

Certificate in Medical Software & Artificial Intelligence



online.yale.edu/medical-software-ai-program



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NEW NAVY DEVICE LEARNS BY DOING

Psychologist Shows Embryo
of Computer Designed to
Read and Grow Wiser

WASHINGTON, July 7 (UPI)—The Navy revealed the embryo of an electronic computer today that it expects will be able to walk, talk, see, write, produce itself and be conscious of its existence.

The embryo—the Weather Bureau's \$2,000,000 "704" computer—learned to differentiate between right and left after fifty attempts in the Navy's demonstration for newsmen.

The service said it would use this principle to build the first of its Perceptron thinking machines that will be able to read and write. It is expected to be finished in about a year at a cost of \$100,000.

Dr. Frank Rosenblatt, designer of the Perceptron, conducted the demonstration. He said the machine would be the first device to think as the human brain. As do human beings,

Perceptron will takes at first, but wiser as it gains experience, he said.

Dr. Rosenblatt, a psychologist at the Aeronautical Laboratory, said Perceptron fired to the planets and other space explorers.

Without Human

The Navy said the machine would be the first mechanism "capable of learning, recognizing and reacting to its surroundings without human training or control."

The "brain" is designed to remember images and action it has perceived. Ordinary computers remember what is fed into them on cards or magnetic tape.

Later Perceptrons will be able to recognize people and their names and imitate speech in one language, it was predicted.

Mr. Rosenblatt said the principle it would be used to build brains that could produce themselves on a line and which would be conscious of their existence.

WASHINGTON, July 7 (UPI)—

The Navy revealed the embryo of an electronic computer today that it expects will be able to walk, talk, see, write, reproduce itself and be conscious of its existence.

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Dr. Frank Rosenblatt, designer of the Perceptron, conducted the demonstration. He

HYPE NYTIMES 1958

BREAKTHROUGH MOMENT FOR DEEP LEARNING

ImageNet Classification with Deep Convolutional Neural Networks

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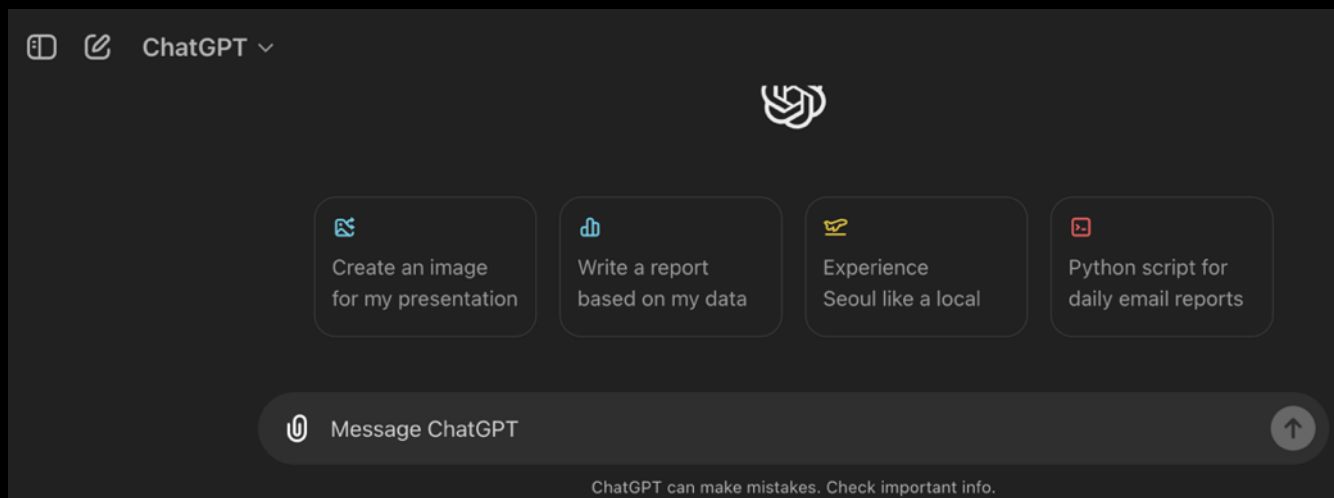
Geoffrey E. Hinton

University of Toronto

hinton@cs.utoronto.ca

Abstract

We trained a large, deep convolutional neural network to classify the 1.2 million high-resolution images in the ImageNet LSVRC-2010 contest into the 1000 different classes. On the test data, we achieved top-1 and top-5 error rates of 37.5% and 17.0% which is considerably better than the previous state-of-the-art. The neural network, which has 60 million parameters and 650,000 neurons, consists of five convolutional layers, some of which are followed by max-pooling layers, and three fully-connected layers with a final 1000-way softmax. To make training faster, we used non-saturating neurons and a very efficient GPU implementation of the convolution operation. To reduce overfitting in the fully-connected



Attention Is All You Need

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Illia Polosukhin* ‡
illia.polosukhin@gmail.com

31st Conference on Neural Information Processing Systems (NIPS 2017), Long Beach, CA, USA.

