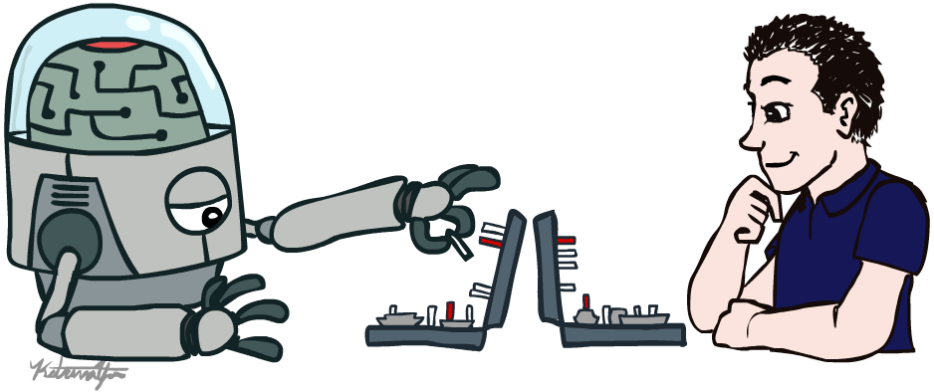
Artificial Intelligence

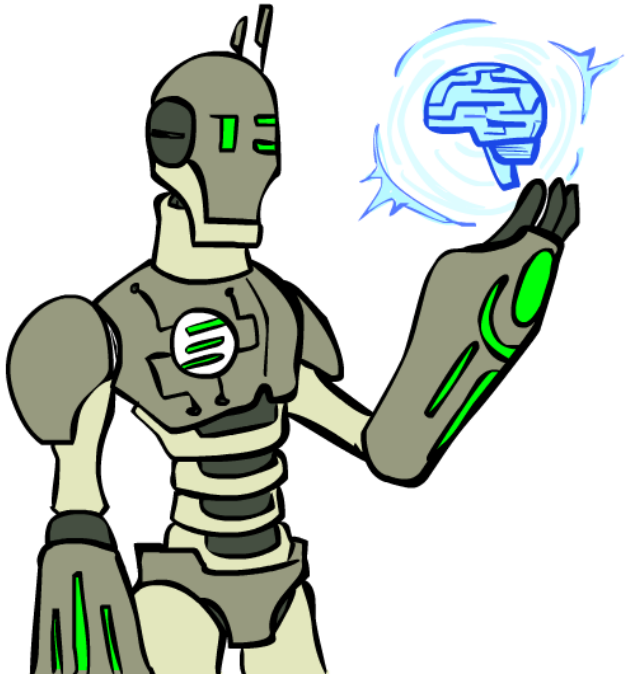


Seyyed Mohammad Tabatabaei

(Associate Professor in Medical Informatics)

دانشگاه علوم پزشکی مشهد

- What is artificial intelligence?
- Where did it come from
- What can AI do?
- AI in Healthcare
- Smart Hospital
- AI in Midwifery



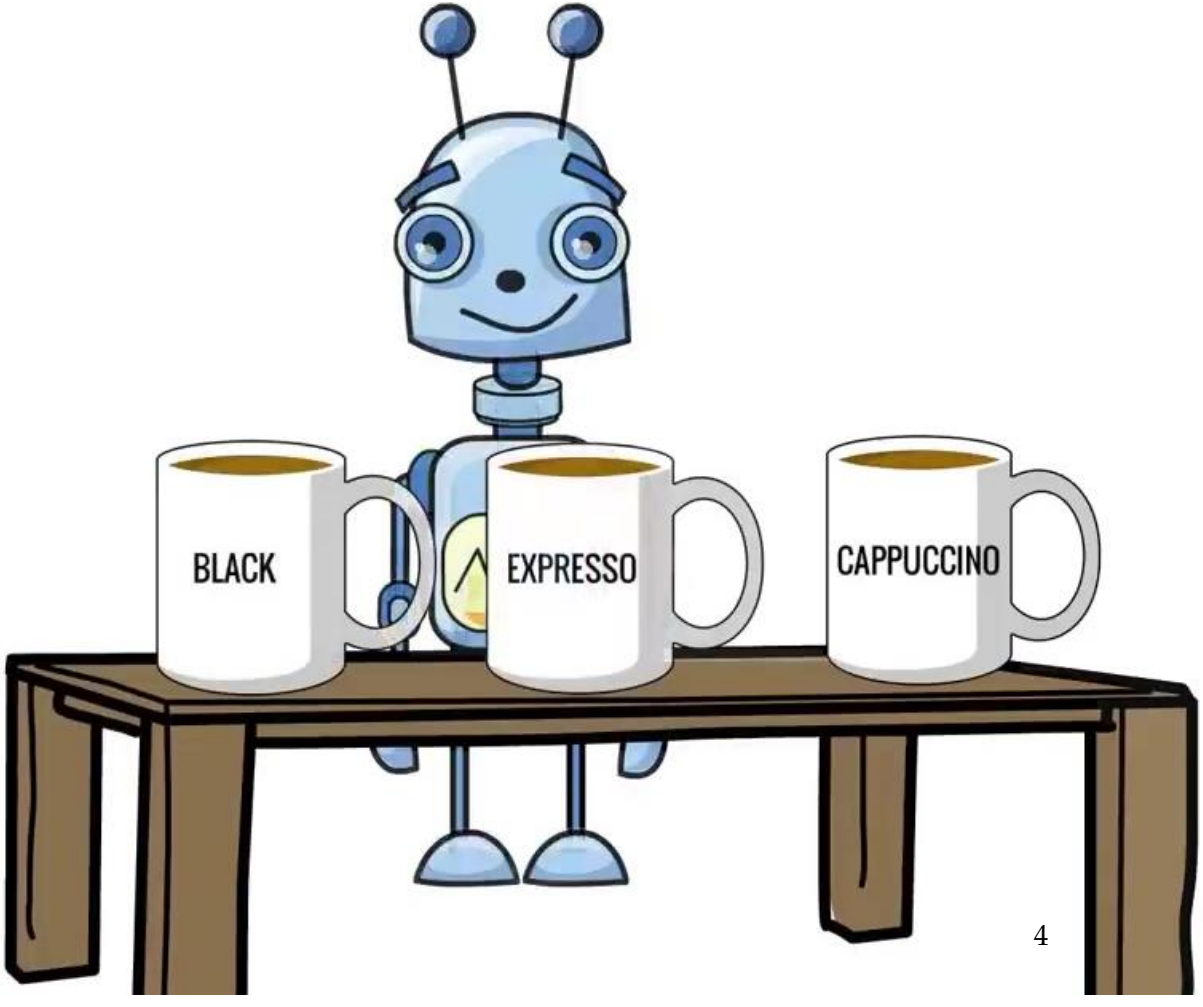
AI

An Apple Original Film
TOM HANKS
FINCH

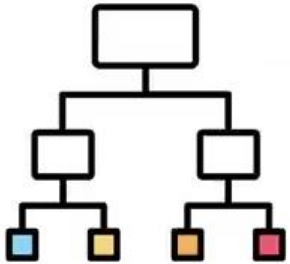
ROBOCOP

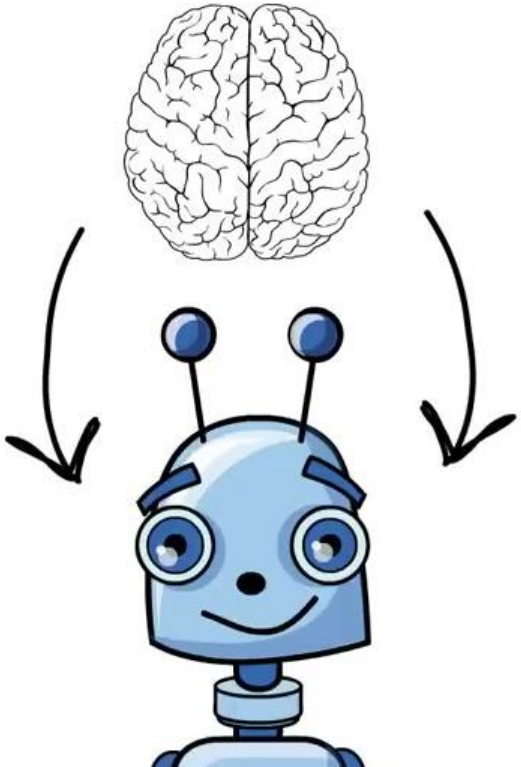
RON'S GONE WRONG

WALL-E


BLACK
EXPRESSO
CAPPUCCINO

THESE ARE THE PRODUCTS OF ARTIFICIAL INTELLIGENCE





$f(x)$

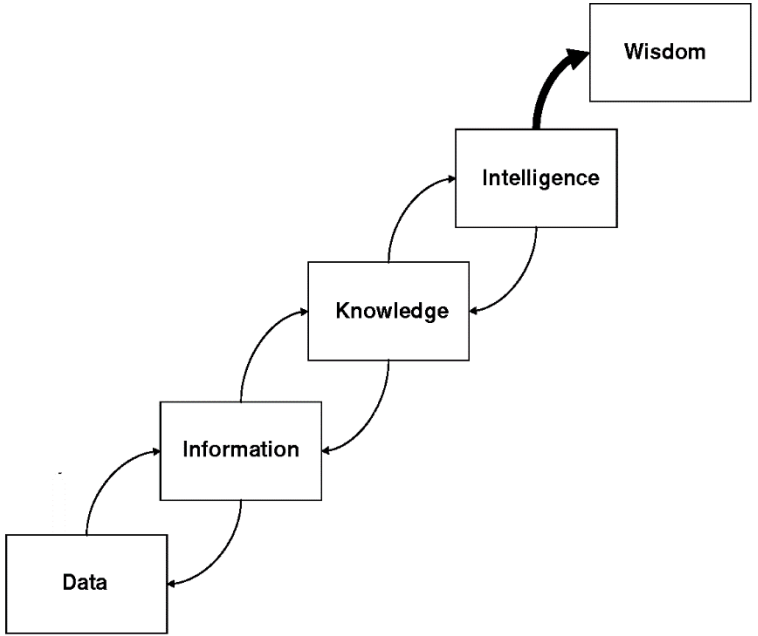
What is AI?

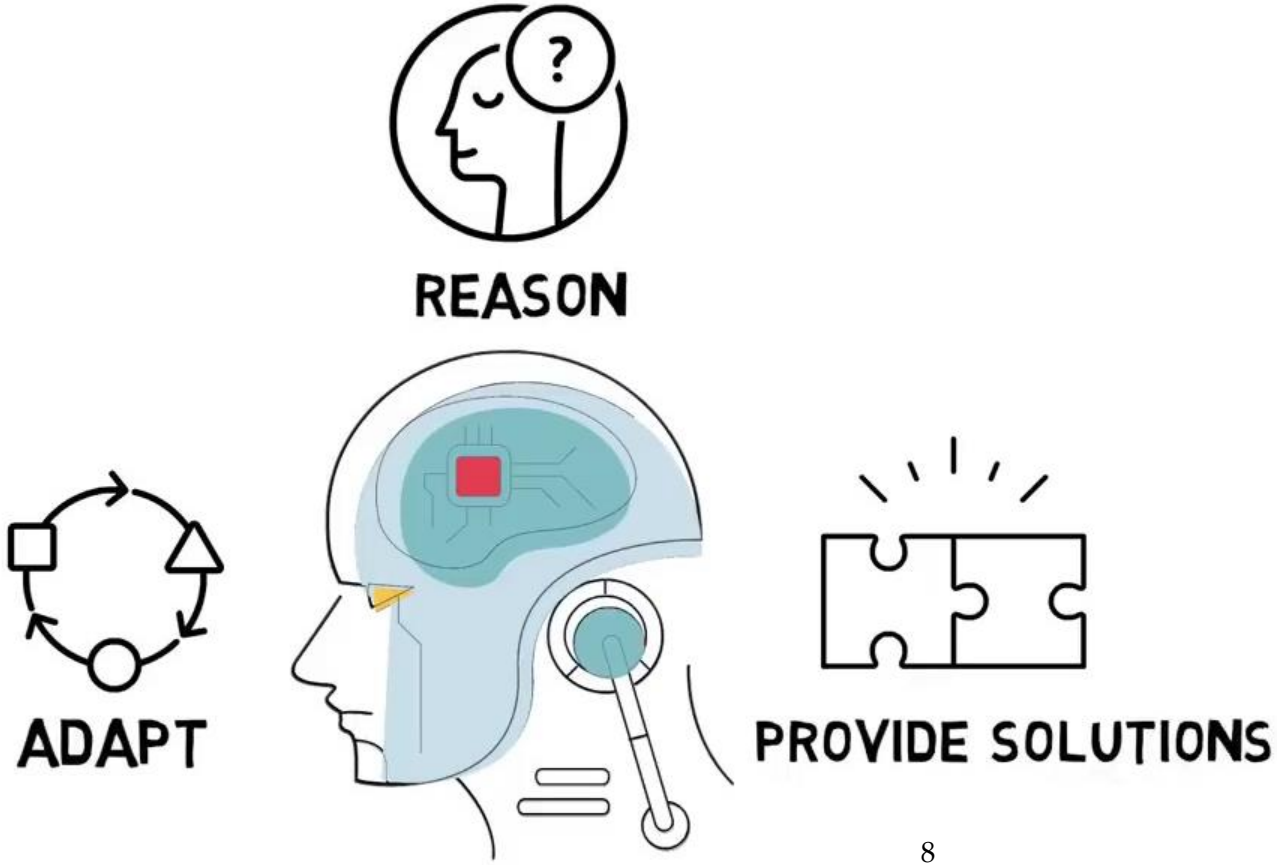
- **Artificial Intelligence** (AI)
- Artificial + Intelligence
- Artificial : Something not natural (*man-made*)
- Intelligence : The ability to learn and solve problems(*thinking power*)
- **“a man-made thinking power!”**

What is AI?

