A Brief Introduction to Robotics

Learning Objectives

- Nature of robotics
- History of robotics
- Type of robots
- Robotic applications
- Principal engineering issues
- The future of robotics

What is modern robotics?

- Can we define it formally?

- No answer at present time
- And why so?

Robotics is a multi-discipline

- Viewpoints and components of robotics

  - Mechanical Engineering (*mechanisms and machine theory, kinematic chains of bodies*)
  - Electrical Engineering
  - Control Theory (*nonlinear multi-input multi-output systems*)
  - Computer Science and Artificial Intelligence (*programmable device with memory*)
  - Biology and Cognitive Science (*behavior-based and reactive systems*)

Robotics

- Meaning and definitions
- Laws of robotics (science fiction)
- Prehistory
- History
- Basic types of robots

Robot Defined

- Word robot was coined by a Czech novelist Karel Capek in a 1920 play titled Rassum's Universal Robots (RUR)
- Robot in Czech is a word for worker or servant

Karel Capek

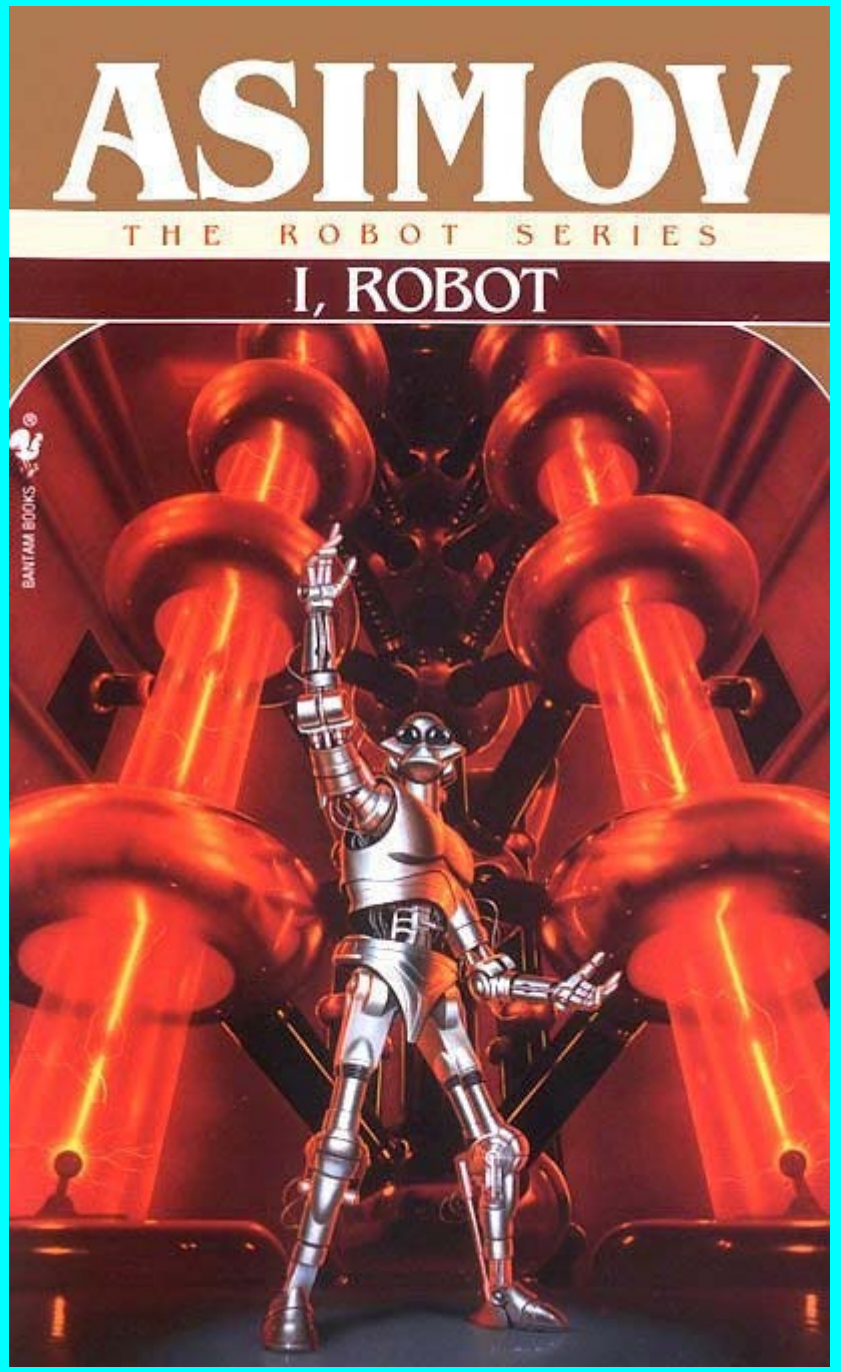
- Definition of robot:

  –Any machine made by by one our members: Robot Institute of America ☺

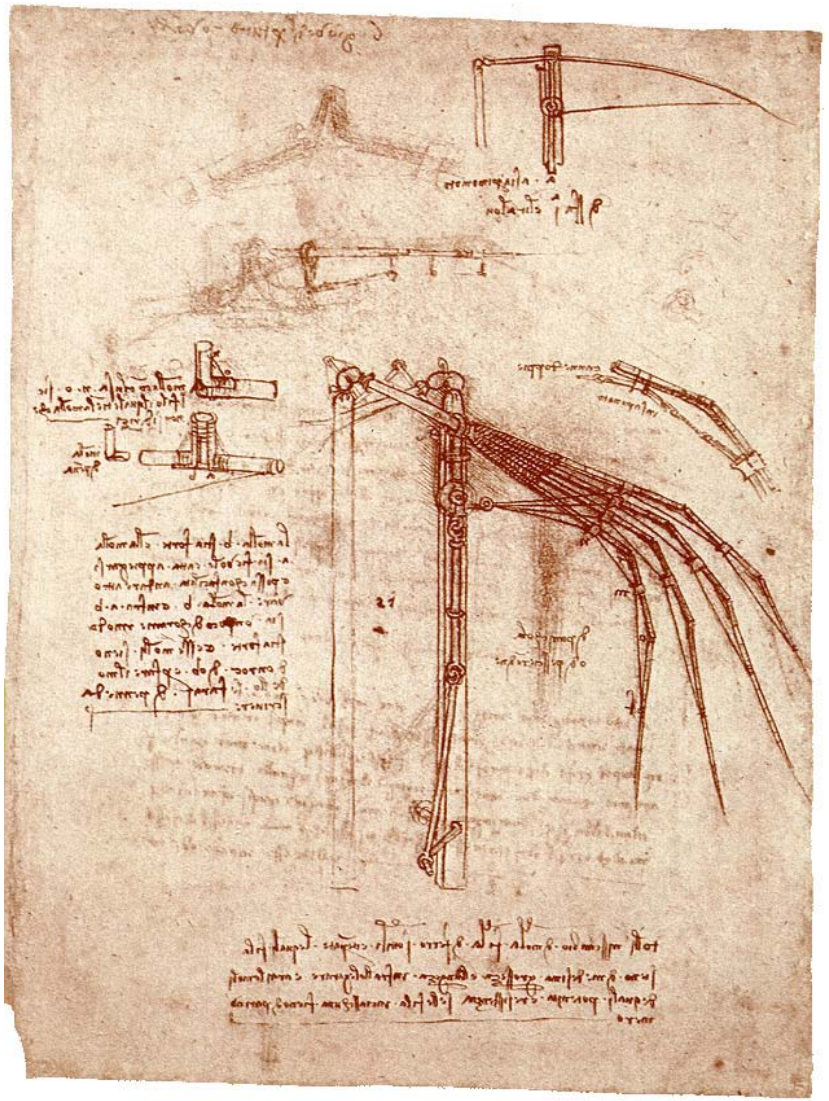
  –A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks: Robot Institute of America, 1979

