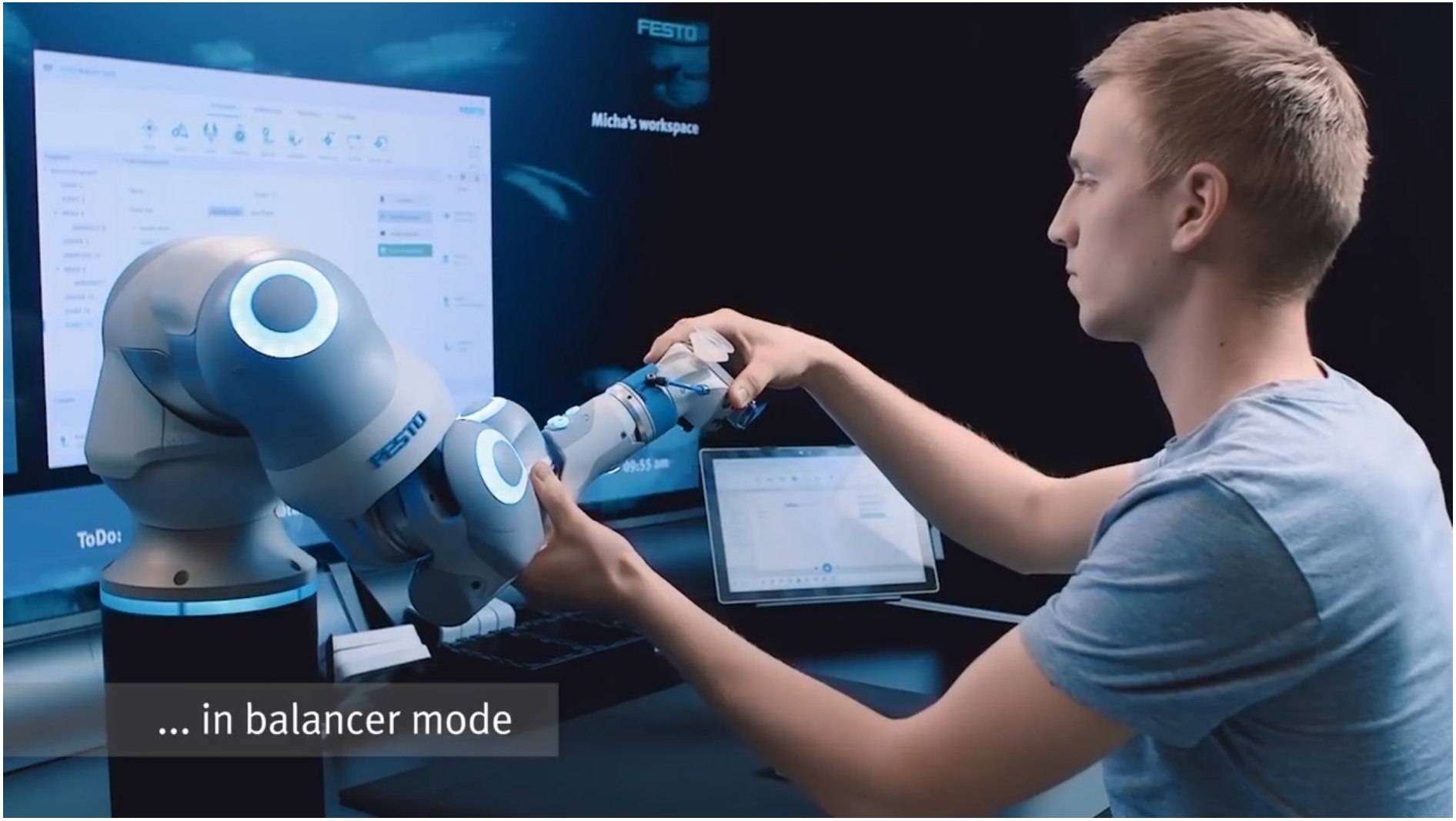
Week 02 | Lecture 03
The Rise of Robots & AI

Wan Fang
Southern University of Science and Technology

Robot of the Day



Cobot by Festo

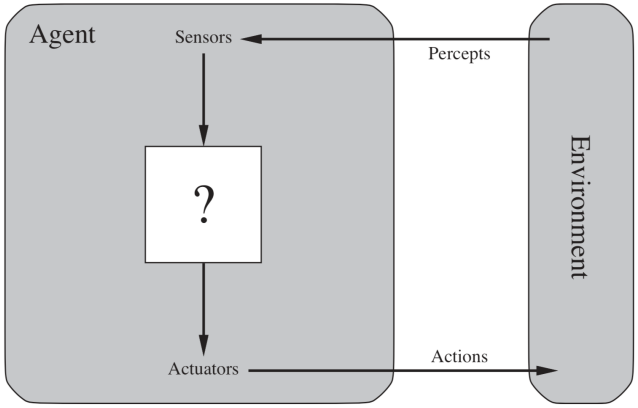
The Rise of Robots & AI

- Differences between Robots and AI
- The Rise of Robotics & AI – Part I before 1990
- The Rise of Robotics & AI – Part II after 1990
- A Look at Robots Ready for Work
- Just Another Movie Clip

Robots vs. AI

Both are Programmable Agents that interact with the Environment for the sake of Human interest through Sensing, Planning, and Actuation.

