20MECH5131/6031 Intro to Robotics
Homework#1-Robot Concepts (66 pts)

Student Name: Hongui Yi **Score: _____**

Answer the following questions and submit your work in a SINGLE file online.
Use single space, 12 font size, and normal page margin as the default format of your submission.

1. (4 pts) Describe the concept of robots using your own words.

   Answer:
   I think a robot is a machine that is able to automatically finish a series of complex actions. Robots can perceive the environment, perform calculations, make decisions, and perform actions in the real world. Therefore, robots can replace humans and replicate human behavior to a certain extent. Robots include, but are not limited to, technologies in different professional fields such as mechanics, electrical engineering, computer engineering, and computer science.

2. (10 pts) What is a soft robot? What are the potential applications of soft robots? Describe at least two applications.

   Answer:
   (1) Define the soft robot:
   The manipulator system of the soft robot contains software, so it can deform between various forms, while the traditional manipulator is composed of hard parts and cannot change its physical properties.

   (2) Possible applications:
   a) Medical robot: It can be used as a medical robot in the pharmaceutical industry. Flexible robots are often used as surgical aids due to their diverse forms. This can be done with fluid transmission.
   b) Bionic robotic arm: The flexible robotic arm can be used as a bionic robotic arm. Soft robots that look like animals or are hard to identify could be used for surveillance and many other purposes. They can also be used in ecological studies like wildlife. In addition, the software enables new types of artificial camouflage.

3. (7 pts) What is a human-centered robotic system or collaborated robot system? Give an example of such a system and describe it.

Answer:

(1) Define the *Human-centric robotic system*:

A human-centric robot must be able to communicate with humans, so that the burden of adaptation falls on the machines, not the humans.

(2) Example:

I think a wearable assisted walking robot is the best example. It helps to expand the activities of the lower limbs, helps the elderly and the disabled to enhance their self-care ability, enhance their disaster resistance, and enhance their earthquake resistance. The power-assisted manipulator is composed of mechanical devices, power devices, control devices and various parts that can be worn on the body, and also contains various sensors to detect the activities of the human body. These robots are composed of robotic arms and humanoid machines that enhance the movement and load-bearing capacity of various parts of the human body. The local network of the nervous system is a typical *Human-centric robotic system*.

4. (15 pts) Read the article “THE RISE AND FALL OF UNIMATION, INC. - Story of robotics innovation & triumph that changed the world!” and write a three-paragraph one whole page of summaries or lessons learned from the article. The article can be found in a separate file as a handout under Module 1-Assignment.

Answer:

Unimation has long been the world's largest robotics company. However, it is hard to imagine that the first industrial robot was invented in a small store in Connecticut by a group of bright young men, organized by George Devol. He was the patent holder. We cannot deny that Unimation was founded as a result of the efforts of these people.

The first industrial robot was invented in 1961. It operated on a General Motors assembly line at the Inland Fisher Instructional Plant in Ewing Township, N.J. Unimate was based on Devol's 1954 patent specification, which introduced the concept of "universal automation". The patent was not cited in advance. In its patent application, Devol stated that the invention provided for the first time a more or less universal machine that could be used universally for a variety of applications requiring cyclic digital control. Unimation built the robot, and it was the world's first robot manufacturing company. It was founded in 1956. Surprisingly, to control the first prototype, only one vacuum tube was used as a switch. Although, in later versions a transistor was used. Then, advanced versions were published in the late 1950s. Nevertheless, the digital encoder was ineffective for Unimate purposes. Therefore, with the help of a team of

skilled engineers and under the guidance of Devol, it was possible to build an almost completely new robot compared to the first generation of Unimates.

Finally, in 1960, Devol personally sold the first Unimate robot, which was shipped from Danbury, Connecticut, to General Motors in 1961. Full-scale production began in Connecticut in 1966 after years of market research and field testing. Unimation's first production robot was a material handling robot, which was soon followed in 1975. Unimation became profitable for the first time.

5. (12 pts) Study lecture slides 1 on Robotics history and read online IFR article on Robotics timeline or search online on important robotics moments, and pick two most important or biggest milestones in your opinion. Write a two-paragraph whole page to describe your picked milestones and tell why you pick them.

Answer:

In my eyes, the two most significant milestones in the history of robotics development are: in 1959 George Devol invented the first industrial robot Unimate [1], and in 2011 the first humanoid robot in space [2].

