



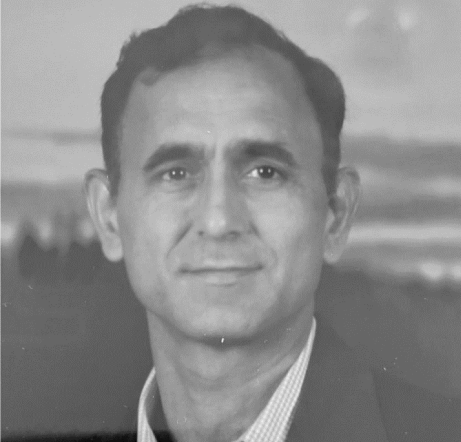
a SYNEOS HEALTH company

Transforms life science companies by leveraging their data with **advanced analytics**, to deliver **actionable insights** & **competitive edge**



ET03 - Empowering Healthcare through Generative AI





Ravindra Shukla, Managing Director, RxDataScience

- A seasoned IT leader with 20+ years of experience in global delivery in big data and advanced analytics with expertise in mathematical modeling, service-oriented architecture and predictive analysis and data science
- Current areas of work – Generative AI, LLMs, NLP, computer vision, time series and anomaly detection
- Experience with multiple start-ups (advanced analytics, AI)
- Published and presented papers related to data science, advanced analytics, artificial intelligence
- Published author of classic fiction, *A Maverick Heart Between Love and Life* and member of the film writer's association, and film direction
- Active in building US and India think-tank and various international social organizations
- Enjoys outdoor sports (tennis, cricket, trekking, travelling)



Aman Bahl, Associate Director, Syneos Health

- 20+ years of clinical industry experience in the areas of leadership, team management, statistical programming, and other statistical services
- Focused on providing innovative solutions and services based on customer needs
- Enables agility and drives change within teams to constantly rethink, revive, respond, and reinvent based on customer needs
- Dedicated to implementing cutting-edge methodologies and technologies to optimize data analysis and drive business growth
- Published and presented over 20 papers related to healthcare, trends and technology, AI/ML, SAS programming, CDISC standards, and R programming at various conferences
- Enjoys outdoor sports, trekking, travelling and volunteering

Which face is real ?



A

B

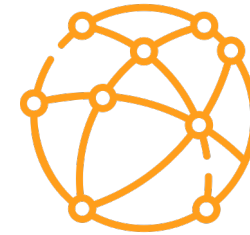
C

Image credit: Wepik

ChatGPT correctly diagnosed a 4-year-old's mysterious disease after 17 doctors failed



Frustrated by watching her son struggle with a seemingly undiagnosable condition, an American mother did what many people around the world are doing: she uploaded results from his medical tests to ChatGPT.



The software uncovered a condition that had eluded the attention of 17 doctors consulted over a span of three years. GPT directed attention to a rare form of spina bifida, that was restricting the movement of the child's spinal cord.



A surgeon confirmed the diagnosis and quickly initiated treatment

Source: [Toddler whose symptoms puzzled 17 doctors for three YEARS is finally diagnosed with rare condition... by ChatGPT. Daily Mail. Published 12 September 2023.](#)

AGENDA

Generative AI overview

Key Generative AI use cases in healthcare

Challenges of using Generative AI in healthcare

Future trends and prospects

Conclusion

Generative AI is a type of artificial intelligence technology that can produce various types of content, including text, imagery, audio and synthetic data.

ChatGPT/OpenAI Example

ChatGPT 3.5 ▾



You

Write three short captions for a social post for new line of clothing for kids



ChatGPT

- 1. "Sprinkling joy with our latest kids' collection! 🌈👶👶 Dress them in smiles and let the adventures begin. #KidStyle #PlayfulFashion"
- 2. "Tiny fashion, big statements! 🧸 Explore our new kiddie lineup – where comfort meets cuteness. #KidsWardrobe #AdorableEssentials"
- 3. "Because every kid deserves a wardrobe as vibrant as their spirit! 🌈👉 Discover our latest styles for the little trendsetters. #KidFashion #TinyTrendspotters"



	Traditional AI	Generative AI
Objective	Performs tasks based on pre-defined rules and patterns	Creates new data
Strengths	Effective, easily understandable, adept at solving specific tasks	Creative, innovative, can handle uncertainty, and novel applications
Weaknesses	May lack creativity and innovation, and exhibit challenges in managing uncertainty	Not as good at pattern recognition and task-specific problem-solving as traditional AI systems
Applications	Fraud detection, medical diagnosis, self-driving cars, voice assistants, gaming, trading etc.	Drug discovery, design creation, Image and video generation, medical diagnosis, code generation, Music, art, creative writing etc.

Generative AI applications and few conversion tool examples

Text-to-Text

ChatGPT, Bard,
LLaMA 2, Gemini

Text-to-Speech

Eleven Multilingual
v2, SeamlessM4T

Text-to-Image

MidJourney, DALL-
E3, Stable Diffusion,
Jasper Art

Text-to-Audio

AudioCraft,
MusicLM, AutoLM,
Jukebox

Image-to-Text

ChatGPT, Flamingo

Image-to-Video/3D

Pika Labs,
InstaVerse (3D)

Image-to-Image

Pix2Pix, Runway,
ZMO.AI

Text-to-Video

Make-A-Video,
Elai.io, Gen-2

Speech-to-Text

Whisper, SpeakAI,
Otter.ai, AudioPen

Video-Video

Wonder Studio,
Gen-2

Exploring Self-Attention and Transformer Architecture in Generative AI

“ How are words, sentences, and para interpreted?

