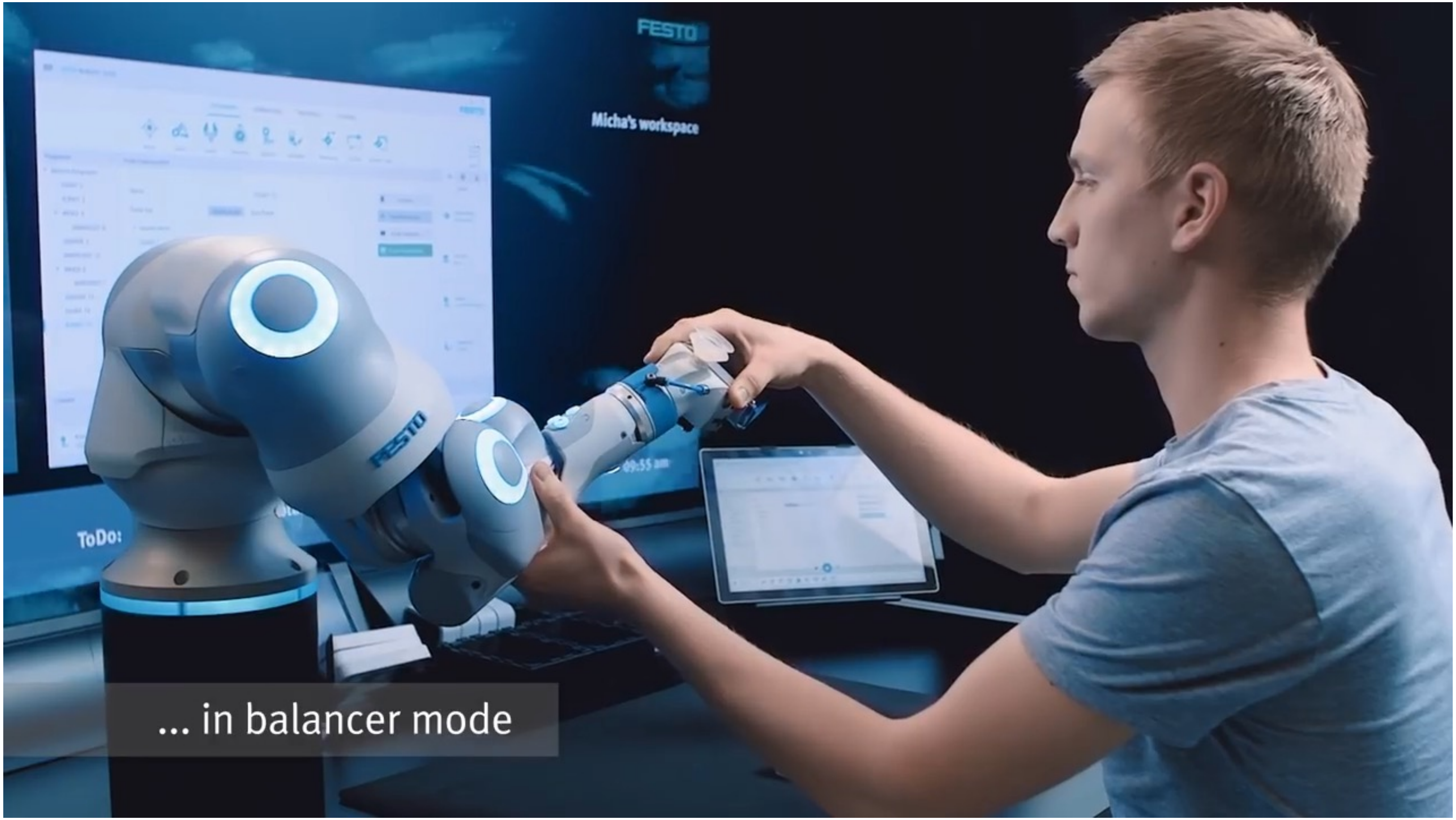
# Week 01 | Lecture 02
# The Rise of Robots & AI

Wan Fang

Southern University of Science and Technology

# Robot of the Day




Cobot by Festo

# The Rise of Robots & AI

- Differences between Robots and AI
- The Rise of Robotics & AI – Part I before 1990
- The Rise of Robotics & AI – Part II after 1990
- Robotics & AI in Applications

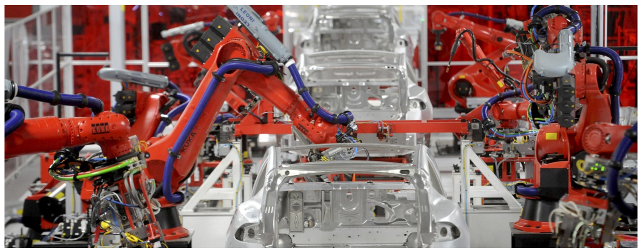
# Robots vs. AI

Robots are programmable machines that are usually able to carry out a series of actions autonomously, or semi-autonomously

“sense, plan, and act”

## Most Robots …

- Take a phyical form
- Effect changes through physical interactions

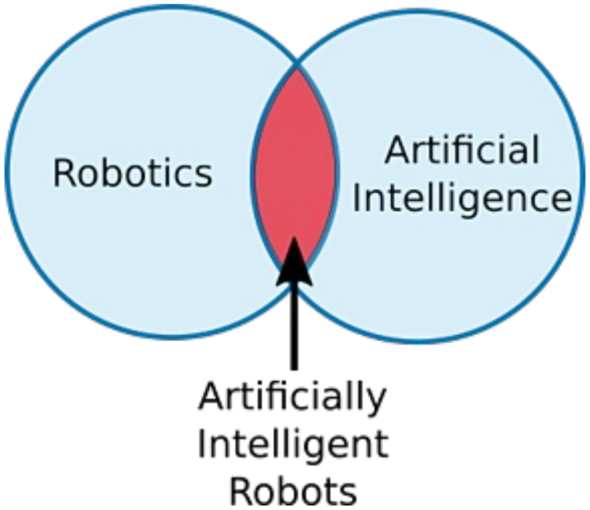


Artificial intelligence (AI) is a branch of computer science. It involves developing computer programs to complete tasks that would otherwise require human intelligence.

Tackle learning, perception, problem-solving, language-understanding and/or logical reasoning.

