Artificial intelligence and its applications in medicine

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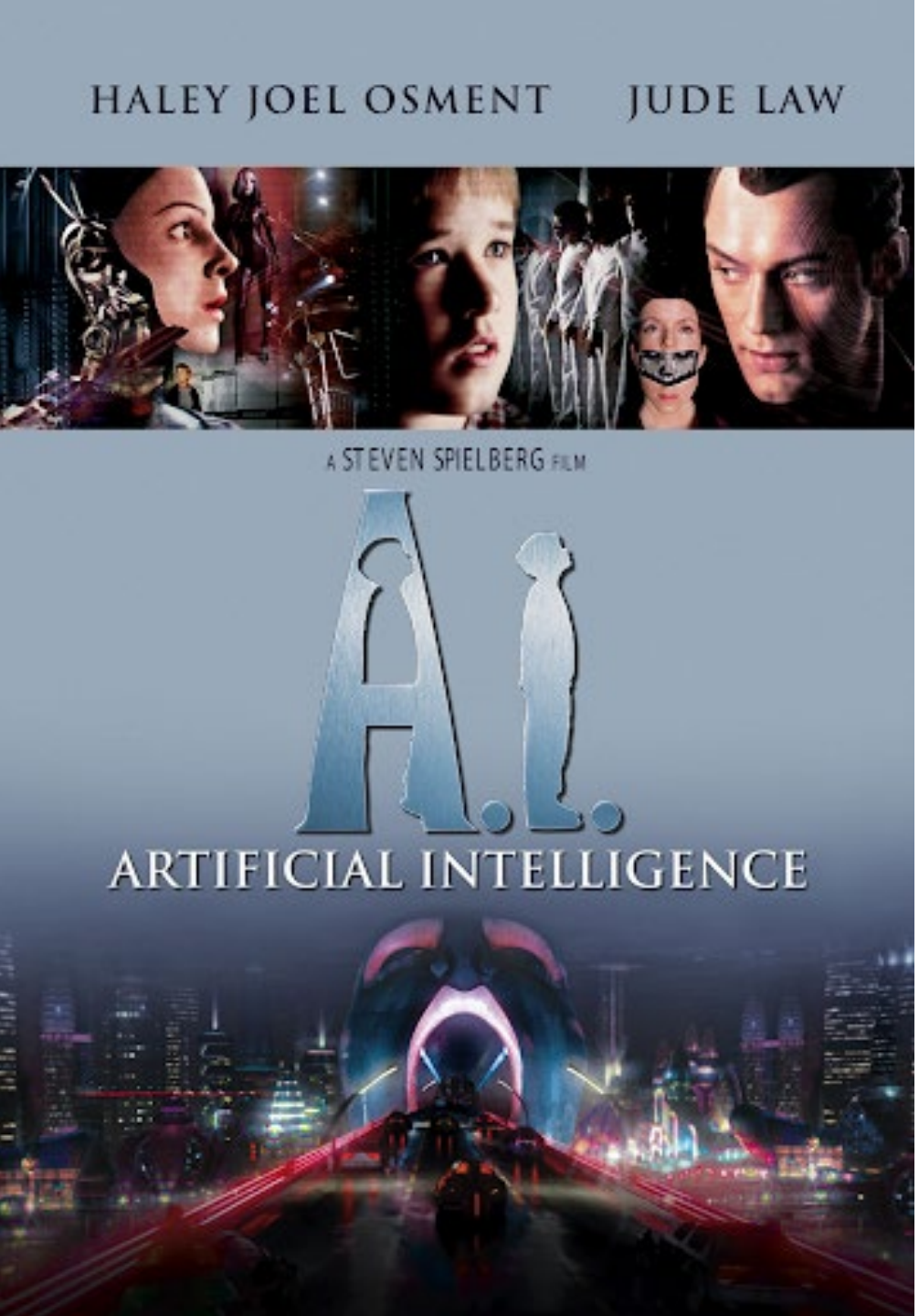
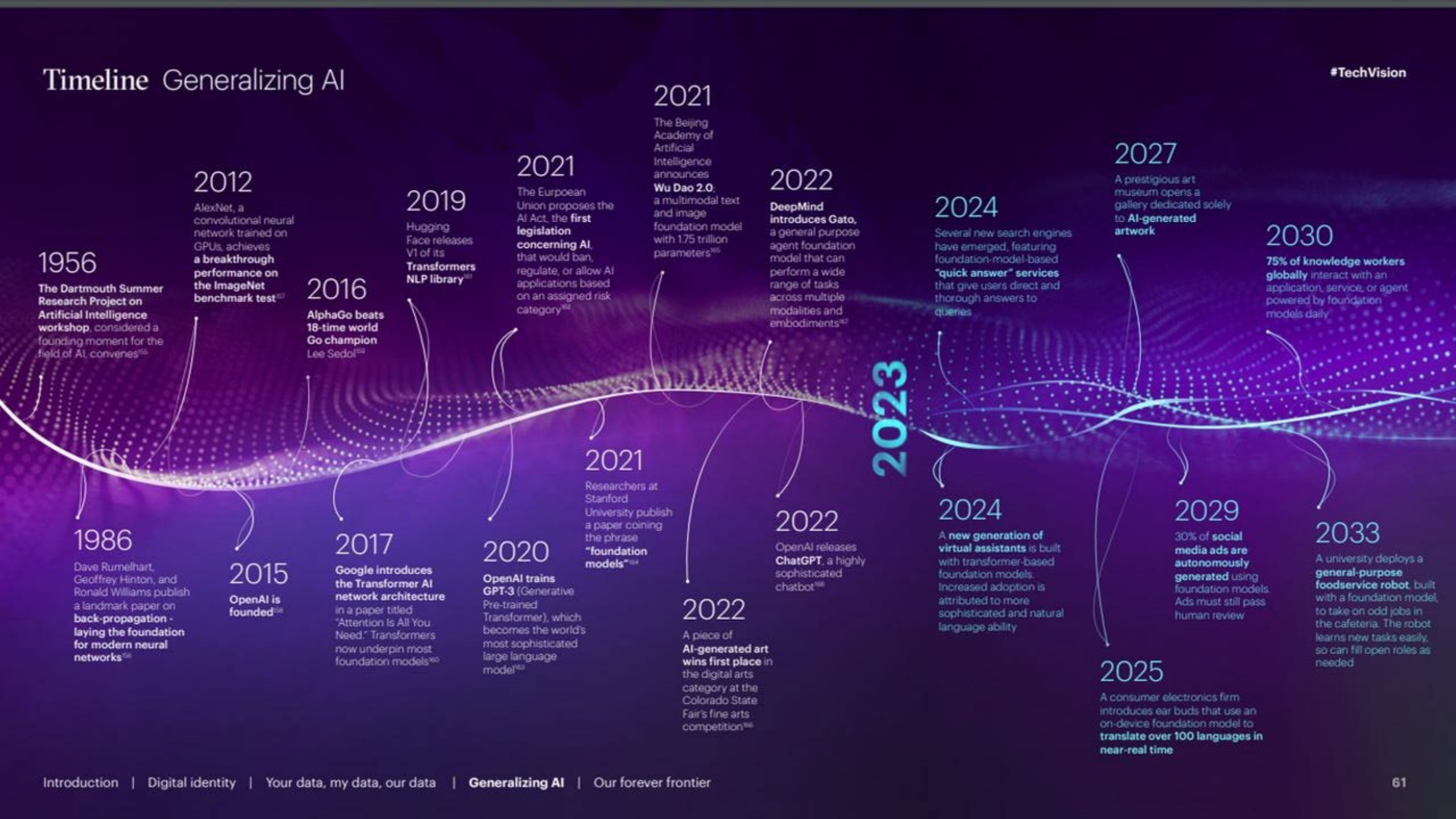


Brief history of artificial intelligence

- Definition of AI: the capability of computer systems or algorithms to **imitate intelligent human behaviour**

The plot: A robotic boy, the first programmed to love, David (Haley Joel Osment) is adopted as a test case by a Cybertronics employee (Sam Robards) and his wife (Frances O'Connor). Though he gradually becomes their child, a series of unexpected circumstances make this life impossible for David. Without final acceptance by humans or machines, David embarks on a journey to discover where he truly belongs, uncovering a world in which the line between robot and machine is both vast and profoundly thin.

