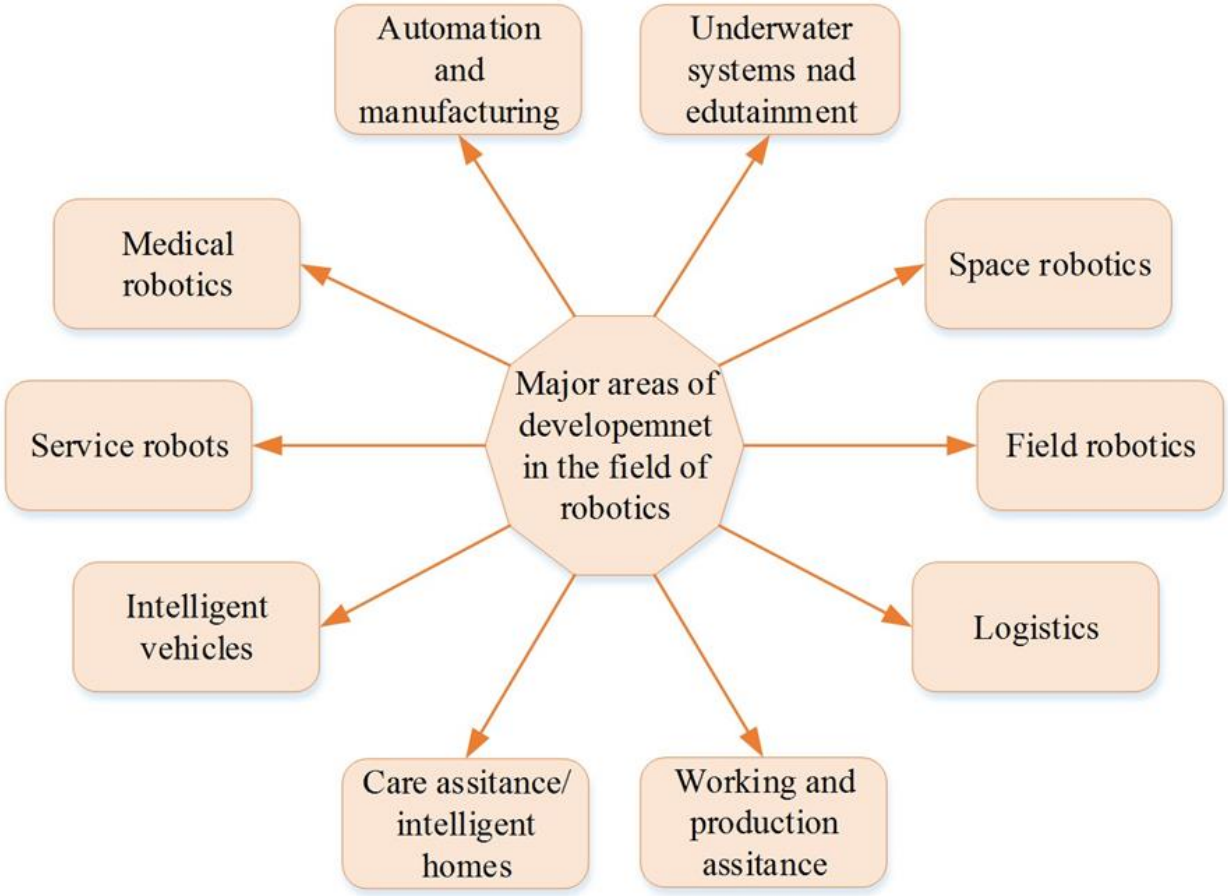
21AIE201-INTRODUCTION TO ROBOTICS

Robots — A 50 year journey

Robots — A 50 year journey


Major areas of developemnet in the field of robotics
Automation and manufacturing
Underwater systems nad edutainment
Medical robotics
Space robotics
Service robots
Field robotics
Intelligent vehicles
Logistics
Care assitance/ intelligent homes
Working and production assitance

Aerospace: This is a broad category. It includes all sorts of flying robots—the **SmartBird robotic seagull** and the **Raven surveillance drone**, for example—but also robots that can operate in space, such as Mars rovers and NASA's Robonaut, the humanoid that flew to the International Space Station and is now back on Earth.

