

History of Robotics

University of Ottawa
ENRICHMENT MINI-COURSE

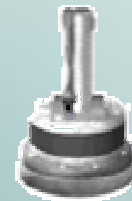
Robotics – Intelligent Connection of the Perception to Action

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Introduction

- Definitions
- The early stages
- Our times
- The future



Definitions

What is the definition of a 'robot'?

- “A reprogrammable, multifunctional **manipulator** designed to move material, parts, tools, or specialized devices through various **programmed motions** for the performance of a variety of **tasks**.”

Robot Institute of America, 1979

- “Force through **intelligence**.”
- “Where AI (Artificial Intelligence) meet the real world.”
- “An **automatic device** that performs functions normally ascribed to humans or a machine in the form of a human.”

Webster's Dictionary

The Early Stages

Early Mythology



The notion of **putting machines to work** for us to perform routine tasks on command can be credited to great thinkers like **Aristotle** (384-322 BC).

The Early Stages (cont.)

13th – 15th Century

- Inventors were busy developing real **automatons** that **mimicked human mannerisms**. This first generation of robots were clock controlled ornaments with self-moving parts.
- An automated rooster erected on top of the cathedral in Strasbourg in 1350 is a good example. It was designed to flap its wings and crow every day at noon.

The Early Stages (cont.)

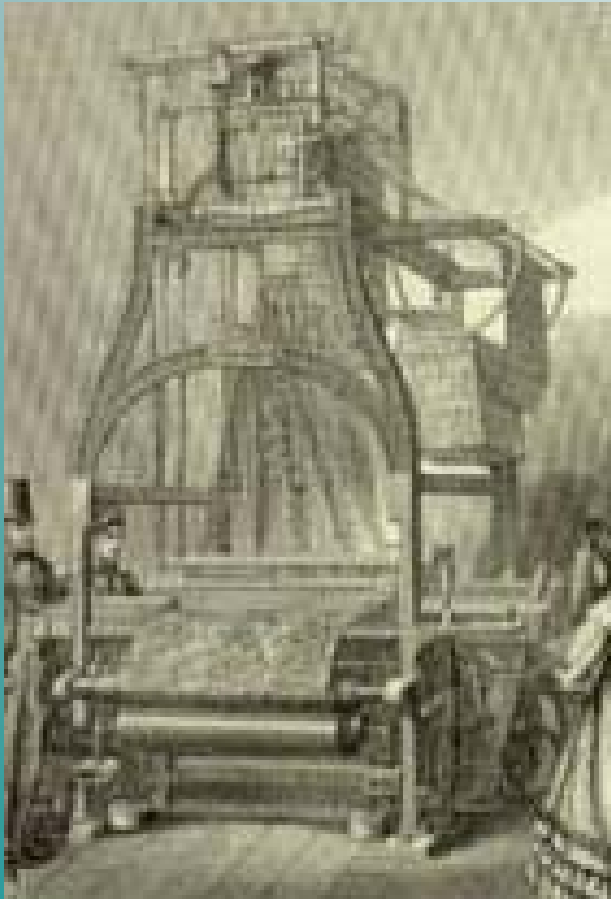
18th Century

In 1774 inventors Pierre and Henri-Louis Jacquet-Droz unveiled the “**Automatic Scribe**”. This lifelike figure of a boy could draw and write any message up to 40 characters long. A robot woman **playing a piano** was another one of their great inventions.



The Early Stages (cont.)

19th Century



- Unlike the **toy automatons** of 18th century, robots of the 1800s were chiefly designed to meet the growing demands of a flourishing **industrial society**.
- A good example is this **Textile Machine**. Operated by punch cards, this programmable Loom was capable of mass production and is one of the earliest machines to store a programme designed to control its entire operation.

The Early Stages (cont.)

19th Century (cont.)

- 1890: **Thomas Edison** used a condensed version of his phonograph invention in the design of the famous **talking doll**.



- 1898: **Nikola Tesla**, a famous inventor, patents the first remote controlled device. The '**teleautomaton**' was a crewless boat that was controlled from a distance without wires.



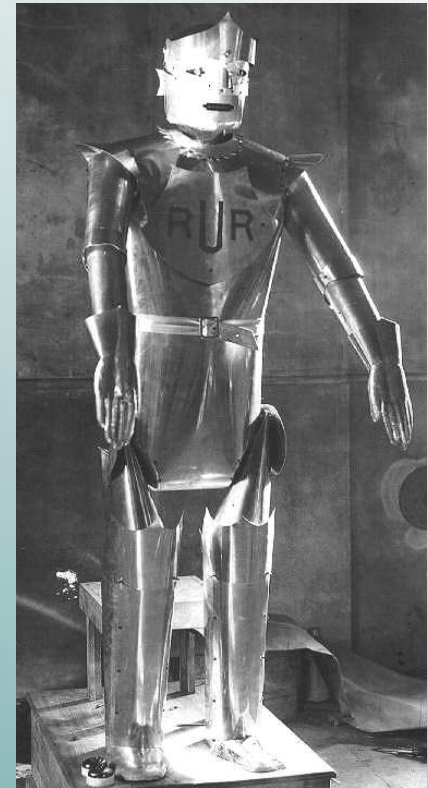
The Early Stages (cont.)