Timeline Generalizing AI



1956

The Dartmouth Summer Research Project on Artificial Intelligence workshop, considered a founding moment for the field of AI, convenes[155]

1986

Dave Rumelhart, Geoffrey Hinton, and Ronald Williams publish a landmark paper on **back-propagation - laying the foundation for modern neural networks**[156]

2012

AlexNet, a convolutional neural network trained on GPUs, achieves **a breakthrough performance on the ImageNet benchmark test**[157]

2015

OpenAI is founded[158]

2016

AlphaGo beats 18-time world Go champion Lee Sedol[159]

2017

Google introduces the Transformer AI network architecture in a paper titled "Attention Is All You Need." Transformers now underpin most foundation models[160]

2019

Hugging Face releases V1 of its **Transformers NLP library**[161]

2020

OpenAI trains GPT-3 (Generative Pre-trained Transformer), which becomes the world's most sophisticated large language model[163]

2021

The European Union proposes the AI Act, the **first legislation concerning AI**, that would ban, regulate, or allow AI applications based on an assigned risk category[162]

2021

Researchers at Stanford University publish a paper coining the phrase **"foundation models"**[164]

2021

The Beijing Academy of Artificial Intelligence announces **Wu Dao 2.0**, a multimodal text and image foundation model with 1.75 trillion parameters[165]

2022

A piece of **AI-generated art wins first place** in the digital arts category at the Colorado State Fair's fine arts competition[166]

2022

DeepMind introduces Gato, a general purpose agent foundation model that can perform a wide range of tasks across multiple modalities and embodiments[167]

2022

OpenAI releases **ChatGPT**, a highly sophisticated chatbot[168]

2023

2024

Several new search engines have emerged, featuring foundation-model-based **"quick answer" services** that give users direct and thorough answers to queries

2024

A **new generation of virtual assistants** is built with transformer-based foundation models. Increased adoption is attributed to more sophisticated and natural language ability

2025

A consumer electronics firm introduces ear buds that use an on-device foundation model to **translate over 100 languages in near-real time**

2027

A prestigious art museum opens a gallery dedicated solely to **AI-generated artwork**

2029

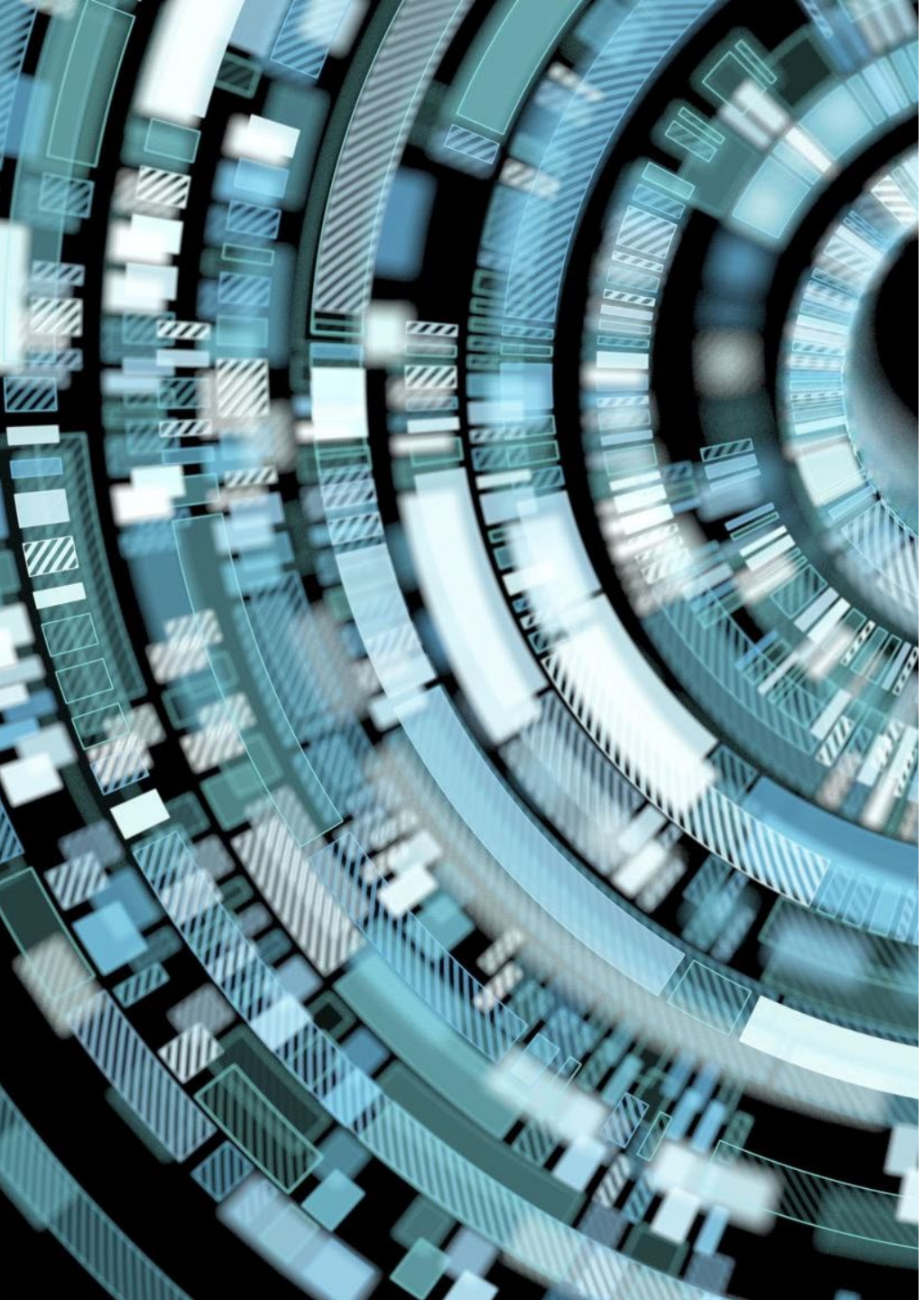
30% of **social media ads are autonomously generated** using foundation models. Ads must still pass human review

2030

75% of knowledge workers globally interact with an application, service, or agent powered by foundation models daily

2033

A university deploys a **general-purpose foodservice robot**, built with a foundation model, to take on odd jobs in the cafeteria. The robot learns new tasks easily, so can fill open roles as needed



Introduction to Medical AI

- What is Medical AI?

Medical AI involves the application of artificial intelligence technologies such as machine learning, NLP, computer vision, and robotics in healthcare settings to improve diagnosis, treatment, and patient management.

- Rapid Development of AI Technology

Medical AI has rapidly developed due to advancements in computational power, big data availability, algorithmic innovations, interdisciplinary collaboration, and significant funding.

