20/11/18

Unit-I

Alt + zoom = 🔍

zoom = 🔍

→ principles of Simulated physics:-

1) Squash and ~~Streeth~~ Stretch. (Compress and expand).

2) timing :- large objects move slow (w.r.t time object moves)

3) Secondary Action (primary action response)

4) Slow-in and Slow-out (zooming and zoom out of opening Scenes)

5) Arcs :- (movement in linear, curved path) physical changes.

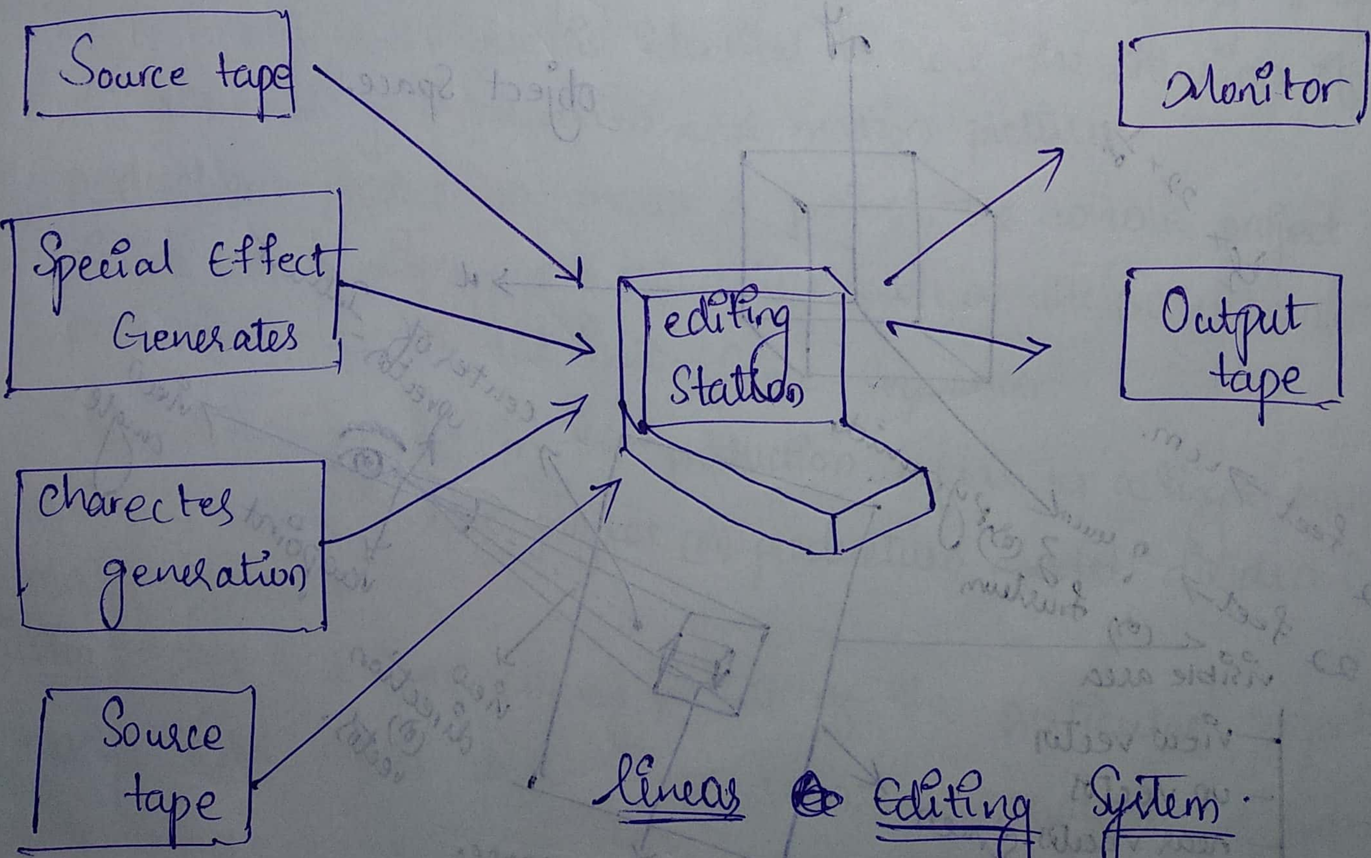
→ Designing A ____ Actions :- (Background Sounds, side sounds) directing.

follow through (previous scenes)

:- focusing (or) directing (ambulance lights blinking).

appeal :- making Scenes enjoyable

22/11/18



linear ~~&~~ Editing System.

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EDL ⇒ Edit Decision List.

Offline Editing → editing the changes and modifications on duplicate tap

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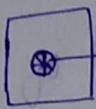
Display Pipeline

Object Space



↓

world Space

↓

eye Space ⇒ depth from world Space. (viewer is kept with z-axis)

↓

image Space ⇒ Object shape is viewed differently i.e, smoothens with far distance.

↓

Screen Space.

