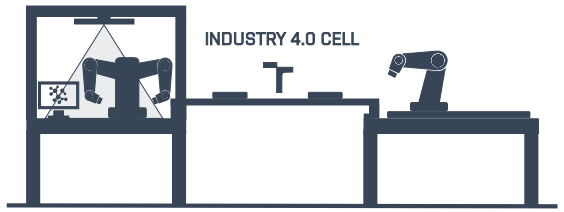
INSTITUTE OF AUTOMATION AND COMPUTER SCIENCE

Programming for robots and manipulators
Lecture 1

Roman Parak

NETME Centre



FACULTY OF MECHANICAL ENGINEERING
institute of automation and computer science

Brno, 2023

Content

Course Organization

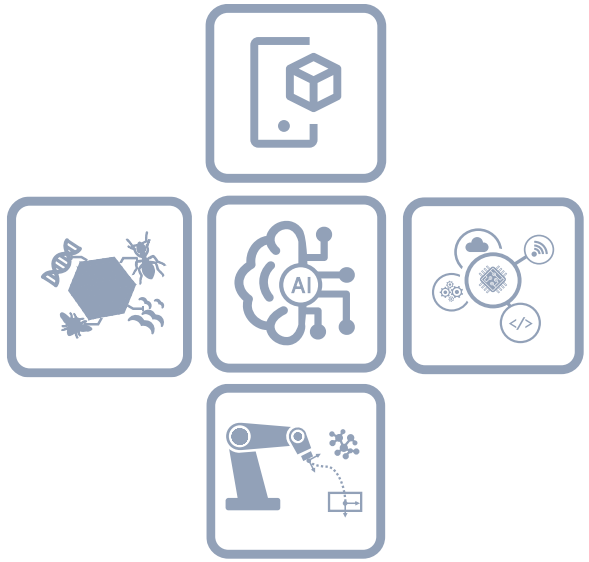
Course Organization

Institute of Automation and Computer Science FME, BUT

- https://uai.fme.vutbr.cz

Lecturers: Roman Parak, Branislav Lacko, Martin Juricek

- **Contact:** Roman.Parak@vutbr.cz or Microsoft Teams
- **Room:** A1/0642
- **Research interests:** General Robotics and Machine Learning
- **GitHub:** https://github.com/rparak/Programming-for-robots-and-manipulators-VRM

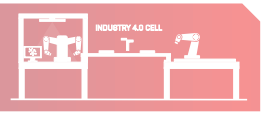


Programming for robots and manipulators (VRM)

- https://www.fme.vutbr.cz/en/studenti/predmety/235124

Extent of teaching: Lecture (1h) + Lab (2h)
Completion: Z,ZK; Credits: 4;

Resources and Literature



Textbooks

- **Introduction to AI Robotics**, Robin R. Murphy
- **Roboty a robotizované výrobní technologie**, Zdeněk Kolíbal
- **Handbook of Robotics**, Bruno Siciliano
- **Modern Robotics: Mechanics, Planning, and Control**, Kevin M. Lynch and Frank C. Park
- **Robotics, Vision and Control**, Peter Corke
- **Planning Algorithms**, Steven M. LaValle
- **Industrial Robotics: Theory, Modelling and Control**, Sam Cubero
- **Mathematics for Computer Graphics**, John Vince

Other

- IEEE Xplore
- Science Direct
- Springer - International Publisher Science

The main technologies used in teaching the VRM course

- Programming Languages

- Tools & Technologies

Introduction to Robotics

What is robotics?

Robotics is defined as "a branch of computer science which deals with the all the procedure involved in the process of building a robot from its design to its application". The constructing and operating of robots is done under the robotic technology. These robots are built to take on tasks which are hard and problematic for a human to perform.

A robot is a machine, especially one that is programmable by a computer and is capable of automatically performing a complex series of actions.

Robotics integrates science and engineering, and overlaps with many disciplines:

1) Artificial Intelligence, Machine Learning, Neuroscience
2) Computer Vision, Machine Perception
3) Electronic / Mechanical Engineering

STAR WARS

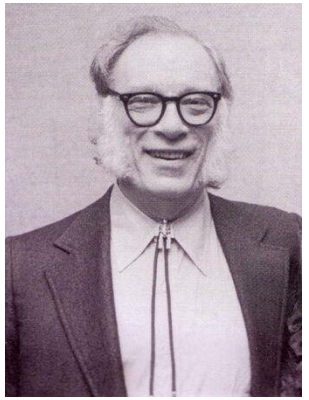
A Brief History of Robotics

A Brief History of Robotics

The first use of the word "robot" occurred in a play about mechanical men that are built to work on factory assembly lines and that rebel against their human masters. These machines in R.U.R. (Rossum's Universal Robots), written by Czech playwright Karl Capek in 1921, got their name from the Czech word for slave.