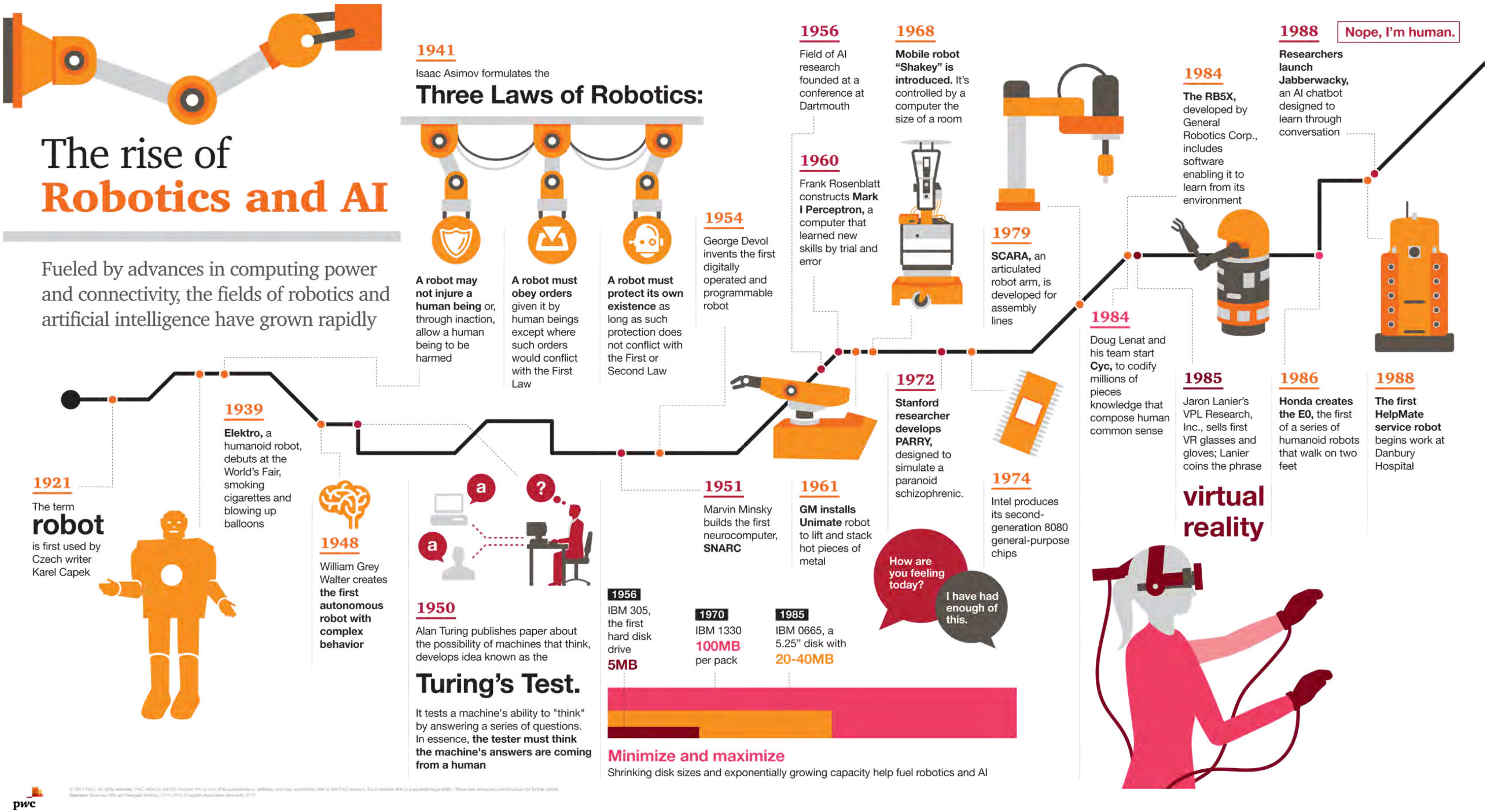
## Most AI …

- Presented as programs
- Effect changes through data and decisions




AlphaGo by Google & Mega Factory by Tesla

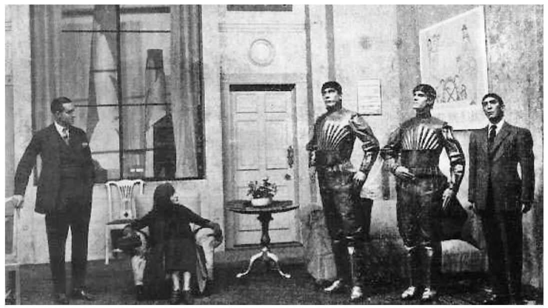
# The Rise of Robotics & AI



# R.U.R

- R.U.R. is a 1920 science-fiction play by the Czech writer Karel Čapek.
  - "R.U.R." stands for Rossumovi Univerzální Roboti (**Rossum's Universal Robots**, a phrase that has been used as a subtitle in English versions).
  - The play had its world premiere on 2 January 1921 in Hradec Králové; it introduced the word "robot" to the English language and to science fiction as a whole. R.U.R. soon became influential after its publication.
- The Universal Robot Company

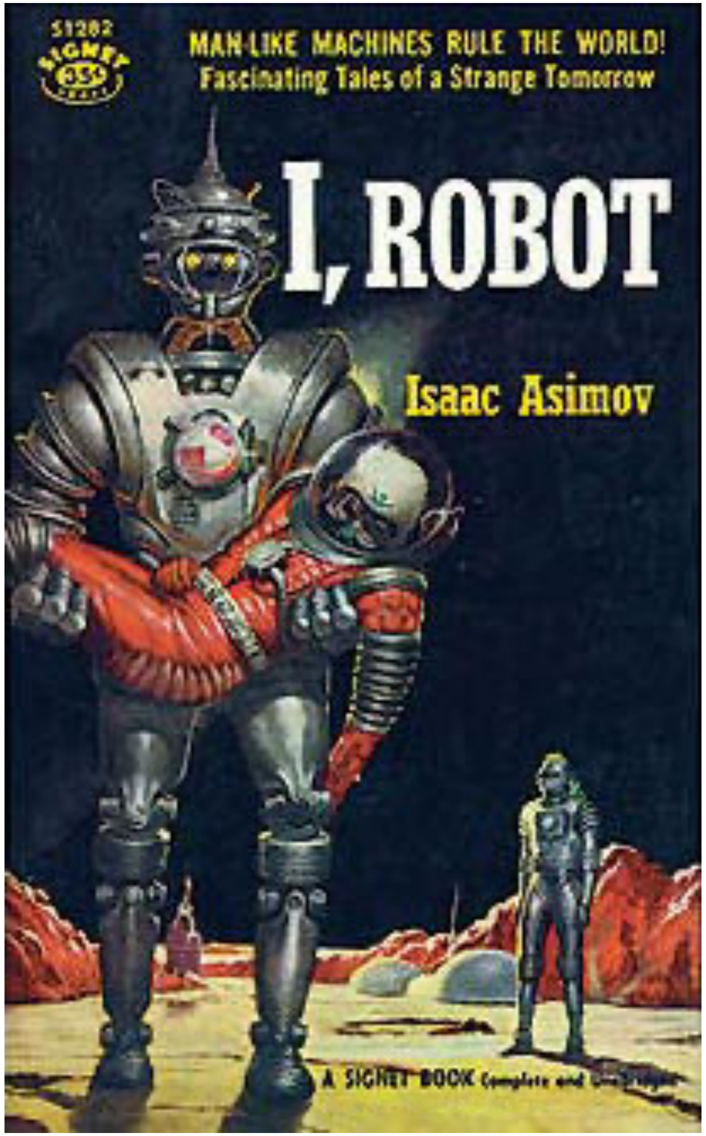




Rossums Universal Robots by Karel Capek & https://patch.com/california/walnutcreek/ev--rossums-universal-robots & https://en.wikipedia.org/wiki/R.U.R.

# The Three Laws of Robotics

- The Three Laws of Robotics (Asimov's Laws)
  - A set of rules devised by science fiction author Isaac Asimov.
  - The rules were introduced in his 1942 short story "Runaround" (included in the 1950 collection I, Robot), although they had been foreshadowed in some earlier stories.
- The Three Laws, quoted from the "Handbook of Robotics, 56th Edition, 2058 A.D.", are:
  - **1st Law**: A robot may not injure a human being or, through inaction, allow a human being to come to harm.
  - **2nd Law**: A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
  - **3rd Law**: A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.
  - **0th** Law: A robot may not harm humanity, or, by inaction, allow humanity to come to harm.




https://en.wikipedia.org/wiki/Three_Laws_of_Robotics

# 1941: The “Laws” of Robotics



**1st Law**: A robot may not injure a human being or, through inaction, allow a human being to come to harm.
**2nd Law**: A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
**3rd Law**: A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.
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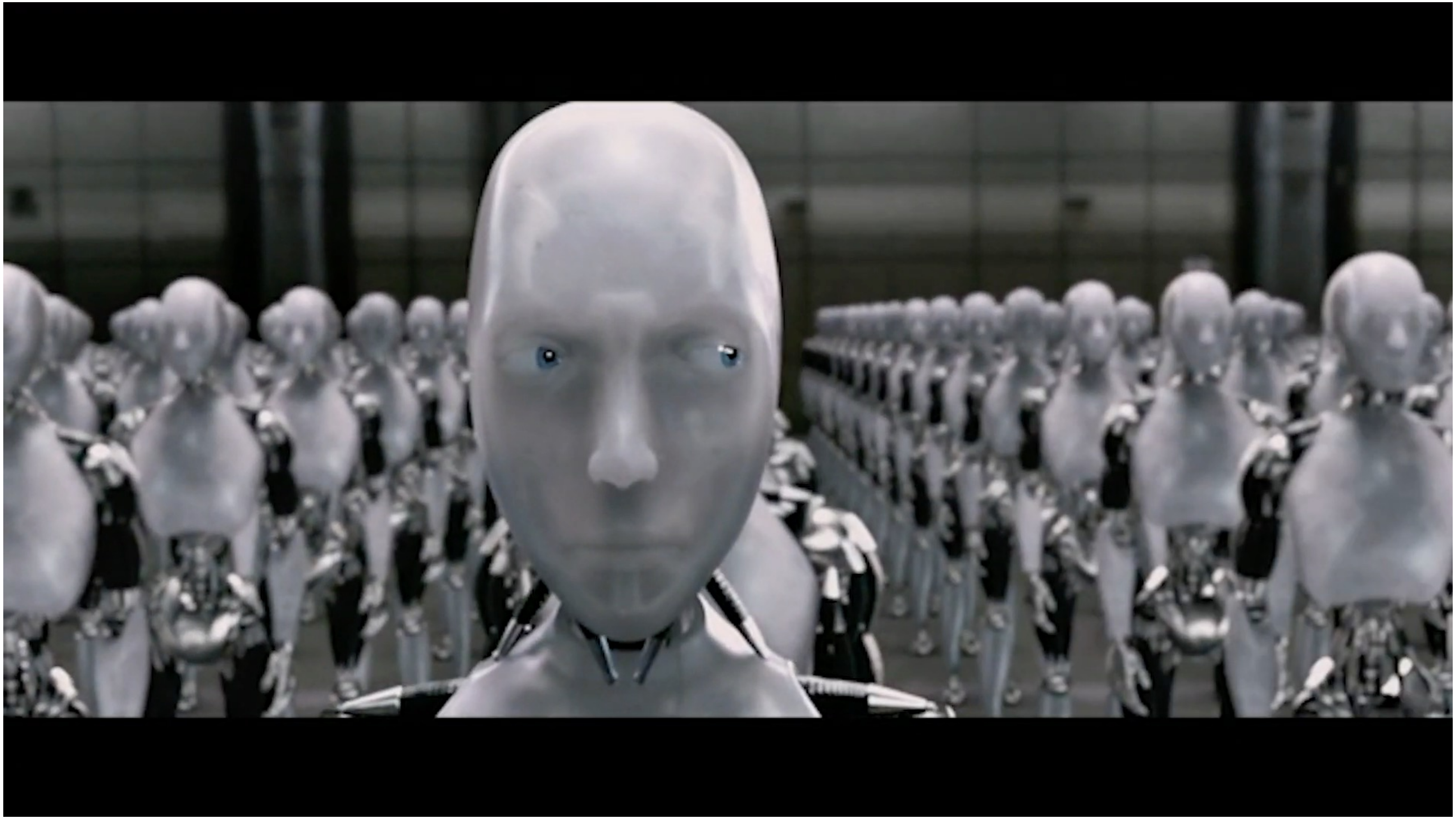
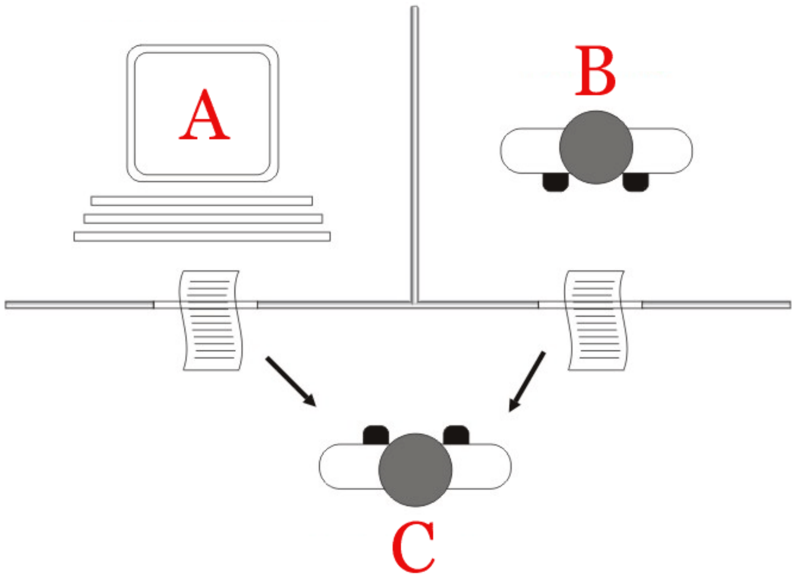