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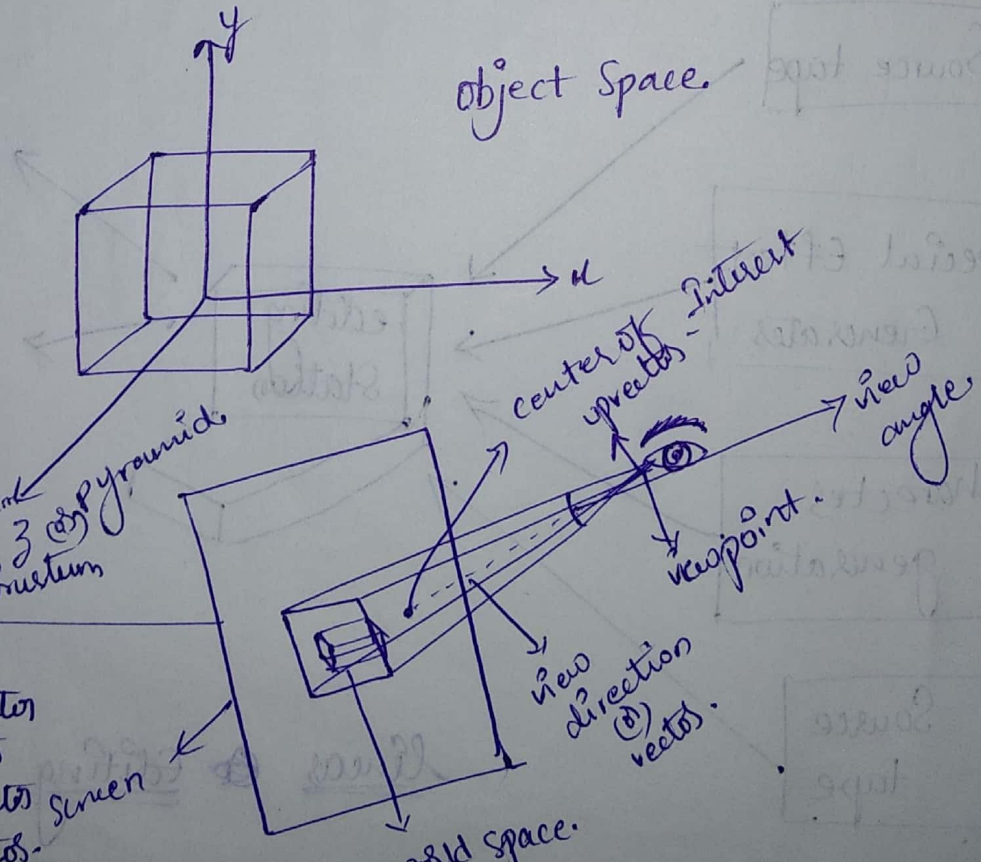
22 + 1/0.5

2.14
× 6
12.5



1/2 feet → 1cm.

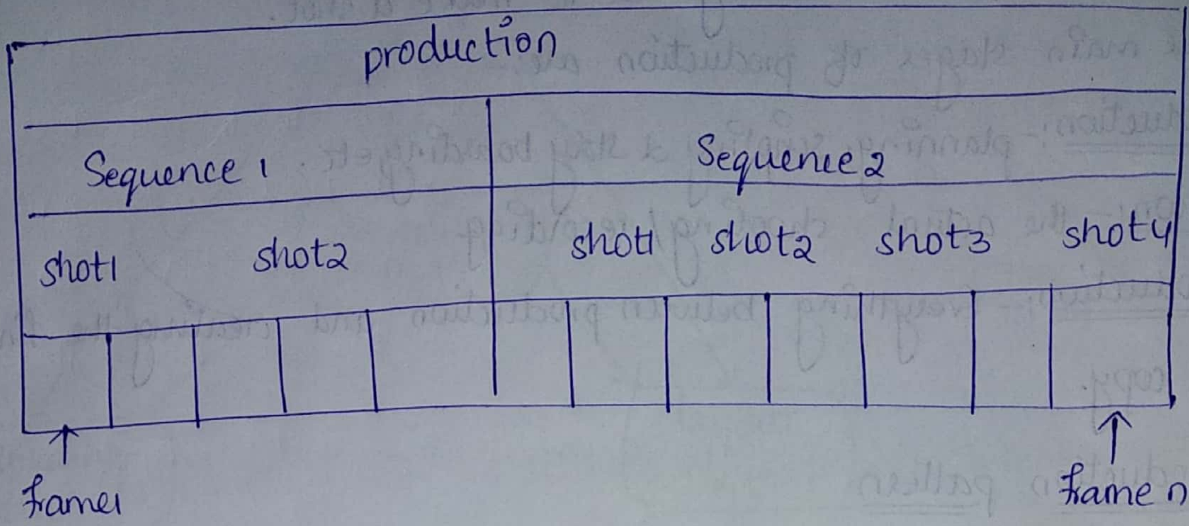
22 feet → ? ucm

3 (or) pyramid (or) frustum

visible area

- view vector
- up vector
- near vector
- far vector.

Up vector:- the vector ⊥ to view vector.



Animation:- it is the technique of photographing successive drawings (or) positions of models to create an illusion of movement when the film is shown as a sequence.

Computer Animation:- it is the process used for generating animated images. Computer ~~graphic~~ generate both static scenes & dynamic images, while Computer animation only refers to the moving images.

This technique is identical to how the illusion of movement is achieved with Television and motion pictures.

production:- production means a project. The whole project to make a picture (or) to display the object is known as the production. This production may divided into some Sequence.

Sequence:- Sequences in the production refers to a single half of animation. the whole project (or) production ~~model~~ divided into 3 major types.

1) Shot:- shot is a single clip (or) picture of the particular object. In film making a shot refers to a single seen. These shots are divided into some frames

2. Frame:- A frame means the poster (or) photo used in each shot is known as a frame. such no. of frames are joined to make a shot.

the three main stages of production are:-

preproduction:- planning, scripting & story boarding, etc.

production:- the actual shooting / recording

post production:- Everything between production and creating the final master copy.

production pattern

preliminary story

story board - sketches :- layout of complete animation theme.

Model sheet :- a document used to standardize appearence, pose and ge

exposure sheet - Audio:- tool, that allows animators to organize their th

route sheet :- blue print of manufacturing process in production unit.