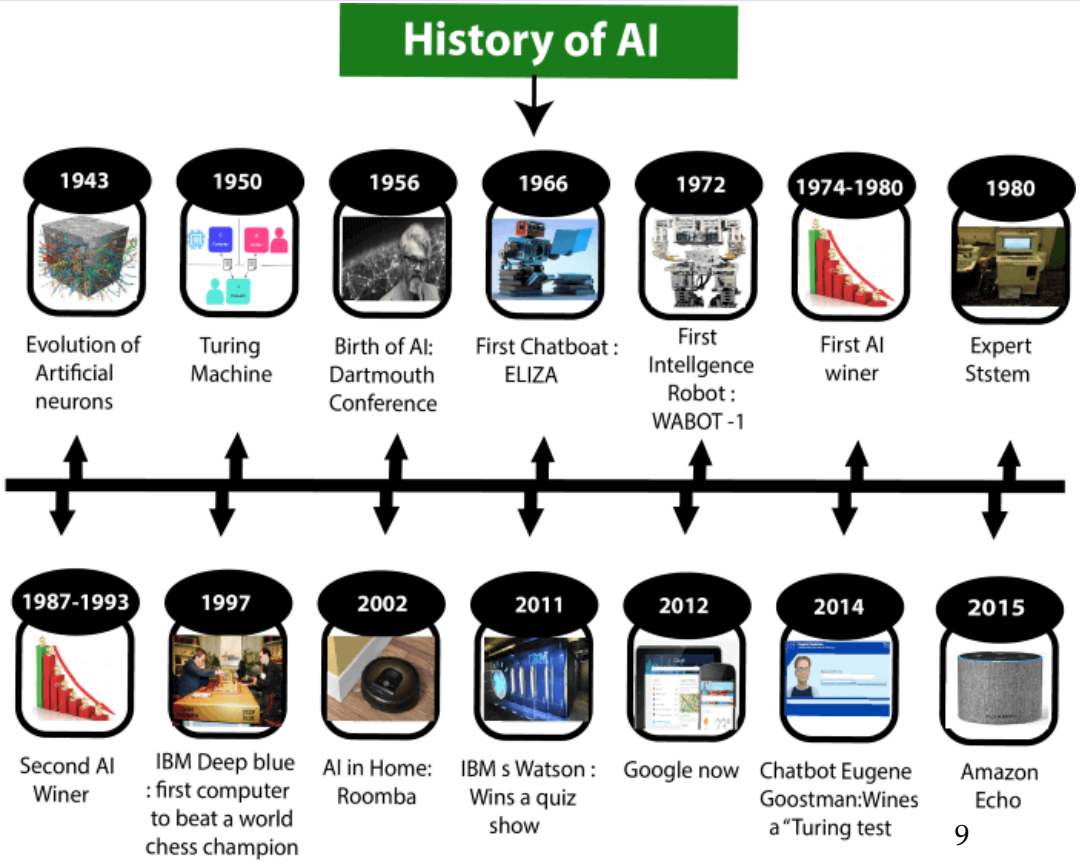
- Intelligence is the ability to acquire and apply knowledge.
- Knowledge is the information acquired through experience.
- Experience is the knowledge gained through exposure(training).

- "copy of something natural(i.e., human beings) 'WHO' is capable of acquiring and applying the information it has gained through exposure."




REASON
ADAPT
PROVIDE SOLUTIONS

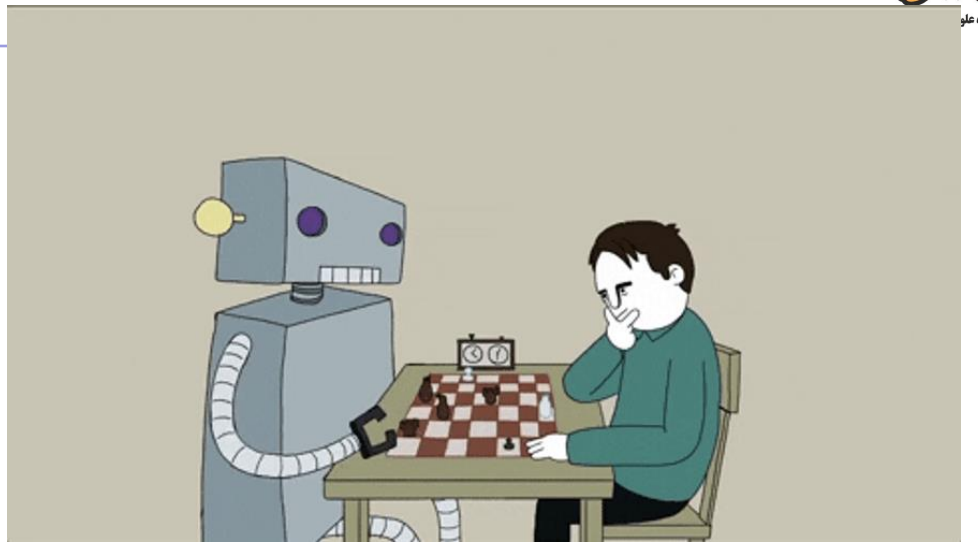
History of Artificial Intelligence



e4 c6 2. d4 d5 3. Nc3 dxe4

Game Agents

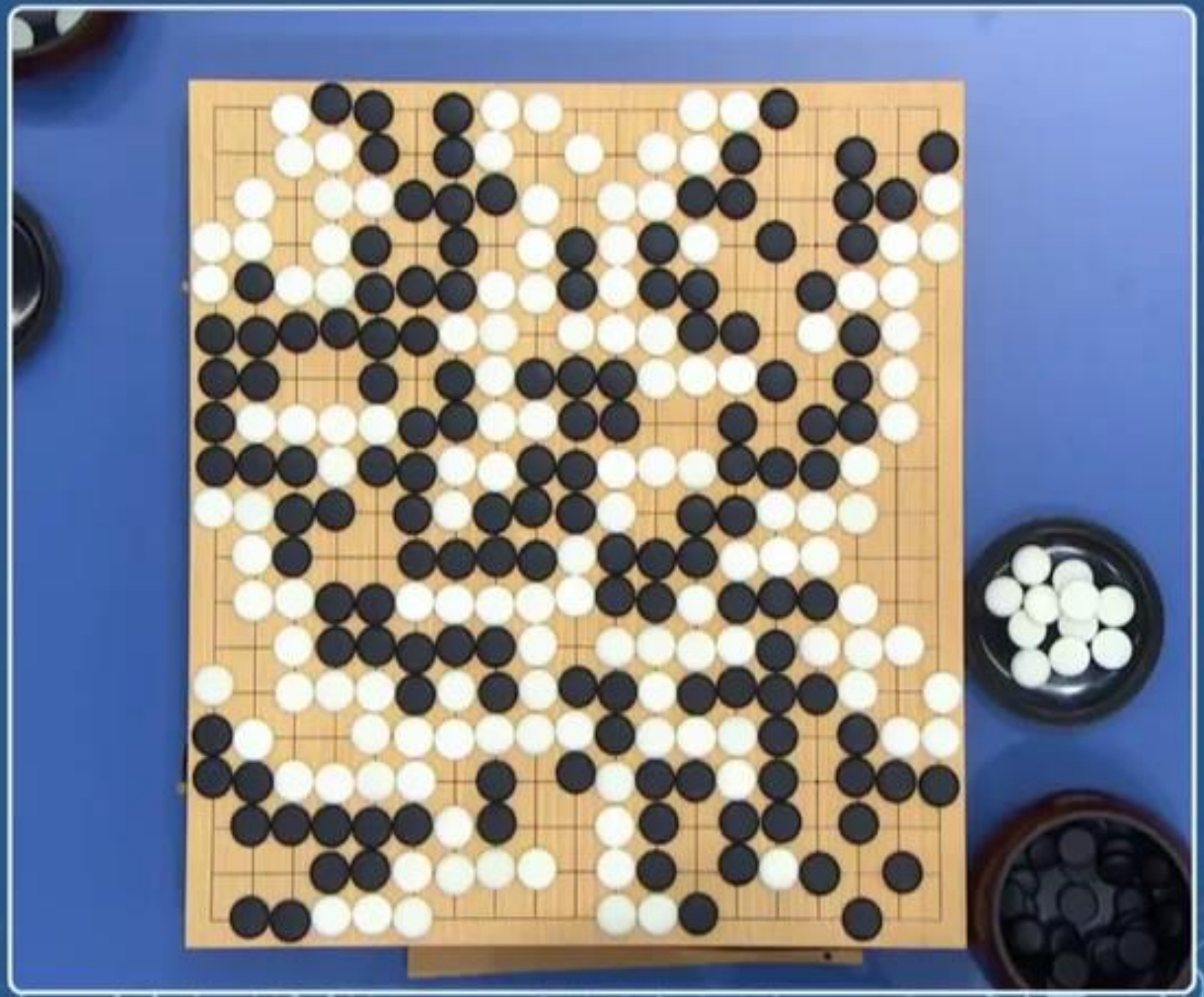
- Classic Moment: May, '97:
  Deep Blue vs. Kasparov
  - First match won against world champion
  - "Intelligent creative" play
  - 200 million board positions per second



- 1996: Kasparov Beats Deep Blue
  "I could feel --- I could smell --- a new kind of intelligence across the table."
- 1997: Deep Blue Beats Kasparov
  "Deep Blue hasn't proven anything."

Game	Board size	State space	Game tree size
Go	19 x 19	10^{172}	10^{360}
Chess	8 x 8	10^{50}	10^{123}

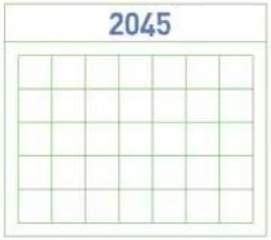
Text from Bart Selman, image from IBM's Deep Blue pages

