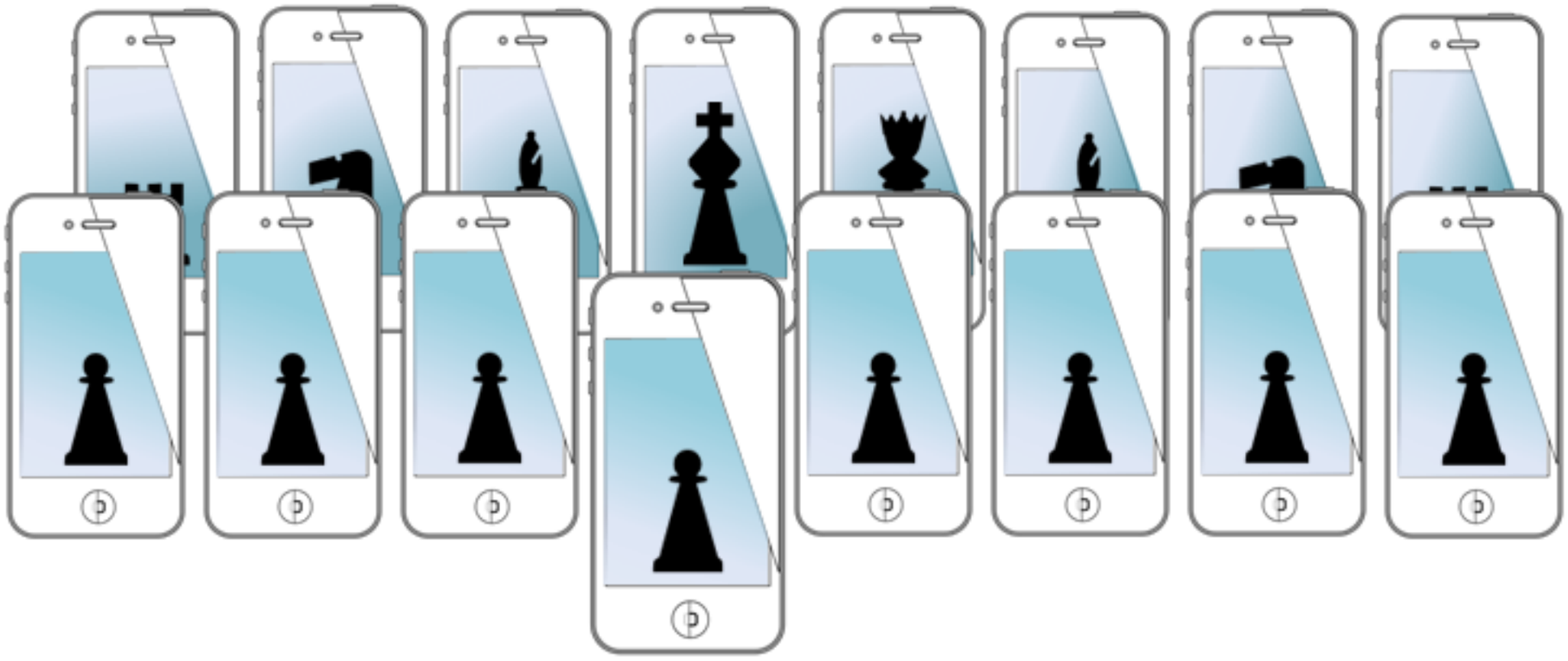
MOBILE SENSING LEARNING



CS5323 & 7323

Mobile Sensing and Learning

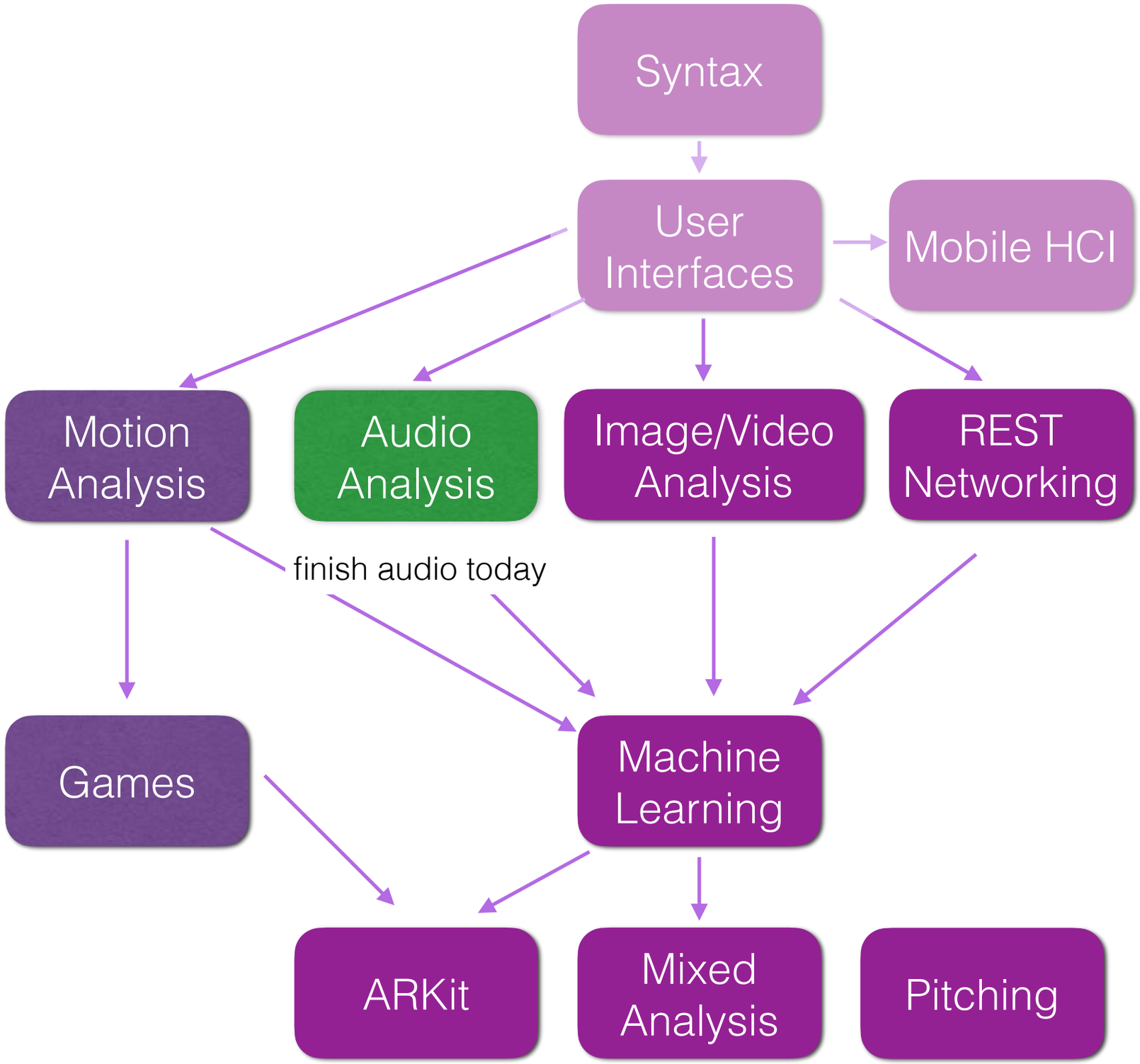
doppler and activity monitoring

Eric C. Larson, Lyle School of Engineering,
Computer Science, Southern Methodist University

agenda and logistics

- logistics:
  - grades update
  - A2 is due soon!
- agenda:
  - A2 explanations
    - general FFT review
    - peak finding
    - the doppler effect
  - activity processing

class overview

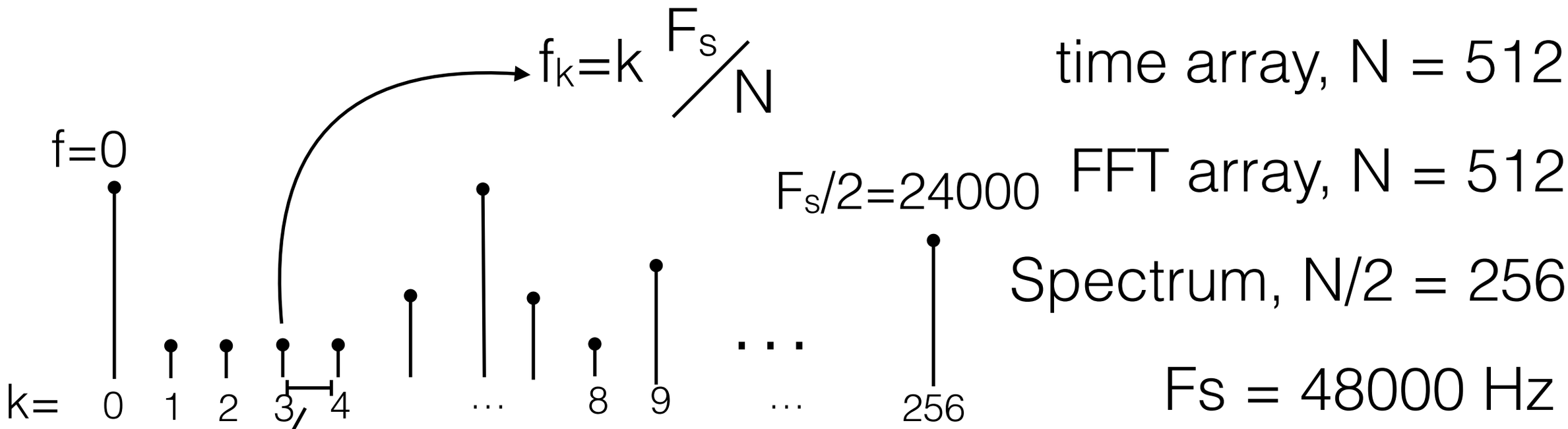


