

[Jeju Bio Forum Special AI Seminar]  
The AI Recipe for Food Innovation - Silicon Valley  
Technologies, Business Models, and Opportunities for  
FoodTech

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## About Speaker

- *Co-Founder & CTO @ Erudio Bio, Inc., San Jose & Novato, CA, USA* 2023 ~
- *Co-Founder & CEO @ Erudio Bio Korea, Inc., Korea* 2025 ~
- *Leader of Silicon Valley Privacy-Preserving AI Forum (K-PAI), USA* 2024 ~
- *AI-Korean Medicine Integration Initiative Task Force Member @ The Association of Korean Medicine* 2025 ~
- *KFAS-Salzburg Global Leadership Fellow @ Salzburg Global Seminar* 2024 ~
- *Adjunct Professor, EE Department @ Sogang University, Seoul, Korea* 2020 ~
- *Advisory Professor, EECS Department @ DGIST, Korea* 2020 ~
- *Global Advisory Board Member @ Innovative Future Brain-Inspired Intelligence System Semiconductor of Sogang University, Korea* 2020 ~
- Technology Consultant @ Gerson Lehrman Group (GLG), NY, USA 2022 ~
- Chief Business Development Officer @ WeStory.ai, Cupertino, CA, USA 2025 ~
- Advisor @ CryptoLab, Inc., San Jose, CA, USA 2025 ~
- *Co-Founder & CTO / Head of Global R&D / Chief Applied Scientist / Senior Fellow @ Gauss Labs, Inc., Palo Alto, CA, USA* 2020 ~ 2023

- Senior Applied Scientist @ Amazon.com, Inc., Vancouver, BC, Canada 2017 ~ 2020
- Principal Engineer @ Software R&D Center, Samsung Electronics 2016 ~ 2017
- Principal Engineer @ Strategic Marketing & Sales, Memory Business 2015 ~ 2016
- Principal Engineer @ DT Team, DRAM Development, Samsung 2012 ~ 2015
- Senior Engineer @ CAE Team, Memory Business, Samsung, Korea 2005 ~ 2012
- PhD - Electrical Engineering @ Stanford University, CA, USA 2001 ~ 2004
- Development Engineer @ Vyan, Santa Clara, CA, USA 2000 ~ 2001
- MS - Electrical Engineering @ Stanford University, CA, USA 1998 ~ 1999
- BS - Electrical & Computer Engineering @ Seoul National University 1994 ~ 1998

## Highlight of Career Journey

- BS in EE @ SNU, MS & PhD in EE @ Stanford University
  - *Convex Optimization - Theory, Algorithms & Software*
  - advisor - *Prof. Stephen P. Boyd*
- Principal Engineer @ Samsung Semiconductor, Inc.
  - AI & Convex Optimization
  - collaboration with *DRAM/NAND Design/Manufacturing/Test Teams*
- Senior Applied Scientist @ Amazon.com, Inc.
  - e-Commerce AIs - anomaly detection, deep RL, and recommender system
  - *Jeff Bezos's project - drove \$200M in sales via Amazon Mobile Shopping App*
- *Co-Founder & CTO* / Global R&D Head & Chief Applied Scientist @ Gauss Labs, Inc.
- *Co-Founder & CTO* - AI Technology & Business Development @ Erudio Bio, Inc.
- *Co-Founder & CEO* - AI Technology & Business Development @ Erudio Bio Korea, Inc.

# Unpacking AI & FoodTech

- Artificial Intelligence - 5
  - AI history & recent significant achievements
  - market indicators for unprecedented AI progress
- AI Agents - 30
  - Big Data → ML/DL → LLM & genAI → Agentic AI
  - implication of grand success of LLM in multimodal AI
- AI & FoodTech - 38
  - AI-powered food innovation & discovery
  - opportunities for Jeju's food industry
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# **Artificial Intelligence**

## **Definition and History**

## Definition & relation to other technologies

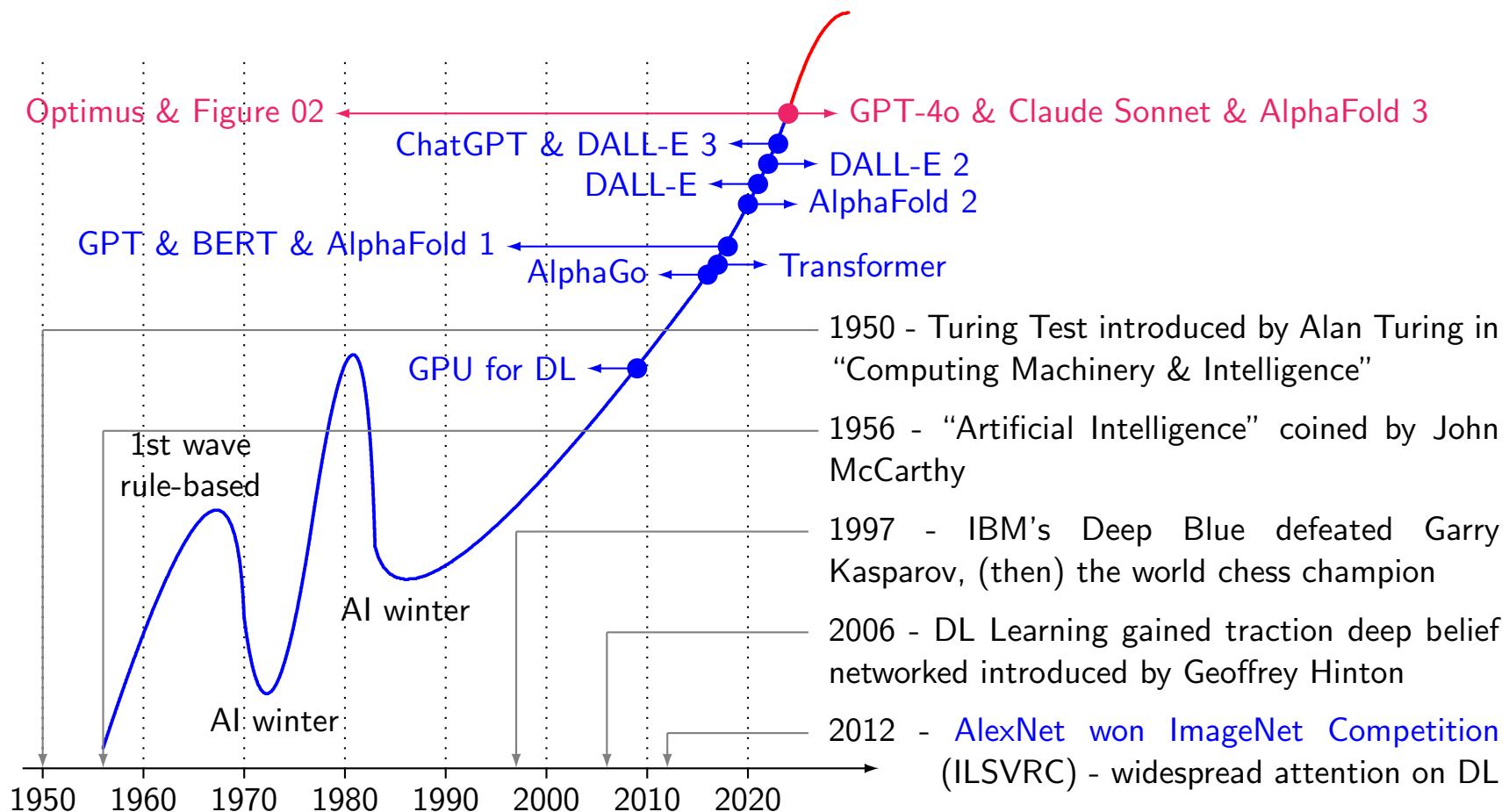
- AI
  - is technology doing tasks requiring human intelligence, such as learning, problem-solving, decision-making & language understanding
  - encompasses *range of technologies, methodologies, applications & products*
- AI, ML, DL, statistics & expert system<sup>1</sup> [HGH<sup>+</sup>22]