WHAT HAPPENED
ON
NOVEMBER 30TH,
2022?

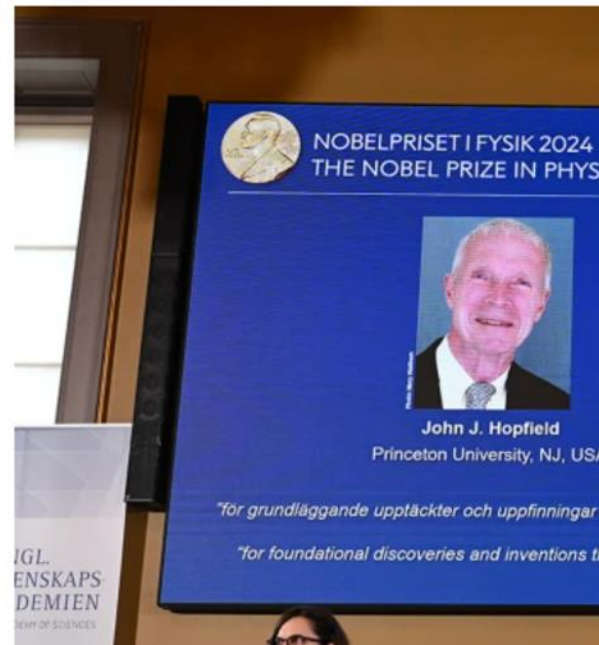
TWO NOBEL PRIZES (OCTOBER 2024)

NEWS | 08 October 2024

Physics Nobel goes to learning pioneers

John Hopfield and Geoffrey Hinton pioneer
development of neural networks.

By [Elizabeth Gibney](#) & [Davide Castelvecchi](#)



[Nature.com]

[nature](#) > [news](#) > [article](#)

NEWS | 09 October 2024

Chemistry Nobel goes to developers of AlphaFold AI that predicts protein structures

This year's prize celebrates computational tools that have transformed biology and have
the potential to revolutionize drug discovery.

By [Ewen Callaway](#)



David Baker, Demis Hassabis and John Jumper (left to right) won the chemistry Nobel for developing
computational tools that can predict and design protein structures. Credit: BBVA Foundation