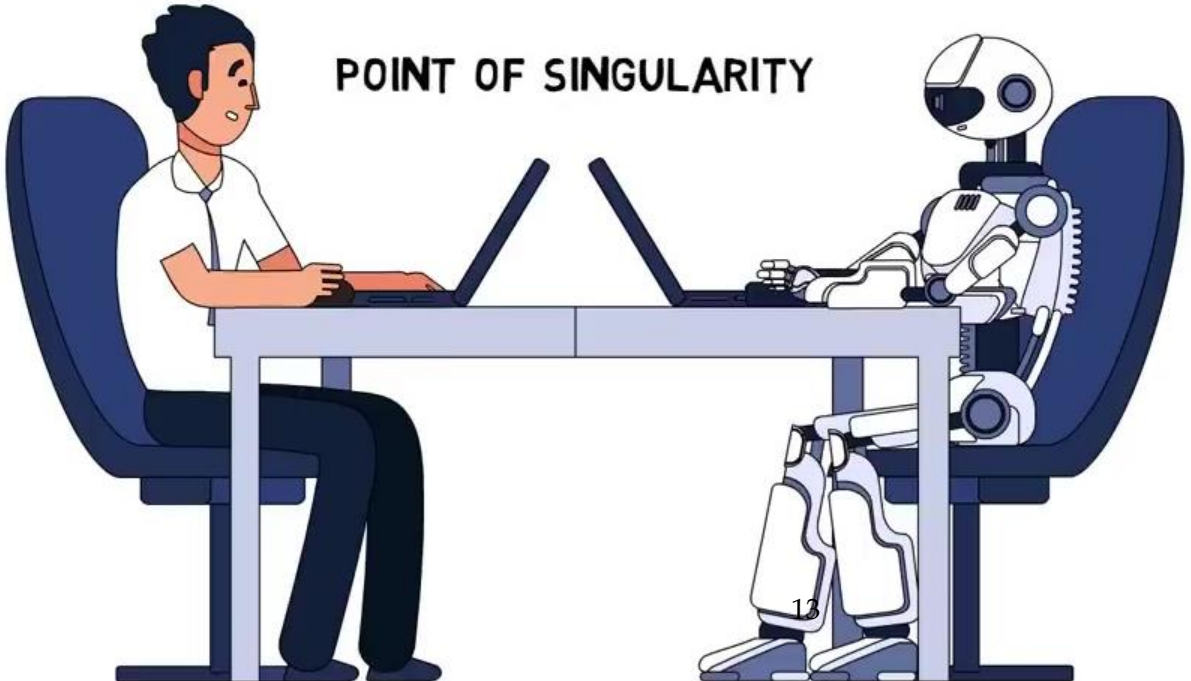


柯洁 KE JIE
00:13:28

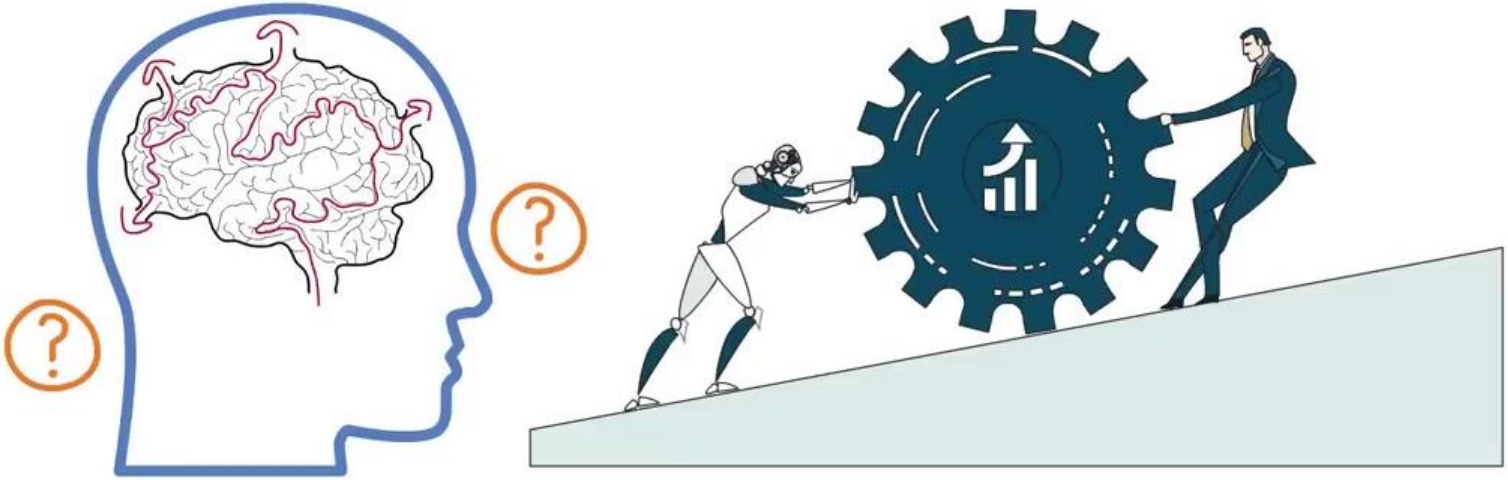
ALPHAGO
01:30:35

RAY KURZWEIL





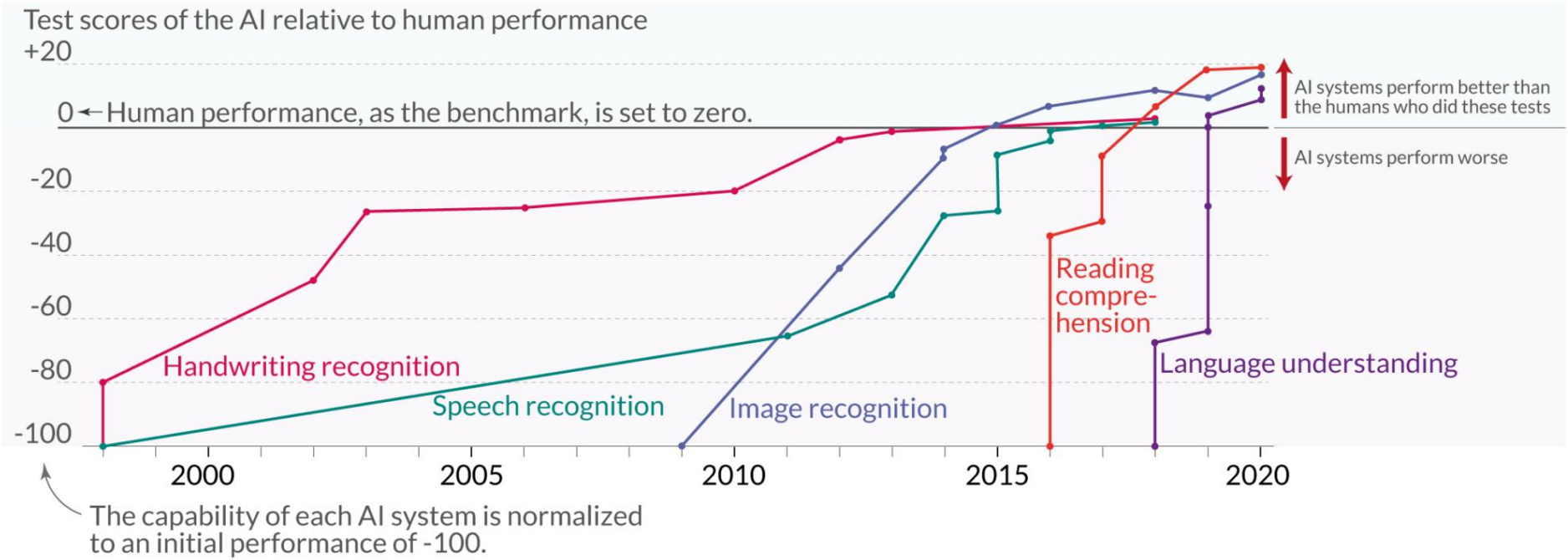
WHICH WOULD MAKE US PARTLY
CYBORGS!



HOWEVER, WITH THE MATURATION OF TECHNOLOGY, WE CAN ONLY WAIT AND WATCH WHAT THE FUTURE OF AI HOLD FOR US

Language and image recognition capabilities of AI systems have improved rapidly

Language and image recognition capabilities of AI systems have improved rapidly



Data source: Kiela et al. (2021) – Dynabench: Rethinking Benchmarking in NLP
OurWorldinData.org – Research and data to make progress against the world's largest problems.

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Timeline of images generated by artificial intelligence

Our World in Data

These people don't exist. All images were generated by artificial intelligence.

2014

Goodfellow et al. (2014) – Generative Adversarial Networks

2015

Radford, Metz, and Chintala (2015) – Unsupervised Representation Learning with Deep Convolutional GANs

2016

Liu and Tuzel (2016) – Coupled GANs

2017

Karras et al. (2017) – Progressive Growing of GANs for Improved Quality, Stability, and Variation

2018

Karras, Laine, and Aila (2018) – A Style-Based Generator Architecture for Generative Adversarial Networks

2019

Karras et al. (2019) – Analyzing and Improving the Image Quality of StyleGAN

2020

Ho, Jain, & Abbeel (2020) – Denoising Diffusion Probabilistic Models

2021

Image generated with the prompt: *"a couple of people are sitting on a wood bench"*

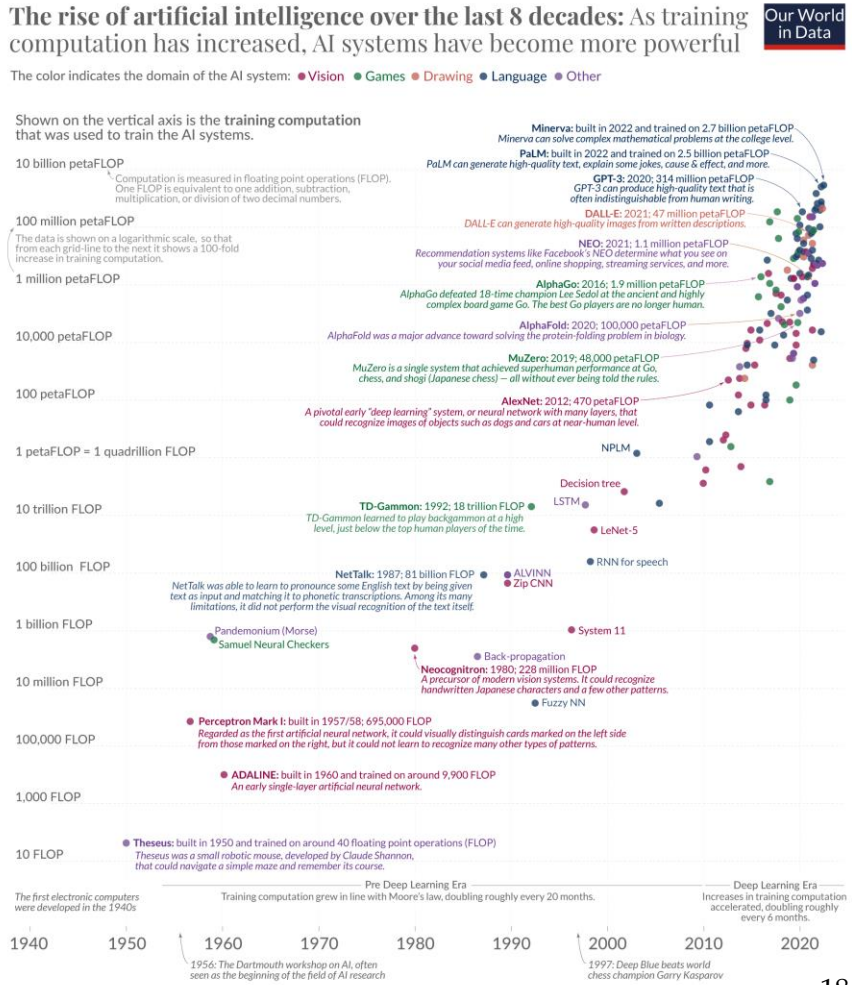
Ramesh et al. (2021) – Zero-Shot Text-to-Image Generation (OpenAI's DALL-E 1)

2022

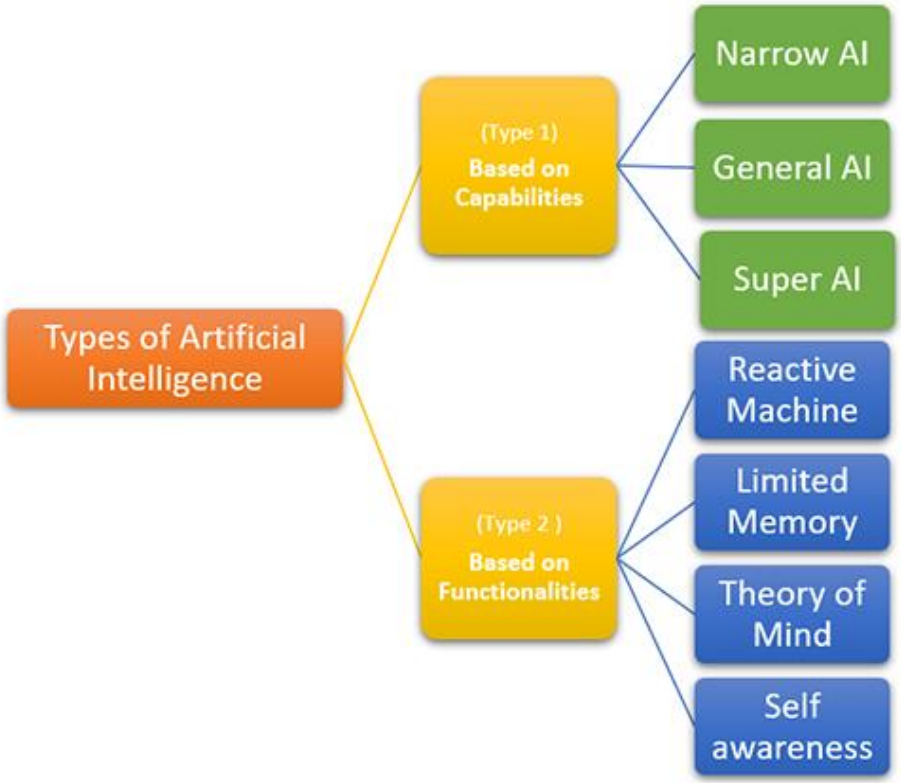
Image generated with the prompt: *"A Pomeranian is sitting on the King's throne wearing a crown. Two tiger soldiers are standing next to the throne."*

Saharia et al. (2022) – Photorealistic Text-to-Image Diffusion Models with Deep Language Understanding (Google's Imagen)

OurWorldinData.org – Research and data to make progress against the world's largest problems. Licensed under CC-BY by the authors Charlie Giattino and Max Roser



Peta = 1,000,000,000,000,000

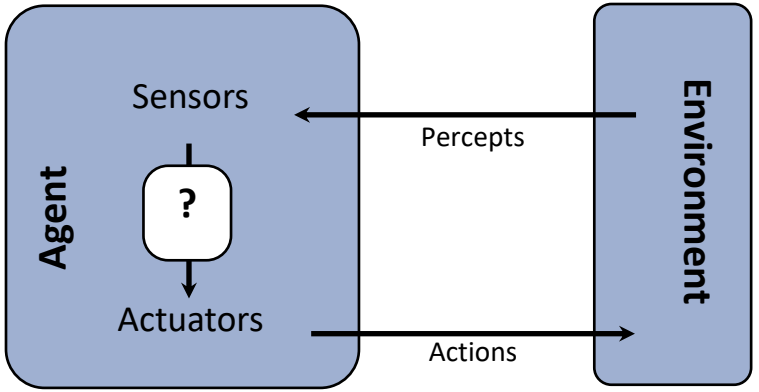

Types of Artificial Intelligence
(Type 1)
Based on Capabilities
Narrow AI
General AI
Super AI
(Type 2)
Based on Functionalities
Reactive Machine
Limited Memory
Theory of Mind
Self awareness

What is AI?

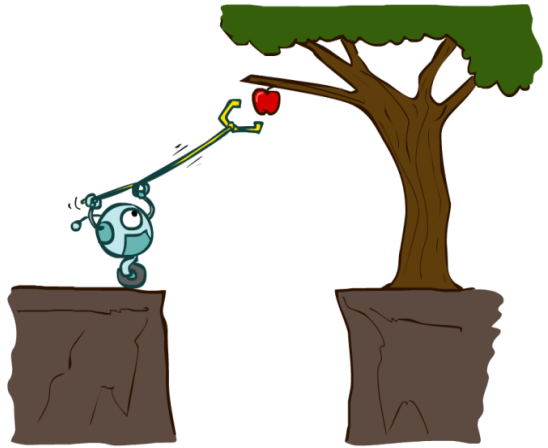
The science of making machines that:

Agents

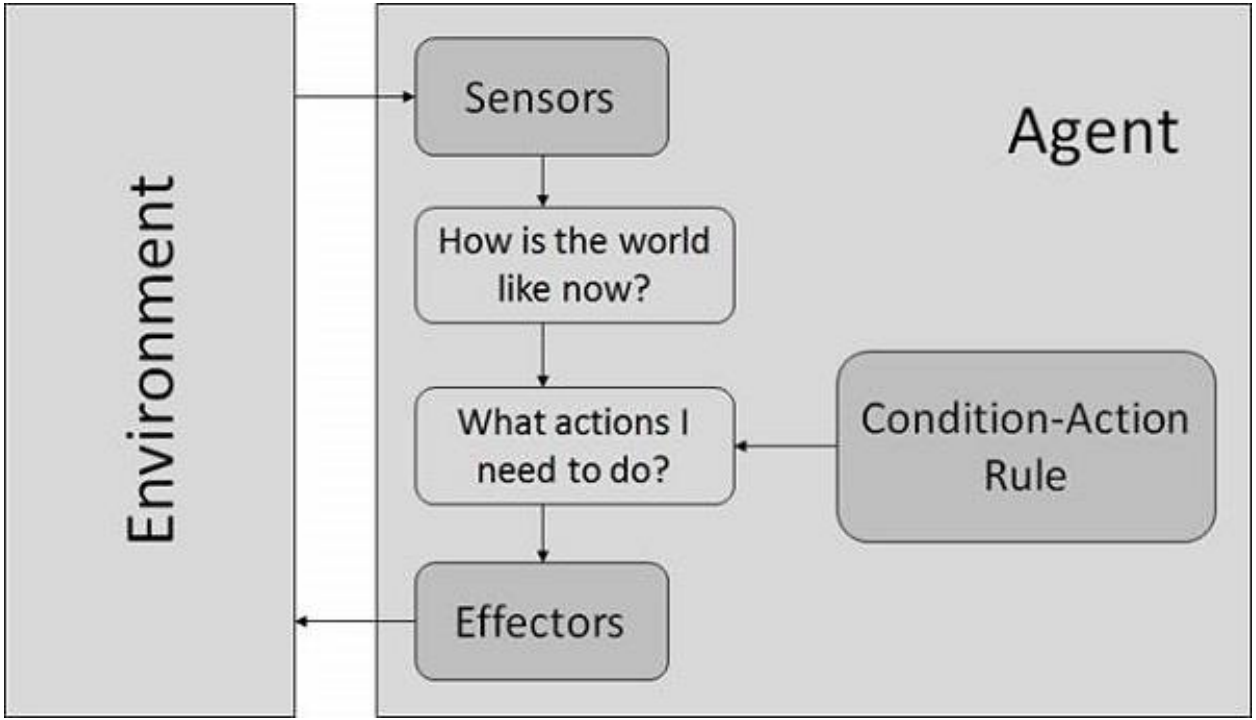
- An **agent** is an entity that *perceives* and *acts*.