20th Century

- 1921: The first reference to the word **robot** is made in a play by Czech writer **Karel Capek** (1890 - 1938) - R.U.R (Rossum's Universal Robots). The word comes from the Czech “robota” which means serf or one in subservient labour.



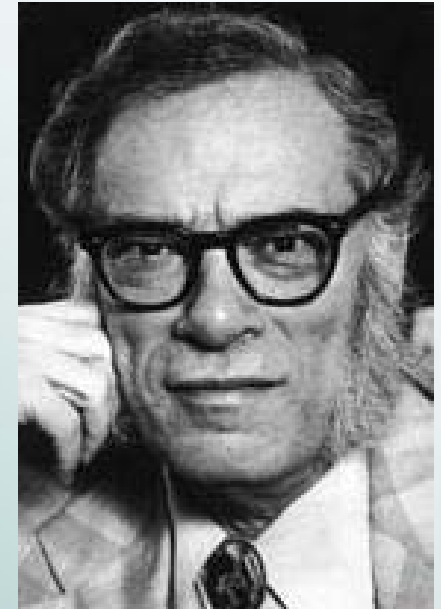
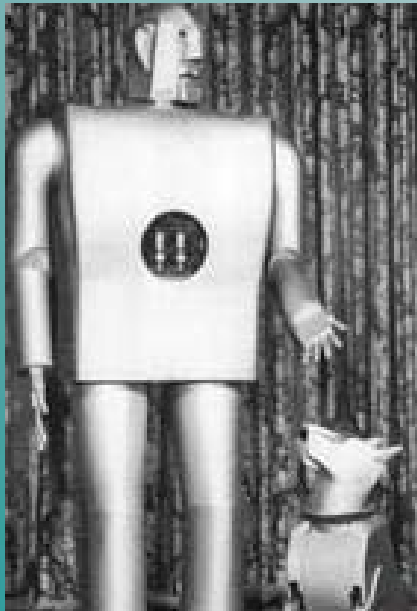
- In the play, the Czech robot is defined as "a worker of forced labour". After this play, electromechanical automatons were referred to as robots.



The Early Stages (cont.)

20th Century (cont.)

- 1940: Westinghouse Electric Corp. creates two of the **first robots** that use the **electric motor** for entire body motion. Elektra could dance, count to ten and smoke, while his dog companion Sparko, could walk, stand on its hind legs and bark.



- 1941: **Isaac Asimov** first uses the term '**robotics**' to describe the technology of robots. He predicted the rise of the robot industry.

The Early Stages (cont.)

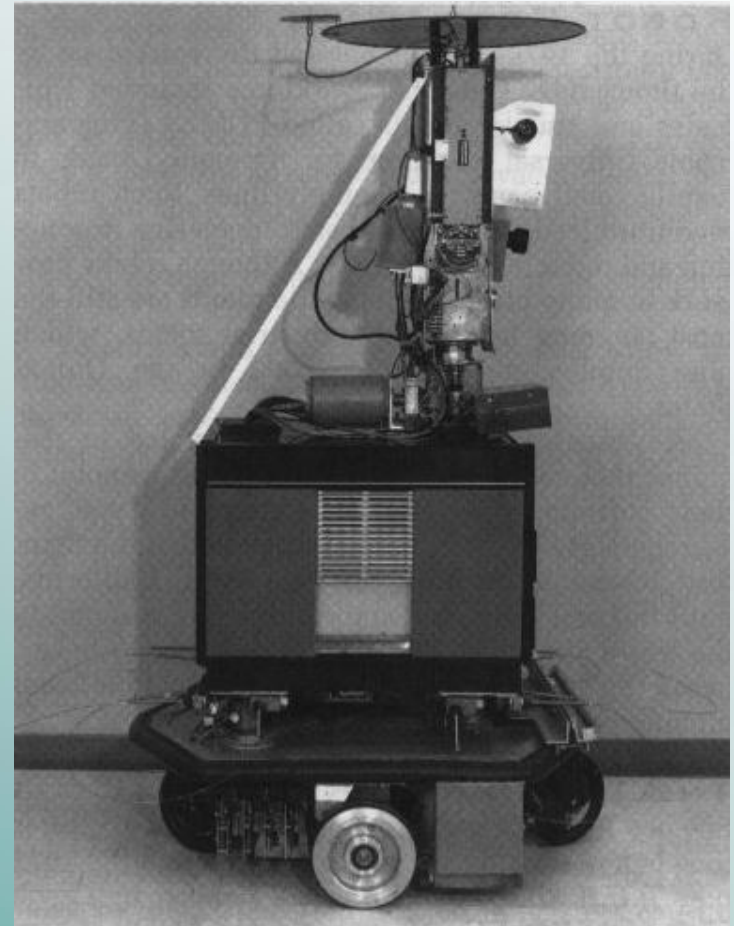
20th Century (cont.)