animatic / story reel :- entire film in still picture form with sound tra

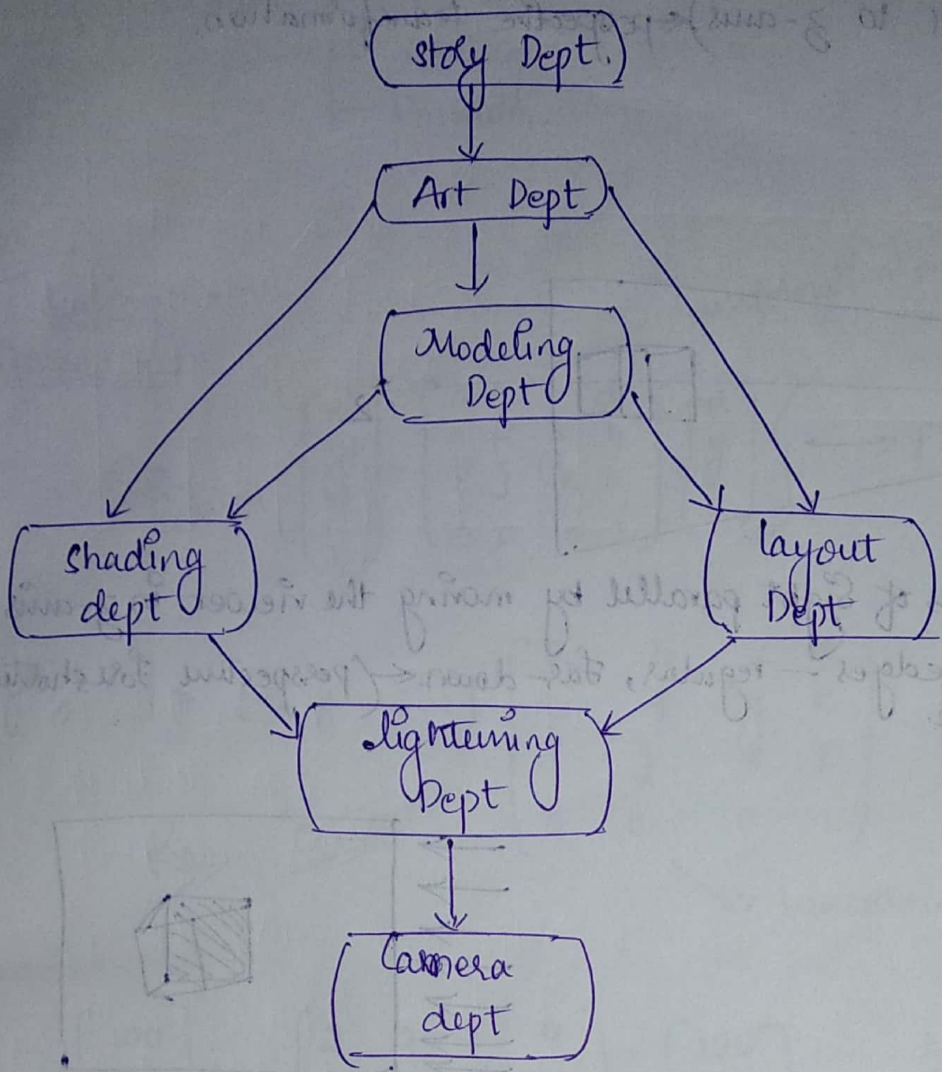
detailed story :- each and every charecter with getup is explained

Key Frames :- starting and ending points of any smooth transitio

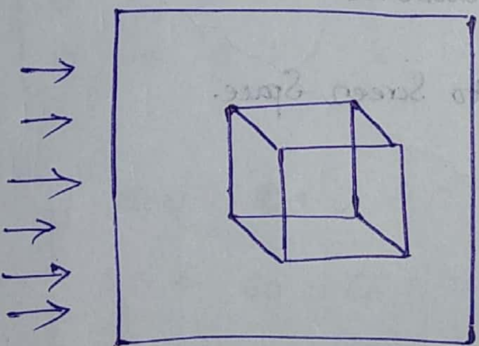
pencil test :- add something more to animation

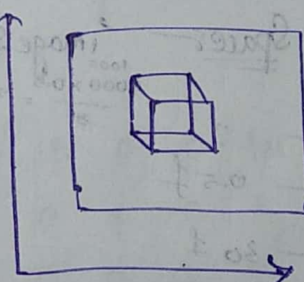
Inking :- Colouring to animation

Opaqueing :- to create the illumination is "light" (or) "Dark".



1/12/18





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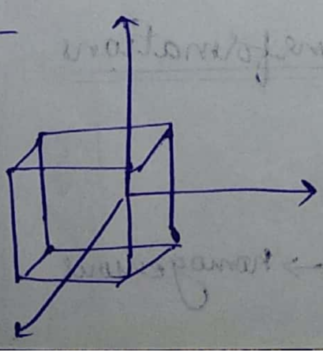
Display Pipeline:-

Object Space:-



eye Space:- (Bring viewer to z-axis) ← perspective transformation.

