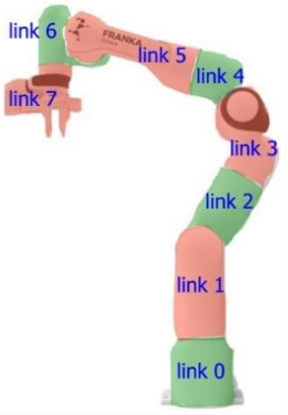
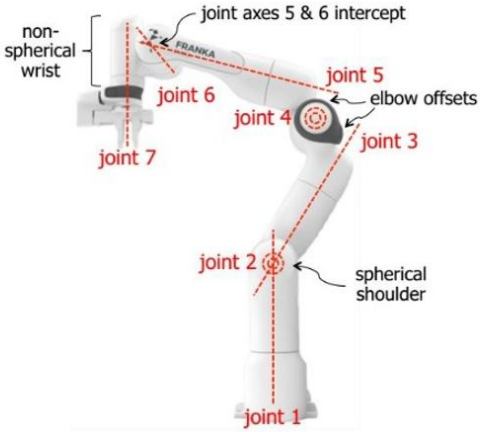
CS3011-INTRODUCTION TO ROBOTICS

Structure of Serial Robot manipulator

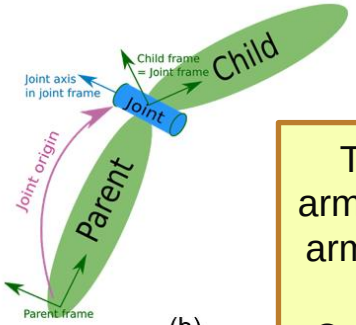
The following figure shows the structure of a typical robot manipulator



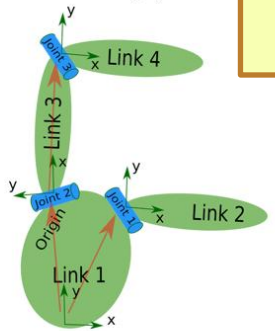
(a)



(b)



(b)

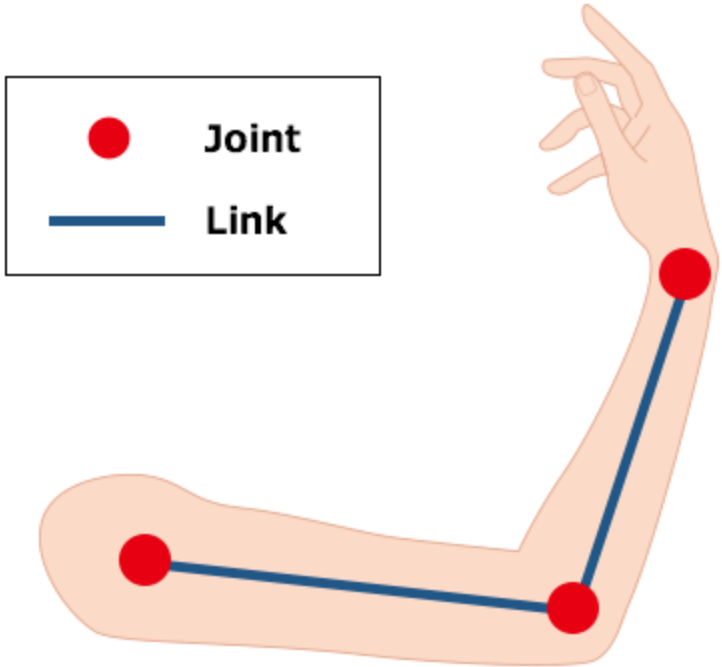


(c)

Two main parts of the robotic arm are ***Links*** and ***Joints***. A robotic arm is a chain of joints and links.

So let's see what is a link and a joint.

Let’s take an example from the human body. The links and joints of a human arm are demonstrated in the image below. The concept can be applied to robots too.