- Dr. W. Grey Walter, one of the great pioneers in the field of robotics, develops the first **autonomous** tortoise-type **robots**, Elsie and Elmer (ElectroMEchanical Robot, Light-Sensitive), designed with wheel motors controlled by very basic electronic circuitry and two vacuum tubes.
- 1951: Raymond Goertz designs the first 'teleoperator' - a device allowing **actions to be performed at a distance**. Goertz's device was an articulated arm, used to handle radioactive material.
- 1962: General Motors installs the first **industrial robot** on a production line. It is a Unimate robot and is used in a car factory run by General Motors in Trenton, New Jersey. The robot lifted hot pieces of metal from a die-casting machine and stacked them.

The Early Stages (cont.)

20th Century (cont.)

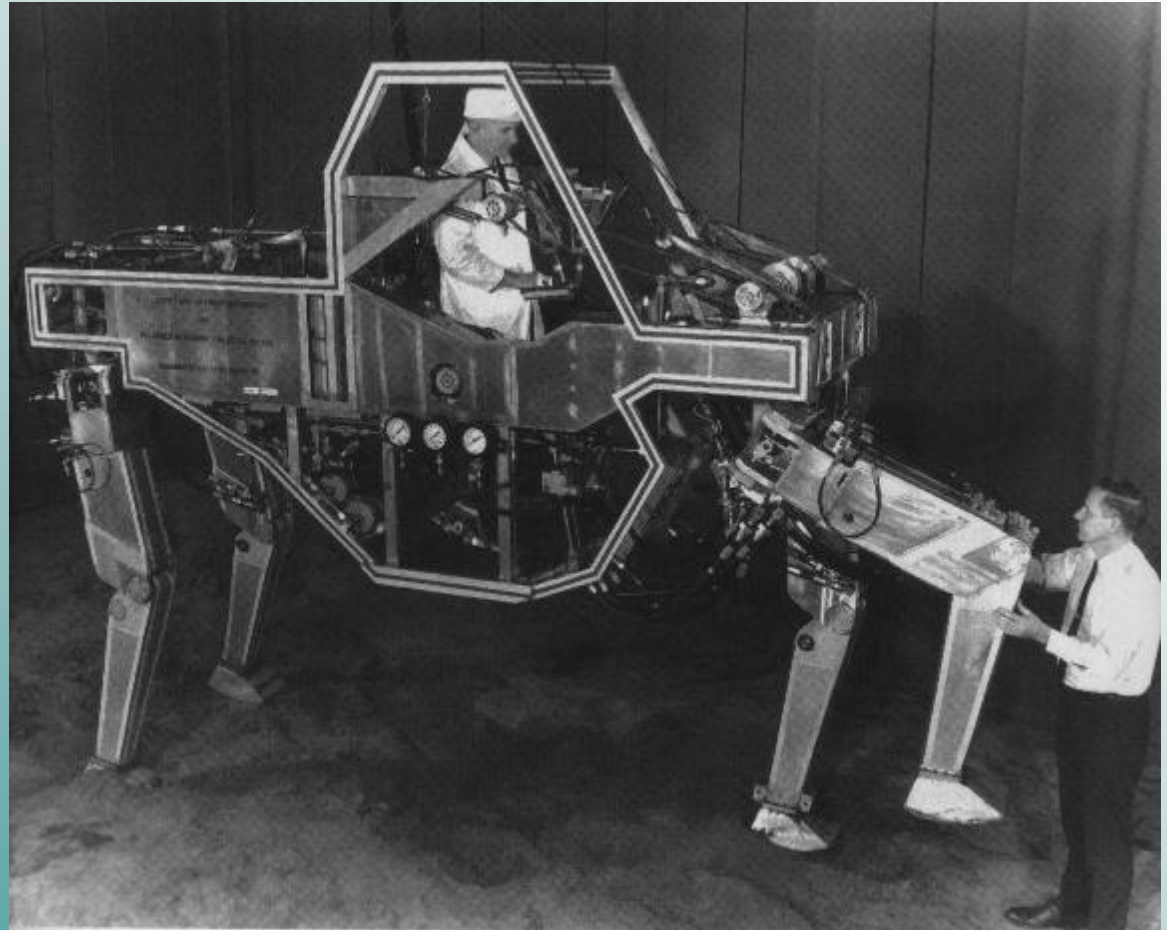
- 1968: SRI International, formerly known as the Stanford Research Institute, builds and tests the **first mobile robot with vision capability**. 'Shakey' was equipped with a television camera, a range finder and sensors.
- **Shakey** was the first mobile robot that could **think** and **respond** to the world around it.