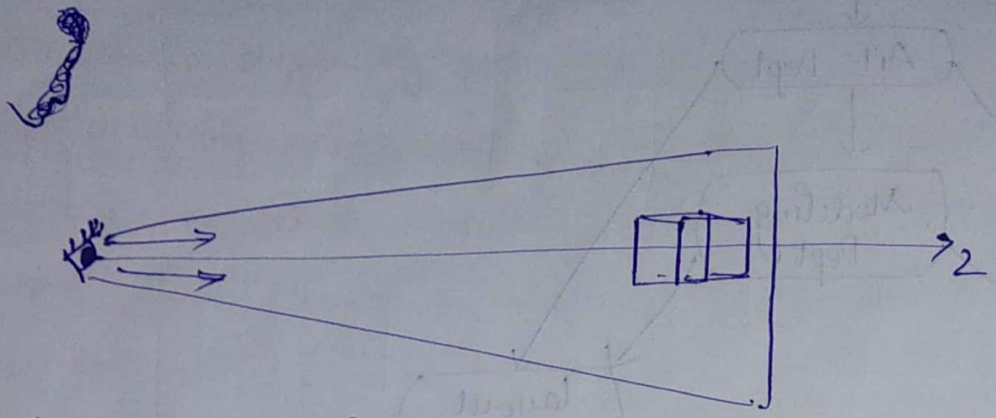
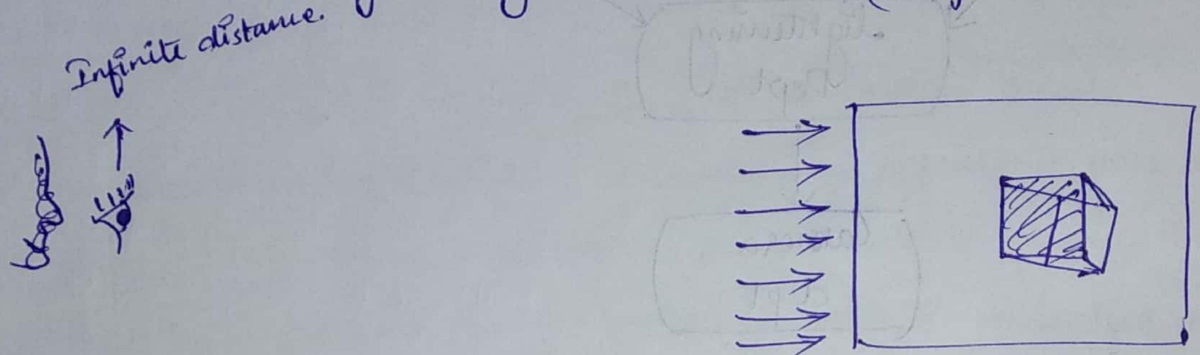
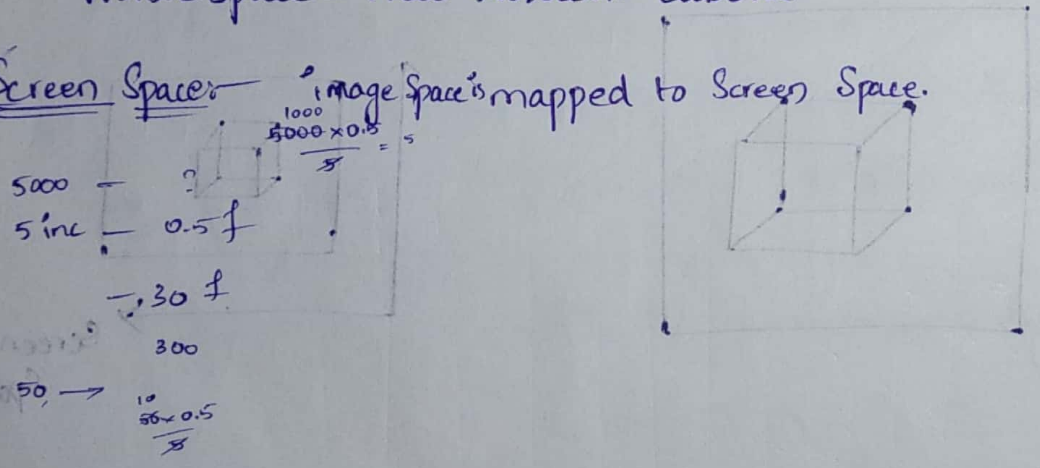


Image Space:- make lines of Sight parallel by moving the viewer in z-axis to Infinite distance. near edges — regular, far — down. ← (perspective foreshortening)



visible space — view frustum — cuboid.

Screen Space:- image space is mapped to Screen Space.



homogeneous Coordinates and transformations

actual Coordinates $\left(\frac{x}{w}, \frac{y}{w}, \frac{z}{w}\right) = x, y, z, w.$

Ex:- $\left(\frac{100}{10}, \frac{20}{10}, \frac{30}{10}\right) = (100, 20, 30, 10)$ → homogeneous

transformations :-
- translation
- Scaling
- Rotation.

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Scaling :-

~~Translation~~ :-

~~Row~~ Column

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \underbrace{\begin{bmatrix} a & b & c & d \\ e & f & g & h \\ i & j & k & l \\ 0 & 0 & 0 & 1 \end{bmatrix}}_{\text{transformation matrix}} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} \Big\} \longrightarrow \text{pre-multiplication}$$

$$[x' \; y' \; z' \; 1] = [x \; y \; z \; 1] \begin{bmatrix} a & b & c & d \\ e & f & g & h \\ i & j & k & l \\ 0 & 0 & 0 & 1 \end{bmatrix} \Big\} \longrightarrow \text{post Multiplication}$$

Row ~~Column~~

→ transformation matrix.

$$\begin{bmatrix} 100 \\ 20 \\ 30 \\ 1 \end{bmatrix} = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 4 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 100 \\ 20 \\ 30 \\ 1 \end{bmatrix}$$

$1/2$

$1/3$

$1/4$

$$x' \begin{bmatrix} 200 \\ 60 \\ 120 \\ 1 \end{bmatrix} = \begin{bmatrix} 200 + 0 + 0 \\ 0 + 60 + 0 + 0 \\ 0 + 0 + 120 + 0 \\ 0 + 0 + 0 + 1 \end{bmatrix} x$$

$$\begin{bmatrix} p & 0 & 0 & t_x \\ 0 & p & 0 & t_y \\ 0 & 0 & q & t_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} t_x \\ t_y \\ t_z \\ 1 \end{bmatrix} \qquad \begin{bmatrix} 1 & 0 & 0 & t_x \\ 0 & 1 & 0 & t_y \\ 0 & 0 & 1 & t_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

translation

$$= \begin{bmatrix} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 1 & 4 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 100 \\ 20 \\ 30 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 102 \\ 23 \\ 34 \\ 1 \end{bmatrix}$$

RayCasting :-

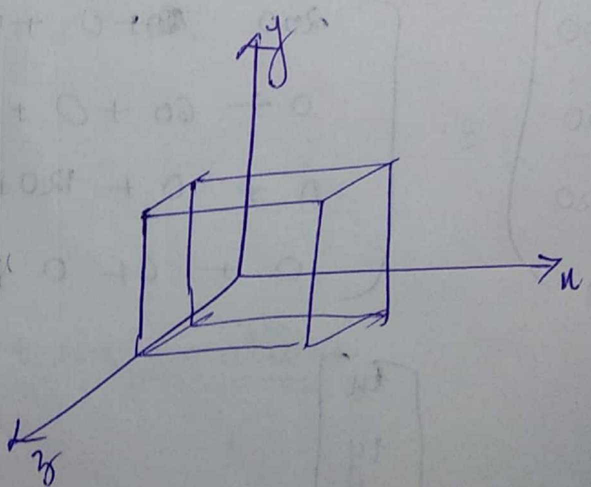
(Object Space)

↓

(world Space)

↓

(Screen Space)



