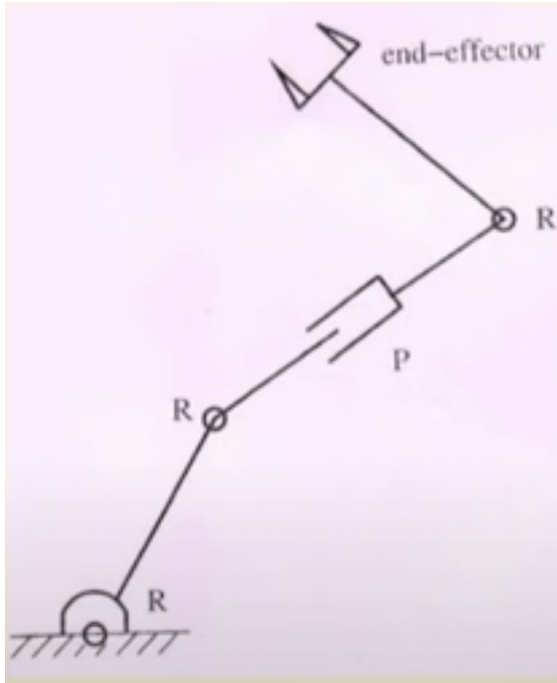


# Introduction to robots and robotics

# Numerical example

## Serial Planar Manipulator



$$n=4, m=4$$

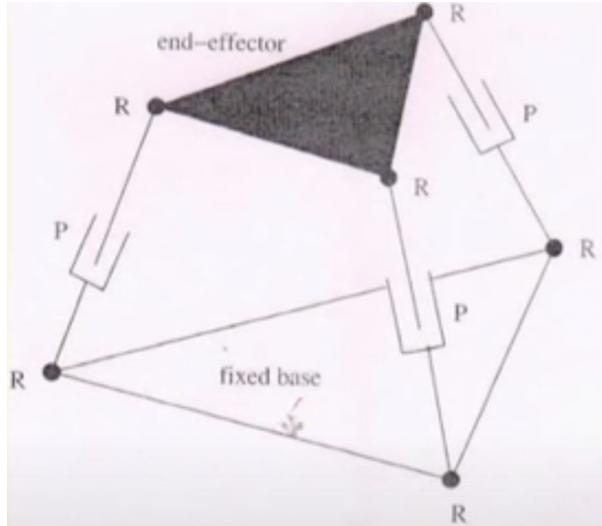
$$c_1=c_2=c_3=c_4=1$$

Mobility/dof:

$$M=3n-\sum_{i=1}^m(3-C_i)=3*4-8=4$$

# Numerical example

## Parallel I Planar Manipulator



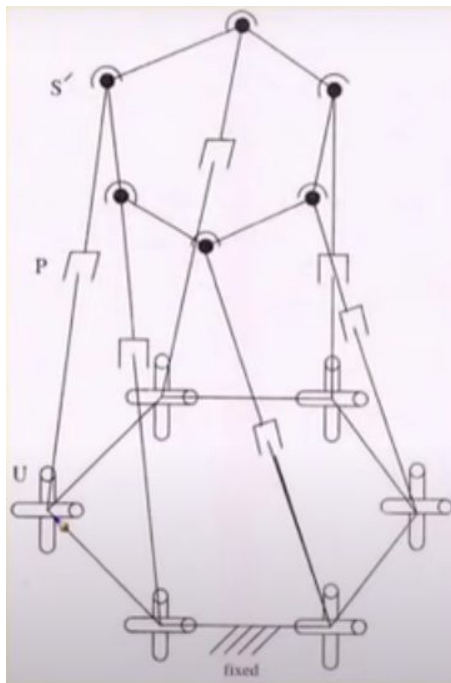
$$n=7, m=9$$

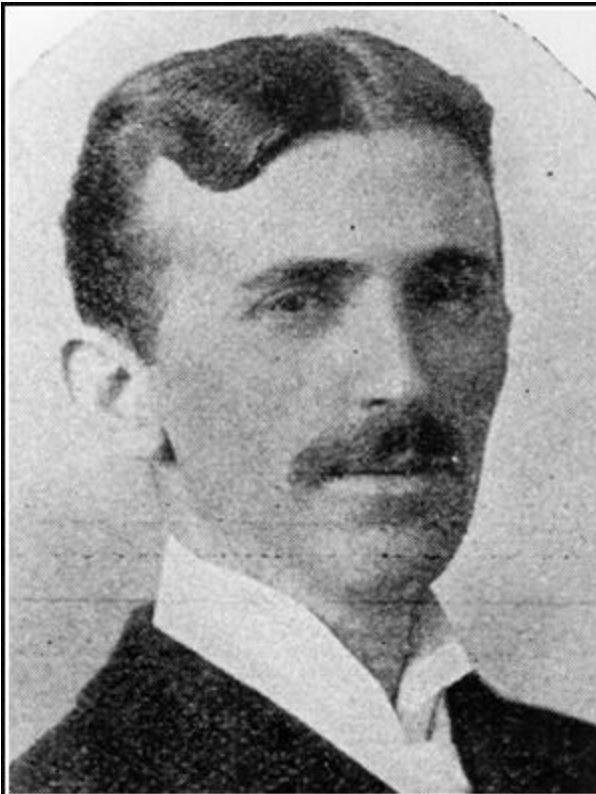
$$c_i=1 \text{ where } i=1, \dots, 9$$

Mobility/dof:

$$M=3n-\sum_{i=1}^m(3-C_i)=3*7-18=3$$

# Parallel Spatial manipulator





In the twenty-first century, the robot  
will take the place which slave labor  
occupied in ancient civilization.

— *Nikola Tesla* —

AZ QUOTES

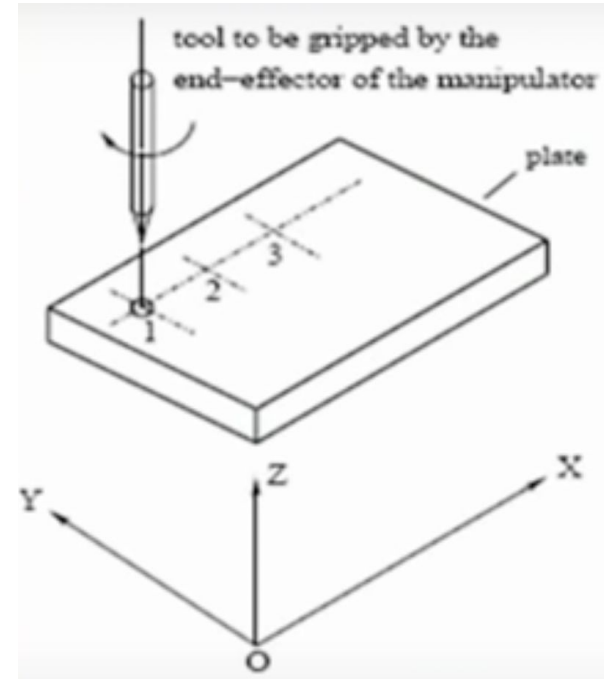
# Classification of Robots

Based on the types of tasks performed

## 1. Point-to-Point Robots

a. Example:

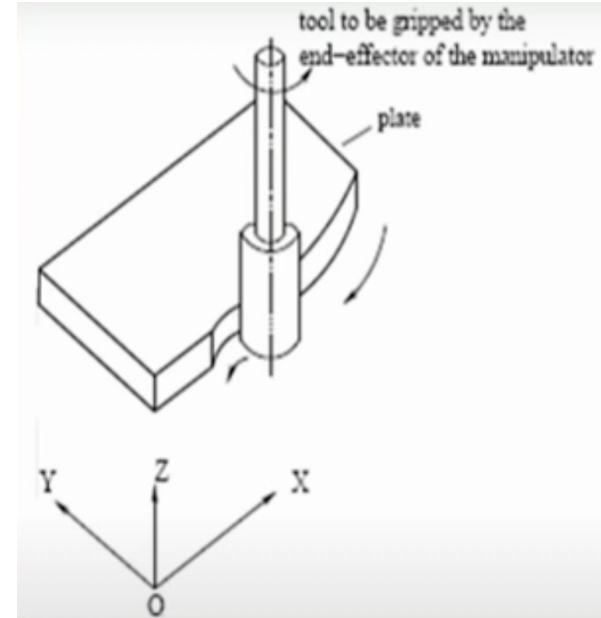
- i. Unimate 2000
- ii. T3



# Classification of Robots

## 2. Continuous Path Robots

- a. Example:
  - i. PUMA
  - ii. CRS



# Based on the type of Controller

## 1. Non-servo-Controlled Robots

### a. Open loop control system

- Example: seiko PN-100

Less accurate and less expensive

## 2. Servo-Controlled Robots

### a. Closed-loop control system

- Examples: unimate 2000, PUMA,
- T3

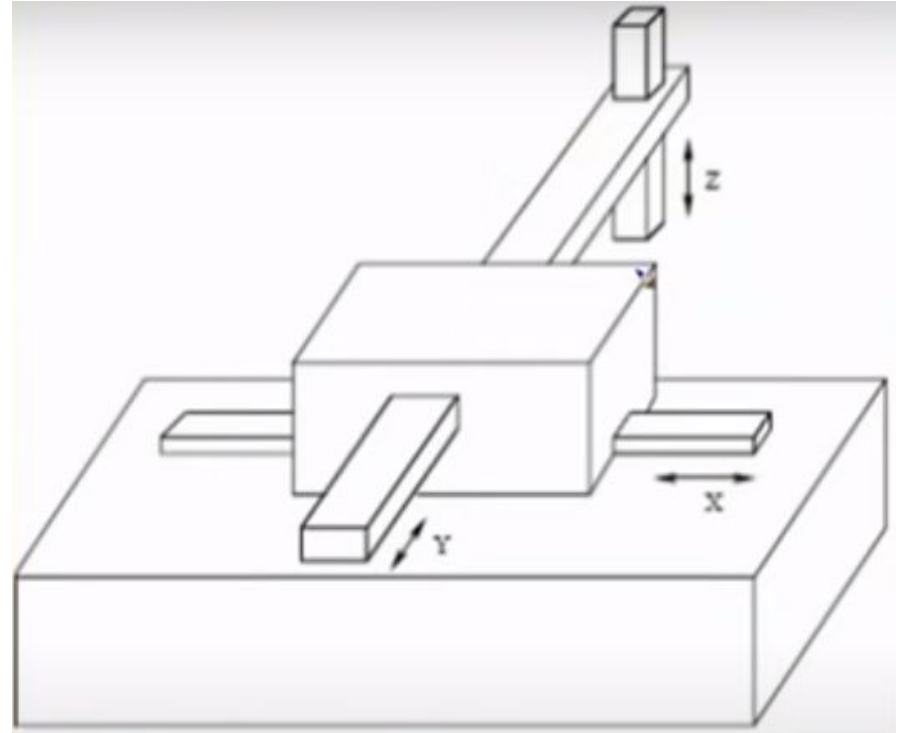
More accurate and more expensive



# Based on Configuration (Coordinate system) of the Robot

## 1. Cartesian Coordinate Robots

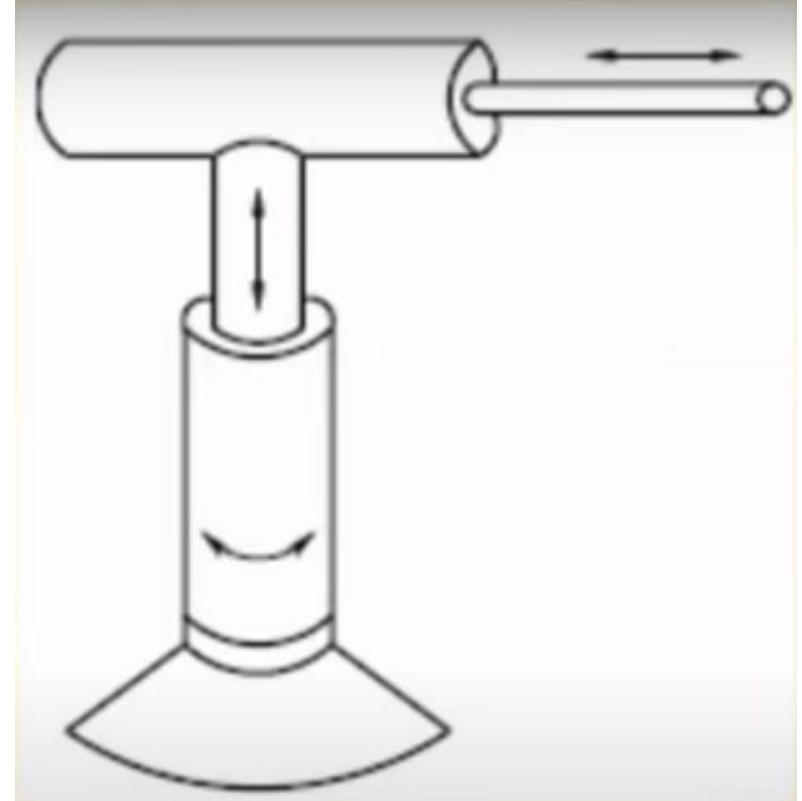