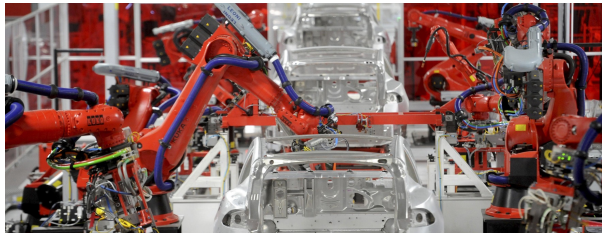
A systematic integration of robotic devices that "sense, plan, and act"

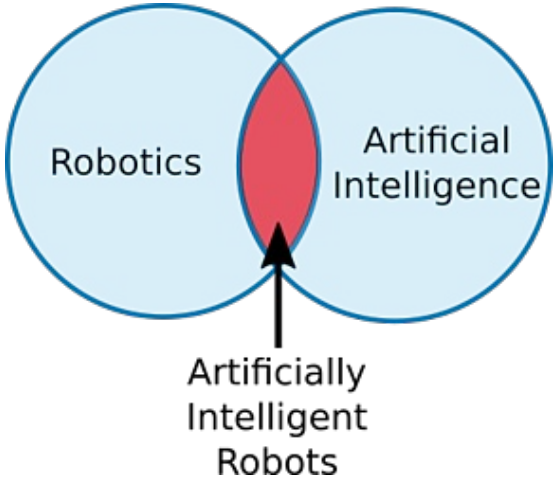


Computational Intelligence demonstrated by the Machines

Most Robots …

- Take a phyical form
- Effect changes through physical interactions





Most AI …

- Presented as programs
- Effect changes through data and decisions

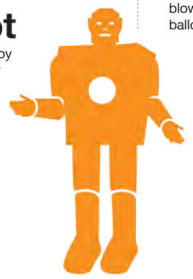
AlphaGo by Google & Mega Factory by Tesla

The Rise of Robotics & AI

The rise of Robotics and AI

Fueled by advances in computing power and connectivity, the fields of robotics and artificial intelligence have grown rapidly

1921
The term **robot** is first used by Czech writer Karel Capek



1939
Elektro, a humanoid robot, debuts at the World's Fair, smoking cigarettes and blowing up balloons

1941
Isaac Asimov formulates the **Three Laws of Robotics:**

A robot may not injure a human being or, through inaction, allow a human being to be harmed

A robot must obey orders given it by human beings except where such orders would conflict with the First Law

A robot must protect its own existence as long as such protection does not conflict with the First or Second Law

1948
William Grey Walter creates **the first autonomous robot with complex behavior**

1950
Alan Turing publishes paper about the possibility of machines that think, develops idea known as the **Turing's Test.**

It tests a machine's ability to "think" by answering a series of questions. In essence, **the tester must think the machine's answers are coming from a human**

1951
Marvin Minsky builds the first neurocomputer, **SNARC**

1954
George Devol invents the first digitally operated and programmable robot

1956
Field of AI research founded at a conference at Dartmouth

1960
Frank Rosenblatt constructs **Mark I Perceptron,** a computer that learned new skills by trial and error

1961
GM installs Unimate robot to lift and stack hot pieces of metal

1968
Mobile robot "Shakey" is introduced. It's controlled by a computer the size of a room

1972
Stanford researcher develops PARRY, designed to simulate a paranoid schizophrenic.

How are you feeling today?

I have had enough of this.

1974
Intel produces its second-generation 8080 general-purpose chips

1979
SCARA, an articulated robot arm, is developed for assembly lines

1984
The RB5X, developed by General Robotics Corp., includes software enabling it to learn from its environment

1984
Doug Lenat and his team start **Cyc,** to codify millions of pieces knowledge that compose human common sense

1985
Jaron Lanier's VPL Research, Inc., sells first VR glasses and gloves; Lanier coins the phrase **virtual reality**

1986
Honda creates the E0, the first of a series of humanoid robots that walk on two feet

1988
Researchers launch Jabberwacky, an AI chatbot designed to learn through conversation

Nope, I'm human.

1988
The first HelpMate service robot begins work at Danbury Hospital

1956
IBM 305, the first hard disk drive
5MB

1970
IBM 1330
100MB
per pack

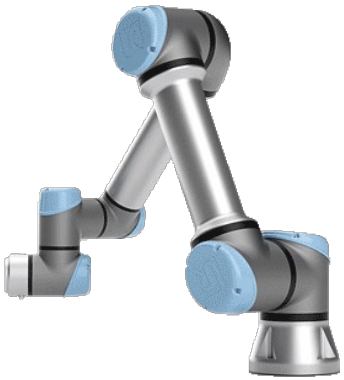
1985
IBM 0665, a 5.25" disk with
20-40MB

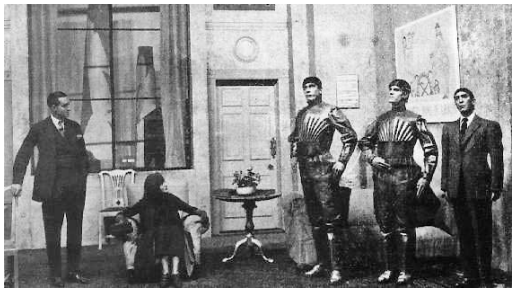
Minimize and maximize
Shrinking disk sizes and exponentially growing capacity help fuel robotics and AI