How is new content generated?

Advanced Tasks – Processing Text, Images, Audio, Video

Google Translation (journey from 2006 – 2017 – 2023)

How transformer architecture and self attention changed the NLP

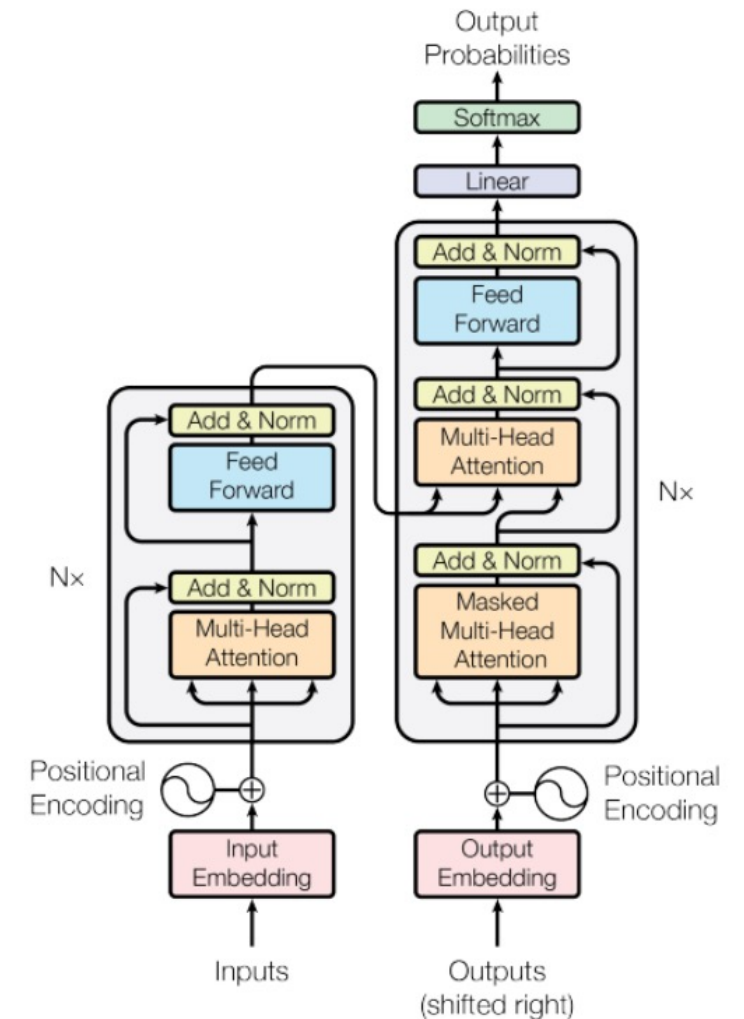


Image source: [Vaswani, A., et. al. Attention Is All You Need. 31st Conference on Neural Information Processing Systems \(NIPS 2017\), Long Beach, CA, USA.](#)

Approaching Generative AI based Applications

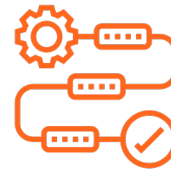
40 years ago, SQL fulfilled a role comparable to the current function of Large Language Models (LLMs) for unstructured data.

Therefore, before delving into a solution, it is crucial to have a comprehensive understanding of both the problems and the data.

Generative AI transcends being a mere tool; it serves as a canvas for limitless creativity. Envision your data as the paint and your communication as the brushstrokes. With Generative AI, we can



Discover the depths of the data ocean, revealing a wealth of continuously expanding information