The market will be **ACCELERATING** growing at a **CAGR** of over

(Compound Annual Growth Rate)

33%

INCREMENTAL GROWTH

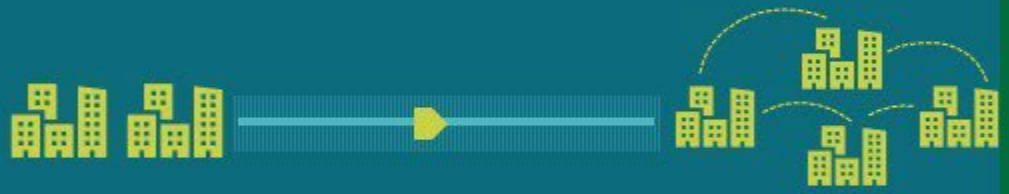
$ 75.54 bn

2018 2023

The year-over-year growth rate for **2019** is estimated at

29.43%

The market is **FAIRLY FRAGMENTED** with many players occupying the market share



61% of the growth will come from **NORTH AMERICA**

One of the **KEY DRIVERS** for this market will be the **BENEFIT OF INCREASE IN EMPLOYEE PRODUCTIVITY**

READ THE REPORT:

GLOBAL ARTIFICIAL INTELLIGENCE (AI) MARKET 2019-2023

10,000+ reports covering niche topics

INFORMATION TECHNOLOGY

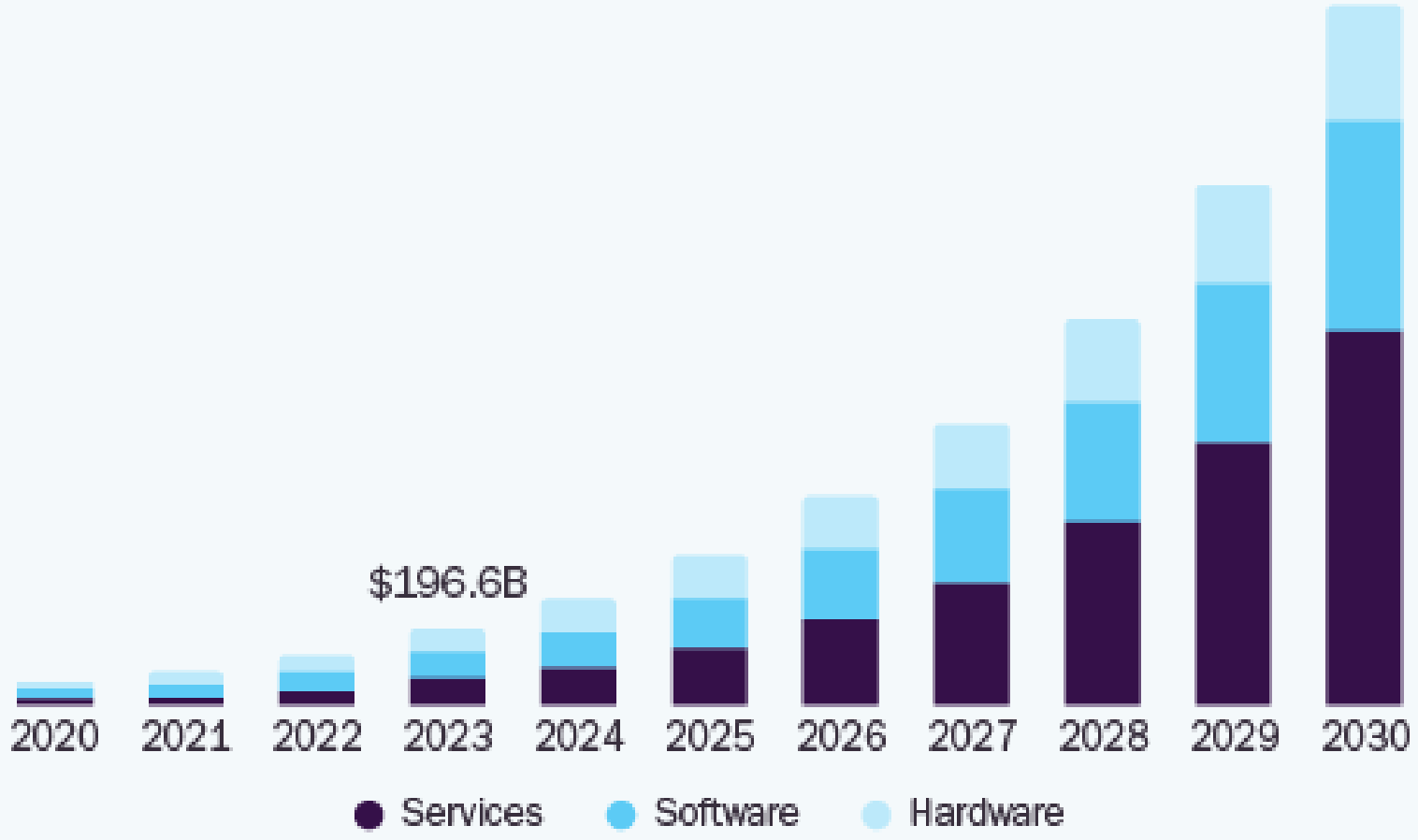
Read them at:

www.technavio.com

technavio

Global Artificial Intelligence Market

Size, by Solution, 2020 - 2030 (USD Billion)



