

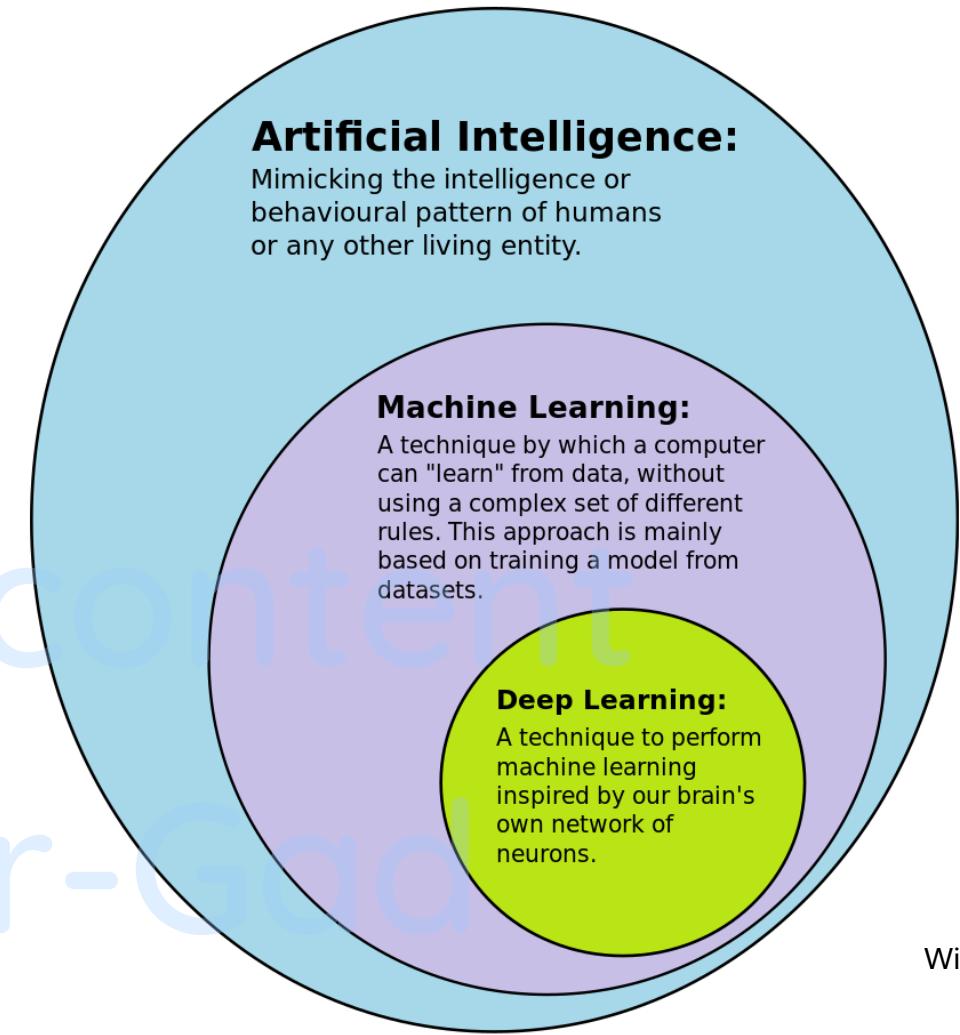
# Tic assessments YGTSS vs. artificial intelligence

Arguing for a brave new way

Izhar Bar-Gad

# The AI/ML/... revolution

- AI – Artificial intelligence
- ML – Machine learning
- NN – Neural networks
- DNN – Deep neural networks
- GenAI – Generative AI
- Foundational models



Wikimedia.org

Instead of explaining the reasoning just provide it with:

- (i) the decision (ii) hint or even just the (iii) statistics of the world
- (i) Supervised (ii) Weakly supervised / reinforcement (iii) unsupervised

# ML recent successes

- In general
  - Image analysis
  - Voice analysis
  - Text generation
  - Image generation
  - Game playing
  - Driving?
  - ...
- In science and medicine
  - MRI analysis
  - AlphaFold
  - ...

