IE410 / Lecture 4, Date 22/01/2021

1. What is Robot

Ans:, Robot is a Machine

* Programmable Machine -> Python/C++
* Performs some Complex work in Real Environt
* Manupulation

Electro-Mechanical Machine

1. Servo - Motor
2. Sensors

Electro-Mechanical parts are

Actuator & Sensors (Camera)

(Servo motor)

CAN

Communication Protocol

- TESLA:
- Electric Car:
- HOND
- BOSCH
- SIMENSE
- L&T
- HAL

C++

python

ROS

(*) Animation

16 weeks

51000 weeks

ROS Basics

Robotics Theory

* Coordinate Frames

Co-ordinate Systems

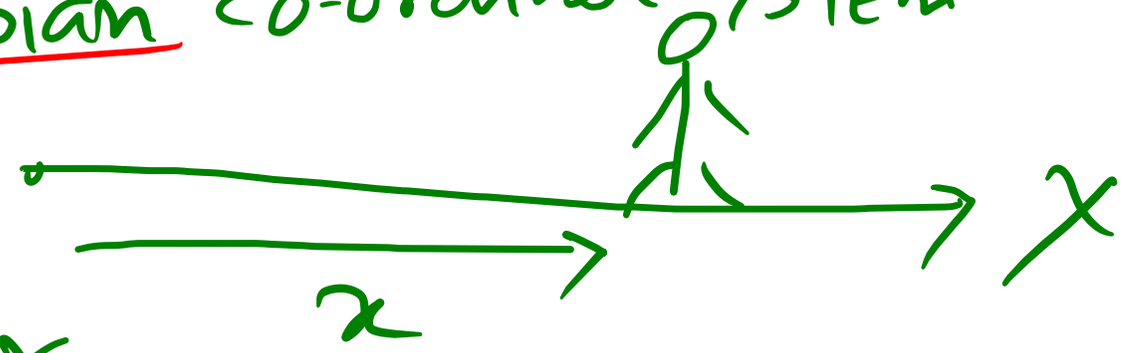
- Cartesian Coordinat Systems
  - 1-D
  - 2D
  - 3D
- Polar - Co-ordinate systems
  - 2-D
  - 3D

2D- Plane System

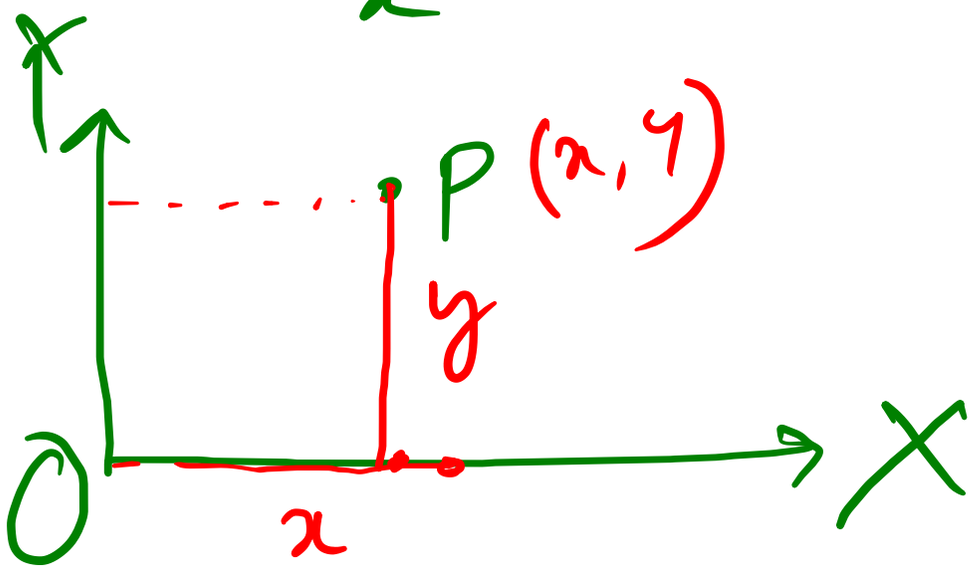
3D - Spherical System

Cartesian co-ordinate system:

1D

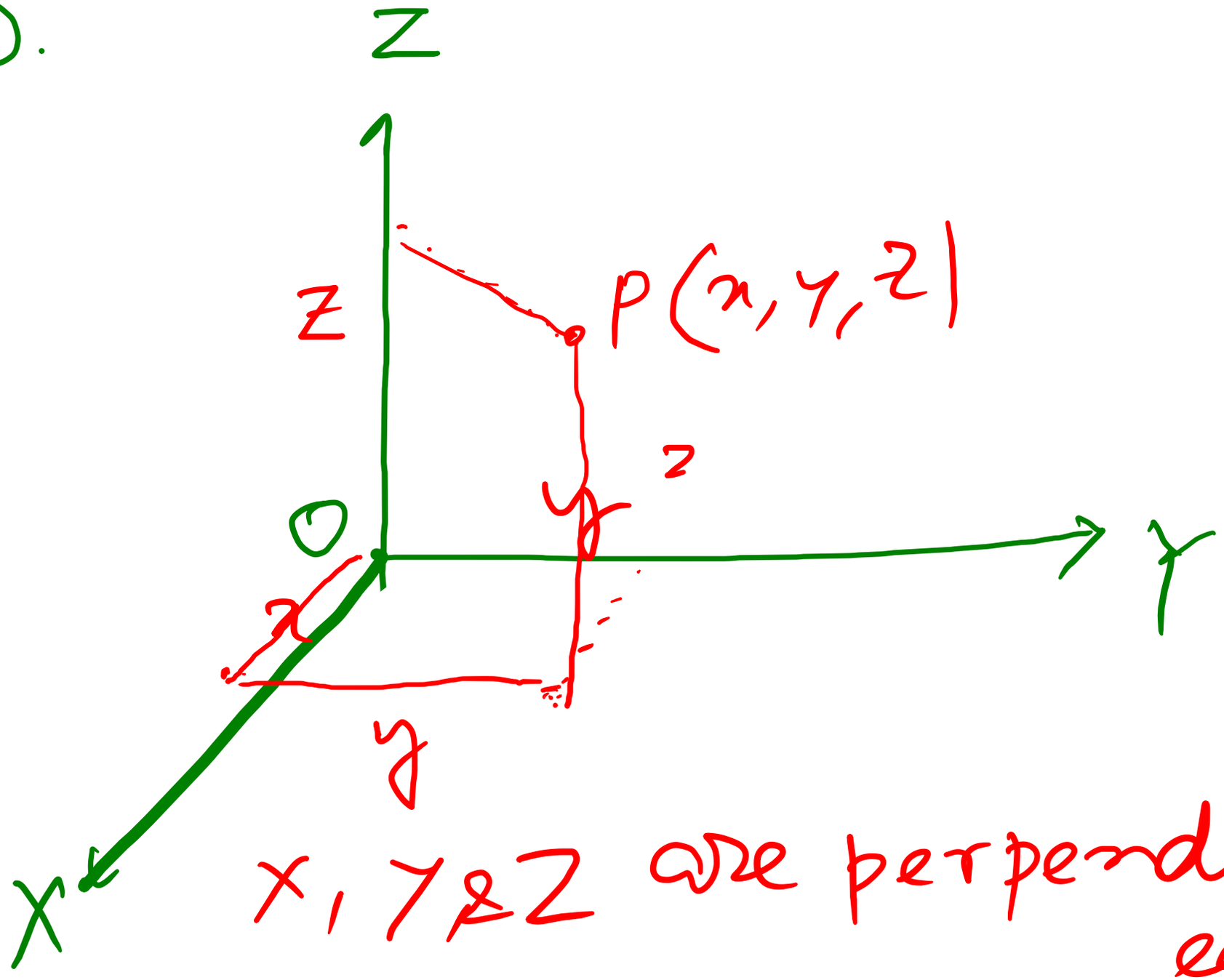


2D:



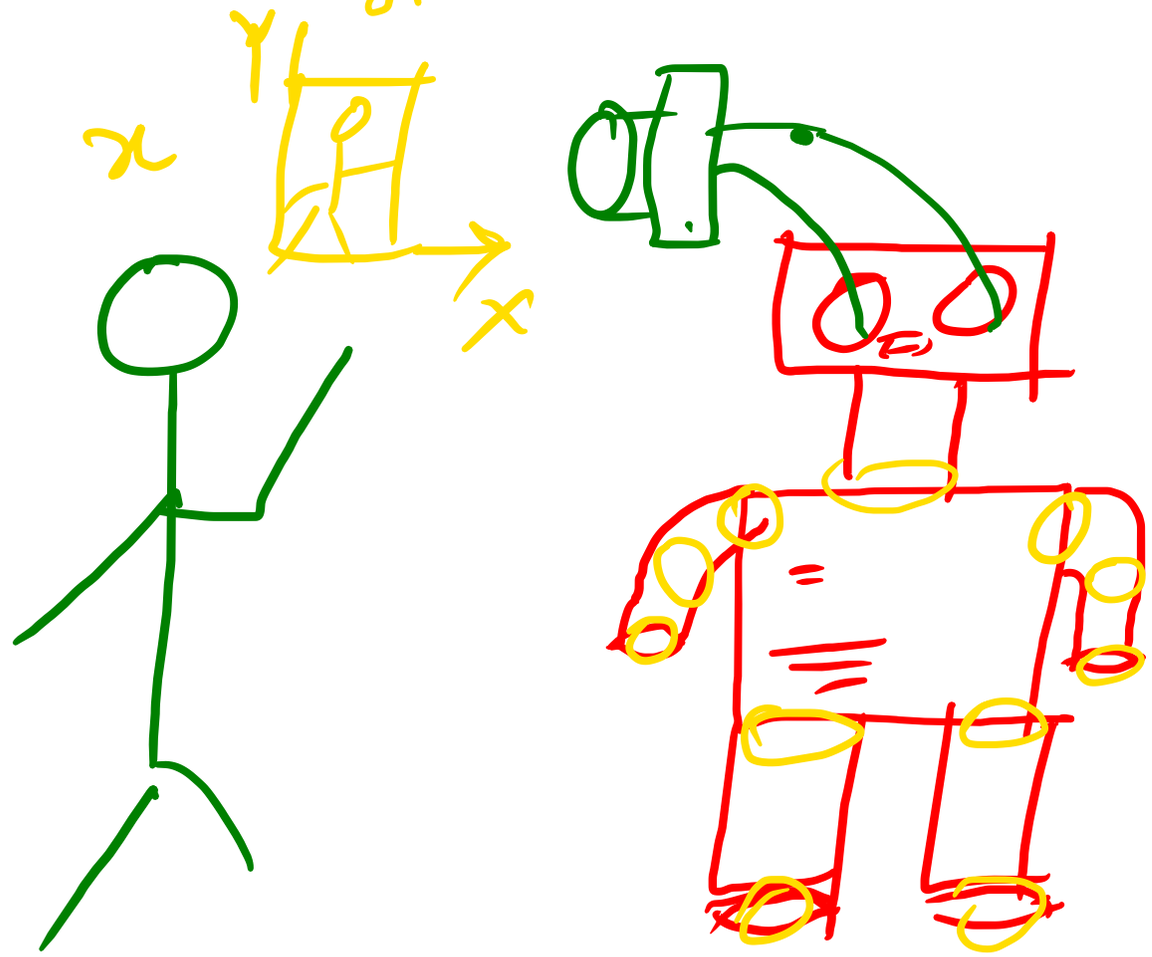
X & Y coordinates are perpendicular to each other

3D:



X, Y & Z are perpendicular to each other

Certesian World



Servo-motors

$$x = f(\theta) \quad \text{or} \quad \theta = f(x)$$

Edge Computing

AI/ML

image

$x = f(\theta)$ ⟶ Forward k

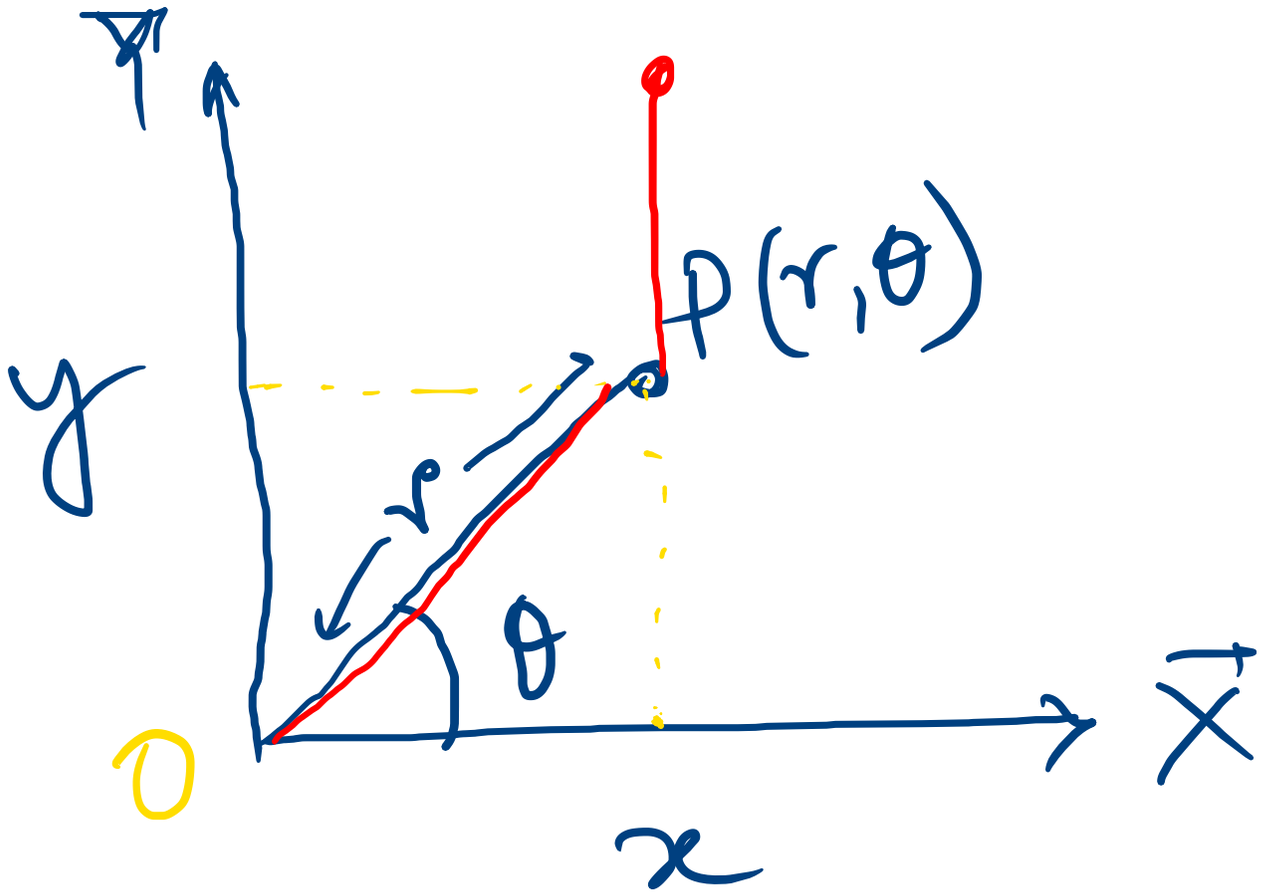
$\theta = f(x)$ ⟶ Inverse k

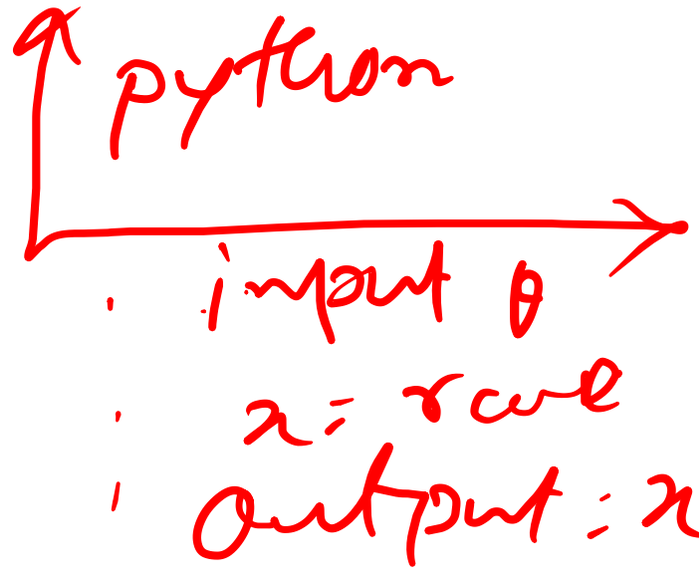
Polar Coordinates