GRAND VIEW RESEARCH

36.6%

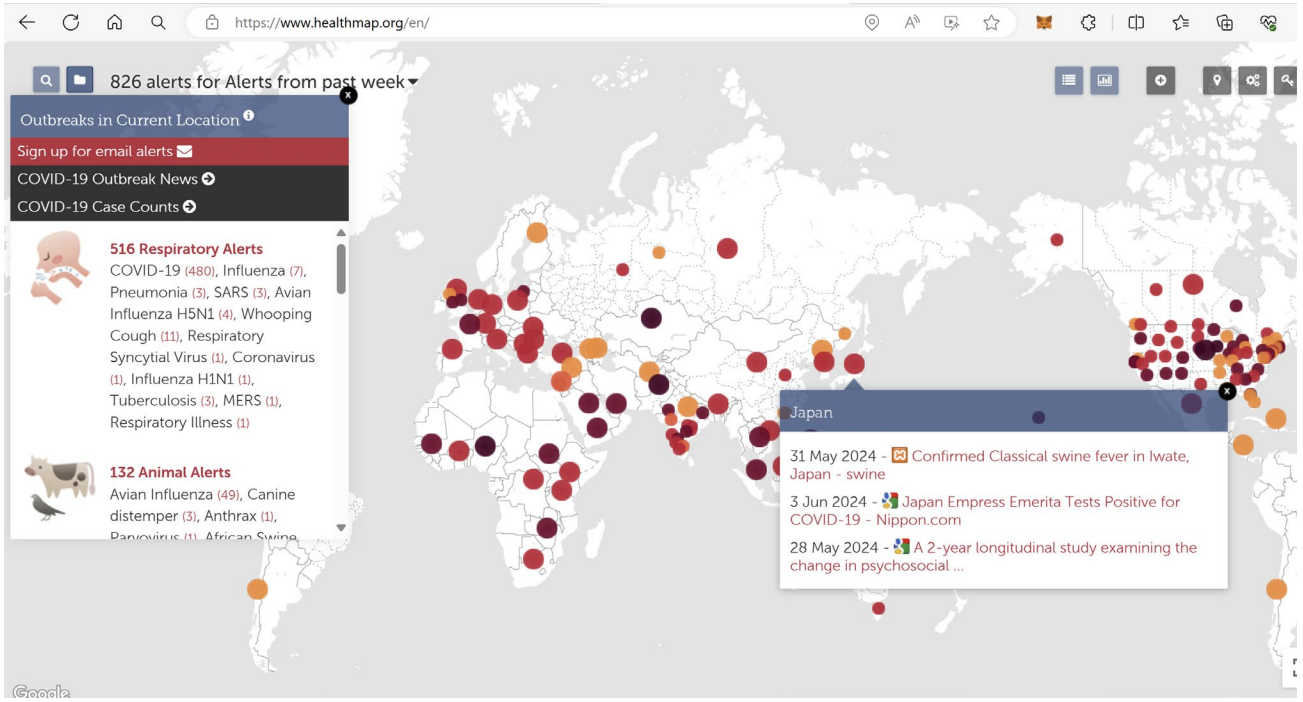
Global Market CAGR, 2024 - 2030

Source:
www.grandviewresearch.com

Early Detection and Diagnosis

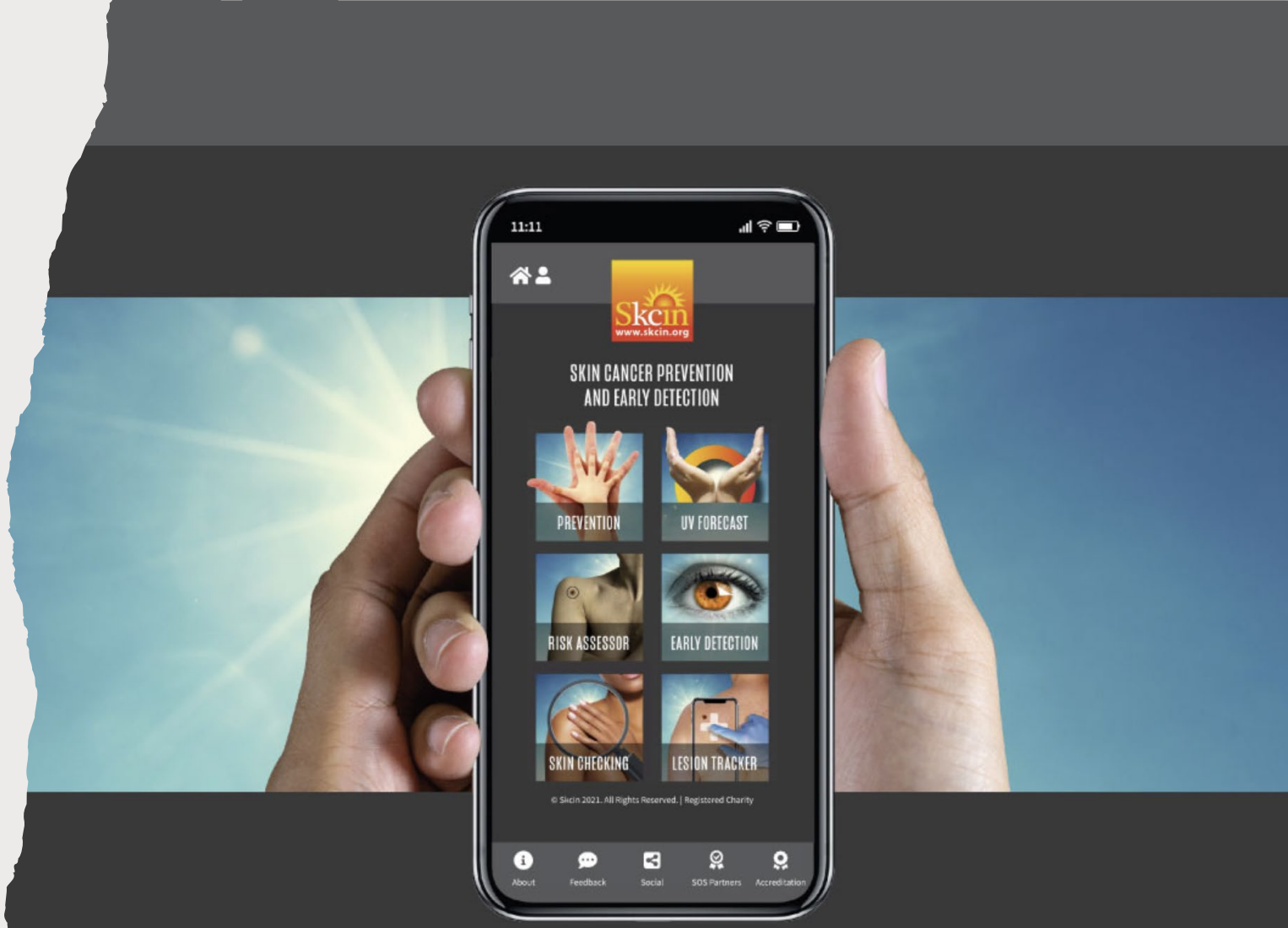
Predictive Analytics:

Example: HealthMap, an AI-driven platform that tracks disease outbreaks by analyzing online news, social media, and other data sources.
Reference: HealthMap (https://www.healthmap.org/)



Early Detection and Diagnosis

Imaging and Diagnostics:



WELCOME TO THE SKCIN APP

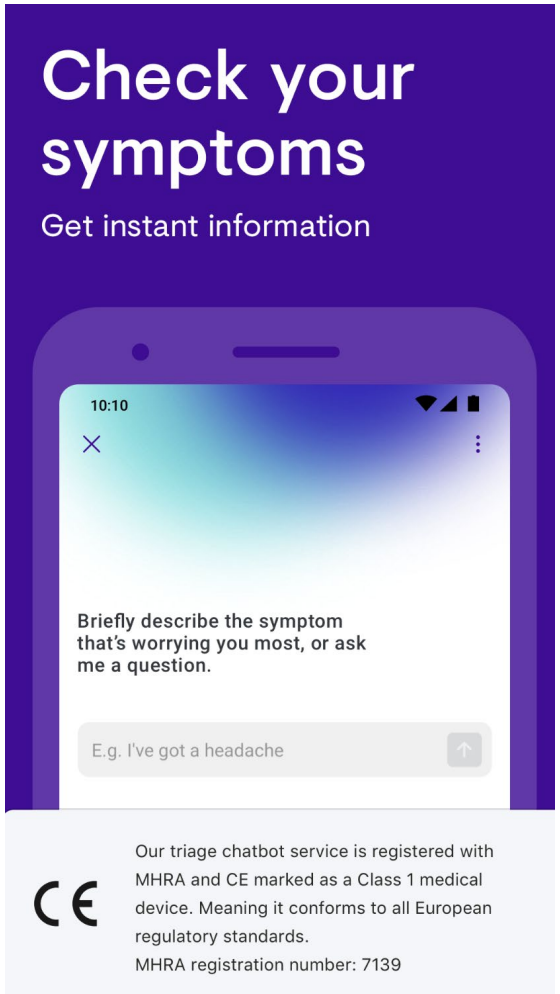
A comprehensive, educational and self- management mobile application, dedicated to the prevention and early detection of skin cancer.

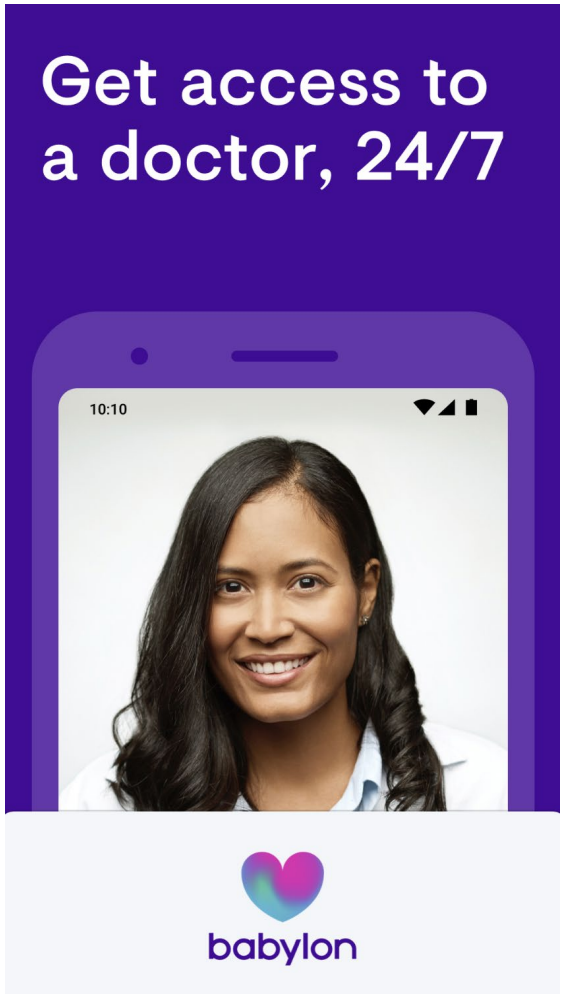
Early Detection and Diagnosis

Symptom Checkers:

Example: Babylon Health's AI-powered app provides symptom checking and triage advice, helping users understand when to seek medical care.

Reference: Babylon Health (https://www.babylonhealth.com/)





Early Detection and Diagnosis

AI-enabled tools, exemplified by Google DeepMind's diabetic retinopathy detection system, facilitate early disease detection, enabling prompt intervention and better management of chronic conditions.

Gulshan et al. (2016) showed that AI algorithms can accurately identify diabetic retinopathy from retinal images, potentially preventing vision loss in diabetic patients.

