the term “ROBOT” was first used in 1920 in a play called “R.U.R.” (Rossum’s universal robots”) by the Czech writer Karel Capek

the word robot comes from the word “ROBOTA” meaning, in czech, forced labour, drudgery.
Laws of Robotics by Isaac Asimov in “I, Robot” (1950)
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 orders given to 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 or Second Law
Robotics terminology

- **robot** – Mechanical device that performs human tasks, either automatically or by remote control
- **Robotics** – Study and application of robot technology
- **Telerobotics** - Robot that is operated remotely
Definition

- 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
Types of Robots

- Industrial Robots
  - materials handling
  - welding
  - improving productivity
  - Laboratory applications
COMPONENTS OF AN INDUSTRIAL ROBOT

Manipulator consists of joints and links

• Joints provide relative motion
• Links are rigid members between joints
• Various joint types: linear and rotary
• Each joint provides a “degree-of-freedom”
• Most robots possess five or six degrees-of-freedom

Robot manipulator consists of two sections:
• Body-and-arm – for positioning of objects in the robot's work volume
• Wrist assembly – for orientation of objects
MANIPULATOR JOINTS

Translational motion (T)
  Linear joint

Orthogonal joint

Rotary motion (R)
  Rotational joint

Twisting joint

Revolving joint
Structure and components of an industrial robot

Joints

- Two kinds of joints are considered:
- **Prismatic joint:** translation (linear) motion ("T" joint)
- **Rotational joint:** rotational motion ("R" joint)
- More complex joints, such as spherical or helicoidal joints, can be considered as proper combination of prismatic and rotational joints.
Prismatic joint (T)
Rotational joint (R)
Main geometrical configurations of industrial robots

- Different types of geometric configurations can be adopted in an industrial robot. Among the most common ones:
  - Polar configuration,
  - Cylindrical configuration,
  - Cartesian configuration,
  - Anthropomorphic configuration,
  - SCARA.
Spherical robots, or polar robots, are stationary robot arms with spherical or near-spherical work envelopes that can be positioned in a polar coordinate system. So, these robots are more sophisticated than Cartesian and cylindrical robots.
POLAR CONFIGURATION

Consists of a sliding arm (T joint) actuated relative to the body, which can rotate about both a vertical axis (R joint) and horizontal axis (R joint).
CYLINDRICAL BODY-AND-ARM ASSEMBLY

Consists of a vertical column, relative to which an arm assembly is moved up or down. The arm can be moved in or out relative to the column.
CARTESIAN COORDINATE BODY-AND-ARM ASSEMBLY

• Notation TTT:
  • Consists of three sliding joints, two of which are orthogonal
  Other names include rectilinear robot and x-y-z robot
JOINTED-ARM ROBOT

Notation RRR:
SCARA ROBOT

Notation RRT
SCARA stands for Selectively Compliant Assembly Robot Arm
Similar to jointed-arm robot except that vertical axes are used for shoulder and elbow joints to be compliant in horizontal direction for vertical insertion tasks
WRIST CONFIGURATIONS

Wrist assembly is attached to end-of-arm
End effector is attached to wrist assembly
Function of wrist assembly is to orient end effector

Body-and-arm determines global position of end effector
Two or three degrees of freedom:
  Roll
  Pitch
  Yaw
Notation: RRR
JOINT DRIVE SYSTEMS

Electric

Uses electric motors to actuate individual joints
Preferred drive system in today's robots

Hydraulic

Uses hydraulic pistons and rotary vane actuators
Noted for their high power and lift capacity

Pneumatic

Typically limited to smaller robots and simple material transfer applications
END EFFECTORS

The special tooling for a robot that enables it to perform a specific task

Two types:
- Grippers – to grasp and manipulate objects (e.g., parts) during work cycle
- Tools – to perform a process, e.g., spot welding, spray painting
HOW ROBOTS CAN DO ?