pwc

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

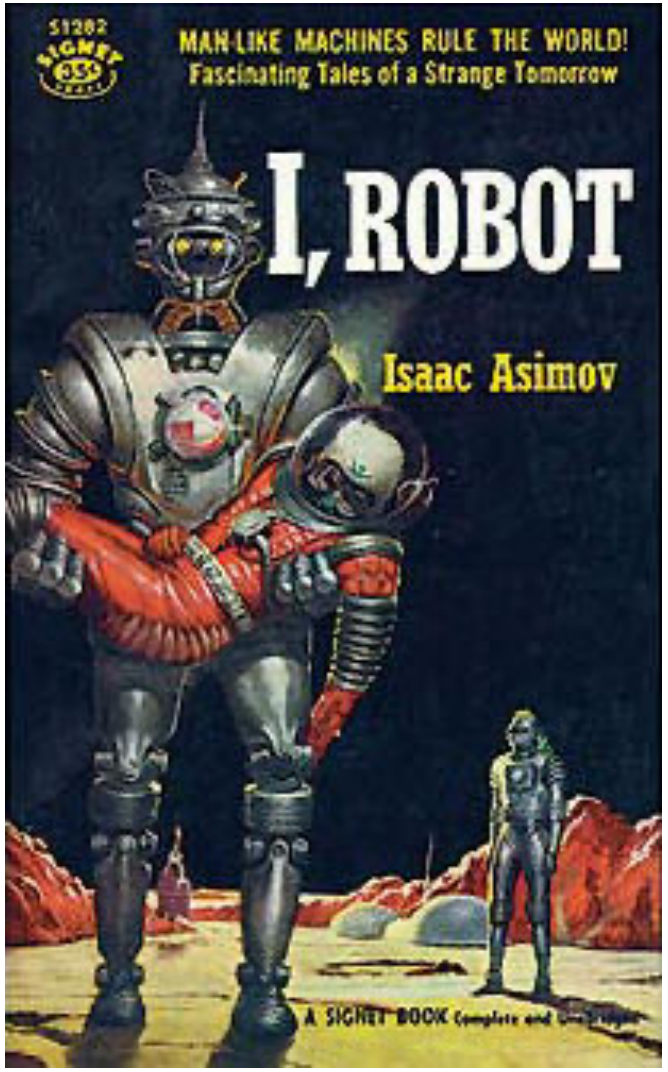




Rossums Universal Robots by Karel Capek & https://patch.com/california/walnutcreek/ev--rossums-universal-robots & https://en.wikipedia.org/wiki/R.U.R.

The Three Laws of Robotics

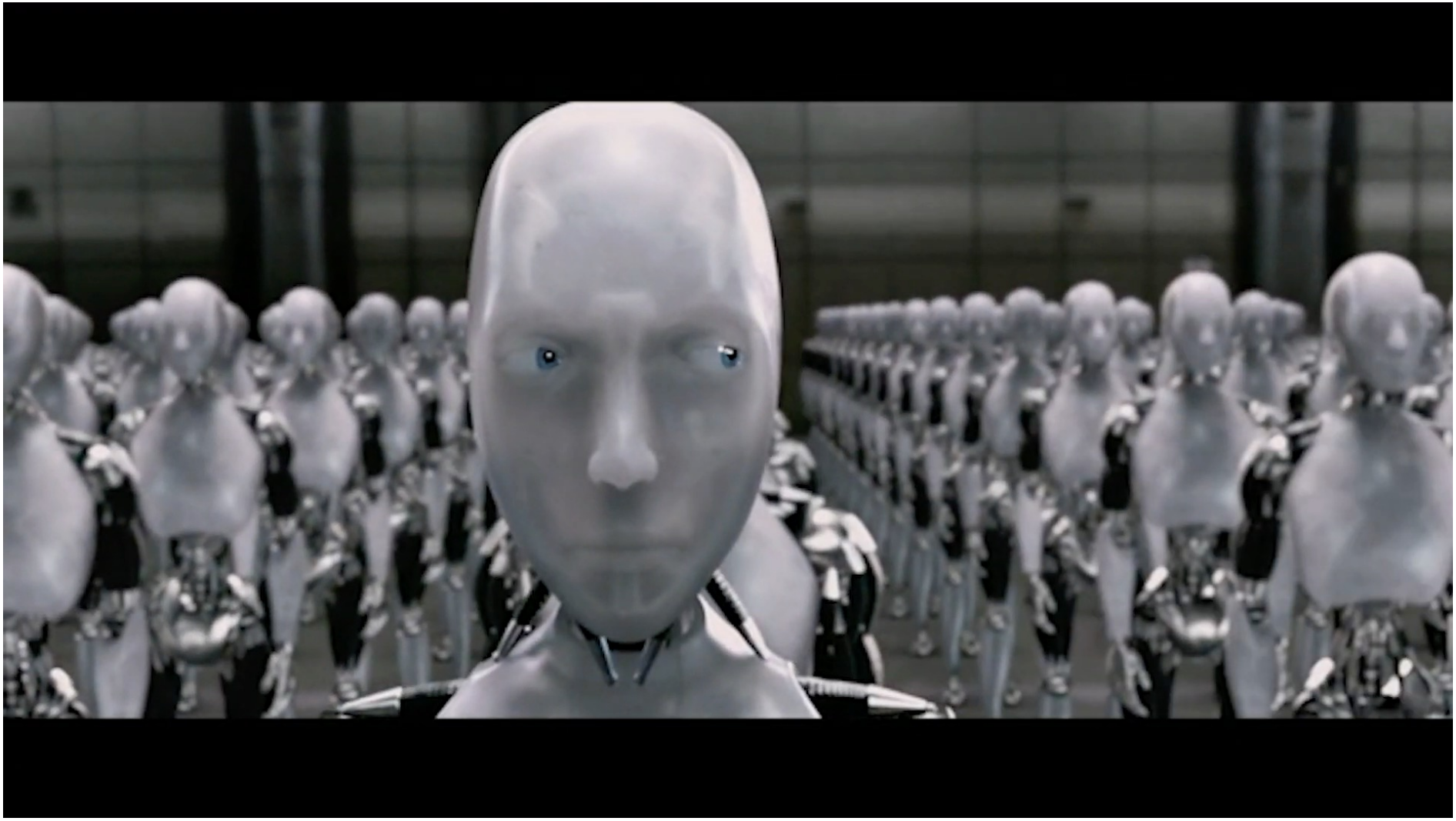
- The Three Laws of Robotics (Asimov's Laws)
  - A set of rules devised by science fiction author Isaac Asimov.
  - The rules were introduced in his 1942 short story "Runaround" (included in the 1950 collection I, Robot), although they had been foreshadowed in some earlier stories.
- The Three Laws, 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.
0th Law: A robot may not harm humanity, or, by inaction, allow humanity to come to harm.

