

# **ME 165: Basic Mechanical Engineering Robotics**



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# What is **Robotics**?

Robotics is the branch of mechanical engineering, electrical engineering, and computer science that deals with the design, construction, operation, and application of robots in human endeavors.

## ❖ **International Organization for Standardization (ISO)**

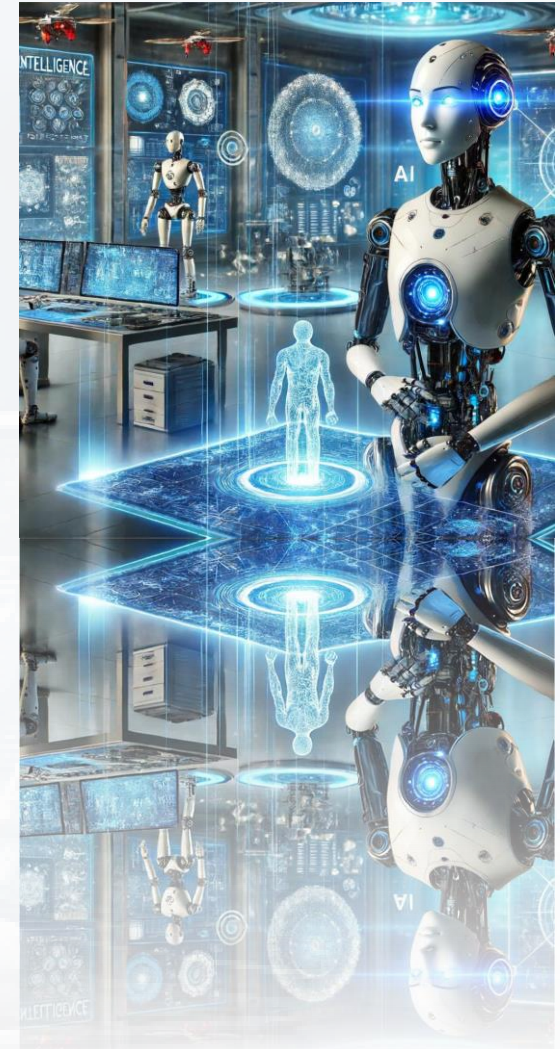
### **Definition:**

An automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications.



# How Robotics Related with CSE!!

- Programming and Control Systems
- Artificial Intelligence & Machine Learning
- Embedded Systems
- Data Structures & Algorithms
- Cybersecurity
- Human-Robot Interaction (HRI)



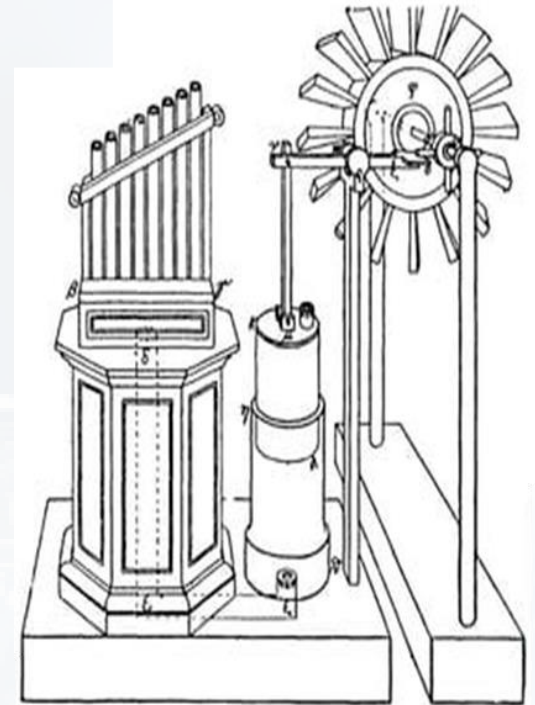
# History of the **Robotics**



## *Ancient and Classical Eras*

### **Mythology & Automata:**

- Ancient myths, like the Greek tale of **Talos**, a giant bronze robot, show early human fascination with artificial beings.
- In the **3<sup>rd</sup> century BCE**, the **Hero of Alexandria** built simple steam-powered devices and automata using gears and pneumatics.