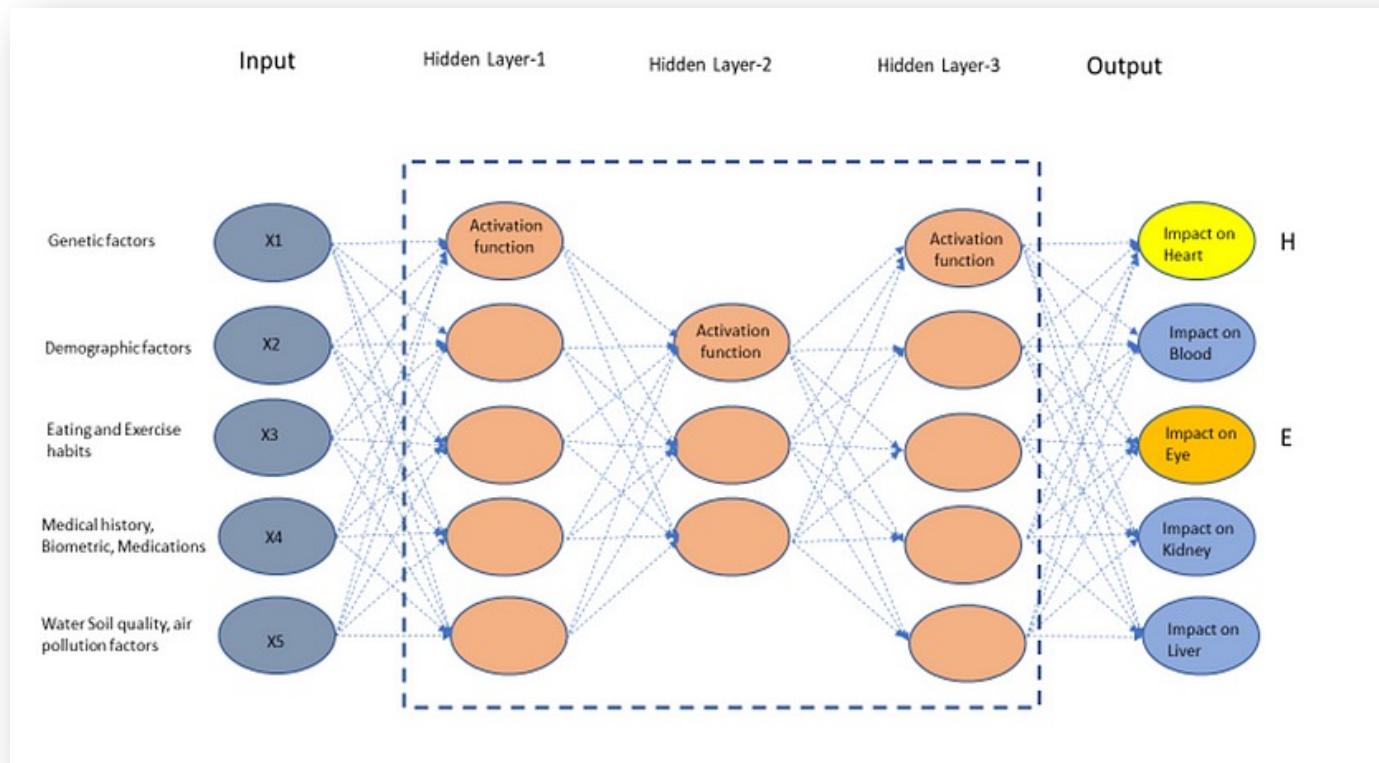


Unearth hidden insights and connect scattered dots



Amplify human intelligence, enhancing organizational capabilities through harmonized data and communication.

Understanding Latent Factor (Attributes) in Models



Legend

- **Entity 1 (E):** Various types of scanned eye images
- **Entity 2 (H):** Various types of heart conditions
- **Latent Factors:** Feature vectors include different sets of activities, previous medical history, demography, etc. and act as input in deep learning models
- **Data Collection:** Patient records can be gathered for both eye scans and heart conditions
- **Matrix Factorization:** Used to determine the correlation between Entity 1 (E) and Entity 2 (H)

Image source: [Shukla, R. Developing a prescriptive recommender system through Matrix Factorization. Medium. 11 Oct. 2019](#)

Multi-modal data processing in large language model (LLMs)