2015

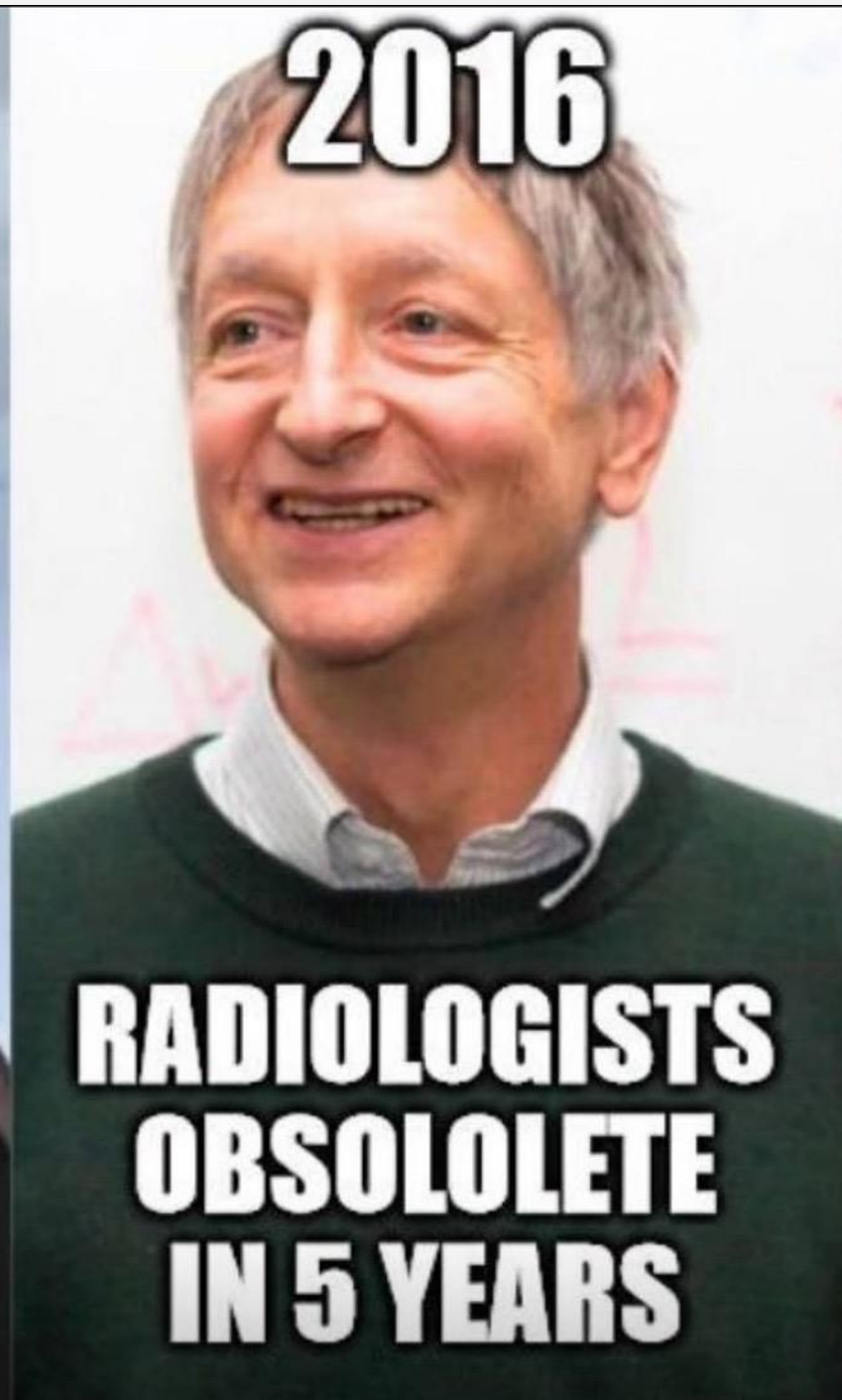


**SELF-DRIVING
CARS IN 2 YEARS**

CausalPython.io