2D , 3D

$P(r, \theta)$, $P(r, \theta, \phi)$

* Position
  * Velocity
  * Acc
  * Force
  * momentum

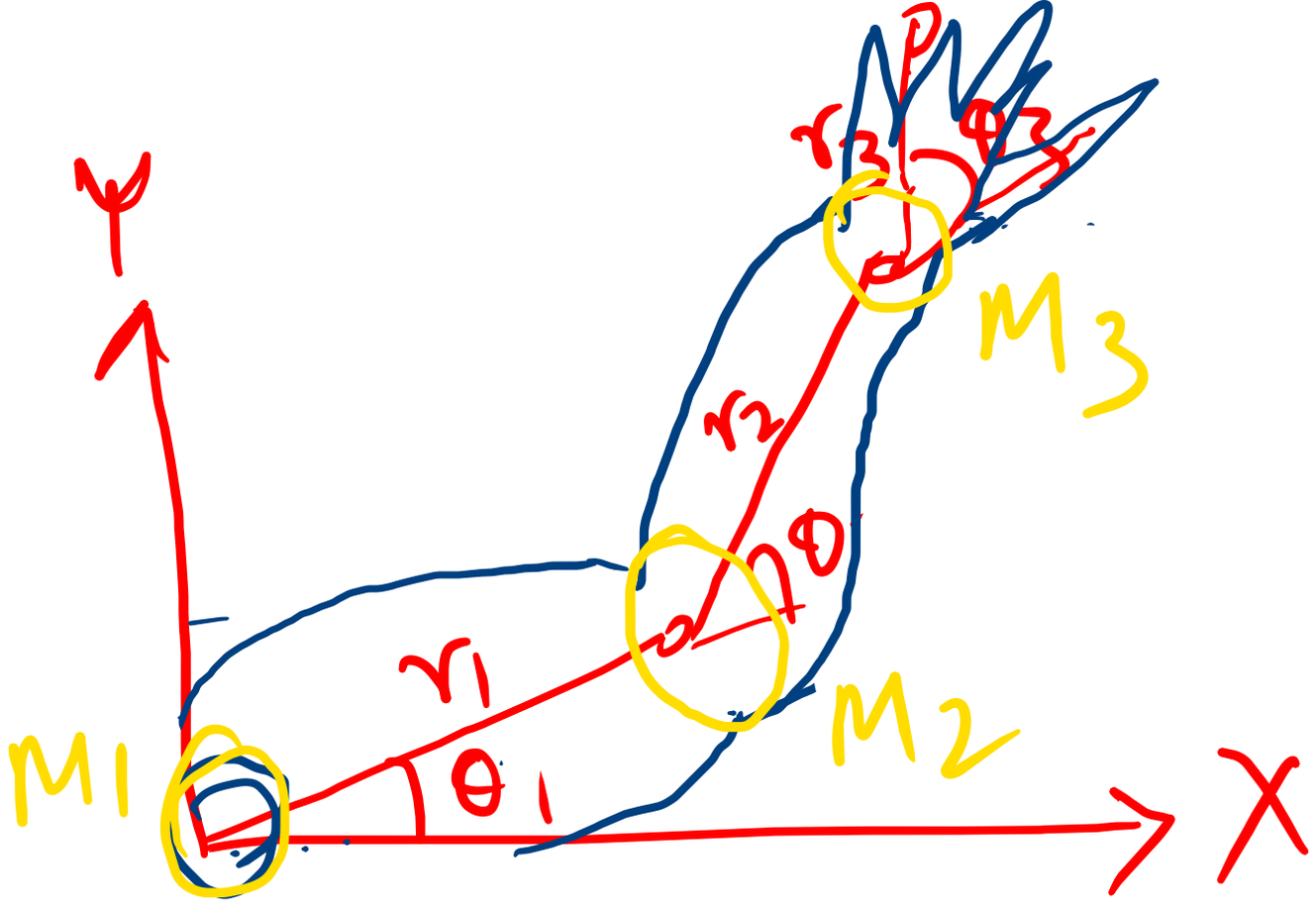




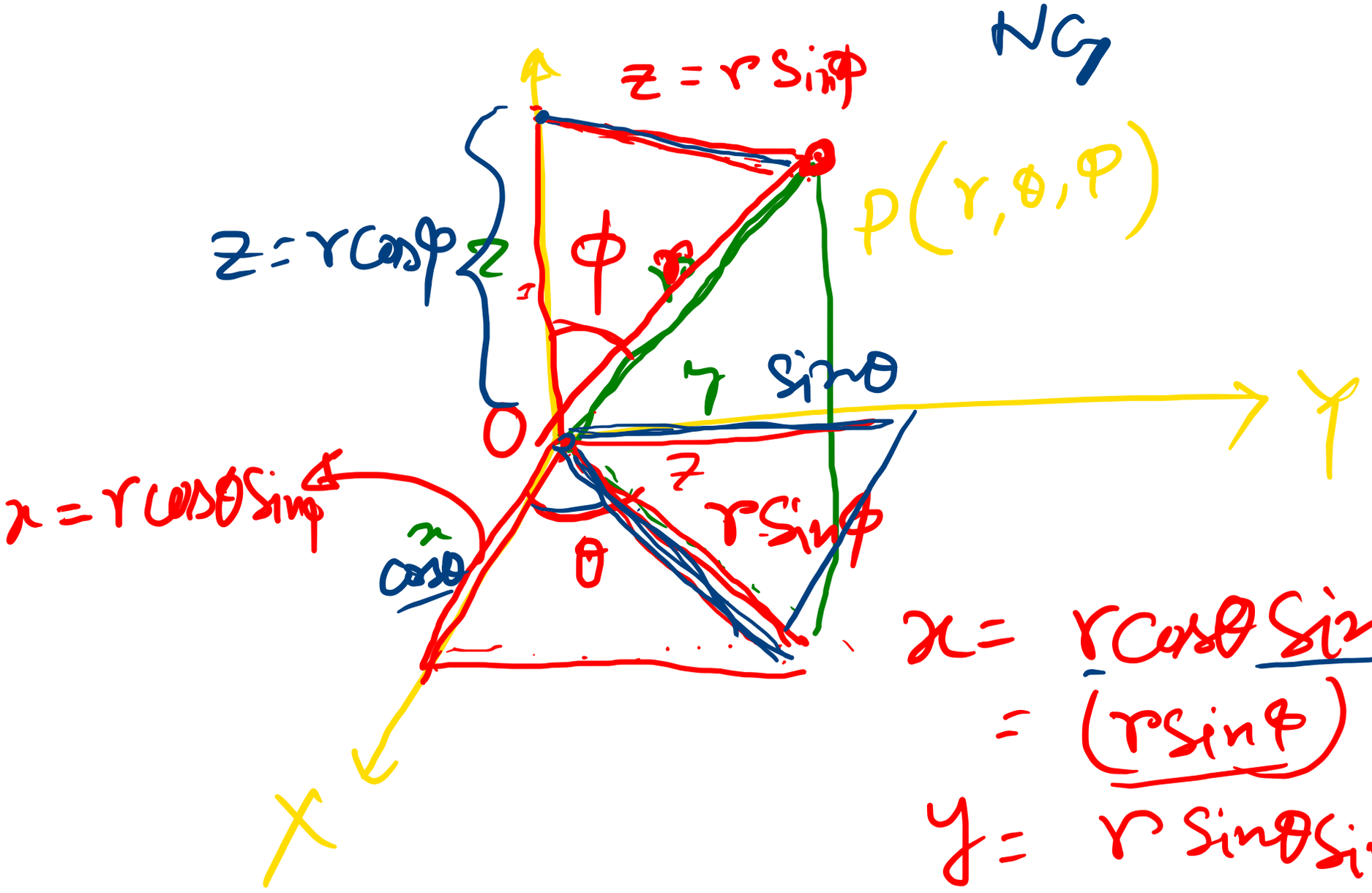
θ. Projection of P along x-axis

$$x = r\cos\theta$$
$$y = r\sin\theta$$

$$r = \sqrt{x^2+y^2}$$
$$\theta = \tan^{-1}(y/x)$$