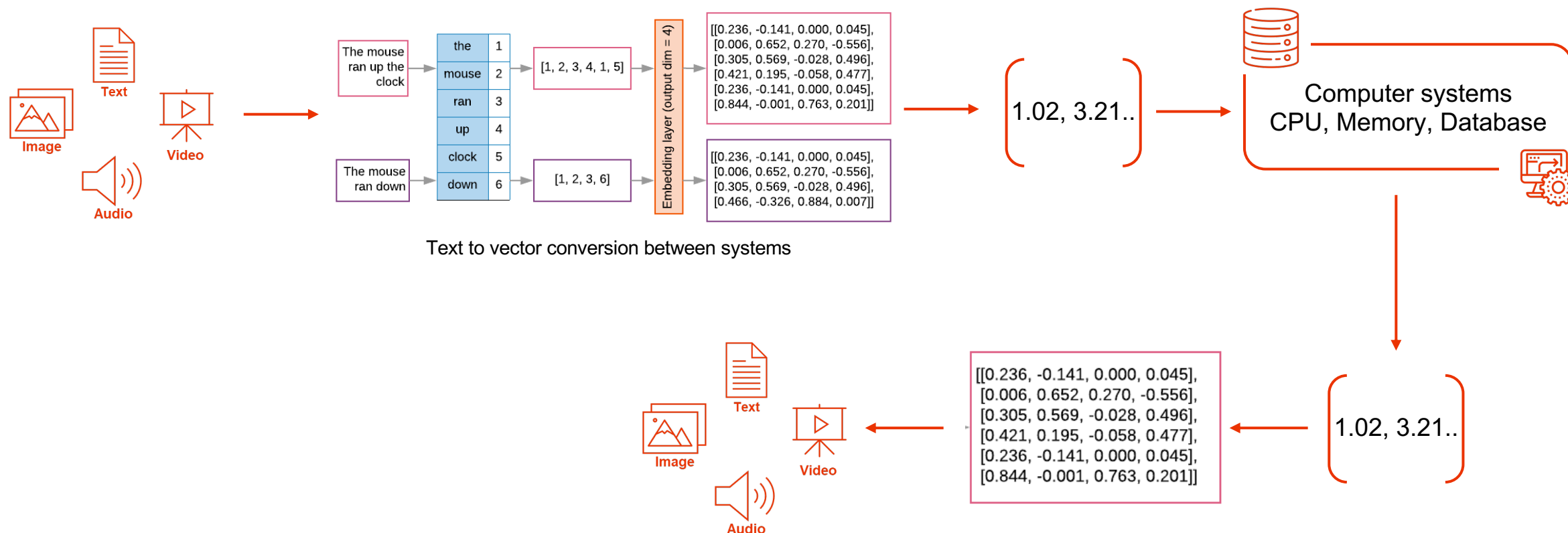
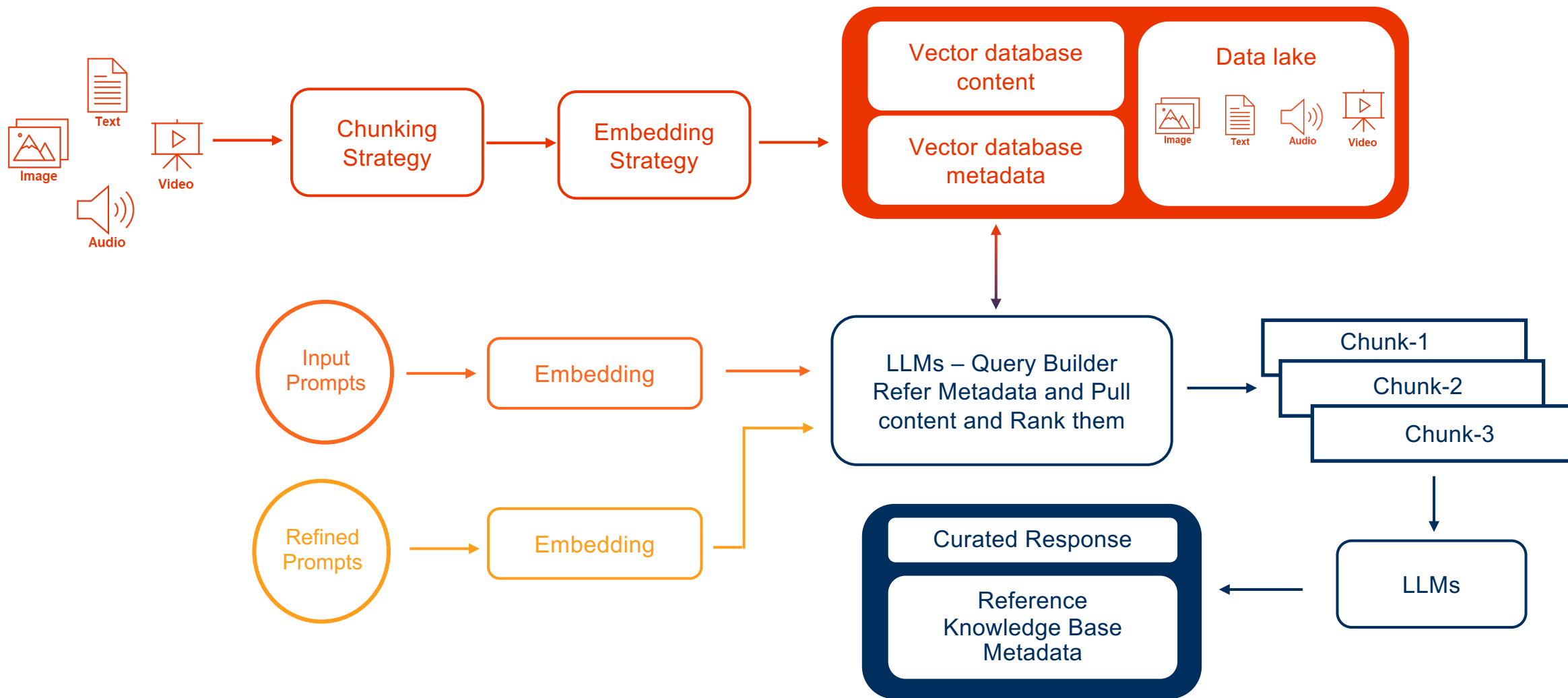


Image source: [Google Machine Learning Guides. Text Classification.](#)

