Difference between Cybernetic Intelligence and Artificial Intelligence

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History of cybernetics | |

Contemporary cybernetics : a great variety of independent fields

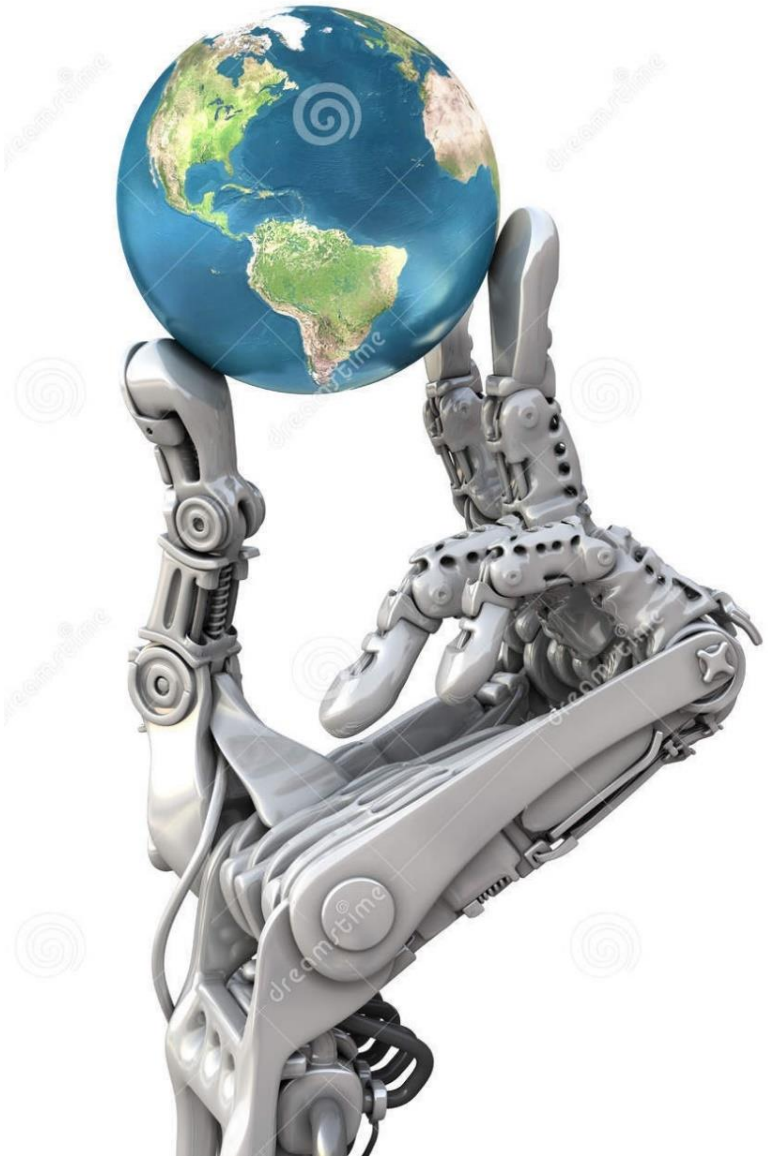
- Dynamical systems: state feed back control, space, stochastic systems, control, ...
- Communication theory: information entropy, communications channel and its capacity, ...

– Artificial intelligence: perception and learning, multi-agent systems, robotics, ...

- Biocybernetics: neural networks, connectionism, man-machine interaction, ...
- Decision theory, game theory, complexity theory, chaotic systems, etc.