The word "robotics" was also coined by a writer. Russian-born American science-fiction writer Isaac Asimov first used the word in 1942 in his short story "Runabout." Asimov had a much brighter and more optimistic opinion of the robot's role in human society than did Capek. He generally characterized the robots in his short stories as helpful servants of man and viewed robots as "a better, cleaner race."

Karl Capek
(1890 – 1938)



Isaac Asimov
(1920-1992)

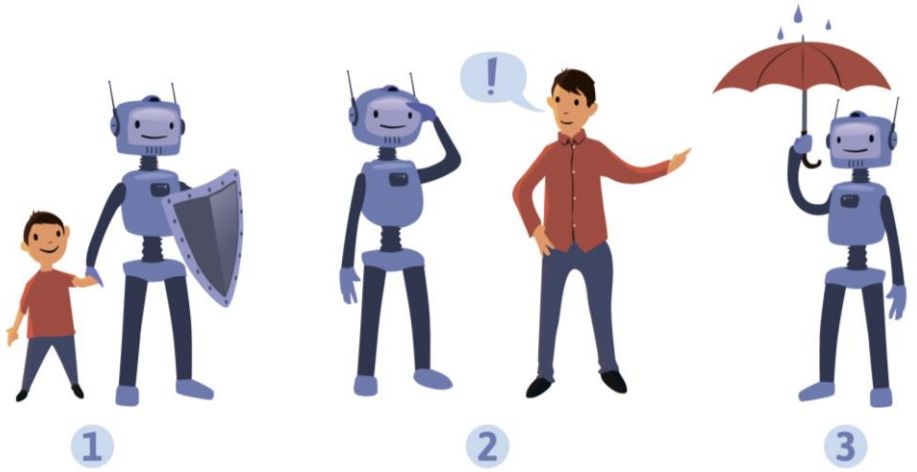
The Three Laws of Robotics (Asimov's Laws)

Asimov's suggested laws were devised to protect humans from interactions with robots.

1. Law:
A Robot may not injure a human being or, through inaction, allow a human being to come to harm.

2. Law:
A Robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

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

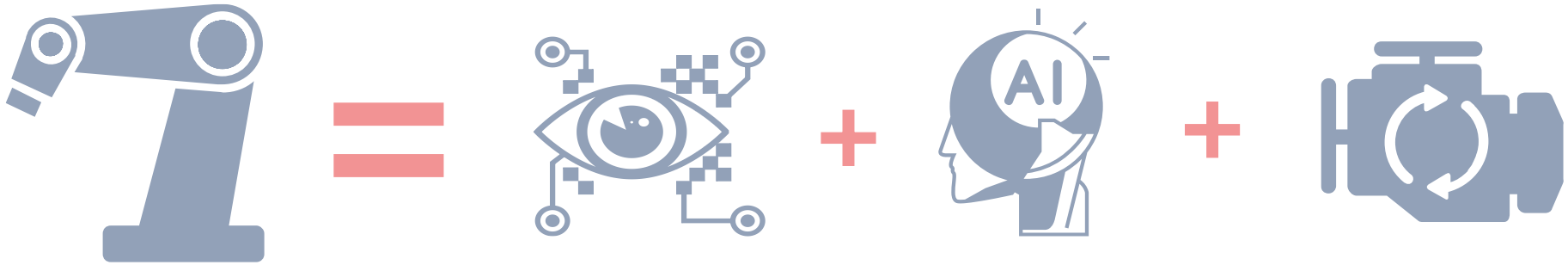


Three Laws of Robotics

Sense, Think, Act (STA)

