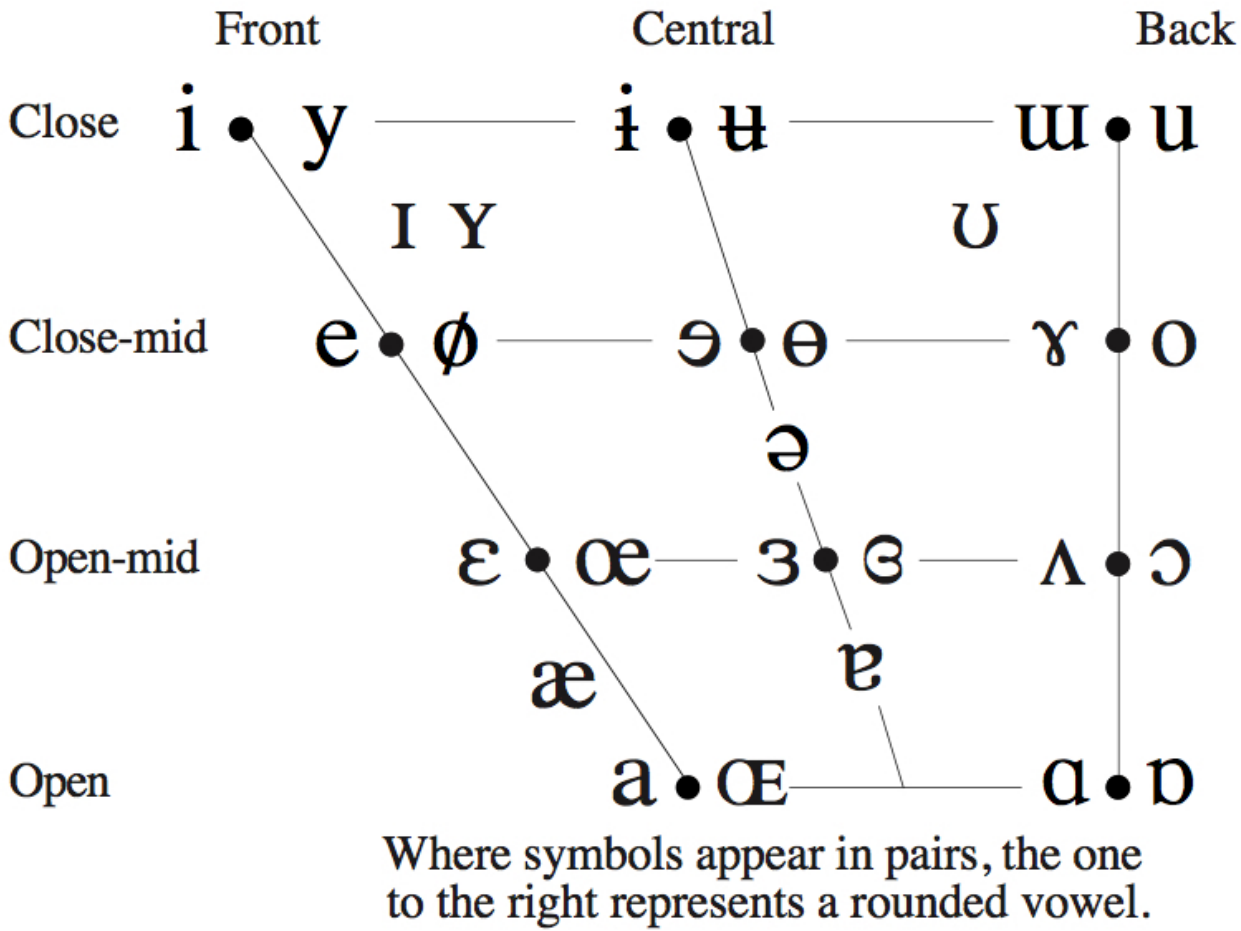
Ling 105
Sounds of Language

Tuesday, September 24, 2024

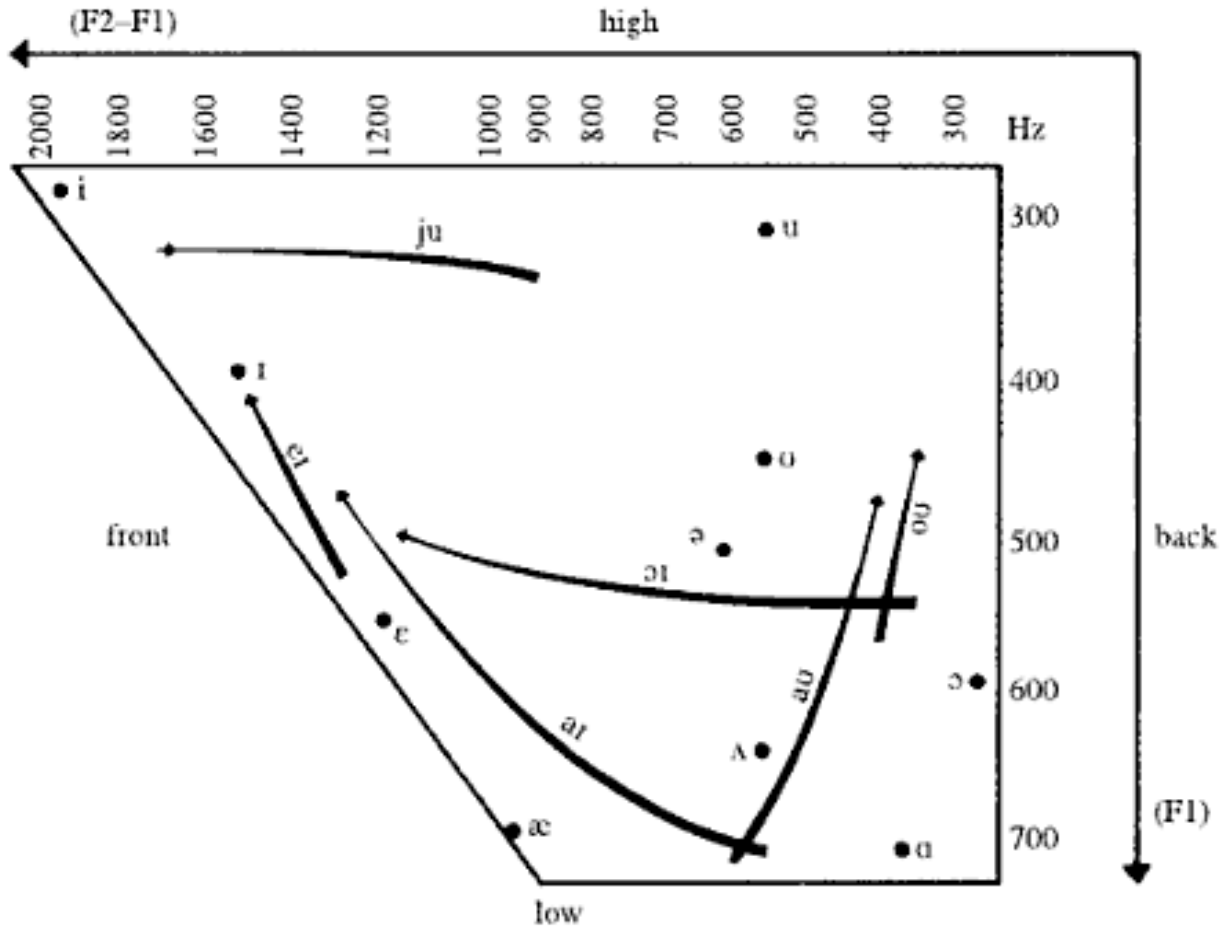
Kevin Ryan

- Articulatory vowel space