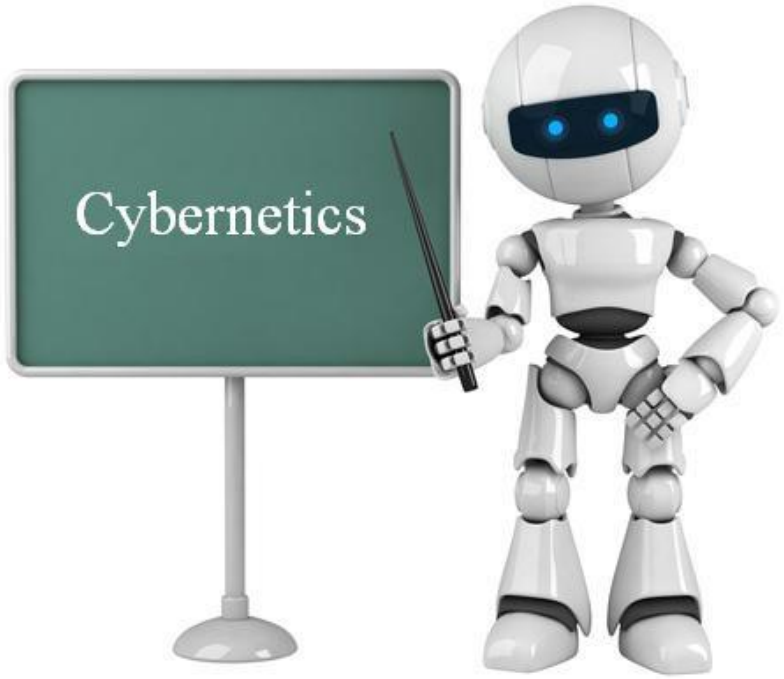
What is Cybernetics?

- Study of control processes
- Communication in mechanical, electronic and biological systems
- Study of how complex systems function through the use of information, feedback and interaction



Cybernetics is used in:

- Mathematics
- Biology
- Engineering
- Psychology



Its most well-known application is computer science, in which it has been used in the development of technology such as artificial intelligence, robotics simulation.

System observer model

- What do these fields of study have in common? They examine various aspects of (complex) systems.
- How to define a system?
- System is an assemblage of entities, real or abstract, comprising a whole with each and every component/element interacting or related to at least one other component/element.
- The definition is trivial . What is important are the systems originated by abstraction of real systems.

System observer model

- Observer defines an abstract system by a determination of:
- – a list of crucial variables of a real system and their interaction
- – all the other variables/interactions represent the environment of the system
- – they can be ignored or influence the system inputs resp. be affected by its outputs (If input/output variables explicitly defined, the system is referred to as oriented.)
- Some cybernetic models valid equally for different systems.

System aspects related to Cybernetics and Robotics programme

- System aspects of interest in this course
- Dynamics
  - − Linear and non-linear systems: from order to chaos.
- Entropy and Information
  - − How to measure system disorder and quantify information using probability.
- Information transmission
  - − How to transmit information. Communication channel, erroneous transmission, data compression.
- Algorithmic entropy, decidability
  - − How to measure system complexity without using probability Decidability of problems.
- Artificial intelligence
  - − Problem solving, decision making under uncertainty, recognition, learning, ...
- Control
- − External dynamics description, feedback, regulation of systems.

System Dynamic

- Stochastic
  - Determines probability distribution of next state.
- Deterministic
  - A function

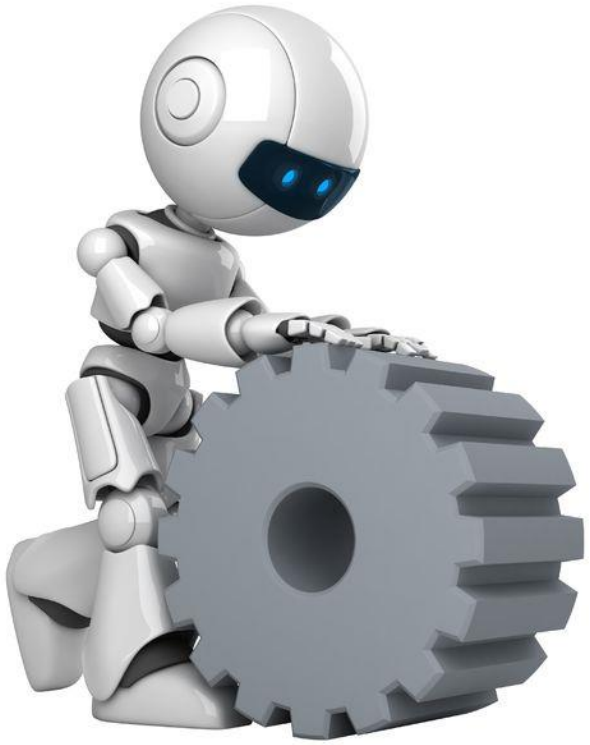
What Is the Connection between Artificial Intelligence and Robotics?