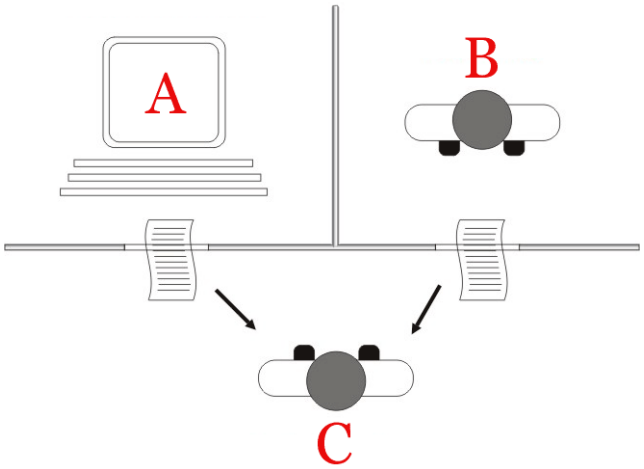


I, Robot Movie Trailer: https://www.youtube.com/watch?v=7Dlo-VB0-HI

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.

- If the evaluator could not reliably tell the machine from the human, the machine would be said to have passed the test.
- The test results would not depend on the machine's ability to give correct answers to questions, only on how closely its answers resembled those a human would give.



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

1950: Turing Test

If the evaluator could not reliably tell the machine from the human, the machine would be said to have passed the test.

The test results would not depend on the machine's ability to give correct answers to questions,
only on how closely its answers resembled those a human would give.

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

Unimate (Universal Automation)

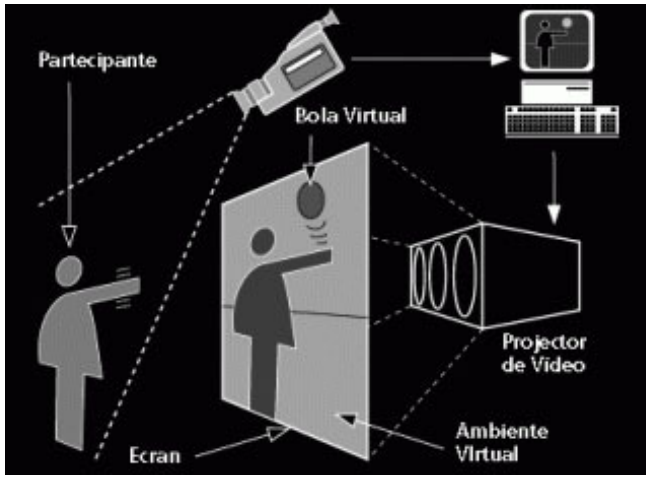
- **The Unimate was the first industrial robot ever built.** It was a hydraulic manipulator arm that could perform repetitive tasks. It was used by car makers to automate metalworking and welding processes.

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.** 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.