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Rotation:-

along x-axis:-

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

~~along y-axis:-~~

$$\cancel{\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & \sin\theta & \\ 0 & \sin\theta & \cos\theta & \\ 0 & & & \end{bmatrix}}$$

along y-axis

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos\theta & 0 & \sin\theta & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\theta & 0 & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

along z-axis

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta & 0 & 0 \\ \sin\theta & \cos\theta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

$= (100, 20, 30, 10)$

$= (10, 2, 3).$

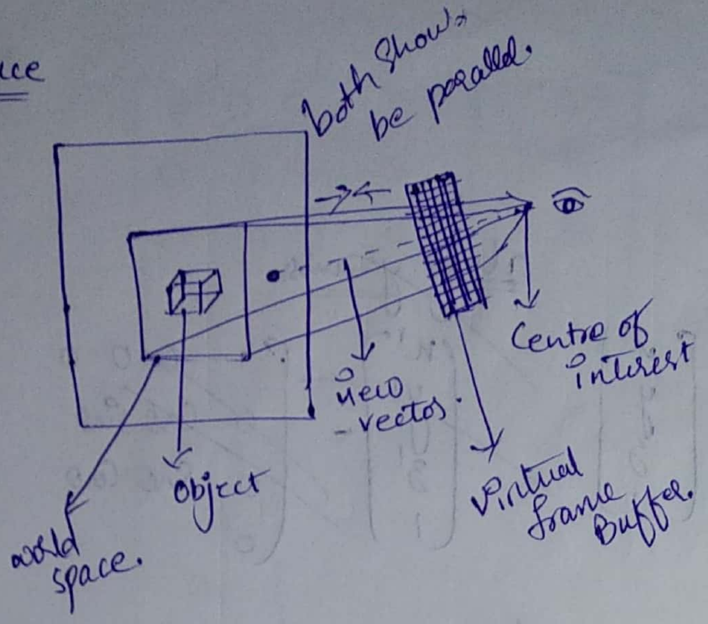
$$= \begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \cancel{\cos 90}\ 1 & 0 & 0 & 0 \\ 0 & \cos 90 & -\sin\theta & 0 \\ 0 & \sin 90 & \cos 90 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 10 \\ 2 \\ 3 \\ 1 \end{bmatrix} \Rightarrow \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 10 \\ 2 \\ 3 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 10 \\ -3 \\ 2 \\ 1 \end{bmatrix}$$

along z

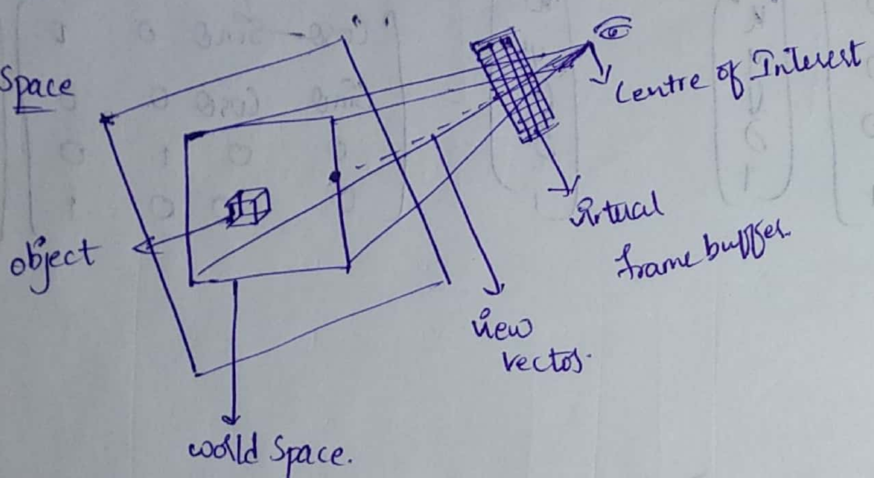
$$= \begin{bmatrix} 0 & -1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 10 \\ -3 \\ 2 \\ 1 \end{bmatrix} \Rightarrow \boxed{\begin{bmatrix} 3 \\ 10 \\ 2 \\ 1 \end{bmatrix}}$$

world Space

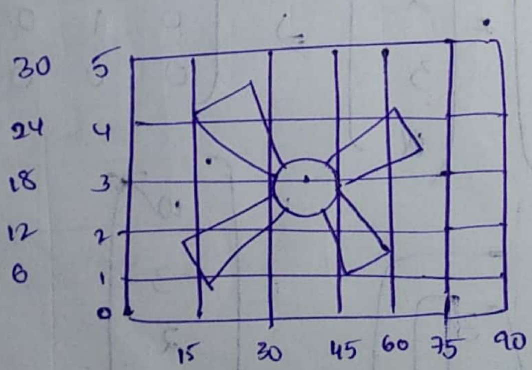


11/12/18.

world Space



$6 \times 5 = 0.5$

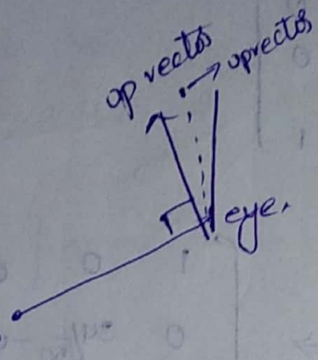


Representing An Arbitrary Orientation:-

View vector = Eye position − Center of Interest (COI)

$y = -x + c$

$x + y = c$



① → line

② → perpendicular line

③ → Cross product with y-axis.