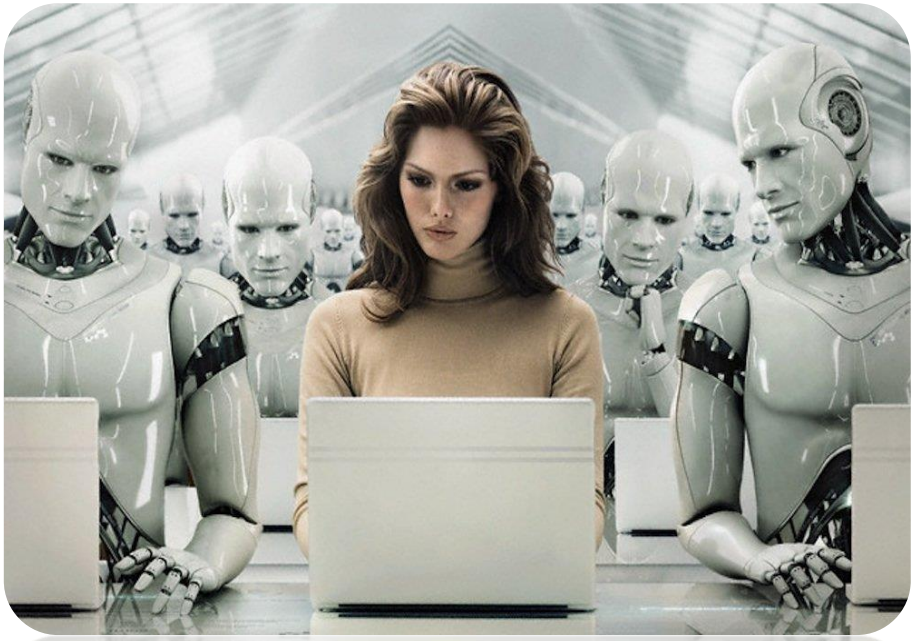
Development of robots that:

- React to their environments in ways similar to animals
- Move using robotic systems
- Walk up and down stairs and play table tennis
- Demonstrate “emotional” responses based on interactions with people

Robotics –

a field of engineering in which machines are designed to be able to move in a number of different ways.