Laws of Robotics

- Asimov proposed three “Laws of Robotics” and later added the “zeroth law”
- Law 0: A robot may not injure humanity or through inaction, allow humanity to come to harm
- Law 1: A robot may not injure a human being or through inaction, allow a human being to come to harm, unless this would violate a higher order law
- Law 2: A robot must obey orders given to it by human beings, except where such orders would conflict with a higher order law
- Law 3: A robot must protect its own existence as long as such protection does not conflict with a higher order law



Dates in Robotics History



In ancient time

3500 BC

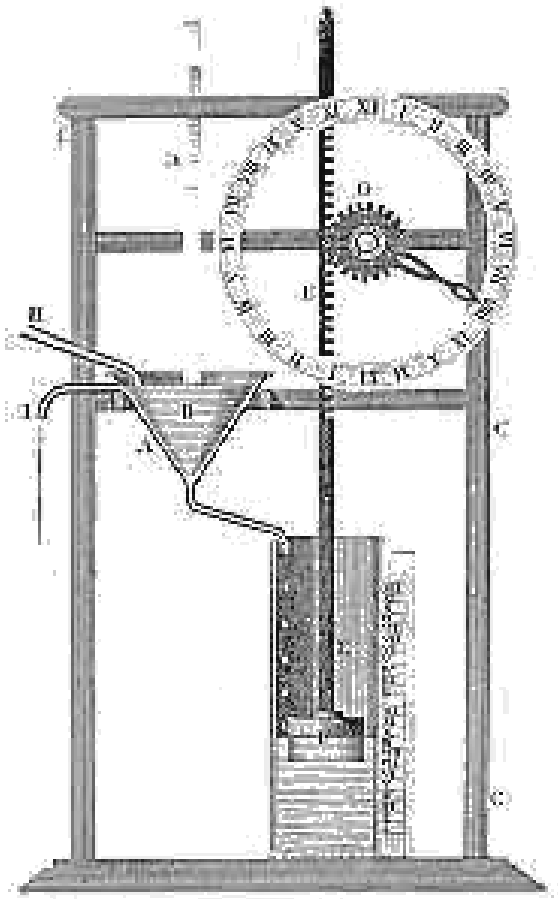
Greek myths incorporated the idea of *intelligent robots*.

2500 BC

Egyptians invent the idea of *thinking machines*.

1400 BC

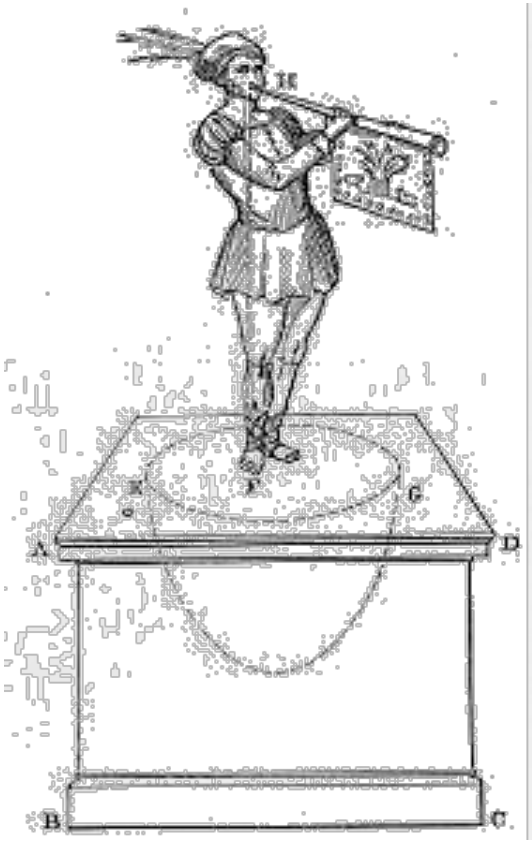
Babylonians develop a *water Clock*, the "clepsydra."