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<sup>1</sup>ML: machine learning & DL: deep learning

# History



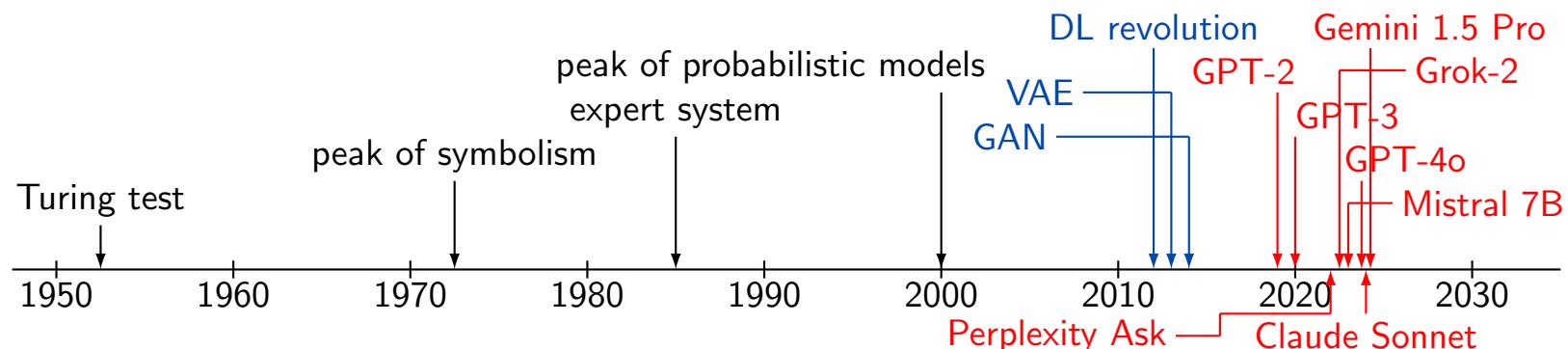
## Birth of AI - early foundations & precursor technologies

- 1950s ~ 1970s
  - Alan Turing - concept of “*thinking machine*” & *Turing test* to evaluate machine intelligence (1950s)
  - *symbolists* (as opposed to connectionists) - early AI focused on symbolic reasoning, logic & problem-solving - Dartmouth Conference in 1956 by *John McCarthy, Marvin Minsky, Allen Newell & Herbert A. Simon*
  - precursor technologies - genetic algorithms (GAs), Markov chains & *hidden Markov models (HMMs)* - laying foundation for generative processes (1970s ~)



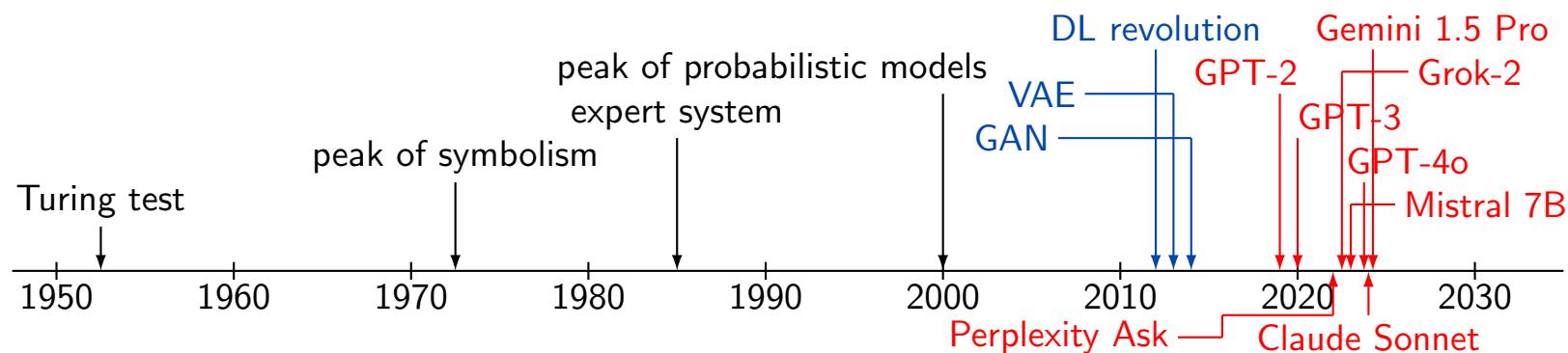
## Rule-based systems & probabilistic models

- 1980s ~ early 2000s
  - *expert systems* (1980s) - AI systems designed to mimic human decision-making in specific domains
  - development of neural networks (NN) w/ backpropagation *training multi-layered networks* - setting stage for way more complex generative models
  - *probabilistic models* (including network models, *i.e.*, Bayesian networks) & Markov models - laying groundwork for data generation & pattern prediction



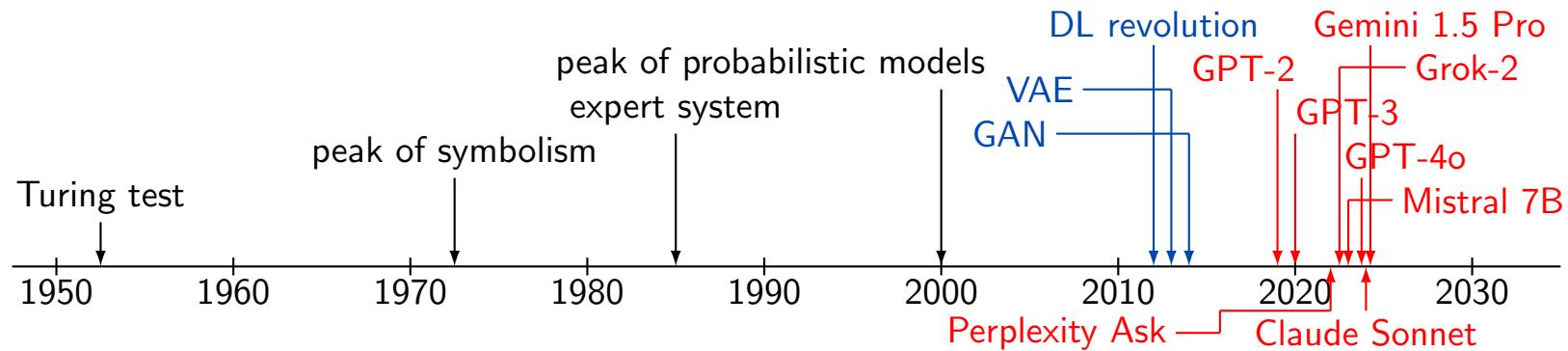
## Rise of deep learning & generative models