I, Robot Movie Trailer: https://www.youtube.com/watch?v=7Dlo-VB0-HI

# The Turing Test

- Originally called *the imitation game* by Alan Turing in 1950, is a test of a machine's ability to exhibit intelligent behaviour equivalent to, or indistinguishable from, that of a human.
  - Turing proposed that a human evaluator would judge natural language conversations between a human and a machine designed to generate human-like responses.
  - The evaluator would be aware that one of the two partners in conversation was a machine, and all participants would be separated from one another. The conversation would be limited to a text-only channel, such as a computer keyboard and screen, so the result would not depend on the machine's ability to render words as speech.




Vol. lix. No. 236.] [October, 1950

MIND
A QUARTERLY REVIEW
OF
PSYCHOLOGY AND PHILOSOPHY

## I.—COMPUTING MACHINERY AND INTELLIGENCE

By A. M. Turing

1. *The Imitation Game.*

I propose to consider the question, 'Can machines think ?' This should begin with definitions of the meaning of the terms 'machine' and 'think'. The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words 'machine' and 'think' are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning and the answer to the question, 'Can machines think ?' is to be sought in a statistical survey such as a Gallup poll. But this is absurd. Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.

The new form of the problem can be described in terms of a game which we call the 'imitation game'. It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman. He knows them by labels X and Y, and at the end of the game he says either 'X is A and Y is B' or 'X is B and Y is A'. The interrogator is allowed to put questions to A and B thus :

C : Will X please tell me the length of his or her hair ?

https://en.wikipedia.org/wiki/Turing_test

# Unimate (Universal Automation)

- **The Unimate was the first industrial robot ever built.** It was a hydraulic manipulator arm that could perform repetitive tasks. It was used by car makers to automate metalworking and welding processes.

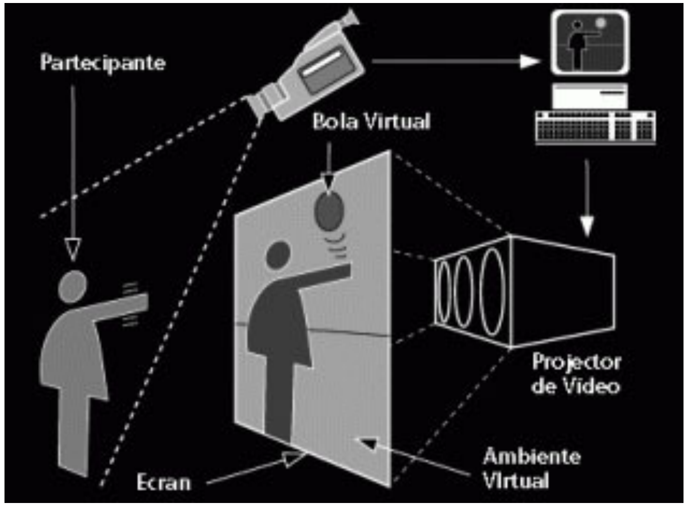


https://robots.ieee.org/robots/unimate/

# Virtual Reality

- Jaron Lanier and Thomas Zimmerman founded VPL Research, Inc. **This company is known as the first company to sell VR goggles and gloves.** (founded in 1984) They developed a range of VR equipment, such as, the DataGlove, EyePhone HMD and the Audio Sphere.

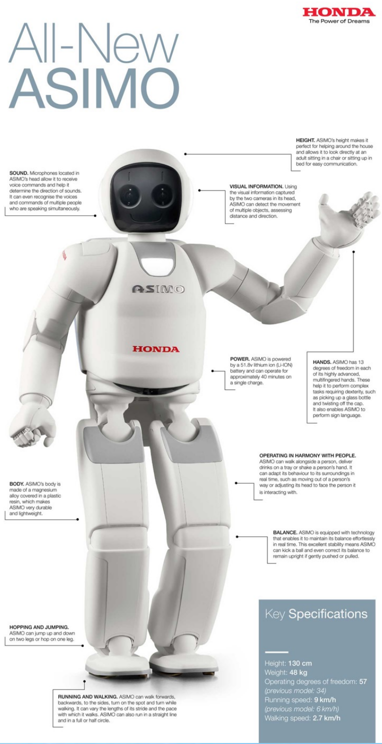
Krueger's VIDEOPLACE, the first interactive VR platform, was displayed at the Milwaukee Art Center in 1975.