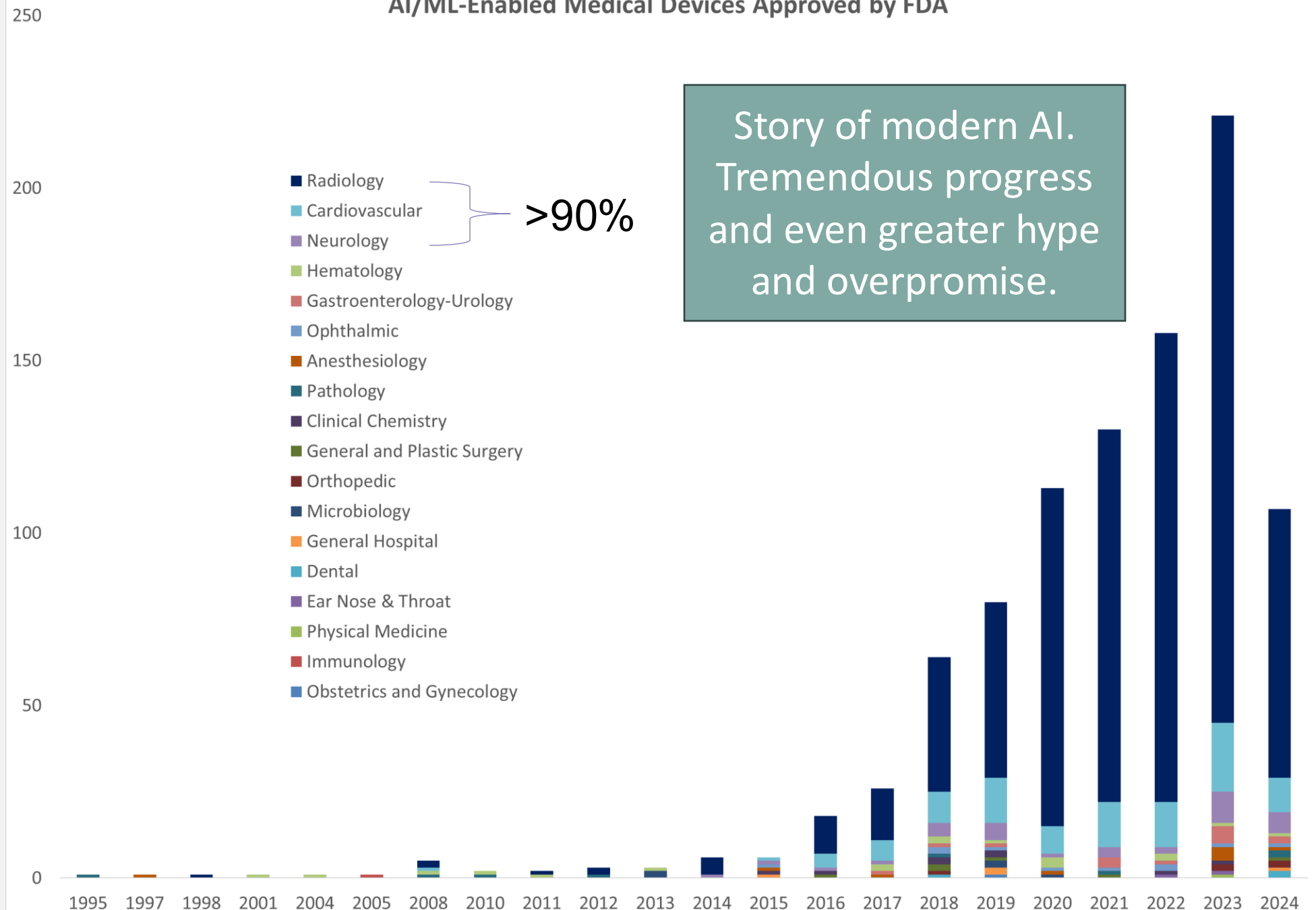
imgflip.com

2016



**RADIOLOGISTS
OBSOLETE
IN 5 YEARS**

AI/ML-Enabled Medical