- 2010s - breakthrough in genAI
  - *deep learning (DL) revolution* - advances in GPU computing and data availability led to the rapid development of deep neural networks.
  - *variational autoencoder (VAE)* (2013) - by Kingma and Welling - learns mappings between input and latent spaces
  - *generative adversarial network (GAN)* (2014) - by Ian Goodfellow - game-changer in generative modeling where two NNs compete each other to create realistic data
    - widely used in image generation & creative tasks



## Transformer models & multimodal AI

- late 2010s ~ Present
  - Transformer architecture (2017) - by Vaswani et al.
    - *revolutionized NLP*, e.g., LLM & various genAI models
  - GPT series - generative pre-trained transformer
    - GPT-2 (2019) - generating human-like texts - *marking leap in language models*
    - GPT-3 (2020) - 175B params - set *new standards for LLM*
  - multimodal systems - DALL-E & CLIP (2021) - *linking text and visual data*
  - emergence of diffusion models (2020s) - new approach for generating high-quality images - progressively “denoising” random noise (DALL-E 2 & Stable Diffusion)



# **Significant AI Achievements - 2014 – 2025**

## Deep learning revolution

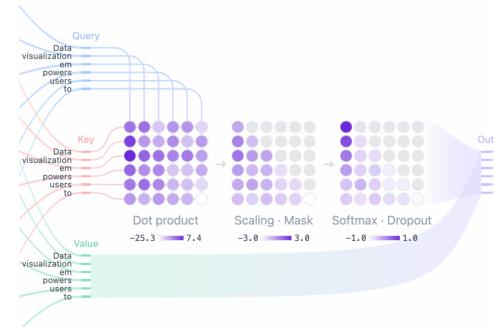
- 2012 – 2015 - DL revolution<sup>2</sup>
  - CNNs demonstrated exceptional performance in image recognition, e.g., *AlexNet's victory in ImageNet competition*
  - widespread adoption of DL learning in CV transforming industries
- 2016 - AlphaGo defeats human Go champion
  - DeepMind's AlphaGo defeated world champion in Go, extremely complex game *believed to be beyond AI's reach*
  - significant milestone in RL - AI's potential in solving complex & strategic problems



<sup>2</sup>CV: computer vision, NN: neural network, CNN: convolutional NN, RL: reinforcement learning

## Transformer changes everything

- 2017 – 2018 - Transformers & NLP breakthroughs<sup>3</sup>
  - *Transformer (e.g., BERT & GPT) revolutionized NLP*
  - major advancements in, *e.g.*, machine translation & chatbots
- 2020 - AI in healthcare – AlphaFold & beyond
  - DeepMind's *AlphaFold solves 50-year-old protein folding problem* predicting 3D protein structures with remarkable accuracy
  - accelerates drug discovery and personalized medicine - offering new insights into diseases and potential treatments



<sup>3</sup>NLP: natural language processing, GPT: generative pre-trained transformer

## Lots of breakthroughs in AI technology and applications in 2024

- proliferation of advanced AI models
  - GPT-4o, Claude Sonnet, Claude 3 series, Llama 3, Sora, Gemini
  - *transforming industries* such as content creation, customer service, education, etc.
- breakthroughs in specialized AI applications
  - Figure 02, Optimus, AlphaFold 3
  - driving unprecedented advancements in automation, drug discovery, scientific understanding - *profoundly affecting healthcare, manufacturing, scientific research*



## Major AI Breakthroughs in 2025

- next-generation foundation models
  - GPT-5 and Claude 4 demonstrate emergent reasoning abilities
  - open-source models achieving parity with leading commercial systems from 2024
- hardware innovations
  - NVIDIA's Blackwell successor architecture delivering 3-4x performance improvement
  - AMD's MI350 accelerators challenging NVIDIA's market dominance
- AI-human collaboration systems
  - seamless multimodal interfaces enabling natural human-AI collaboration
  - AI systems effectively explaining reasoning and recommendations
  - augmented reality interfaces providing real-time AI assistance in professional contexts



# Transformative impact of AI - reshaping industries, work & society

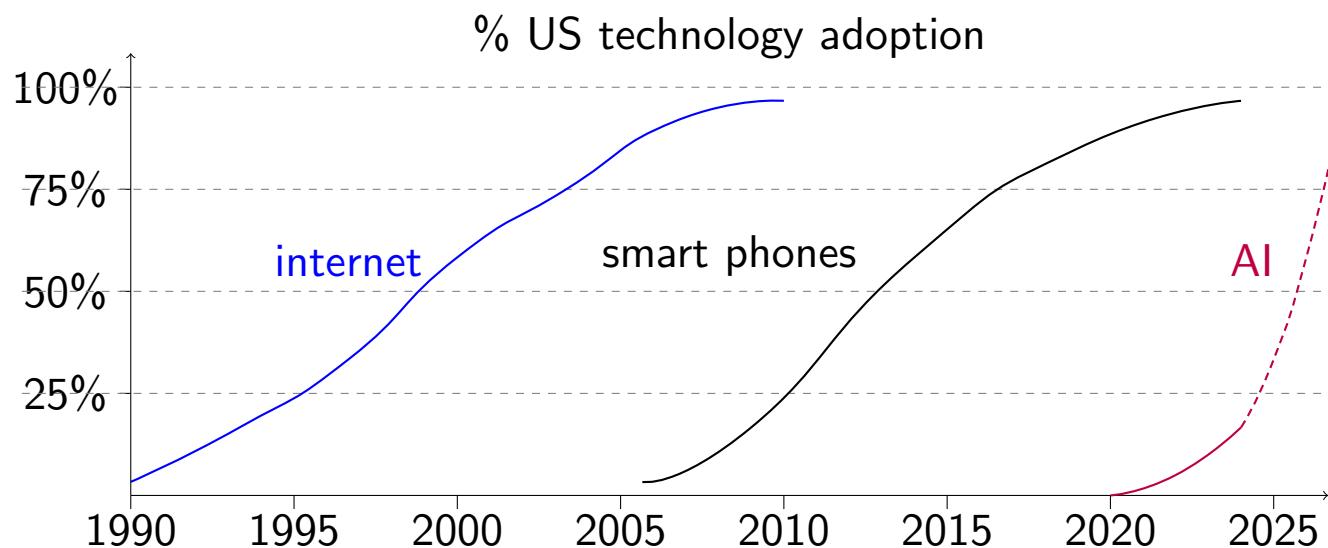
- accelerating human-AI collaboration
  - not only reshaping industries but *altering how humans interact with technology*
  - AI's role as collaborator and augmentor redefines productivity, creativity, the way we address global challenges, e.g., *sustainability & healthcare*
- AI-driven automation *transforms workforce dynamics* - creating new opportunities while challenging traditional job roles
- *ethical AI considerations* becoming central not only to business strategy, but to society as a whole - *influencing regulations, corporate responsibility & public trust*



