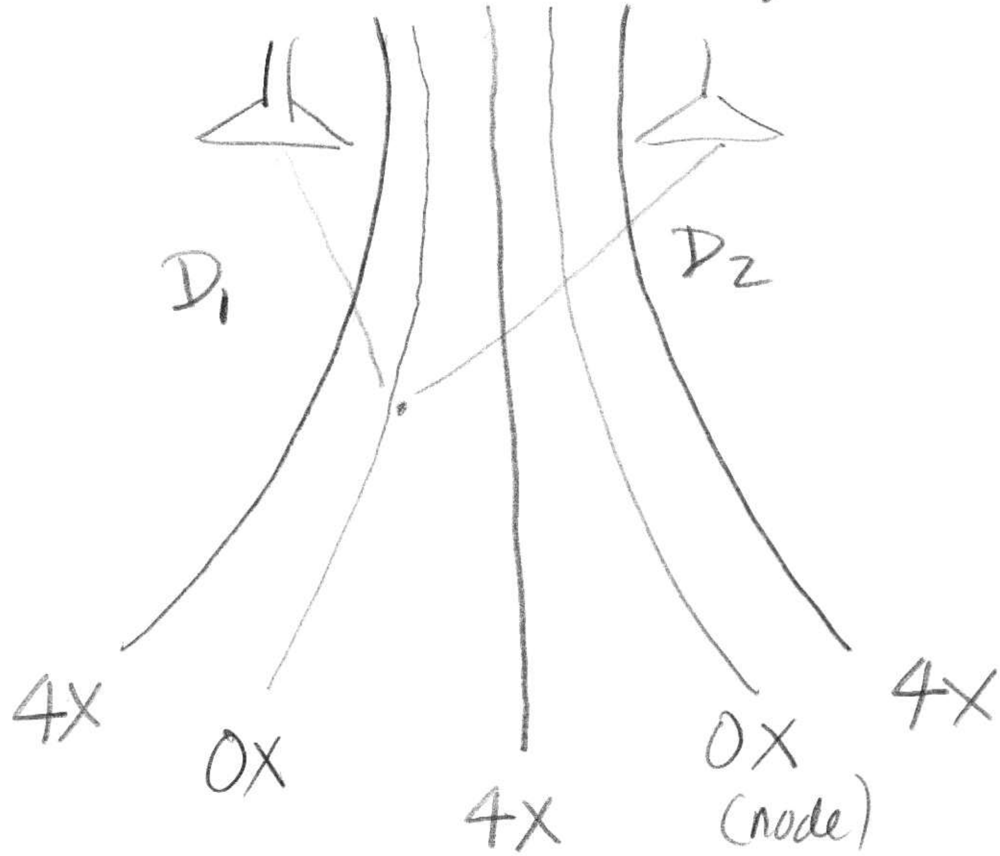
When $D_1 = D_2$, speakers <u>in phase</u>, hear 4X the intensity.



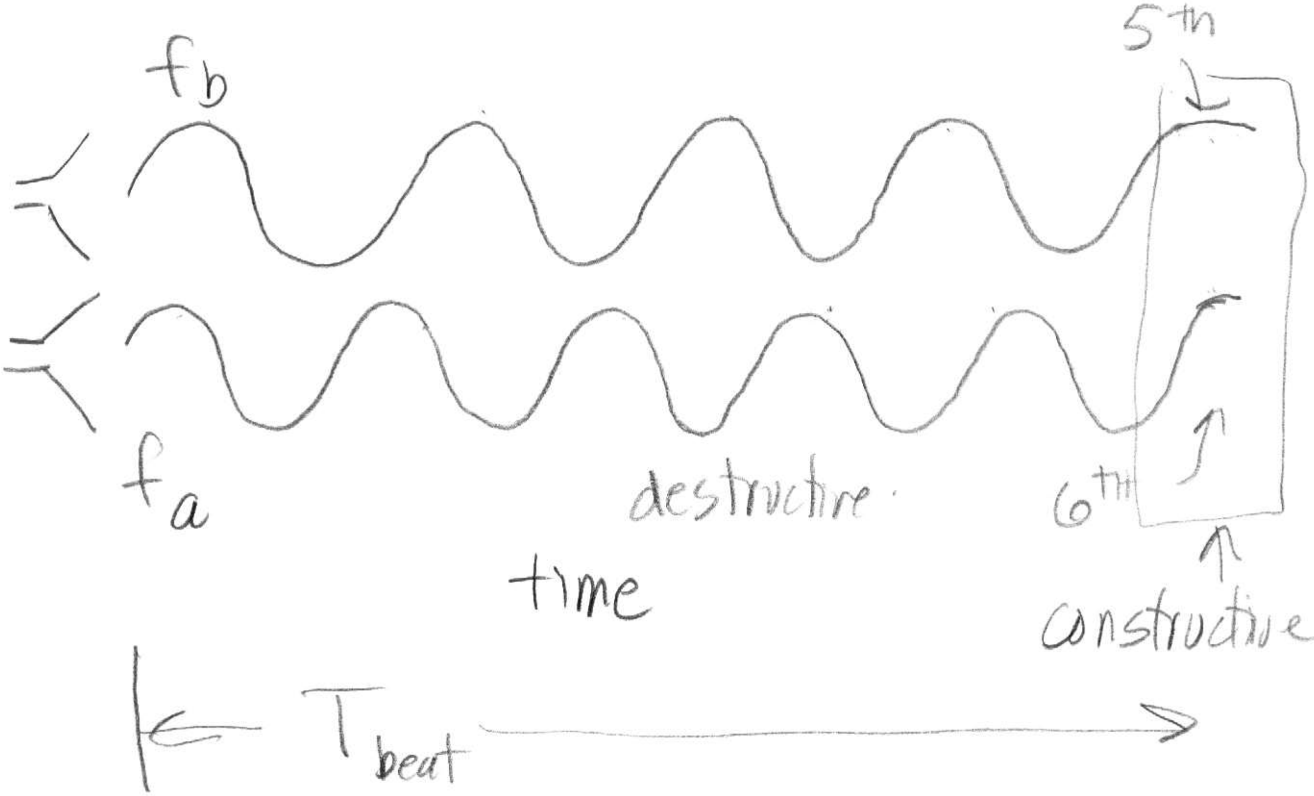
when $|D_2 - D_1| = \frac{\lambda}{2}$ destructive