The Early Stages (cont.)

20th Century (cont.)

1968: The General Electric **Walking Truck** was the first manual controlled walking truck.



The Early Stages (cont.)

20th Century (cont.)

- 1969: Stanford University develop the first electrically powered **computer controlled robotic arm**. This becomes standard for research projects.



- 1974: Professor Sheinman, of Stanford Arm fame, forms Vicarm Inc. to market a version of the arm controlled by microcomputer for **industrial applications**. This robotic arm, known as the Silver Arm performs small-parts assembly using touch sensitive sensors.

Our Times

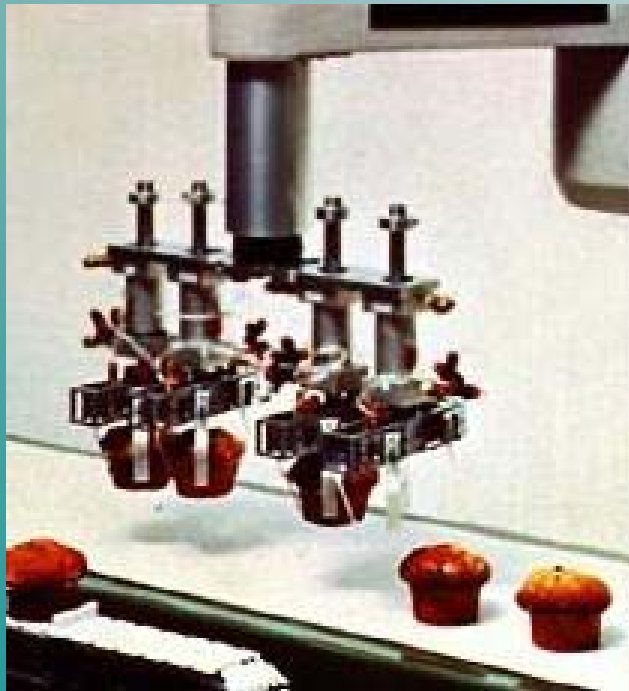
- Industry
- Military
- Research
- Space

Our Times (cont.)

Material Handling

A robot is required to **palletize** soft packages onto a pallet.

- Robot Palletizer for the Sugar and Flour Industry



- Handle with care: robotic system packages muffins.



Our Times (cont.)

Material Handling (cont.)



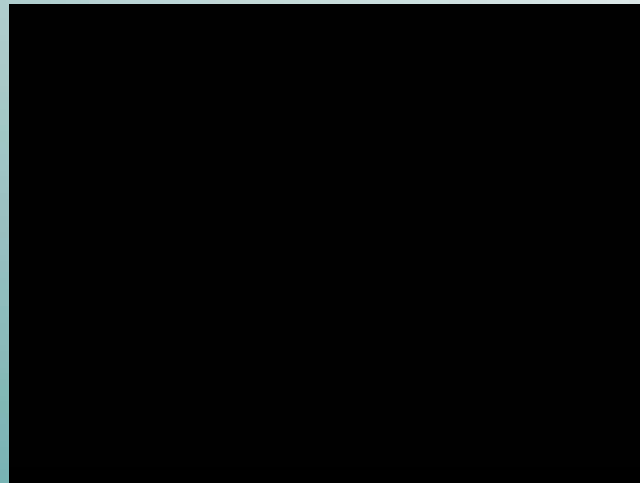
Our Times (cont.)

Automotive - Welding



Our Times (cont.)

Automotive – Deburring Crankshafts



Our Times (cont.)

Automotive - Painting



Our Times (cont.)

Bomb disposal robots make a dangerous job a little less hazardous. They're designed to search for, locate and neutralise explosive devices.



Our Times (cont.)