Joints and Links of a human arm

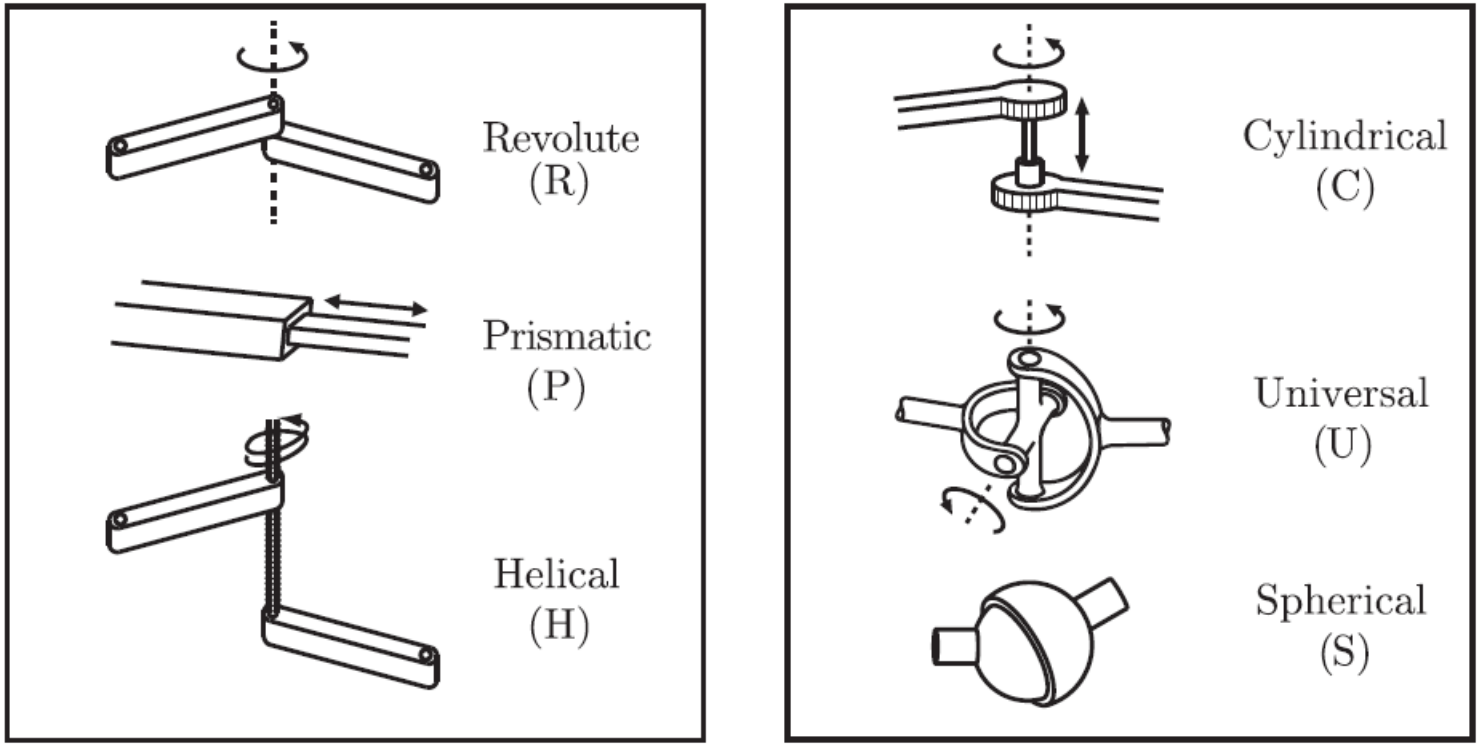
What is a link in a robot?

Here is one definition of a robot link.

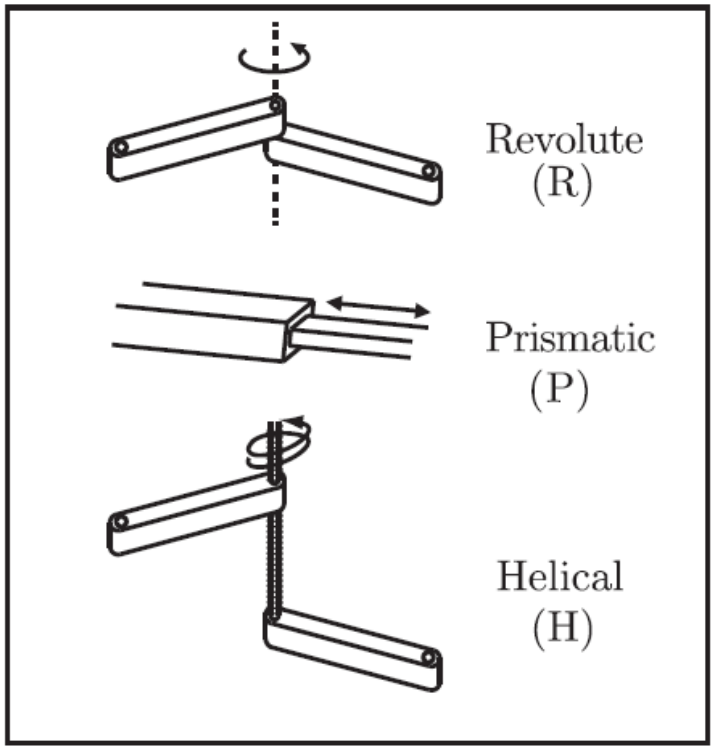
- “A link is defined as a single part which can be a resistant body or a combination of resistant bodies having inflexible connections and having a relative motion with respect to other parts of the machine.

