Length Contraction and Asynchron

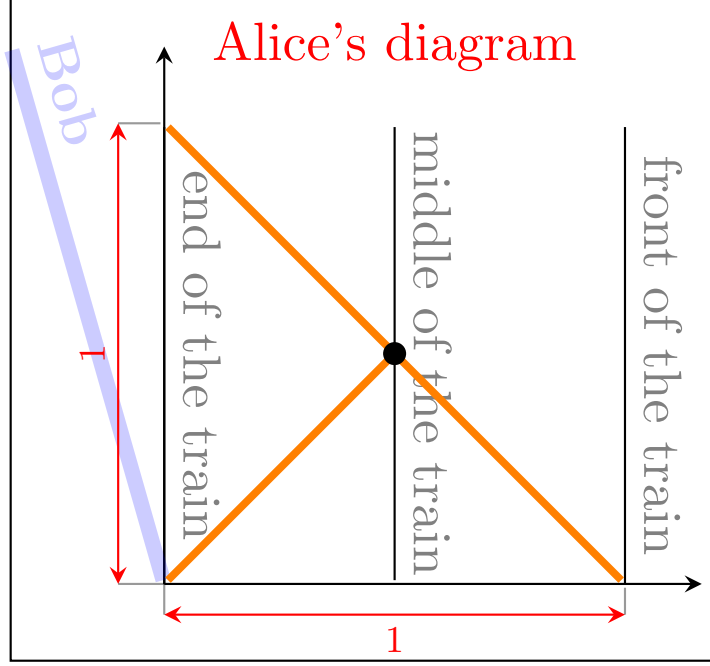
Alice is sitting in the 1-lightsecond long train's end, when two lightning struck into the end and the front of the ship at the same time according to Alice. If the train has a speed of v according to Bob, then

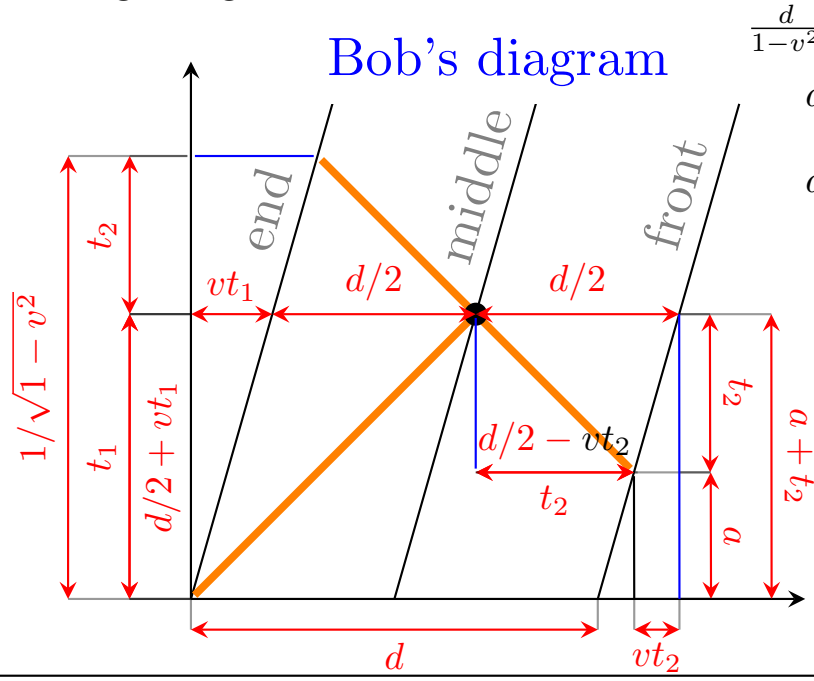
Contraction: 1 lightsecond for Alice is $\sqrt{1-v^2}$ lightsecond for Bob. E.g., if Alice travels with the 87% of the speed of light, then the train is only 0.5 lightsecond long for Bob.

Asynchron: 1 lightsecond far away a simultaneous event for Alice is happened $\frac{v}{\sqrt{1-v^2}}$ second later for Bob. E.g., if Alice travels with the 87% of the speed of light, then, according to Bob, the end of the the train got the lightning first, and 1.74 second later got the front the other lightning.

$$
\begin{aligned}
t_1 &= \tfrac{d}{2} + t_1 v \\
t_1 - t_1 v &= \tfrac{d}{2} \\
t_1(1-v) &= \tfrac{d}{2} \\
t_1 &= \tfrac{d}{2(1-v)} \\
\hline
t_2 &= \tfrac{d}{2} - v t_2 \\
\dots &= \tfrac{d}{2(1+v)}
\end{aligned}
$$

$$
\begin{aligned}
\tfrac{1}{\sqrt{1-v^2}} &= t_1 + t_2 \\
&= \tfrac{d}{2(1-v)} + \tfrac{d}{2(1+v)} \\
&= \tfrac{d(1+v)+d(1-v)}{2(1-v)(1+v)} \\
&= \tfrac{d+dv+d-dv)}{2(1-v)(1+v)} \\
&= \tfrac{2d}{2(1-v)(1+v)} \\
&= \tfrac{d}{(1-v)(1+v)} \\
&= \tfrac{d}{1-v^2} \\
\tfrac{d}{1-v^2} &= \tfrac{1}{\sqrt{1-v^2}} \\
d &= \tfrac{1-v^2}{\sqrt{1-v^2}} \\
d &= \sqrt{1-v^2}
\end{aligned}
$$





$$a \overset{\text{hw}}{=} \frac{v}{\sqrt{1-v^2}}$$