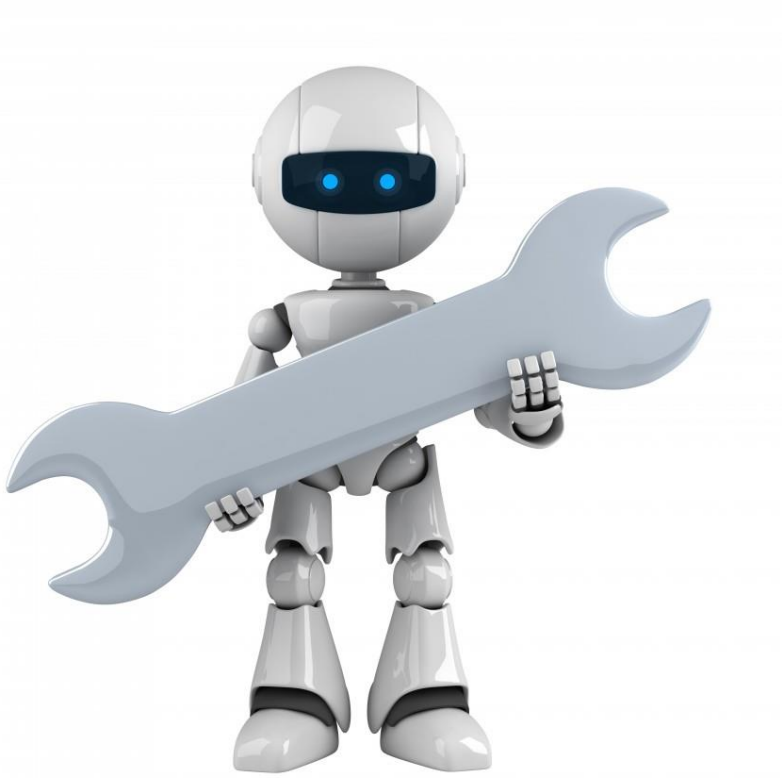




Artificial intelligence – a field of computer science in which software programs are designed to emulate the way in which the human brain perceives the world around it.

How Close are We to Developing Cyborgs?

- Research has been in progress for decades already



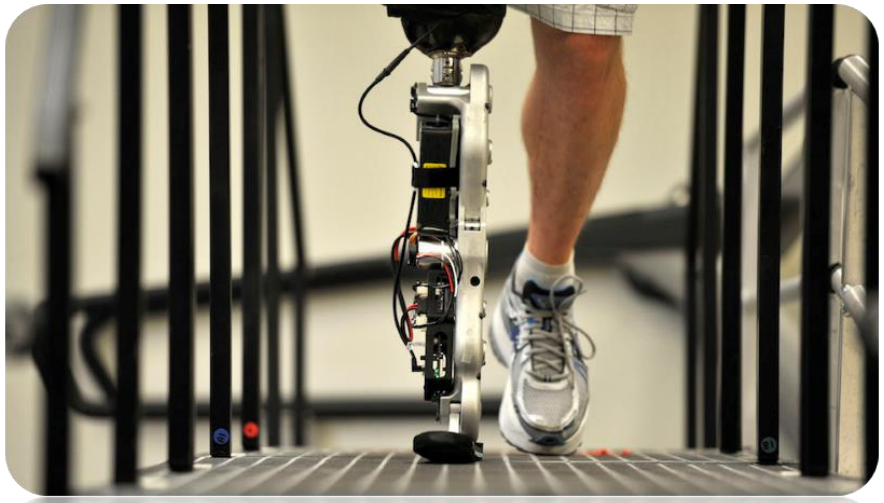
- Printing synthetic bones

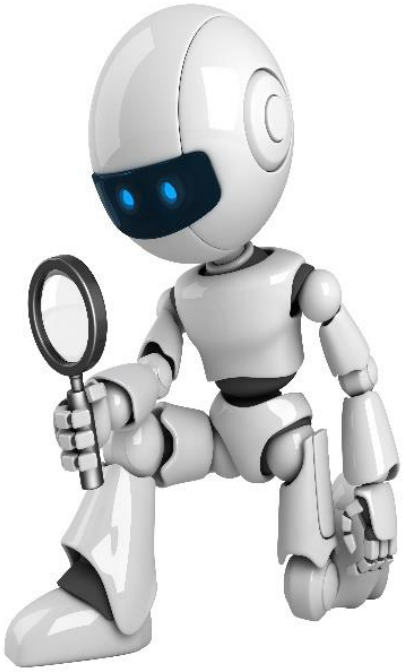
- Exceptional synthetic eyes

- Artificial noses are also under development.

What are Cybernetic Organisms?