Fixed Angle Representation:-

Orientation Representation

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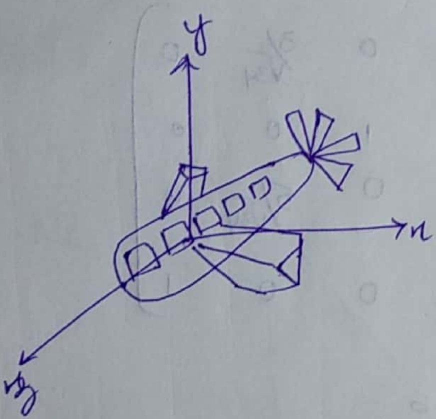
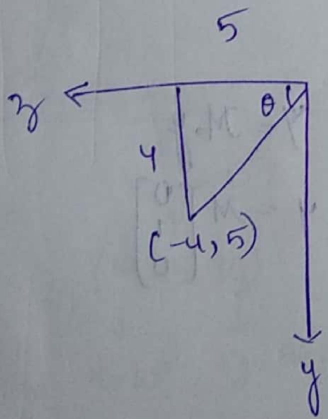
(23, −14, 30)

(20, −10, 35)



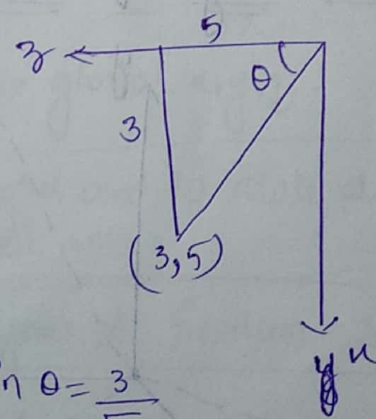
(23−20, −14+10, 30−35)

= (3, −4, −5)



$\sin\varphi = 4/\sqrt{50}$

$\cos\varphi = \frac{34}{\sqrt{50}}$



$\sin\theta = \frac{3}{\sqrt{34}}$

$\cos\theta = \frac{5}{\sqrt{34}}$.

transformation matrix along x-axis:-

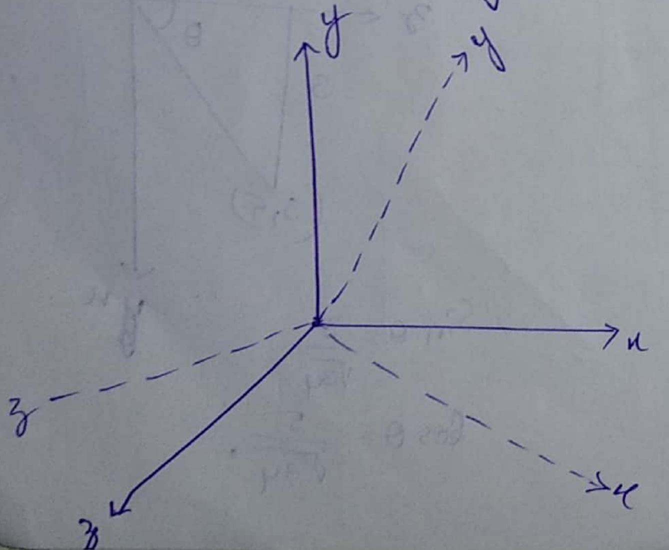
$$= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\varphi & -\sin\varphi & 0 \\ 0 & \sin\varphi & \cos\varphi & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\varphi & -\sin\varphi & 0 \\ 0 & \sin\varphi & \cos\varphi & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \Rightarrow \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 34/\sqrt{50} & -4/\sqrt{50} & 0 \\ 0 & \frac{4}{\sqrt{50}} & \frac{34}{\sqrt{50}} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

transformation matrix along y-axis:-

$$\begin{bmatrix} \cos\theta & 0 & \sin\theta & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\theta & 0 & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \Rightarrow \begin{bmatrix} 5/\sqrt{34} & 0 & 3/\sqrt{34} & 0 \\ 0 & 1 & 0 & 0 \\ -3/\sqrt{34} & 0 & 5/\sqrt{34} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Another ways of finding transformation matrix:-



$X = M \cdot x$

$X = M \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$

$Y = M \cdot y$

$Y = M \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$

$Z = M \cdot z$

$= M \cdot \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

Ortho Normalization

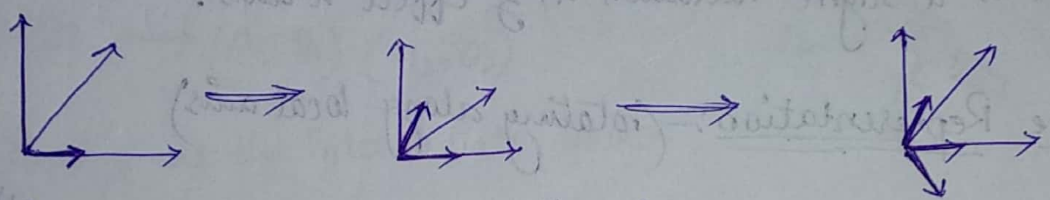
0 1 2 3 - - - - | 100

10 20 30 40

0 0.1 0.2 0.3 0.4 - - - - 1

30 - 4
2 - ? } normalization

$30 \Rightarrow \frac{4 \times 2}{30} = \frac{8}{30} = 0.26666$



normalize 'n'.

N_x

cross product 'n' with any of the axis, then other axis is obtained

$N_x \otimes y$ (or) z
$= N_z$

cross product both 'n' and obtain axis then third axis is normalized.

$N_x \otimes N_z$
$= N_y$.

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1) Fixed Angle Representation:- fixed angle → global x, y, z.

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* Angles used to rotate about fixed axis.

degrees of freedom = 3

$y = 45^\circ$

(10, 45, 90)

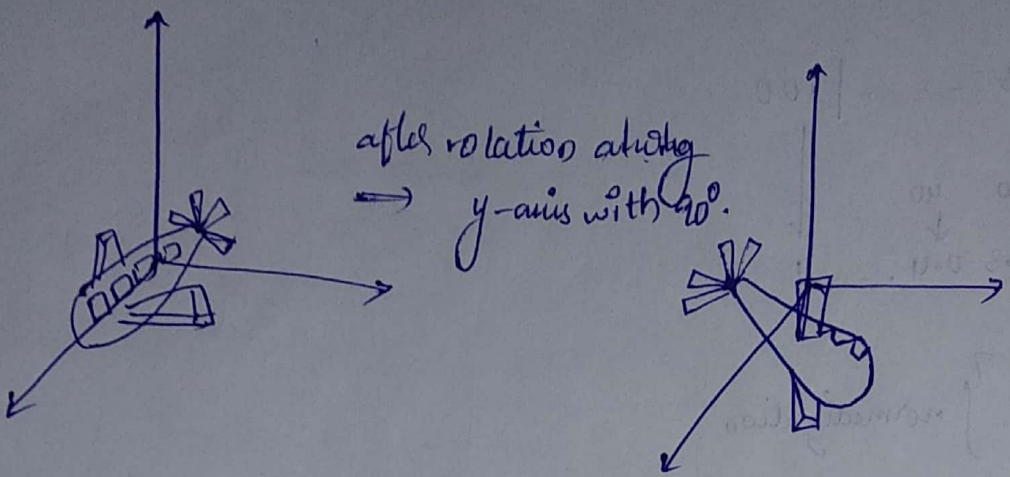
$x = 10^\circ$ $z = 90^\circ$.