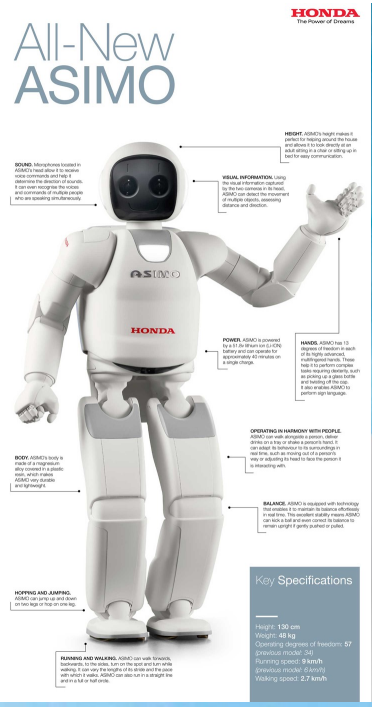


https://virtualspeech.com/blog/history-of-vr

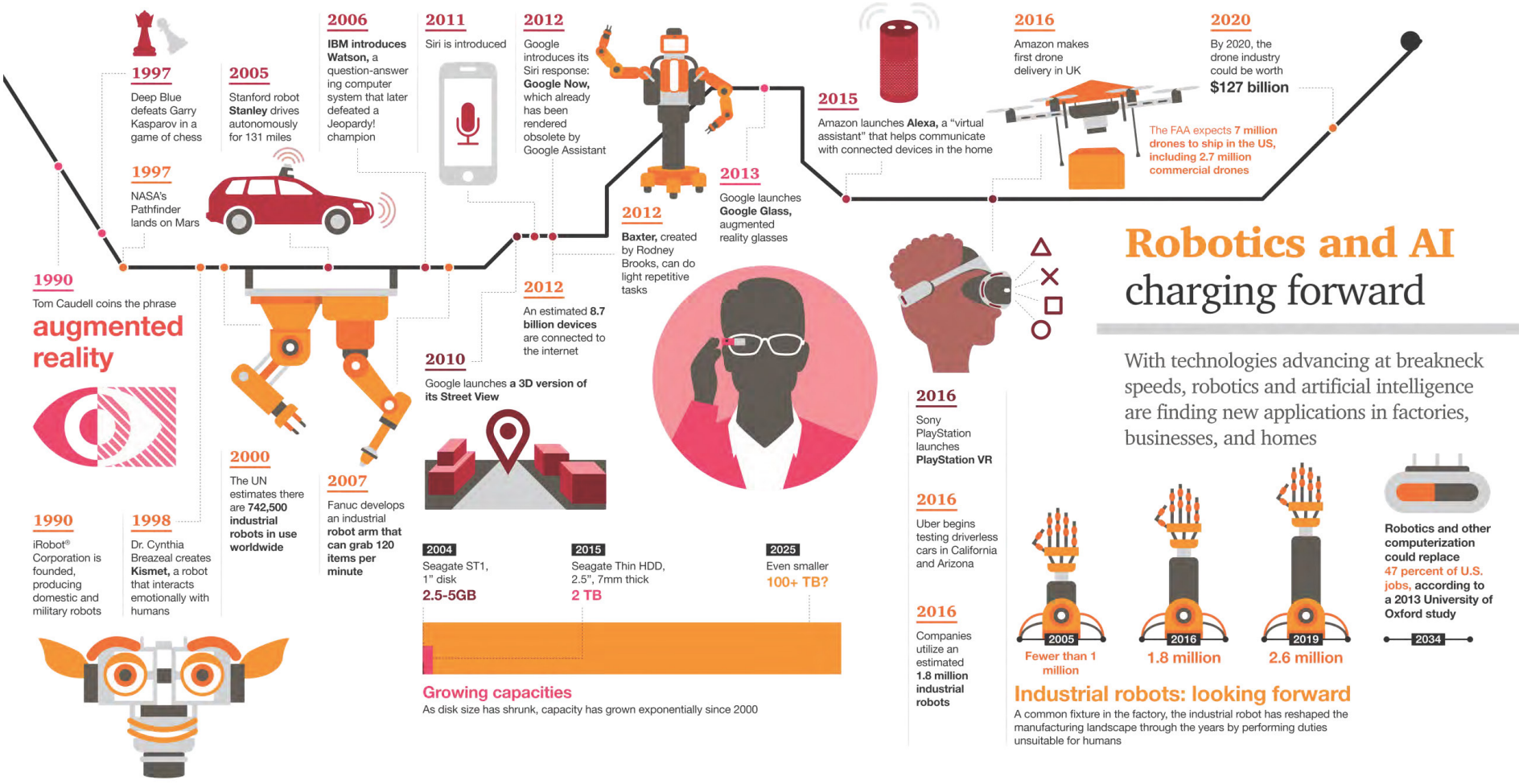
HONDA's ASIMO

Advanced **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**.



The Rise of Robotics & AI



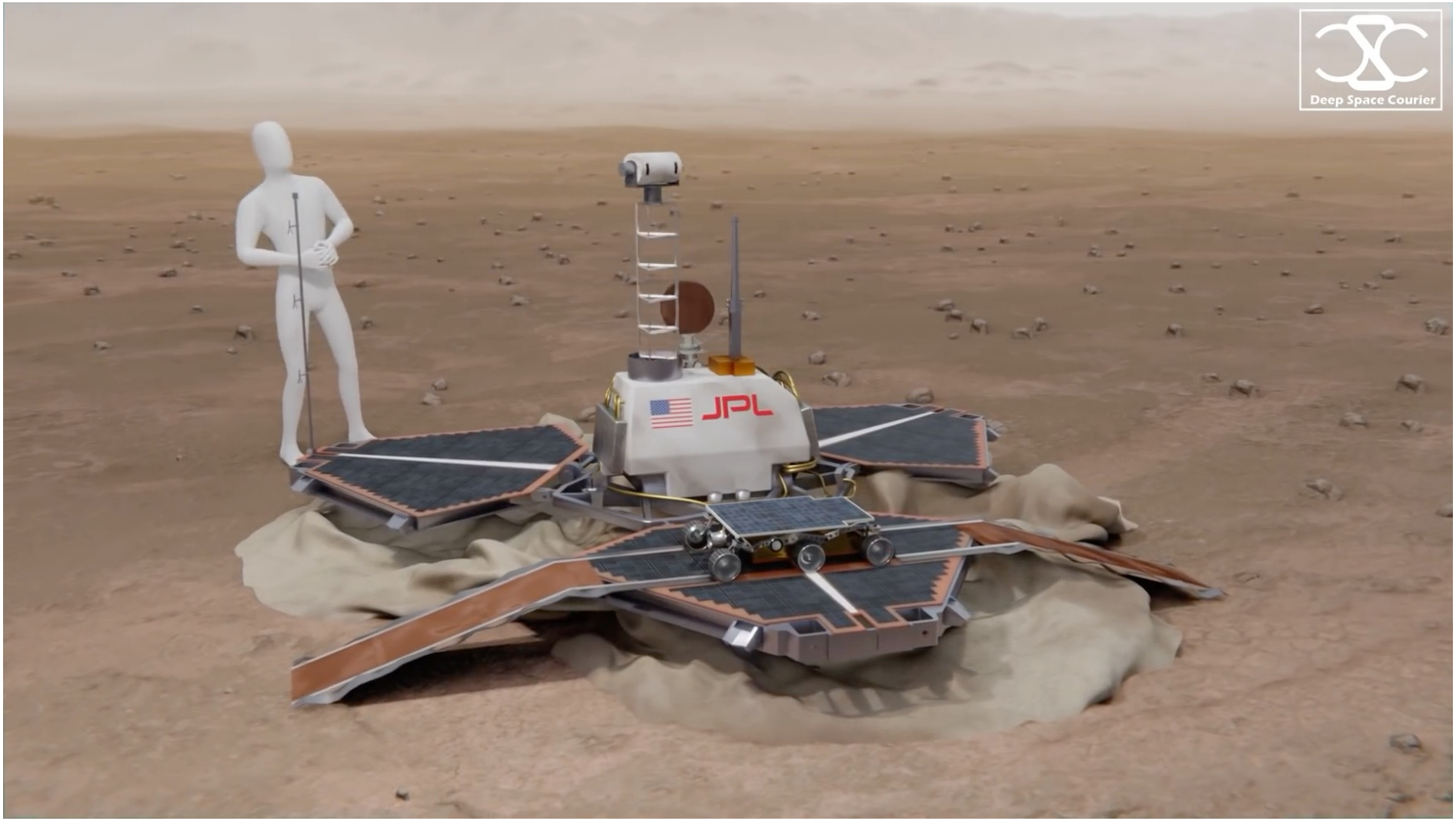
From Research to Space, then Military to Domestics

