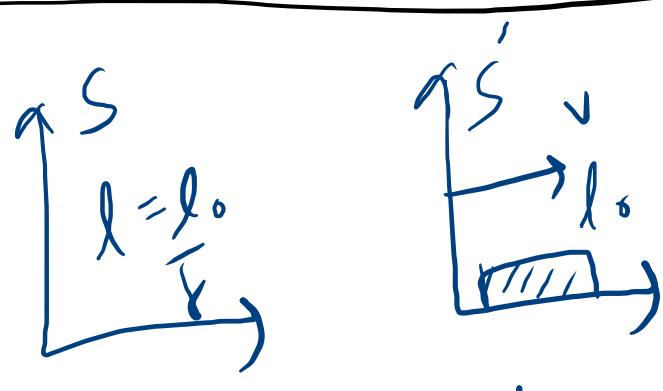
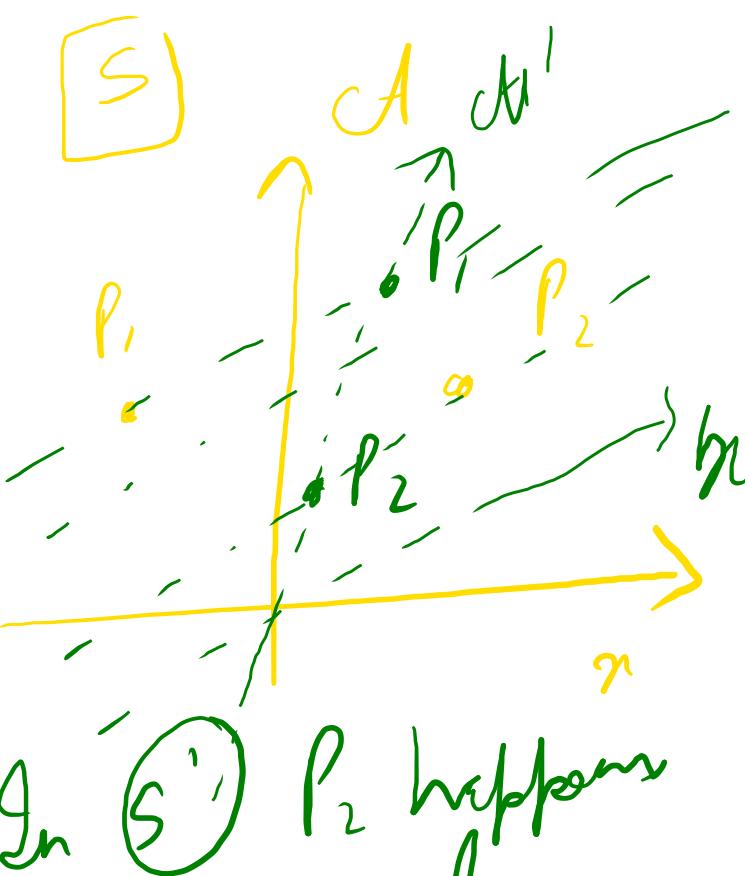
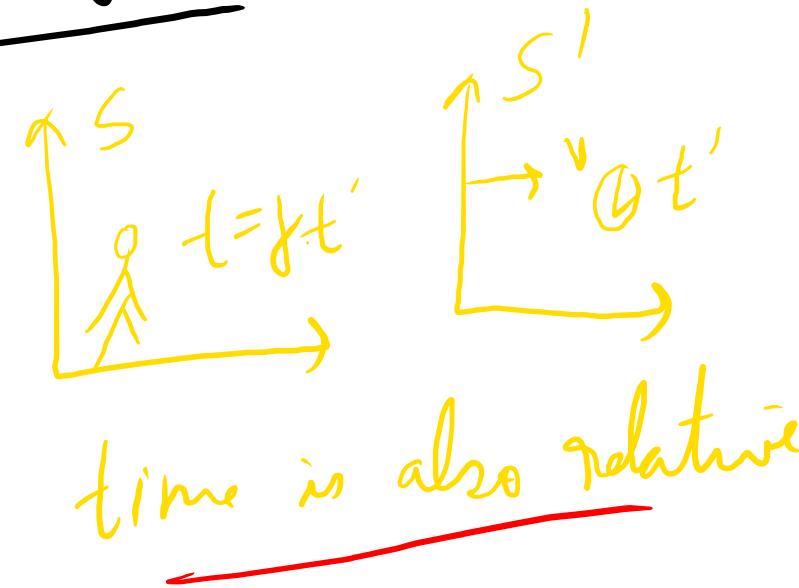