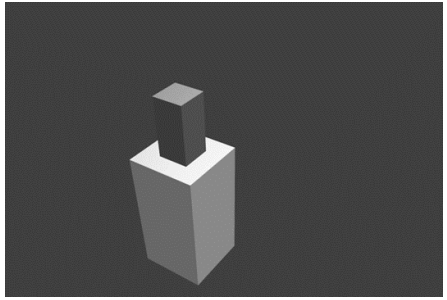
- A link is also known as a kinematic link or element.

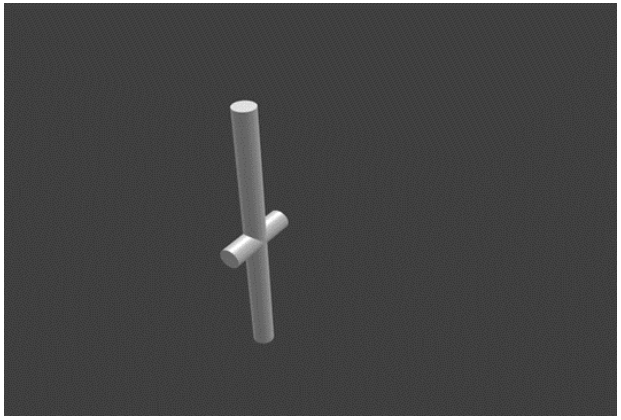
- A resistant body is one which does not go under deformation while transmitting the force.”

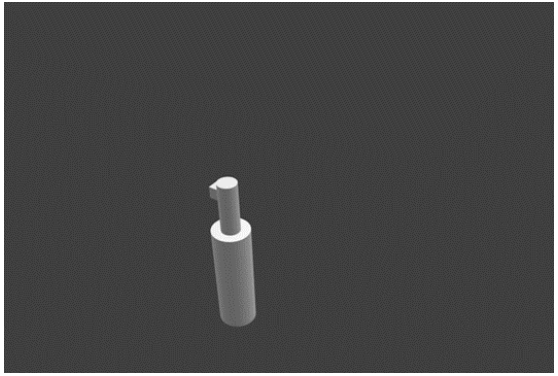


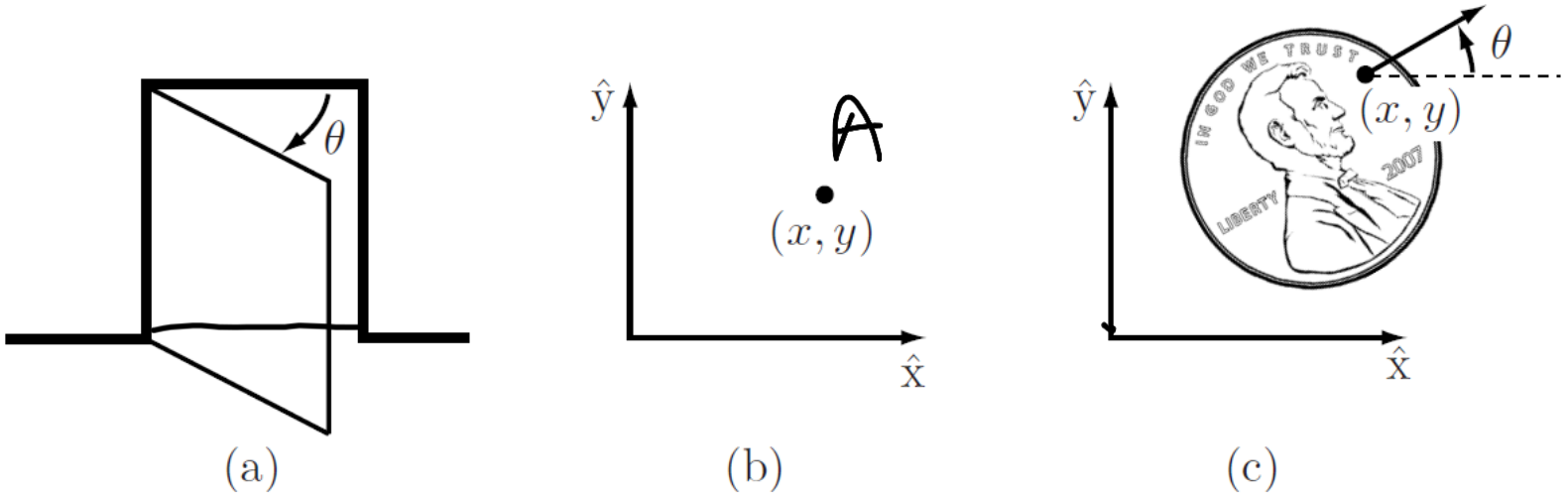
Typical robot joints.