Designing LLM applications



Key Generative AI
use cases
in healthcare

Drug discovery and development

Patient care

Medical simulation

Disease diagnosis

Medical imaging

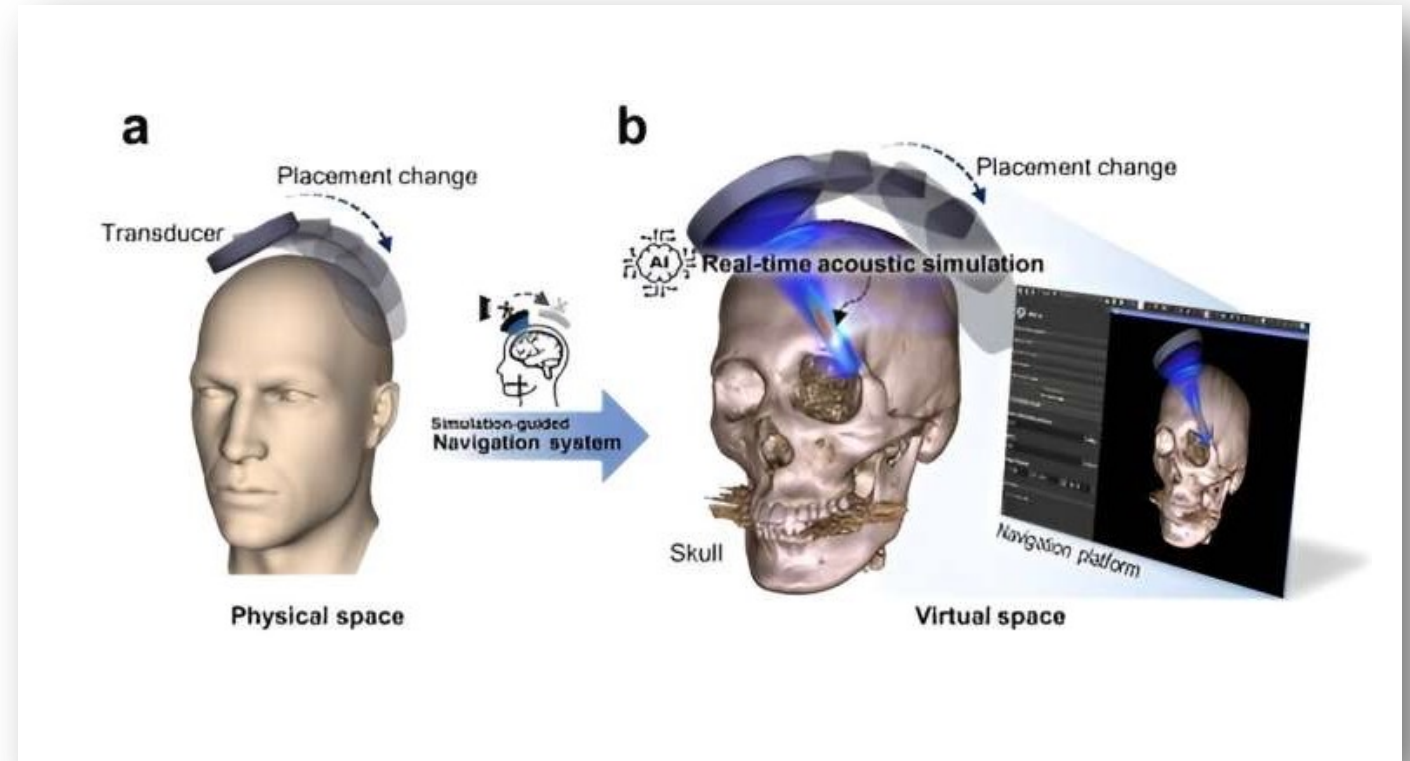
Medical research

Medical chatbots

Personalized treatment plans

Medical Simulation

Artificial intelligence
lowers the barrier to
ultrasound brain disease
treatment.



Simulation-guided navigation systems

Credit: Korea Institute of Science and Technology

Source: [Tae YP, et. al. Real-Time Acoustic Simulation Framework for tFUS: A Feasibility Study Using Navigation System, NeuroImage, Volume 282, 2023.](#)

Drug Discovery and Development



Insilico Medicine has completed the first dose in patients in the phase II clinical trial of INS018_055, marking the world's first anti-fibrotic small molecule inhibitor discovered and designed using generative AI.¹

Medical Chatbots

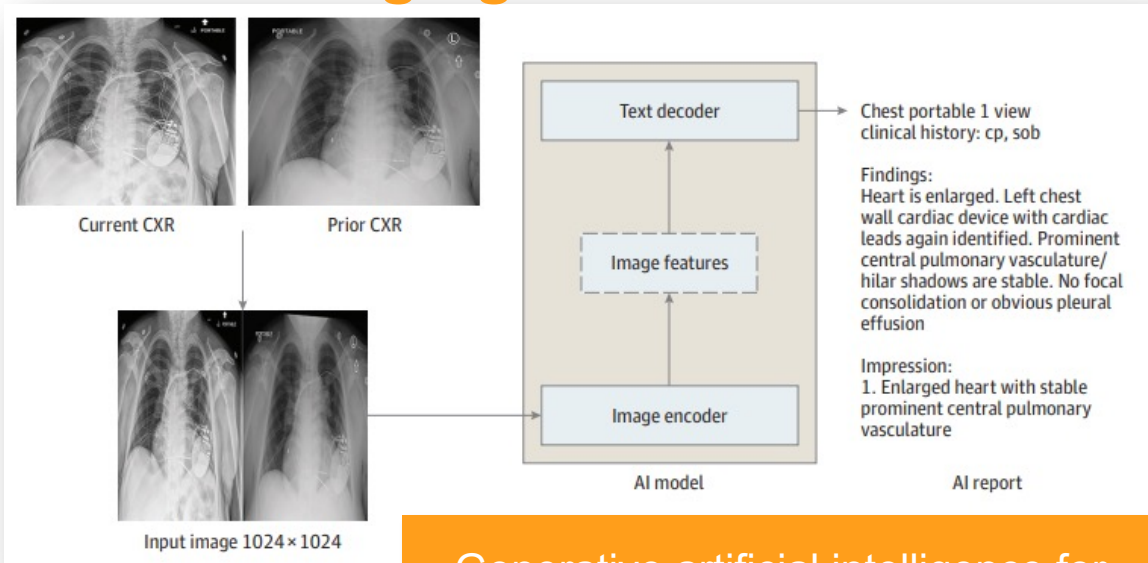


A generative AI powered counseling chatbot available on demand from Serena delivers accessible and affordable mental health care.²

Sources:

1. [First drug discovered and designed with generative AI enters Phase II trials, with first patients dosed. EurekaAlert. 27 June 2023.](#)
2. [Serena: Your Mental Health Companion.](#)

Medical Imaging



Generative artificial intelligence for chest radiograph interpretation in the emergency department.¹

Medical Research



Ordaōs is developing a class of miniproteins with enhanced biological and therapeutic attributes to treat uniquely challenging rare cancers that primarily afflict ethnic minorities.²