$= \lambda$ constructive.

$= \frac{3\lambda}{2}$ destructive.

On average ... 2X two speakers

Temporal Interference



$$(n-1)\cdot\left(\frac{1}{f_b}\right) = n\cdot\frac{1}{f_a} = T_{beat}$$

$$n = f_a T_{beat}$$

$$\left(f_a T_{beat} - 1\right)\frac{1}{f_b} = T_{beat}$$

$$T_{beat}\left(\frac{f_a}{f_b} - 1\right) = \frac{1}{f_b}$$

$$T_{beat} = \frac{1}{f_b\left(\frac{f_a}{f_b} - 1\right)} = \frac{1}{f_a - f_b}$$

$$\boxed{f_{beat} = \frac{1}{T_{beat}} = f_a - f_b}$$

pick a point in space

$$y_a(t) = -A\sin(\omega_a t) \qquad y_b(t) = -A\sin(\omega_b t)$$

$$\omega_a = 2\pi f_a \qquad \omega_b = 2\pi f_b$$

$$y_a(t) + y_b(t) = -A\left(\underbrace{\sin(\omega_a t) + \sin(\omega_b t)}\right)$$

hmm.. a trick!

$$\sin a + \sin b = 2\sin\tfrac{1}{2}(a+b)\cos\tfrac{1}{2}(a-b)$$

$$\sin a = \frac{e^{ia} - e^{-ia}}{2}$$ etc.. good way to prove!

$$y_a(t) + y_b(t) = -2A\sin\left(\tfrac{1}{2}(\omega_a+\omega_b)t\right)\cos\left(\tfrac{1}{2}(\omega_a-\omega_b)t\right)$$

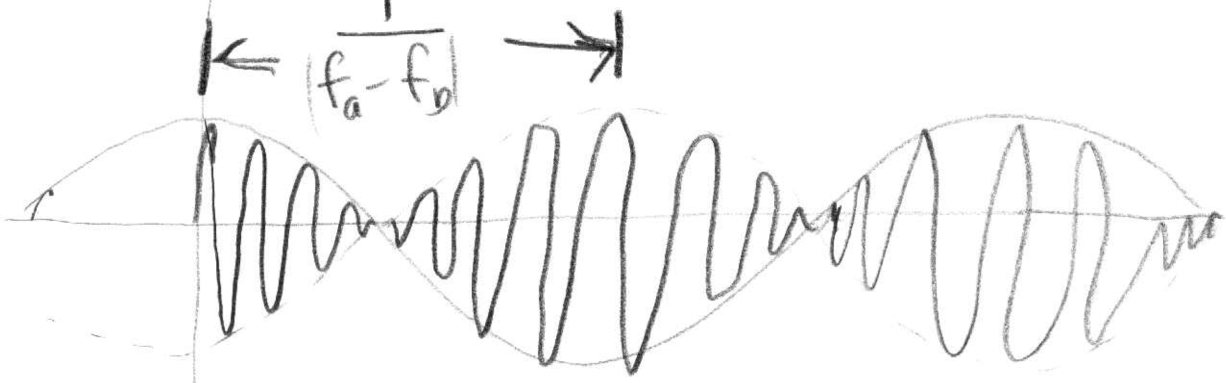
$f = \frac{1}{2}(f_a + f_b)$

looks like frequency $\frac{1}{2}(f_a - f_b)$

but it is really $f_a - f_b$

why?

this guy always flipping signs!



$\cos\left(\frac{1}{2}(\omega_a - \omega_b)t\right)$

$\sin\left(\frac{1}{2}(\omega_a + \omega_b)t\right)$

$\omega_a, \omega_b \gg |\omega_a - \omega_b|$