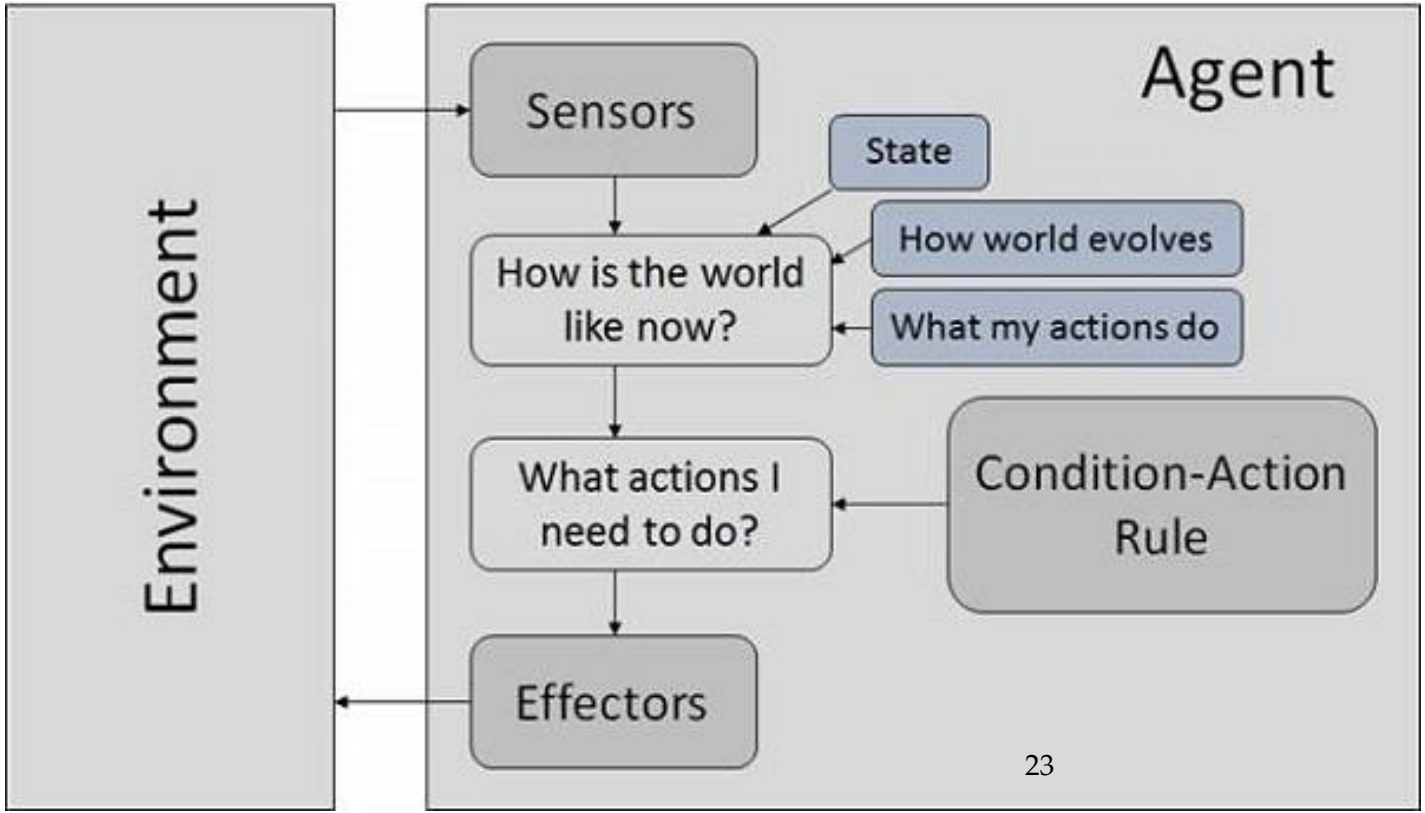
- Agent = Architecture + Agent Program
- Architecture = the machinery that an agent executes on.
- Agent Program = an implementation of an agent function.



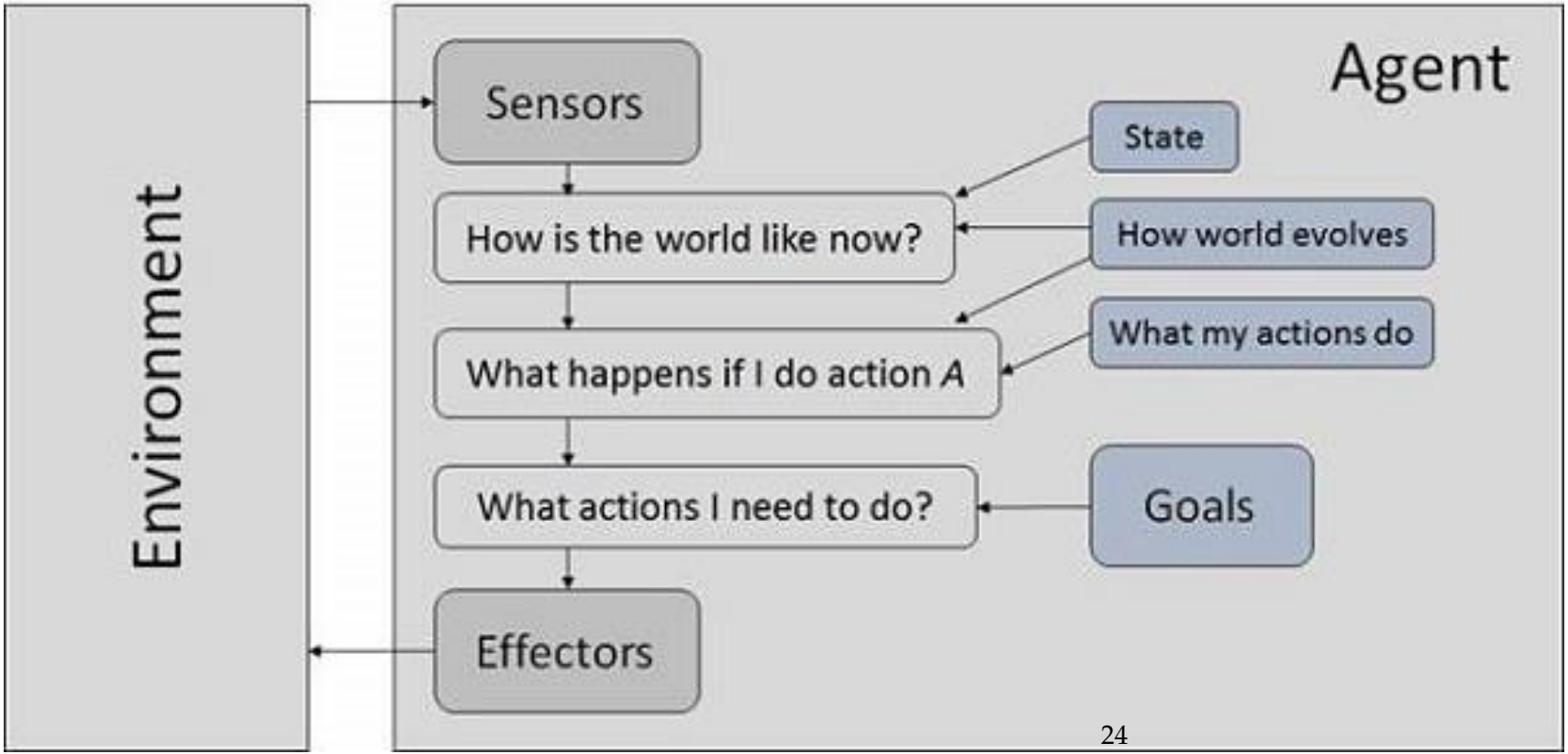
Simple Reflex Agents



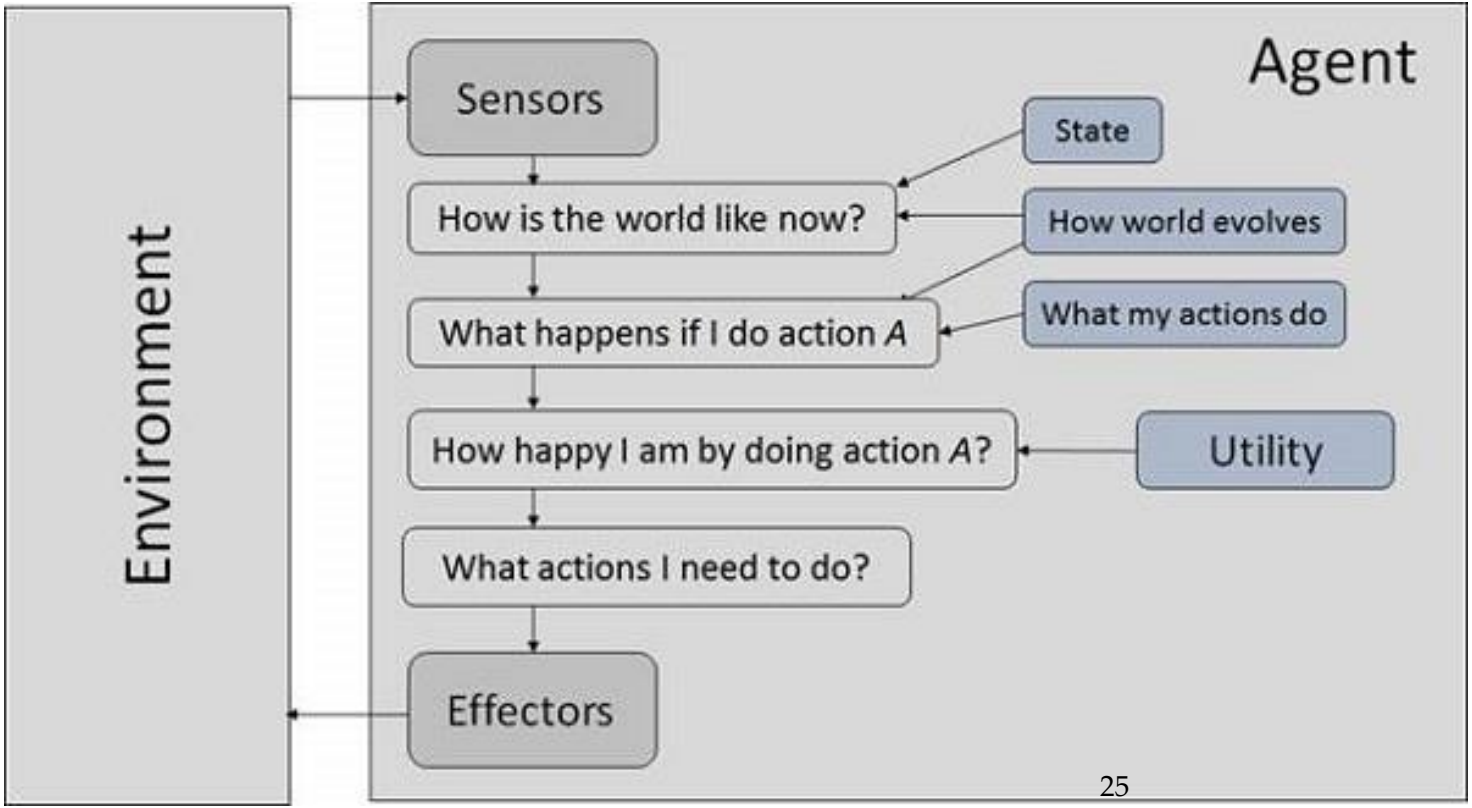
Model Based Reflex Agents



Goal Based Agents



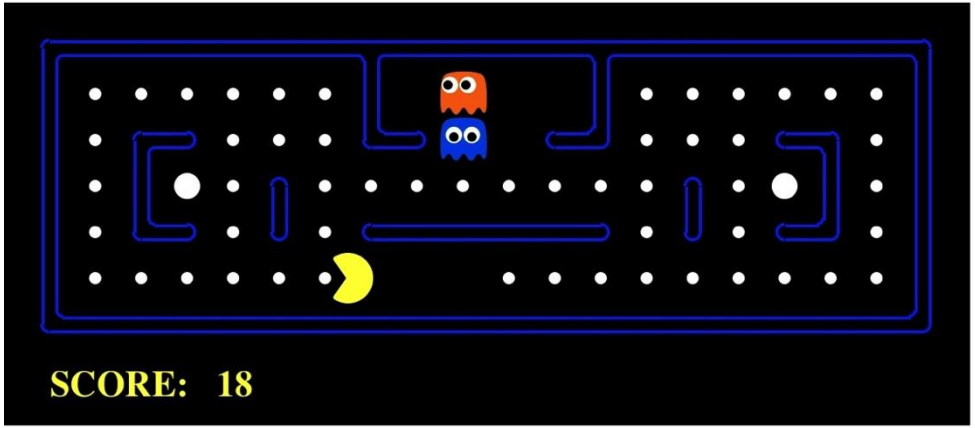
Utility Based Agents

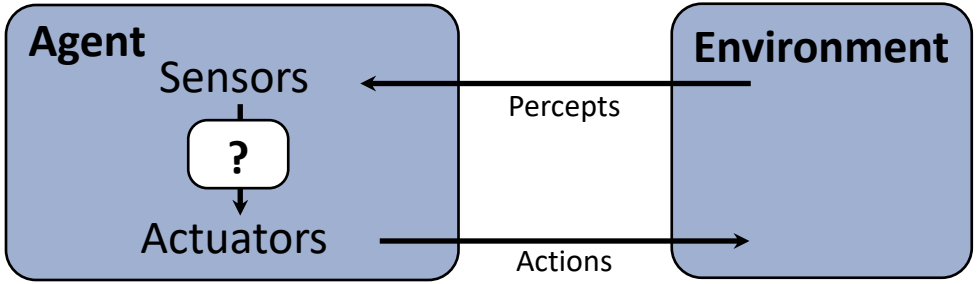


Properties of Environment

- **Discrete / Continuous**
- **Observable / Partially Observable**
- **Static / Dynamic**
- **Single agent / Multiple agents**
- **Deterministic / Non-deterministic**
- **Episodic / Non-episodic**