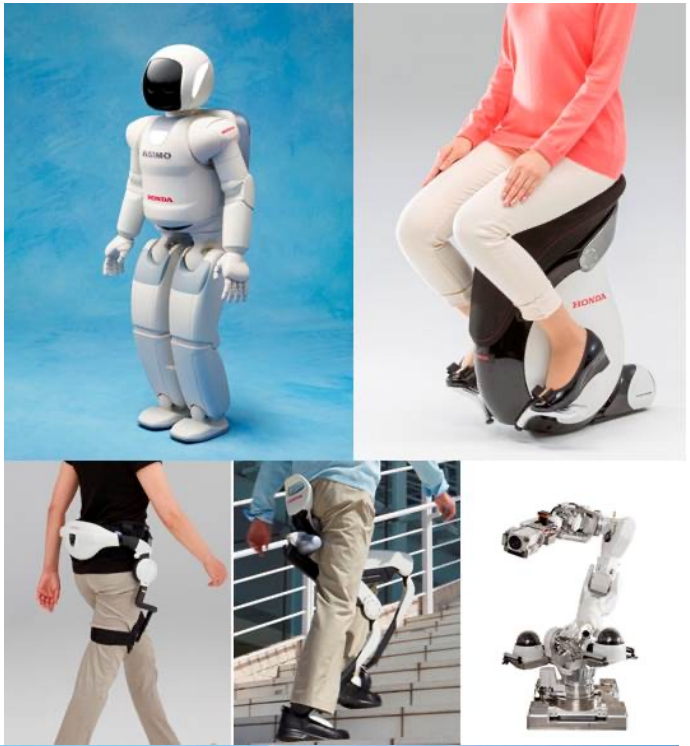



# HONDA's ASIMO

**A**dvanced **S**tep in **I**nnovative **MO**bility

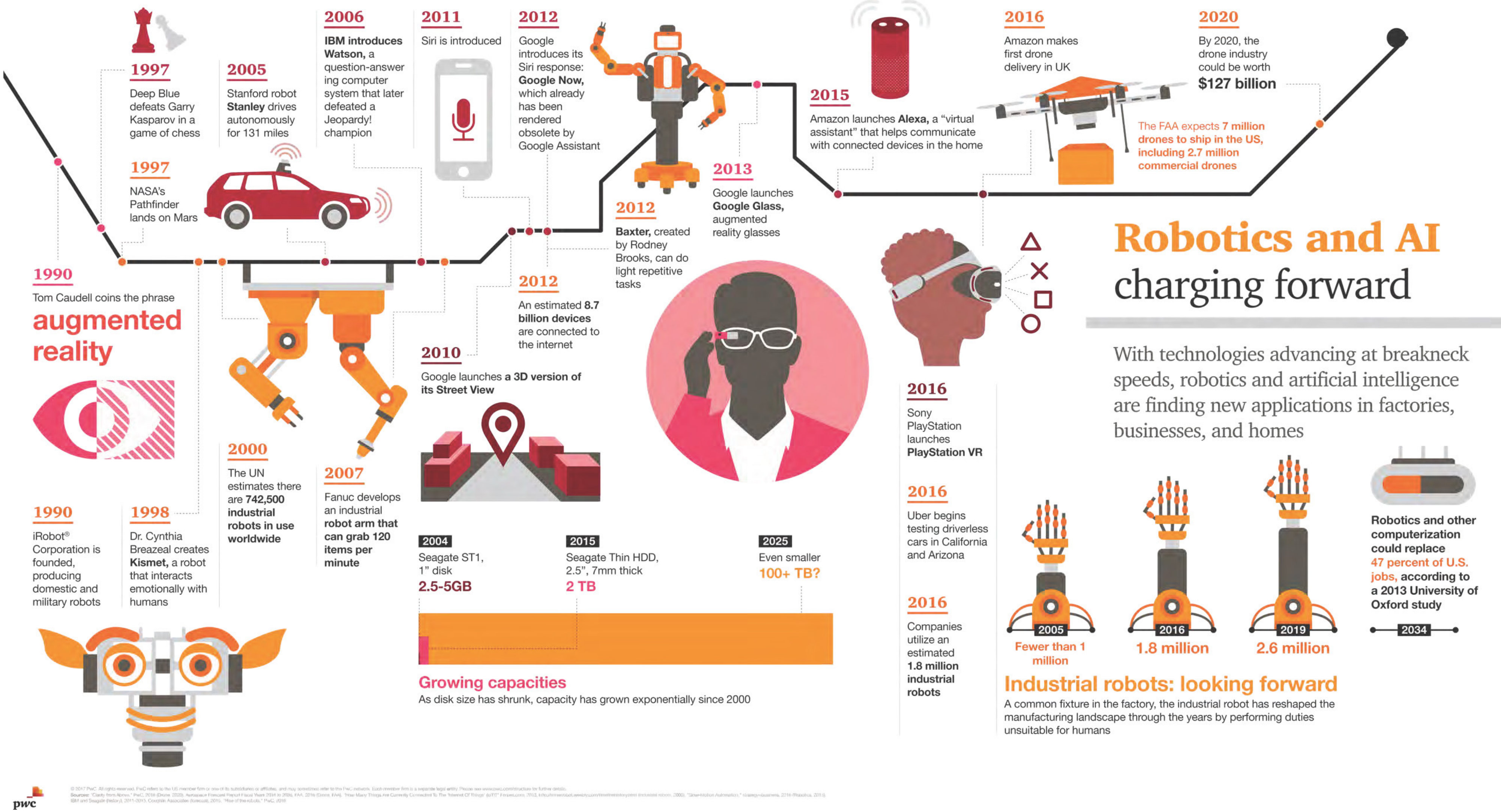
- Humanoid Design for Advanced Robotics usually takes an iterative process that requires a great amount of **time, money, technology** and **public acceptance**.




Honda Robotics

# The Rise of Robotics & AI



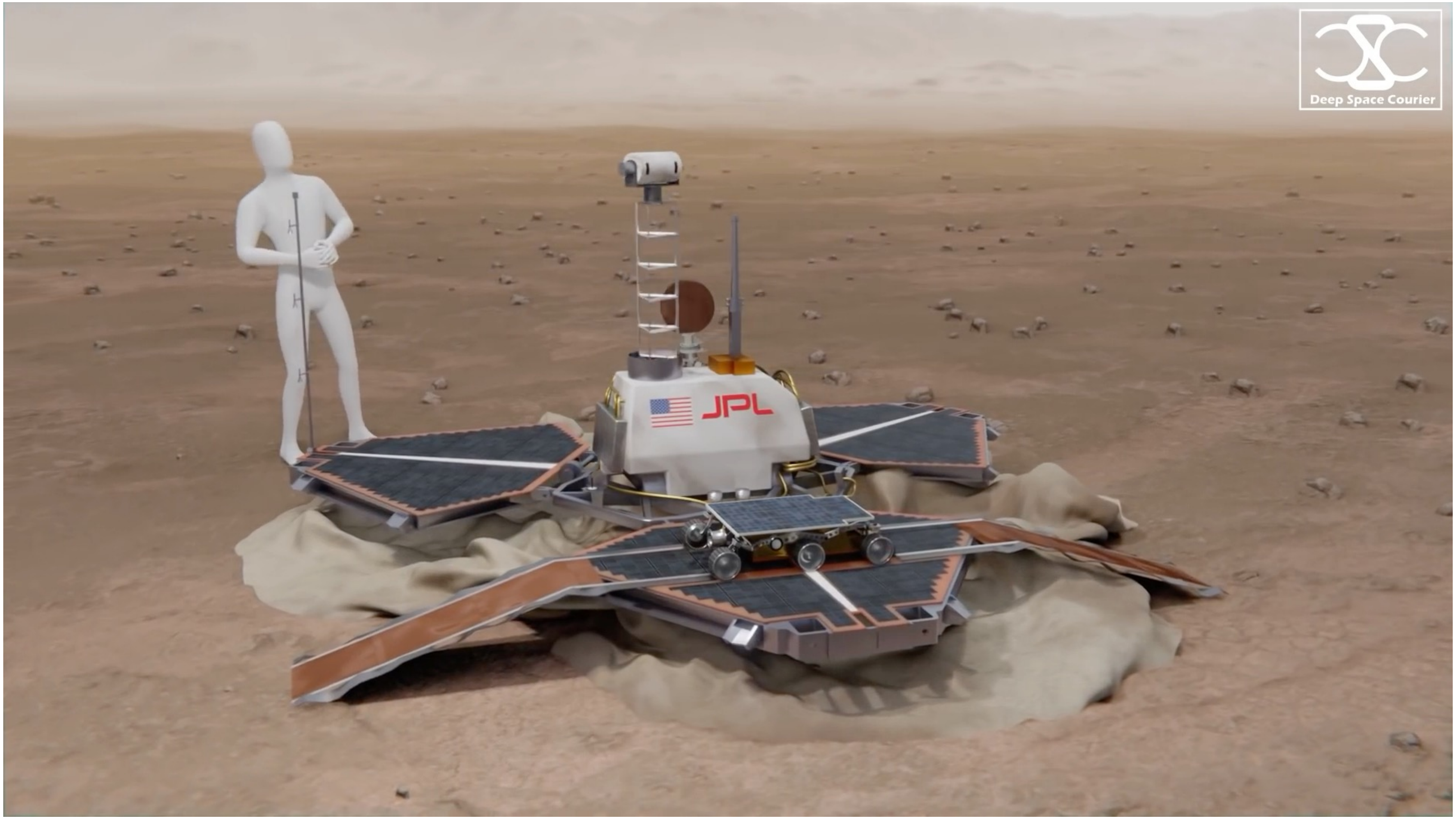
# From Research to Space, then Military to Domestics


https://www.youtube.com/watch?v=A5H9mkr_NYE

# Human vs. Agent (Computer? Robot?)

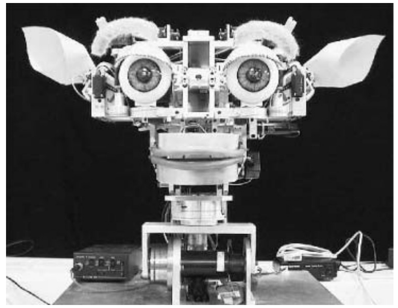

https://media.pri.org/s3fs-public/styles/story_main/public/story/images/DeepBlue.png?itok=N01yMnCK