# History of the **Robotics**



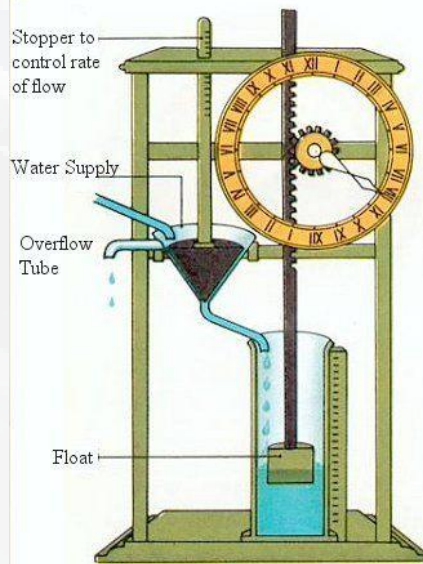
## *Medieval Period*

### •Al-Jazari (1206 CE):

- An Islamic engineer who designed **mechanical water clocks**, **musical automata**, and even an early programmable humanoid robot (a boat with musicians).

### •Da Vinci's Robot (1495):

- Leonardo da Vinci sketched a **mechanical knight** that could sit, wave arms, and move its head.



# History of the **Robotics**



## *18th to 19th Century*

### •**Mechanical Wonders:**

- Inventors like **Jacques de Vaucanson** created life-like automata, such as a duck that could "digest" food.

### •**Industrial Revolution:**

- The rise of automated factory machinery using punch cards later influenced computer and robot control systems.



@Pinterest

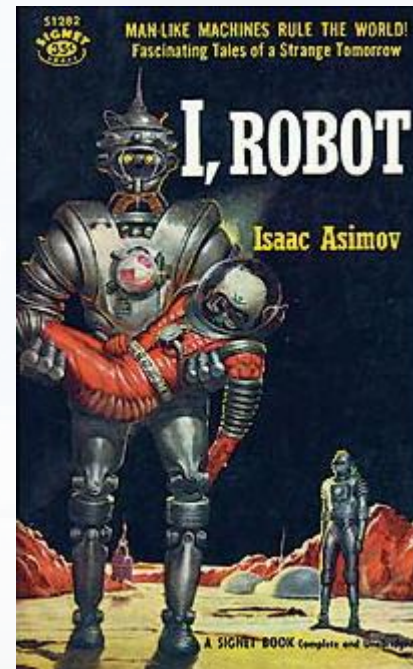
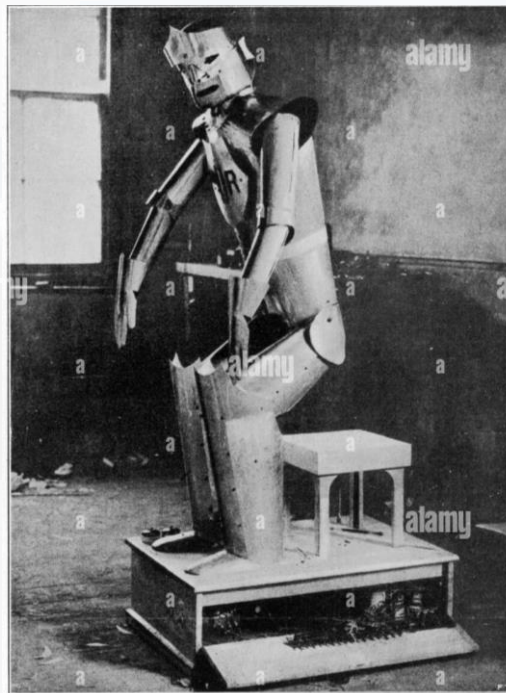


# History of the Robotics



## 20th Century: Birth of Modern Robotics

- 1920:** The word "**robot**" first appears in **Karel Čapek's** play *R.U.R. (Rossum's Universal Robots)*—from the Czech word *robota* (forced labor).
- 1942:** **Isaac Asimov** introduces the **Three Laws of Robotics** in his science fiction stories.