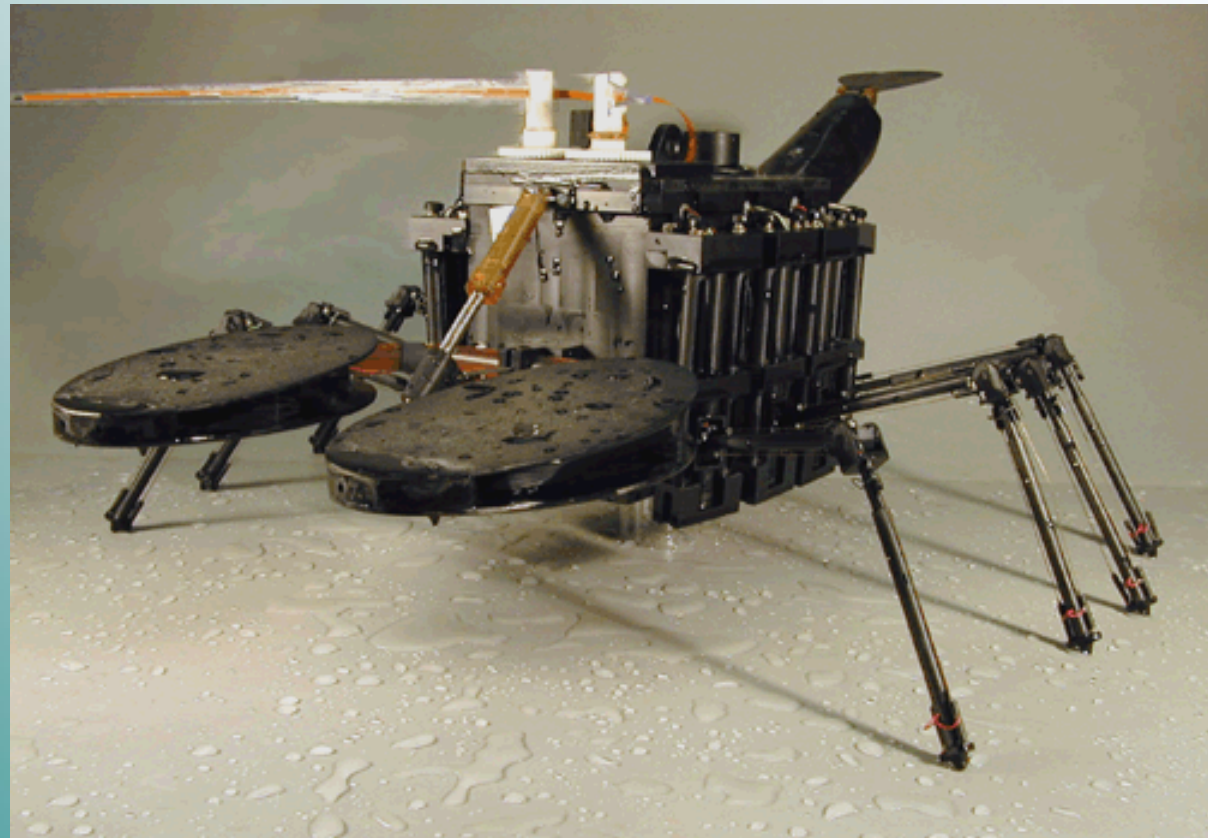
One of the main advantages of robots is their ability to operate in environments that are hazardous or deadly to humans. American scientists developed **Pioneer** in response to the disaster at the Chernobyl Nuclear Power Station. This robot was designed to withstand large doses of radiation and is capable of clearing debris.



Our Times (cont.)

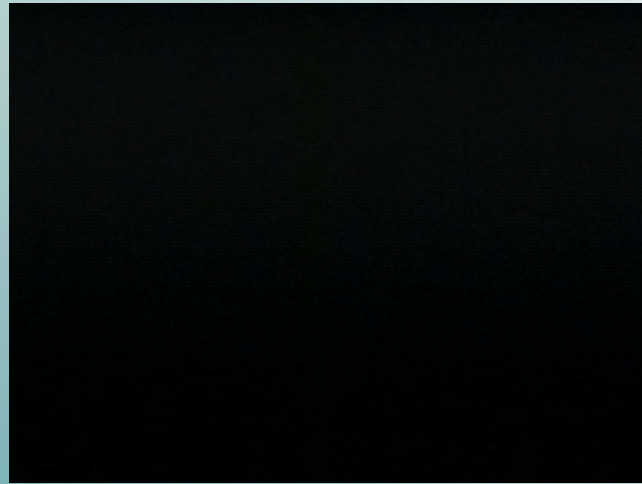
Research - biology

Biologically inspired ("biomimetic") autonomous **underwater robots** based on the lobster and the lamprey (an eel-like jawless vertebrate).



Our Times (cont.)

Research – biology (cont.)