# **Measuring AI's Ascent**

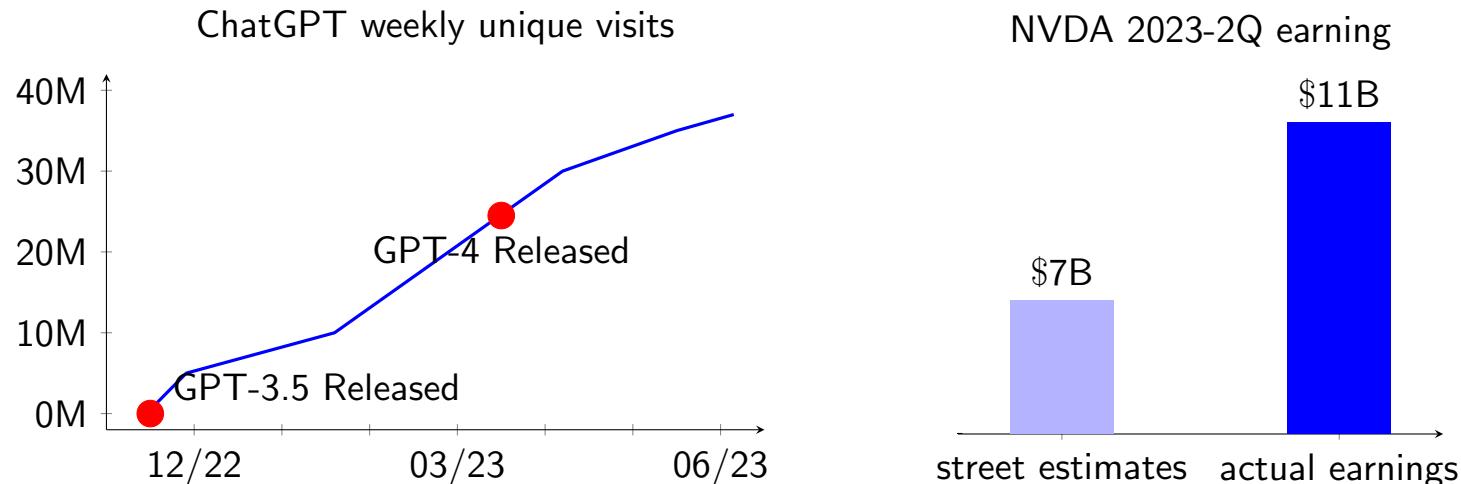
## Where are we in AI today?

- sunrise phase - currently experiencing dawn of AI era with significant advancements and increasing adoption across various industries
- early adoption - in early stages of AI lifecycle with widespread adoption and innovation across sectors marking significant shift in technology's role in society



## Explosion of AI ecosystems - ChatGPT & NVIDIA

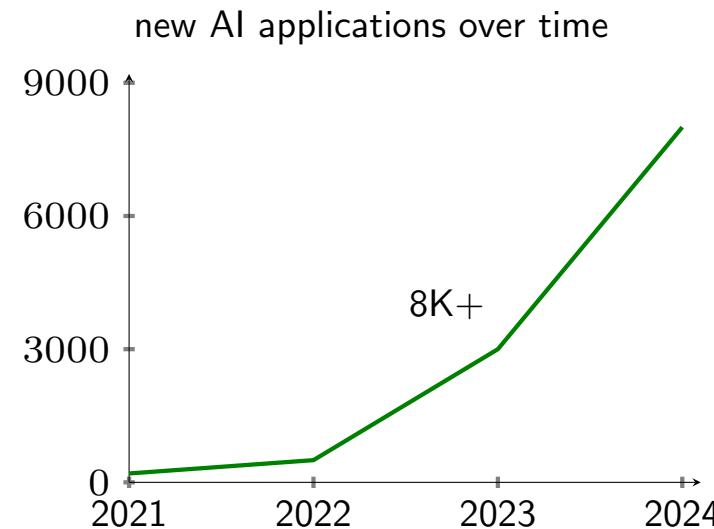
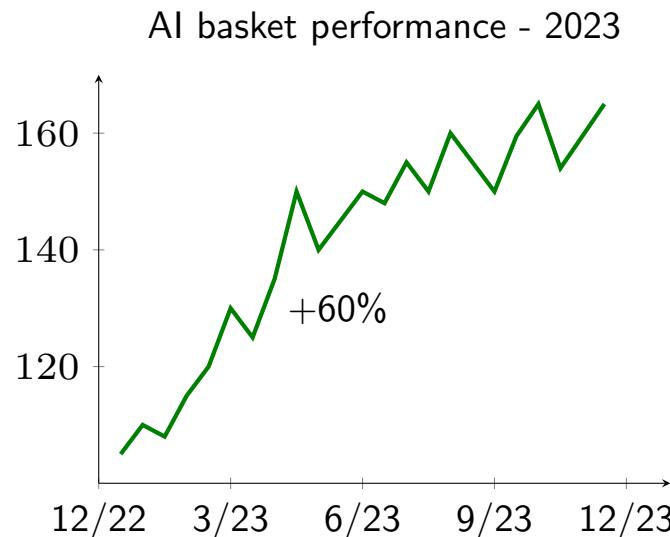
- took only *5 months for ChatGPT users to reach 35M*
- NVIDIA 2023 Q2 earning exceeds market expectation by big margin - \$7B vs \$13.5B
  - surprisingly, *101% year-to-year growth*
  - even more surprisingly *gross margin was 71.2%* - up from 43.5% in previous year<sup>4</sup>