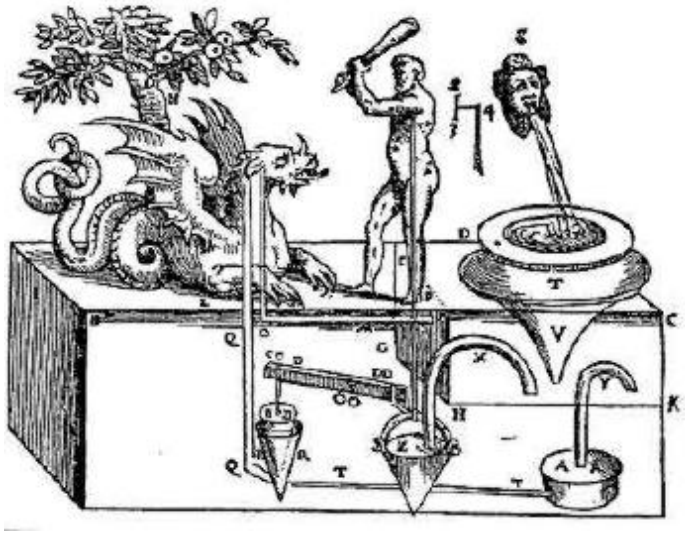


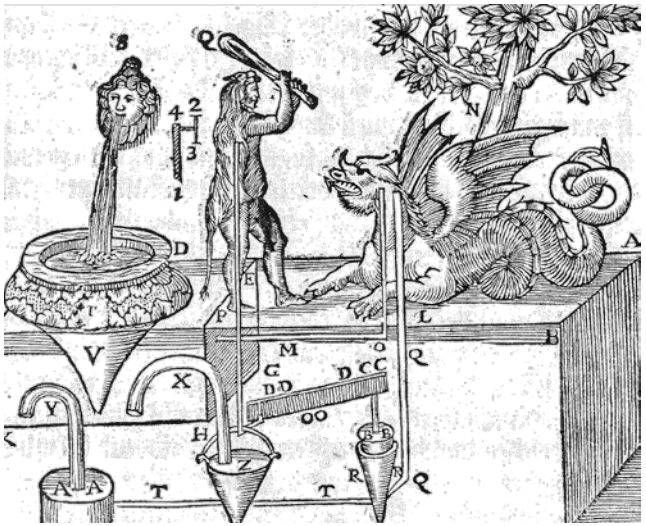
Clepsydra

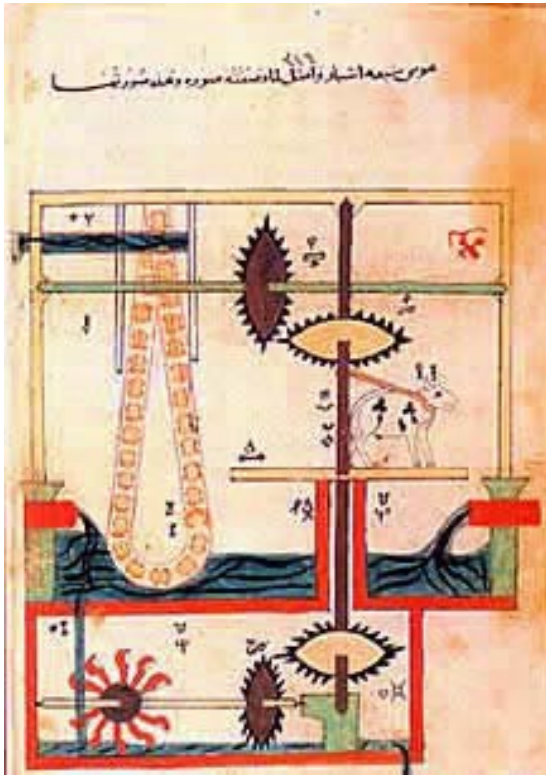
Heron of Alexandria Automata (10-75)