FFT review

- sampling rate
  - dictates the time between each sample, (1 / Fs) (query from the Novocaine `audioManager`)
  - **Nyquist**: max frequency we can measure is half of sampling rate
- **resolution** in frequency
  - tradeoff between length of FFT and sampling rate
  - each frequency "bin" is an index in the FFT array
    - each bin represents (Fs / N) Hz
    - what does that mean for 6 Hz accuracy?

time and frequency

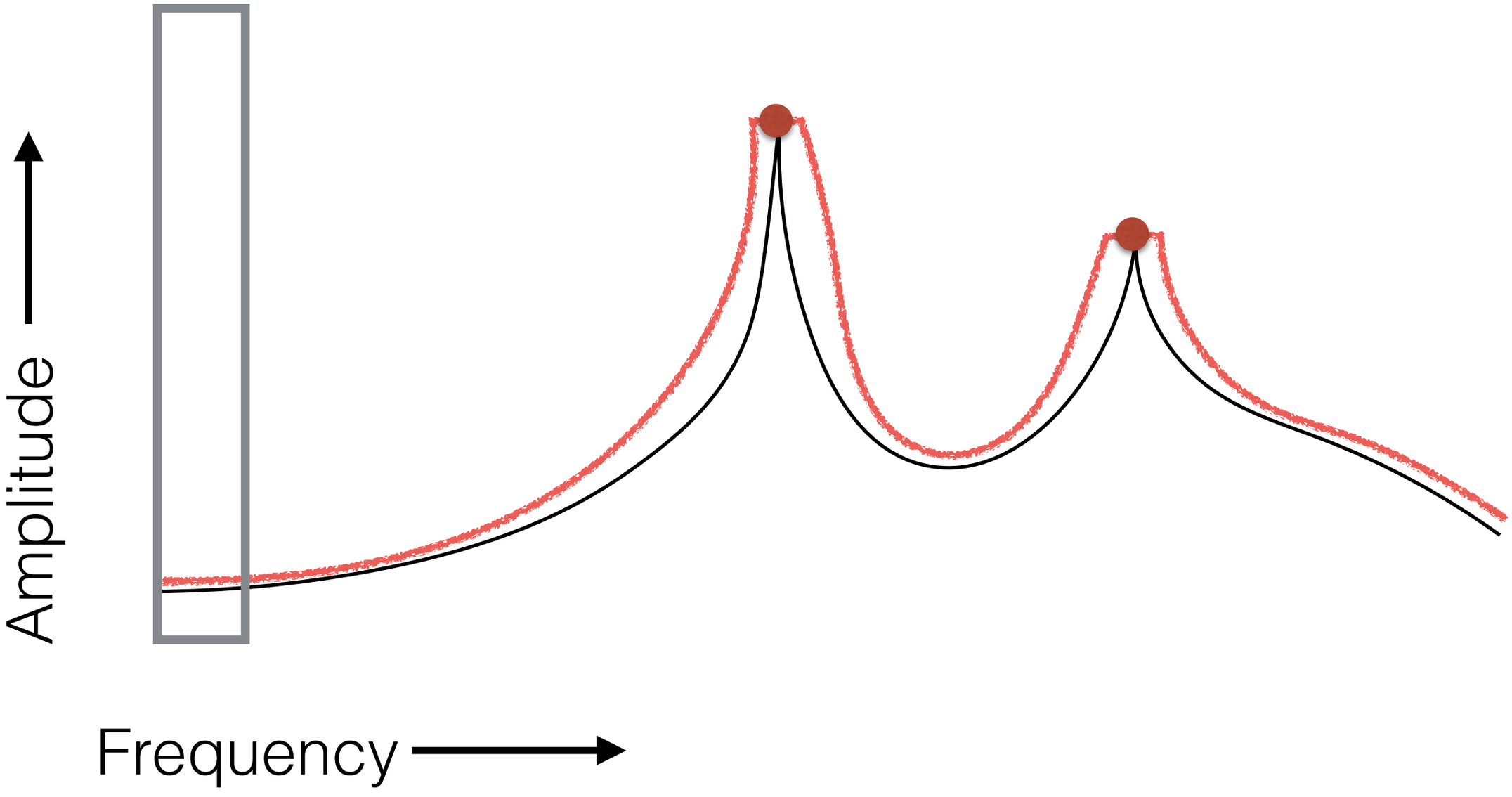
Note: the FFT class **ALWAYS** rounds to the next power of 2