$R_{z\,90}\left[R_{y\,45^\circ}\left(R_{x\,10^\circ}\right)\right]$.

positive 90° rotation along y-axis.

negative 90° along y-axis.

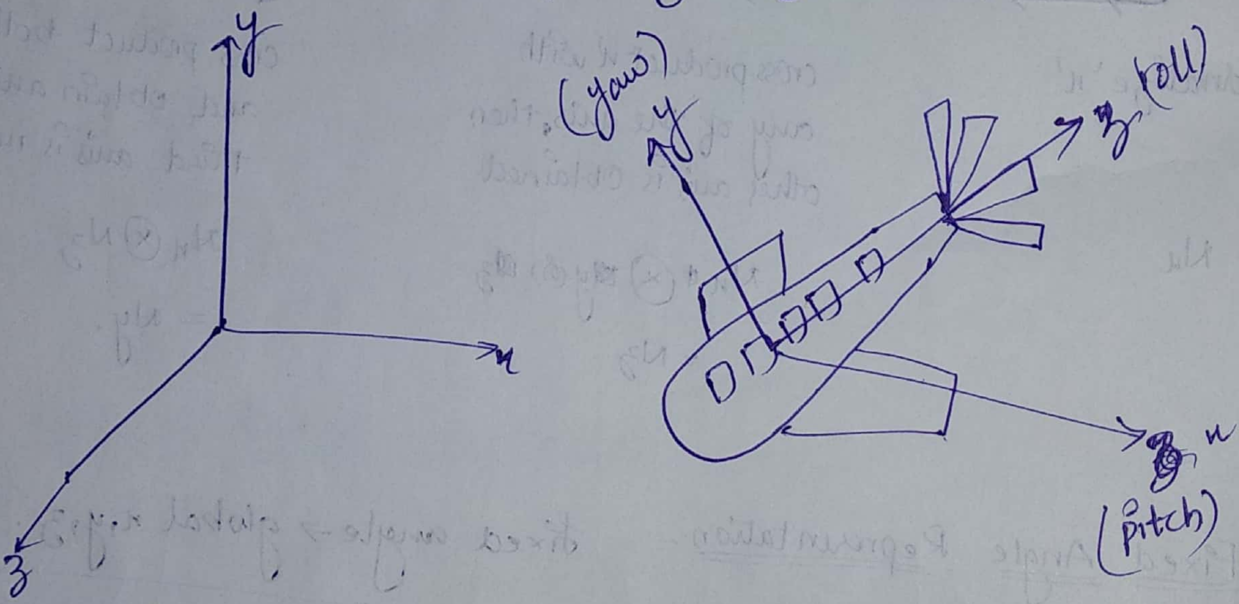
(x-y-z) ✓
(x-y-x) ✓
(x-x-y) × meaning less



Gimbal lock:-

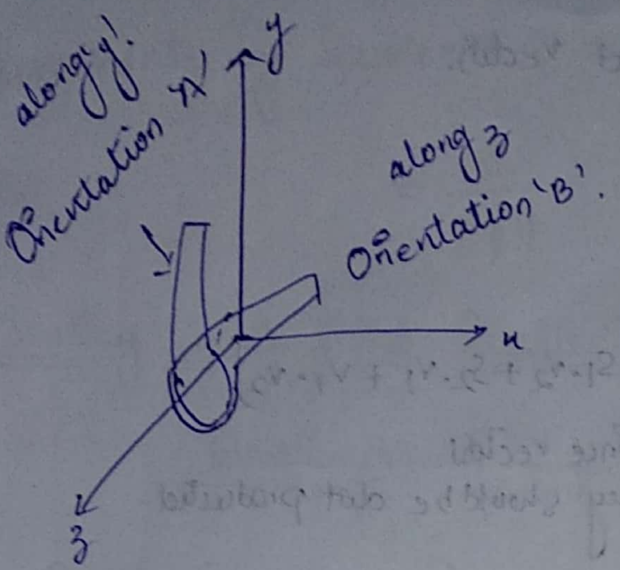
Rotation along y-axis by 90° made 1st axis align with 3rd axis because of this a slight variation in z effect x-axis.

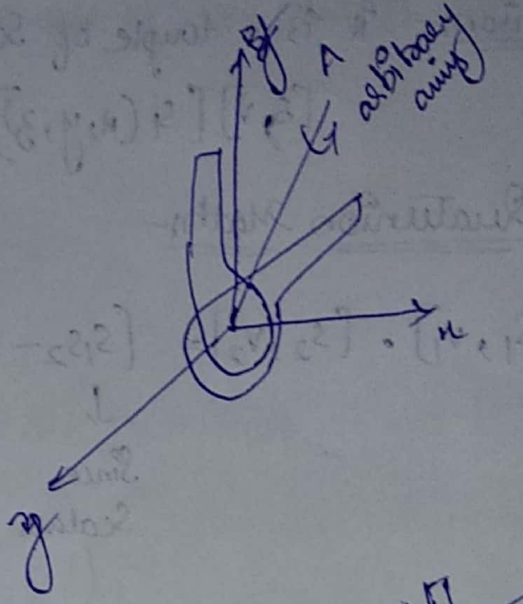
2) Euler Angle Representation:- (rotating along local axis)



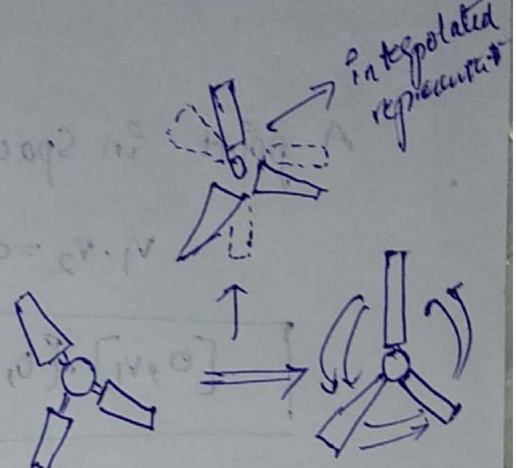
3) Angle and Axis

Euler's theorem implies that for any 2 Orientations of an Object one can be produced from another by a single Rotation about an arbitrary Axis.