Devices Approved by FDA

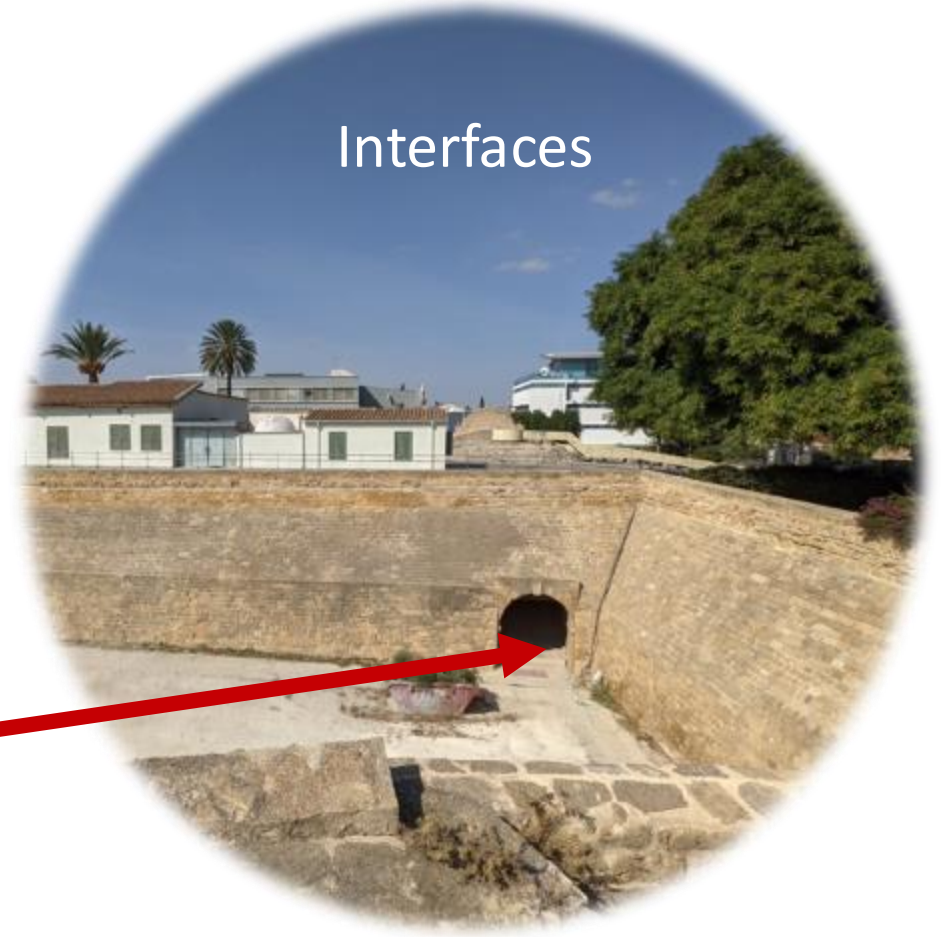
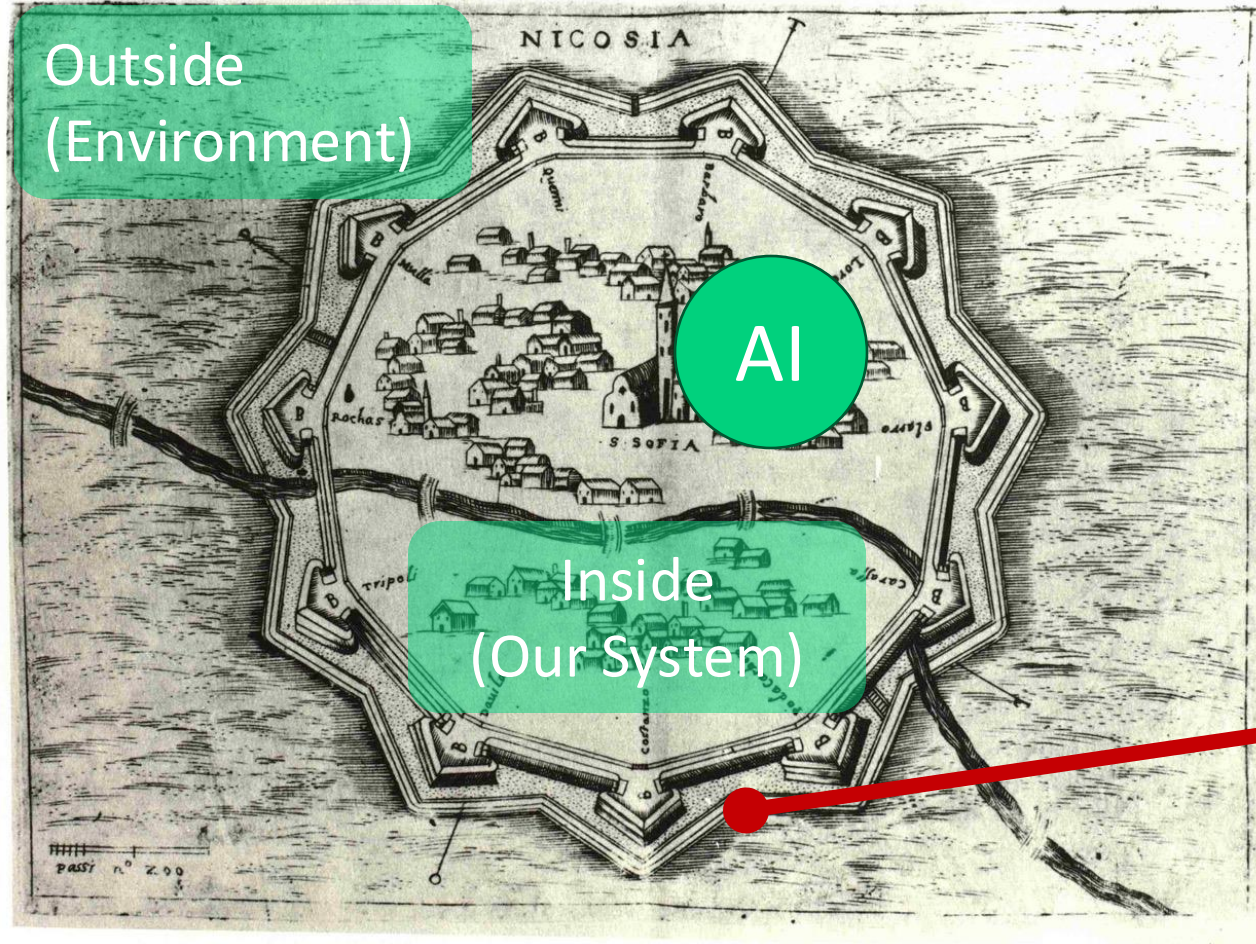