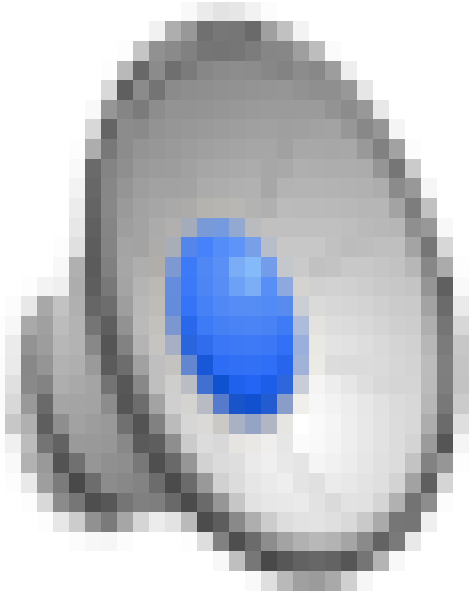
Pac-Man as an Agent

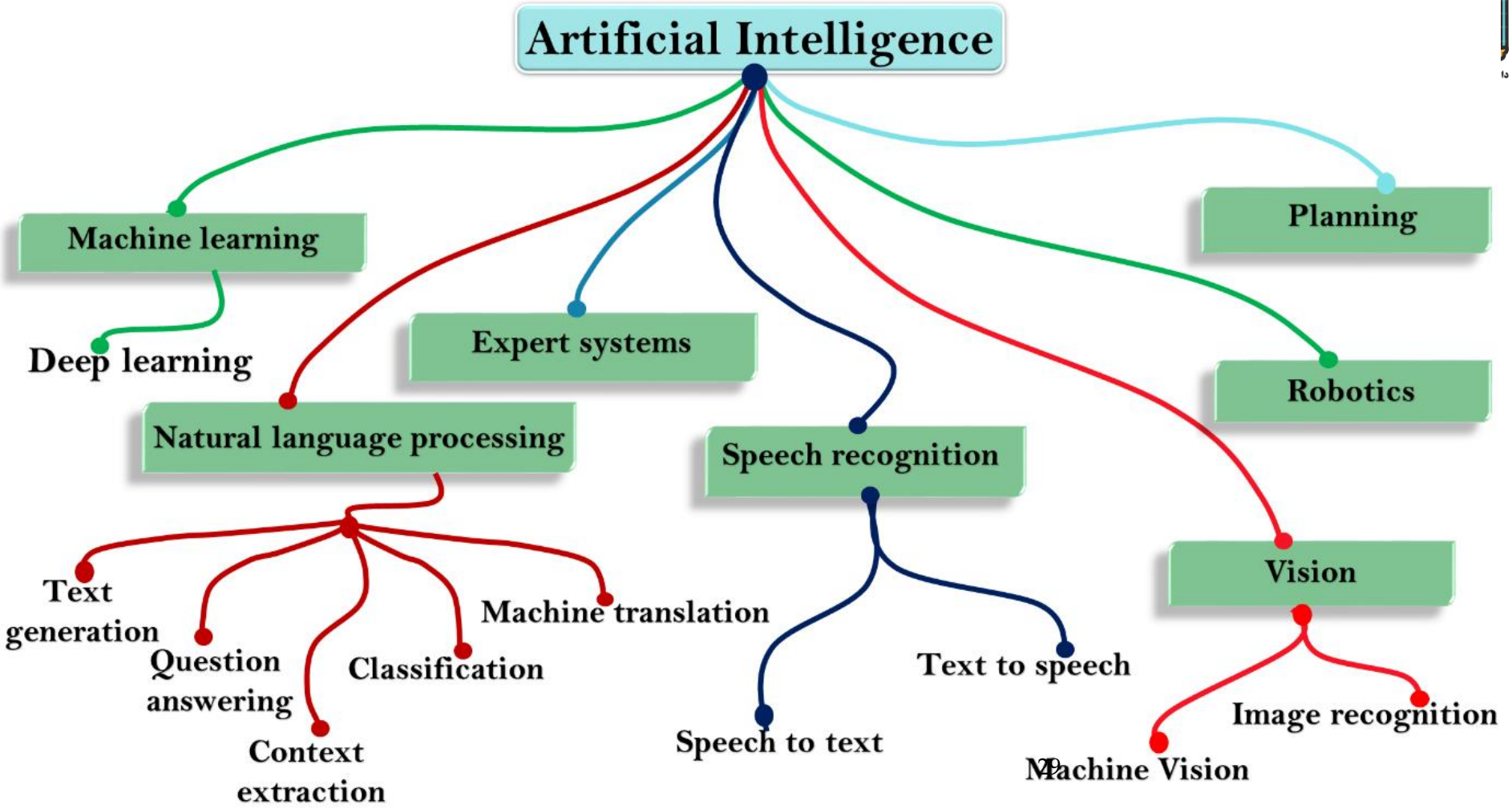




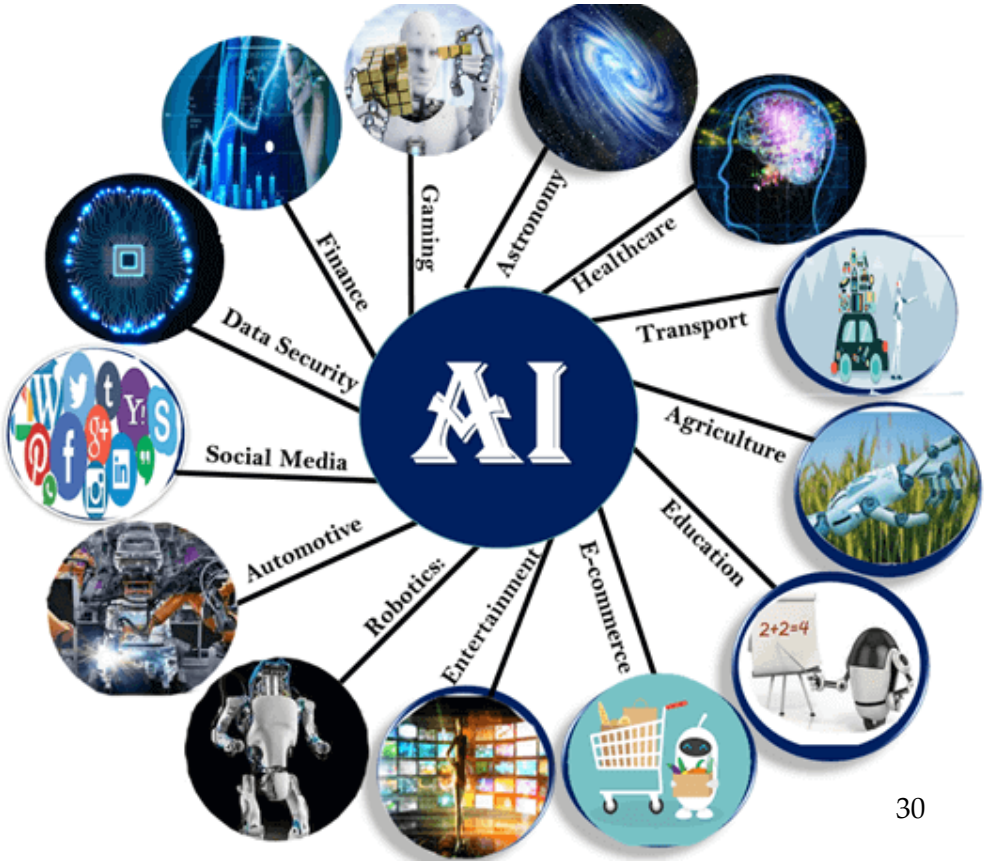
Pac-Man is a registered trademark of Namco-Bandai Games, used here for educational purposes

Demo1: pacman-l1.mp4

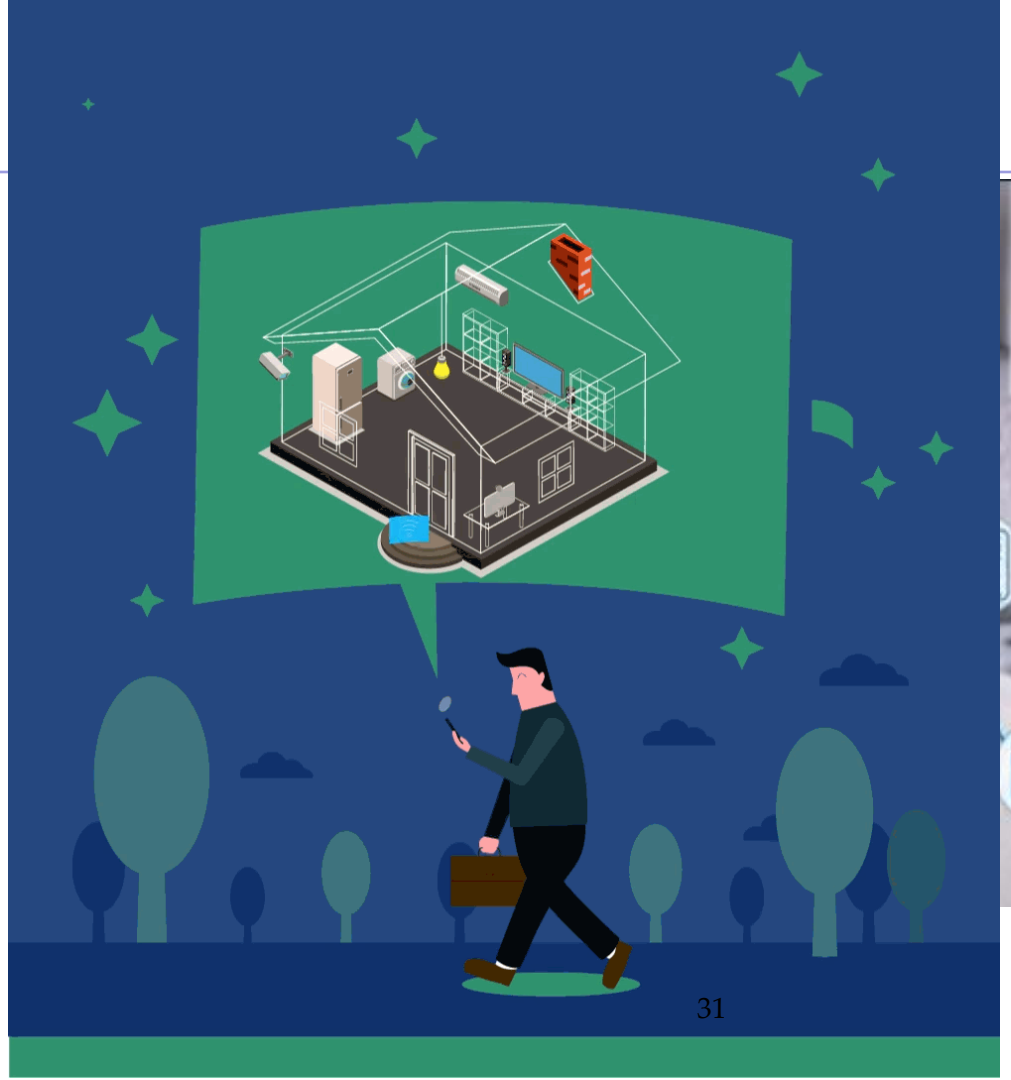



Artificial Intelligence
Machine learning
Deep learning
Natural language processing
Text generation
Question answering
Context extraction
Classification
Machine translation
Expert systems
Speech recognition
Speech to text
Text to speech
Planning
Robotics
Vision
Machine Vision
Image recognition

Application of AI

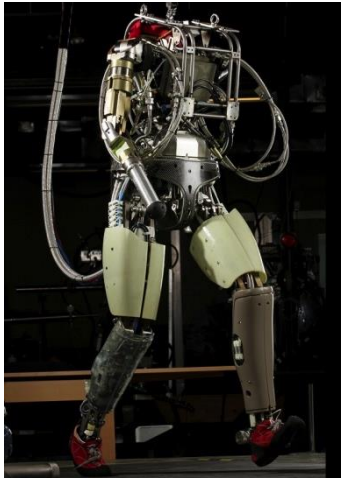


- Smart Home
- Smart Phones
- Smart Watches
- Smart TVs
- Smart Keyboards
- Smart Speakers
- …



Robotics

- Robotics
  - Part mech. eng.
  - Part AI
  - Reality much harder than simulations!
- Technologies
  - Vehicles
  - Rescue
  - Help in the home
  - Lots of automation…