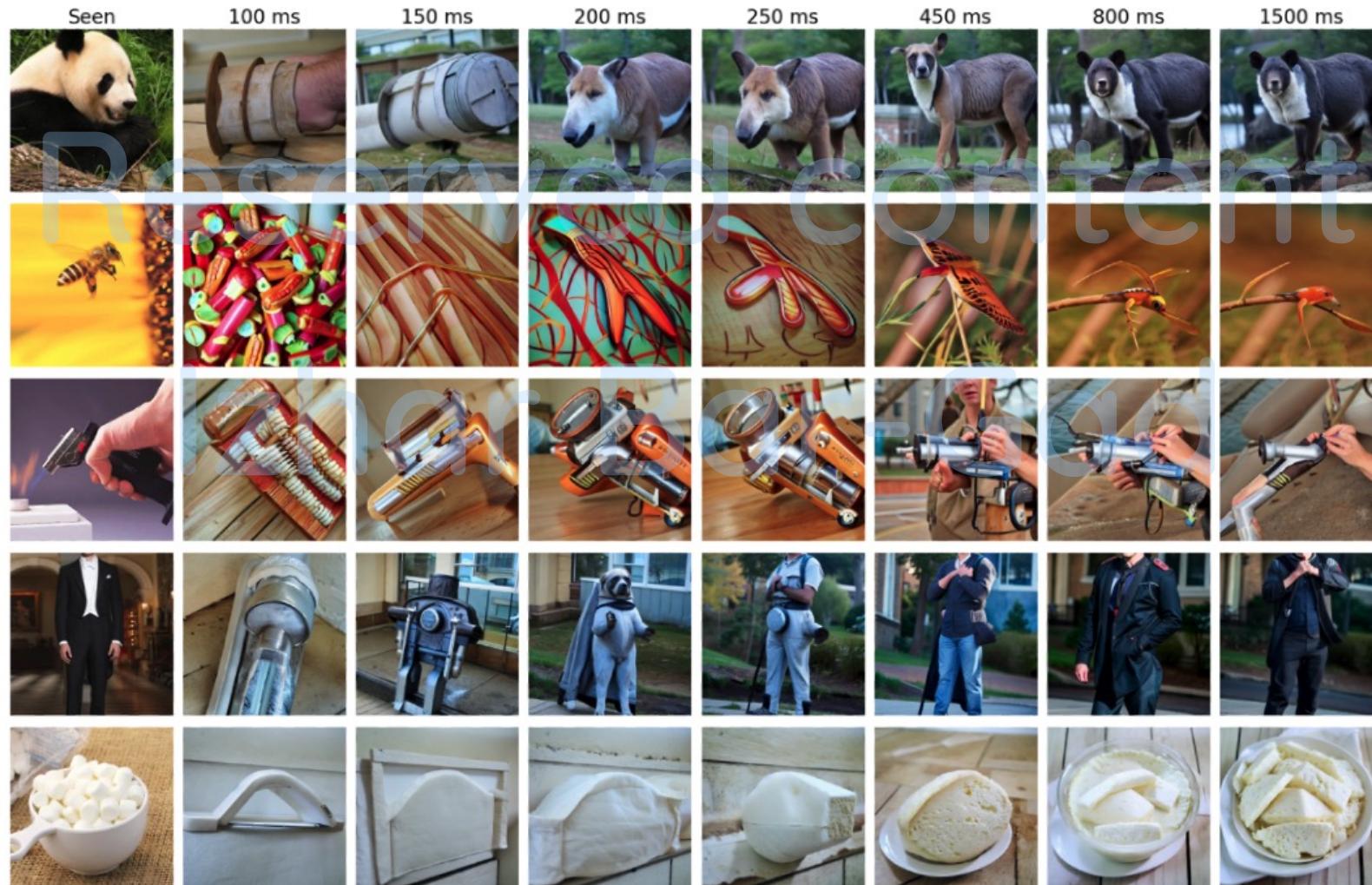
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# Brain decoding: toward real-time reconstruction of visual perception

Yohann Benchetrit<sup>1,\*</sup>, Hubert Banville<sup>1,\*</sup>, Jean-Rémi King<sup>1,2</sup>

<sup>1</sup>FAIR at Meta, <sup>2</sup>Laboratoire des Systèmes Perceptifs, École Normale Supérieure, PSL University

\*Equal contribution.