<sup>4</sup>source - Bloomberg

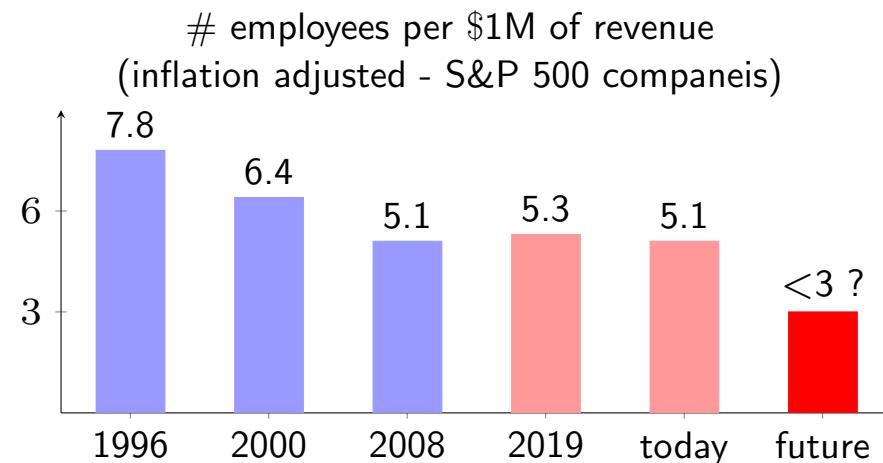
## Explosion of AI ecosystems - AI stock market

- *AI investment surge in 2023 - portfolio performance soars by 60%*
  - AI-focused stocks significantly outpaced traditional market indices
- *over 8,000 new AI applications* developed in last 3 years
  - applications span from healthcare and finance to manufacturing and entertainment



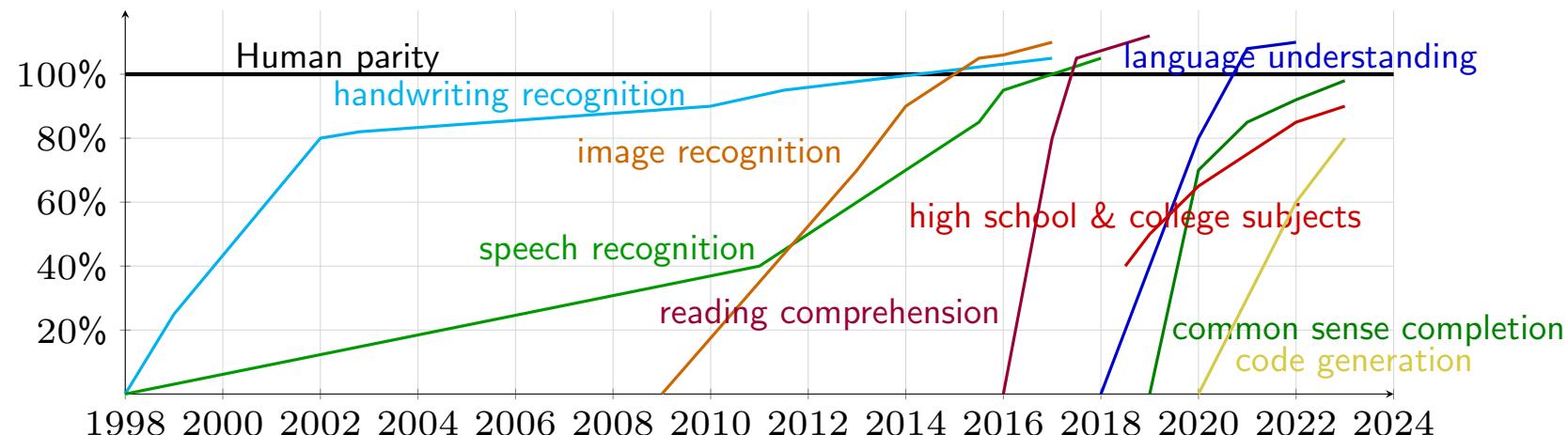
## AI's transformative impact - adoption speed & economic potential

- adoption - has been twice as fast with platform shifts suggesting
  - increasing demand and readiness for new technology improved user experience & accessibility
- AI's potential to drive economy for years to come
  - 35% improvement in productivity driven by introduction of PCs and internet
  - greater gains expected with AI proliferation



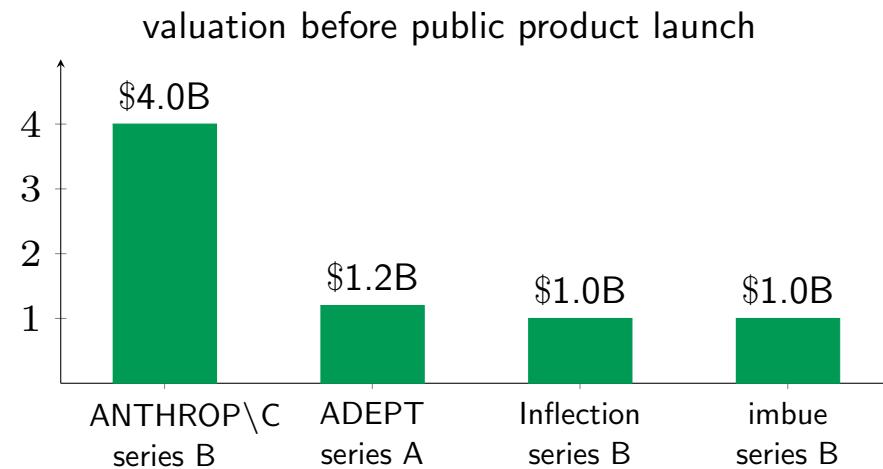
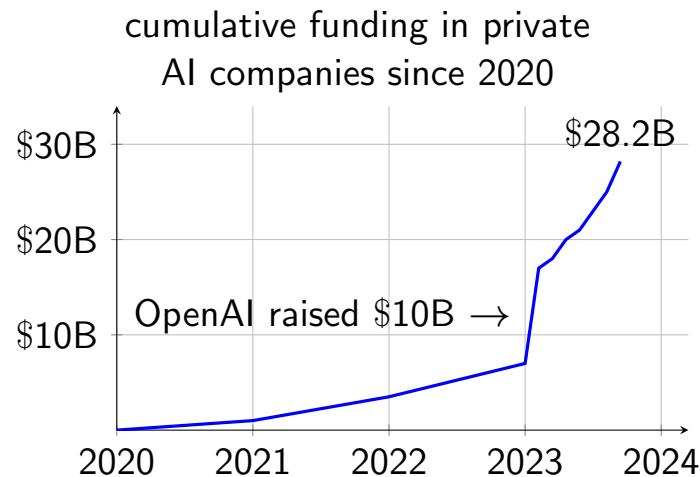
## AI getting more & more faster

- steep upward slopes of AI capabilities highlight accelerating pace of AI development
  - period of exponential growth with AI potentially mastering new skills and surpassing human capabilities at ever-increasing rate
- closing gap to human parity - some capabilities approaching or arguably reached human parity, while others having still way to go
  - achieving truly human-like capabilities in broad range remains a challenge