SmartBird robotic seagull

Raven surveillance drone

NASA's Robonaut

Consumer: Consumer robots are robots you can buy and use just for fun or to help you with tasks and chores.

Examples are the robot dog Aibo, the Roomba vacuum, AI-powered robot assistants, and a growing variety of robotic toys and kits..

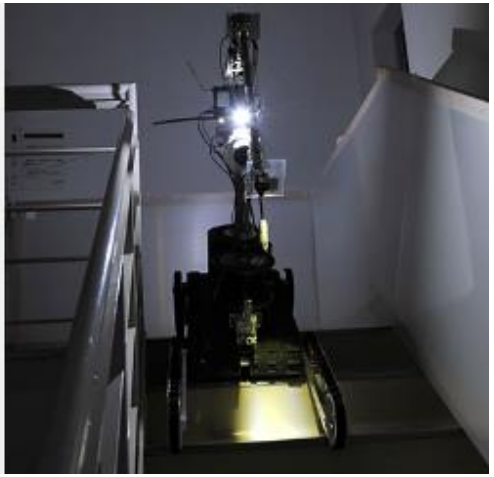
Aibo

Roomba

Disaster Response: These robots perform dangerous jobs like searching for survivors in the aftermath of an emergency.

For example, after an earthquake and tsunami struck Japan in 2011, Packbots were used to inspect damage at the Fukushima Daiichi nuclear power station.





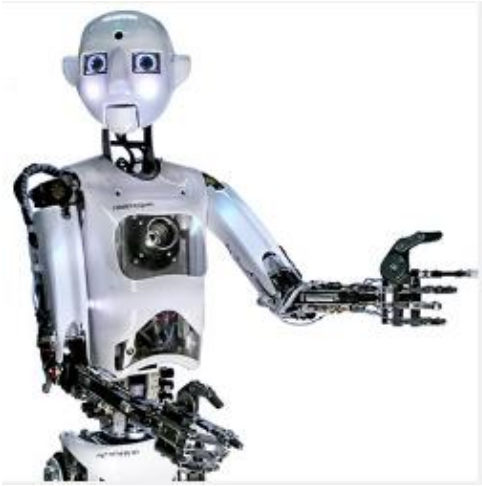
Drones: Also called unmanned aerial vehicles, drones come in different sizes and have different levels of autonomy.

Examples include DJI's popular Phantom series and Parrot's Anafi, as well as military systems like Global Hawk, used for long-duration surveillance.

Education: This broad category is aimed at the next generation of roboticists, for use at home or in classrooms. It includes hands-on programmable sets from Lego, 3D printers with lesson plans, and even teacher robots like EMYS.

Entertainment: These robots are designed to evoke an emotional response and make us laugh or feel surprise or in awe.

Among them are robot comedian RoboThespian, Disney's theme park robots like Navi Shaman, and musically inclined bots like Partner.



Exoskeletons: Robotic exoskeletons can be used for physical rehabilitation and for enabling a paralyzed patient walk again. Some have industrial or military applications, by giving the wearer added mobility, endurance, or capacity to carry heavy loads.

Humanoids: This is probably the type of robot that most people think of when they think of a robot.

Examples of humanoid robots include Honda's Asimo, which has a mechanical appearance, and also androids like the Geminoid series, which are designed to look like people.

Industrial: The traditional industrial robot consists of a manipulator arm designed to perform repetitive tasks.

An example is the Unimate, the grandfather of all factory robots.

This category includes also systems like Amazon's warehouse robots and collaborative factory robots that can operate alongside human workers.

Medical: Medical and health-care robots include systems such as the da Vinci surgical robot and bionic prostheses, as well as robotic exoskeletons.

A system that may fit in this category but is not a robot is Watson, the IBM question-answering supercomputer, which has been used in healthcare applications.