PARADOXES in Special Relativity



space is relative



simultaneity is
also relative

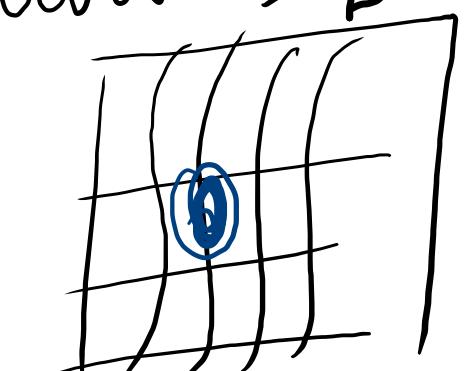
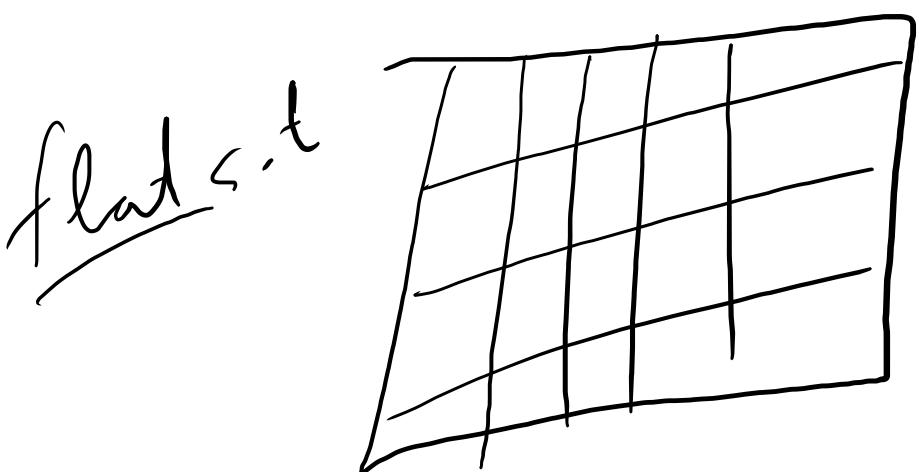
Invariant spacetime interval

$$\begin{aligned} (ds)^2 &= (ct)^2 - (dx)^2 \\ &= (ct')^2 - (dx')^2 \end{aligned}$$

8

Geometry of spacetime (Minkowski - flat) $\Rightarrow ds^2 = c^2 dt^2 - dx^2 - dy^2 - dz^2$

curved s.t.