# History of the **Robotics**

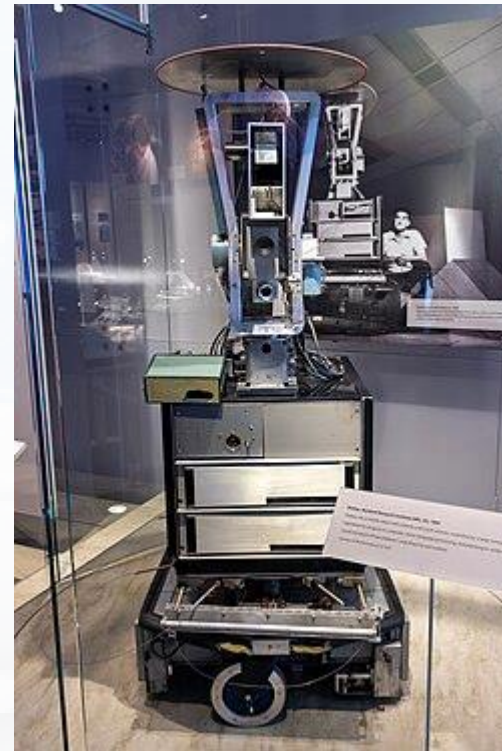


## *20th Century: Birth of Modern Robotics*

- **1950s-60s:**
  - First, industrial robots, like Unimate, were developed and used in **General Motors** factories.
- **1969:** Stanford creates **Shakey the Robot**, an early AI-powered mobile robot.



@Henry Ford



@Wikipedia



# History of the **Robotics**



## *21st Century and Beyond*

### •**Humanoid Robots:**

- Robots like **ASIMO** (by Honda) and **Atlas** (by Boston Dynamics) showcase agility and human-like motion.

### •**AI & Machine Learning:**

- Robots now learn tasks, interact with humans, and adapt to new environments.

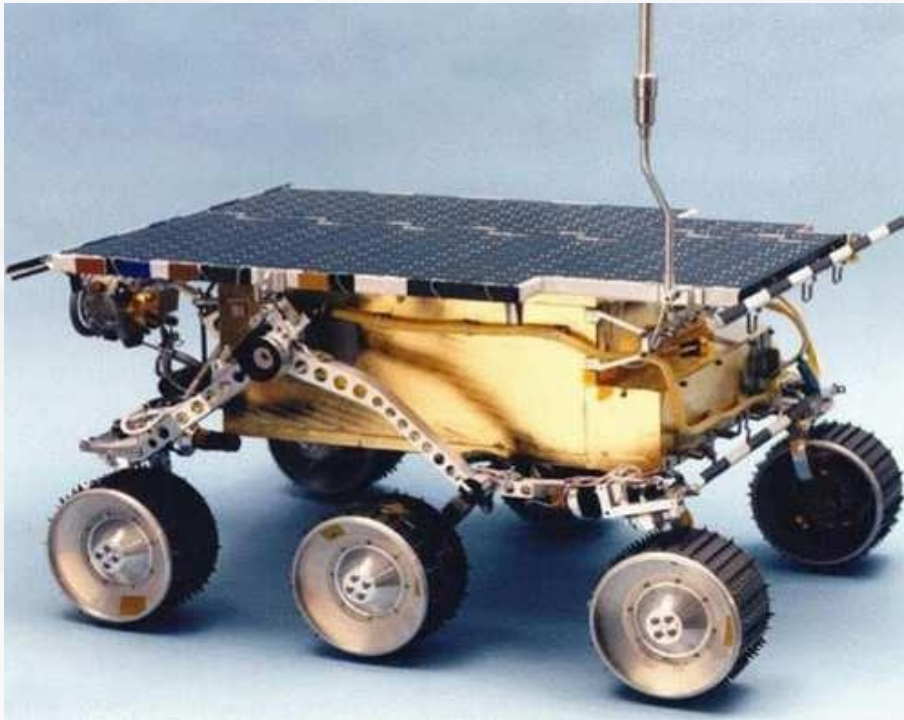
### •**Robots in Daily Life:**

- Vacuuming robots, robotic surgeries, autonomous vehicles, and social robots like **Pepper**.

### •**Space Robots:**

- **Rovers** like **Curiosity** and **Perseverance** explore Mars, while robotic arms help aboard the **ISS**.