Story of modern AI.
Tremendous progress
and even greater hype
and overpromise.



MACHINE LEARNING GRADATIONS

- Fully explainable (simple) models
 - $y=ax+b \rightarrow$ Design everything up to a small number of parameters
 - Classical ML.
- Complex “task-specific” models
 - Train on input/output pairs.
 - Good for one task.
 - Most current deep learning approaches.
- Foundation models
 - Billions of parameters.
 - Train on a generic task (e.g., guess next word.)
 - Emergent properties $\rightarrow$ new tasks they were never designed for (e.g., ChatGPT.)
 - Optionally tweak for specific tasks (Prompting, RAG, finetuning.)



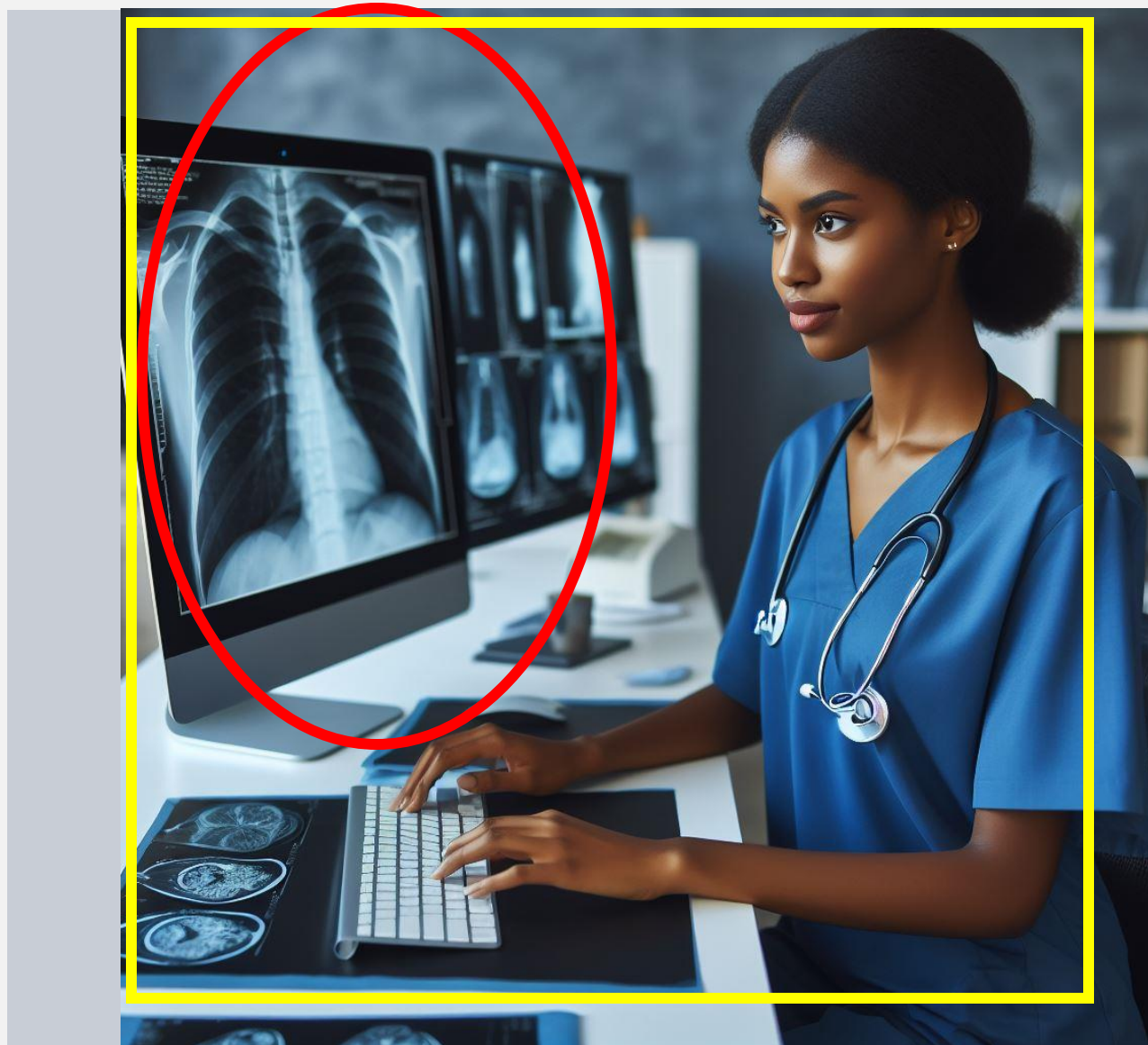
[Nicosia Cyprus. Giovanni Camocio ~1570]



ENGINES AND CARS OR AI AND SYSTEMS

- One way to visualize this is as the software is the car, and the “AI” is a component (e.g., the engine.)
- Users drive the car; not the engine.
- The engine is critical BUT other things (breaks, seat comfort, mirrors) can affect the user as much as the engine.
- Solutions to bias, safety, security are not always better AI but better system design.

FROM SYSTEMS TO HUMANS



[AI Generated using copilot.microsoft.com]

THINGS TO REMEMBER

- If a tool is used to diagnose or treat patients, then it qualifies as a medical device and is subject to regulatory review prior to being able to be sold.
- Focus is on how the tool will be used, not what it does → Use Case.
- Key question: if something goes wrong, how bad can things get → Risk Classification.
- One needs to be able to demonstrate that they did what they said they did → Documentation of entire process.

UNDERSTAND WHAT IT WOULD TAKE TO USE CHATGPT AS A MEDICAL DEVICE?

- Software Regulations and Processes.
- Core AI/ML Issues.
- Validation and Clinical Evaluation.
- Issues with Integration of AI/ML into Medical Software.
- Clinical Applications.

Generative Medical Event Models Improve with Scale

Shane Waxler^{*1}, Paul Blazek^{*1}, Davis White^{*1}, Daniel Sneider^{*1},
Kevin Chung¹, Mani Nagarathnam¹, Patrick Williams¹, Hank Voeller¹, Karen Wong¹,
Matthew Swanhorst¹, Sheng Zhang², Naoto Usuyama², Cliff Wong², Tristan Naumann²,
Hoifung Poon², Andrew Loza³, Daniella Meeker^{3, 4}, Seth Hain¹, and Rahul Shah^{†1}

¹Epic Systems

²Microsoft Research

³Yale School of Medicine

⁴Cosmos Governing Council

Aug 2025



Original Investigation | Health Policy

Use of Ambient AI Scribes to Reduce Administrative Burden and Professional Burnout

Kristine D. Olson, MD, MSc; Daniella Meeker, PhD; Matt Troup, PA-C; Timothy D. Barker, MD; Vinh H. Nguyen, MD; Jennifer B. Manders, MD; Cheryl D. Stults, PhD; Veena G. Jones, MD; Sachin D. Shah, MD; Tina Shah, MD, MPH; Lee H. Schwamm, MD

Abstract

IMPORTANCE While in short supply and high demand, ambulatory care clinicians spend more time on administrative tasks and documentation in the electronic health record than on direct patient care, which has been associated with burnout, intention to leave, and reduced quality of care.