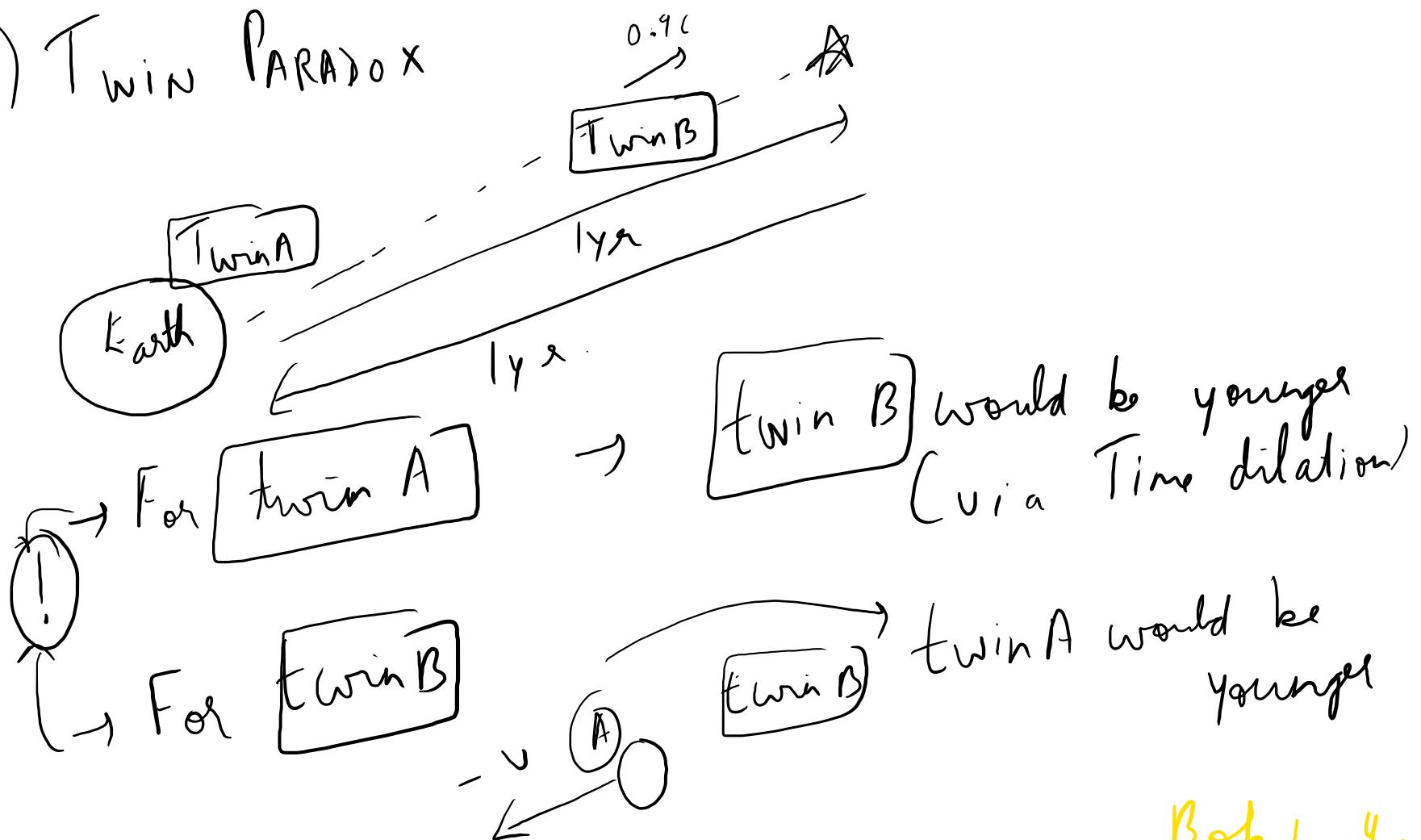


$$() dt^2 - () dx^2$$

S.R.T \rightarrow G.R

$$-1, 1, (\eta_{\mu\nu}) \rightarrow (g_{\mu\nu})(x, t)$$

I) Twin Paradox



II)

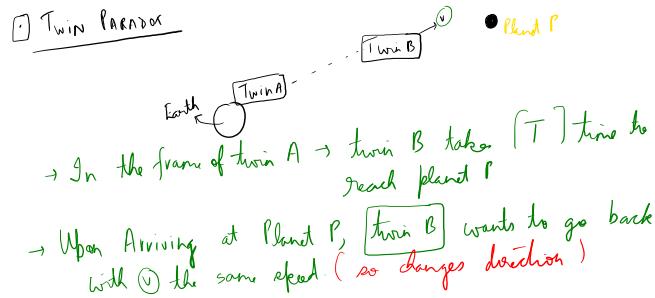
BARN-POLE PARADOX



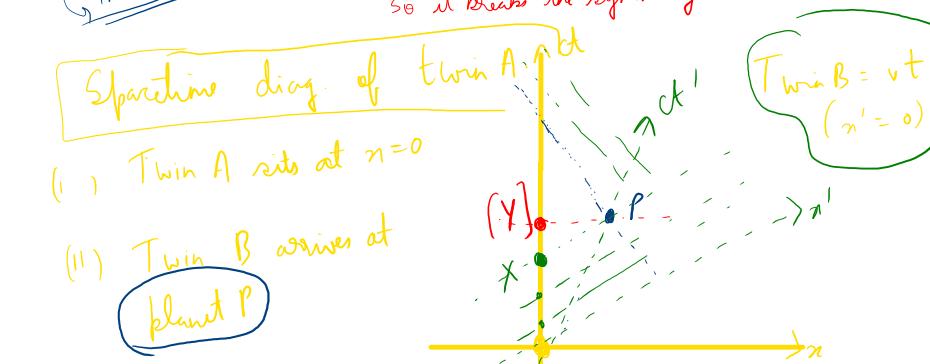
(i) W.r.t to Bob → pole is length contracted
∴ it fits