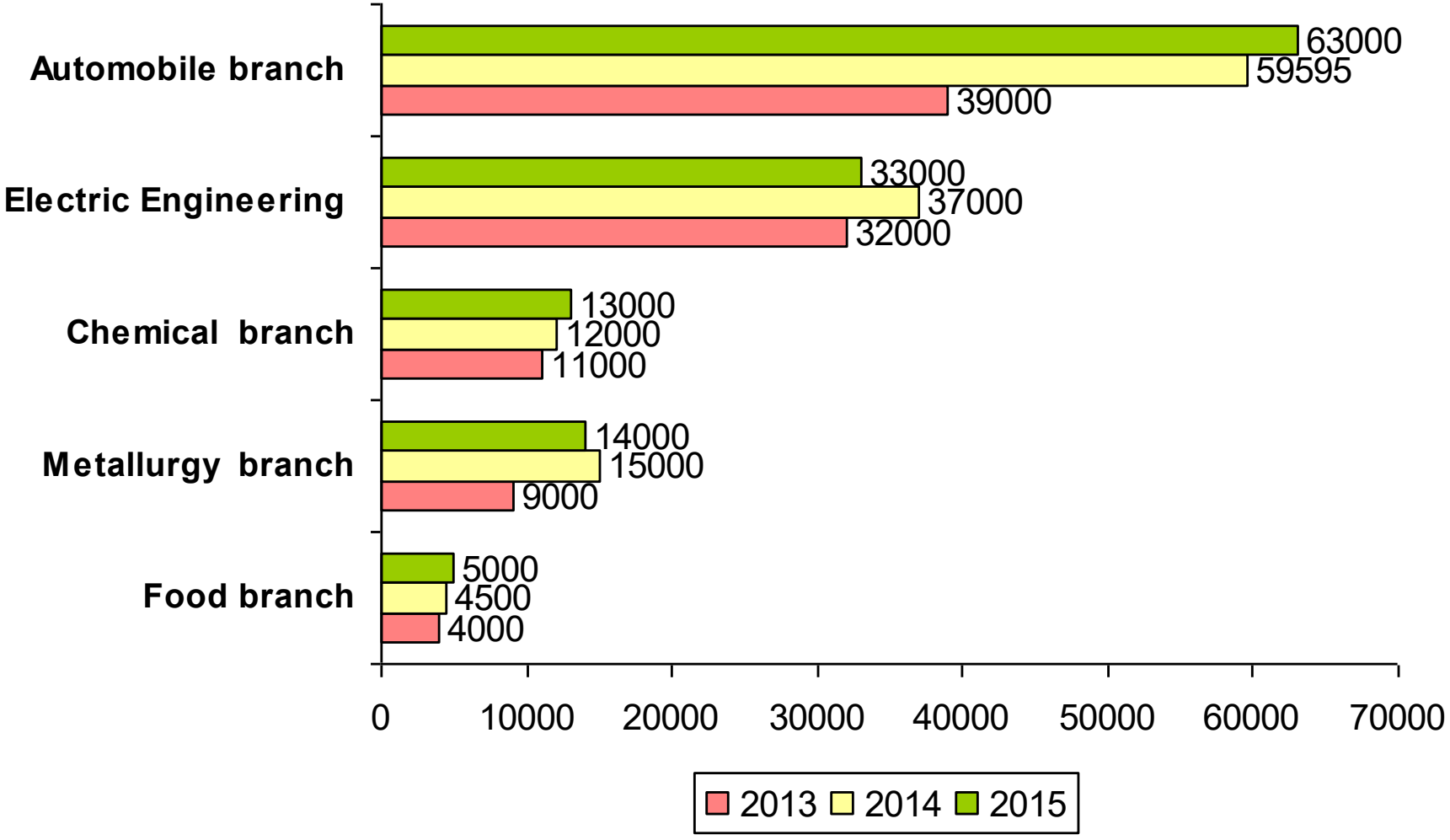
- Humans are already cybernetics organisms