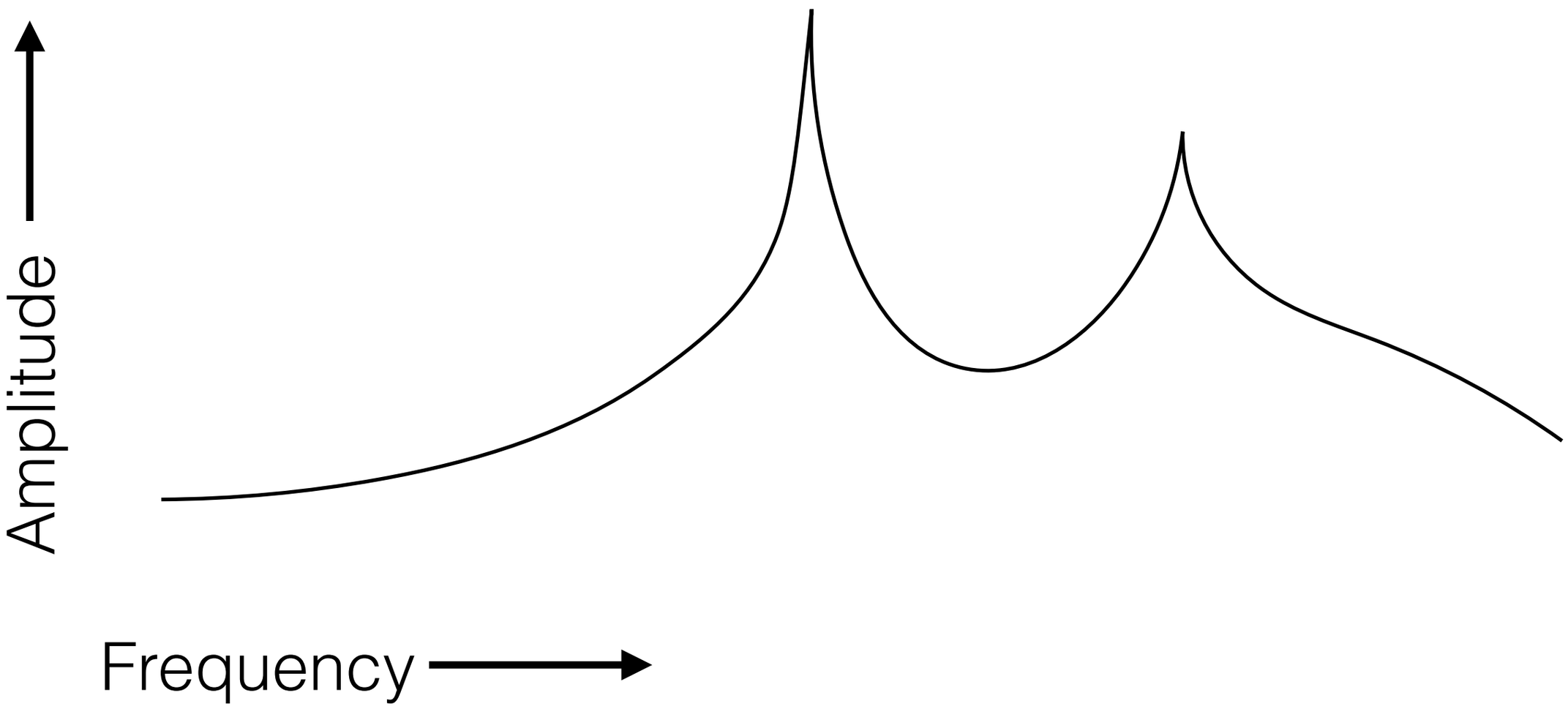
$$df = \frac{F_s/2}{N/2} = F_s/N = 48000/512 = \sim 93.75 \text{ Hz}$$