The PNEUMATICS









1200

Al-Jazari: wrote *Automata*

1495

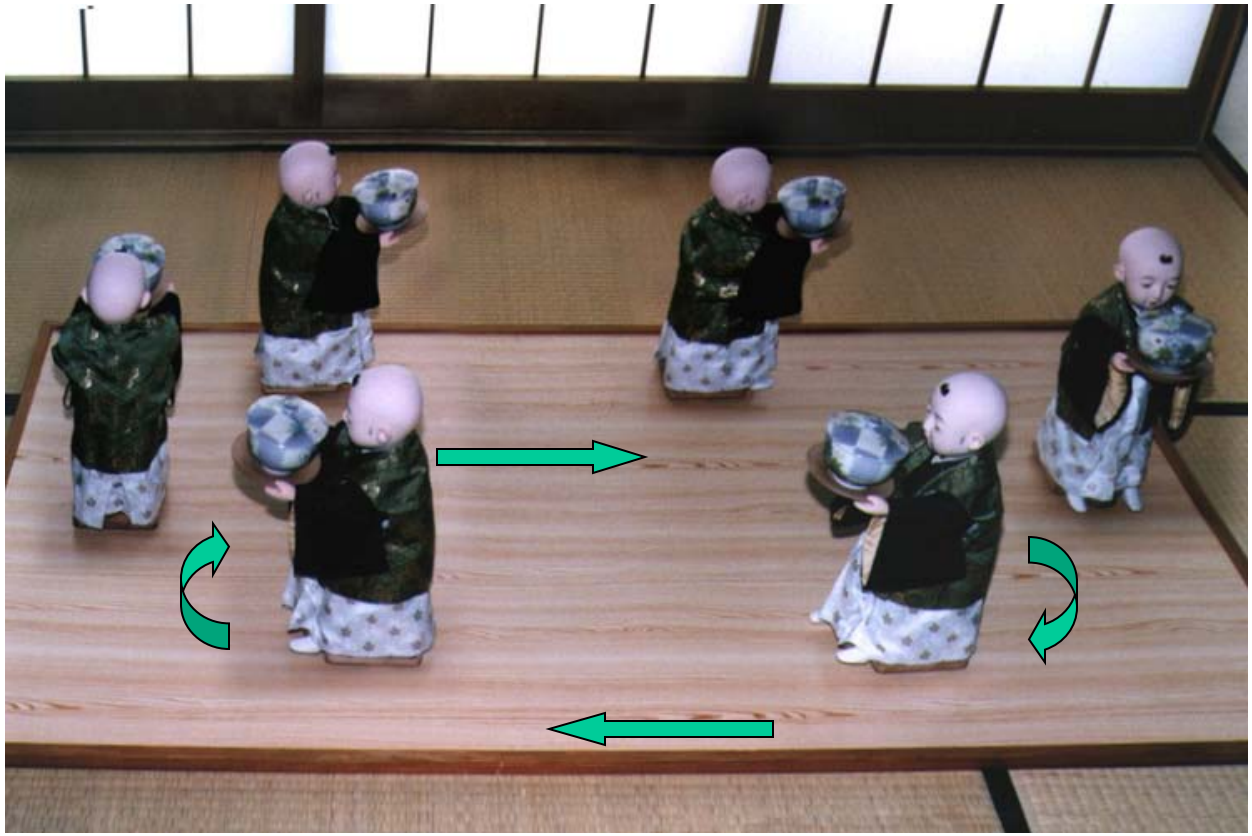
Leonardo da Vinci:

Humanoid Automaton

1773 Jaquet-Droz's Automatons

The Drawer - The Musician - The Writer

1796 KARAKURI “Tea Service” Doll



1818

Mary Shelley wrote ***"Frankenstein."***

1921

The word “**ROBOT**” in Karel Capek’s, R.U.R (Rossum's Universal Robots).