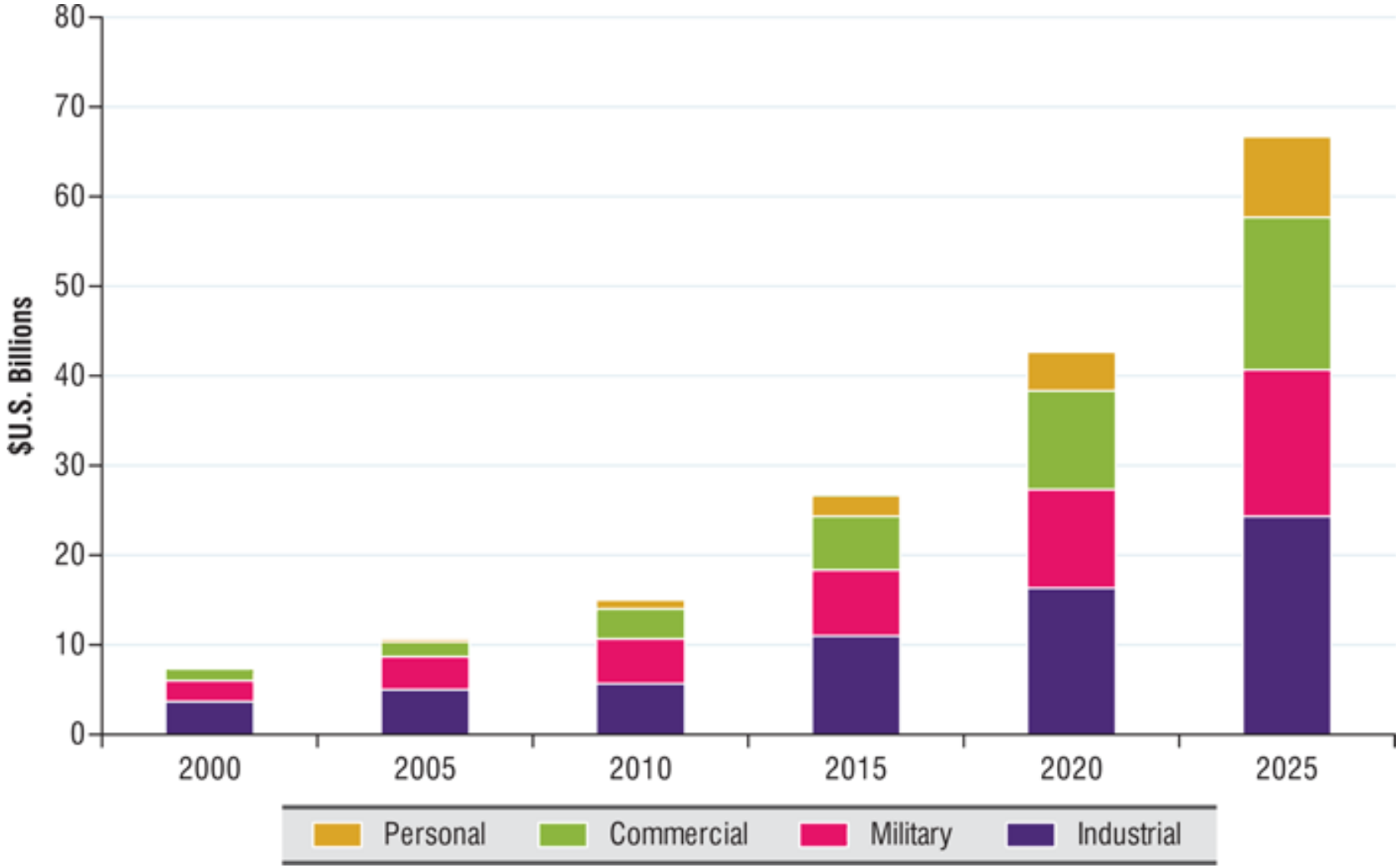


- More advanced medical prostheses such as pacemakers

Demand of robots in basic industrial branches: 2013-2015



Worldwide spending on robotics, $U.S. billion, 2000 – 2025



Summary

- Cybernetics is a science about non-trivial systems and processes, their modeling and control and information transmission.
- Investigates the aspects common to diverse kinds of systems (technical, biological, socioeconomical, ecological, ...).
- One of the aspects of systems is dynamics (state unfolding in time).
- Dynamics easy to model for linear systems.
- Basic system dynamics model: state description.
- From a linear model state description one easily derives important asymptotic properties (mainly stability), and generally the time response, which is always a linear combination of
  - − complex exponential functions (for continuous systems)
  - − complex power functions (for discrete systems)
- For nonlinear systems, unfolding in time may be much more complex and there is in general no way to derive it mathematically.
- Even simply described non-linear systems may unfold in an extremely complicated manner - chaotically.