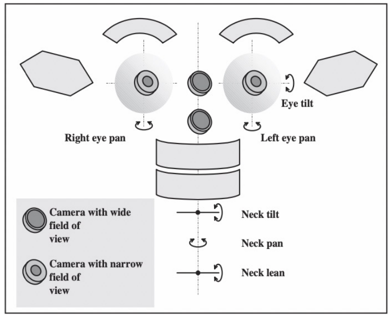
# The 1st Rover Running on Mars

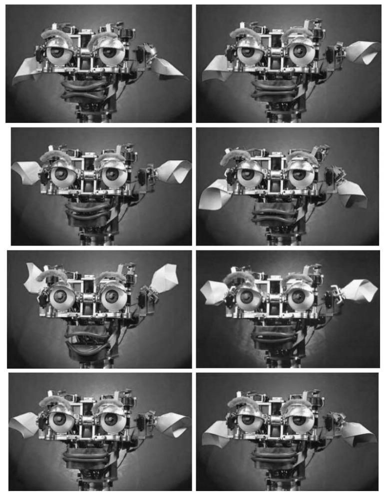



https://www.youtube.com/watch?v=ER6EO4B7V68

# Kismet the Social Robot

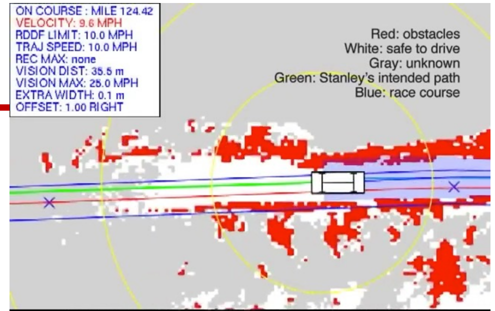




https://www.youtube.com/watch?v=Kw-gOmJwzuc

# Stanley



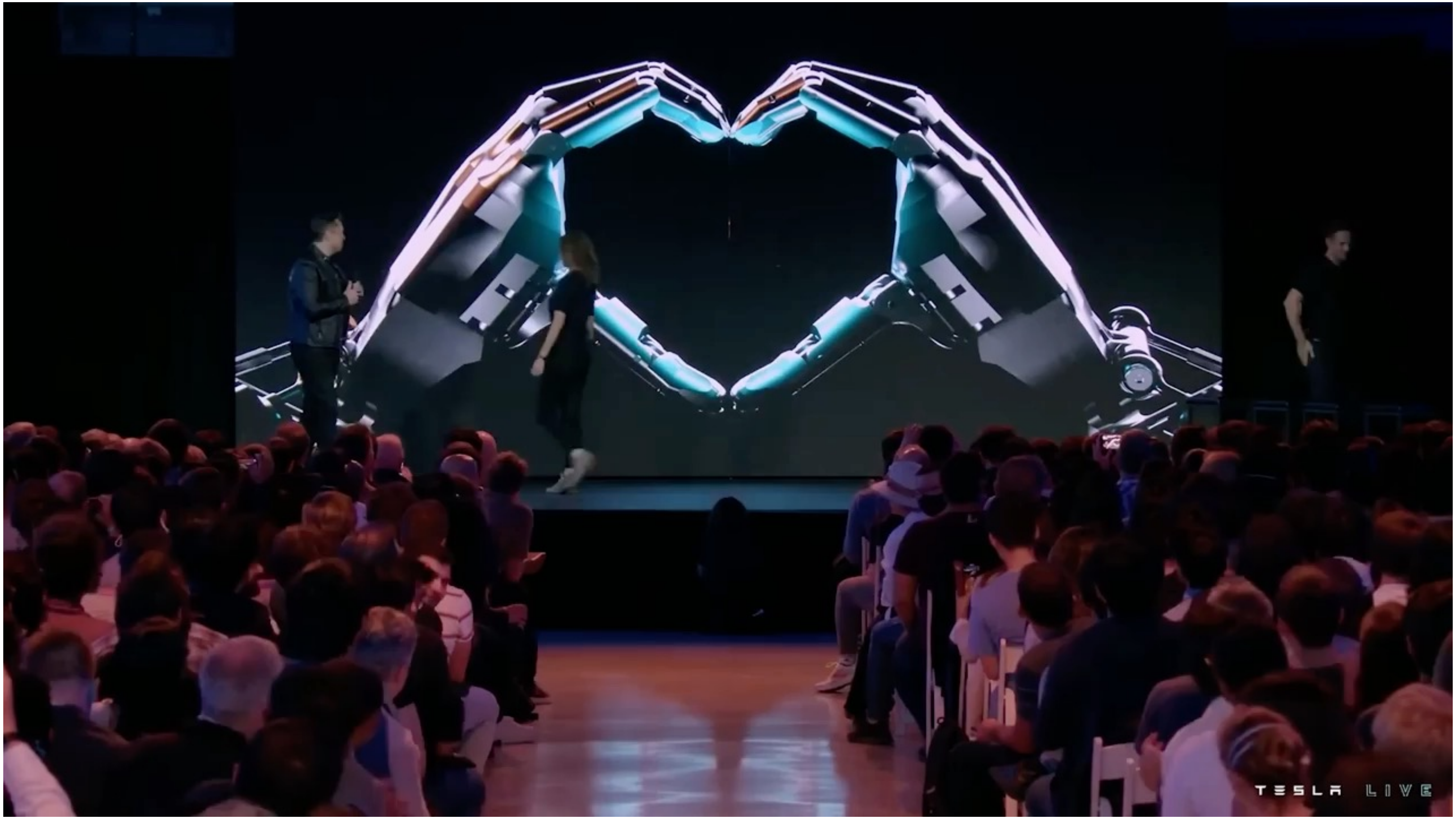

Course overview generated from Stanley's laser sensor data as the robot navigated Beer Bottle Pass


https://www.youtube.com/watch?v=2gQ3P5BpLjQ

# Baxter

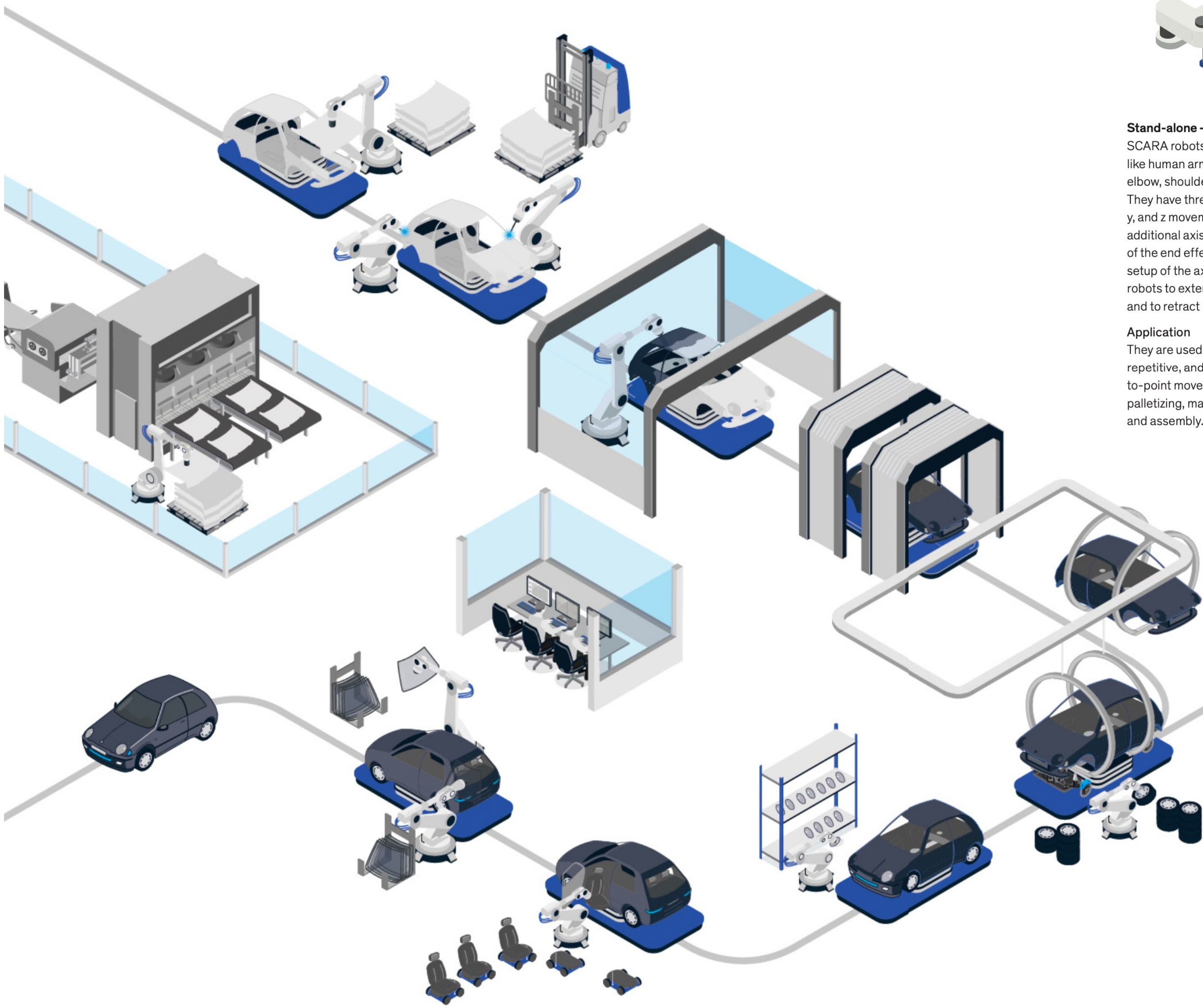

https://www.youtube.com/watch?v=NoKONzD-XsQ

# Tesla Optimus vs. Boston Dynamics Atlas



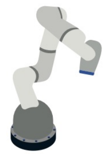

https://www.youtube.com/watch?v=0QuXgUMcGLI

# Example of Automotive Production Line



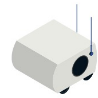
**Stand-alone – SCARA**
SCARA robots are modelled like human arms with an elbow, shoulder, and wrist. They have three axes for x, y, and z movement and an additional axis for movement of the end effector. The setup of the axes allows the robots to extend their arm and to retract it by folding up.