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

Human vs. Agent (Computer? Robot?)

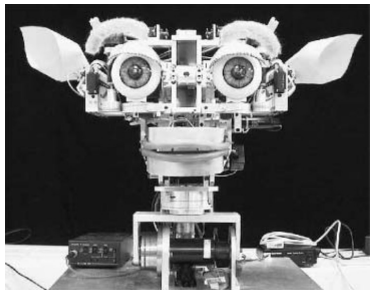
https://media.pri.org/s3fs-public/styles/story_main/public/story/images/DeepBlue.png?itok=N01yMnCK

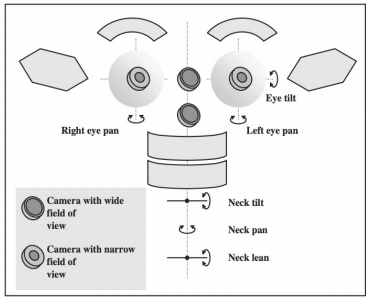
The 1st Rover Running on Mars

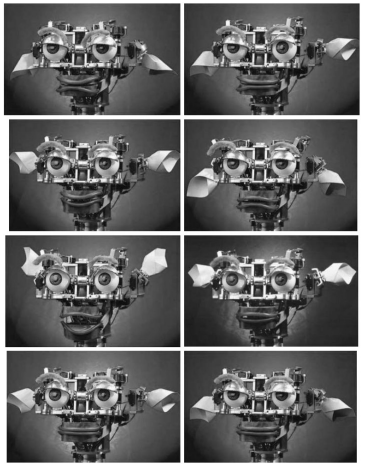


https://www.youtube.com/watch?v=ER6EO4B7V68

Kismet the Social Robot



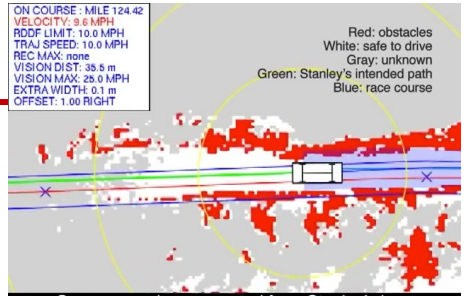




https://www.youtube.com/watch?v=Kw-gOmJwzuc

2005: Autonomous Vehicles

Stanley



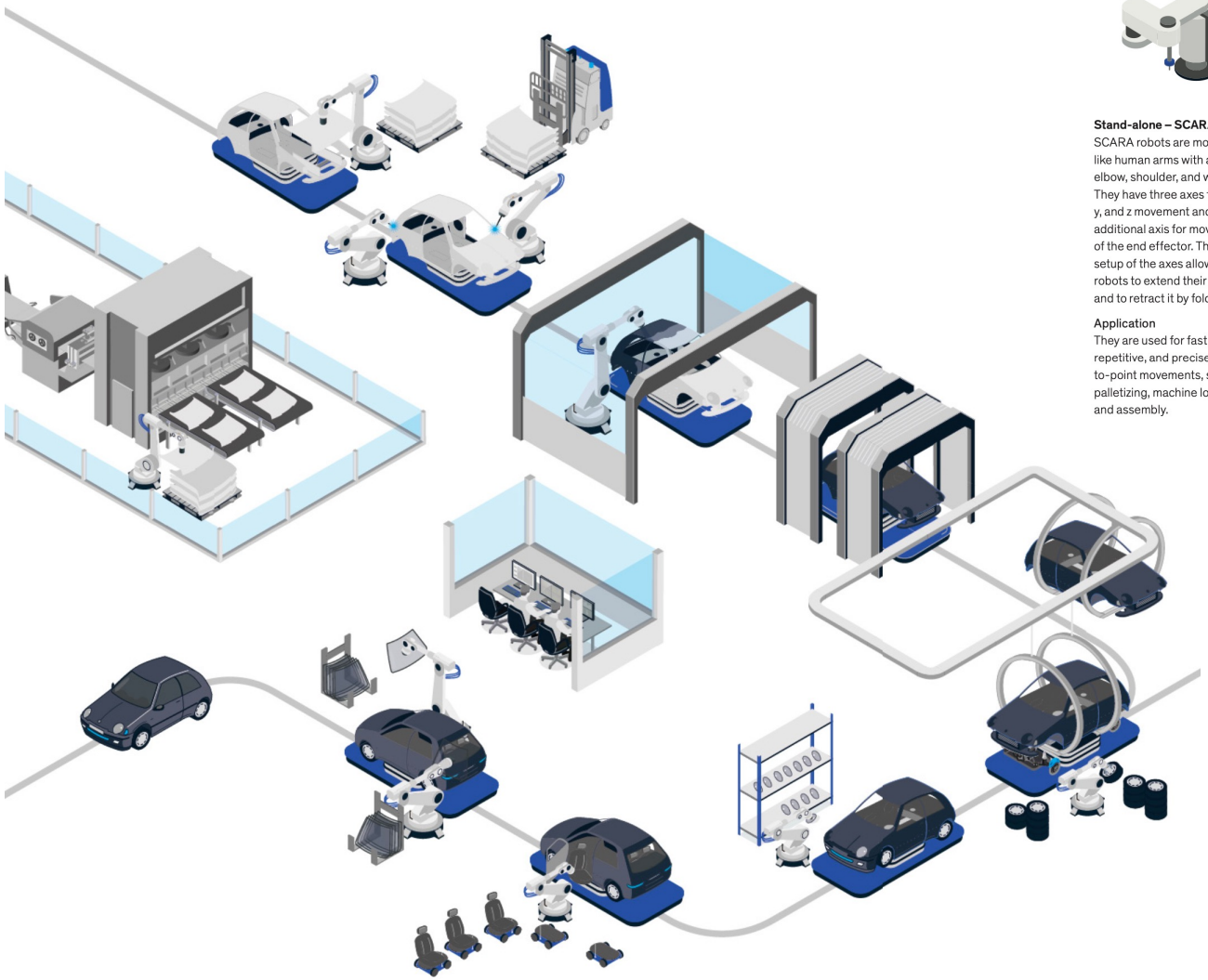
Course overview generated from Stanley's laser sensor data as the robot navigated Beer Bottle Pass