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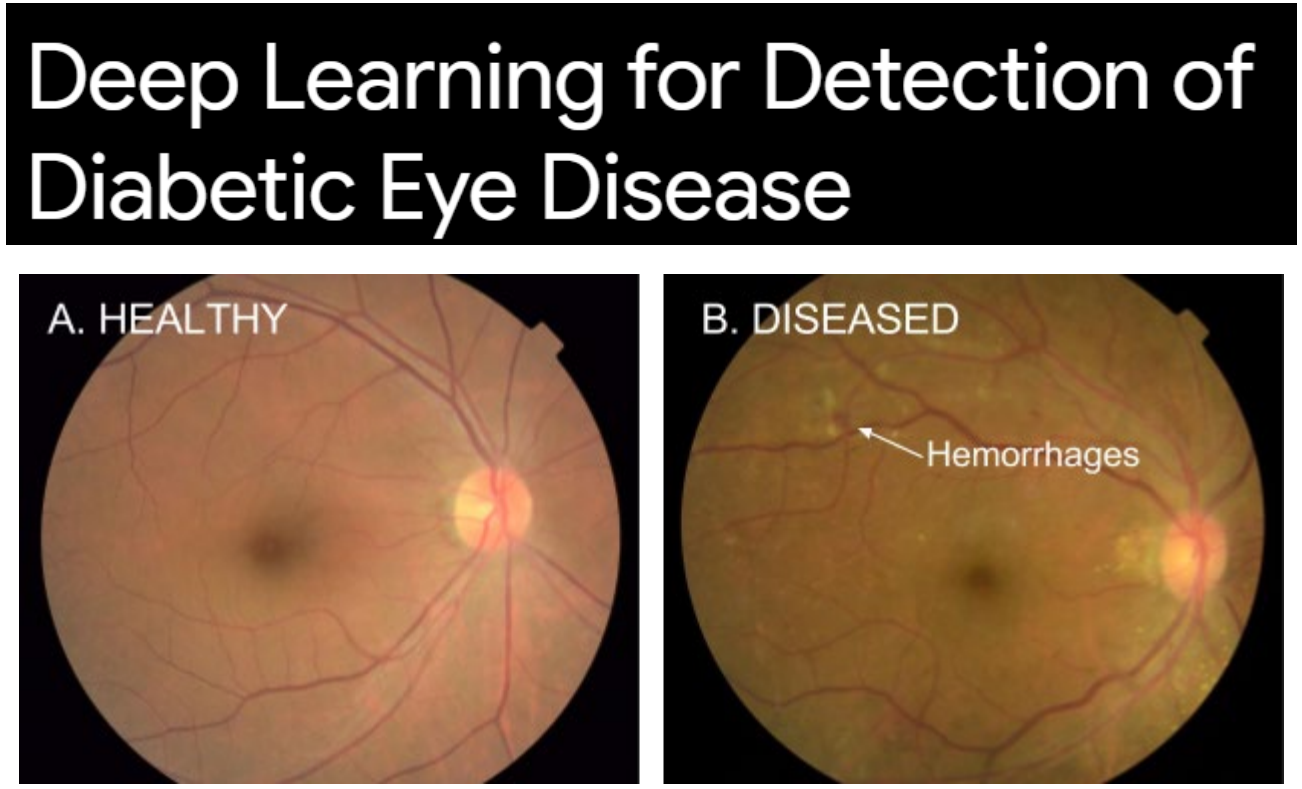
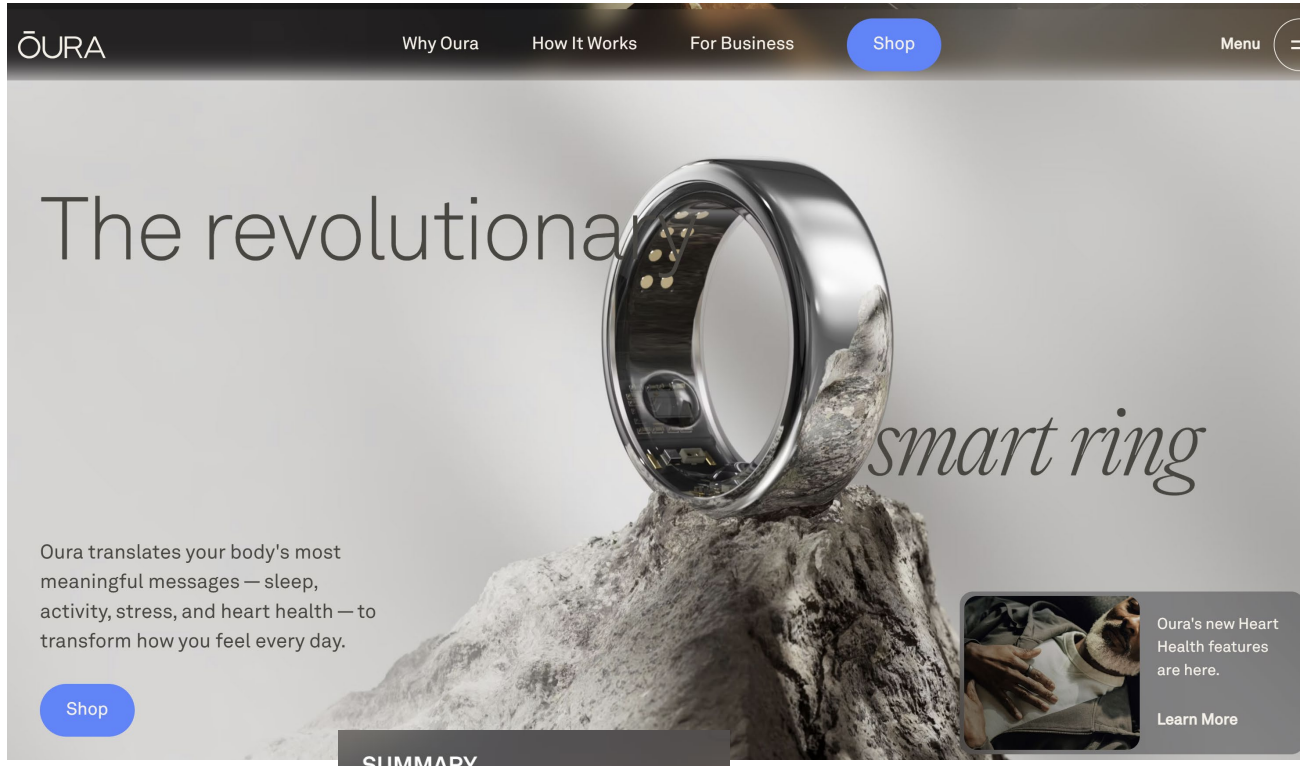
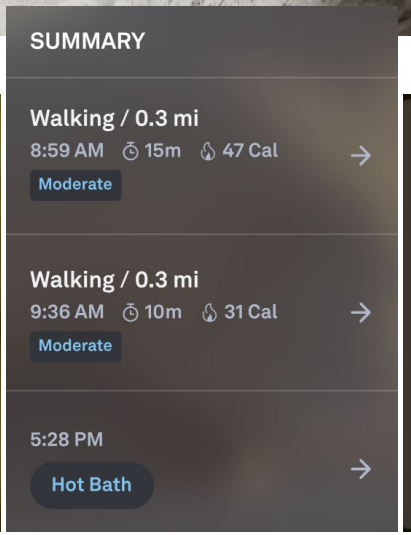


Monitoring and Surveillance

Wearable Technology:

Example: The Oura Ring, a smart ring that monitors vital signs such as body temperature, heart rate, and respiratory rate, was used for early detection of COVID-19 symptoms in healthcare workers.