- a. Linear movement along three different axes
- b. Have either sliding or prismatic joints, that is, SSS or PPP
- c. Rigid and accurate
- d. Suitable for pick and place type of operations
- e. Examples: IBM's RS-1, Sigma, Robot



# Based on Configuration (Coordinate system) of the Robot

## 2. Cylindrical Coordinate Robots

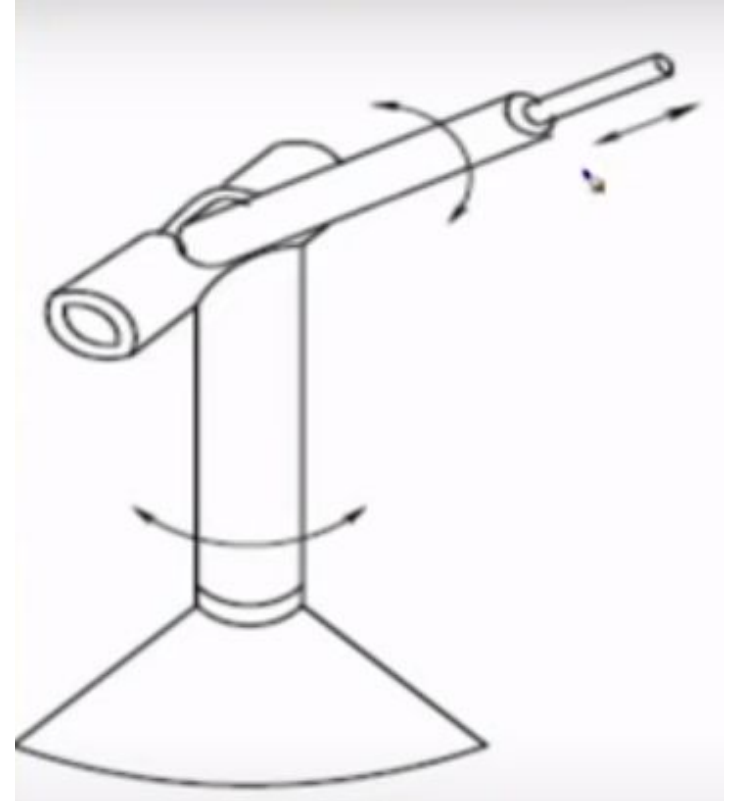
- a. Two Linear and one rotary movements
- b. Represented as TPP, TSS
- c. Used to handle parts/ objects in manufacturing
- d. Cannot reach the objects lying on the floor
- e. Poor dynamic performance
- f. Example : Versatran 600