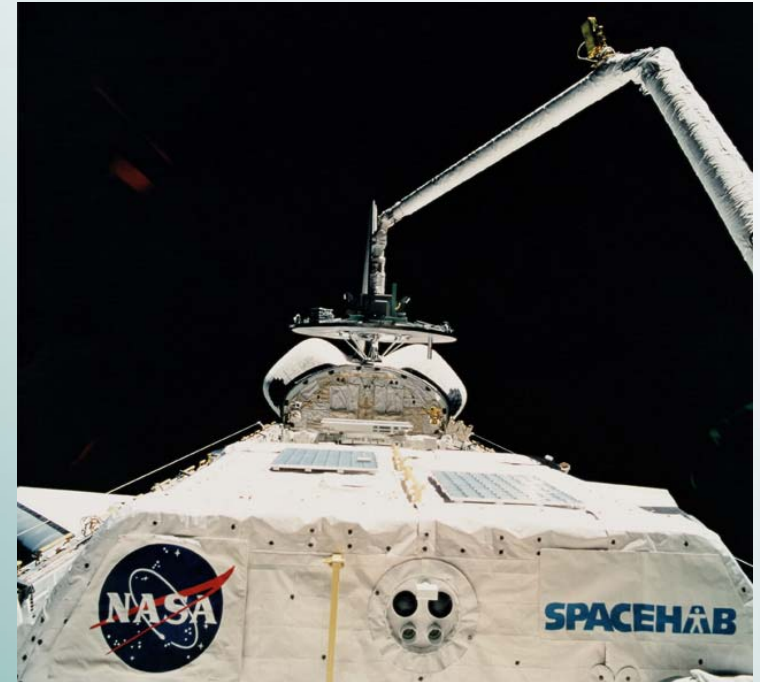
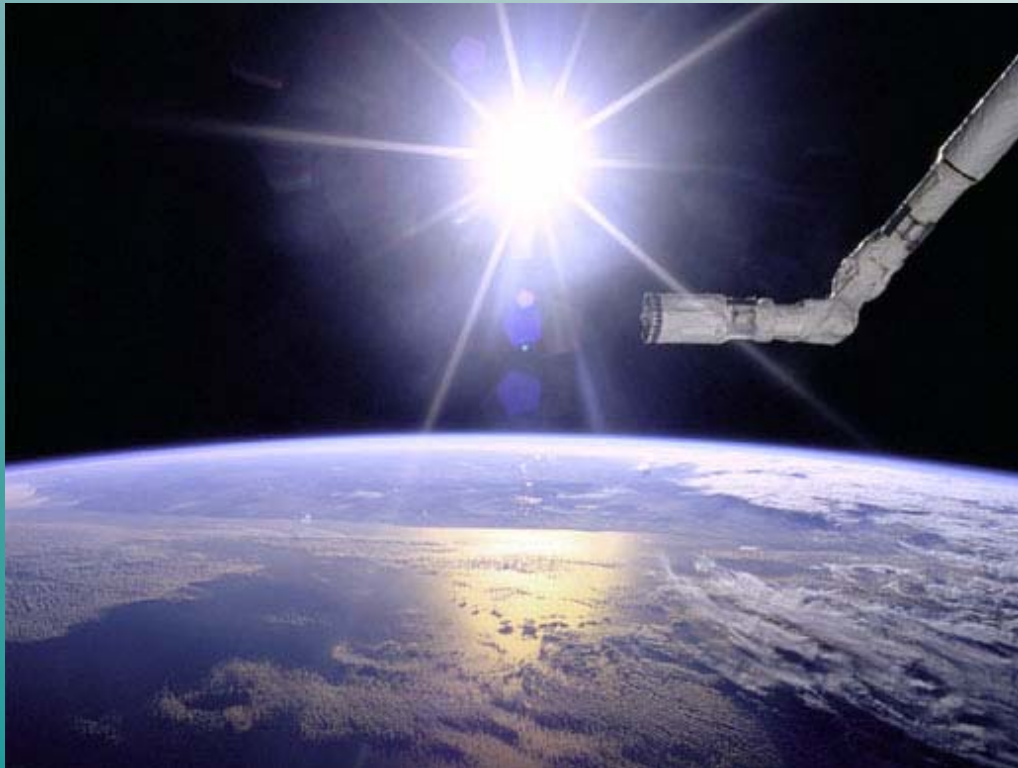


Robot III - Biologically inspired

Our Times (cont.)

Research – exploring the outer space

Canadarm - Canada's most famous robot and technological achievement - made its space debut on November 13, 1981.



It was given to NASA as Canada's contribution to the Space Shuttle Program.

Our Times (cont.)

Research – exploring the outer space (cont.)



Officially known as the **Shuttle Remote Manipulator System (SRMS)**, Canadarm is an analogue of the human arm, with nerves of copper wiring, bones of graphite fibre and electric motors in place of muscles. Like its human counterpart, it has various rotating joints, two at the shoulder, one at the elbow and three at the wrist.

Our Times (cont.)

The arm is controlled by its **brain**, a sophisticated computer. It has been designed such that it can work both manually with astronauts using hand controls to operate it, or automatically. Its hand is a wire-snare device designed to fit over a special prong or grapple fixture attached to a satellite.



Our Times (cont.)

Research – exploring other planets

NASA – Rovers, Landers, Pathfinders

Mars Pathfinder was originally designed as a technology demonstration of a way to deliver an instrumented lander and a free-ranging robotic rover to the surface of the red planet. Pathfinder not only accomplished this goal but also returned an unprecedented amount of data and outlived its primary design life.

Mars Pathfinder used an innovative method of directly entering the Martian atmosphere, assisted by a parachute to slow its descent through the thin Martian atmosphere and a giant system of airbags to cushion the impact.