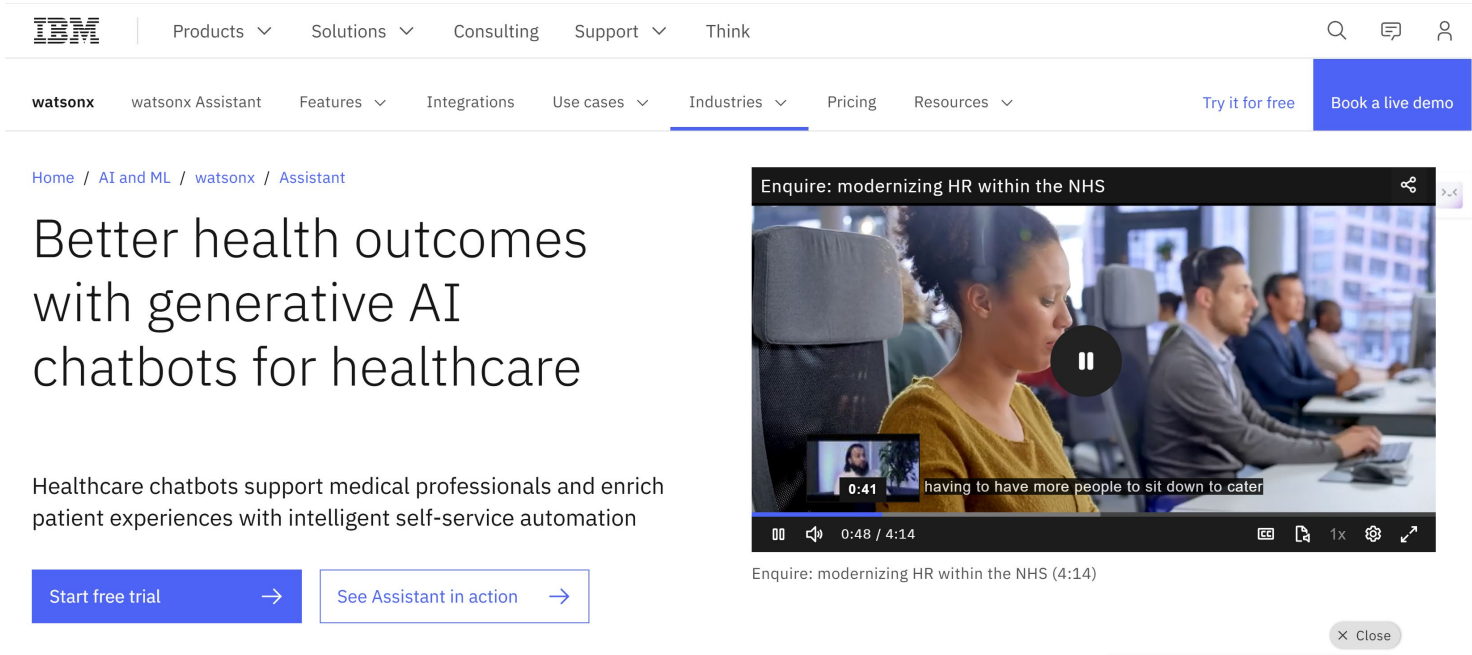




Health self-service automation

Generative AI Chatbots

Healthcare chatbots support medical professionals and enrich patient experiences with intelligent self-service automation

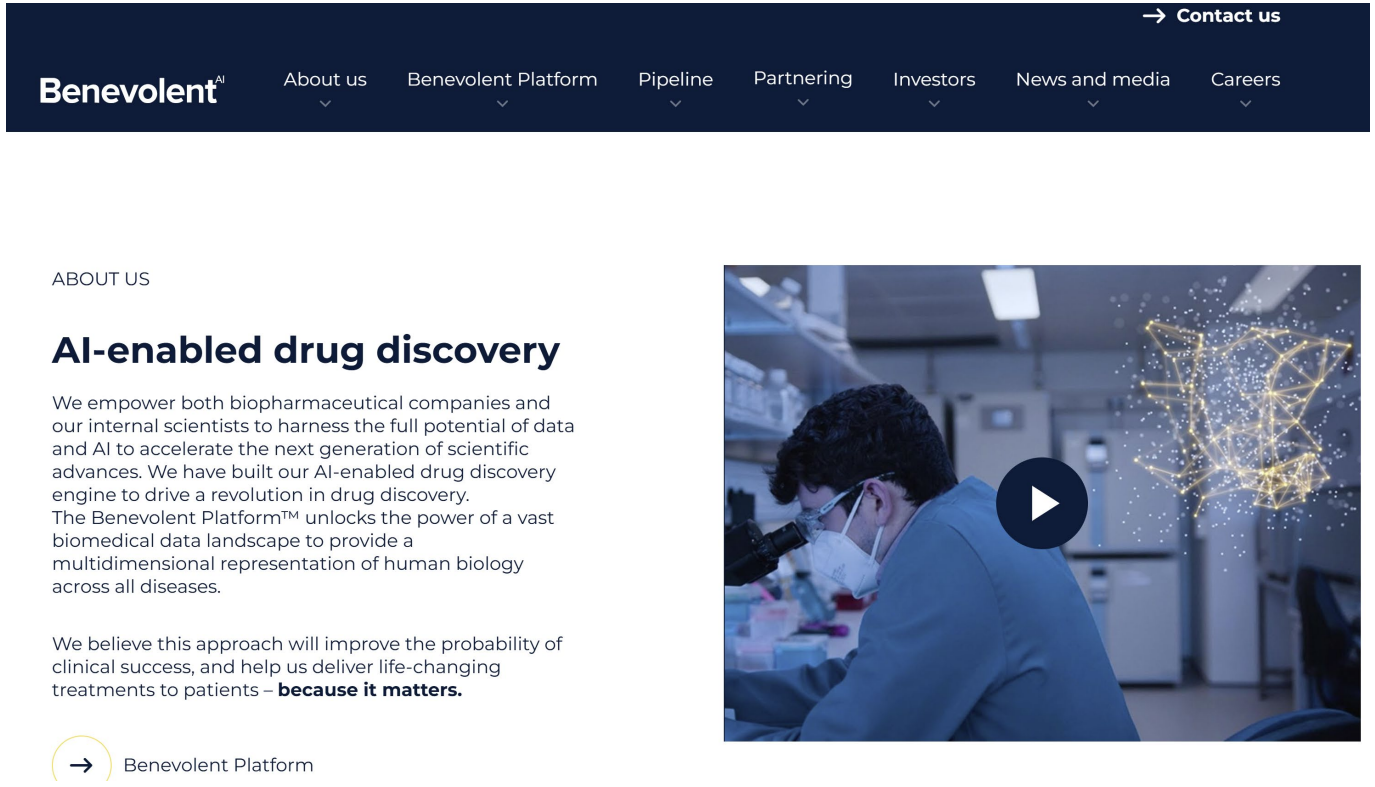


Treatment and Management

Drug Discovery:

Example: BenevolentAI used AI to identify existing drugs that could be repurposed to treat COVID-19.

Reference: BenevolentAI (https://www.benevolent.com/news-and-articles/how-ai-is-helping-to-find-treatments-for-covid-19)