Revolute
(R)
Prismatic
(P)
Helical
(H)









(a) The configuration of a door is described by the angle θ. (b) The configuration of a point in a plane is described by coordinates (x, y). (c) The configuration of a coin on a table is described by (x, y, θ), where θ defines the direction in which Abraham Lincoln is looking.

Configuration of a robot?

- The configuration of a robot is a complete specification of the position of every point of the robot.
- The minimum number n of real-valued coordinates needed to represent the configuration is the number of degrees of freedom (dof) of the robot.
- The n-dimensional space containing all possible configurations of the robot is called the configuration space (C-space).
- The configuration of a robot is represented by a point in its C-space.

Degrees of Freedom of a Rigid Body

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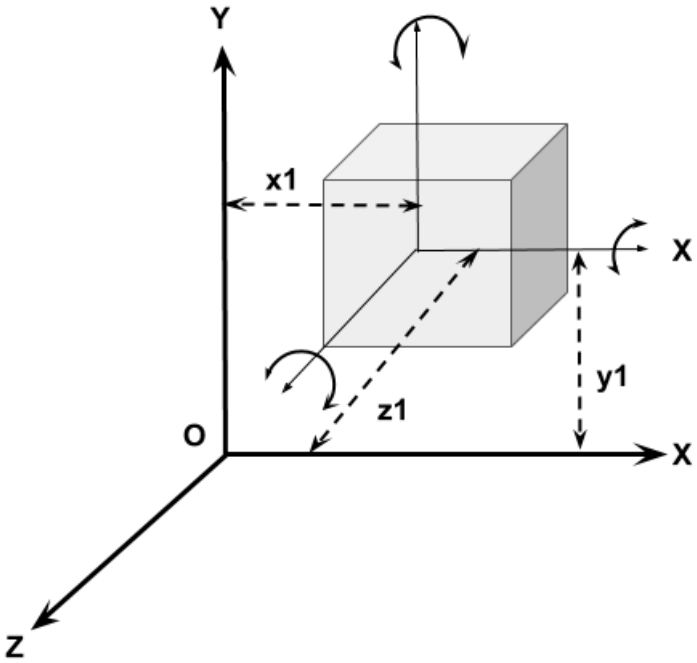
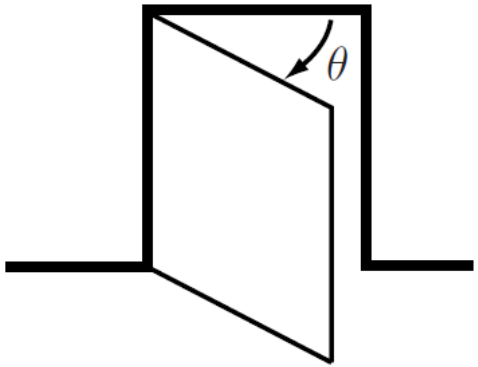
Degrees of Freedom of a Rigid Body



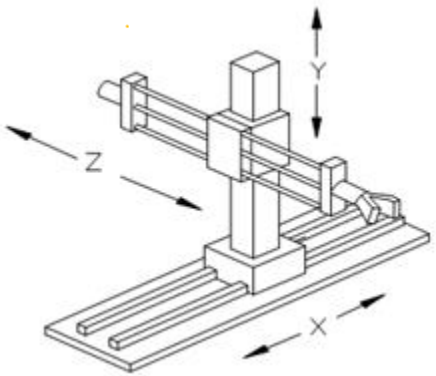
A rigid body moving in three-dimensional space, which we call a spatial rigid body, has six degrees of freedom.