# Modern Robots

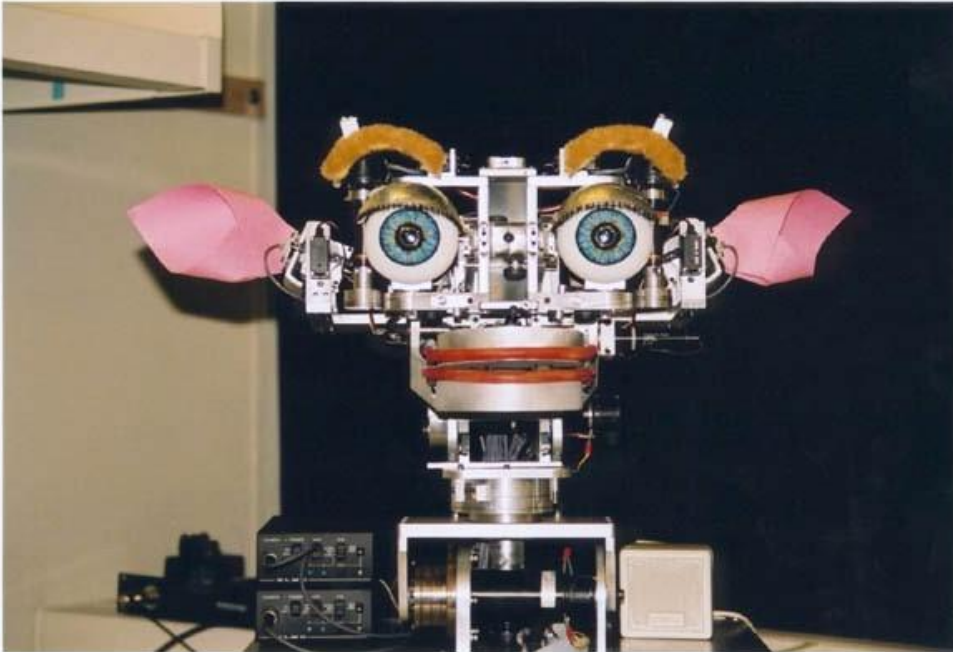


Sojourner rover, deployed by  
Pathfinder in 1997 by NASA  
Landed on Mars.



Asimo by Honda

# Modern Robots

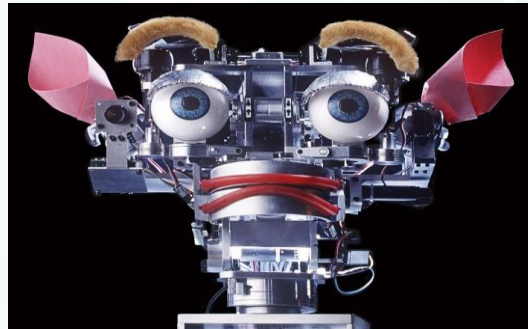
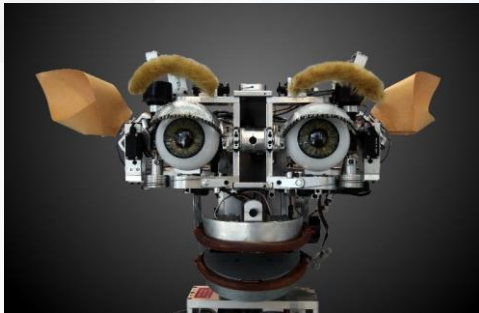
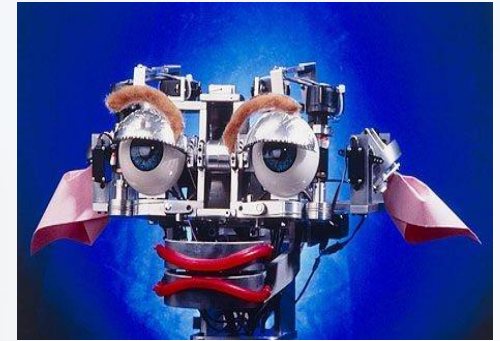
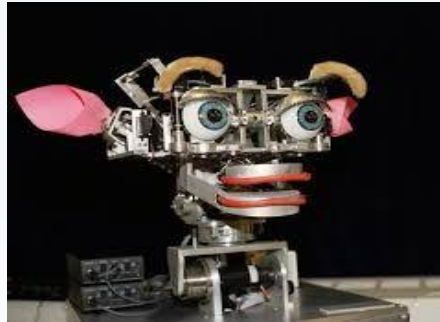
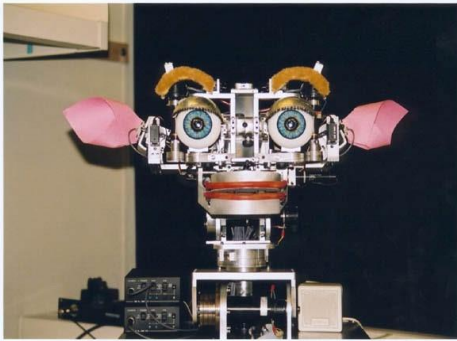


MIT's Kismet: A robot that exhibits expressions e.g., happy, sad, surprise, disgust.