Military & Security: Military robots include ground systems like Endeavor Robotics' PackBot, used in Iraq and Afghanistan to scout for improvised explosive devices, and BigDog, designed to assist troops in carrying heavy gear. Security robots include autonomous mobile systems such as Cobalt.

BigDog

PackBot

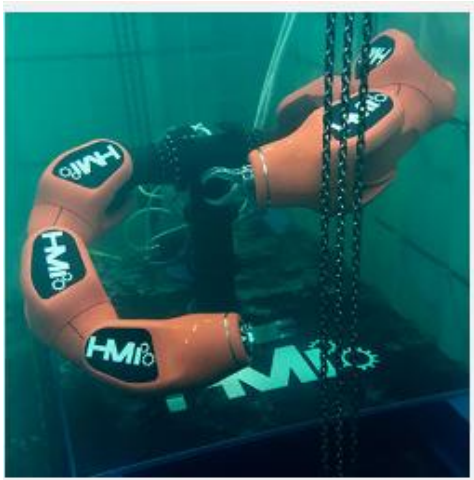
Research: The vast majority of today's robots are born in universities and corporate research labs.

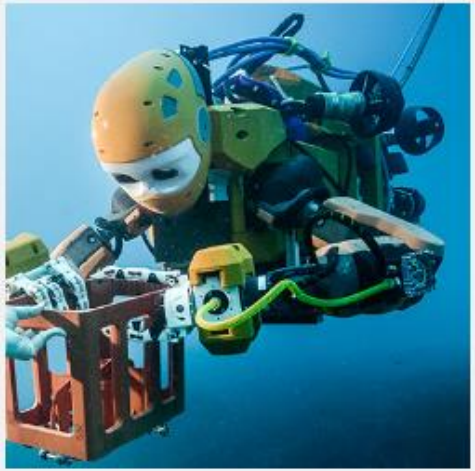
Though these robots may be able to do useful things, they're primarily intended to help researchers do, well, research. So although some robots may fit other categories described here, they can also be called research robots.

Self-Driving Cars: Many robots can drive themselves around, and an increasing number of them can now drive *you* around. Early autonomous vehicles include the ones built for DARPA's autonomous-vehicle competitions and also Google's pioneering self-driving Toyota Prius, later spun out to form Waymo.

Telepresence: Telepresence robots allow you to be present at a place without actually going there. You log on to a robot avatar via the internet and drive it around, seeing what it sees, and talking with people. Workers can use it to collaborate with colleagues at a distant office, and doctors can use it to check on patients.

Underwater: The favourite place for these robots is in the water. They consist of deep-sea submersibles like Aquanaut, diving humanoids like Ocean One, and bio-inspired systems like the ACM-R5H snakebot.