# Based on Configuration (Coordinate system) of the Robot

## 3. Spherical Coordinate or Polar Coordinate Robots

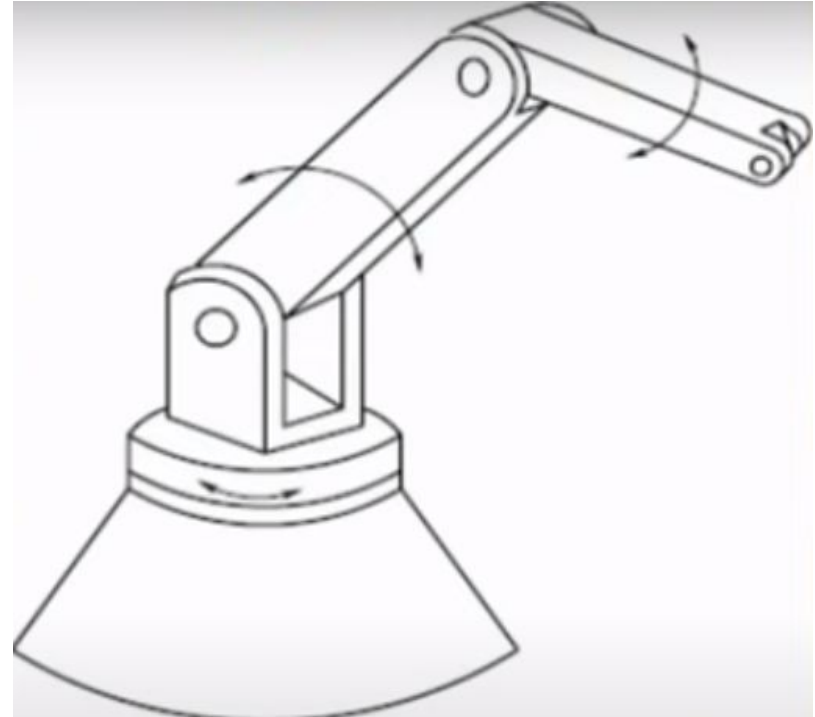
- a. One linear and two rotary movement
- b. Represented as TRP, TRS
- c. Suitable for handling part/ objects in manufacturing
- d. Can pick up objects lying on the floor
- e. Poor dynamic performance
- f. Example: Unimate 2000B



# Based on Configuration (Coordinate system) of the Robot

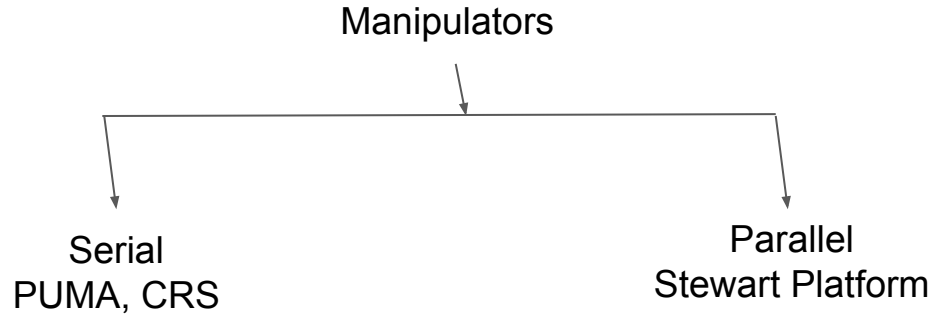
## 4. Revolute Coordinate or Articulated Coordinate Robots

- a. Rotary Movement about three independent axes
- b. Represented as TRR
- c. Suitable for handling parts/ components in manufacturing system
- d. Rigidity and accuracy may not be good enough
- e. Examples: T3, PUMA