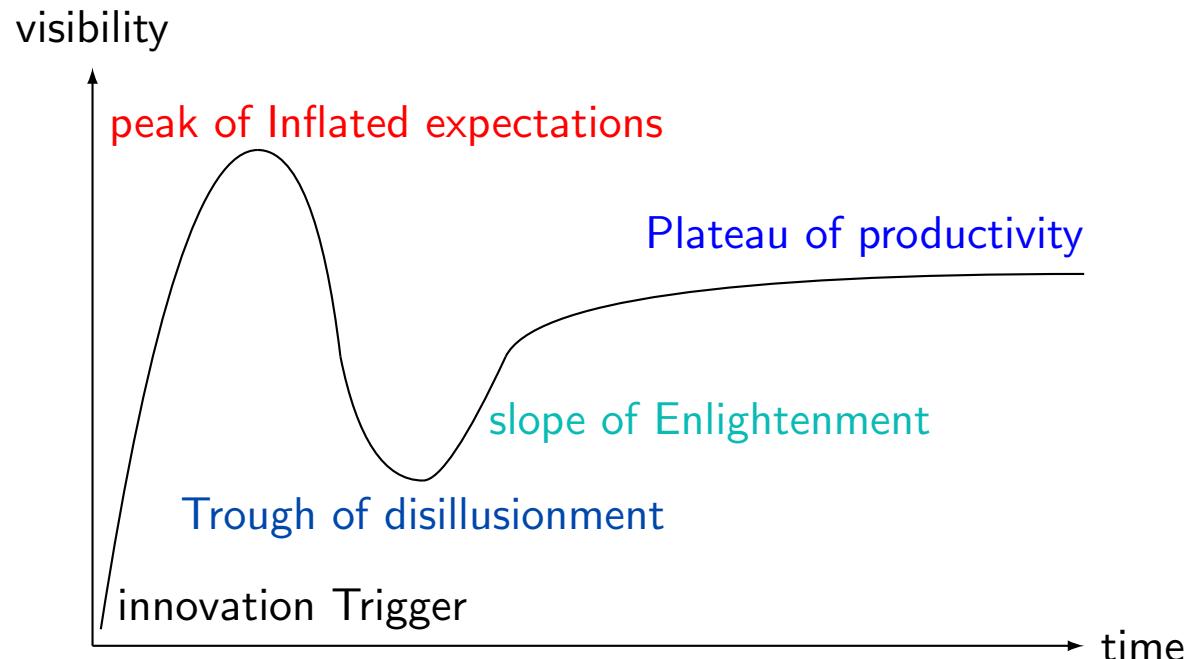
## Massive investment in AI

- *explosive growth* - cumulative funding skyrocketed reaching staggering \$28.2B
- OpenAI - significant fundraising (= \$10B) fueled rapid growth
- *valuation surge* - substantial valuations even before public products for stellar companies
- *fierce competition for capital* among AI startups driving innovation & accelerating development
- massive investment indicates *strong belief in & optimistic outlook for potential of AI* to revolutionize industries & drive economic growth



**Is AI hype?**

## Technology hype cycle



- innovation trigger - technology breakthrough kicks things off
- peak of inflated expectations - early publicity induces many successes followed by even more
- trough of disillusionment - expectations wane as technology producers shake out or fail
- slope of enlightenment - benefit enterprise, technology better understood, more enterprises fund pilots

## Fiber vs cloud infrastructure

- fiber infrastructure - 1990s
  - Telco Co's raised \$1.6T of equity & \$600B of debt
  - bandwidth costs decreased 90% within 4 years
  - companies - Covage, NothStart, Telligent, Electric Lightwave, 360 networks, Nextlink, Broadwind, UUNET, NFS Communications, Global Crossing, Level 3 Communications
  - became *public good*
- cloud infrastructure - 2010s
  - entirely new computing paradigm
  - mostly public companies with data centers
  - *big 4 hyperscalers generate \$150B + annual revenue*



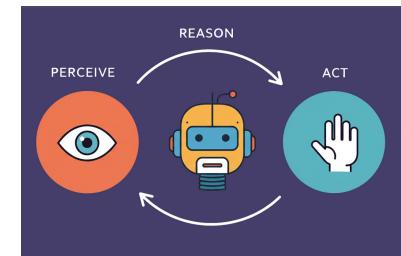
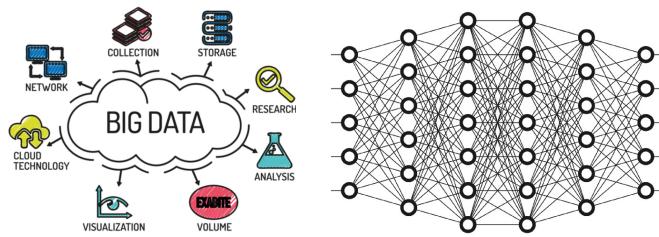
## Yes & No

characteristics of hype cycles	speaker's views
value accrual misaligned with investment	<ul style="list-style-type: none"><li>• OpenAI still operating at a loss; business model <i>still</i> not clear</li><li>• gradual value creation across broad range of industries and technologies (<i>e.g.</i>, CV, LLMs, RL) unlike fiber optic bubble in 1990s</li></ul>
overestimating timeline & capabilities of technology	<ul style="list-style-type: none"><li>• self-driving cars delayed for over 15 years, with limited hope for achieving level 5 autonomy</li><li>• AI, however, has proven useful within a shorter 5-year span, with enterprises eagerly adopting</li></ul>
lack of widespread utility due to technology maturity	<ul style="list-style-type: none"><li>• AI already providing significant utility across various domains</li><li>• vs quantum computing remains promising in theory but lacks widespread practical utility</li></ul>

# AI Agents

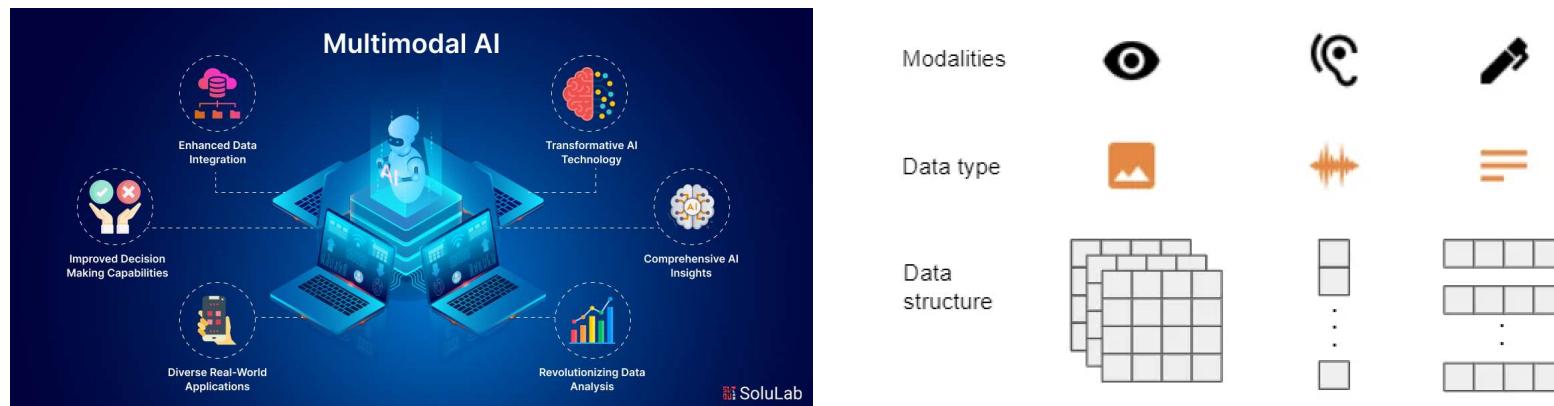
## AI progress in 21st century in keywords