HISTORY OF ROBOTICS

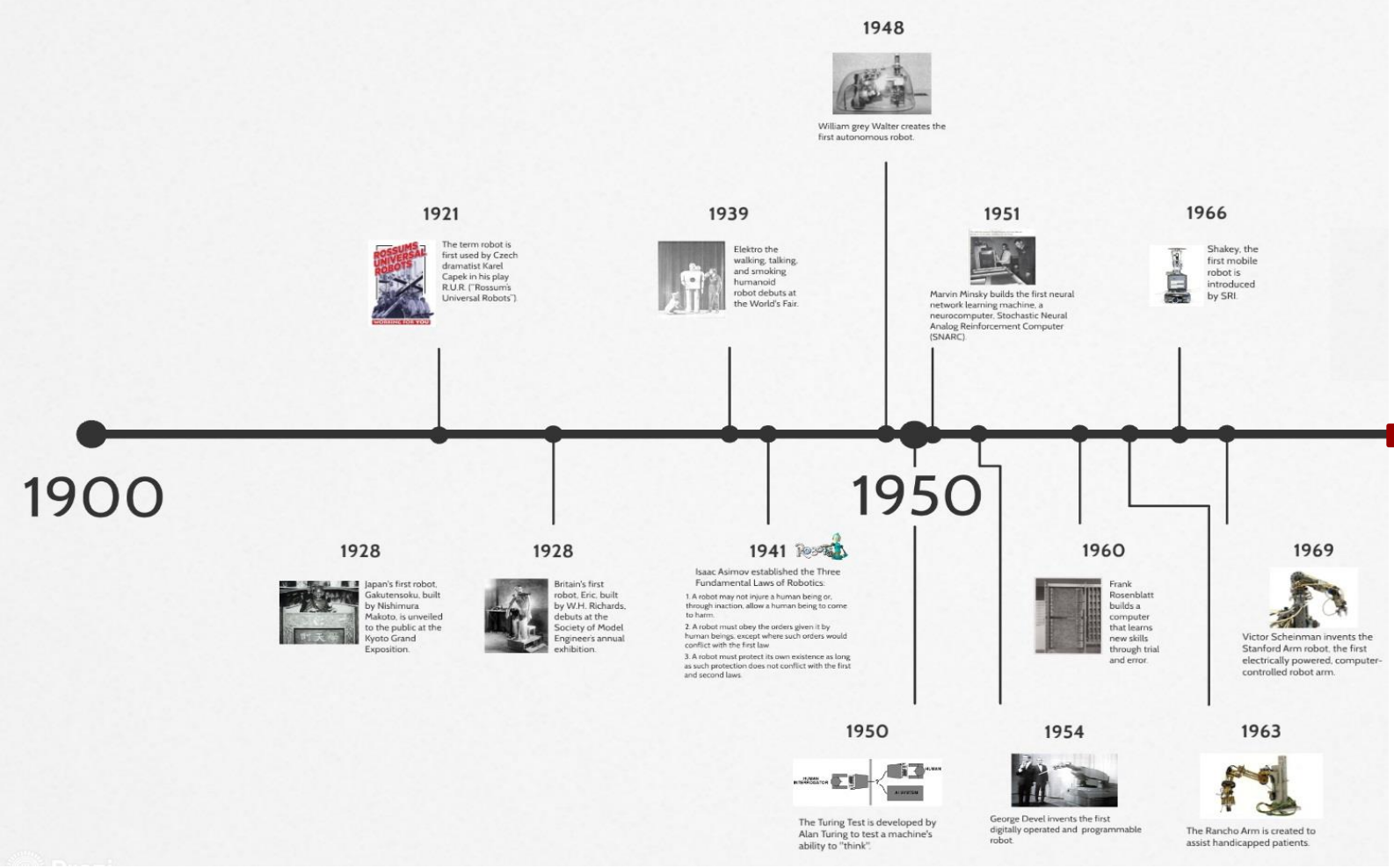
Karel Čapek's R.U.R., 1920

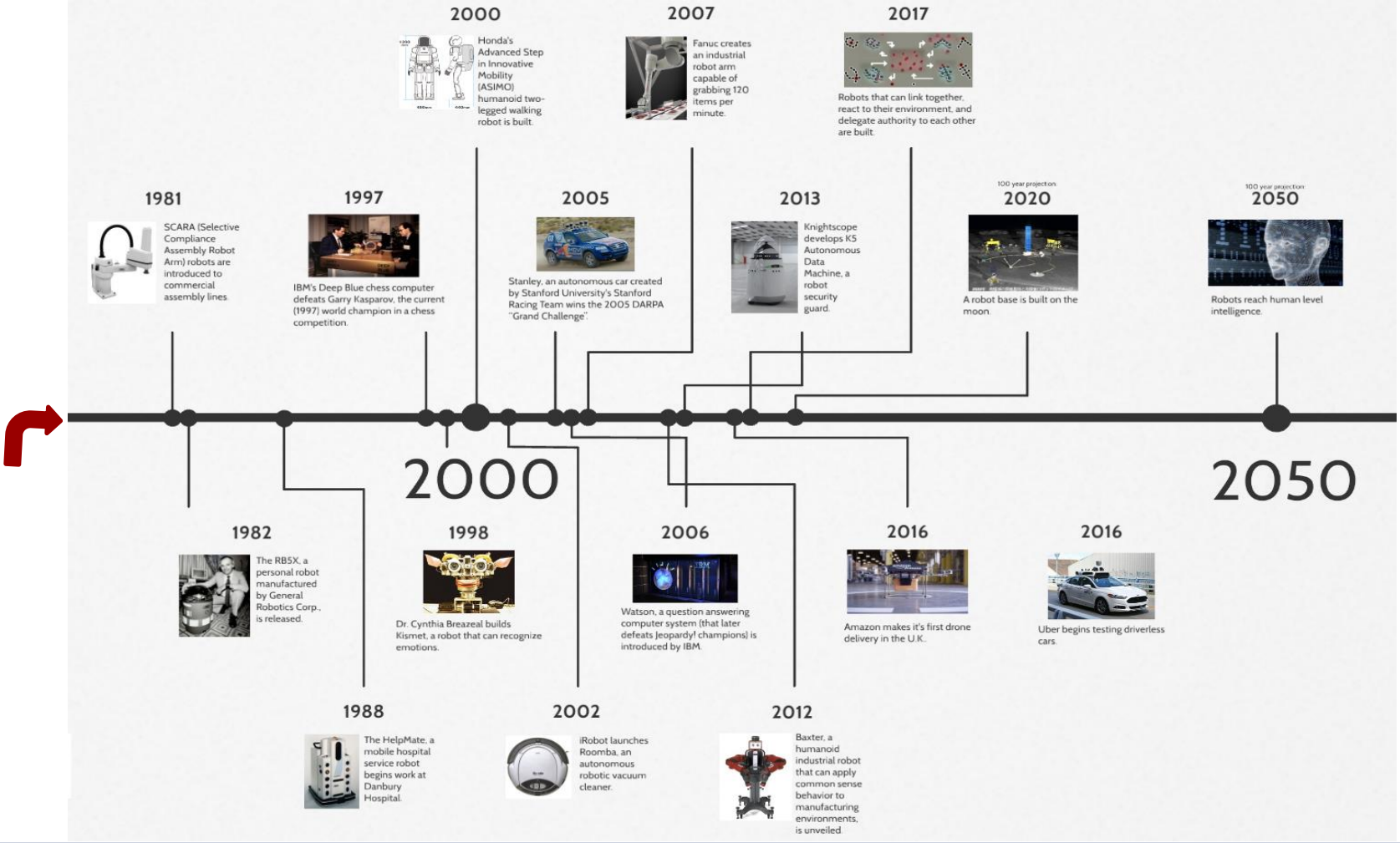
robot - from *robota*, meaning serf labor, drudgery, hard work, servitude

Westinghouse's Electro, 1940

FIRST INDUSTRIAL ROBOT

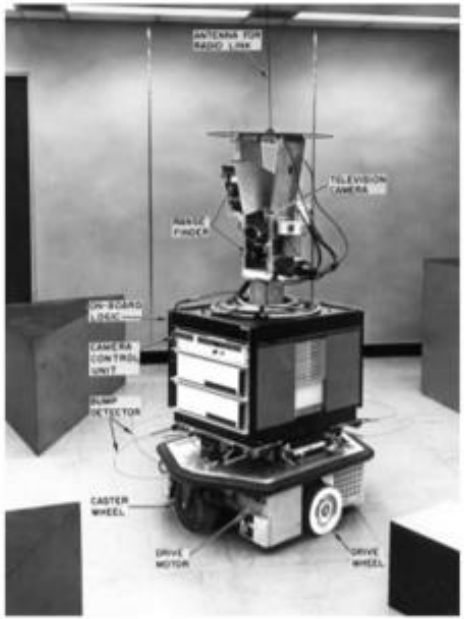
Unimate was the first industrial robot, which worked on a General Motors assembly line at the Inland Fisher Guide Plant in Ewing Township, New Jersey, in 1961