# Deep-learning-enabled antibiotic discovery through molecular de-extinction

Received: 4 October 2023

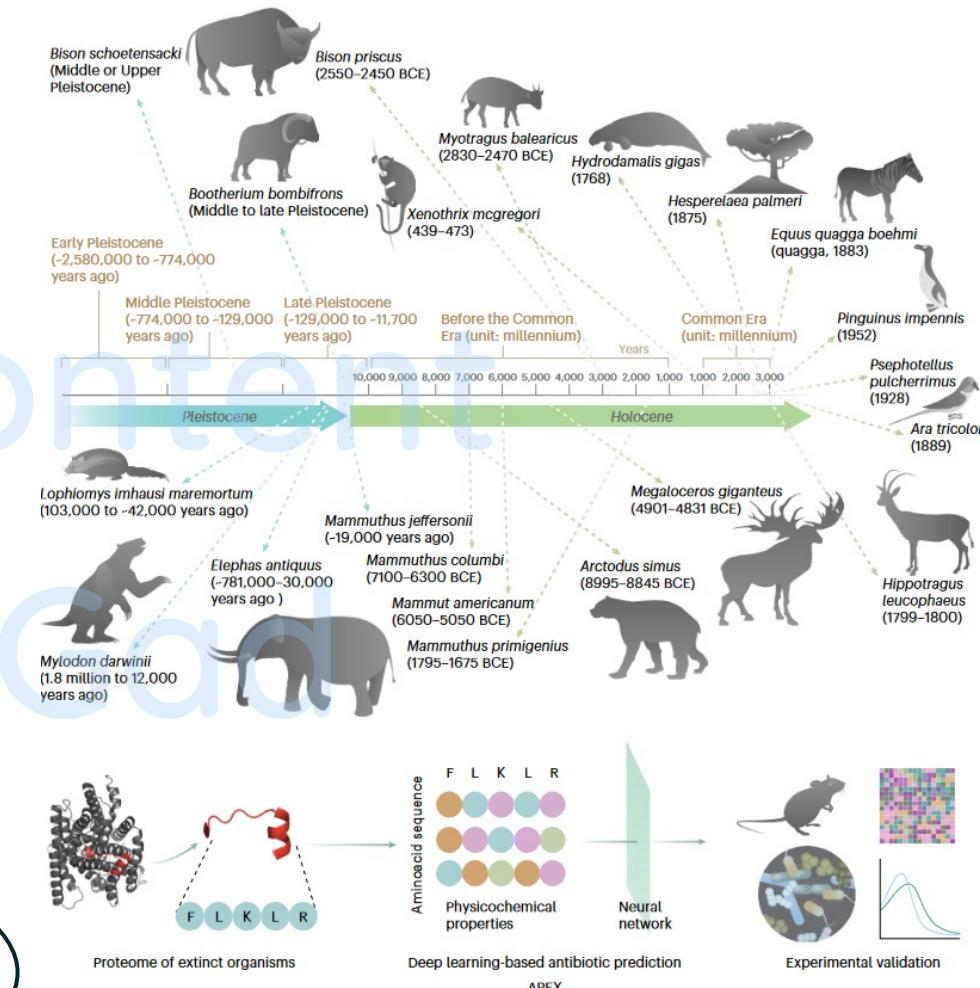
Accepted: 25 March 2024

Published online: 11 June 2024

Check for updates

Fangping Wan<sup>1,2,3,4,6</sup>, Marcelo D. T. Torres<sup>1,2,3,4,6</sup>, Jacqueline Peng<sup>5</sup> & Cesar de la Fuente-Nunez<sup>1,2,3,4,5</sup>

Molecular de-extinction aims at resurrecting molecules to solve antibiotic resistance and other present-day biological and biomedical problems. Here we show that deep learning can be used to mine the proteomes of all available extinct organisms for the discovery of antibiotic peptides. We trained ensembles of deep-learning models consisting of a peptide-sequence encoder coupled with neural networks for the prediction of antimicrobial activity and used it to mine 10,311,899 peptides. The models predicted 37,176 sequences with broad-spectrum antimicrobial activity, 11,035 of which were not found in extant organisms. We synthesized 69 peptides and experimentally confirmed their activity against bacterial pathogens. Most peptides killed bacteria by depolarizing their cytoplasmic membrane, contrary to known antimicrobial peptides, which tend to target the outer membrane. Notably, lead compounds (including mammuthusin-2 from the woolly mammoth, elephasin-2 from the straight-tusked elephant, hydrodamin-1 from the ancient sea cow, mylodonin-2 from the giant sloth and megalocerin-1 from the extinct giant elk) showed anti-infective activity in mice with skin abscess or thigh infections. Molecular de-extinction aided by deep learning may accelerate the discovery of therapeutic molecules.



