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Humanoid Robots

Advanced Robotics research concentrates on an innovative, multidisciplinary approach to humanoid design and control, and the development of novel robotic components and technologies. This encompasses activities from both the hard (mechanical/ electrical design and fabrication, sensor systems, actuation development etc.) and soft (control, computer software, human factors etc) systems areas of robotics.

Bio Medical Applications

The Biomedical Robotics Laboratory focuses on research and development of human-centered robotic technologies. We are a highly multidisciplinary group working towards the creation of novel technologies that can directly impact the health and well-being of people.

The overall research theme involves the creation of robotic systems to augment human capabilities through enhanced interfaces. This includes research in areas such as robot-assisted surgery, micromanipulation, human-robot interfaces, assistive systems for the disabled, medical imaging and computer vision, teleoperation, cognitive controllers, and automation. Typical goals are to improve the consistency, efficiency, usability and safety of difficult and/or delicate operations traditionally performed manually.

Sensing

The 3 D measurements are useful for autonomous mobile robot to recognize its environments as well as the reconstruction of 3 D information of large scale structures in construction sites. The combination of a LRF and a camera can reconstruct the inside of a building.

Actuation

The dexterous hand mechanisms are capable of manipulating and handling various objects in construction sites. A unique finger mechanism is proposed with omnidirectional driving roller to realize the two active rotational axes on the surface of the grasped object.

Mobile Robot

Mobile manipulation is one of the active research areas. A new mobile manipulator platform was designed and built in the NEDO Intelligent Robot Project to promote development of so-called intelligent robot modules (RTM) for generic robot motion programs and application tasks.

Humanoid

The humanoid research and development are one of the most active robotics in Japan. HONDA ASIMO, TOYOTA Partner Robot, and AIST HRPs are well established humanoid platforms. The HRP2 is used as a common platform in universities and institutes where they carry out fundamental researches such as stable walking with energy.

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Artificial Intelligence

From SIRI to self-driving cars, artificial intelligence (AI) is progressing rapidly. While science fiction often portrays AI as robots with human-like characteristics, AI can encompass anything from Google's search algorithms to IBM's Watson to autonomous weapons.

Artificial intelligence today is properly known as narrow AI (or weak AI), in that it is designed to perform a narrow task.

However, the long-term goal of many researchers is to create general AI (AGI or strong AI). While narrow AI may outperform humans at whatever its specific task is, like playing chess or solving equations, AGI would outperform humans at nearly every cognitive task.

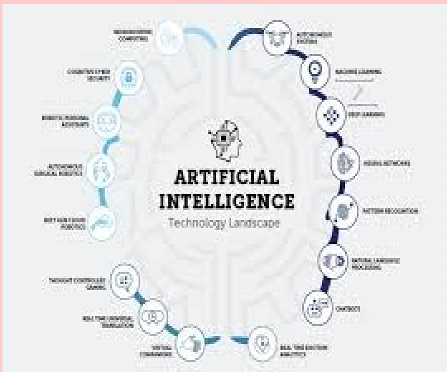
Why Recent Interest In AI Safety

Stephen Hawking, Elon Musk, Steve Wozniak, Bill Gates, and many other big names in science and technology have recently expressed concern in the media and via open letters about the risks posed by AI, joined by many leading AI researchers. Why is the subject suddenly in the headlines?

The idea that the quest for strong AI would ultimately succeed was long thought of as science fiction, centuries or more away. However, thanks to recent breakthroughs, many AI milestones, which experts viewed as decades away merely five years ago, have now been reached, making many experts take seriously the possibility of super intelligence in our lifetime. While some experts still guess that human-level AI is centuries away, most AI researches at the 2015 Puerto Rico Conference guessed that it would happen before 2060. Since it may take decades to complete the required safety research, it is prudent to start it now.

How Does Artificial Intelligence Work

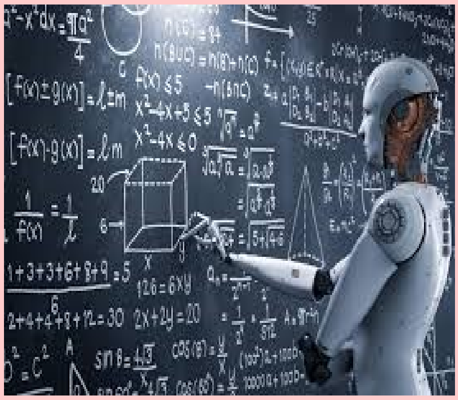
Less than a decade after breaking the Nazi encryption machine Enigma and helping the Allied Forces win World War II, mathematician Alan Turing changed history a second time with a simple question: "Can machines think. Turing's paper "Computing Machinery and Intelligence" (1950), and it's subsequent Turing Test, established the fundamental goal and vision of artificial intelligence. At it's core, AI is the branch of computer science that aims to answer Turing's question in the affirmative. It is the endeavor to replicate or simulate human intelligence in machines.The expansive goal of artificial intelligence has given rise to many questions and debates. So much so, that no singular definition of the field is universally accepted.



