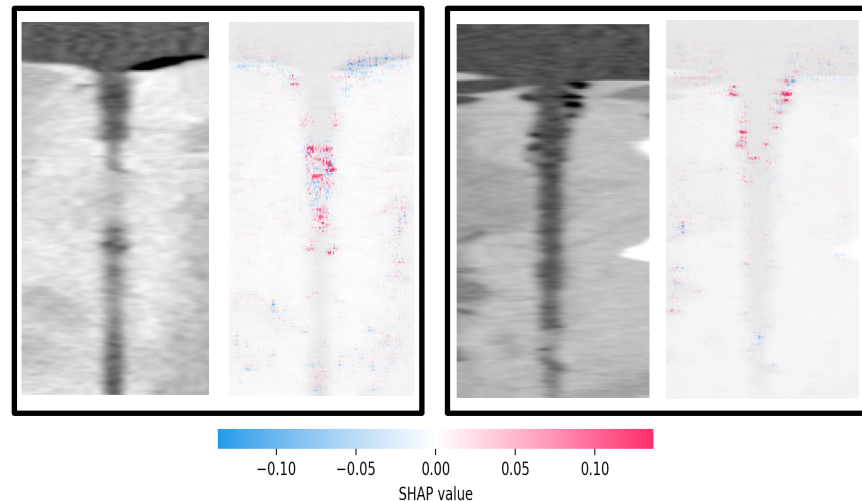
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Evaluating pointwise reliability of machine learning prediction

[Giovanna Nicora](#)<sup>a,\*</sup>, [Miguel Rios](#)<sup>b</sup>, [Ameen Abu-Hanna](#)<sup>b</sup>, [Riccardo Bellazzi](#)<sup>a</sup>



Why an image is classified as positive/negative by a DL model?

# Trustworthiness is a property of socio-technical systems

... in a socio-technical system, multiple stakeholders, e.g., engineers, business owners, and customers interact with technologies, such as AI tools, to achieve their goals according to their roles, ... over time, and following the rules of the system social institution

## **The Value of Measuring Trust in AI – A Socio-Technical System Perspective**

MICHAELA BENK, ETH Zurich, Switzerland

SUZANNE TOLMEIJER, University of Zurich, Switzerland

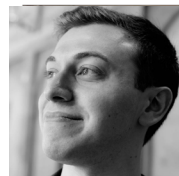
FLORIAN VON WANGENHEIM, ETH Zurich, Switzerland

ANDREA FERRARIO, ETH Zurich, Switzerland

*CHI 2022 - Workshop on Trust and Reliance in AI-Human Teams (TRAIT),  
2022, New Orleans, LA*



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