local peak finding

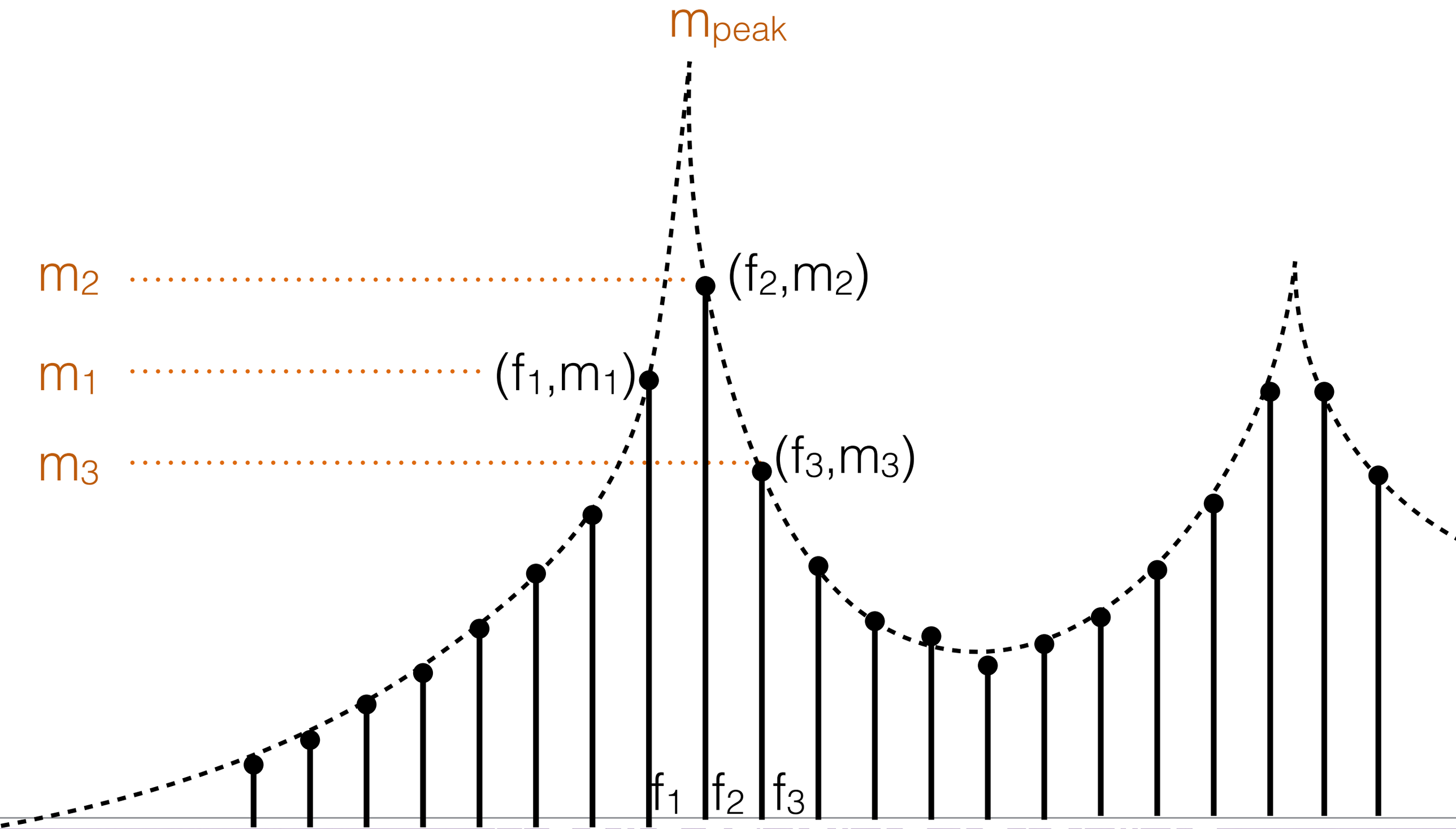
max in window



peak interpolation

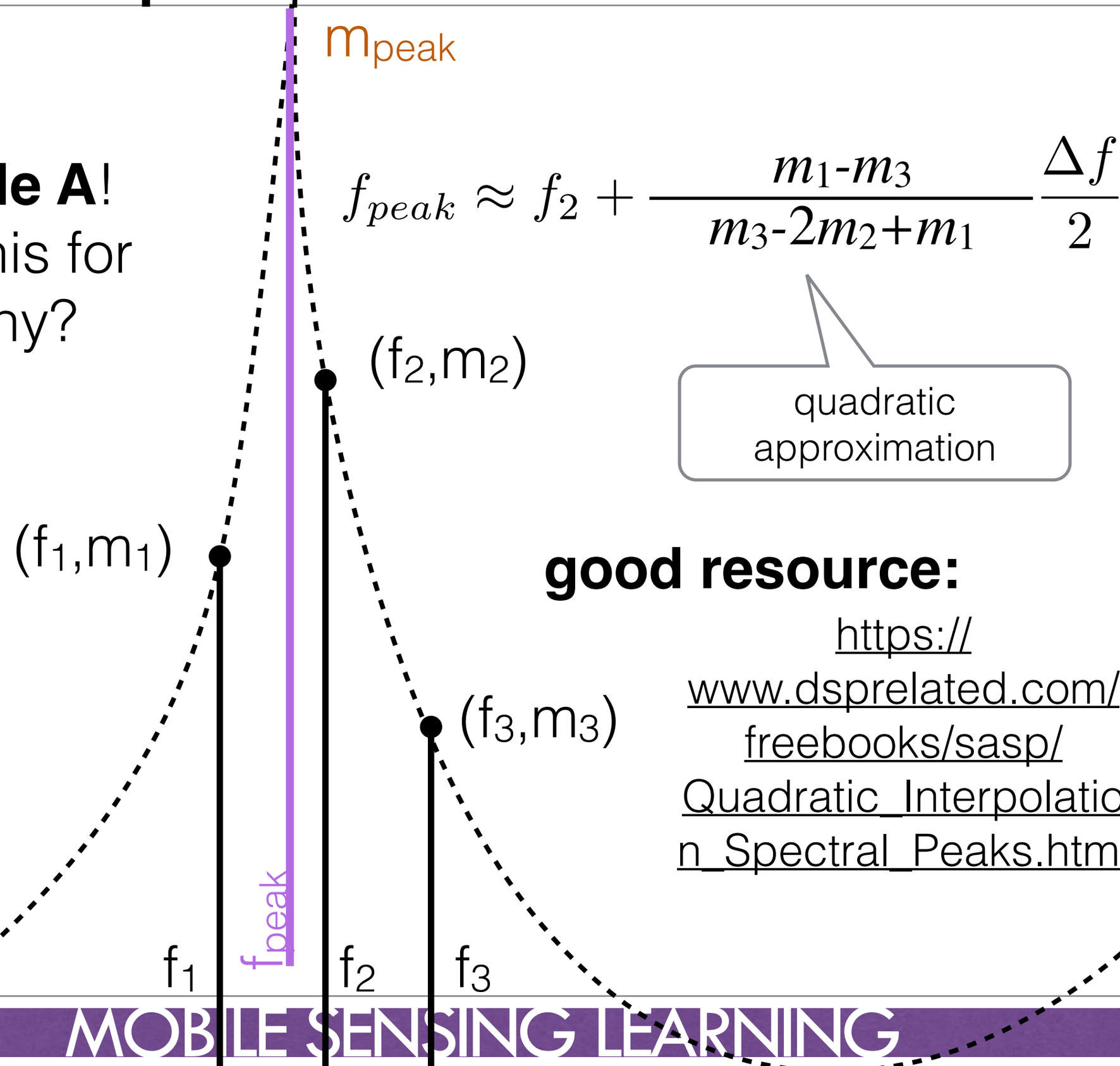


peak interpolation



peak interpolation

great for **module A**!
no need to do this for
module B, Why?