## Accelerated Article Preview

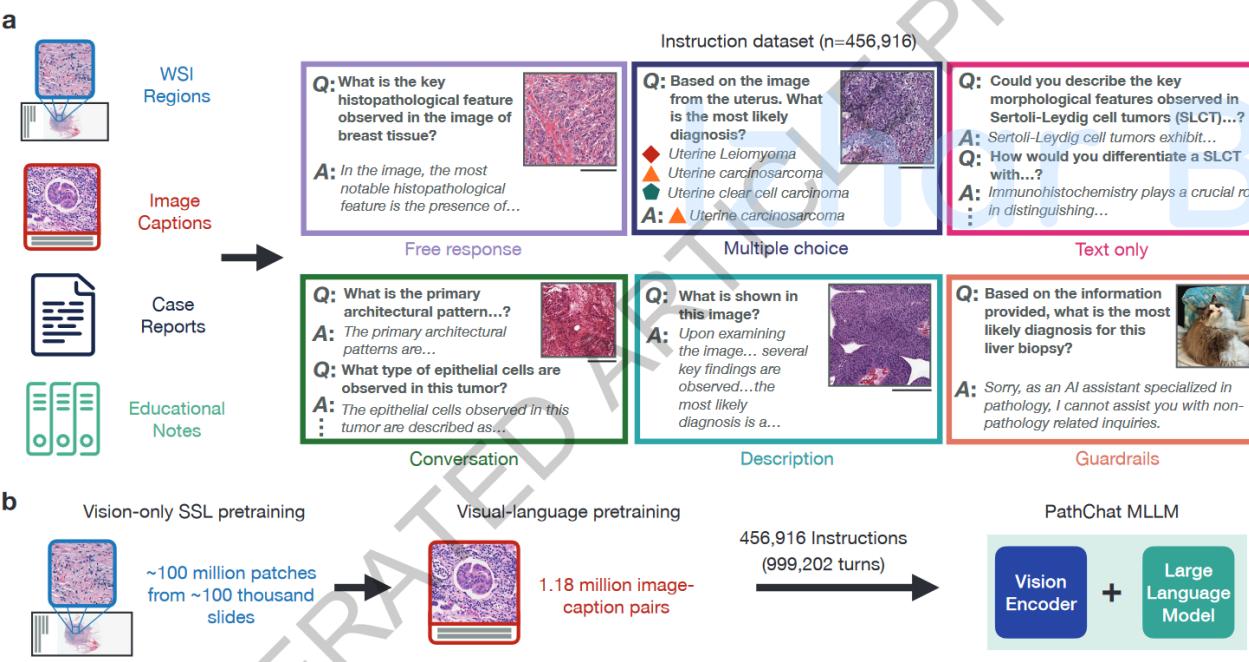
# A Multimodal Generative AI Copilot for Human Pathology

Received: 11 December 2023

Accepted: 28 May 2024

Accelerated Article Preview

Ming Y. Lu, Bowen Chen, Drew F. K. Williamson, Richard J. Chen, Melissa Zhao, Aaron K. Chow, Kenji Ikemura, Ahrong Kim, Dimitra Pouli, Ankush Patel, Amr Solim, Chengkuan Chen, Tong Ding, Judy J. Wang, Georg Gerber, Ivy Liang, Long Phi Le, Anil V. Parwani, Luca L. Weishaupt & Faisal Mahmood

**a****a****PathChat****PathChat**

What morphological features are present in this image?

Human

The image shows a tumor composed of spindle cells, which are elongated and have a fusiform shape. These cells are arranged in fascicles, which are bundles or groups of cells aligned in a parallel or whorled pattern. Additionally, there are scattered melanin-containing cells within the tumor.