- 2010 ~ Big Data
- 2012 ~ Deep Learning
- 2017 ~ Transformer - Attention is All you need!
- 2022 ~ LLM & genAI
- 2024 ~ AI Agent (Agentic AI)



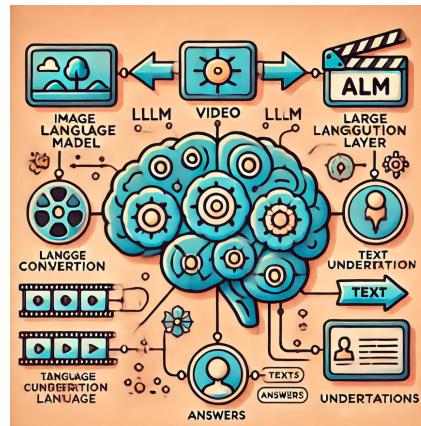
# Multimodal learning

- understand information from multiple modalities, *e.g.*, text, images, audio, video
- representation learning methods
  - combine multiple representations or learn multimodal representations simultaneously
- applications
  - images from text prompt, videos with narration, musics with lyrics
- collaboration among different modalities
  - understand image world (open system) using language (closed system)



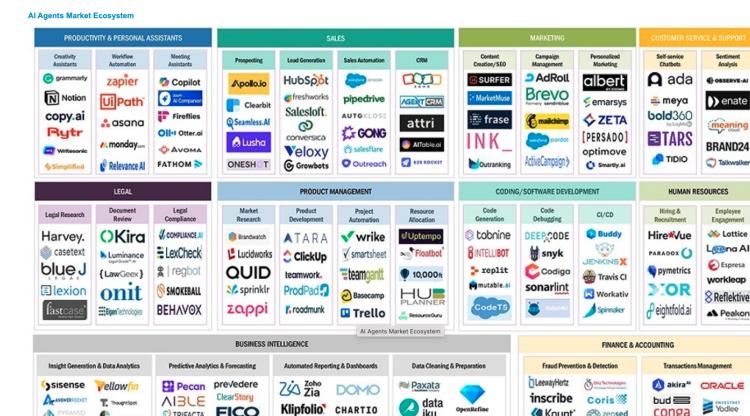
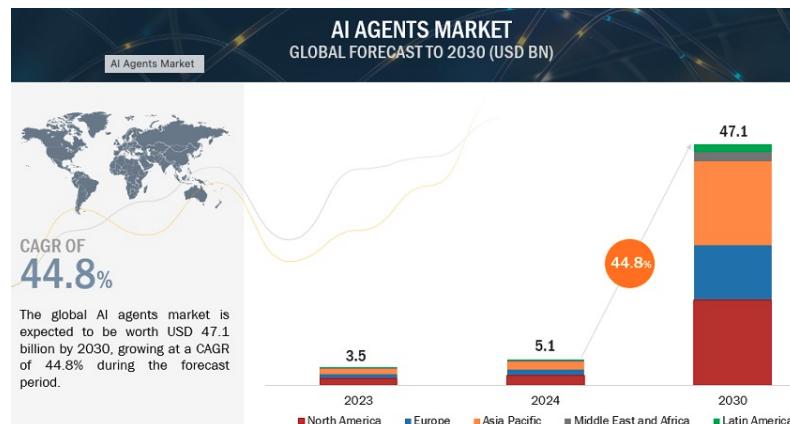
## Implications of success of LLMs

- many researchers change gears towards LLM
  - from computer vision (CV), speech, music, video, even reinforcement learning
- *LLM is not only about NLP . . . humans have . . .*
  - evolved to optimize natural language structures for eons
  - handed down knowledge using *this natural languages* for thousands of years
  - internal structure (or equivalently, representation) of natural languages optimized via *thousands of generation by evolution*
- *LLM connects non-linguistic world (open system) via natural languages (closed system)*



# Multimodal AI (mmAI)

- mmAI - systems processing & integrating data from multiple sources & modalities, to generate unified response / decision
  - 1990s – 2000s - early systems - initial research combining basic text & image data
  - 2010s - CNNs & RNNs enabling more sophisticated handling of multimodality
  - 2020s - modern multimodal models - Transformer-based architectures handling complex multi-source data at highly advanced level
  - mmAI *mimics human cognitive ability* to interpret and integrate information from various sources, leading to holistic decision-making

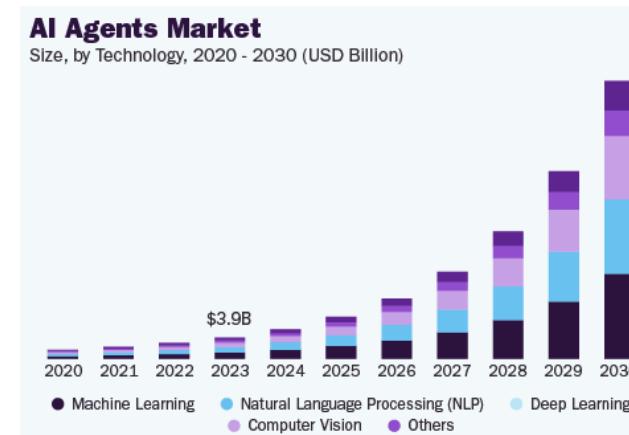
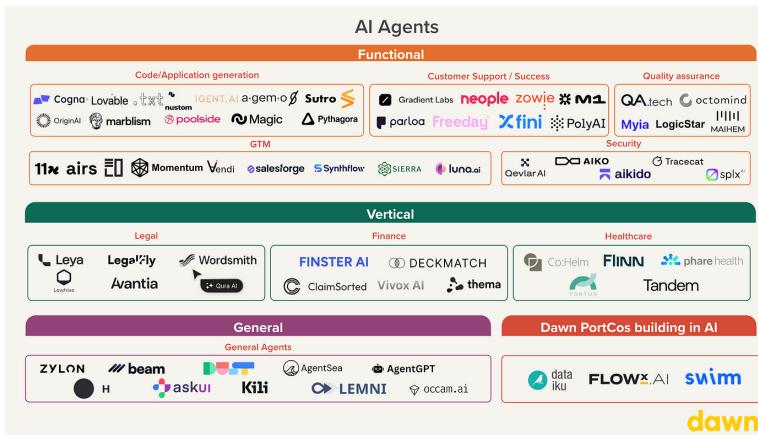