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

Baxter

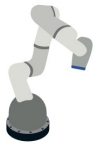
https://www.youtube.com/watch?v=NoKONzD-XsQ

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.

McKinsey

A Look at Robots Ready for Work

Five ways robots are going mainstream

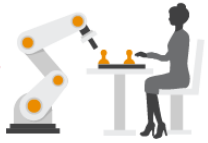
They're not restricted to structured environments.

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.

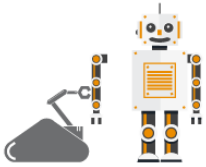
They can work with humans.

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.



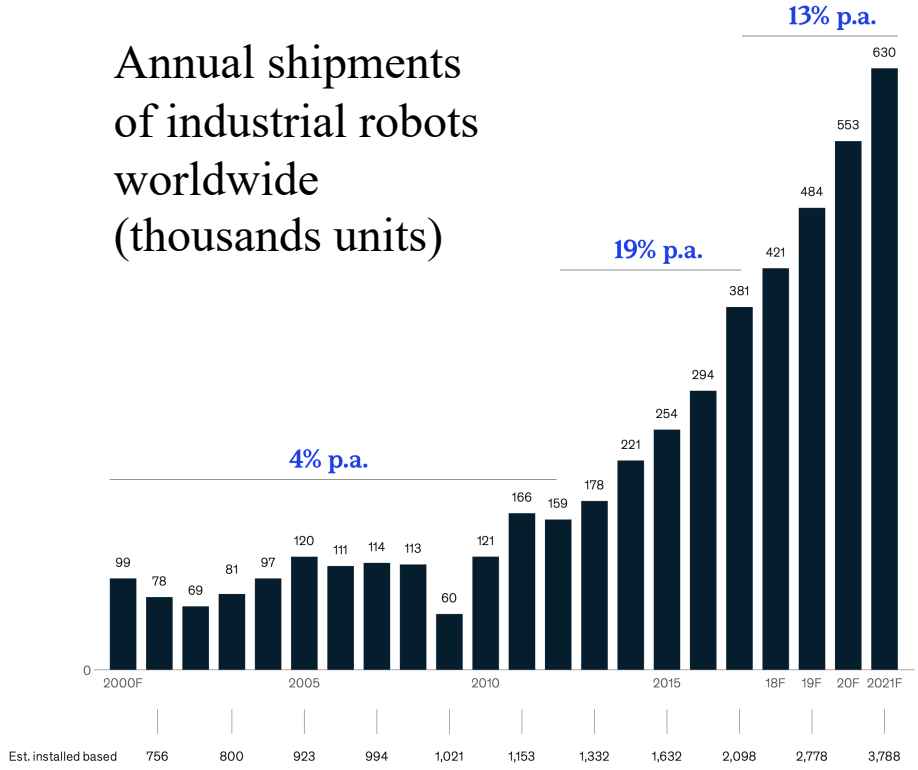
They are no longer single-task machines.