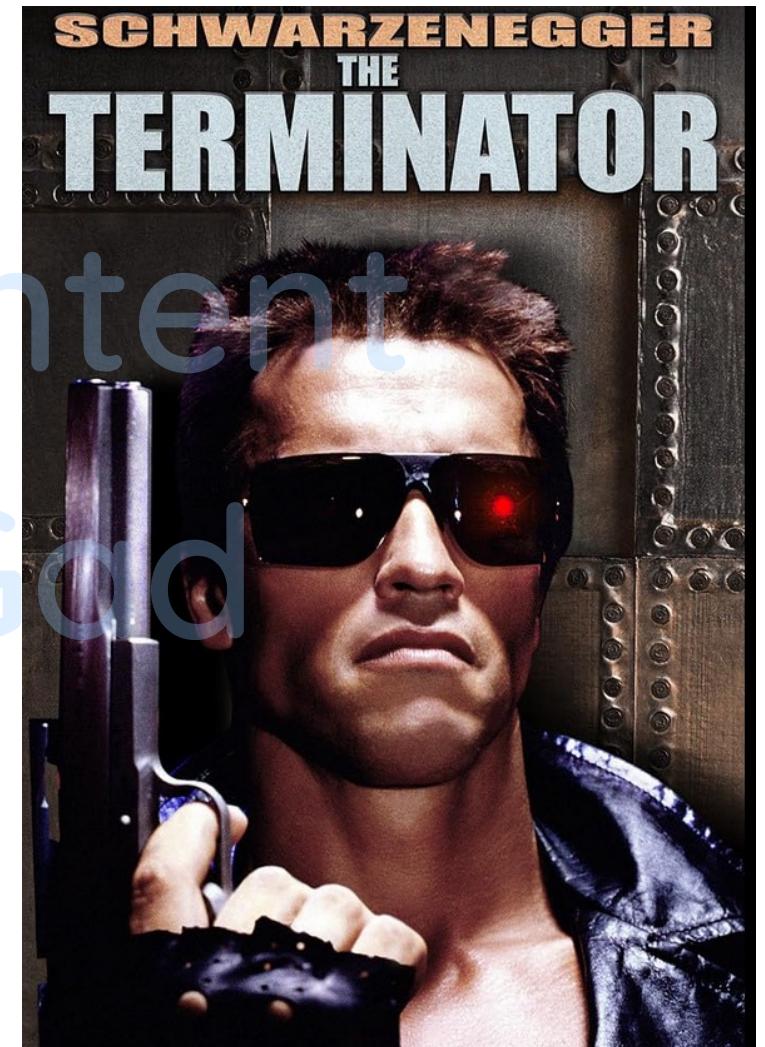
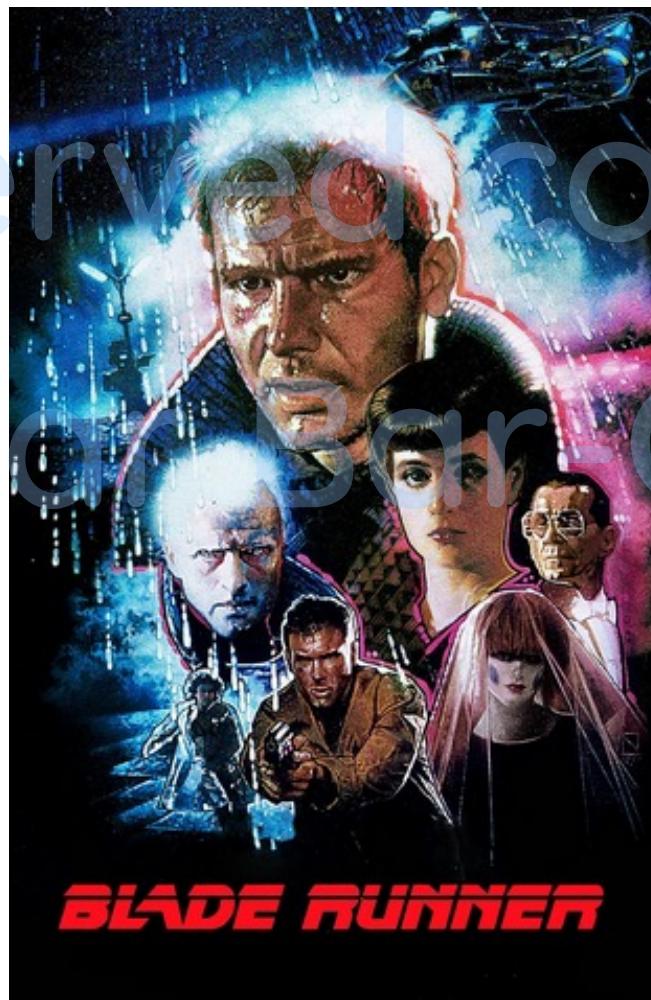
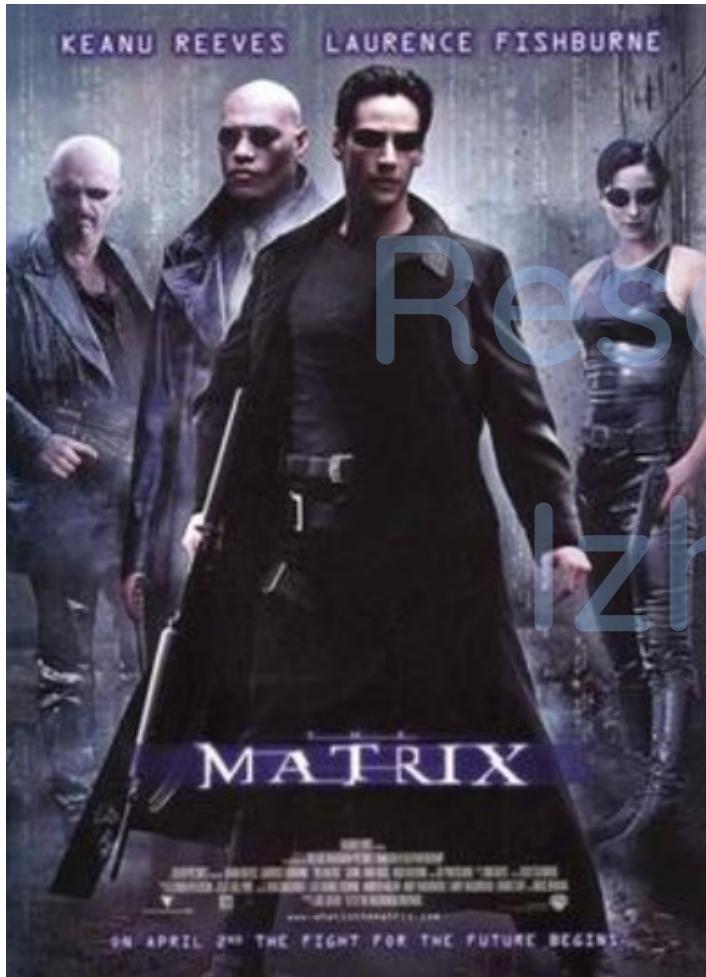
This tumor was found in the liver of a patient. Is it a primary tumor or a metastasis?