**Application**
They are used for fast, repetitive, and precise point-to-point movements, such as palletizing, machine loading, and assembly.



**Collaborative**
Collaborative robots directly interact with human workers without safety fences and are equipped with machine learning capabilities for easier programming.

**Application**
They are used to support human workers' strength and precision for certain movements, in processes that require flexibility and reprogramming, or where space is limited.



**Autonomous guided vehicles (AGVs) and autonomous mobile robots (AMRs)[5]**
AGVs and AMRs are not fixedly installed but mobile. Navigation is either onboard (e.g., camera or laser based) for most advanced types or external (e.g., path based using magnetic tape, wire, or rails on the ground).

**Application**
Mobile robots are used for logistics and delivery as well as for moving pieces, such as boxes, pallets, or tools, in industrial settings between machinery, transfer points, or storage areas.

**Exoskeletons**
Exoskeletons are connected to the human body for support during heavy-duty or ergonomically challenging process steps. They are designed to boost the strength of human workers, e.g., increasing humans' capacity to carry heavy weight.

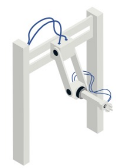
**Application**
They can be used in industrial applications to support worker movements (e.g., lifting in warehouses).

**Stand-alone – articulated**
Articulated robots have rotary joints and between three and six degrees of freedom enabling high flexibility (robot can bend back and forth).

**Application**
Articulated robots are used for a range of applications, e.g., assembly, painting, arc or spot welding, palletizing, and material handling.

**Stand-alone – delta**
Delta (also: parallel) robots have three arms that are connected to a base platform via universal joints. Their arms are arranged as parallelograms to restrict the movement of the end platform. Actuators are located at the base platform, so that passive arms can be lightweight and move with great speed.

**Application**
Applications that require great precision and speed: common applications include packaging, high-precision assembly, and material handling.



**Stand-alone –gantry/ linear/Cartesian**
Cartesian robots consist of three axes of control that are situated at 90 degree angles of each other. The axes do not rotate but move in straight lines, which simplifies robot control – linear robots are comparably simple.

**Application**
With no need for pedestals, Cartesian robots are useful where space is limited, as they can be mounted overhead.

# A Look at Robots Ready for Work

***Five ways robots are going mainstream***

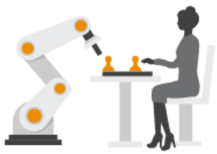
They're not restricted to structured environments.

They can now handle dynamic, less predictable settings. In hospitals, robots can safely roam halls and deliver medications. In hotels, they can deliver towels, toiletries, and minibar items to guest rooms.

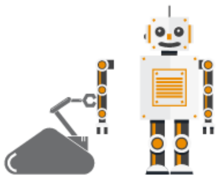
They can work with humans.

Thanks to sensors and smart technology, new-generation robots are much safer around humans.

They can learn.



The new robots can "learn" skills through trial and error, mimicking the way humans learn new tasks.



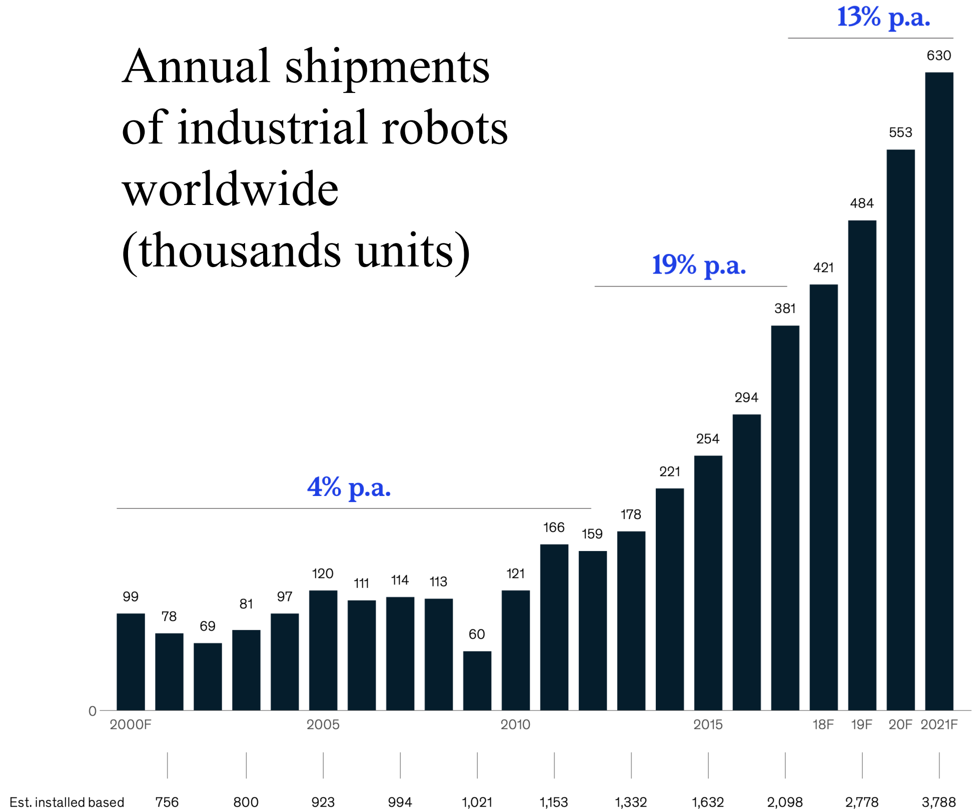
They are no longer single-task machines.

Robots are being designed with modularity in mind, beginning with a platform upon which a customized solution can be built.

They're moving beyond the factory floor.


Robots are engaged in functions across the enterprise, including positions where they interact directly with customers and employees.

Annual shipments of industrial robots worldwide (thousands units)

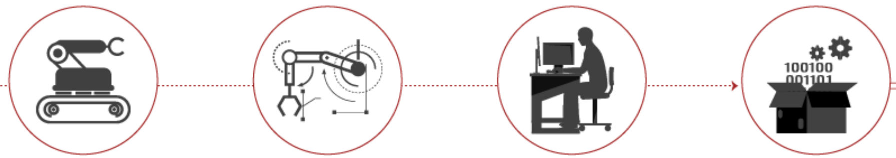


# A Look at Robots Ready for Work

## *Benefits of robotics*

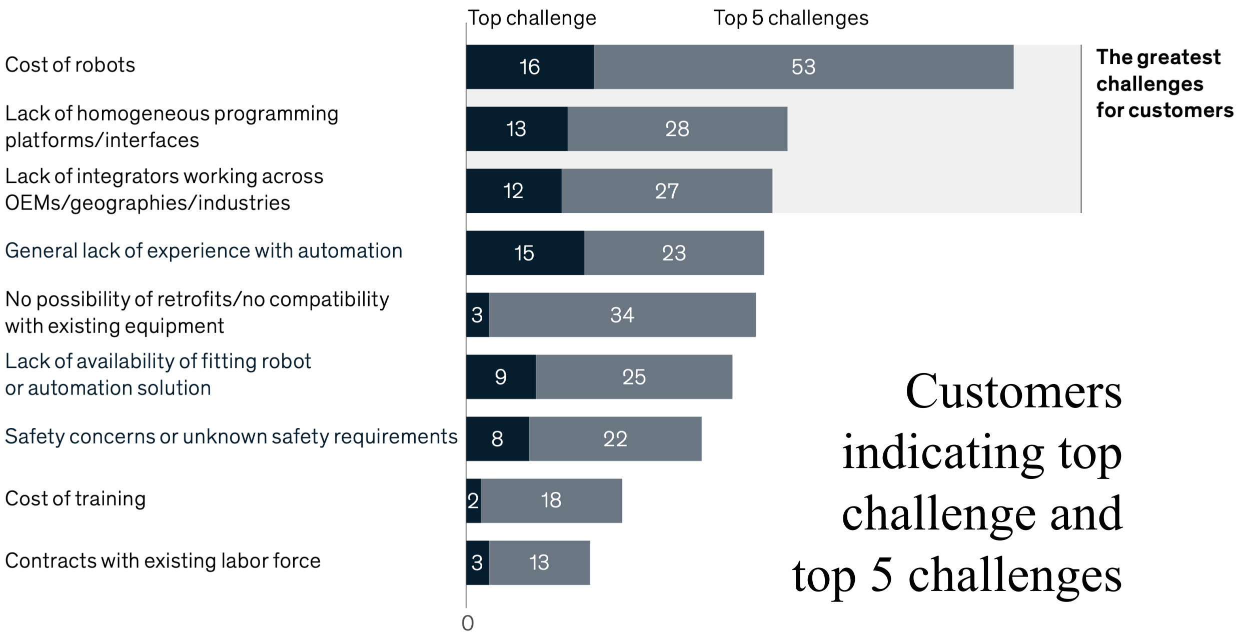
Robots are not just for manufacturing anymore. No matter the industry, they can:

- Automate business operations
- Boost efficiency, quality, and repeatability
- Free up humans for higher-value tasks
- Replace or augment humans in jobs where there are labor shortages




## *Potential challenges*

| | |
|---|---|
| Lack of expertise and support | Your company may not have the knowledge or the resources to buy and maintain robots. |
| Fallout from job losses | Robots could displace workers, which could lower morale and create conflict with labor unions. |
| Regulatory compliance | Safety rules and monitoring and reporting requirements can create burdens, particularly for smaller companies. |
| Costs | Prices for robots are dropping, but the cost of engineering the system, installing it, and managing the change can be prohibitive. |




Customers indicating top challenge and top 5 challenges

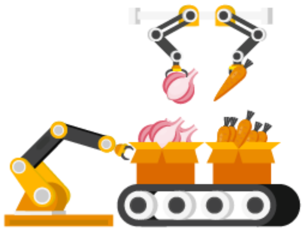
# A Look at Robots Ready for Work

Robots once were viewed as expensive, limited in their abilities, and applicable only in manufacturing. Now, THEY are more capable, easier to use, and less COSTLY, making the technology more desirable and accessible. But competing operating systems, form factors, and interfaces make for a fragmented robotics marketplace. We believe widespread adoption will accelerate when dominant vendors and platforms begin to emerge.