Sources:

1. [Huang J, et al. Generative Artificial Intelligence for Chest Radiograph Interpretation in the Emergency Department. JAMA Netw Open. 2023;6\(10\):e2336100.](#)
2. [Huddle, M., et al. How Generative AI is Transforming Healthcare. BCG. 22 June 2023.](#)

Disease Diagnosis

Glass Health has introduced an AI tool driven LLM akin to OpenAI's ChatGPT that generates diagnoses and provides "evidence-based" treatment options for patient consideration.¹

Paige.AI, a digital pathology company, is incorporating generative AI into its products to enhance the precision and efficiency of prostate cancer detection. Notably, they are the first to receive FDA approval for utilizing generative AI in digital pathology.²

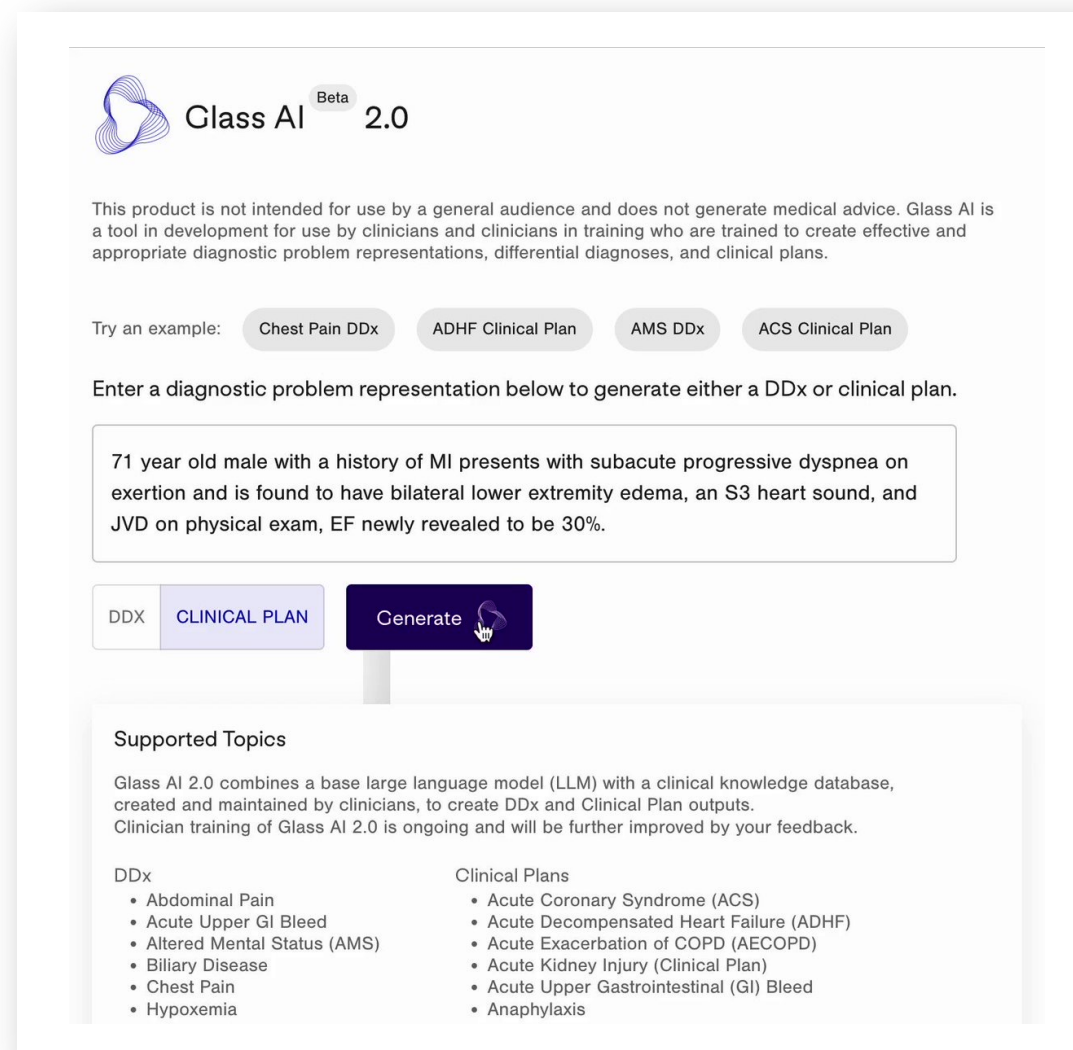


Image Credit: Glass Health

Sources:

1. [Wiggers K. Glass Health Is Building an AI for Suggesting Medical Diagnoses. TechCrunch. 8 September 2023.](#)
2. [Huddle, M., et al. How Generative AI is Transforming Healthcare. BCG. 22 June 2023.](#)

Patient Care



New Generative AI-Native health company RhythmX AI announced precision care platform for doctors to deliver hyper-personalized care to the right patient at the right time.¹

NextGen™ Ambient Assist, an ambient listening solution that interprets patient-provider conversations in real time to summarize appointments and document care plans at exceptional speeds.²

Personalized Treatment Plans



Google's Med-PaLM 2 can be used to help doctors personalize treatment for individual patients. It can do this by considering the patient's medical history, genetic makeup, and other factors.³

Researchers from the University of Texas are studying the use of generative AI for adaptive radiotherapy to better personalize cancer treatments.⁴