1900
1921
The term robot is first used by Czech dramatist Karel Capek in his play R.U.R. ("Rossum's Universal Robots").
1928
Japan's first robot, Gakutensoku, built by Nishimura Makoto, is unveiled to the public at the Kyoto Grand Exposition.
1928
Britain's first robot, Eric, built by W.H. Richards, debuts at the Society of Model Engineers annual exhibition.
1939
Elektro the walking, talking, and smoking humanoid robot debuts at the World's Fair.
1941
Isaac Asimov established the Three Fundamental Laws of Robotics:
1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings, except where such orders would conflict with the first law.
3. A robot must protect its own existence as long as such protection does not conflict with the first and second laws.
1948
William grey Walter creates the first autonomous robot.
1950
1950
The Turing Test is developed by Alan Turing to test a machine's ability to "think".
1951
Marvin Minsky builds the first neural network learning machine, a neurocomputer, Stochastic Neural Analog Reinforcement Computer (SNARC).
1954
George Devel invents the first digitally operated and programmable robot.
1960
Frank Rosenblatt builds a computer that learns new skills through trial and error.
1963
The Rancho Arm is created to assist handicapped patients.
1966
Shakey, the first mobile robot is introduced by SRI.
1969
Victor Scheinman invents the Stanford Arm robot, the first electrically powered, computer-controlled robot arm.


2000
Honda's Advanced Step in Innovative Mobility (ASIMO) humanoid two-legged walking robot is built.
2007
Fanuc creates an industrial robot arm capable of grabbing 120 items per minute.
2017
Robots that can link together, react to their environment, and delegate authority to each other are built.
1981
SCARA (Selective Compliance Assembly Robot Arm) robots are introduced to commercial assembly lines.
1997
IBM's Deep Blue chess computer defeats Garry Kasparov, the current (1997) world champion in a chess competition.
2005
Stanley, an autonomous car created by Stanford University's Stanford Racing Team wins the 2005 DARPA "Grand Challenge".
2013
Knightscope develops K5 Autonomous Data Machine, a robot security guard.
100 year projection
2020
A robot base is built on the moon.
100 year projection
2050
Robots reach human level intelligence.
2000
2050
1982
The RB5X, a personal robot manufactured by General Robotics Corp., is released.
1998
Dr. Cynthia Breazeal builds Kismet, a robot that can recognize emotions.
2006
Watson, a question answering computer system (that later defeats Jeopardy! champions) is introduced by IBM.
2016
Amazon makes it's first drone delivery in the U.K..
2016
Uber begins testing driverless cars.
1988
The HelpMate, a mobile hospital service robot begins work at Danbury Hospital.
2002
iRobot launches Roomba, an autonomous robotic vacuum cleaner.
2012
Baxter, a humanoid industrial robot that can apply common sense behavior to manufacturing environments, is unveiled.

Isaac Asimov: "Runaround," 1942

Shakey (SRI, 1968) and Mobie (Stanford,?)



Stanford Scheinman Arm,1969

Star Wars - 1977

R2-D2 and C-3PO

PUMA, 1978

Joseph Engelberger

Unimation's Programmable Universal Machine for Assembly (PUMA)

Biomemetics: Lobster 1992

Joseph Ayers
Northeastern

full neural emulation

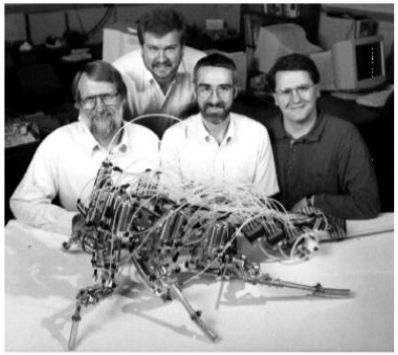
CMU Dante - 1993

exploring Antarctica's Mount Erebus volcano.