(ii) W.r.t to Alice → barn is length contracted
∴ it will not fit

Twin paradox



SPOILER:
Twin A is in inertial frame all the time
 $\ddot{a} = \frac{dv}{dt} = \frac{\text{②}}{\text{③}}$
at Twin P
at Earth
Twin B is no longer in inertial frame so it breaks the symmetry
Potential I: "inertial frame"

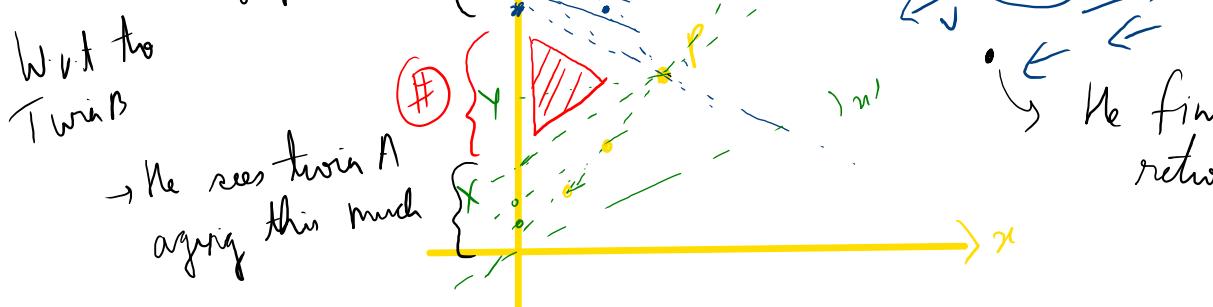


→ Now when does twin A thinks that twin B has reached the planet P → [Y]

→ where was twin A according to twin B when he arrives on planet P → [X]
as seen pt' from S

(iii) When twin B returns

We also see twin A aging this much



④ Twin B does not see twin A age in this region b'cos he changes his vel (direction)

$$\ddot{a} = \frac{dv}{dt}$$

changes to "non-inertial frame"