Key Points

Question What is the association of using ambient artificial intelligence (AI) scribes with clinician administrative burden, burnout, time documenting

PROGRAM OUTLINE

(FOUR MODULES EACH
LASTING FOUR WEEKS)

- A. Introduction
- B. Introduction to Artificial Intelligence
- C. Medical Software with AI
- D. Current and Emerging Applications of AI in Medicine

MODULE A -- INTRODUCTION

1. Systems Theory + Medical Device Regulation
2. Introduction to Probability, Statistics, and Machine Learning
3. The core data challenges in building ML systems.
4. Regulatory Issues II: Quality Systems, Risk Management, Software and AI Regulations

MODULE B – INTRODUCTION TO AI

5. Introduction to Classical Machine Learning
6. Deep Neural Networks
7. Large Generative Models
8. AI Hands-on Lab assignment

MODULE C – MEDICAL SOFTWARE ENGINEERING & AI

9. The Medical Software Engineering Lifecycle
10. Software Engineering for, and with, AI
11. Cybersecurity, Privacy, and Data Management
12. Explainability, Transparency, Bias, and Horizontal AI Regulations

MODULE D – CURRENT AND EMERGING APPLICATIONS OF AI IN MEDICINE

- 13. AI in Medical Imaging
- 14. Clinical Decision Support Systems
- 15. Other current and emerging medical AI applications
- 16. Course summary: the state of Medical AI

STRUCTURE OF EACH WEEK

1. One hour of prerecorded video lectures to be released each Wednesday
2. An accompanying short multiple-choice quiz (10-15 questions) that will be due on Monday
3. A live zoom session (1 hour) on Tuesday to review material and answer questions – we could potentially have two sessions to accommodate different time zones.
 - Instructors and guest experts.
 - Probably 12 pm and 8 pm New York Time
 - There are 3 weeks where daylight savings differs between US and rest of the world.

SCHEDULE

#	Module	Video Release	Zoom
1	A	21-Jan-26	27-Jan-26
2	A	28-Jan-26	3-Feb-26
3	A	4-Feb-26	10-Feb-26
4	A	11-Feb-26	17-Feb-26
	Break		24-Feb-26
5	B	25-Feb-26	3-Mar-26
6	B	4-Mar-26	10-Mar-26
7	B	11-Mar-26	17-Mar-26
8	B	18-Mar-26	24-Mar-26
	Break		31-Mar-26
9	C	1-Apr-26	7-Apr-26
10	C	8-Apr-26	14-Apr-26
11	C	15-Apr-26	21-Apr-26
12	C	22-Apr-26	28-Apr-26
	Break		5-May-26
13	D	6-May-26	12-May-26
14	D	13-May-26	19-May-26
15	D	20-May-26	26-May-26
16	D	27-May-26	2-Jun-26

SUPPLEMENTARY INTERVIEW VIDEOS

- Freely available interviews with guest experts spanning the issues important to medical software and medical artificial intelligence, ranging from regulatory issues, to algorithm development and software engineering, to clinical implementation, and other related areas.
- We try to keep most of the material at the introductory to intermediate level. We hope that you feel them useful and educational.

2024-2025

Home

Zoom

Modules

Announcements

Quizzes

Discussions

People

Grades

Assignments

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Newest First



Xenophon Papademetris

Author

Posted Jan 22 4:11pm | Last edited Jan 22 4:14pm

1 Reply



Extra Materials for Week 2

We will be focusing on quality management systems and risk management. Here are some additional resources:

- An interview with Megan Graham on this topic:
https://youtu.be/POd0LQ80t4w?si=XxOhp_3-TOa_NDum



(She will join us for the zoom sessions.)

- An additional interview on this topic:
<https://youtu.be/ovpHZuCpbQM?si=7sg8lyKEM68XWBVc>



which we recorded 3 years ago.

- The IMDRF Quality System Guidance for Software as a Medical Device -- which we will discuss in some detail in the videos. International Medical Devices Regulator Forum (IMDRF): SaMD Working Group. Software as a Medical Device (SaMD): Application of Quality Management System [Internet]. 2015. Available from: <http://www.imdrf.org/docs/imdrf/final/technical/imdrf-tech-151002-samd-qms.pdf>. (Also from Canvas: [International Medical Devices Regulator Forum \(IMDRF\): SaMD Working Group. Software as a Medical Device \(SaMD\): Application of Quality Management System \[Internet\]. 2015. Available from: http://www.imdrf.org/docs/imdrf/final/technical/imdrf-tech-151002-samd-qms.pdf](#))
- This is one of the earlier papers on Risk Management and Software: I uploaded the pdf to Canvas as this is hard to access: [Fairley 1994 - Risk management for software projects.pdf](#)
- The Titanic Story (a failure of risk management): Kelly G. Titanic anniversary: The myth of the unsinkable ship. BBC [Internet]. 2012 Apr 1 [cited 2022 Mar 31]; Available from: <https://www.bbc.com/future/article/20120402-the-myth-of-the-unsinkable-ship>
- A paper on setting up a QMS for an academic setting (Megan Graham is the second author): Overgaard SM, Graham MG, Brereton T, Pencina MJ, Halamka JD, Vidal DE, Economou-Zavlanos NJ. Implementing quality management systems to close the AI translation gap and facilitate safe, ethical, and effective health AI solutions. NPJ Digit Med [Internet]. 2023 Nov 25;6(1):218. Available from: <http://dx.doi.org/10.1038/s41746-023-00968-8> PMID: PMC10676432. (Also available from Canvas: [Overgaard et al. 2023 - Implementing quality management systems to close the AI translation gap and facilitate safe, ethical, and effective health AI solutions.pdf](#))