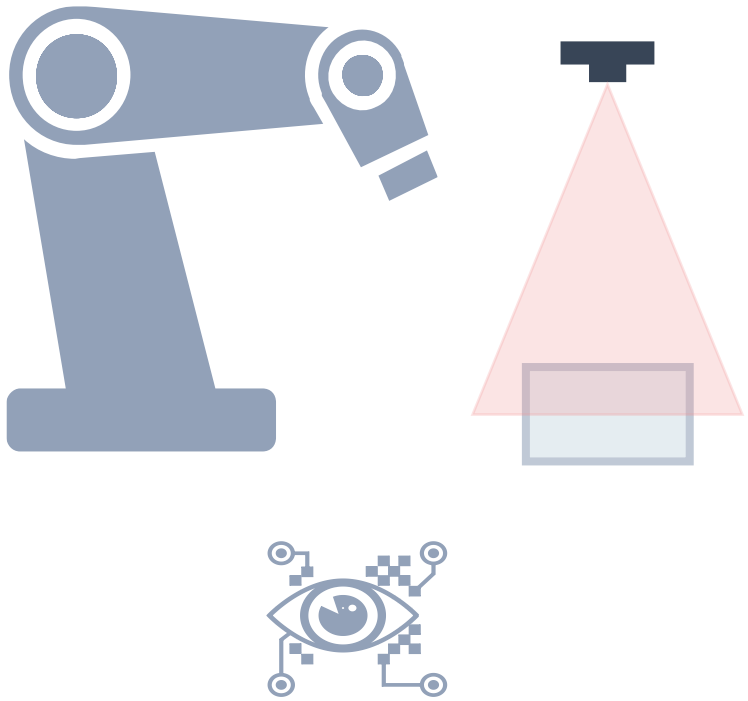
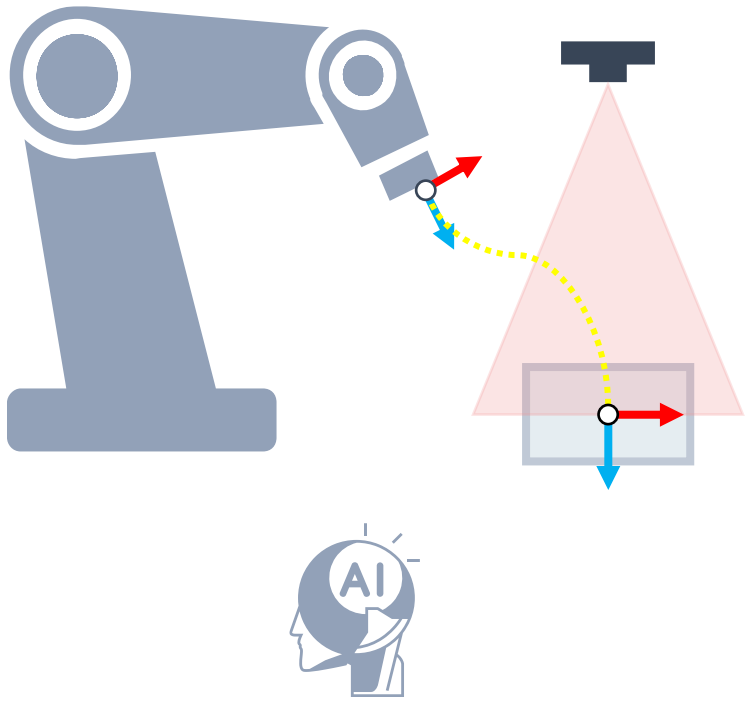
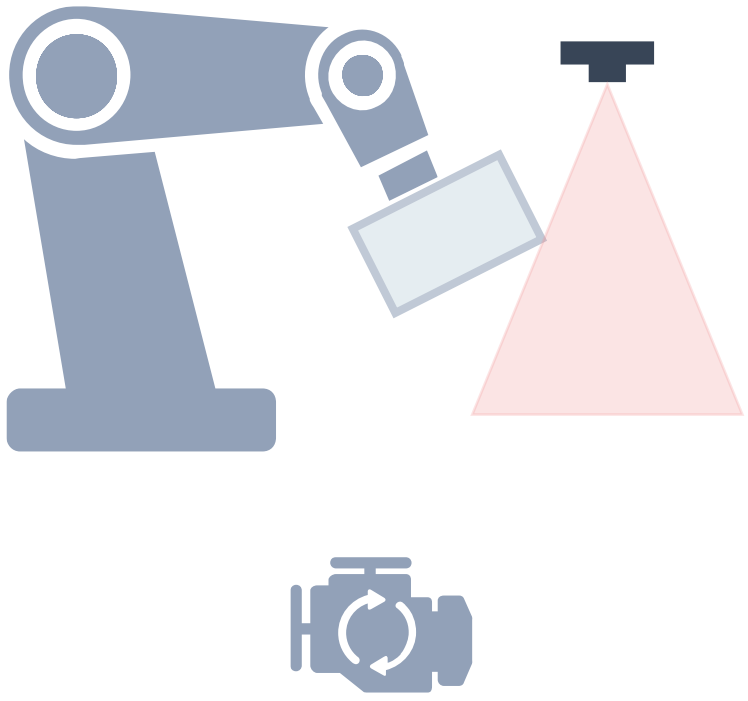
Sense, Think, Act (STA)

A robot is an autonomous system which exists in the physical world, can sense its environment, and can act on it to achieve some goals.