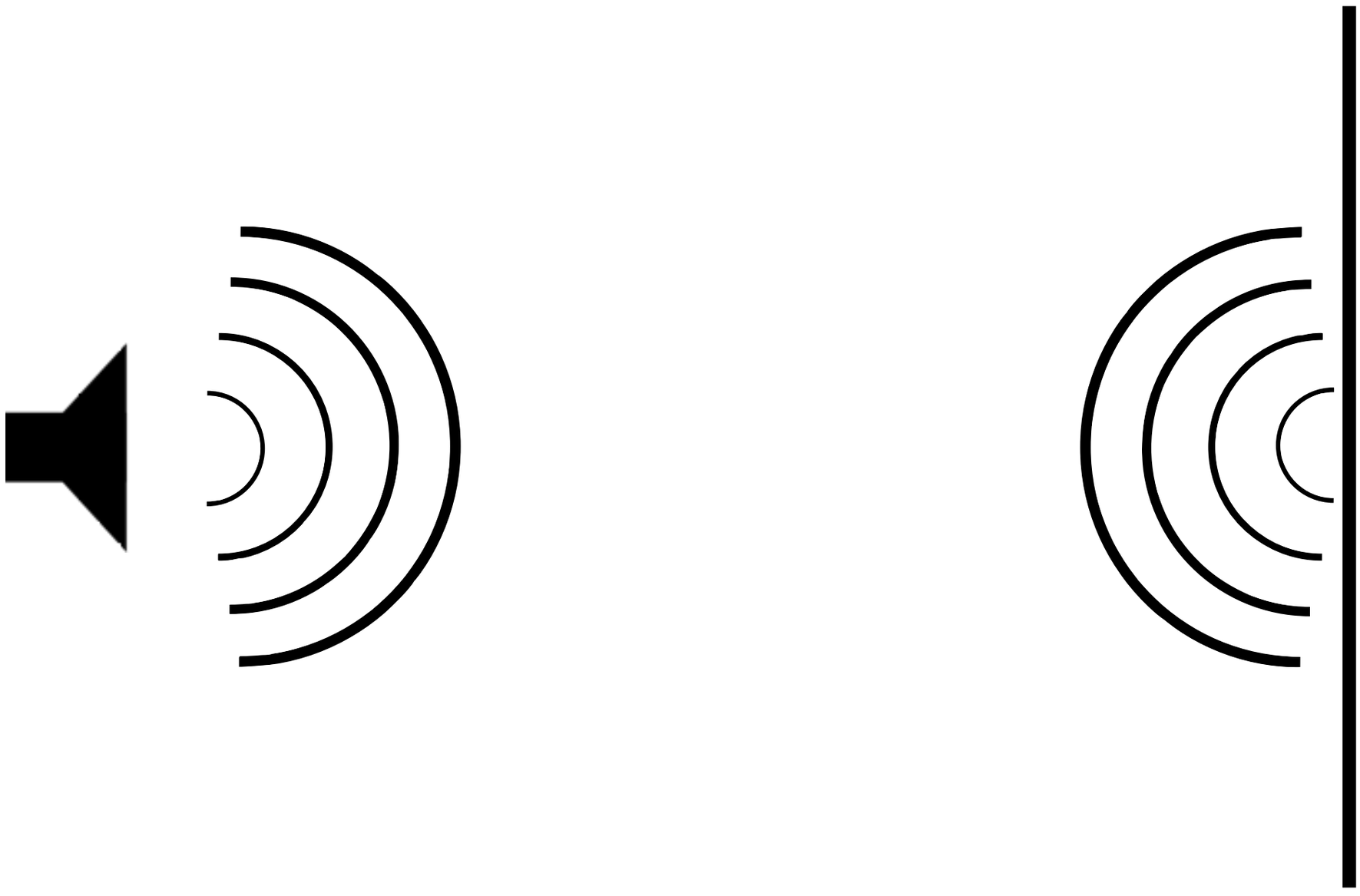
$$f_{peak} \approx f_2 + \frac{m_1\text{-}m_3}{m_3\text{-}2m_2\text{+}m_1}\frac{\Delta f}{2}$$

quadratic approximation

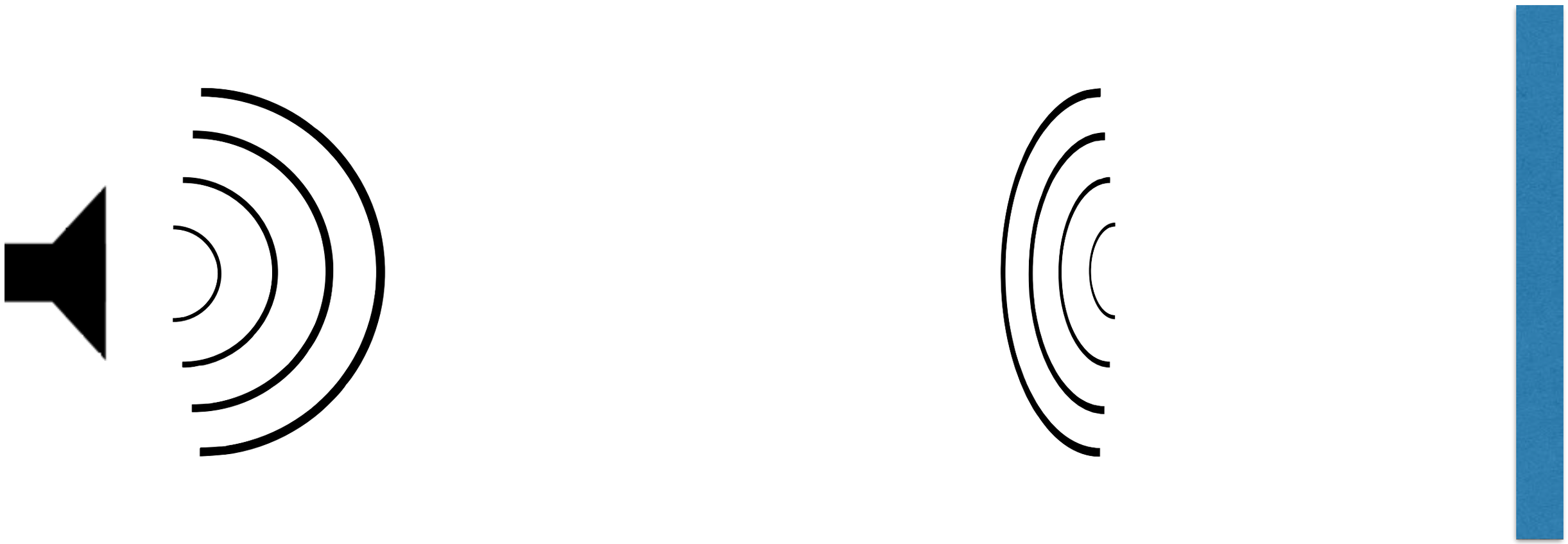
good resource:

https://www.dsprelated.com/freebooks/sasp/Quadratic_Interpolation_Spectral_Peaks.html

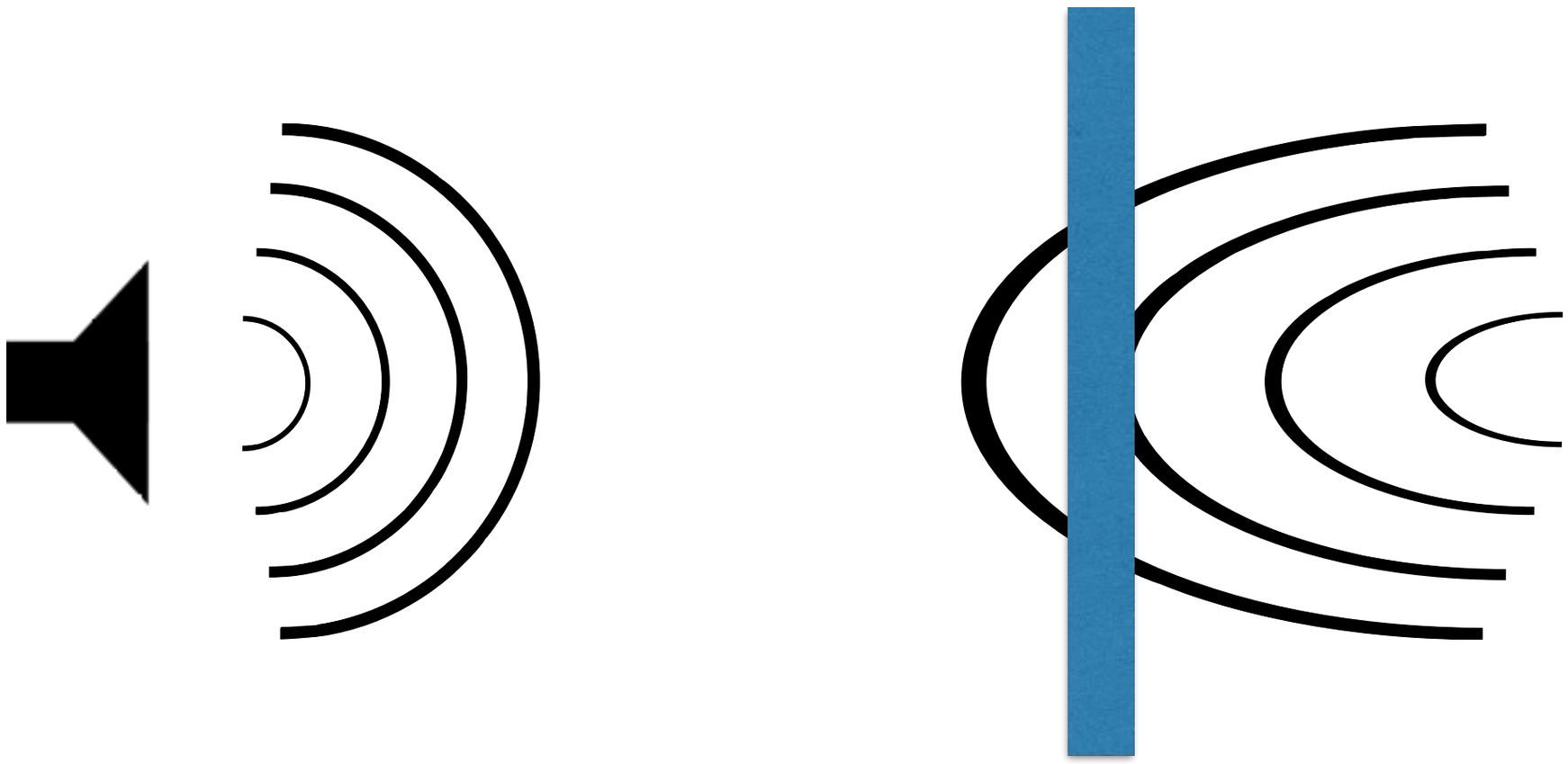
the doppler effect



the doppler effect



the doppler effect



the doppler effect