Y
X
M1
M2
M3
r1
r2
r3
θ1
θ2
θ3

3D polar coordinate



$x = r\cos\theta\sin\phi$

$= (r\sin\phi)\cos\theta$

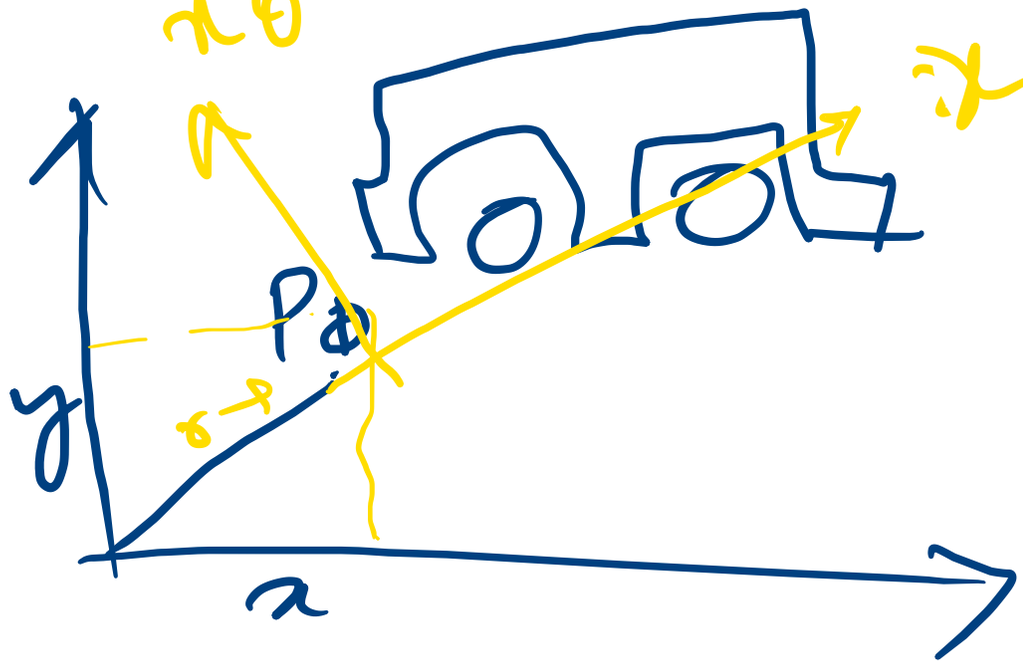
$y = r\sin\theta\sin\phi$

$z = r\sin\phi$

$x = r\cos\theta\sin\phi$

$y = r\sin\theta\sin\phi$

$z = r\cos\phi$



Position

matrix

$$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

$$r = [x, y, z]$$

$$x = f(\theta)$$

x_r

x_θ

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} R_T \end{bmatrix} \begin{bmatrix} r \\ \theta \\ \varphi \end{bmatrix}$$

$$\begin{pmatrix} \sin\theta\cos\varphi & \cdots \\ \sin\theta\sin\varphi & \cdots \end{pmatrix}$$