1926

Fritz Lang's movie ***"Metropolis."***

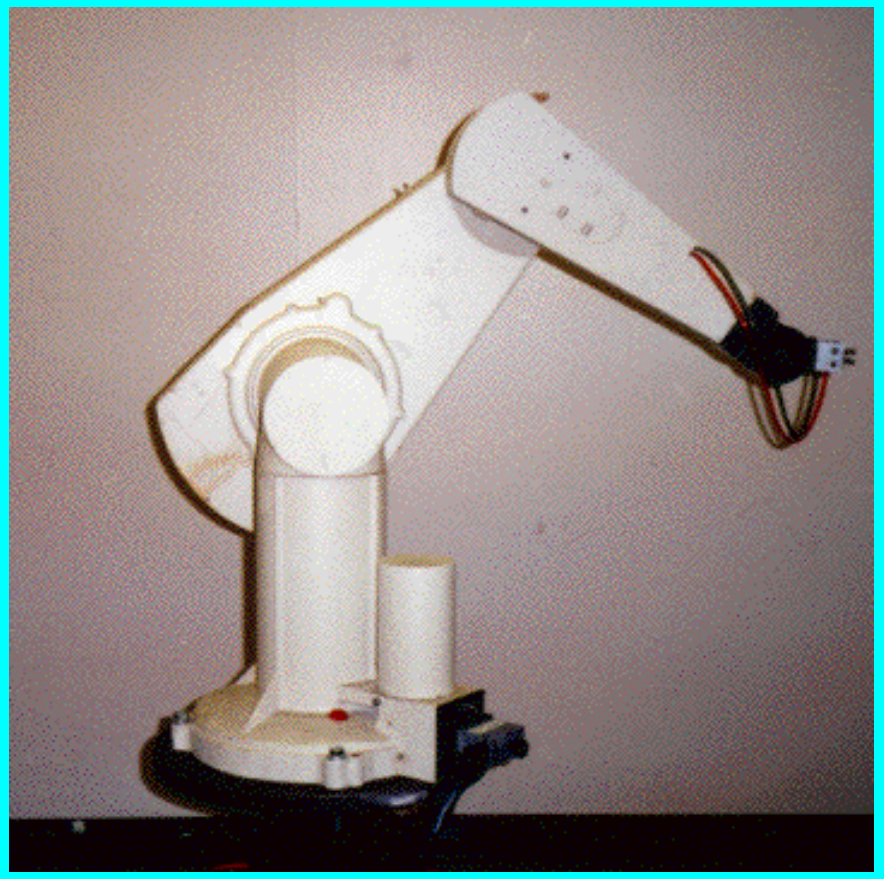
History of Robotics: I

- **The first industrial robot: UNIMATE**
- 1954: The first programmable robot is designed by George Devol, who coins the term Universal Automation. He later shortens this to Unimation, which becomes the name of the first robot company (1962).

UNIMATE originally automated the manufacture of TV picture tubes

History of Robotics: II

1978: The Puma (Programmable Universal Machine for Assembly) robot is developed by Unimation with a General Motors design support



PUMA 560 Manipulator

History of Robotics: III

1980s: The robot industry enters a phase of rapid growth. Many institutions introduce programs and courses in robotics. Robotics courses are spread across mechanical engineering, electrical engineering, and computer science departments.

Adept's SCARA robots

Cognex In-Sight Robot

Barrett Technology Manipulator

History of Robotics: IV

1995-present: Emerging applications in small robotics and mobile robots drive a second growth of start-up companies and research

2003: NASA's Mars Exploration Rovers will launch toward Mars in search of answers about the history of water on Mars

Robots in Industry

- Agriculture
- Automobile
- Construction
- Entertainment
- Health care: hospitals, patient-care, surgery , research, etc.
- Laboratories: science, engineering , etc.
- Law enforcement: surveillance, patrol, etc.
- Manufacturing
- Military: demining, surveillance, attack, etc.
- Mining, excavation, and exploration
- Transportation: air, ground, rail, space, etc.
- Utilities: gas, water, and electric
- Warehouses