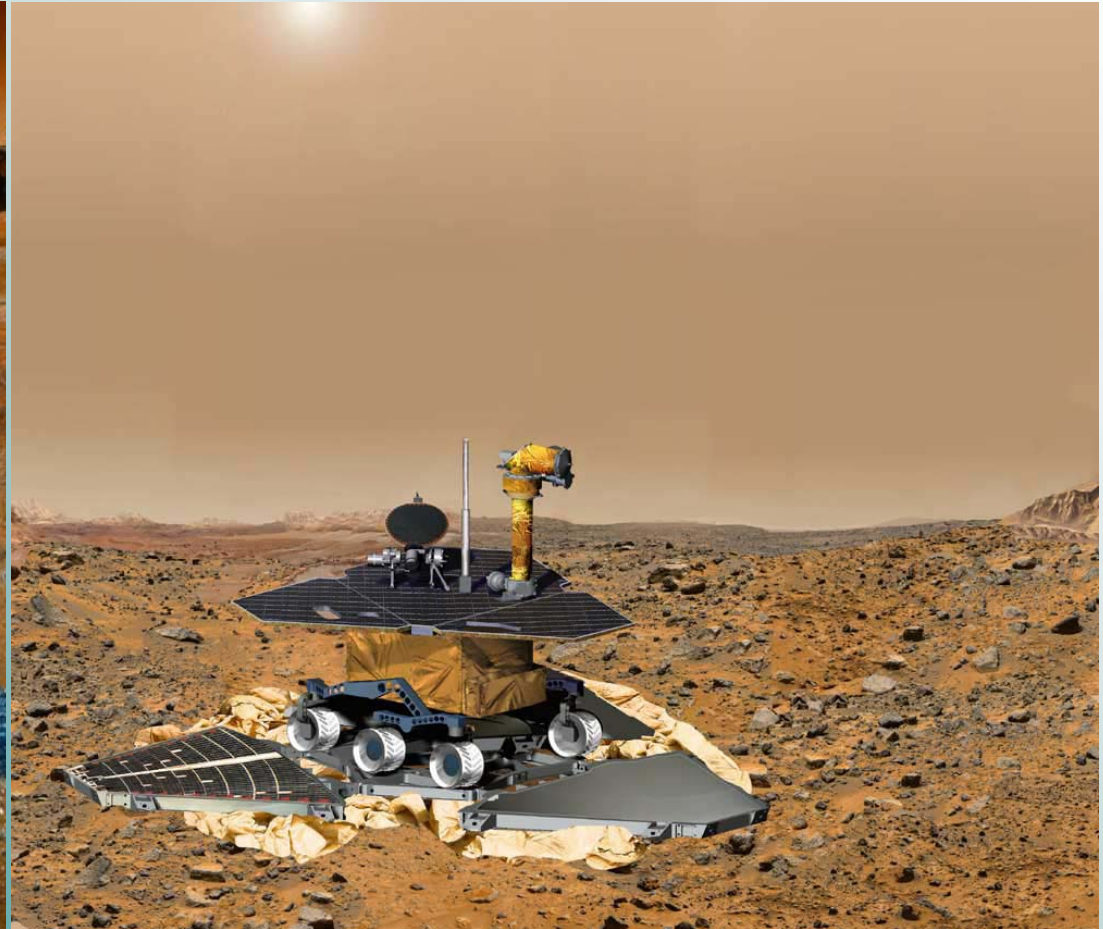
Our Times (cont.)

Research – exploring other planets (cont.)



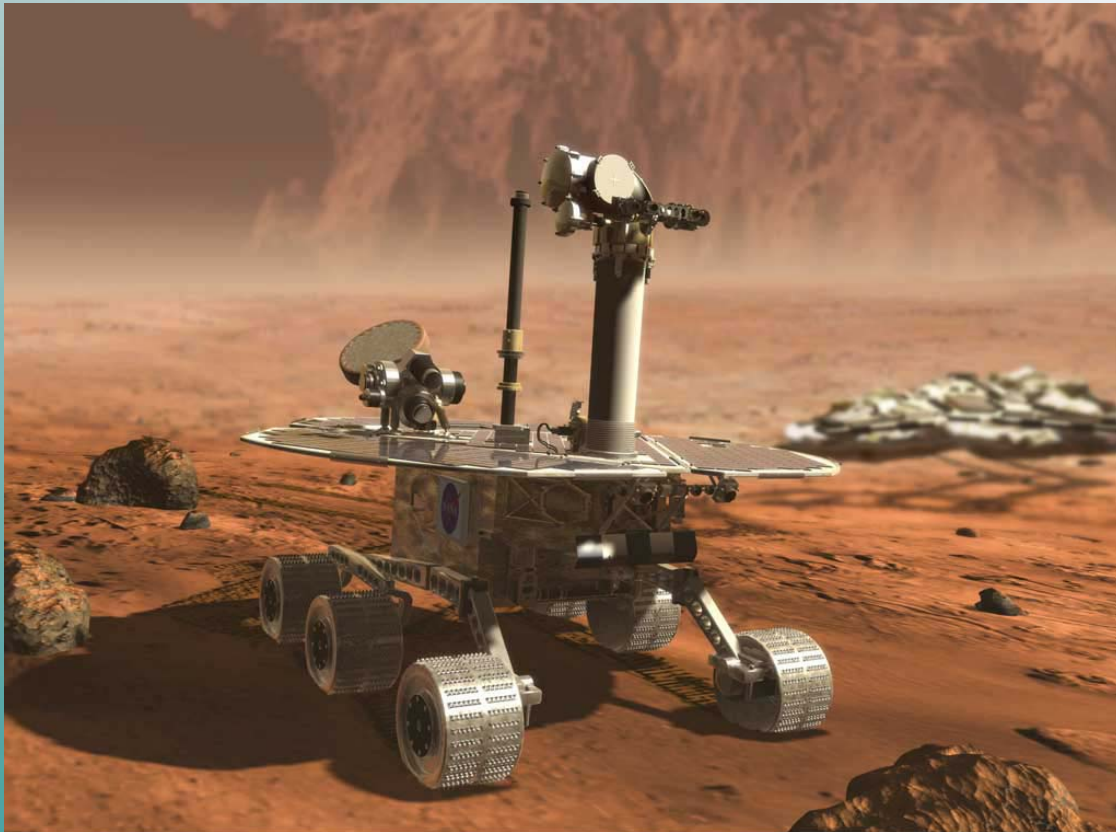
Our Times (cont.)