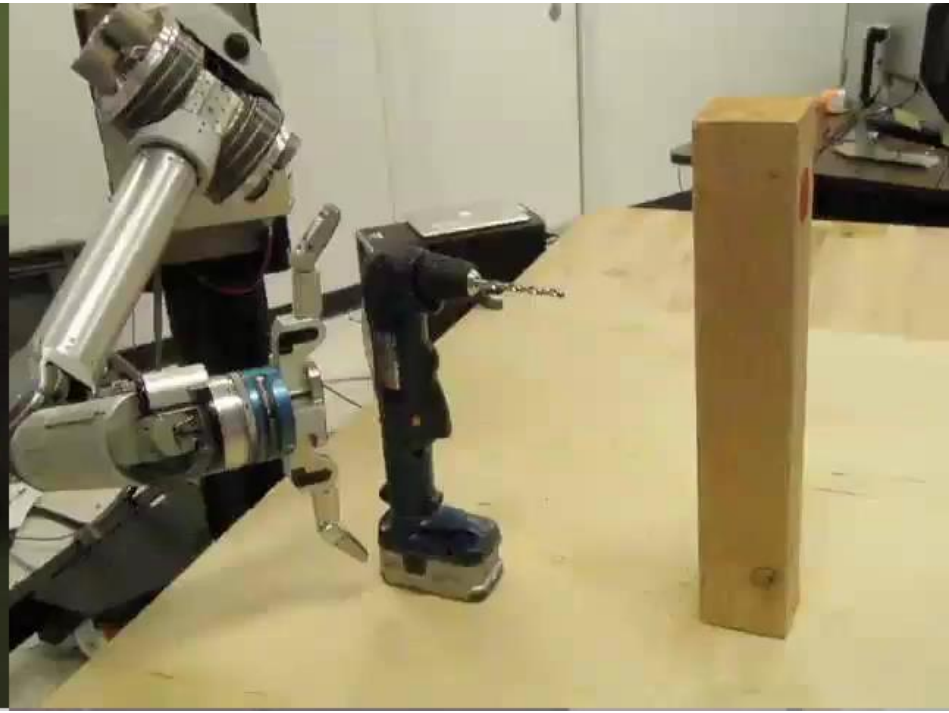


AutoPilot

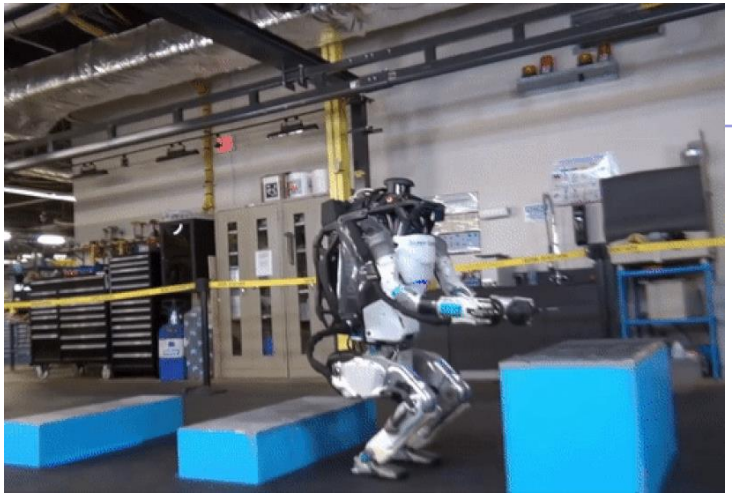
71

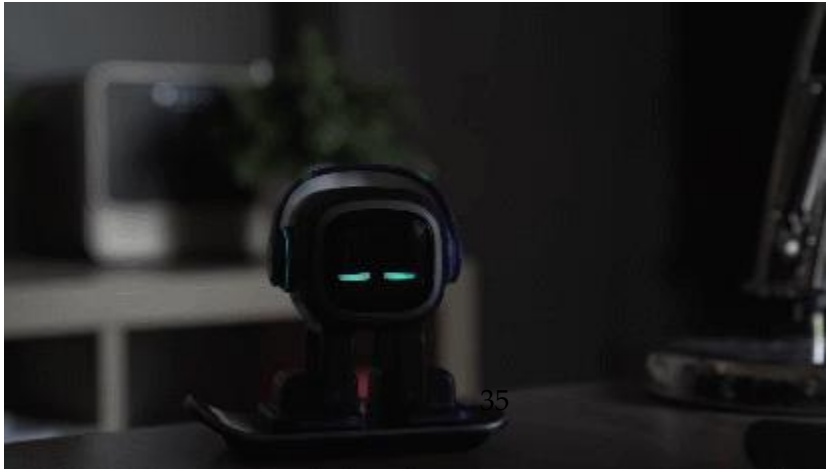
LEFT REARWARD VEHICLE CAMERA
MEDIUM RANGE VEHICLE CAMERA
RIGHT REARWARD VEHICLE CAMERA
MOTION FLOW
LANE LINES
LANE LINES
ROAD FLOW
IN-PATH OBJECTS
ROAD LIGHTS
OBJECTS
ROAD SIGNS

Robots

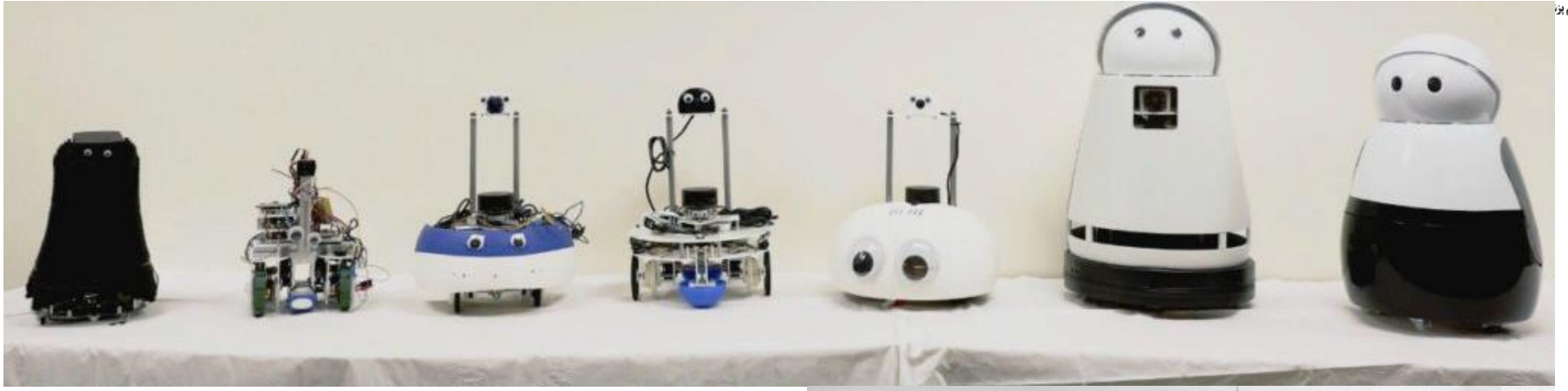


Robots





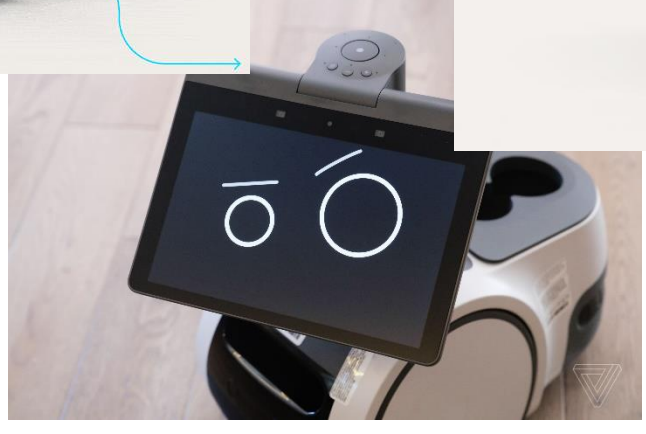
Kuri – the maid robot



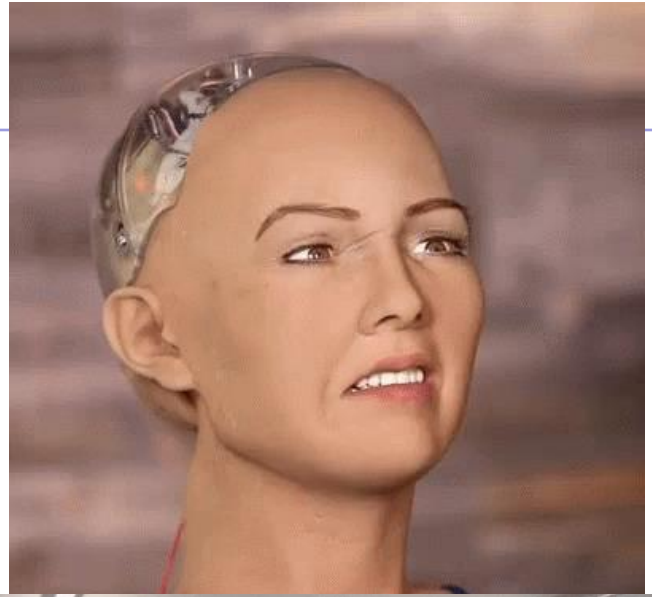
Mayfield Robotics

Amazon Astro

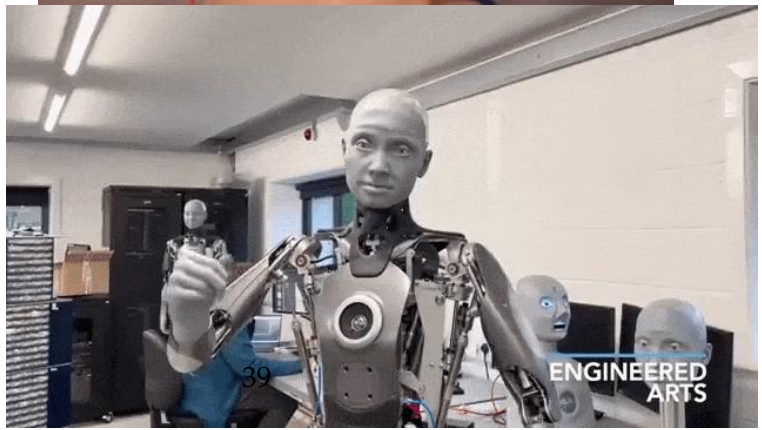
- A Rolling Robot That Uses Alexa to Attend to the Many Needs of a Household

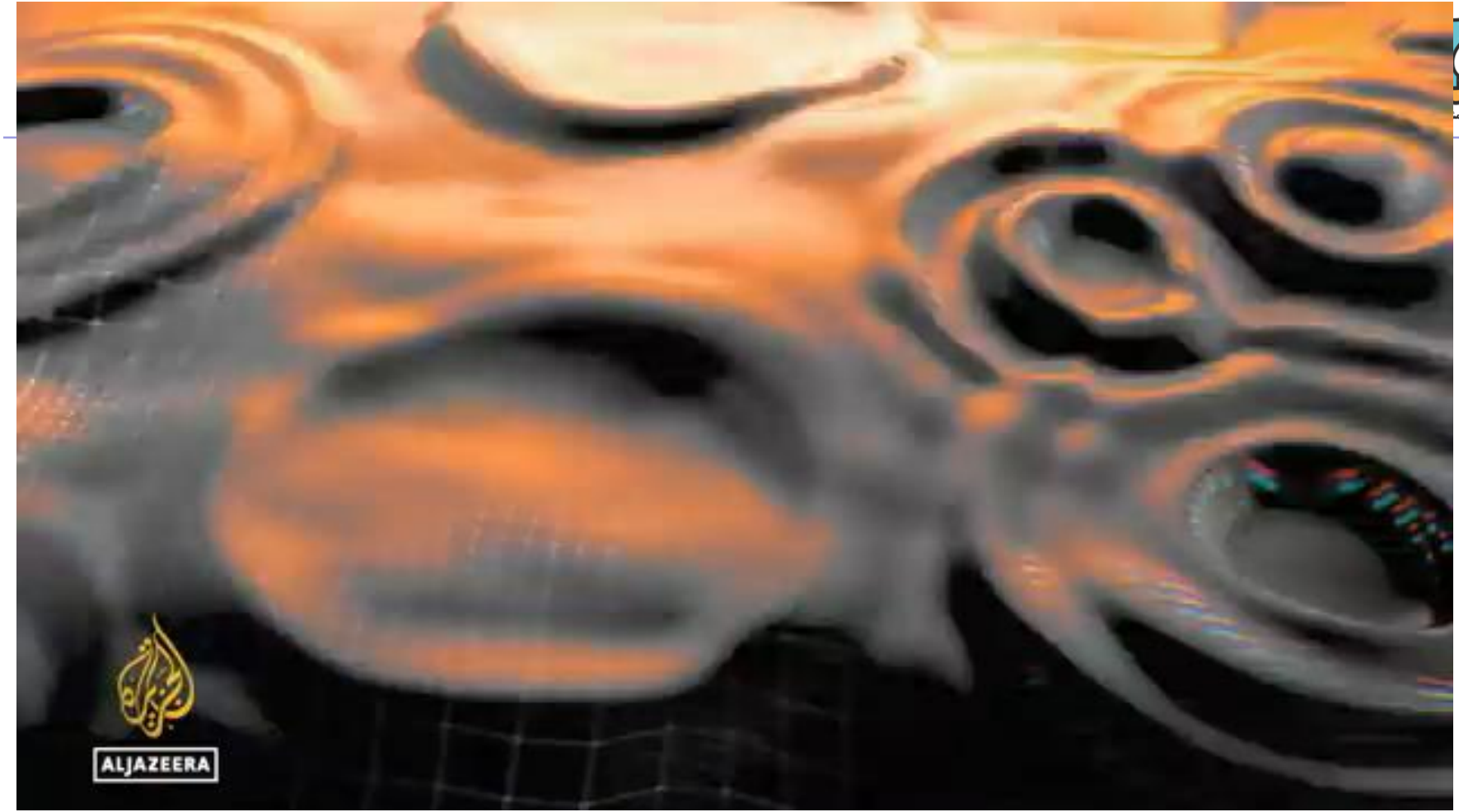


Sophia

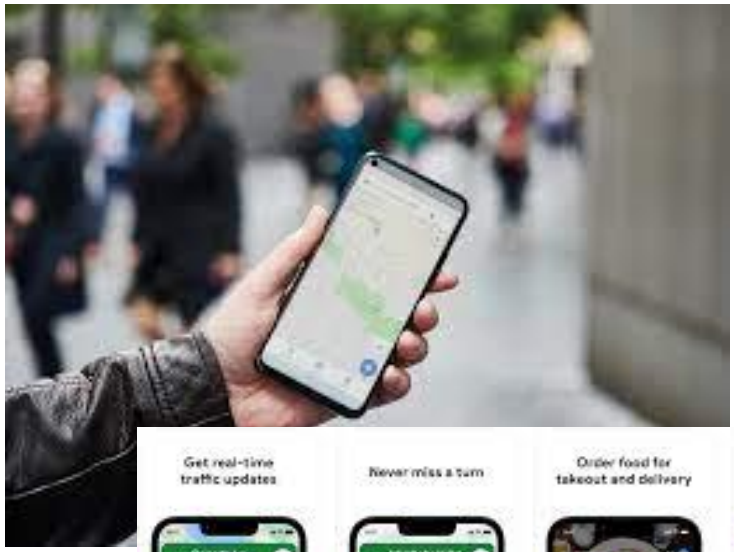


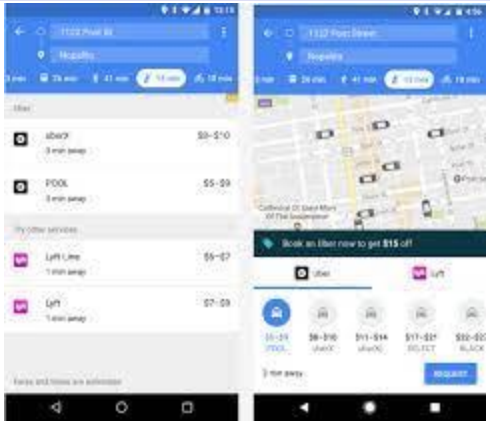
- **2016:** A **humanoid robot named Sophia** is created by Hanson Robotics.
- known as the first “robot citizen.”
- What distinguishes Sophia from previous humanoids is her likeness to an actual human being, with her ability to see (**image recognition**), make facial expressions, and communicate through AI.