Industrial Applications of Robots

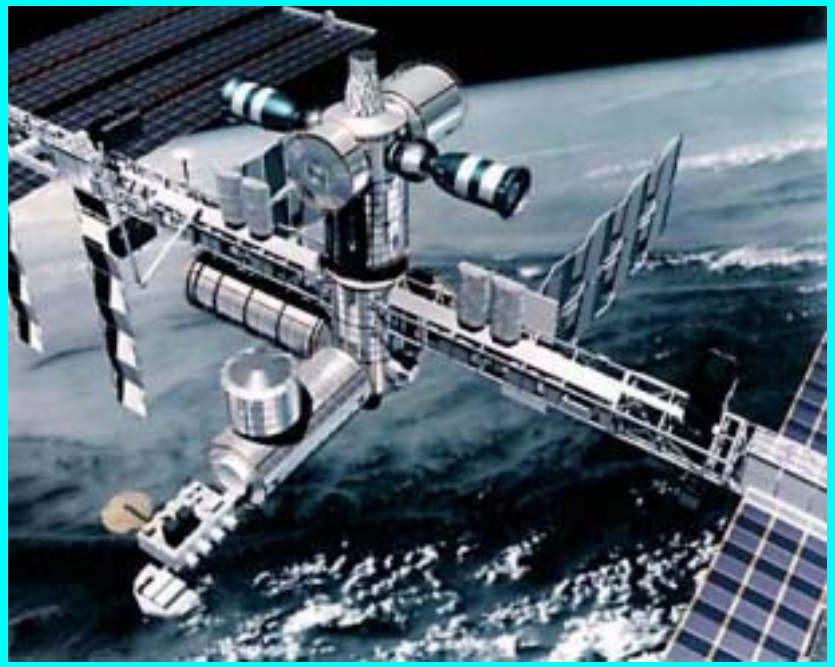
- Material handling
- Material transfer
- Machine loading and/or unloading
- Spot welding
- Continuous arc welding
- Spray coating
- Assembly
- Inspection

Material Handling Manipulator

Assembly Manipulator

Spot Welding Manipulator

Robots in Space



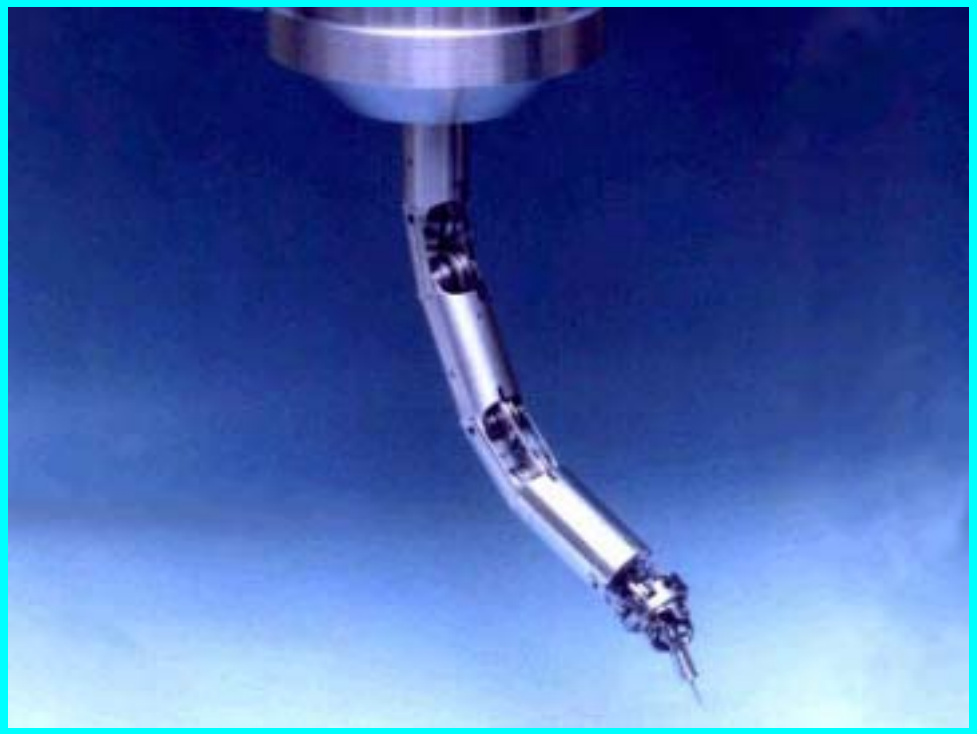
NASA Space Station

Robots in Hazardous Environments

TROV in Antarctica operating under water

HAZBOT operating in atmospheres containing combustible gases

Medical Robots



Robotic assistant for micro surgery

Robots in Military

SPLIT STRIKE: Deployed from a sub's hull, Manta could dispatch tiny mine-seeking AUVs or engage in more explosive combat.

PREDATOR

ISTAR

GLOBAL HAWK

GOLDENEYE

Robots at Home

Sony SDR-3X Entertainment Robot

Sony Aido