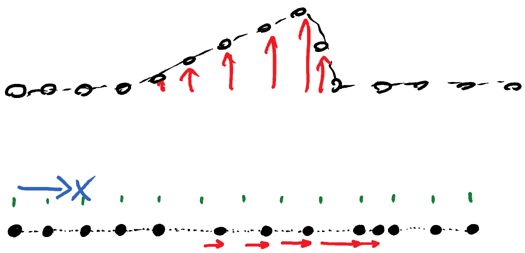
LAST TIME: Waves



TRANSVERSE

or

LONGITUDINAL.

Mathematical description:

$D(x,t) \rightarrow$ tells us how much point x is displaced at time t

e.g. $F(x) = D(x,0)$: shape of wave pulse at time $t=0$

C1

Right-moving pulse: $D(x,t) = F(x - vt)$

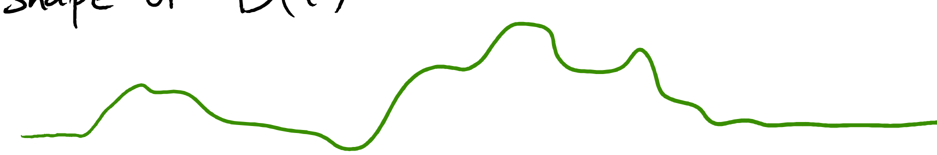
Left-moving pulse: $D(x,t) = F(x + vt)$

C2 SOUND IS A LONGITUDINAL WAVE

TODAY <u>Sound & Music</u>:

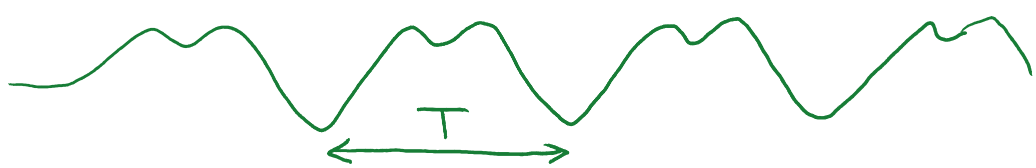
Q1: What distinguishes musical notes from other sounds?

A: The shape of $D(t)$



noise

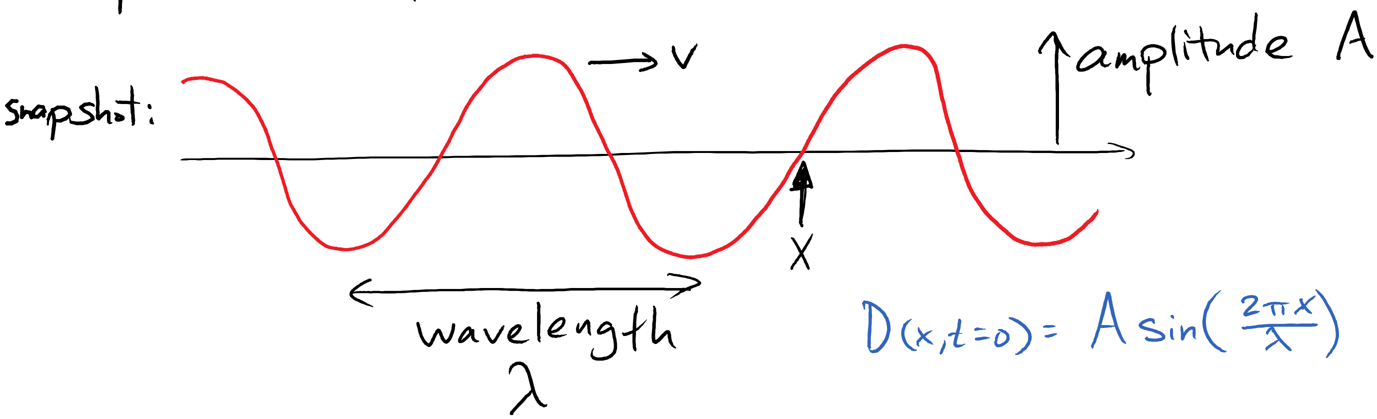
Note:



Note: D repeats w. definite period T

frequency is $\frac{1}{T}$

Important example: sinusoidal waves = "PURE TONE"



$$D(x, t=0) = A \sin\left(\frac{2\pi x}{\lambda}\right)$$

At point X: time dependence is also sinusoidal

$$D(x,t) = A \sin\left(\frac{2\pi}{\lambda}(x - vt)\right)$$

(right moving)

KEY RELATION: $$f = \frac{v}{\lambda}$$

shorter wavelength: peaks pass X more frequently
∴ higher frequency

lingo: $\frac{2\pi}{\lambda} = k$ WAVE NUMBER

$2\pi f = \omega$ ANGULAR FREQUENCY

$$D(x,t) = A \sin(kx - \omega t)$$

Back to music:

What distinguishes "high" and "low" sounds, or different notes?

High = larger frequency Low = smaller frequency

Why do different instruments sound different?

Any wave w. frequency f = sum of sinusoidal waves w. frequencies $f, 2f, 3f, 4f \ldots$ w. different amplitudes. (These are HARMONICS of a note)

Different instruments playing same note → different combinations of harmonics

Why do some notes sound good together?

Notes sound good together if ratio of frequencies is a simple fraction

e.g. 1:2 (octave)

2:3 (fifth)

3:4 (fourth)

What distinguishes "high" and "low" sounds, or different notes?

Why do different instruments sound different?

What determines the sound of an instrument?

How can the same tube/string/etc... make different sounds?

Why do some notes sound good together?