LAST TIME:

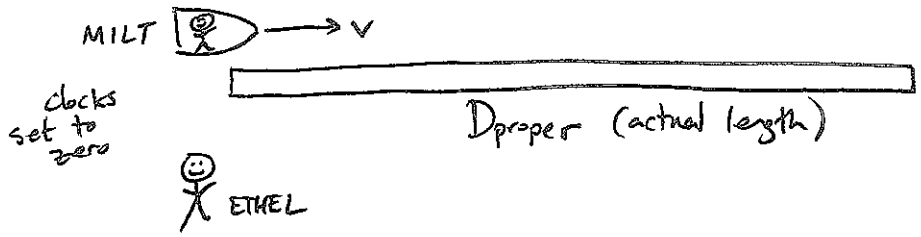
TIME DILATION:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$\Delta t_{OBSERVED} = \gamma \, \Delta t_{PROPER}$$

* only valid if Δt_{PROPER} is between two events at same place *

immediate consequence: LENGTH CONTRACTION



Ethel's clock reads: $\frac{D_{proper}}{v}$

Milt's clock reads: $\frac{D_{proper}}{v \cdot \gamma}$

Milt calculates length = speed × (time for object to pass)

$$= v \cdot \frac{D_{PROPER}}{v \cdot \gamma}$$

$$D_{OBSERVED} = \frac{D_{PROPER}}{\gamma}$$

length of object in own frame (or between 2 stationary objects in same frame)

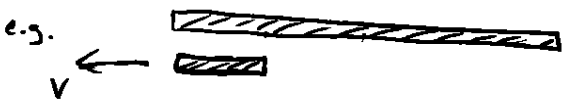
- objects moving relative to observer measured to be shorter in direction of motion.

(NOT in other directions)

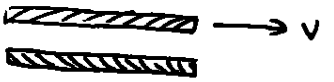
JOMST

CLICKER:

e.g.



frame of upper rod: left ends line up before right ends.

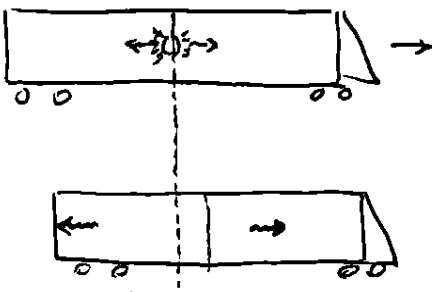


frame of lower rod: left ends line up at same time as right ends.

★ Simultaneous events in one frame NOT simultaneous in another (if separated in direction of relative motion) ★

RELATIVITY OF SIMULTANEITY.

e.g.

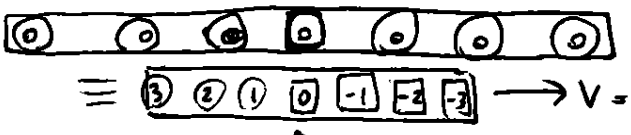


light leaves middle of moving train → hits both ends simultaneously in frame of train

reaches back end first in frame of track.

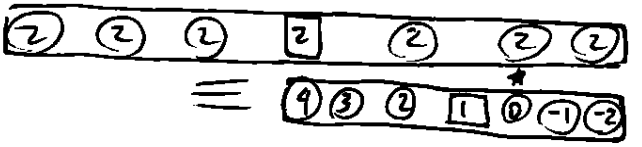
Exercise:

ruler with clocks



$\rightarrow v = \sqrt{\frac{3}{4}}c$

↖ these clocks appear to tick slower.



$\rightarrow v = \sqrt{\frac{3}{4}}c$

1 So FAR:

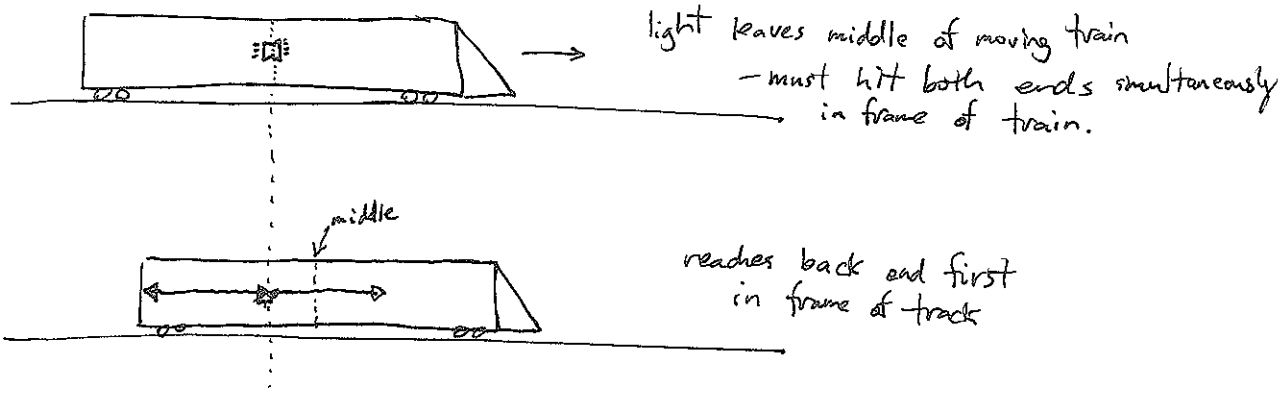
Principle of relativity ⟹

TIME DILATION → moving clocks measured to tick slower

LENGTH CONTRACTION → moving objects measured to be shorter in direction of motion (but NOT other directions)

RELATIVITY OF SIMULTANEITY → events at same time in one frame not at same time in other frames.

e.g.



If clocks at front & back read 12:00 when light hits, observers on track will measure front clock to read EARLIER time than back clock