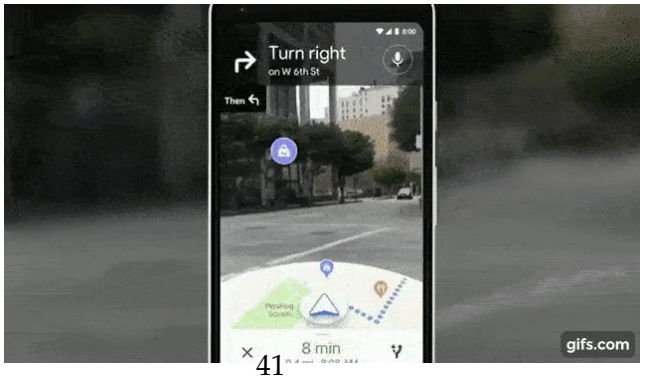



ALJAZEERA

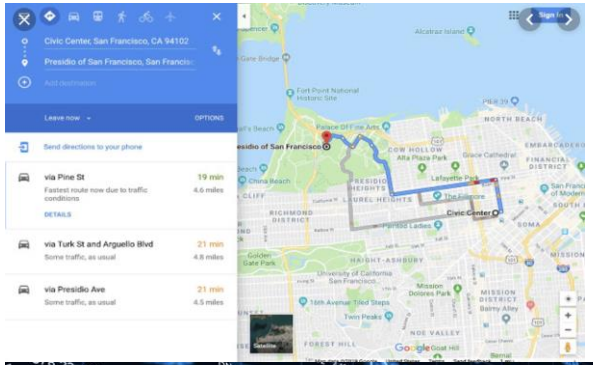
Google Maps and Ride-Hailing Applications

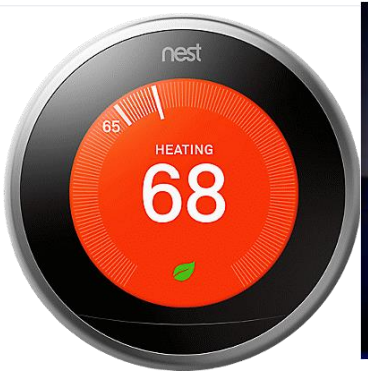




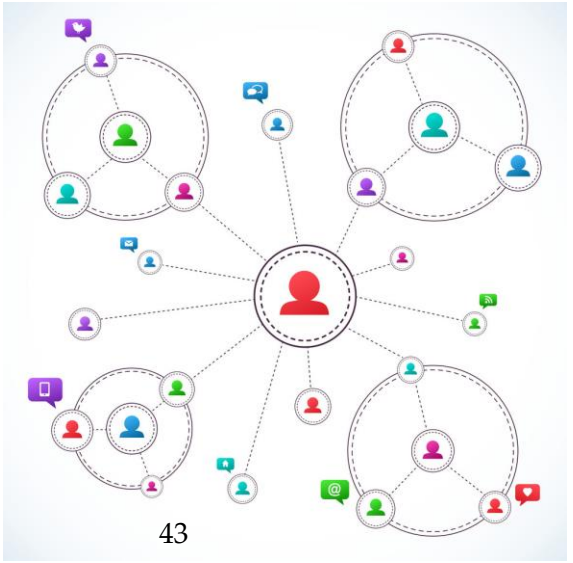


Tools for Predictions & Decisions



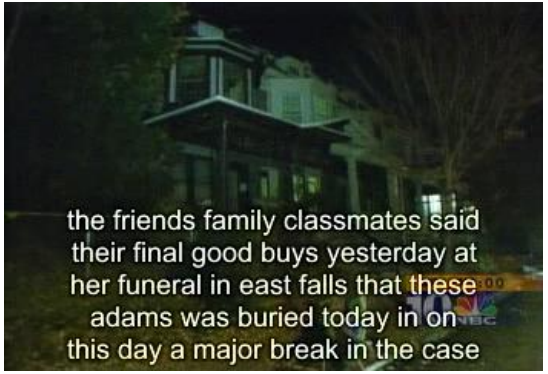


Social Media



Natural Language

- Speech technologies
  - Automatic speech recognition (ASR)
  - Text-to-speech synthesis (TTS)
  - Dialog systems
- Language processing technologies
  - Question answering
  - Machine translation
  - Web search
  - Text Editors or Autocorrect
  - Text classification, spam filtering, etc…

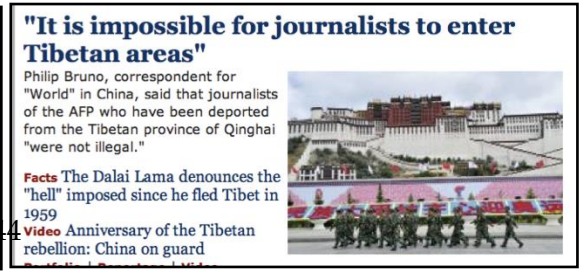


"Il est impossible aux journalistes de rentrer dans les régions tibétaines"

Bruno Philip, correspondant du "Monde" en Chine, estime que les journalistes de l'AFP qui ont été expulsés de la province tibétaine du Qinghai "n'étaient pas dans l'illégalité".

Les faits Le dalaï-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959

Vidéo Anniversaire de la rébellion


"It is impossible for journalists to enter Tibetan areas"

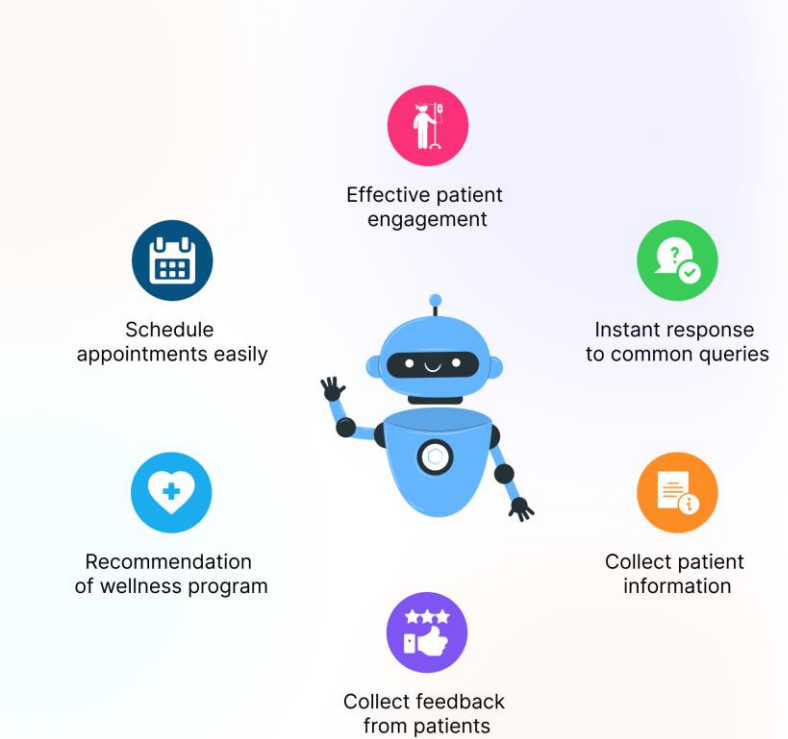
Philip Bruno, correspondent for "World" in China, said that journalists of the AFP who have been deported from the Tibetan province of Qinghai "were not illegal."

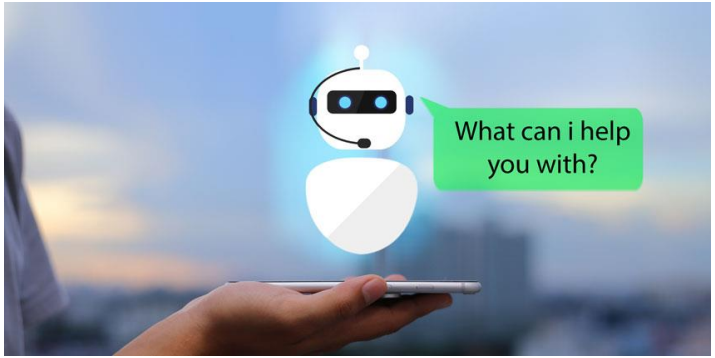
Facts The Dalai Lama denounces the "hell" imposed since he fled Tibet in 1959

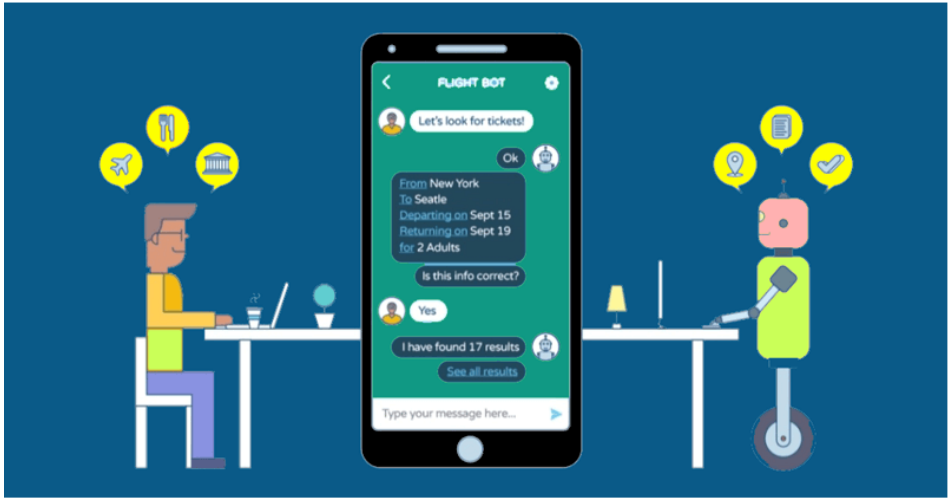
Video Anniversary of the Tibetan rebellion: China on guard

Natural Language

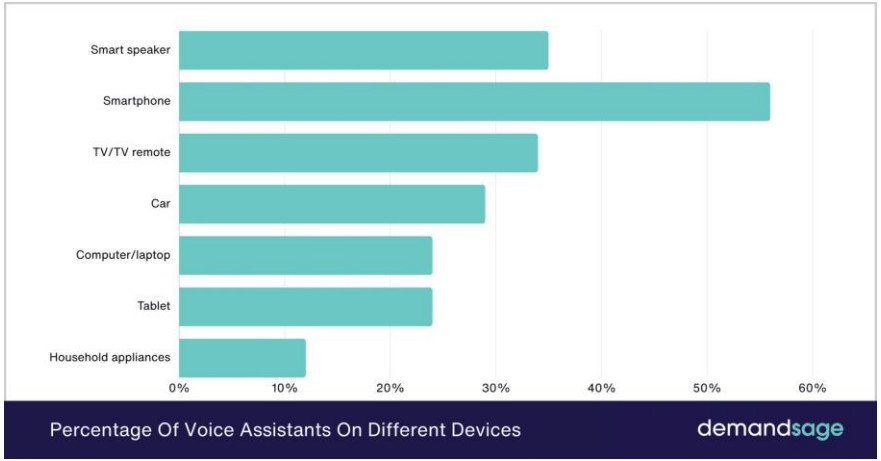
- Chatbots (Mostly Rule-based)

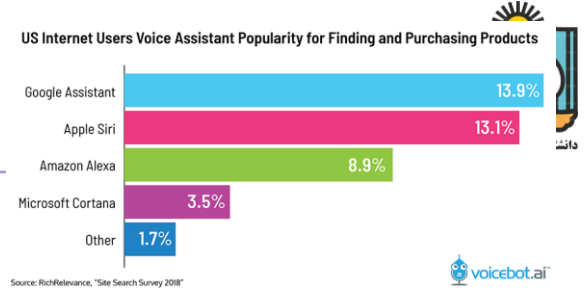


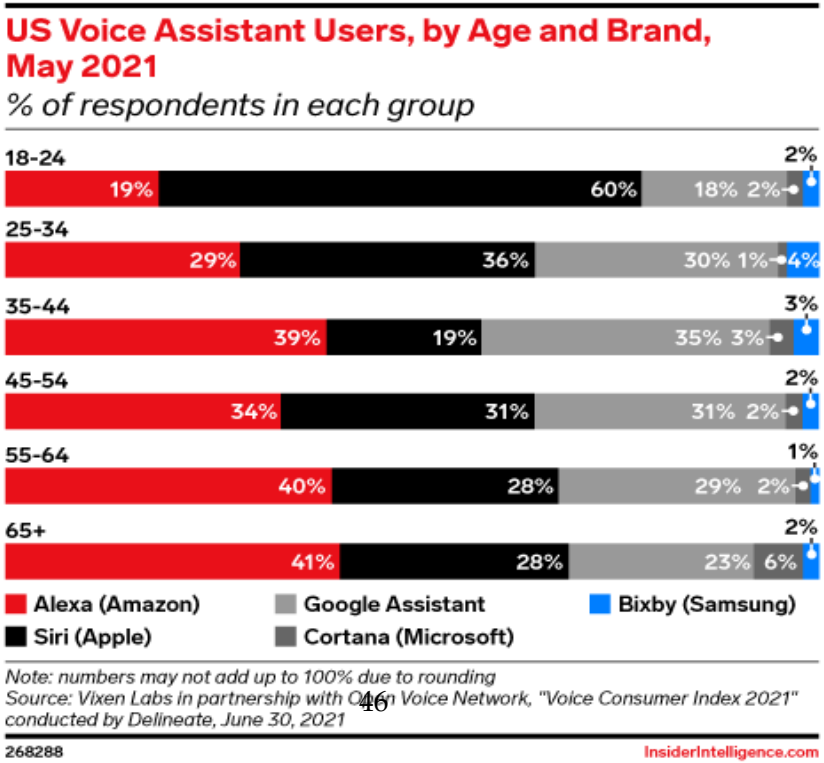




Natural Language







NLP

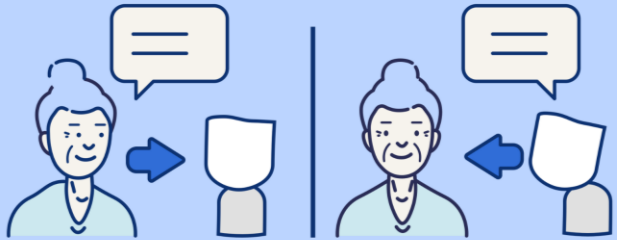
Digital Assistants

VS

Digital Companions

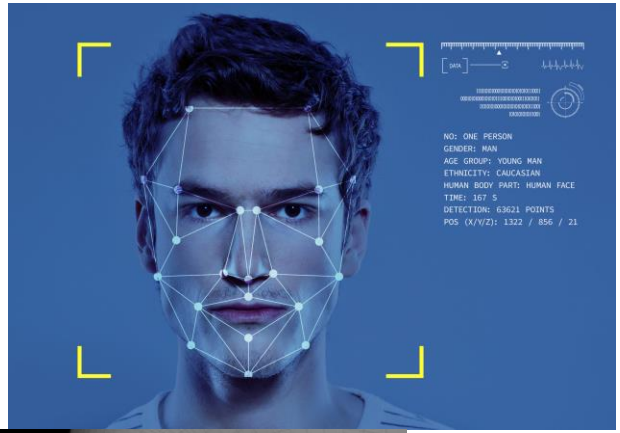
Interactions are primarily command-based