Sources:

1. [New Generative AI-Native Health Company RhythmX AI Announces Precision Care Platform for Doctors to Deliver Hyper-Personalized Care to the Right Patient at the Right Time. SAI Group News Release. 05 Oct. 2023.](#)
2. [NextGen Healthcare Unveils NextGen Ambient Assist, an AI Solution Designed to Boost Provider Efficiency. NextGen Healthcare News Release. 09 Oct. 2023.](#)
3. <https://www.packtpub.com/article-hub/getting-started-with-med-palm-2>
4. <https://healthitanalytics.com/news/researchers-leverage-generative-ai-to-improve-cancer-treatment-targets> 24 Apr. 2023

Current applications of generative AI in clinical trials

Generative AI / LLM

● Protocol RCA

Protocol Development



● Protocol Digitization

● Protocol Optimization

● Protocol Authoring

● Protocol Search/QA

● Patient Burden

● Language Translation

● Regulatory Documentation

● Geographic/Diversity Site selection

● QI Monitoring

● Dynamic Resource Allocation

● Medical coding

● Adverse Event Detection and prediction

● Image Analytics

● eTMF automation

● Insights Engine

● Disease Ontology

● HCP Insights and Classification

● Biometrics automation

● AI Enabled marketing

Business Impact

Draft new protocols faster -- reduce protocol creation from months to weeks

Reduce the number of protocol amendments and review cycles

Manage cost and duration of trials (subject to trial complexity – e.g., manage patient burden, duration and enrollments)

Minimize trial “rescue” through improved enrollment management and site issue monitoring

Optimize protocols for approval and better success

Help overall design failure vs trial failure

Generative AI challenges in healthcare

Inaccuracy and inconsistency

Privacy concerns

Bias and discrimination

Misuse and over-reliance

Lack of transparency

Ethical considerations

Managing LLM Bias Checklist

- ✓ Diverse Training Data
- ✓ Bias Auditing
- ✓ Fine-Tuning
- ✓ SME Review at toll-gates
- ✓ Guidelines and Guardrails
- ✓ Prompt Engineering
- ✓ User Evaluation
- ✓ Explainability (xAI)
- ✓ Bias Mitigation Techniques

Balancing enthusiasm and reality through practical implementation and bias control

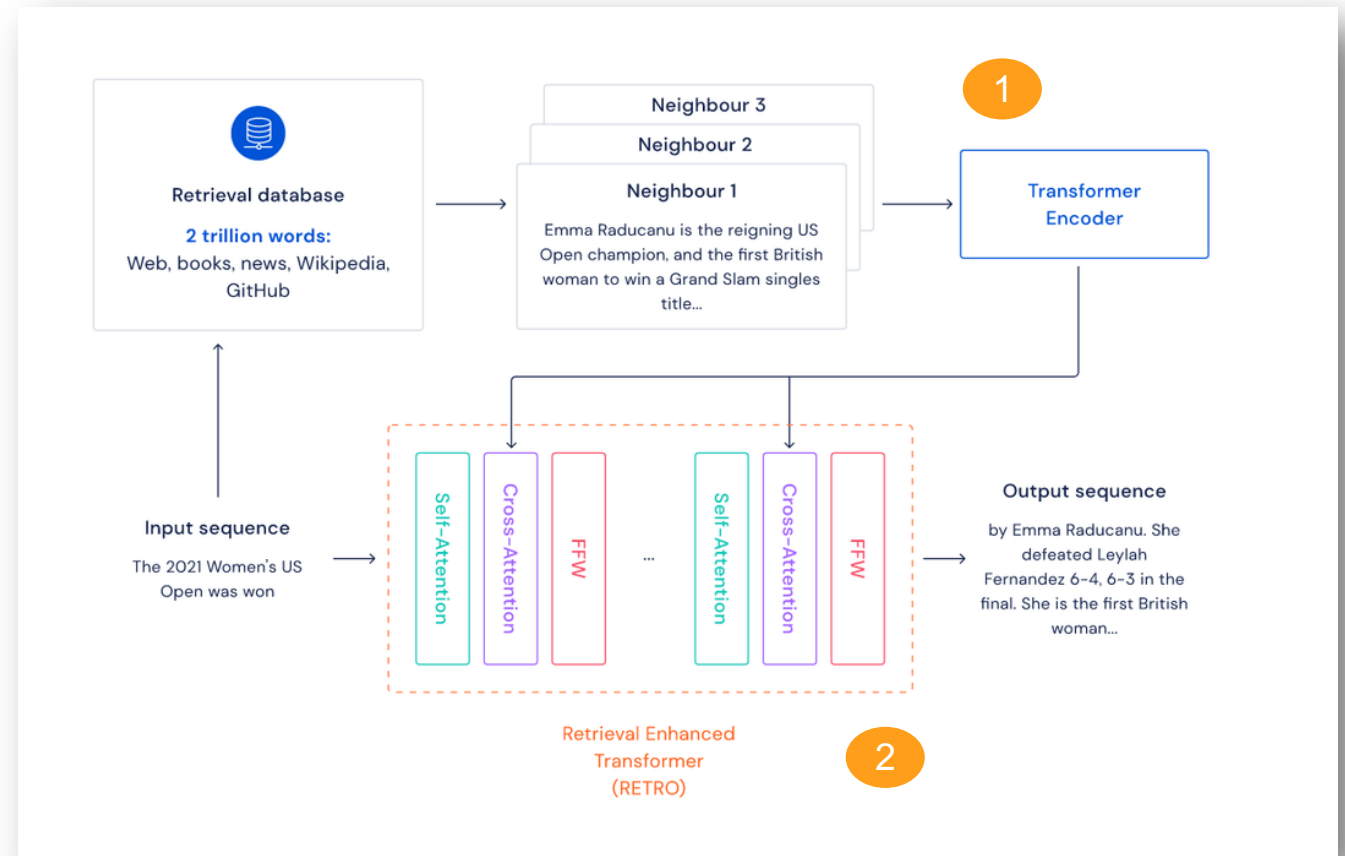
Practical applications: Generative AI offers real-world solutions, from content creation to data analysis, showing its potential to address key challenges in the pharmaceutical industry.