$$\Delta f = \frac{V_{object}}{c} f_0$$

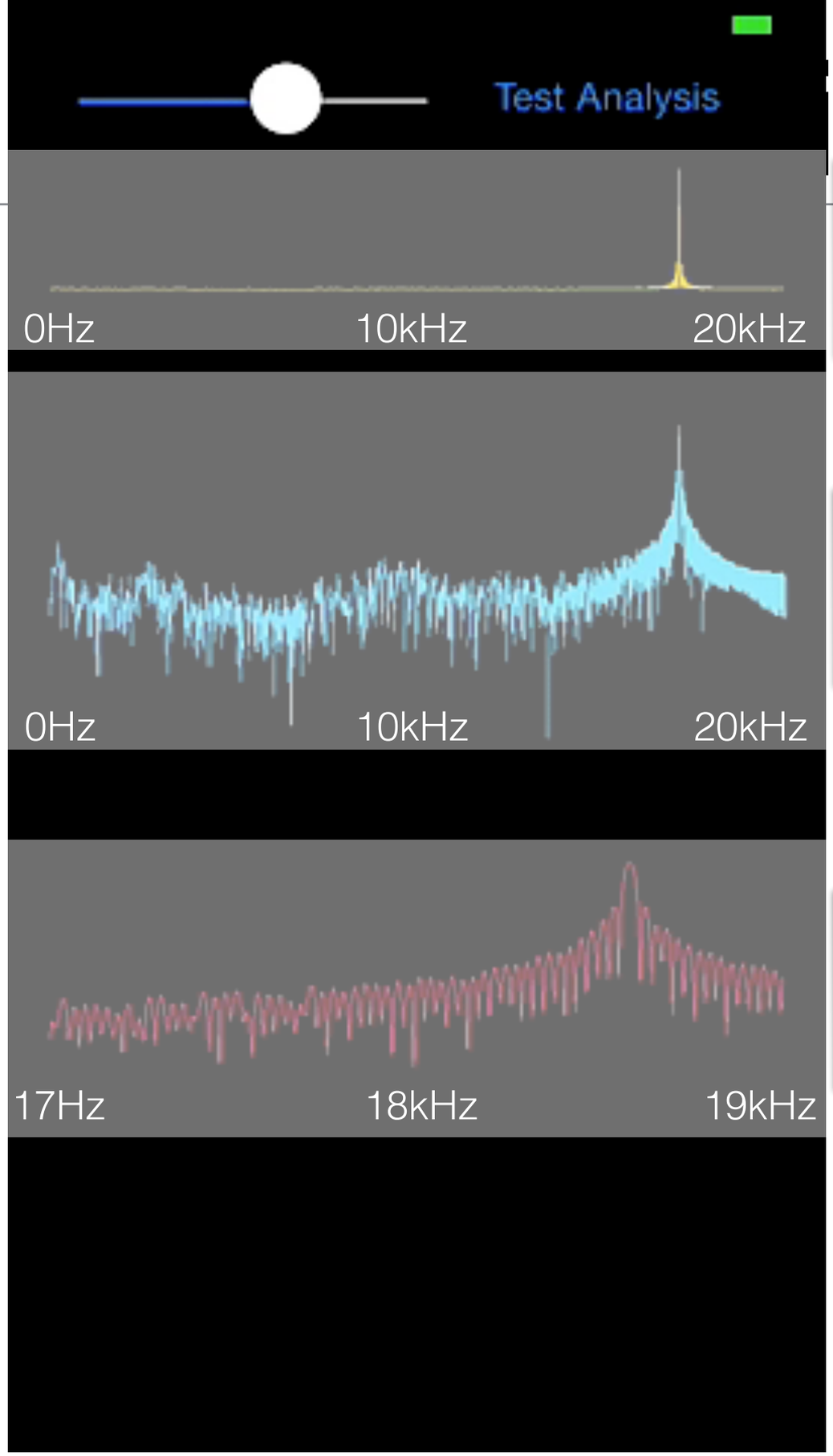
change in frequency

velocity of object

speed of sound

frequency of source

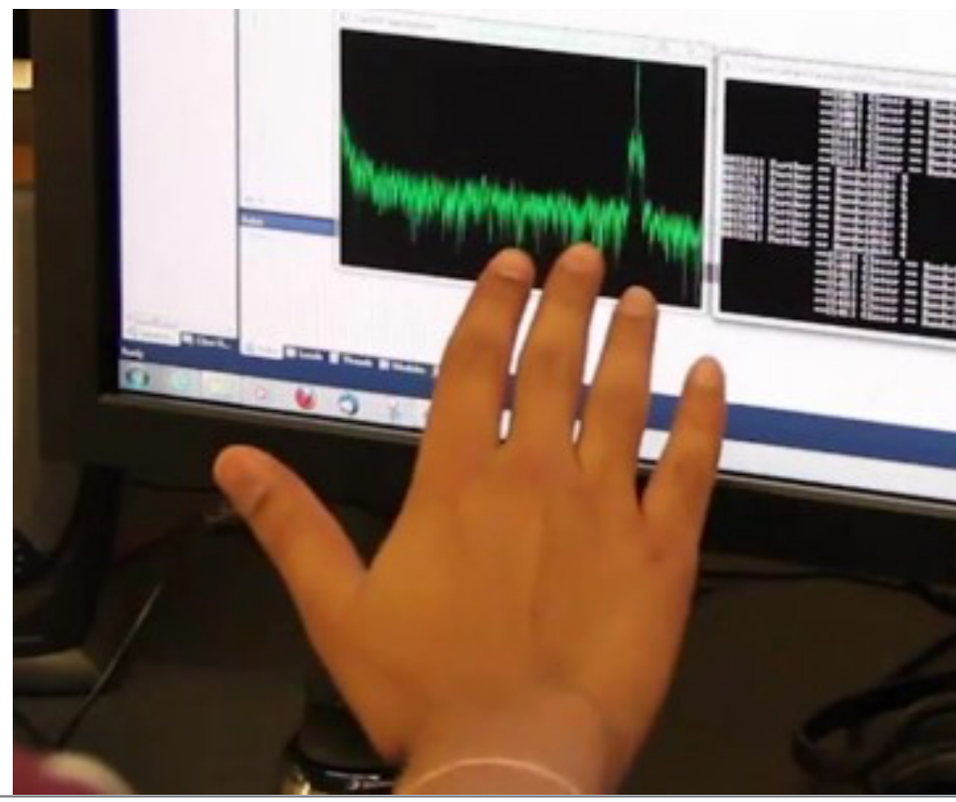
ifts fron



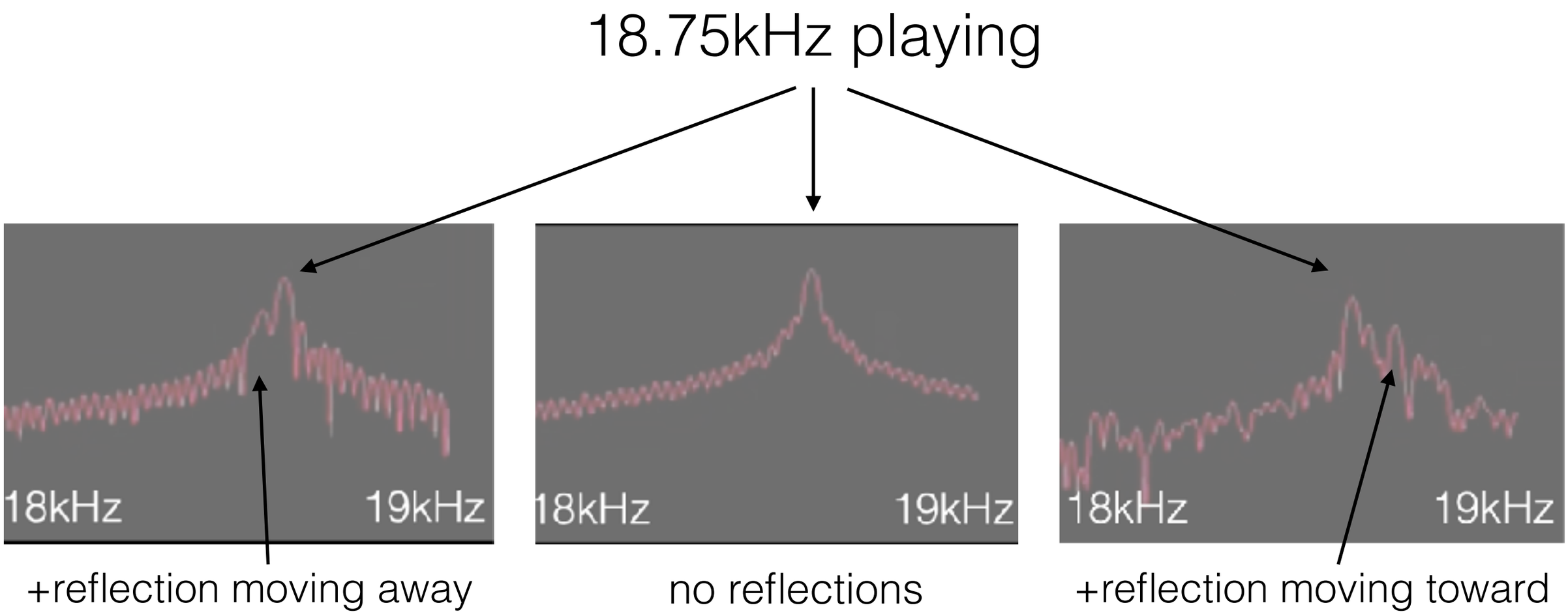