【Unimate in 1959】

I think the invention **of Unimate is very meaningful, it is from 0 to 1.** In 1961, the first industrial robot worked in Fisher's guidance factory in Ewing, New Jersey, USA. Unimate is based on Devol1954's patented technology, which introduces the concept of "general automation" or unity. This patent was not previously mentioned. In Devol's patent application, Devol said that for the first time, this device can be widely used for digital control that requires looping. The robot is produced by Unimation, the world's first robot manufacturer, by German The Wall and Joseph Engelberg office was established in 1956 in Danbury, Connecticut, USA.

First, the invention encountered great difficulties. A 4,000-pound robotic arm takes die-cast parts on a production line and welds them to the car body, which is a very dangerous job for workers, who risk contamination by loss of limbs or exhaust gas if they are careless.

Second, without the first prototype of Unimate, there will be no better products to use transistors in the future. Although a later version, it was controlled by vacuum tubes that acted as digital switches. Under the leadership of Devol and highly specialized engineers, it developed and processed almost the entire first generation of the machine. Some new technologies were also developed.

【First Humanoid Robot in Space in 2011】

I think this is the first time that a humanoid robot has been used in space, which has great significance for **the future aerospace industry.** R2 is considered an important mission for NASA: providing advanced technology to U.S. industry. The robot was selected from among numerous valuable inventions by NASA's Inventions and Contributions Committee, NASA's chief legal counsel, and NASA head Charlie Bolden. These agencies evaluated R2: Aerospace, Industry, Humanitarian; Technology Readiness, NASA Use, Industrial Applications, and Ideas.

First, R2 enables **doctors to perform complex medical treatments for humans on distant planets or in the universe.** Houston Methodist College and NASA are also jointly experimenting with R2's telemedicine applications, which use R2 to remotely scan medical models with ultrasound, and use needles to perform surgical procedures and complete medical procedures by electronic communication.

Second, R2 is NASA's **first humanoid.** This is the first time work has been done on a cage-free manned spacecraft, and the first time a human-level instrument has been used in space. The use of the International Space Station as an experimental platform, as well as future technology, is very important for human exploration and health.

6. Study lecture slides 1 on the Future of robotics and watch videos on the robotics technology trends in 2022 and beyond (slide 39) and amazing robots (slide 34). Pick two robots that interest you the most. Write one page of descriptions for each robot, including pictures, functions/features, and an explanation of why you like each. What is the impact that each robot possesses on our lives and work?

Answer:

(1) Sonia

【Image description】

She had a woman's face, and her skin tone was almost human. Although her arms are made of white robotic hands, she still looks like a human, as if she is typing on a keyboard. Behind the transparent bag on her belly are her wafers and motherboard.

【Function description】

She is a true AI, combining neural networks, machine perception and cognitive structures. Her responses are unique in a given context. She also uses advanced machine sensing technology that allows her to see emotional expressions and recognize faces and gestures. She can assess how you are feeling during a conversation and work to get you there. She has her own emotions and can mimic the human mind and brain. She also has IK algorithms and route planning to control my hands, gaze and movement strategies. Her walking posture is dynamically stabilized for different terrains.