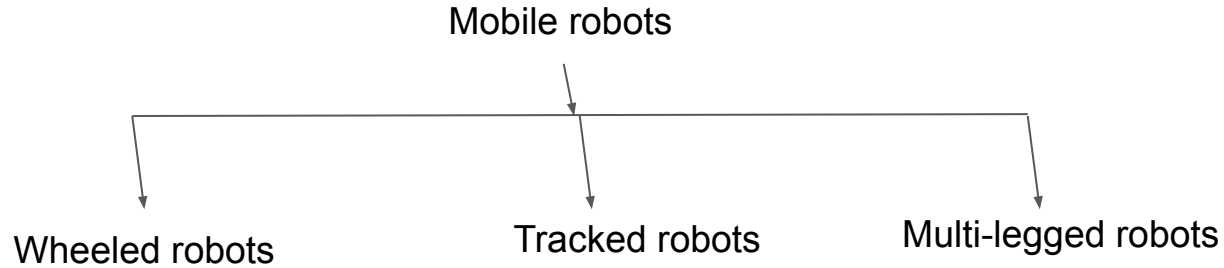
# Based on Mobility Levels

## 1. Robots with fixed base (also known as manipulators)



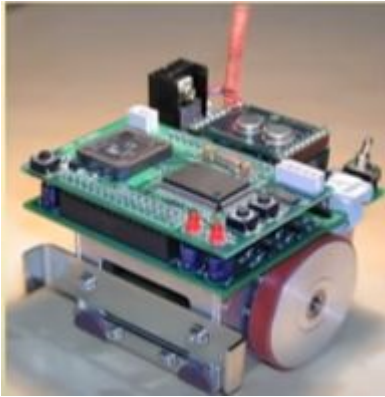
# Based on Mobility Levels

## 2. Mobile Robots

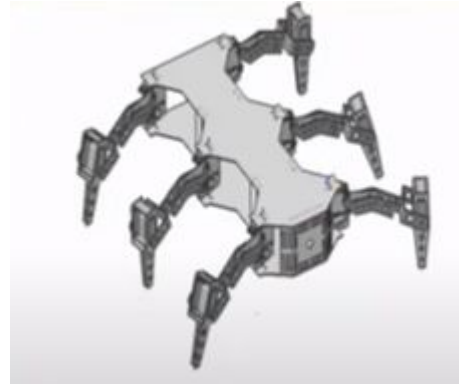


# Based on Mobility Levels

## 2. Mobile robots



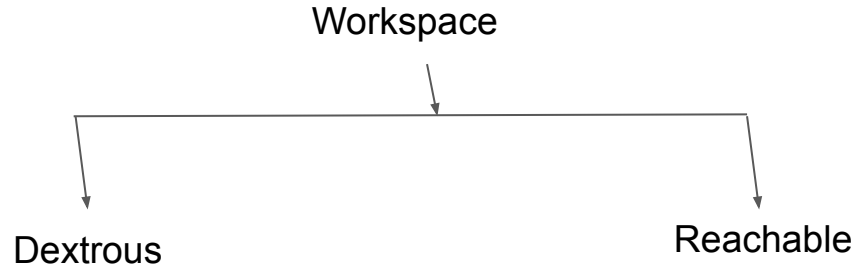
Wheeled Robot



Six-Legged Robot

# Workspace of Manipulators

It is the volume of space that the end-effector of a manipulator can reach





# Workspace of Manipulators

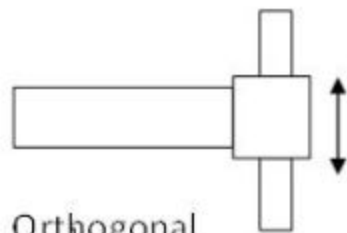
**Dextrous Workspace:** it is the volume of space, which the robot's end-effector can reach with various orientations

**Reachable Workspace:** It is the volume of space that the end-effector can reach with one orientation

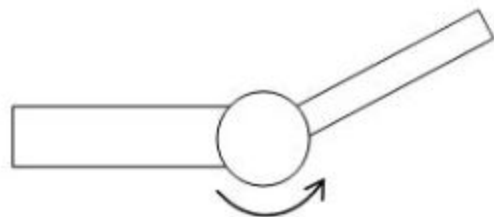
**Note:** Dextrous workspace is a subset of the reachable workspace



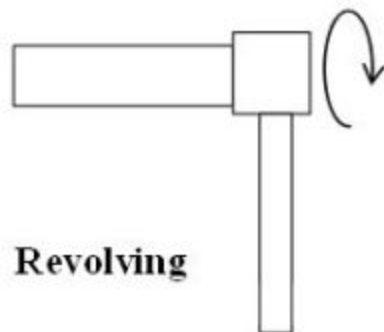
Linear



Orthogonal

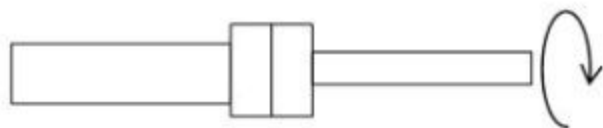


Rotational



Revolving

Twisting



→ Prismatic

→ Revolute