Human

Based on the information provided, this tumor is most likely a metastasis rather than a primary tumor. The presence of spindle cells and melanin-containing cells further supports the possibility of a metastatic melanoma. The liver is a common site for metastasis of melanoma, especially when it has spread from the skin.

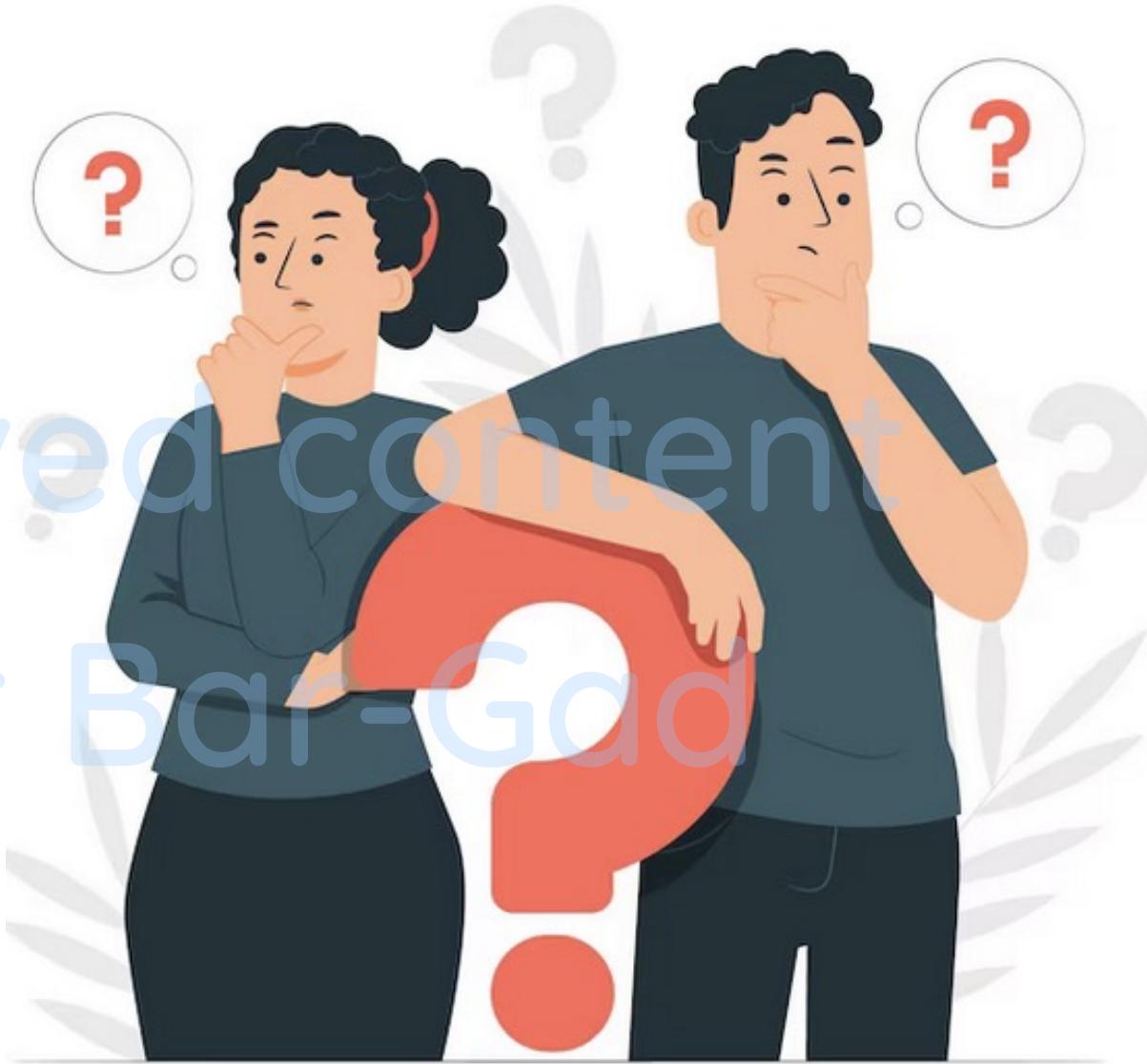
ML recent success leads to 2  
fundamental question !!!

# Will it take over the world?



Can it replace  
YGTSS?