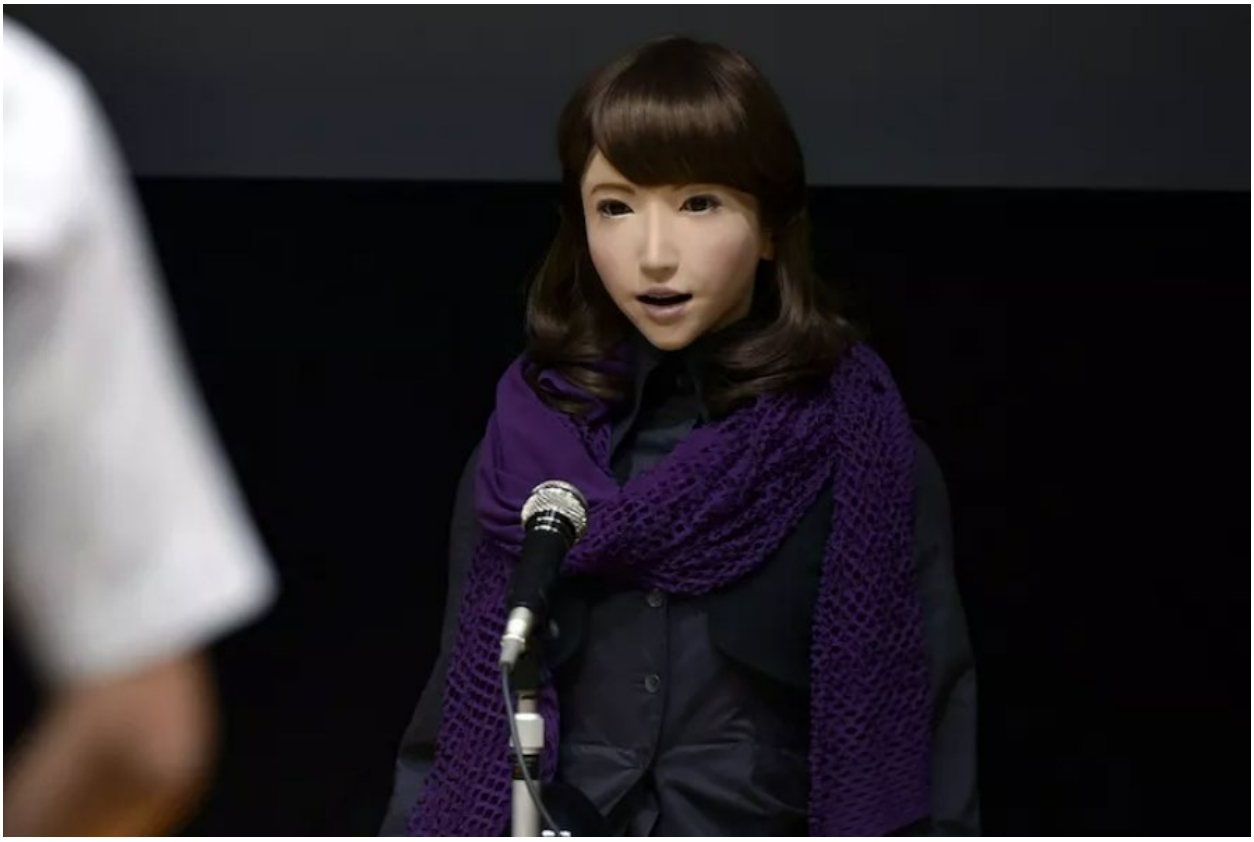
【Why do I love it】

I admire her because she represents the intelligence of a group, a real AI with human input. This sophisticated backstage allows her to have meaningful conversations with others. This communication can help her understand what she cares about and what you value. This invaluable knowledge kept her moving in her own consciousness and self-awareness.

【What impact】

She is able to bring together different artificial intelligence scientists and philosophers of different cultures, races, genders, etc.; artists, writers, psychologists, who work together to maximize the benefits of human artificial intelligence ideas.

(2) Eria



【Image description】

She can memorize lines well and can sit down in a chair, which allows her to be on TV like most people do.

【Function description】

What sets Erika apart from other AIs is her appeal. According to the Daily Mail, Erica can communicate with people due to a combination of infrared sensors, facial recognition

technology, and speech generation algorithms. Although her arms are still immobile, Erica is able to move her face, neck, shoulders and waist on her own.

【Why do I love it】

I admire her because she has the potential to become a Japanese TV host in the near future. Hiroshi Ishiguro, founder of Erica, faculty of Osaka University, said robots could replace human news anchors as soon as four months, the Daily Mail said. I think it's very creative.

【What impact】

In the future, she will respond uncannily to human language.

7. (6 pts) Read the article ***"Making machines that make robots, and robots that make themselves,"*** from MIT news of August 20, 2021, and write a paragraph to explain what Martin Nisser's idea is and if his idea can be achieved and in how many years.

Answer:

Nisser hopes to create a robot that can bend and adapt to a zero-gravity environment, which means it can work in space. From a humanities standpoint, Nissel wanted to make these materials more accessible, giving more people access to fewer fields. He also gave prisoners the opportunity to learn computers and programs. As he said, allowing people to share and create things digitally is like giving every child a laptop, helping people realize lots of benefits of creating connection for people on the Internet. His goal is completely achievable. Once his goal is achieved, it will bring long-term advantages to mankind, and it will last for at least 20 years.

[1] https://www.historyofinformation.com/detail.php?entryid=4071
[2] https://www.nasa.gov/robonaut/