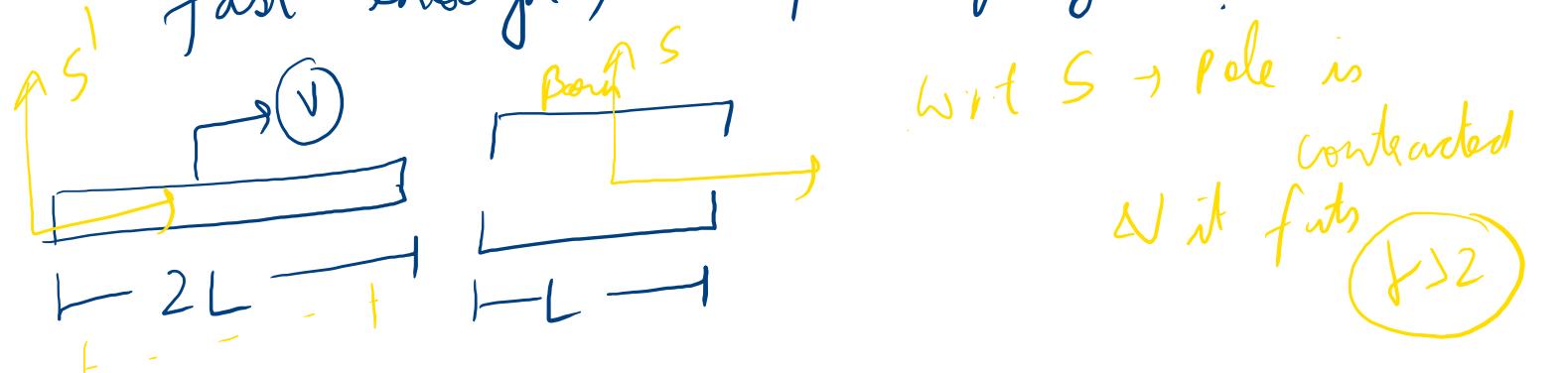
∴ twin B's calculation is wrong

and twin B is more younger when he returns

$$\ddot{a} = \frac{dv}{dt}$$

$$at$$

Barn-Pole Paradox → Take a ladder of length $2L$ and try to put it in a barn of length L . If you run fast enough, can you squeeze it?



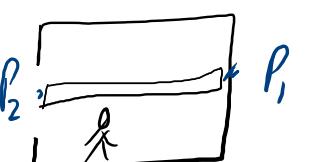
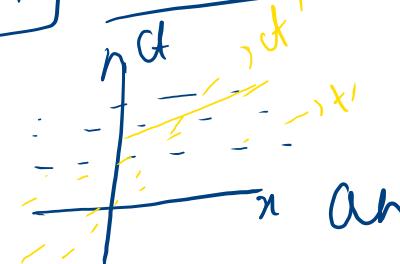
(i) Perspective of Barn = ladder contracts to length

$$\frac{2L}{\gamma} \quad \therefore \text{it fits :-)}$$

(ii) Perspective of Pole = barn has contracted by $\frac{L}{\gamma}$
 \therefore it does not fit

"Fitting a ladder inside" → Any observer will agree
 that we have 'fit' the ladder when the back end gets
 in the front end hits the far wall

! UWAGA → But these are two different events

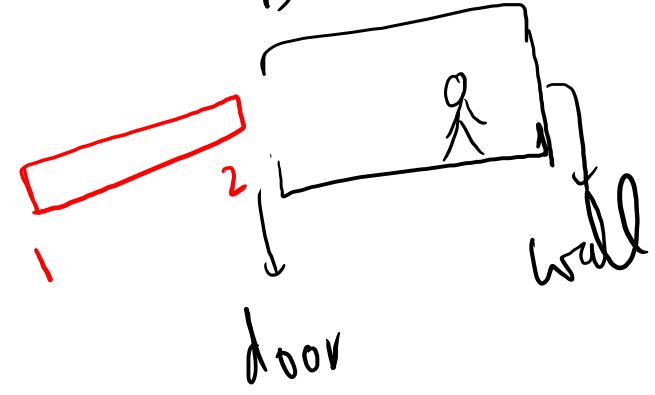


and simultaneity of events is not fixed
 So the word 'when' / 'before' ⇒ different observers
 will disagree on this