Sophia: Imitates human gestures and facial expressions and can answer certain questions and make simple conversations on predefined topics

# Modern Robots

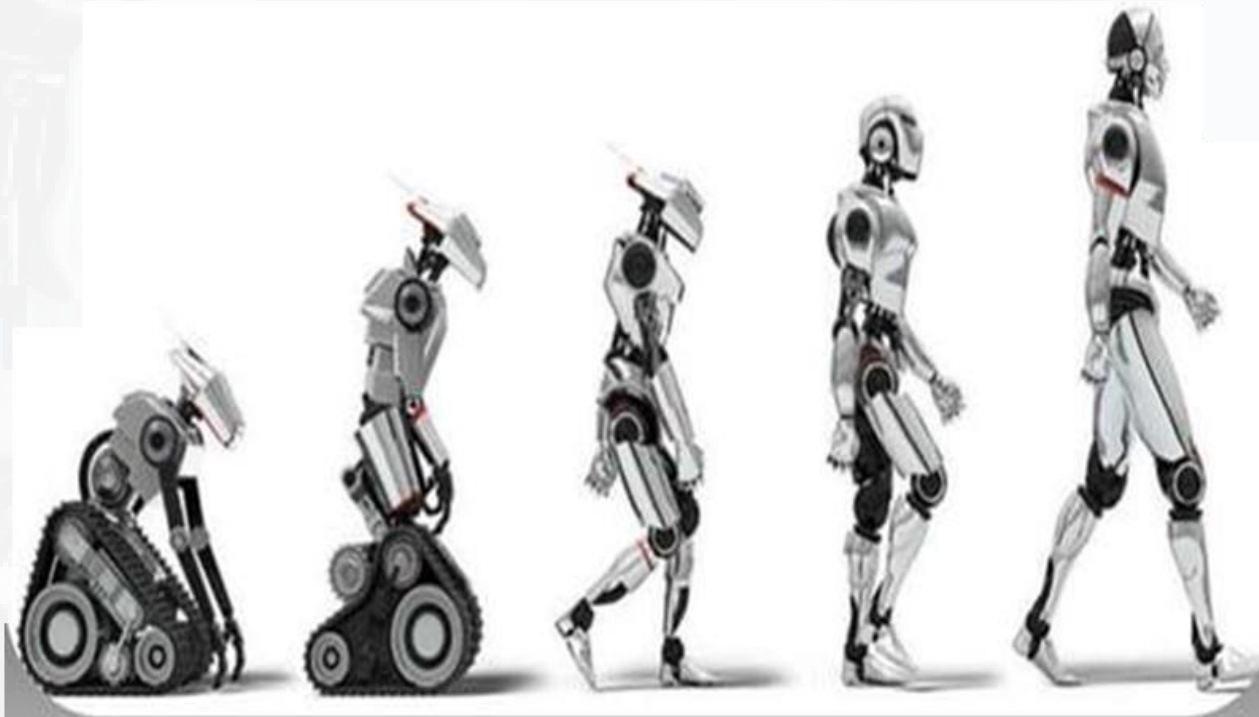


Various facial expressions of MIT's Kismet.





# Evaluation







# Advantages:

- Robotics and automation can, in many situations, increase the productivity, safety, efficiency, quality, and consistency of products.
- Robots can work in hazardous environments (such as radiation, darkness, hot and cold, ocean bottoms, space, and so on) without the need for life support, comfort, or concern for safety.
- Robots need no environmental comfort like lighting, air conditioning, ventilation and noise protection.
- Robots work continuously without tiring or fatigue or boredom.
- Robots have repeatable precision at all times unless something happens to them, or unless they wear out.
- Robots can be much more accurate than humans.
- Robots and their accessories and sensors can have capabilities beyond those of humans.
- Robots can process multiple stimuli or tasks simultaneously.



# Disadvantages:

- Robots replace human workers, causing economic hardship, worker dissatisfaction and resentment, and the need for retraining the replaced workforce.
- Robots lack the capability to respond in emergencies, unless the situation is predicted and the response is included in the system.
- Safety measures are needed to ensure that they do not injure operators and other machines that are working with them
- Robots have limited capabilities in cognition, creativity, decision making, and understanding.
- Robots are costly due to: Initial cost of equipment and installation, need for integration into the manufacturing processes, need for programming, etc.