Research – exploring other planets (cont.)



Our Times (cont.)

Research – exploring other planets (cont.)



Our Times (cont.)

Weird robots



- **K9**, a **robot dog**, was the long term assistant of Dr WHO (played at the time by Tom Baker) - one of the most popular of his travelling companions. Although he looked rather harmless, K9 did come equipped with a weapon that came out of his 'nose'.

Our Times (cont.)

Weird robots (cont.)



Robocow

This bizarre looking robot was built in 1996 as a device for training a **cowboy's horse**. It has been programmed to mimic the movements of a cow. The idea was to have a device that could prepare the horse for meeting the real thing.

Our Times (cont.)

Weird robots (cont.)



The **Roboroo** robot was developed by Holden, a car-making firm in Australia. Engineers wanted to design better protective bars for their cars and this plastic and metal test dummy was ideal to assess the effects of collisions with suicidal kangaroos. The first Roboroo was built in 1994.

Our Times (cont.)

Toys

- **Robodog** is the world's most powerful, advanced and largest commercial legged robot. It has a wide range of 'senses' to interact with. These allow it to balance, position itself, see and hear.



- Robodog can think and act for itself as it overcomes obstacles and navigates around any room. This amazing machine uses voice recognition to understand and act on up to 60 verbal instructions, not to mention reading out your emails.
- When away on holiday you can take control of Robodog by logging into the robot via the net, manoeuvre it around your home seeing through its two way camera eyes, and hearing through its ears.

Our Times (cont.)

Toys (cont.)



AIBO was designed by Sony. The idea was to create a robot that was cute and could interact with people. AIBO can express emotions of happiness, sadness, anger, surprise, fear and dislike. It uses sounds and melodies, body language and light. You can talk to AIBO and it'll respond. You can play with it and also give it commands.

Our Times (cont.)

In 1997 Honda produced a robot that was more human-like than any other. Honda's aim was to produce a two-legged robot with the ability to be totally mobile in everyday environments. The **P3** can walk around, climb stairs, carry things, pick things up and push things. Its camera-based 'eyes' help it to position itself accurately in its environment and stay balanced when walking or even climbing stairs.



Our Times (cont.)

The technology used for the P3 was incorporated into Honda's dancing robot **ASIMO**, the latest in the range. Its ability to move has been increased and a new portable controller makes it much easier to operate.



Our Times (cont.)

ASIMO



Our Times (cont.)

ASIMO (cont.)



Our Times (cont.)

The **Micro Machine**, a miniature robot, can inspect pipes and also fix problems while the power plant is still running.



Here you can see the 0.42 gram ant-size robot pushing a one yen coin, which is 2 cm in diameter and weighs 1 gram.

The Future

- Nanotechnology
- Telesurgery

The Future (cont.)

Nanotechnology

Nanomedicine is a branch of **nanotechnology** which includes the construction, repair, monitoring and control of the human body at the molecular level.

Basically this technology will be comprised of tiny **nanomachines** and programmable **nanorobots** which will be able to operate on the human body with greater precision than ever before imagined.

The Future (cont.)

Telesurgery

The idea of robots performing **open-heart surgery** sounds like science fiction but recently this idea has become a reality.





Telesurgery (cont.)

With the invention of the “da Vinci Surgical System”, introduced in 1999 by the California company Intuitive Surgical, surgeons can operate on patients while sitting at a **computer console** from across the room where they control a **robot** much like playing a **video game**.

References

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- www.fanucrobotics.com
- <http://asimo.honda.com>
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- www.site.uottawa.ca/~petriu

Thank You!