Yale Biomedical Informatics & Data Science

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[linkedin.com/company/yale-biomedical-informatics-data-science](https://www.linkedin.com/company/yale-biomedical-informatics-data-science) and 5 more links



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How Digital Apps are Transforming Healthcare in Zanzibar (Yale Course Excerpt)

Yale Biomedical Informatics & Data Science · 278 views · 5 months ago

This excerpt from our new Certificate Program in Medical Software and Medical AI offers a preview into the look and feel of the online course. As part of the Global Health Informatics segment...

Videos



Play all



Bringing AI to the Bedside: Yale AI in Medicine Seminar...

65 views · 7 days ago



Introduction to AI in Medicine: Lucila Ohno...

151 views · 2 weeks ago



Large Language Model-based Chatbots and Medical...

531 views · 2 months ago



Curating Data for the All of Us Research Program:...

51 views · 2 months ago



AI and Medical Software Engineering...

160 views

Medical Software & Medical AI

Yale Online

Guest Expert Interviews

Guest Expert Interviews in Medical Software & Medical AI

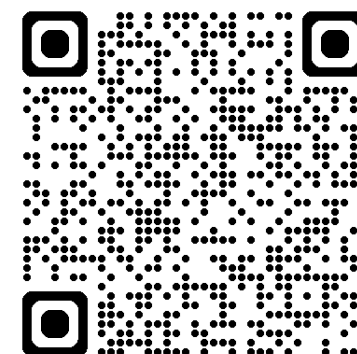
Yale Biomedical Informatics & Data Science...

15 episodes · Updated 4 days ago



▶ Play all

This is a set of interviews that were recorded as supplementary teaching material for the course...



Sort

1

Introducing Our Medical Software & Medical AI Podcast

2

Healthcare and Artificial Intelligence

3

Regulatory Issues & Medical AI

4

Quality Systems & Risk Management

5

Cloud Computing & Medical Devices

6

Human Factors & Medical Software

7

EU Artificial Intelligence Act

8

Medical Artificial Intelligence

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Introduction to Medical Software



Instructor: [Xenophon Papademetris](#)

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All Videos now also on YouTube!

the fundamentals
gain insight into a topic and learn
14 modules

(524 reviews)
4.8 ★ 3200

Recommended experience ⓘ
intermediate level

Introduction to Medical Software

Foundations for
Digital Health, Devices
and Diagnostics



Xenophon Papademetris,
Ayesha N. Quraishi and Gregory P. Licholai

[Cambridge University Press, 2002]

ADMISSIONS PROCESS

- Applications are open and we have had a number of applications already.
- We will use a “rolling admissions” process.
- We will do a first review early December and make the first offers.
- Applications that request scholarships will be reviewed in early January to allow for a more equitable process.

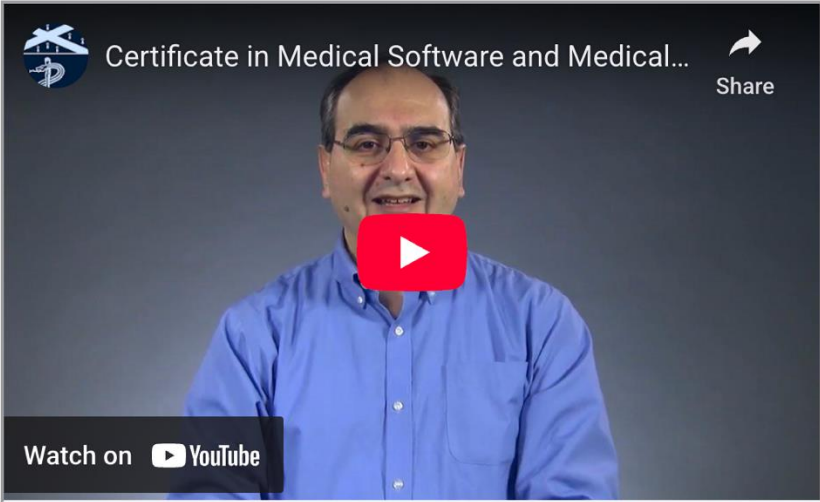


Medical Software and Medical Artificial Intelligence

Published: October 2023




Certificate in Medical Software and Medical...
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Watch on

YouTube

Description

APPLY NOW

Applications are open through December 31, 2025. Join the Fall 2025 info session webinar on Medical Software & AI at Yale on Thursday, November 13. Details in the program description.