Via Spacetime diag

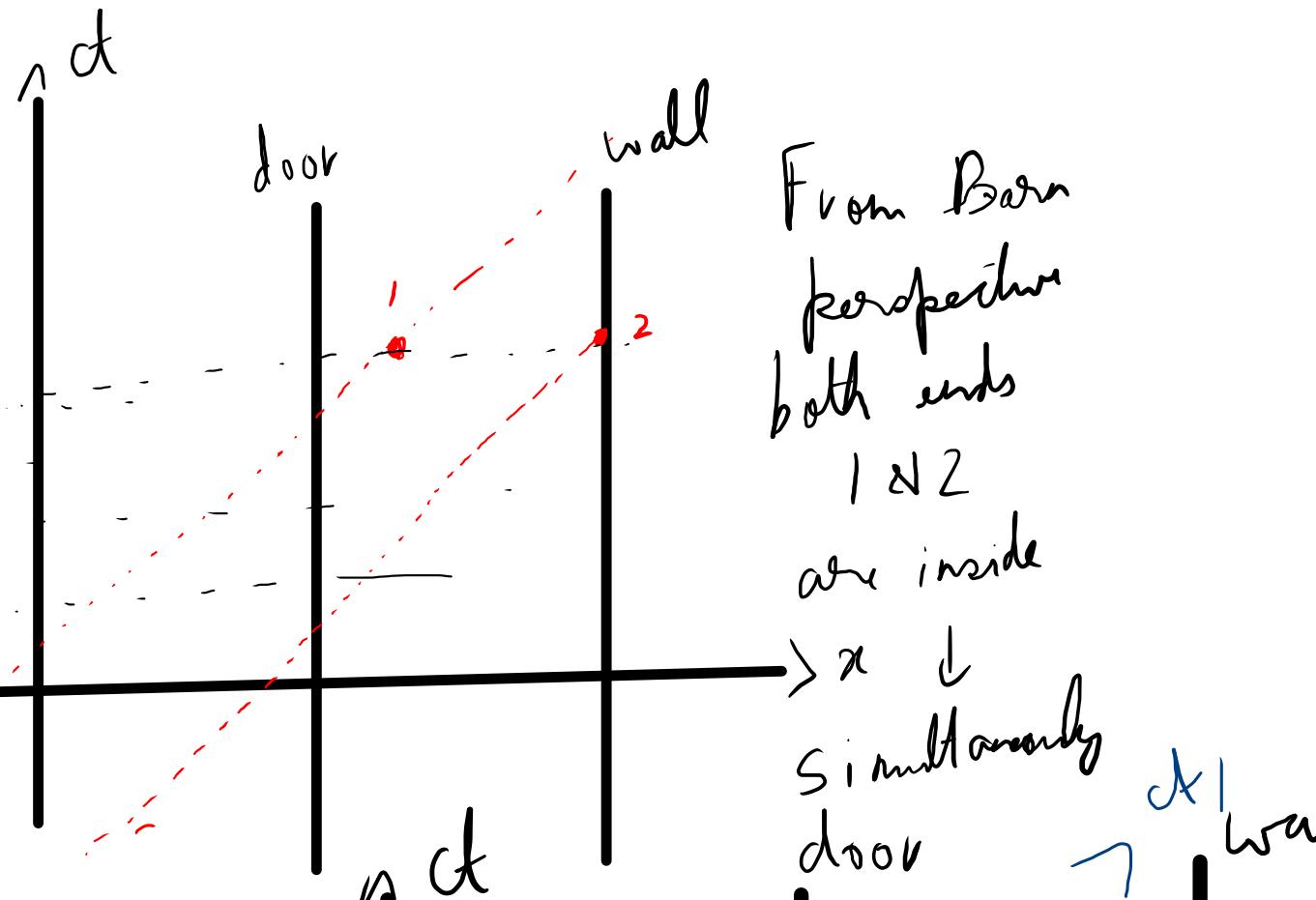
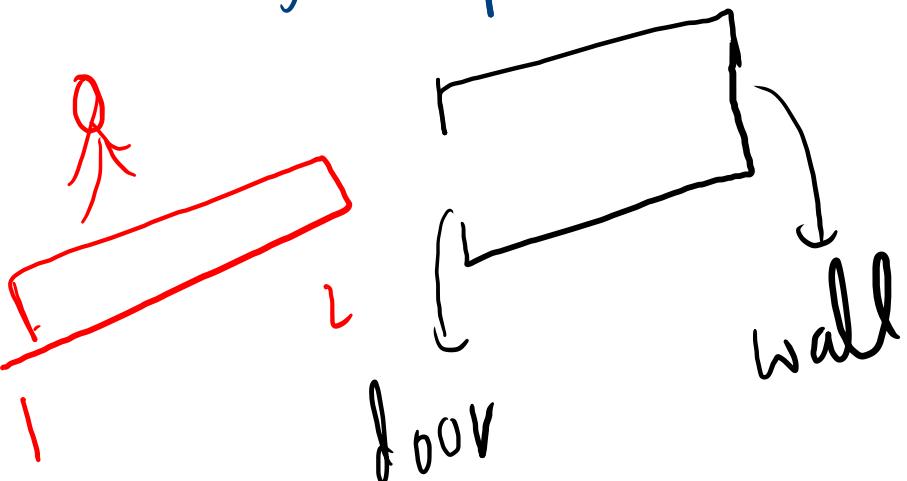
This is how the

Barn sees.



This shows how

the pole sees



Now P.O.V of pole

1, 2 are simultaneous but they are not inside the barn