MIT Leg Lab - 1989-1995

Marc Raibert

Biomemetics Deaths Head Cockroach - 1998



death head cockroach

full gait simulation

full neural simulation

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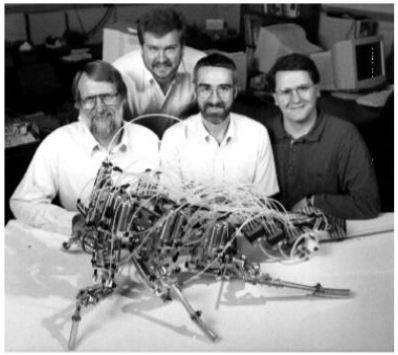

death head cockroach

full gait simulation

full neural simulation

Da Vinci Surgical Robot - *ca.* 2000

$1.2M

Market Acceptability - Roomba - 2002

inexpensive, reliable, functional

HONDA Asimo


ASIMO
The Honda Humanoid Robot ASIMO
1986
History
Robot Development Process
maybe $500M!
2012

DLR's Justin - 2011

Catching Flying Balls and Preparing Coffee
Humanoid Rollin'Justin Performs Dynamic and Sensitive Tasks

B. Bäuml, F. Schmidt, T. Wimböck, O. Birbach[1], A. Dietrich, M. Fuchs,
W. Friedl, U. Frese[1], Ch. Borst, M. Grebenstein, O. Eiberger, and G. Hirzinger

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German Aerospace Center (DLR)
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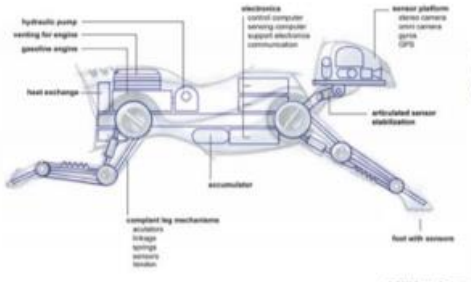
[1]DFKI Safe and Secure Cognitive Systems

a mobile manipulator

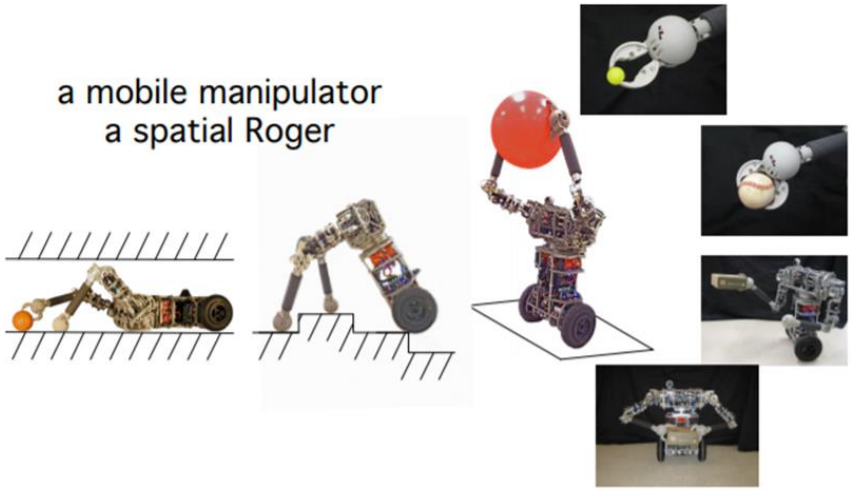


Boston Dynamics
Marc Raibert

Biomemetics: BigDog 2008-2012

uBot: 2004-2012

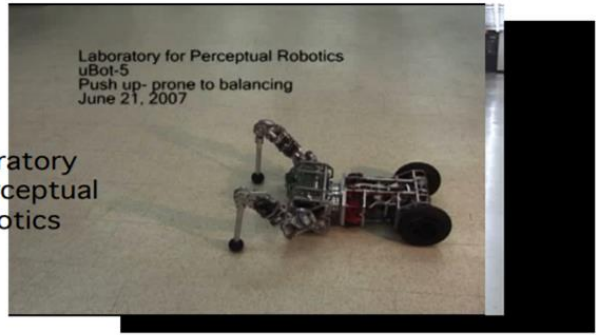
a mobile manipulator
a spatial Roger



uBot: 2004-2012

UMass

Laboratory for Perceptual Robotics



Time for Discussions

Thank You!