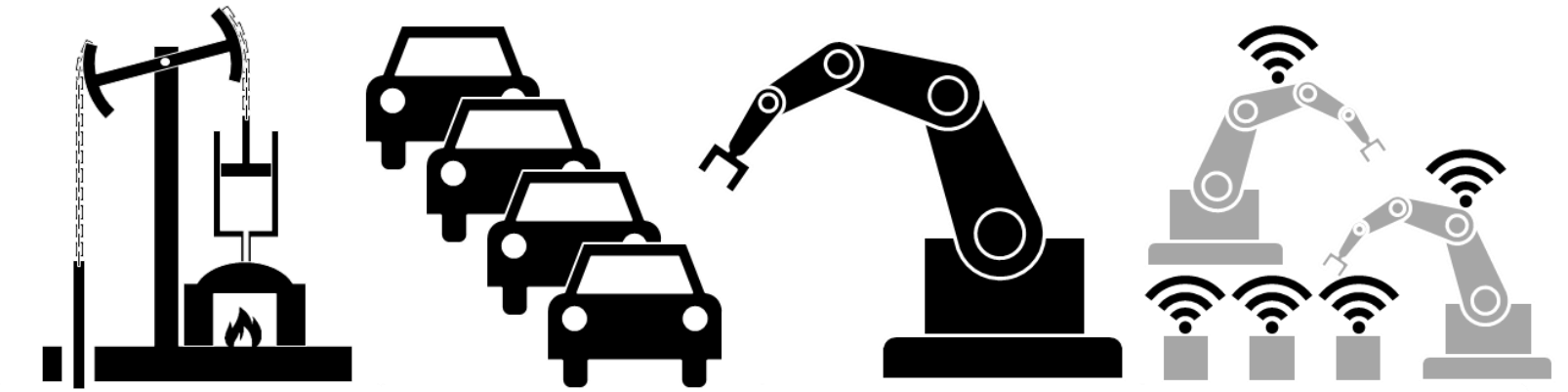
SENSE: Robotic devices typically have one or more physical inputs (such as sensors, etc.) that gather data from the physical environment.
THINK: Robotic devices are programmed to analyze data from their inputs to make decisions and respond to certain conditions by acting through their outputs.
ACT: Robotic devices typically have one or more physical outputs (such as motors, etc.) that can perform movements and actions in the physical environment.

Sense, Think, Act (STA)

SENSE	THINK	ACT
		

Industrial Revolutions

Industrial Revolutions

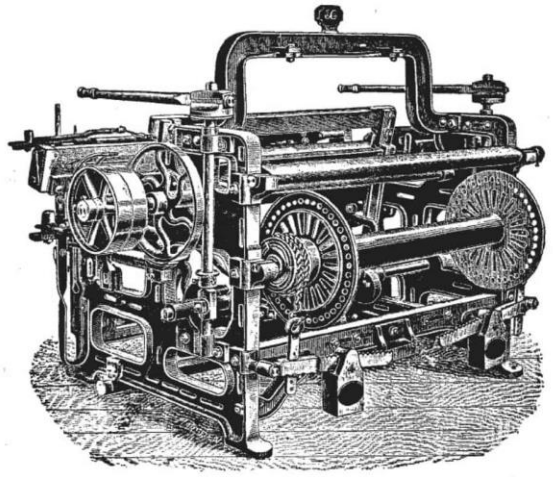


KTC & INDUSTRY 4.0
BRIEF OVERVIEW OF THE 4TH INDUSTRIAL REVOLUTION

The 1st Industrial Revolution 1765

The first industrial revolution followed the proto-industrialization period. It started at the end of the 18th century to the beginning of the 19th. The biggest changes came in the industries in the form of mechanization. Mechanization was the reason why agriculture started to be replaced by the industry as the backbone of the societal economy.

At the time people witnessed massive extraction of coal along with the very important invention of the steam engine that was the reason for the creation of a new type of energy that later on helped speed up the manufacturing of railroads thus accelerating the economy.



First power loom (1784)

The 2nd Industrial Revolution 1870

The second industrial revolution started at the end of the 19th century, with massive technological advancements in the field of industries that helped the emergence of a new source of energy. Electricity, gas, and oil.