## mmAI Technology

- core components
  - data preprocessing - images, text, audio & video
  - architectures - unified Transformer-based (*e.g.*, ViT) & cross-attention mechanisms / hybrid architectures (*e.g.*, CNNs + LLMs)
  - integration layers - fusion methods for combining data representations from different modalities
- technical challenges
  - data alignment - accurate alignment of multimodal data
  - computational demand - high-resource requirements for training and inferencing
  - diverse data quality - manage variations in data quality across modalities
- advancements
  - multimodal embeddings - shared feature spaces interaction between modalities
  - self-supervised learning - leverage unlabeled data to learn representations across modalities

# AI agents powered by multimodal LLMs

- foundation
  - integrate multimodal AI capabilities for enhanced interaction & decision-making
- components
  - perceive environment through multiple modalities (visual, audio, text), process using LLM technology, generate contextual responses & take actions
- capabilities
  - understand complex environments, reason across modalities, engage in natural interactions, adapt behavior based on context & feedback



## AI agents - Present & Future

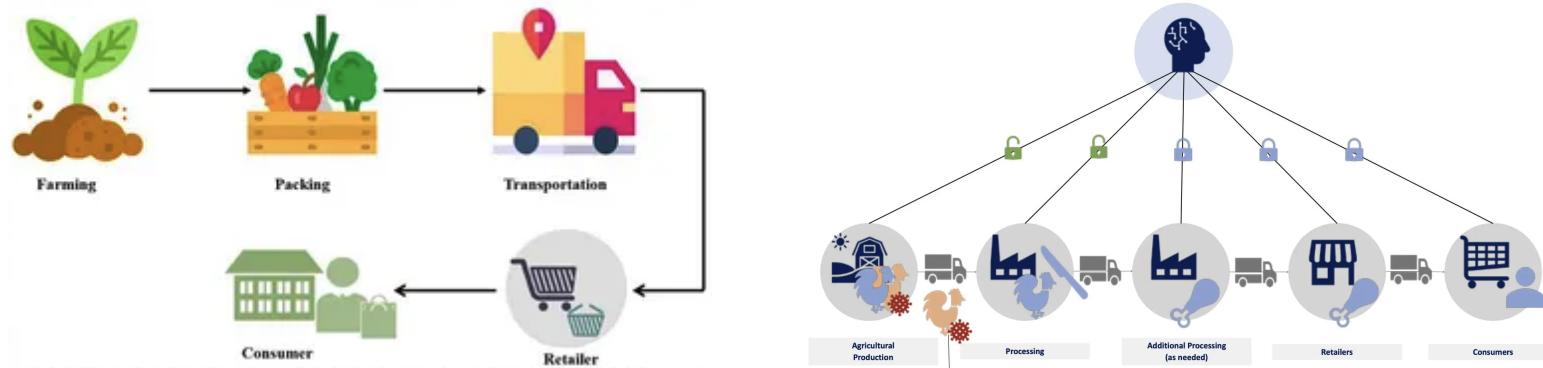
- emerging applications
  - scientific research - agents analyzing & running experiments & generating hypotheses
  - creative collaboration - AI partners in design & art combining multiple mediums
  - environmental monitoring - processing satellite sensor data for climate analysis
  - healthcare - enhanced diagnostic combining imaging, *e.g.*, MRI, with patient history
  - customer experience - virtual assistants understanding spoken language & visual cues
  - autonomous vehicles - integration of visual, radar & audio data
- future
  - ubiquitous AI agents - seamless integration into everyday devices
  - highly tailored personalized experience - in education, entertainment & healthcare



**AI & FoodTech**

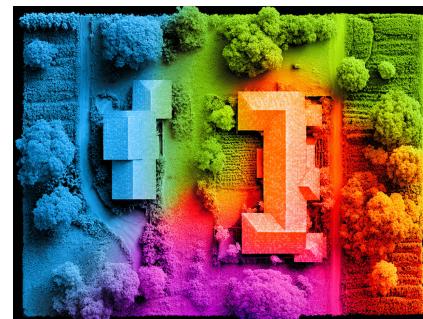
## AI transforming the food value chain

- farm to fork revolution - AI reshaping every stage of food production & distribution
- precision agriculture - satellite imagery analysis, IoT sensors, autonomous equipment
  - yield prediction models, soil health monitoring, water optimization
- smart food processing - computer vision for quality control, predictive maintenance, waste reduction
- intelligent supply chain - demand forecasting, cold chain management, logistics optimization
- consumer personalization - dietary recommendations, food discovery, taste prediction



## Precision agriculture - AI in the field

- computer vision for crop monitoring
  - drone/satellite imagery detecting plant diseases, pest infestations, nutrient deficiencies
  - early intervention reducing crop losses by 20-30%
- autonomous farming equipment
  - self-driving tractors, robotic harvesters, automated irrigation systems
  - labor cost reduction & 24/7 operation capability
- predictive analytics for yield optimization
  - weather patterns, soil conditions, historical data → optimal planting/harvesting
  - increasing yields by 10-25% while reducing resource consumption



## AI-powered food innovation & discovery

- accelerated R&D through AI
  - ingredient discovery platforms analyzing molecular structures for novel flavor combinations
  - reducing development time from years to months
- personalized nutrition at scale
  - AI analyzing individual microbiome, genetics, lifestyle → customized meal plans
  - addressing obesity, diabetes, food allergies through data-driven nutrition
- alternative protein innovation
  - AI optimizing plant-based & cultured meat formulations
  - taste, texture, nutritional profile matching traditional proteins



## FoodTech business models & Silicon Valley success stories

- vertical farming platforms - Plenty, Bowery Farms
  - AI-controlled indoor agriculture, 95% less water, 350x yield per acre
  - \$600M+ raised, serving urban markets
- food delivery optimization - DoorDash, Instacart
  - ML for demand prediction, route optimization, delivery time estimation
  - multi-billion dollar valuations through AI-driven logistics
- ingredient intelligence - Motif FoodWorks, Climax Foods
  - AI designing novel proteins & fats, \$350M+ investments



## Opportunities for Jeju's food industry

- Jeju's unique advantages
  - premium agricultural products (citrus, tea, seafood) + tourism destination
  - opportunity to position as “Smart Food Island” - testbed for AI foodtech
- actionable pathways
  - partner with Korean AI institutes + Silicon Valley foodtech startups
  - pilot programs - precision agriculture for tea, AI traceability for premium seafood
- investment priorities
  - data infrastructure - IoT sensors across farms, supply chain tracking systems
  - talent development - AI + agriculture cross-training programs
  - startup ecosystem - foodtech accelerator focusing on sustainable + premium food



# **Selected References & Sources**

## Selected references & sources

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**Thank You**