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Izhar Bar-Gad



## Tic Detection in Tourette Syndrome Patients Based on Unsupervised Visual Feature Learning

Junya Wu ,<sup>1</sup> Tianshu Zhou,<sup>2</sup> Yufan Guo,<sup>3</sup> Yu Tian,<sup>1</sup> Yuting Lou,<sup>3</sup> Hua Ru,<sup>2</sup> Jianhua Feng , and Jingsong Li <sup>1,2</sup>

## Automatic Identification of Facial Tics Using Selfie-Video

Yocheved B. Loewenstein, Noa Benaroya-Milshtein, Katya Belelovsky and Izhar Bar-Gad

## Facial Tic Detection in Untrimmed Videos of Tourette Syndrome Patients

Yutao Tang\*, Benjamín Béjar†, Joey K.-Y. Essoe†, Joseph F. McGuire‡ and René Vidal\*

## Automated Motor Tic Detection: A Machine Learning Approach

Nele Sophie Brügge, MSc,<sup>1,2</sup> Gesine Marie Sallandt, MD,<sup>3,4</sup> Ronja Schappert, MSc,<sup>3</sup> Frédéric Li, PhD,<sup>1</sup> Alina Siekmann,<sup>3</sup> Marcin Grzegorzek, PhD,<sup>1,5</sup> Tobias Bäumer, MD,<sup>3</sup> Christian Frings, PhD,<sup>6</sup> Christian Beste, PhD,<sup>7,8,9</sup> Roland Stenger, MSc,<sup>1</sup> Veit Roessner, MD,<sup>7</sup> Sebastian Fudickar, PhD,<sup>1</sup> Heinz Handels, PhD,<sup>1,2</sup> and Alexander Münchau, MD<sup>9\*</sup> 

A deep learning approach for detecting tic disorder using wireless channel information

Arnab Barua | Chunxi Dong | Xiaodong Yang 

Reserved content

Multiple papers for automatic tic-detection recently

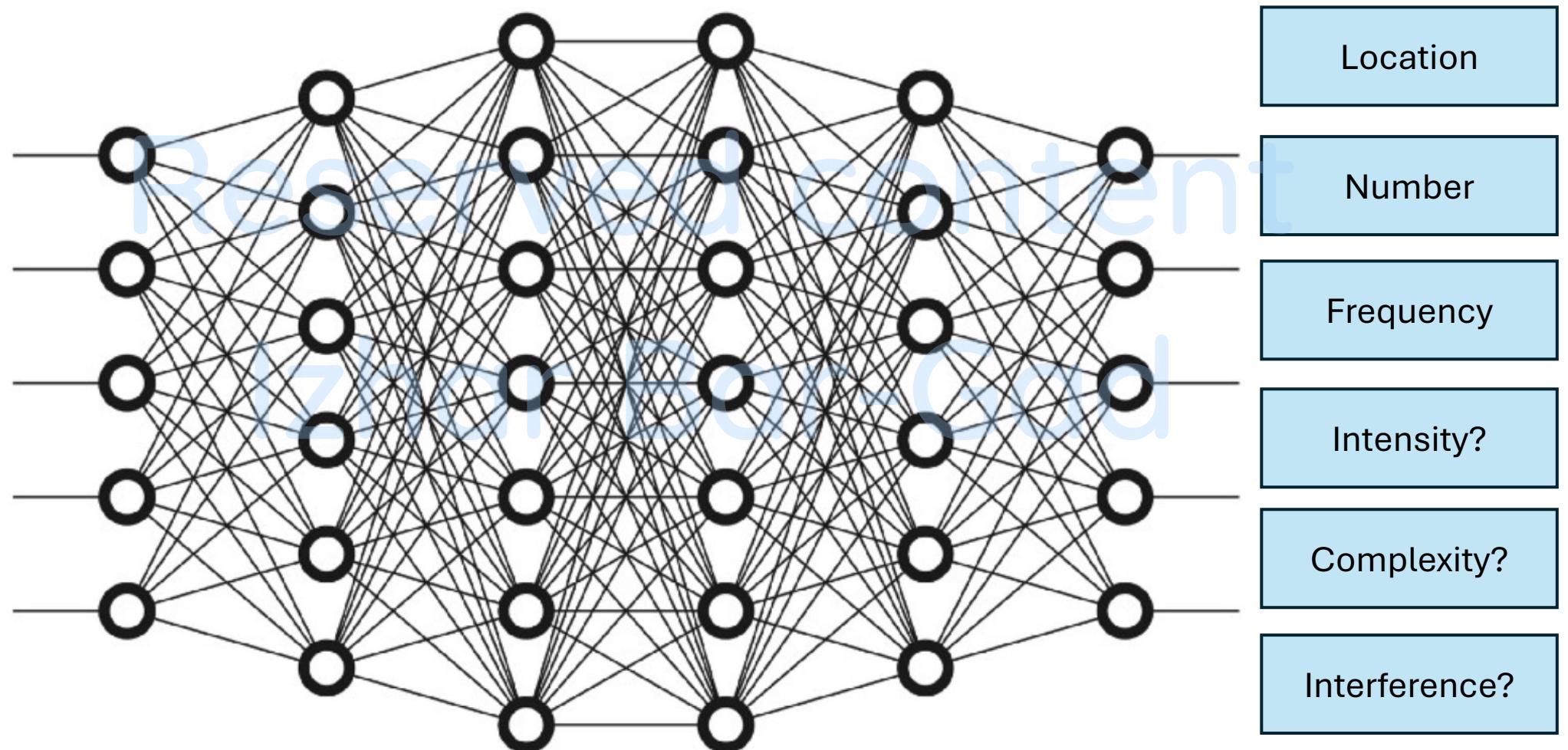
part of...