The result of this revolution was the creation of the internal combustion engine that started to reach its full potential. Other important points of the second industrial revolution was the development for steel demand, chemical synthesis and methods of communication such as the telegraph and the telephone.

Finally, the inventions of the automobile, and the plane in the beginning of the 20th century.

First assembly line (1870)

The 3rd Industrial Revolution 1969

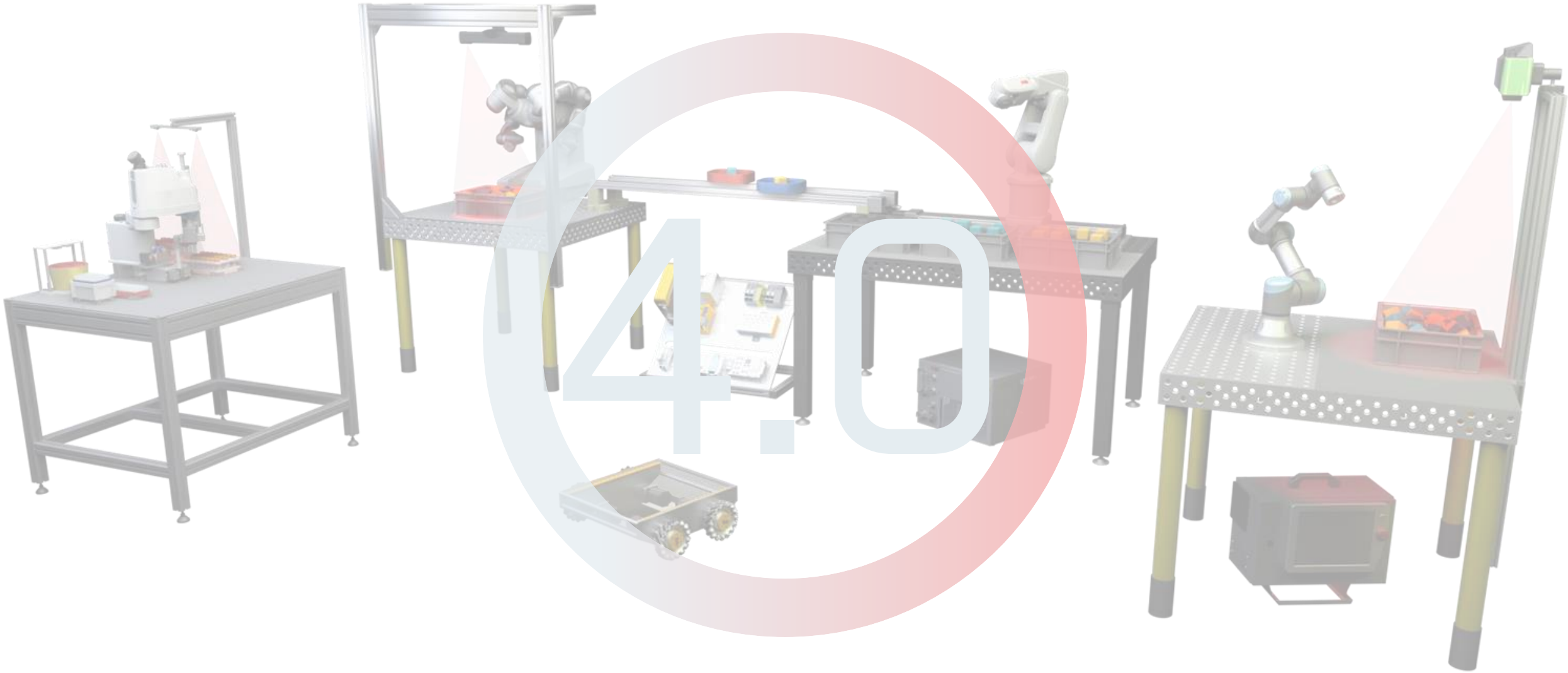
The third industrial revolution started in the second half of the 20th century and brought forth the rise of electronics, telecommunications and of course computers. Through new technologies, the third industrial revolution opens the door to space expeditions, research and biotechnology.

In the world of the industries, two major inventions, Programmable Logic Controllers (PLCs) and Robots helped give rise to an era of high-level automation.

First Programmable logic controller (1969)

The 4th Industrial Revolution – Industry 4.0

The 4th Industrial Revolution – Industry 4.0



Industry n.0 → 5.0, 6.0, ... ?

Thank You!

Questions?

INSTITUTE OF AUTOMATION AND COMPUTER SCIENCE