## *Potential new applications*

### *Collaboration*

Robots can replace or work as "cobots," in tandem with humans.



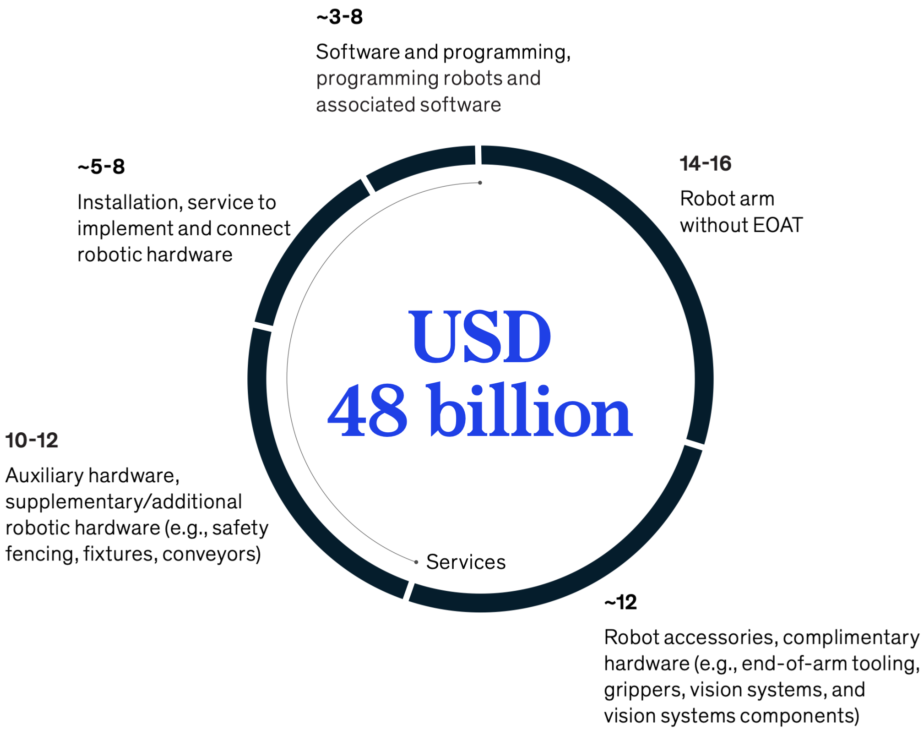
### *Handling more complex tasks*

Robots can be instrumental in warehousing and fulfillment by fetching, monitoring inventory, moving pallets, picking, packing, screening, and inspecting. They can also greet, direct, and assist customers.

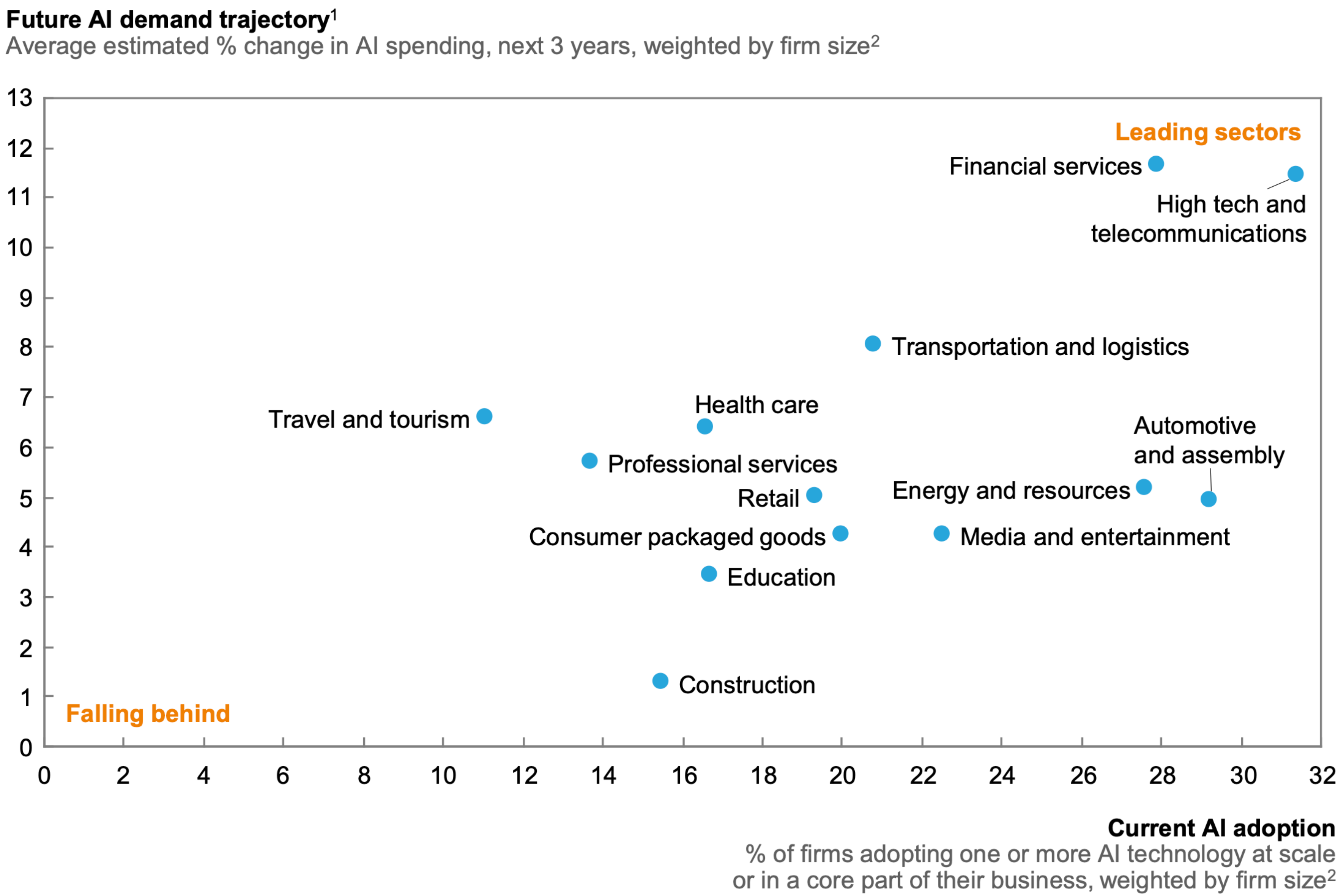
### *Mitigating labor shortages*

Robots can be used to automate tasks too difficult and expensive for human manual labor. For example, robots won't just plant and harvest crops; they'll also monitor their health, size, and maturity, and target-spray fertilizer, herbicides, and fungicides where most needed.