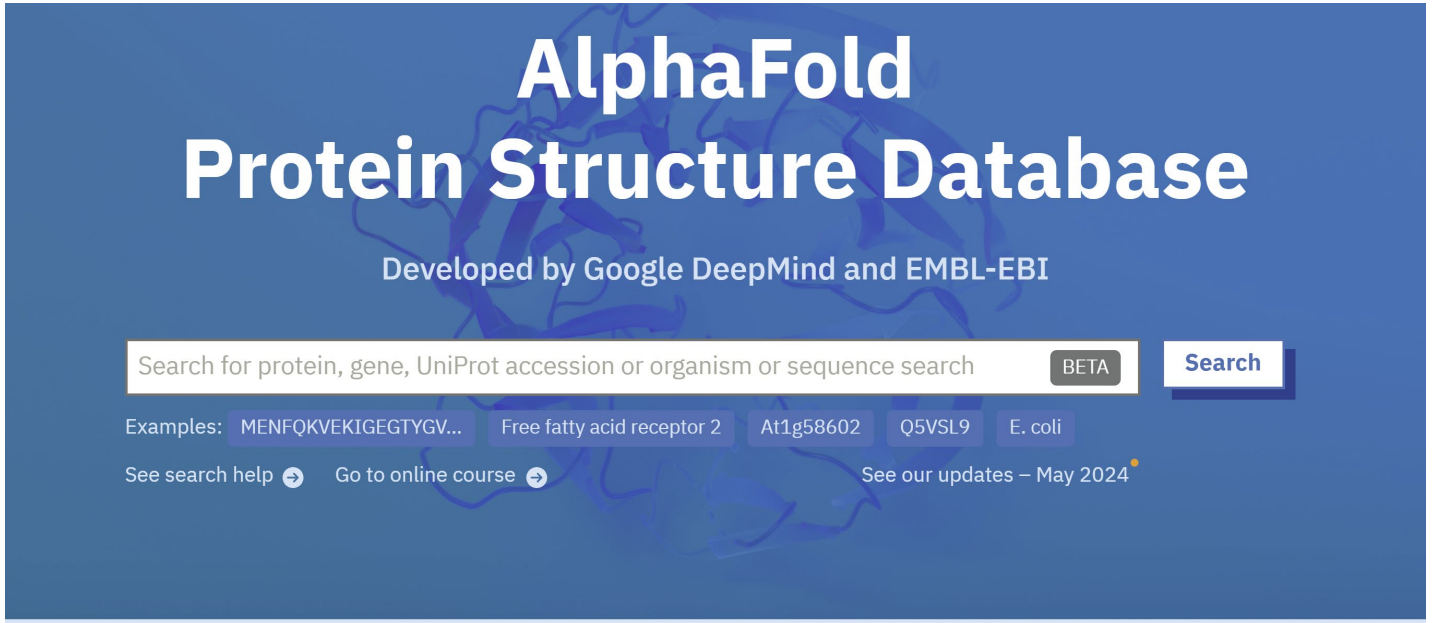


Treatment and Management

Genomic Analysis:

Example: DeepMind's AlphaFold uses AI to predict protein structures, significantly advancing research in understanding pathogen mutations and aiding in vaccine development.

Reference: Nature (https://www.nature.com/articles/d41586-020-03348-4)



AlphaFold DB provides open access to over 200 million protein structure predictions to accelerate scientific research.

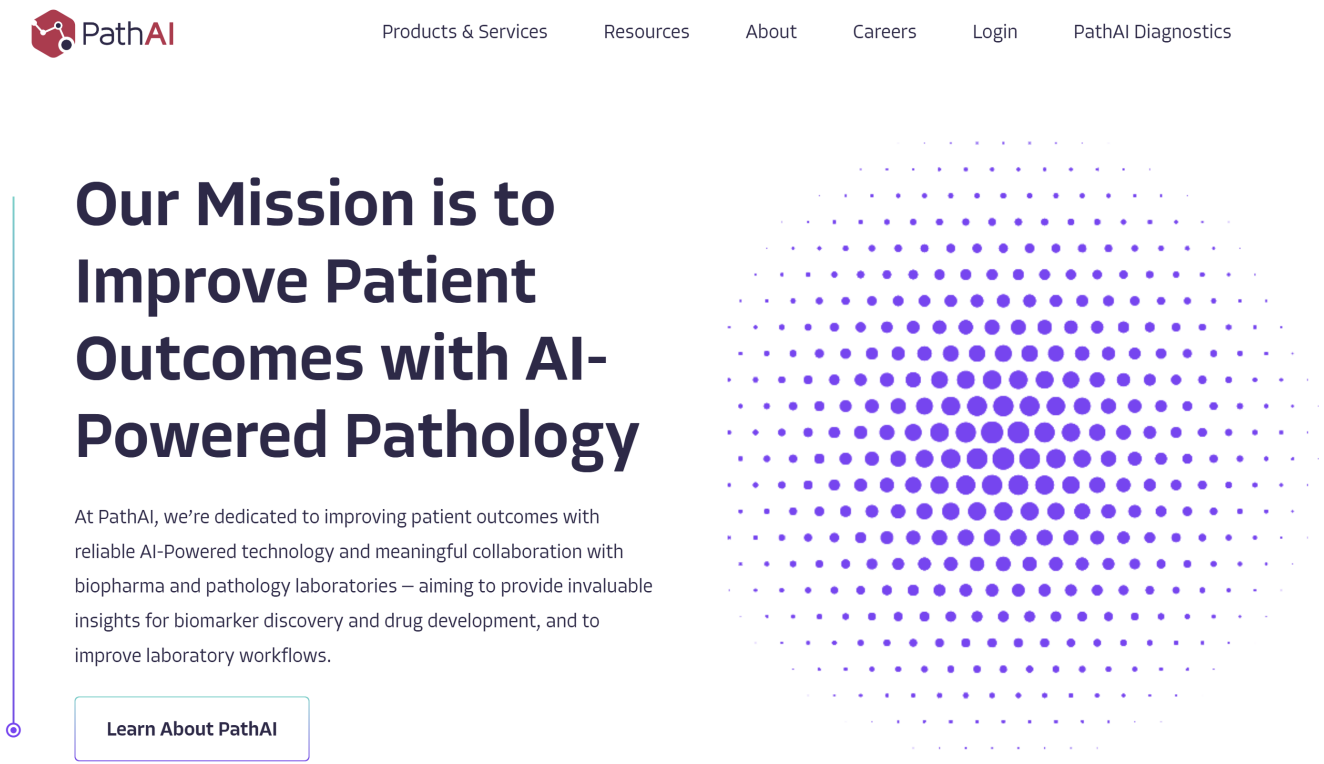
AlphaFold is an AI system developed by Google DeepMind that predicts a protein's 3D structure from its amino acid sequence. It regularly achieves accuracy competitive with experiment.

Treatment and Management

Clinical Trials:

Example: PathAI uses AI to optimize clinical trial designs by analyzing pathology data, improving the efficiency and accuracy of trials.

Reference: PathAI (https://www.pathai.com/)



Challenges and Shortcomings

Data Privacy

The use of AI in healthcare raises concerns about the privacy and security of patient data, especially with unauthorized access or data breaches.

Organizations must implement robust data protection measures to safeguard sensitive health information. Privacy Rights Clearinghouse provides resources on data privacy practices.

'Bias and Fairness'

AI algorithms may inherit biases from training data, leading to disparities in healthcare delivery and outcomes, particularly among marginalized populations.

Addressing bias and ensuring fairness in AI algorithms is crucial to promoting equitable healthcare access and treatment. Obermeyer et al. (2019) discuss the implications of bias in algorithmic decision-making.

'Regulation'

The regulatory landscape for medical AI is complex and often lacks standardized frameworks, leading to challenges in ensuring the safety, efficacy, and ethical use of AI technologies.

Regulatory bodies, such as the Food and Drug Administration (FDA), play a vital role in developing and enforcing regulations to govern the deployment of AI in healthcare.

'Integration'

Integrating AI technologies into existing healthcare systems poses technical challenges, including compatibility issues, interoperability concerns, and resistance to change from healthcare professionals.

Overcoming integration barriers requires collaborative efforts among technology developers, healthcare providers, and policymakers. Raghupathi & Raghupathi (2018) explore strategies for successful AI integration in healthcare settings.