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)



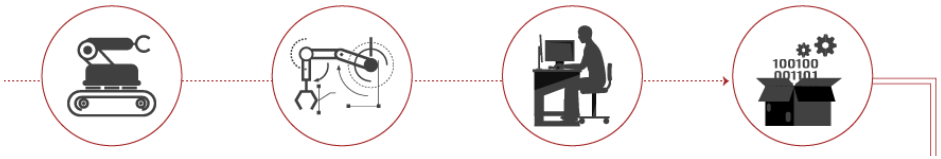
pwc & McKinsey

A Look at Robots Ready for Work

Benefits of robotics

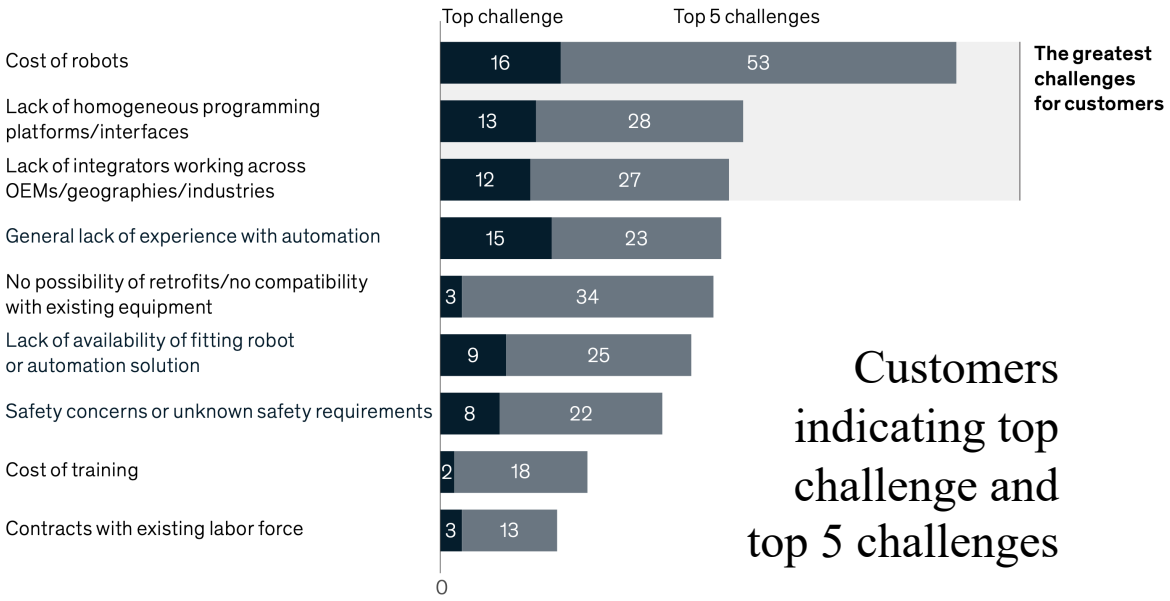
Robots are not just for manufacturing anymore. No matter the industry, they can:

- 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

pwc & McKinsey

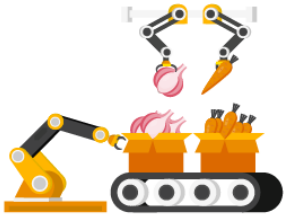
A Look at Robots Ready for Work

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.



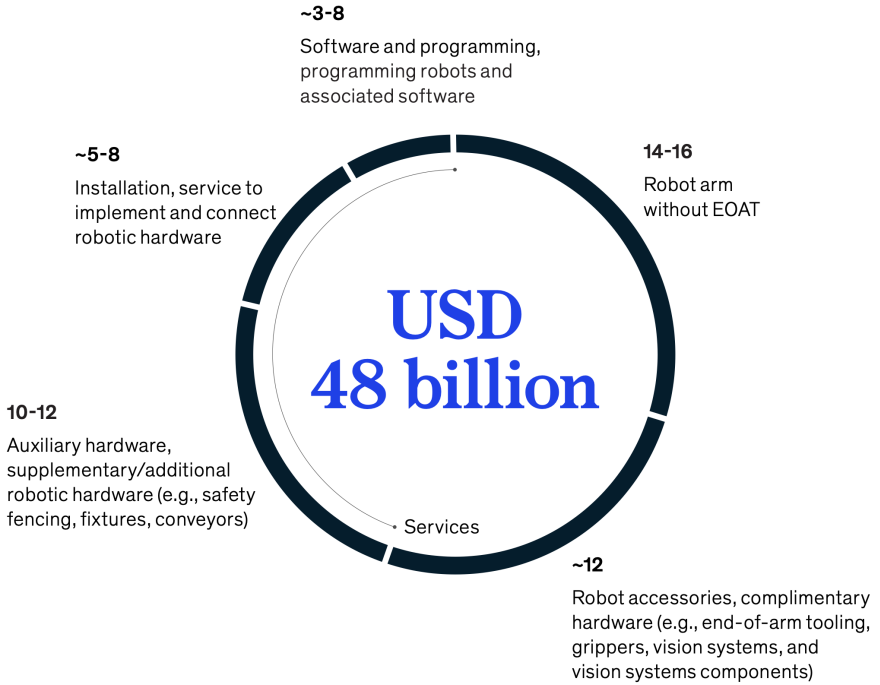
Handling more complex tasks

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



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Thank you~

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