Large trend of neurologic and psychiatric disorders detection

part of...

Huge trend of detection everything using ML/AI revolution

# Can we quantify YGTSS?



# Invite AI to represent itself in the debate !

IBG → ChatGPT4o: I am participating in a debate on pro/con usage artificial intelligence for detecting of motor and vocal tics instead of the traditional scales (like YGTSS). I need to argue pro ai, give me some points to use

ChatGPT4o → IBG: 



# Now ask ChatGPT4o for just bullet points

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- 1. Accuracy , Objectivity and Consistency**
- 2. Real-Time Continuous Monitoring in Any Environment**
- 3. Comprehensive Multimodal Data Collection**
- 4. Efficiency and Convenience for Clinicians and Patients**
- 5. Enhanced Research Capabilities due to Aggregation**
- 6. Early Detection and Prediction**
- 7. Patient Empowerment and Engagement**
- 8. Accessibility and Scalability**
- 9. Personalized treatment plans**

# AI – always reliable (?!)

- IBG→ChatGPT4o: Can you also give me quotes with references supporting the subject from Davide Martino?

- ChatGPT4o→IBG: Davide Martino is a prominent researcher in the field of tic disorders. Here are some points that align with your arguments, along with references to Martino's work:

Quote: "AI-driven real-time observation, providing a comprehensive picture of tic disorders, which is a key element in their management."

Reference: Martino, D., et al. (2020). "Tics and Their Disorders." *Neurologic Clinics*, 38 (3), 563-580.



Fake  
News

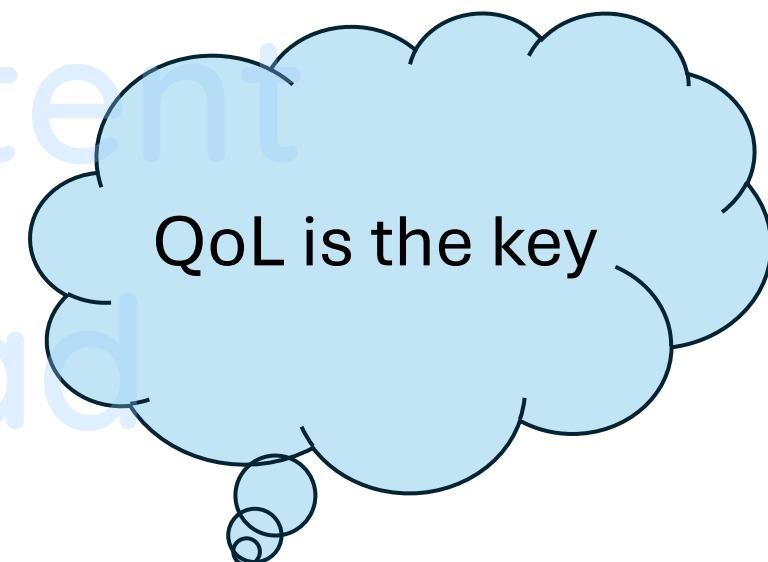
# Caveats: You are only as good as your data

- Limitations in all modalities
  - Video
  - Audio
  - IMUs
  - WiFi
  - Phone interaction
  - ...
- Privacy
- Engagement

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# But is that really good enough?

- Tic expression is only part of the whole picture
- Premonitory urge
- Perception of the tics
- Comorbidities
- AI allows following objective **and** subjective measures over time



# Bottom line

- Automatic tic quantification has multiple advantages:
  - Performed in a natural environment
  - Multiple assessments can relate to different effectors
  - Presentation over prolonged timescales
  - Potential for closing the loop
  - Empowering to patients and non-expert clinicians
- Crucial for research and clinical trials
- The major disadvantages are shared with YGTSS
  - Tic quantification is only part of the story

# Changes are inevitable

- Multimodal multi-environment data streams will provide more and more information about patients and their surrounding
- AI/ML tools will extract more information from these data streams guided by both the patients and the expert clinicians
- It will form a key component in the toolset available to tic experts, clinician and caregivers in the community and finally the patients and their families
- This will not replace any of the treating personnel but rather provide them with better ways of helping persons with tics.