'Cost'

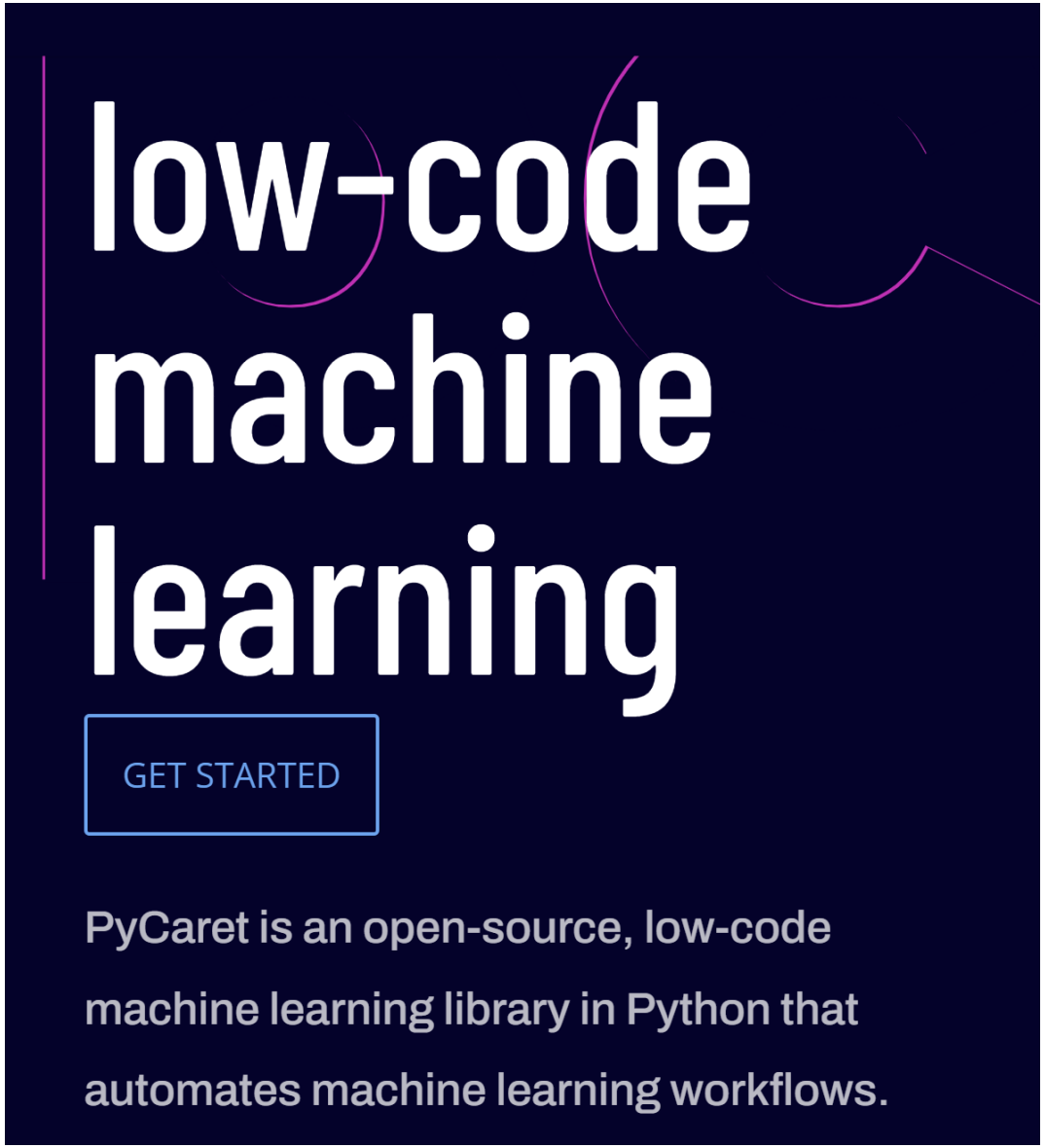
The initial implementation costs associated with adopting AI in healthcare can be prohibitive for some healthcare organizations, limiting access to advanced AI-driven technologies.

Efforts to reduce costs and increase affordability through innovation, scalability, and value-based pricing models are essential for ensuring widespread adoption of AI in healthcare. Sengupta & Pachava (2020) discuss the economic considerations of implementing AI in healthcare.

Workshop outline

Risk prediction

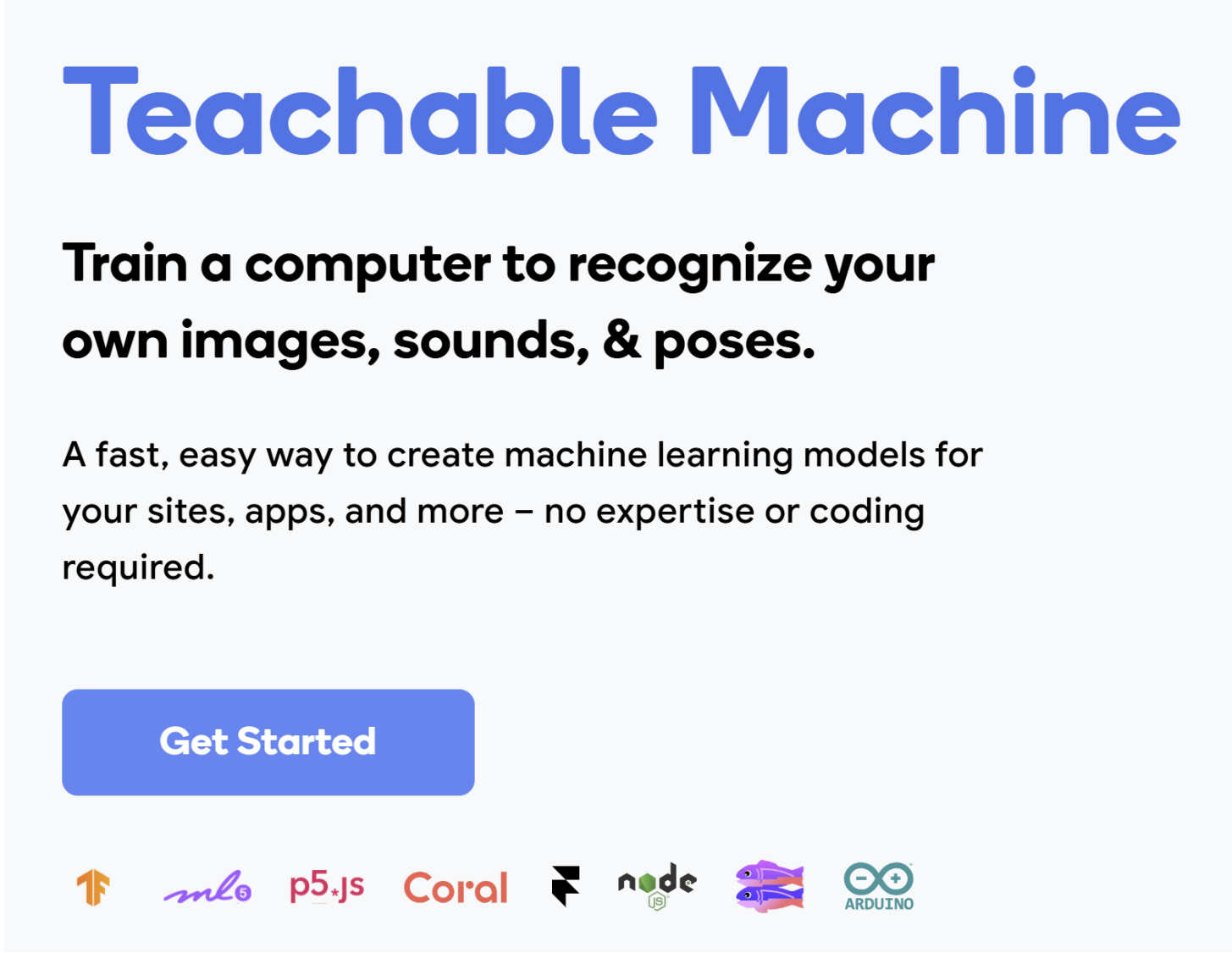
- Text-based
- Machine-learning
- Example: identify the risk of HIV/STIs in individuals
- Dataset: HIV/STI status and Behavioural indicators (computer-generated)
- Platform: PyCaret



Workshop outline

Image recognition

- Image-based
- Deep-learning
- To distinguish STI-related skin lesions
- Labelled and open-sourced STI images
- Platform: TeachableMachine



Conclusion

In conclusion, medical AI holds immense promise for transforming disease management in medicine, revolutionizing healthcare delivery, improving patient outcomes, and advancing public health.

However, realizing the full potential of medical AI requires addressing various challenges, including ethical considerations, regulatory frameworks, and equitable access, while embracing continued innovation, collaboration, and responsible implementation.