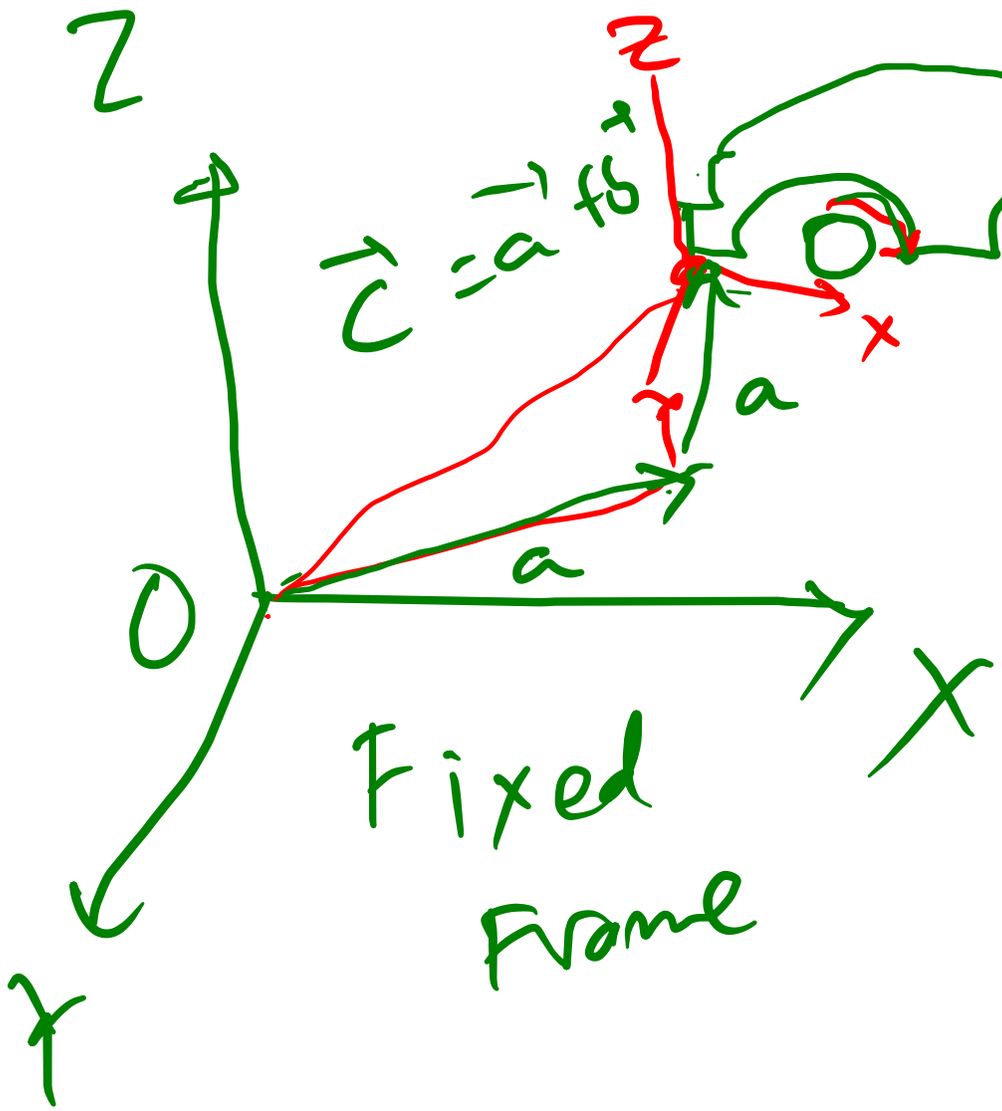
Frame of References

Two frames of References

* Fixed frame of Referenced

* Moving frame of Reference

Inertia frame of Refare.
nonon intertial frame



moving Frame

Robotics Coding

Rosl