# Application

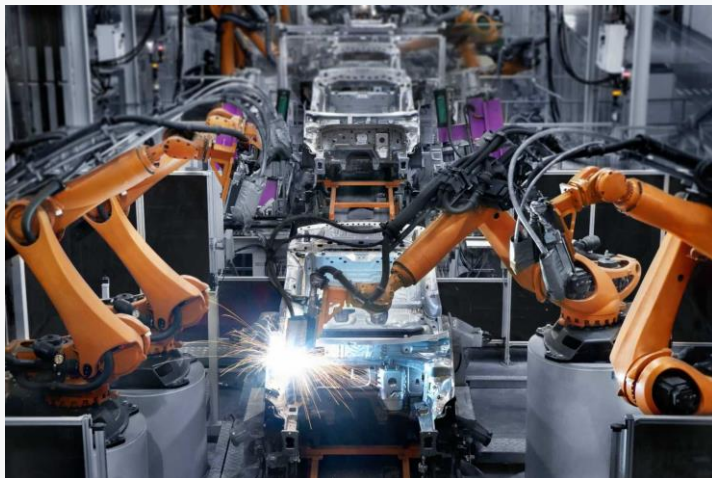
- **Manufacturing:** Automates assembly and packing.
- **Healthcare:** Assists in surgeries and rehab.
- **Agriculture:** Helps with planting and harvesting.
- **Logistics:** Moves and sorts products.
- **Exploration:** Used in space and underwater.
- **Military:** Drones, bomb disposal, and surveillance.
- **Service:** Household tasks like cleaning.
- **Entertainment:** Robot performers and interactive shows.
- **Education:** Teaches STEM and helps students.
- **Construction:** Assists in building and 3D printing.
- **Retail:** Customer service and inventory management.



# Classification

## Function:

- **Industrial Robots:** Used in manufacturing (e.g., assembly, welding).
- **Service Robots:** Assist with tasks like cleaning or healthcare (e.g., Roomba, surgical robots).
- **Humanoid Robots:** Resemble humans (e.g., Boston Dynamics' Atlas).
- **Exploration Robots:** Used in space or deep-sea exploration (e.g., Mars rovers).
- **Military Robots:** For defence and surveillance (e.g., drones, bomb disposal robots).



@Boston Dynamics



# Classification

## Mobility:

- **Stationary Robots:** Fixed in place (e.g., industrial arms).
- **Mobile Robots:** Can move (e.g., wheeled robots, drones, underwater robots).

## Control:

- **Autonomous Robots:** Perform tasks without human input (e.g., self-driving cars).
- **Teleoperated Robots:** Controlled remotely (e.g., bomb disposal robots).
- **Hybrid Robots:** Combine both autonomous and manual control.







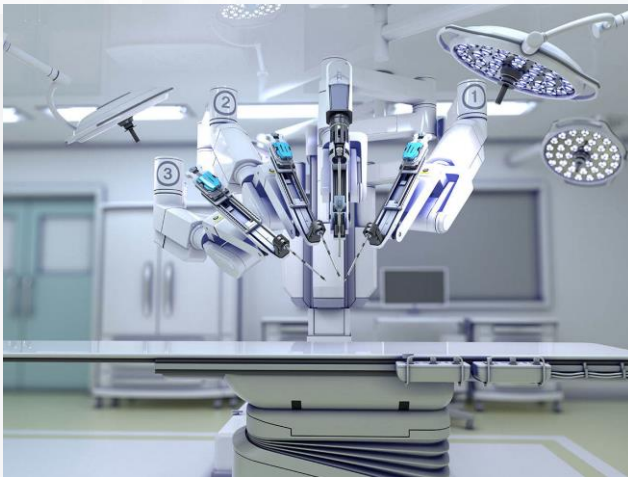
# Classification

## Application:

- **Medical:** Assist with surgeries or rehabilitation.
- **Educational:** Used in teaching (e.g., LEGO Mindstorms).
- **Entertainment:** Perform or interact for entertainment (e.g., theme park robots).

## Power Source:

- **Electric Robots:** Powered by batteries (e.g., most modern robots).
- **Pneumatic/Hydraulic Robots:** Use air or fluid for movement (e.g., industrial robots)





# Laws of Robotics





# Laws of Robotics

Isaac Asimov proposed three laws of Robotics to guide the behavior of Robotics

## **First Law: Do not harm human being**

A robot may not injure a human being or, through inaction, allow a human being to come to harm.

## **Second Law: Obey human being**

A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

## **Third Law: Protects itself from harm**

A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.



Thank You