Expertise and engagement: Deep understanding, prompt engineering, and time spent with the AI system enhance its effective utilization, allowing for tailored and meaningful applications in the pharmaceutical sector.

Ethical and responsible use: Emphasize the ethical and responsible application of AI to address concerns and ensure alignment with industry standards and regulations in the pharma sector.

Large language models (LLMs) Areas of improvement (RETRO Model)

- Search and ranking of content
- Embedding and match against content embedding
- Embedding have pre-learning components
- Bias due to pre-training
- Content curation, prompt engineering and text generation
- SMEs evaluation as part of application flow



Source: [Borgeaud, S., et. al. \(2021\). Improving language models by retrieving from trillions of tokens. ArXiv, 2112.04426\(v3\).](#)

Navigating the future landscape of human intelligence and AI



Relying solely on logic may yield solutions that are incomplete or overly simplistic.

By integrating imagination and visualization, we can attain the following:

- Visualize the problem scene to identify non-numerical factors influencing the outcome
- Encourage creativity by going beyond strict logic, opening paths for alternative solutions and unexpected insights
- Improve problem-solving by integrating human understanding, adding depth and realism to the methodology

Future trends and prospects

- Opensource, Google, AWS, Azure etc
- ChatGPT 3.5 – 4 - 4.5
- Parameters – Billions to 200 Billions to Trillions
- Model: Transformer and beyond
- CPU and processing power
- Quantum Computers

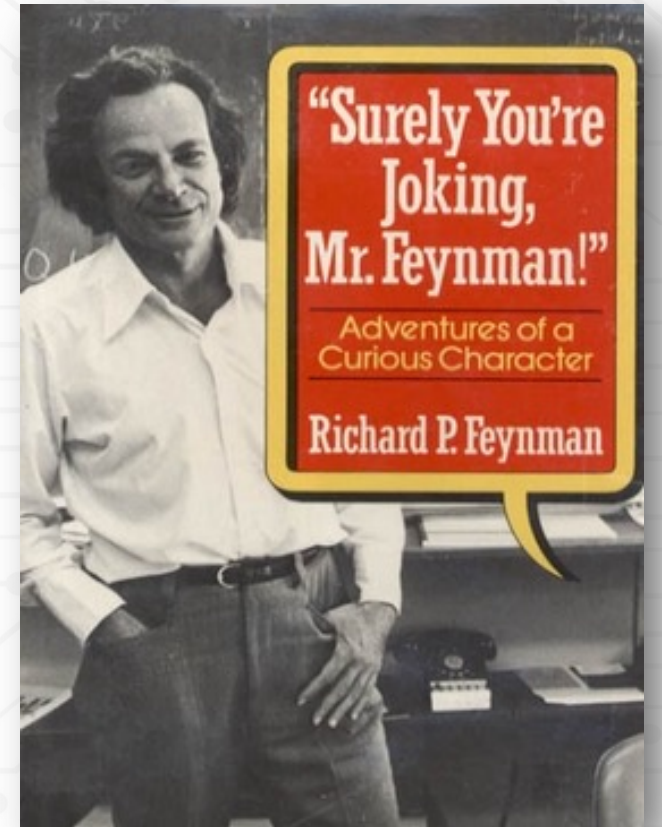


Image source: [Wikipedia](https://en.wikipedia.org/wiki/Surely_You're_Joking,_Mr._Feynman).



Now, machines are not just interpreting text, which has traditionally been a means of human communication; they are also generating it. This marks a new era in Generative AI, bringing machines a step closer to human-like capabilities. The gap between artificial intelligence and human intelligence is narrowing even more.

“We’re still five minutes into the marathon.”

—Chirag Dekate, Gartner Analyst¹



ChatGPT is doubling in power every six months to a year.

In 5 years, it’s going to be **30x** more powerful than it is today. In 10 years, it will be **1,000x** more powerful.

What exists today is like a toy. In next-generation tools, it’s estimated there will be a trillion parameters, which is interestingly the approximate number of connections in the human brain.²

Sources:

1. [Jennings, K. Inside Google's Plans To Fix Healthcare With Generative AI. Forbes. 29 August 2023.](#)
2. [Eramo, LA. Leveraging ChatGPT and Generative AI in Healthcare Analytics. Journal of AHIMA. 27 June 2023.](#)

(ahima.org)

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About RxDataScience

RxDataScience is a global team of cross-disciplinary data scientists, technologists and domain experts putting our unique experience together to help pharma companies solve their most complex business problems using advanced data science.

Get in touch with us at
rxdatascience.com/contact-us