TIMELINE MYTHS

One popular myth is that we know we'll get superhuman AI this century.

AI is a computer system able to perform tasks that ordinarily require human intelligence... Many of these artificial intelligence systems are powered by machine learning, some of them are powered by deep learning and some of them are powered by very boring things like rules. There have been a number of surveys asking AI researchers how many years from now they think we'll have human-level AI with at least 50% probability. All these surveys have the same conclusion: the world's leading experts disagree, so we simply don't know. researchers guessed hundreds of years or more.



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Croyogenics

Cryogenics describes the science that deals with the production, effects, and uses of a wide variety of materials at very low temperatures1. To put this into perspective, water undergoes a phase transition from liquid state to solid state at 32° F (0° C), whereas cryogenic temperatures range from -150° C to -273° C. At -273° C or 0 Kelvin (K), which is also known as absolute zero.

At such low temperatures, gases undergo a phase transition from its gaseous state to a liquid state. For example, when present at a temperature of -183° C, oxygen transitions to a liquid state.

Applications of Cryogenics

When at cryogenic temperatures, certain properties of materials, such as their mechanical strength, ductility, thermal conductivity, and electrical resistance, will be significantly altered.

Storage and Transportation of Gasses

As a result of the inter-atomic or inter-molecular distances present in gases, the transportation or storage of gases can present several challenges. However, through the use of cryogenic technology, gases can be converted into liquids, which, as a result, saves a significant amount of space while also reducing the associated cost of transportation and potential hazards that can arise when these chemicals are resent in their gaseous state.

Food Preservation

It is well known that chemical reactions proceed more rapidly in the presence of heat. To preserve packaged produce, food products can be sprayed with liquid nitrogen, which results in rapid absorption of the heat present within the produce2,3.

Electronics

Cryogenic temperatures allow the electrons present within the materials to move freely with little to no resistance, thereby facilitating them to behave like superconductors2.

Aerospace Industry

Oxygen and hydrogen, when stored as cryogenic fuels, are useful fuel sources that can be used to power rockets for space flight.

Surgery

Certain types of biological tissues that have been damaged, as well as some tumors, can be removed from the body through the use of cryosurgery. During cryosurgery, a probe or scalpel that has been cooled by a cryogenic liquid, such as liquid nitrogen, is used to freeze unhealthy cells to allow them to die2,3. These dead cells can then be naturally eliminated from the body through normal physiological processes.

Cryopreservation

Cells or biological tissues obtained from animals, such as those acquired following animal experiments or experiment-related surgical procedures, are often preserved in liquid nitrogen in laboratories for a prolonged period. This is a particularly useful tool when researchers are interested in studying the macromolecules present within the cells or tissues. Furthermore, researchers are also able even to utilize cryopreserved specimens for various downstream research applications.

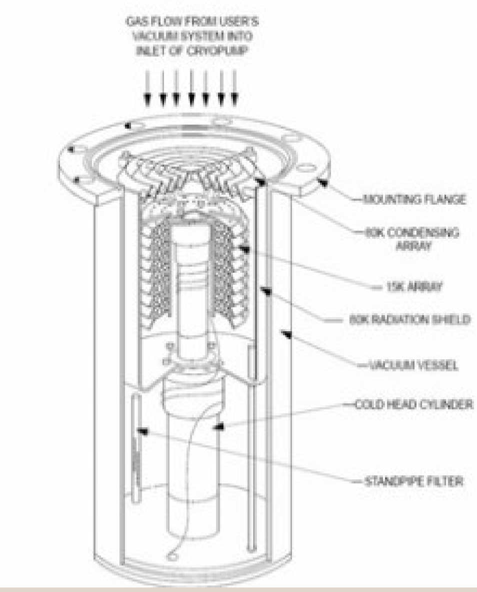
Cryonics

It is common practice for human embryos to be frozen in procedures involving in vitro fertilization. Furthermore, nematodes have been revived to life after being frozen at -196 °C4. In fact, there have been several cases where dead bodies of human patients were cryogenically preserved in the hope that the bodies can be brought back to life following the development of future scientific advancements.

Characteristic temperatures of cryogens

Cryogen	Triple point [K]	Normal boiling point [K]	Critical point [K]
Methane	90.7	111.6	190.5
Oxygen	54.4	90.2	154.6
Argon	83.8	87.3	150.9
Nitrogen	63.1	77.3	126.2
Neon	24.6	27.1	44.4
Hydrogen	13.8	20.4	33.2
Helium	2.2 (*)	4.2	5.2

(*): λ Point



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