* Orientation Represented by a 4 touple
  an angle and (x, y, z) (angle, x, y, z)



Interpolation $\longrightarrow (A_1, \theta_1)\ (A_2, \theta_2)$ Ex:-

↳ finding out the intermediate frames.

Axis of rotation — Cross product of 2-axises.

Angle b/w Axis — inverse cosine of dot product of normalized version of axis.

$$\Longrightarrow \cos^{-1}\left(\frac{A_1}{|A_1|} \cdot \frac{A_2}{|A_2|}\right) \Rightarrow \cos^{-1}\left(\frac{A_1 \cdot A_2}{|A_1|\,|A_2|}\right)$$

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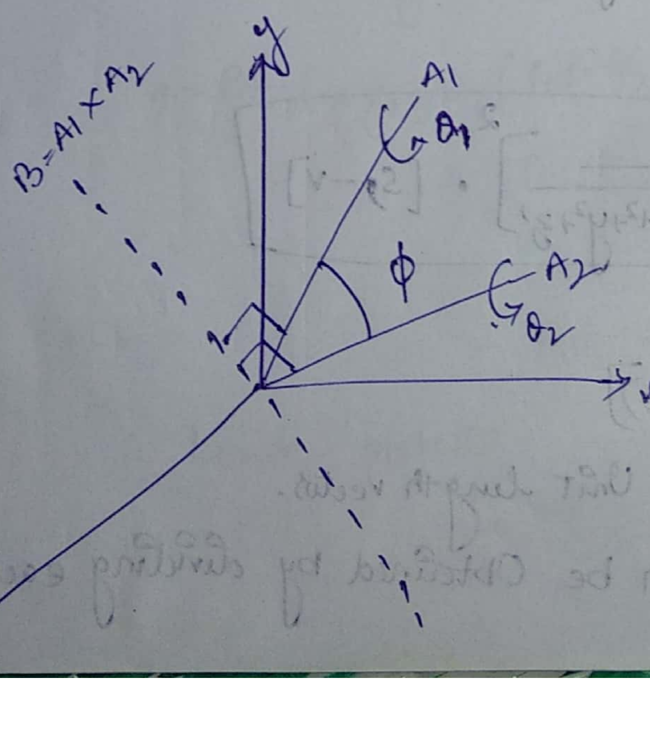

$\Longrightarrow$

$B = A_1 \times A_2$

$\phi = \cos^{-1}\left(\frac{A_1 \cdot A_2}{|A_1||A_2|}\right)$

$A_k = R_B(k \cdot \phi)_{A_1}$

$\theta_k = (1-k) \cdot \theta_1 + k\theta_2$.

Scanned by CamScanner

Quaternion:- it is a touple of Scalar and vector.

$[s, \vec{v}]$ $[s, (x, y, z)]$

Basic Quaternion Maths:-

$[s_1, v_1] \cdot [s_2, v_2] = [s_1 s_2 - v_1 \cdot v_2, \; s_1 \cdot v_2 + s_2 \cdot v_1 + v_1 \cdot v_2]$

Since Scalars

Since vectors they should be dot producted.

A point in Space, 'v'. vector from Origin to point is $(0, v)$.

$v_1 \cdot v_2 = 0$, when v_1 and v_2 are Orthogonal vectors

$$\boxed{[0, v_1] \cdot [0, v_2] = [0, v_1 \times v_2] \text{ iff } v_1 \cdot v_2 = 0.}$$

⇒ Quaternion is Multiplicative Identity

$$\boxed{[s, v] \, [1 (0, 0, 0)] = [s, v]}$$

Inverse of Quaternion:- it is obtained by nagating its vector part and dividing both parts by magnitude square.

Inverse of s, v is

$$\boxed{[s, v]^{-1} = \left[\frac{1}{\sqrt{s^2 + x^2 + y^2 + z^2}}\right]^2 \cdot [s, -v]}$$

$q \cdot q^{-1} = [1, (0, 0, 0)]$

↳ Unit length vector.

→ Unit length Quaternion can be Obtained by dividing each of 4

Components by Squareroot of Sum of Square of Components.

$$= \frac{q}{\|q\|}$$

Rotating Vector Using Quaternion:-

$$Rotation(v) = v^{-1} = q \cdot v \cdot q^{-1}.$$

$$Rotation_q(Rotation_p(v)) \Rightarrow q \cdot (p \cdot v \cdot p^{-1}) \cdot q^{-1}$$

$$= (qp) \cdot v \cdot (qp)^{-1}$$

$$= Rot_{qp}(v)$$

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$$Rotation^{-1}(Rotation(v)) = (\cancel{q}^{-1}(q(v)\, q^{-1})\cancel{q}) = v.$$

Representing Rotations Using Quaternions:-

$$q = Rot_{\theta,}(x, y, z) = [\cos(\theta/2), \sin(\theta/2) \cdot (x, y, z)]$$

show that

→ Quaternion and its nagation $[-s, -v]$ ~~show~~ represent same rotation.

$$q = Rot_\theta(x, y, z) = [\cos(-\theta/2), \sin(-\theta/2) \cdot -(x, y, z)]$$

$$= [\cos \theta/2, -\sin(\theta/2) \cdot -(x, y, z)]$$

$$= \cos \theta/2, \sin(\theta/2) \cdot (x, y, z)$$

$$= Rot_\theta(x, y, z)$$

∴ hence proved