Similarly, a rigid body moving in a two-dimensional plane, which we henceforth call a **planar rigid body**, has three degrees of freedom.

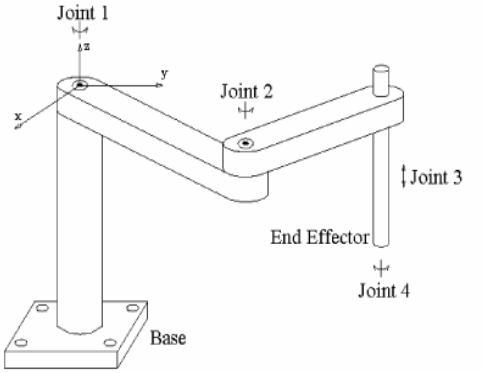


- This observation suggests a formula for determining the number of degrees of freedom of a robot, simply by counting the number of rigid bodies and joints.
- one way to identify the number of DOF of a robot is to simply count its motors.

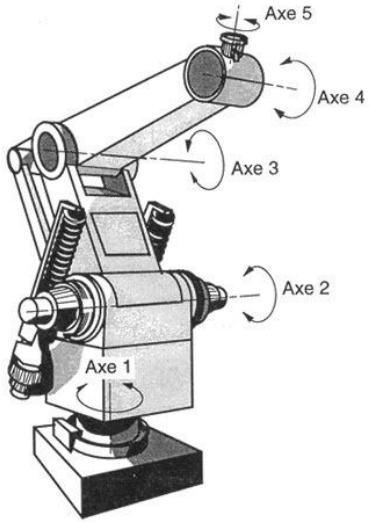
3-axis



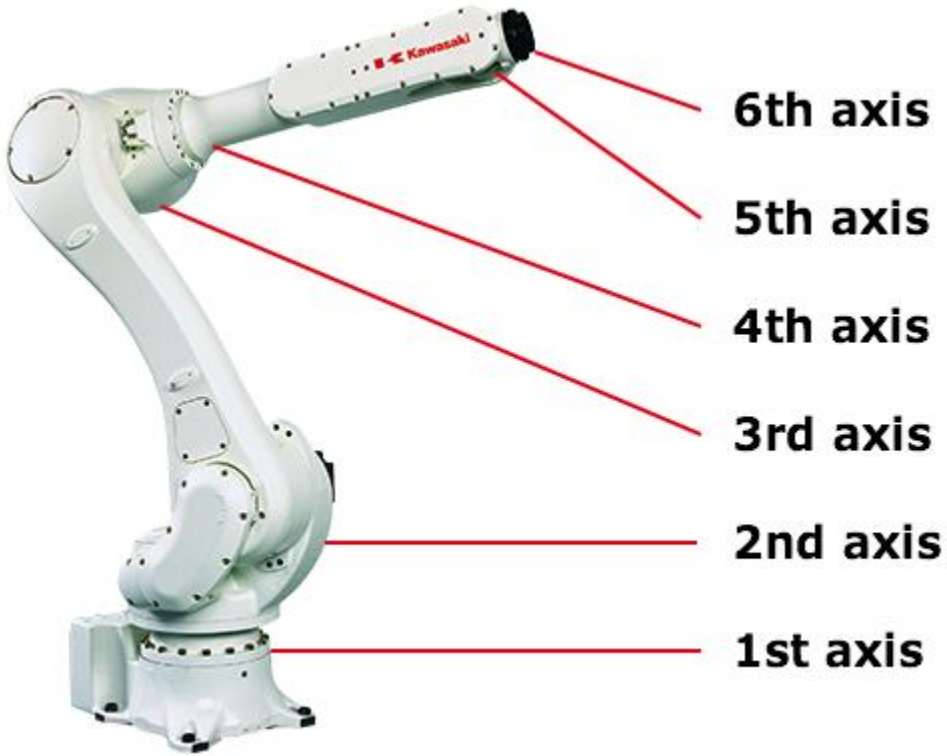
4-axis



5-axis



6-axis


Kawasaki
6th axis
5th axis
4th axis
3rd axis
2nd axis
1st axis