Source: PwC, 2017



# Sectors leading in AI adoption today also intend to grow their investment the most

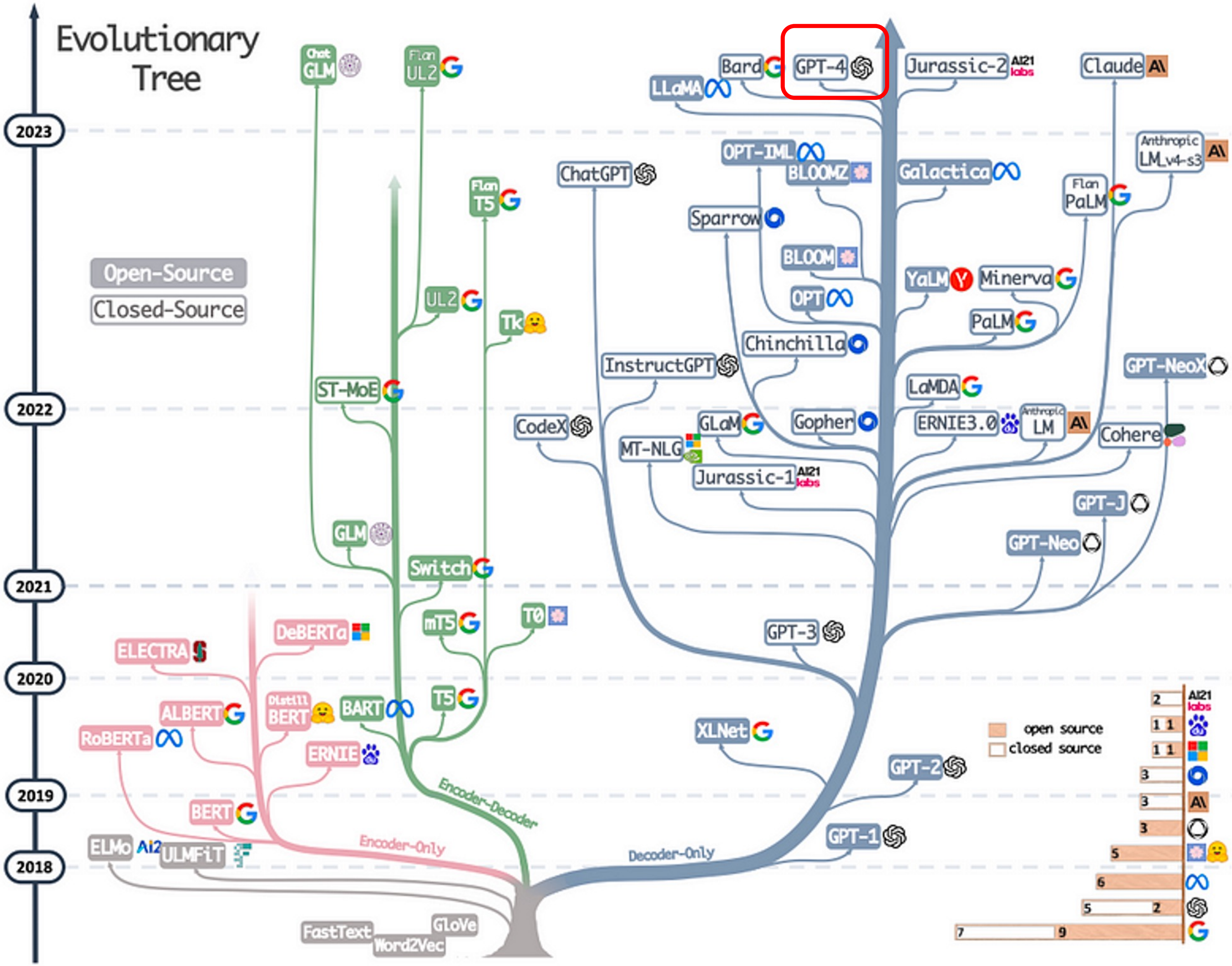


# To maximize value capture, leading businesses draw on a range of automation technologies and application techniques.

| Technologies | + | Techniques | = | Optimal value |
|---|---|---|---|---|
| Robotic process automation | | Design thinking | |  |
| Smart workflows | | Process clean-sheeting | | |
| Optical character recognition (OCR) | | Role-level assessment | | |
| Machine learning | | Minimum viable product | | |
| Natural-language technologies | | | | |
| Cognitive agents | | | | |

# 2023: Generative AI's breakout year

- 也被业内人士称为"机器人觉醒之年"。
- ChatGPT 等生成式AI 与人形机器人行业结合，开启了具身智能（Embodied Intelligence）的时代。


Evolutionary Tree
2023
2022
2021
2020
2019
2018
Open-Source
Closed-Source
Chat GLM
Flan UL2
Bard
GPT-4
Jurassic-2
Claude
LLaMA
OPT-IML
BLOOMZ
Galactica
Anthropic LM v4-s3
ChatGPT
Flan T5
Sparrow
Flan PaLM
BLOOM
YaLM
Minerva
UL2
OPT
Tk
PaLM
Chinchilla
InstructGPT
GPT-NeoX
ST-MoE
LaMDA
CodeX
GLaM
Gopher
ERNIE3.0
Anthropic LM
Cohere
MT-NLG
Jurassic-1
GPT-J
GLM
GPT-Neo
Switch
mT5
T0
GPT-3
DeBERTa
ELECTRA
T5
Distill BERT
BART
ALBERT
XLNet
RoBERTa
ERNIE
GPT-2
BERT
Encoder-Decoder
ELMo
ULMFiT
Encoder-Only
Decoder-Only
GPT-1
FastText
GloVe
Word2Vec
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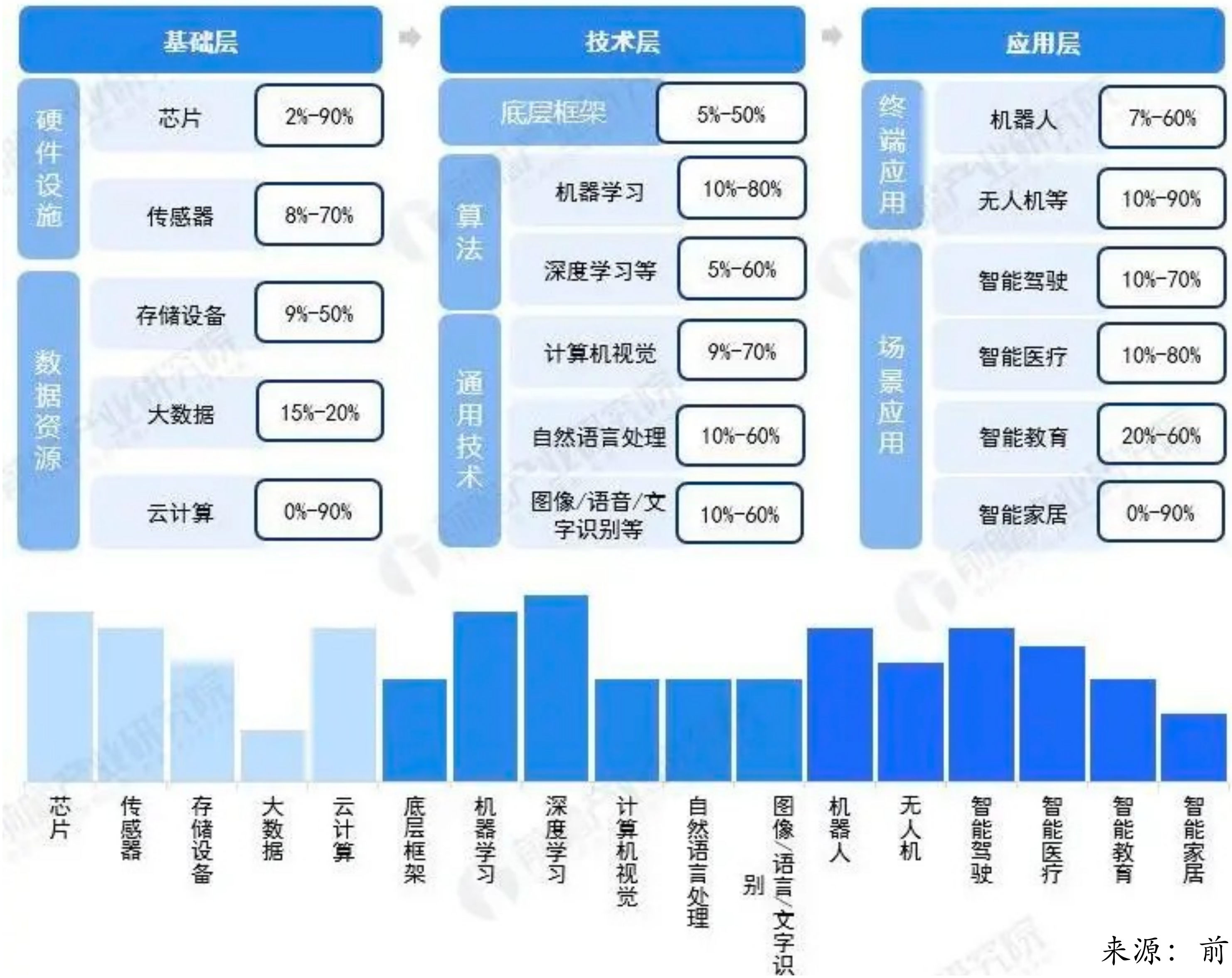
# 中国人工智能产业链




来源：前瞻产业研究院

# 深圳人工智能产业链


资料来源：HIIC智能经济研究所

# 深圳

- 从规模上来看，我国已成为全球最大的机器人消费国，2022 年营收超过 1700 亿元，工业机器人装机量全球第一，制造业机器人密度达到每万名工人 392 台。
- 深圳市是国内机器人产业链最为完整的城市之一，南山区和宝安区是深圳机器人企业数量最多的两个区，
- 人形机器人是一个载体，当大模型和人形机器人相结合时，机器人可以帮助 AI 大模型感知物理世界，可以操作环境上下文；机器人利用多模态感知控制自己的身体，完成复杂的任务

# 深圳市智能机器人应用示范典型案例

- http://gxj.sz.gov.cn/xxgk/xxgkml/qt/tzgg/content/post_10633040.html

# Thank you~

Wan Fang
Southern University of Science and Technology