linear

db

db zoomed (freq axis)



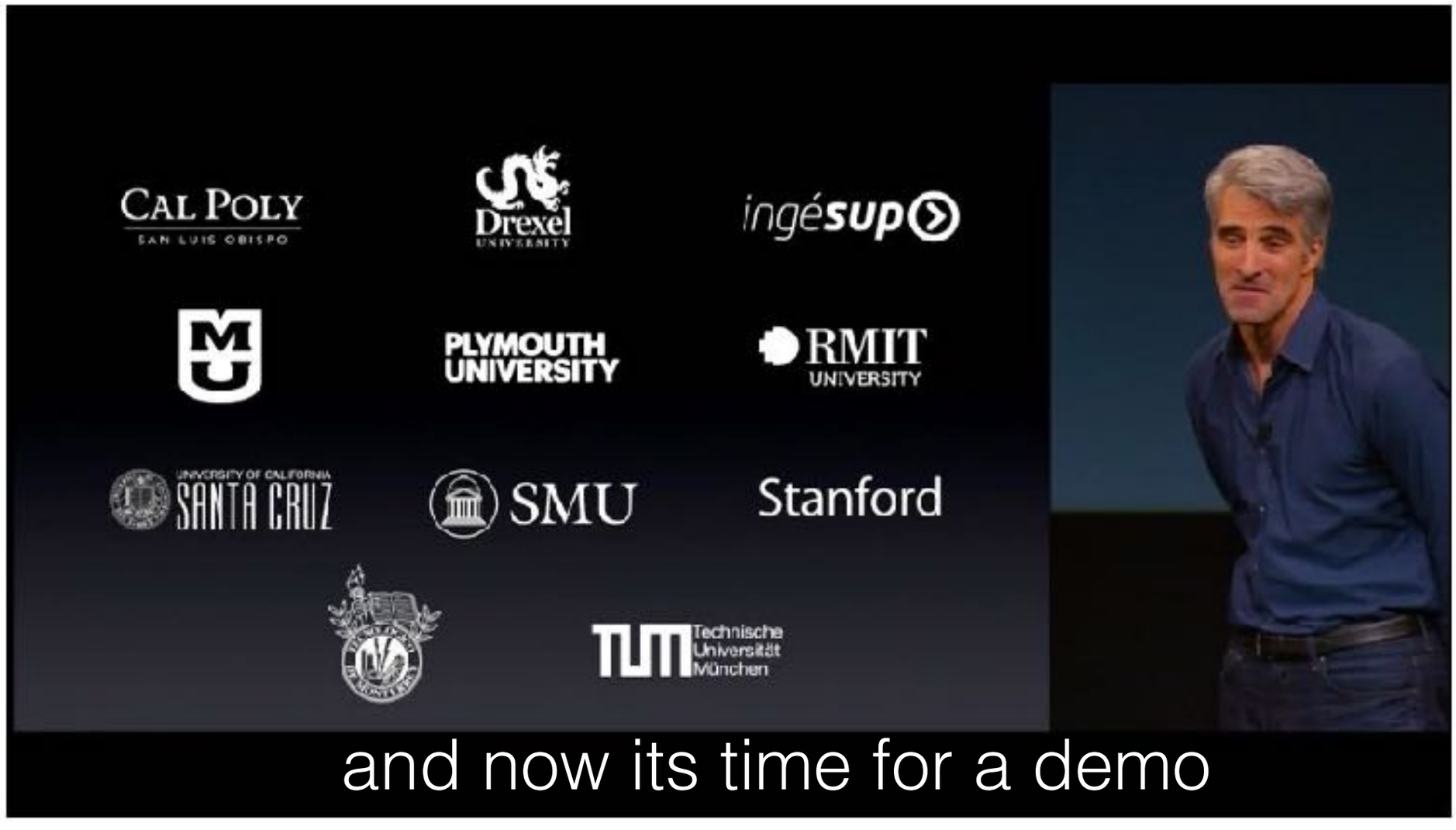
doppler shifts



Questions on the FFT/audio

- we are about to move to motion processing…
- so ask now!

A2 specifications



6_Zoomed FFT

7_Test App