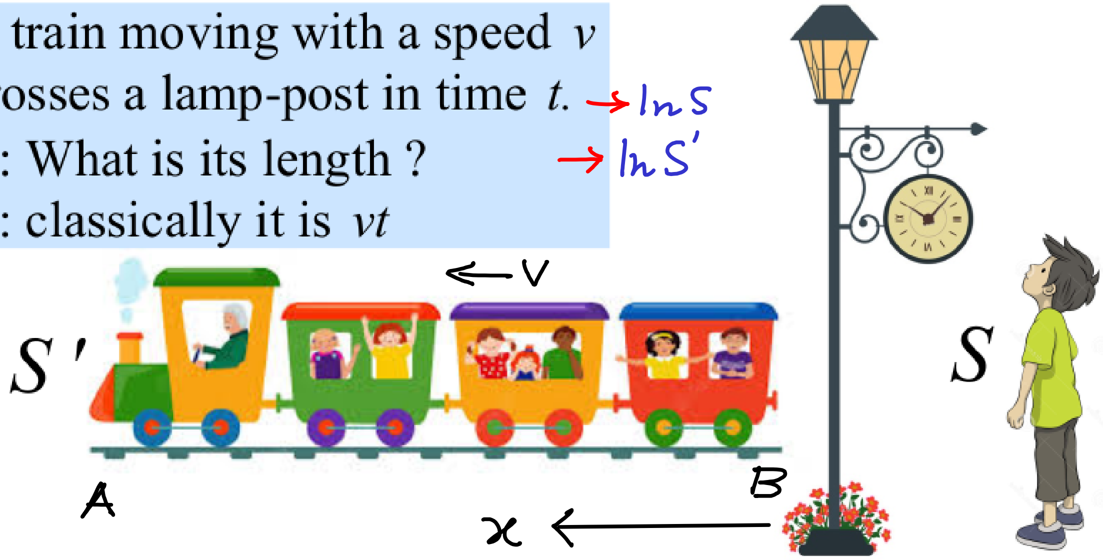
A train moving with a speed v crosses a lamp-post in time t. → In S

Q: What is its length ? → In S'

A: classically it is vt

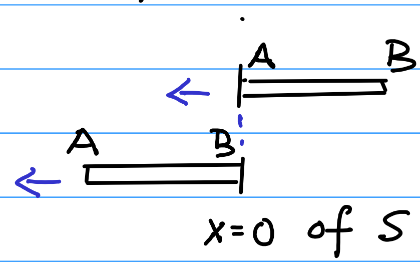


In S, train moves at v & takes time t to cross the post.

Consider 2 events : E_1 : A crosses post (origin of S)

E_2 : B crosses post

	S'	S
E_1 :	$(x_A'=0,\ t_A'=0)$	$(x_A=0,\ t_A=0)$
E_2 :	$(x_B'=-L_0,\ t_B')$	$(x_B=0,\ t_B=t)$



Let's use $x_A' = \frac{x_A - v t_A}{\sqrt{1-\beta^2}}$ & $x_B' = \frac{x_B - v t_B}{\sqrt{1-\beta^2}}$

$\Downarrow$ $\qquad\qquad\qquad\qquad$ $\Downarrow$

$0 = 0 - 0$ $\qquad\qquad$ $-L_0 = \frac{0 - vt}{\sqrt{1-\beta^2}}$

$\Rightarrow L_0 = \frac{vt}{\sqrt{1-\beta^2}} > vt$

Length contraction from S

In S' events occur at A & B (diff spots) but in S they occur at same spot $x=0$

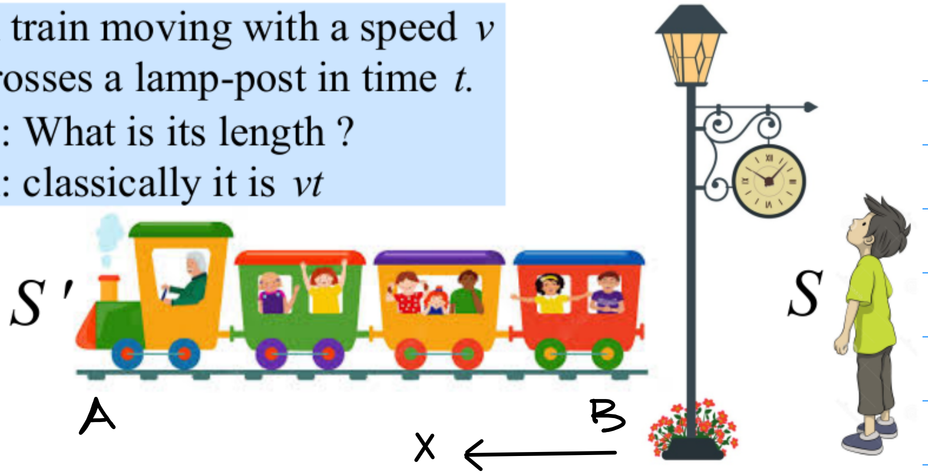
S moves at speed $+v$ wrt S'.

S takes $t' = \frac{L_0}{v}$ to cross from A to B (according to S')

$t' = \frac{L\gamma}{v} = \frac{vt}{v}\gamma = t\gamma > t$, so S' sees time dialation

ANOTHER WAY :

A train moving with a speed v crosses a lamp-post in time t.
Q: What is its length ?
A: classically it is vt



Track the events at B at 2 diff times

S'	S	$x_B' = \frac{x_B - vt_B}{\sqrt{1-\beta^2}}$
$E_1'(x_B' = -L_0, t_B' = 0)$	$(x_B = -L, t_B = 0)$	$\to -L_0 = \frac{-L - 0}{\sqrt{\ }} \Rightarrow L_0 = L\gamma$
$E_2\,(x_B' = -L_0, t_B' > 0)$	$(x_B = 0, t_B = t)$	$\to -L_0 = \frac{0 - vt}{\sqrt{\ }} \Rightarrow L_0 = vt\gamma$

Diff from $E_1\,(x_A' = 0, t_A' = 0)$

Recall: $L = vt$

Although $t_A' = t_B' = 0$ for E_1 because clocks in S' are in sync