Interactions are both proactive and command-based

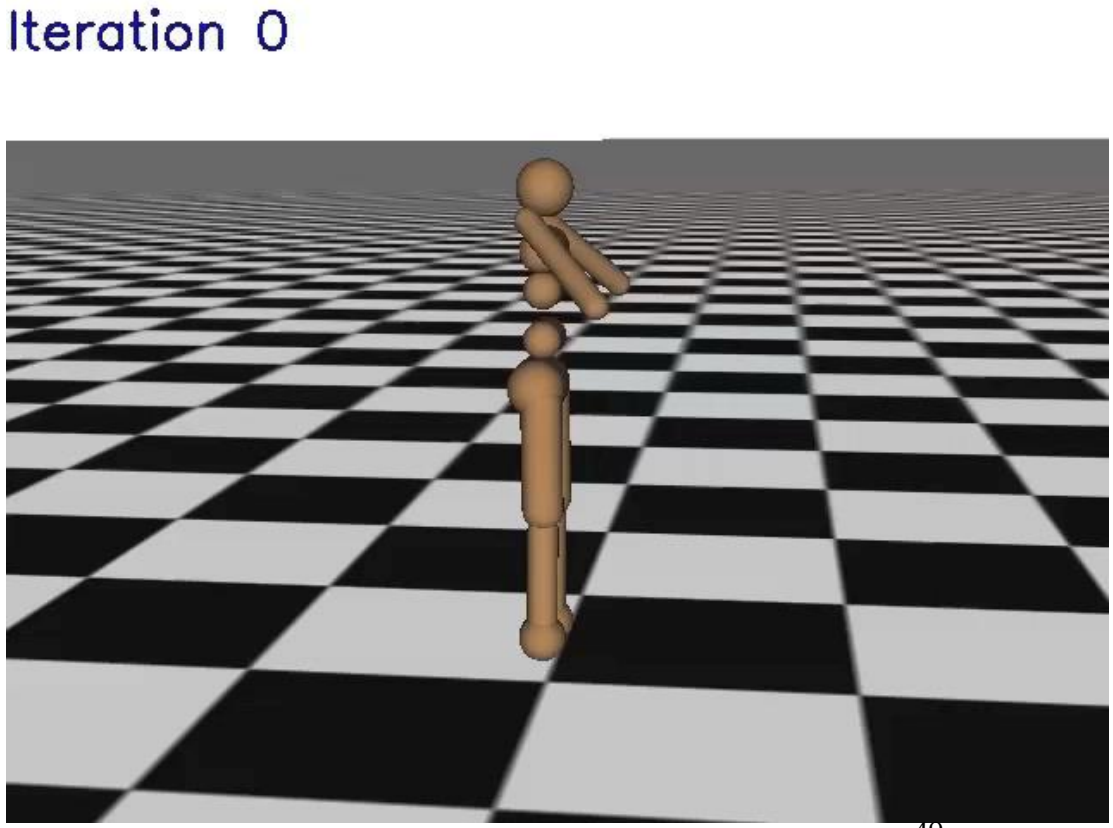


Computer Vision

Face Detection
and
Recognition



Simulated Agents



[Schulman, Moritz, Levine, Jordan, Abbeel, ICLR 2016]

ETHICS OF ARTIFICIAL INTELLIGENCE

Values

- Respect, protection and promotion of human rights and fundamental freedoms and human dignity
- Environment and ecosystem flourishing
- Ensuring diversity and inclusiveness
- Living in peaceful, just and interconnected societies

Principles

- Proportionality and Do No Harm
- Safety and security
- Fairness and non-discrimination
- Sustainability
- Right to Privacy, and Data Protection
- Human oversight and determination
- Transparency and explainability
- Responsibility and accountability
- Awareness and literacy
- Multi-stakeholder and adaptive governance and collaboration

Policy Area

POLICY AREA
01
Ethical impact assess-ment
02
Ethical governance and stewardship
03
Data policy
04
Development and international cooperation
05
Environment and ecosystems
06
Gender
07
Culture
08
Education and research
09
Communication and information
10
Economy and labour
11
Health and social wellbeing

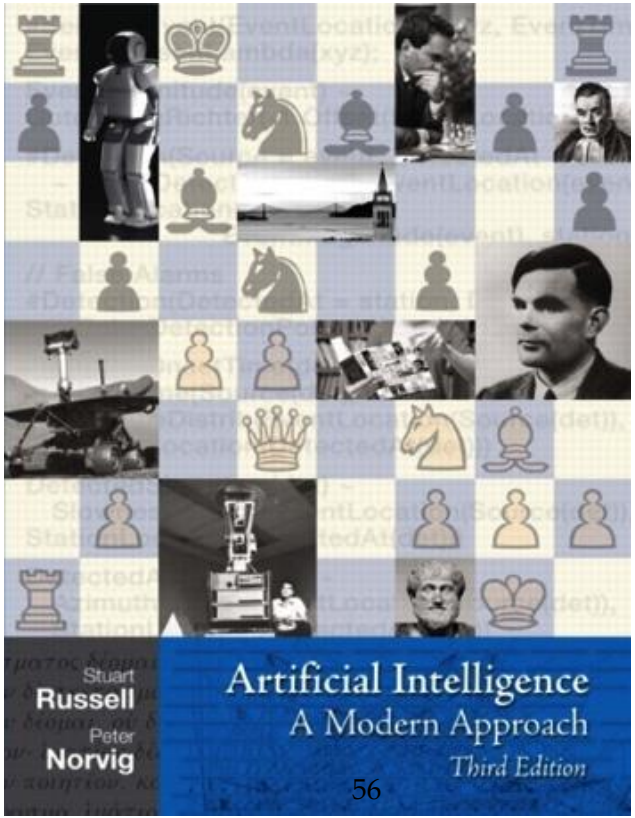
Ethical and Bias Considerations in Artificial Intelligence

Ethical principle	Health care and medical research	Medical AI
Respect for Autonomy (the principle of self-governance)	Physicians and researchers respect an individual's right to make their own decisions regarding their health care and participation in research	AI developers and users ensure that individuals have sufficient control over their interactions with AI
Beneficence (the principle of doing good)	Physicians and researchers act for the benefit of the individual and protect and defend their rights	AI developers and users are responsible for maximizing human benefits
Nonmaleficence (the principle of avoiding harm)	Physicians and researchers do not harm the individual intentionally, negligently, or unintentionally	AI developers and users are responsible for preventing harm and mitigating risks
Justice (the principle of fairness)	Physicians and researchers treat the individual fairly and equitably, regardless of factors such as race, gender, socioeconomic status, or medical condition	AI developers and users are responsible for promoting equity, regardless of factors such as race, gender, socioeconomic status, or medical condition
Accountability	Physicians and researchers take responsibility for their activities	AI developers and users are accountable for ensuring that AI is designed, implemented, and operated ethically, transparently, and reliably

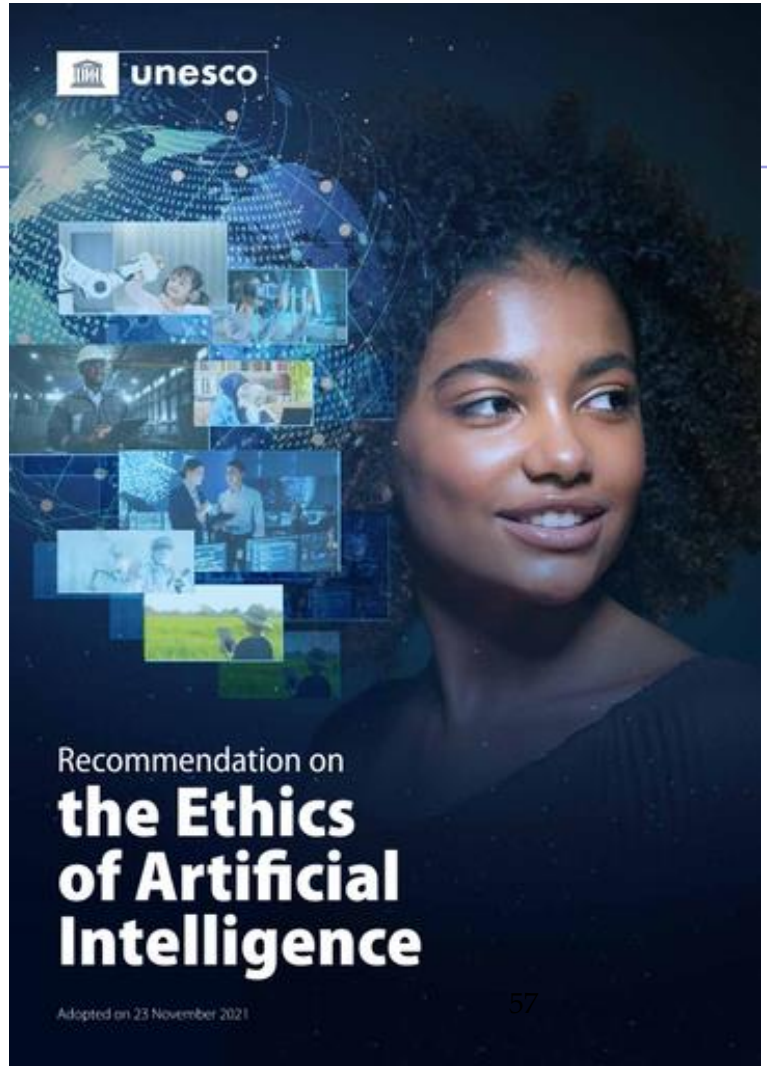
Guideline/checklist	Purpose
STARD-AI	Reporting standards for studies evaluating diagnostic AI algorithms to ensure transparency.
TRIPOD-AI	Reporting guidelines for studies developing and validating AI-driven diagnostic/prognostic models.
PROBAST-AI	Reporting guidelines for assessing the risk of bias and applicability of diagnostic and prognostic AI models.
CLAIM/MI-CLAIM	Checklist for developing and validating AI models in medical imaging (CLAIM) and clinical applications (MI-CLAIM).
MINIMAR	Minimum reporting standard for AI studies in medicine, focusing on essential reproducibility elements.
PRIME	Guidelines for developing AI in medical imaging to ensure robustness and reliability.
DECIDE-AI	Development and validation of AI-driven decision support systems in clinical practice.
SPIRIT-AI	Guidelines for writing protocols for clinical trials involving AI to ensure consistency.
CONSORT-AI	Reporting standards for AI clinical trials to ensure transparency and completeness.
QUADAS-AI	To evaluate the quality of studies assessing diagnostic accuracy of AI in healthcare. This tool helps to assess the methodological quality and risk of bias in AI-based diagnostic studies.

Textbook

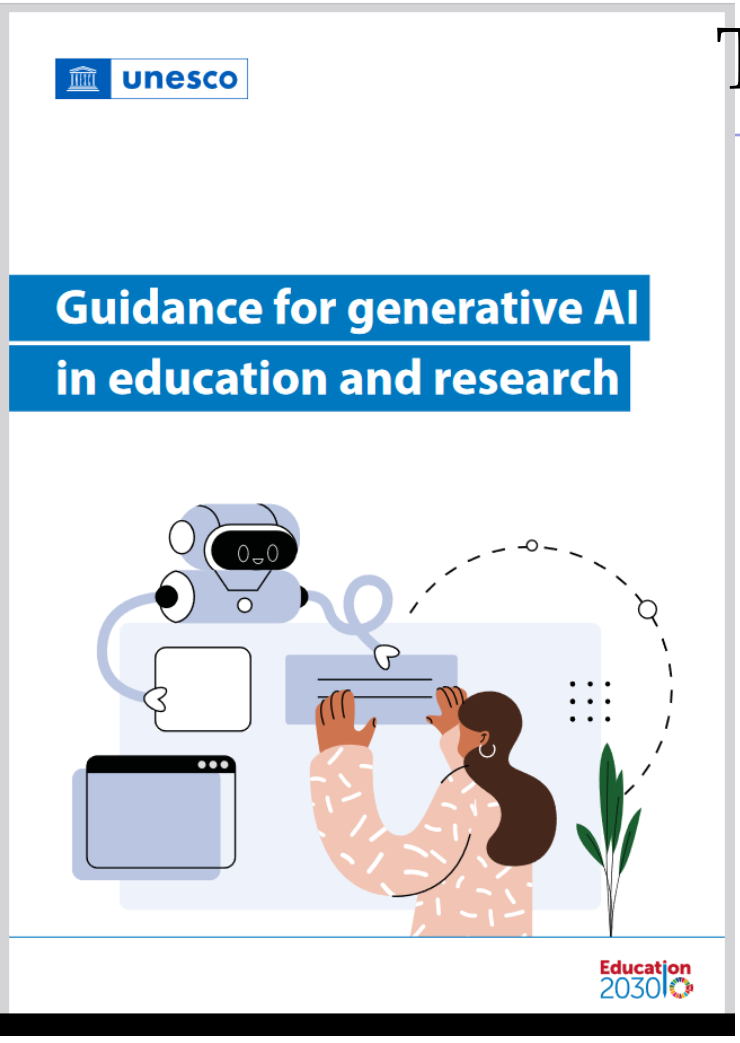
- Russell & Norvig, AI: A Modern Approach



- Recommendation on the Ethics of Artificial Intelligence



Textbook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Guidance for generative AI
in education and research
Education
2030

Artificial Intelligence
in Science
CHALLENGES, OPPORTUNITIES AND THE FUTURE
OF RESEARCH
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