Production vs. acoustics

- Acoustic vowel space

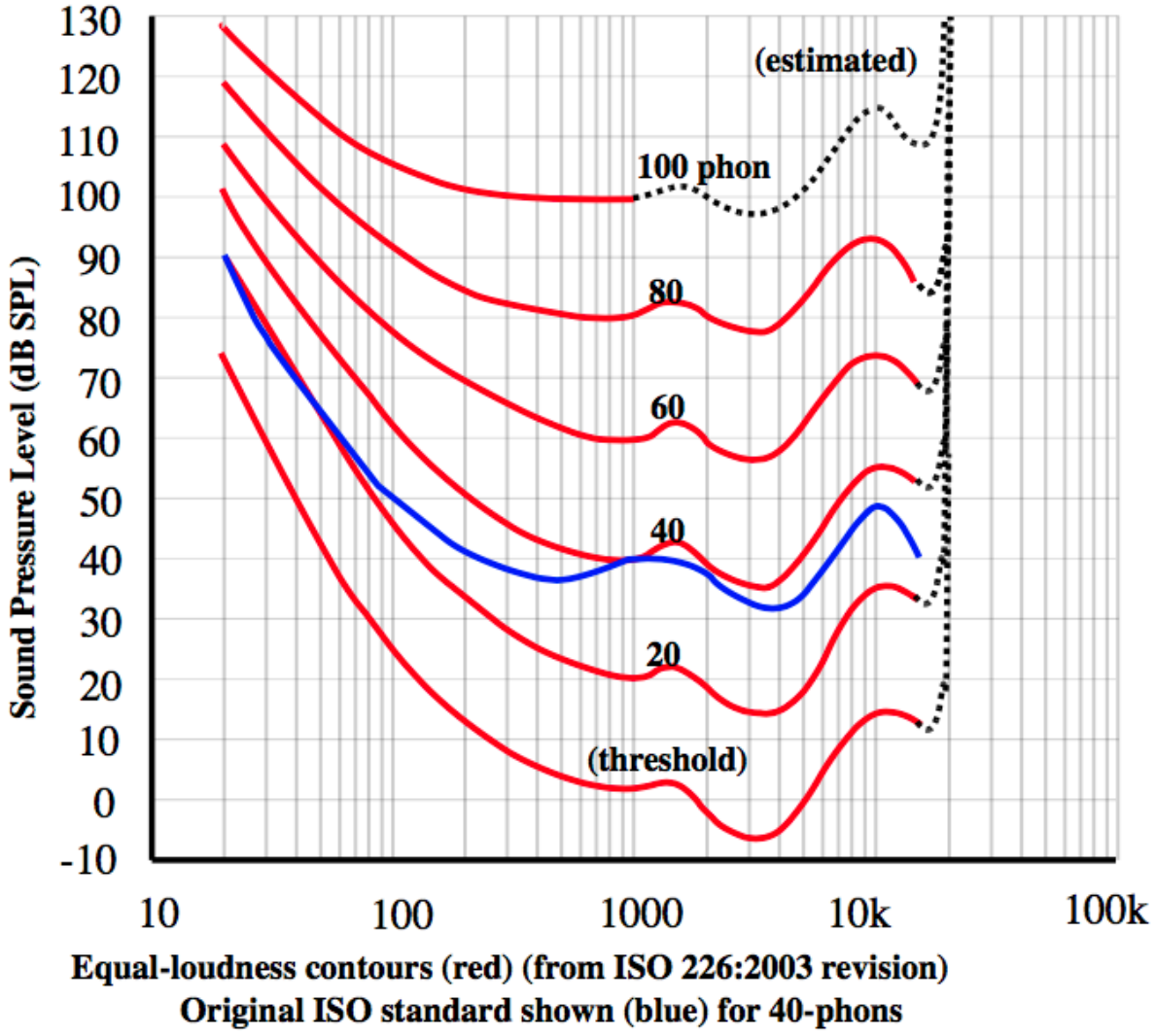


Fundamental frequency (f0)

- Rate of vocal fold vibration
- Largest periodic component of waveform (not just "the frequency of the sound")
- Measured in Hertz (Hz): # of cycles per second (s)
  - i.e. inverse of wavelength (measured in seconds), i.e. Hz = 1 / wavelength

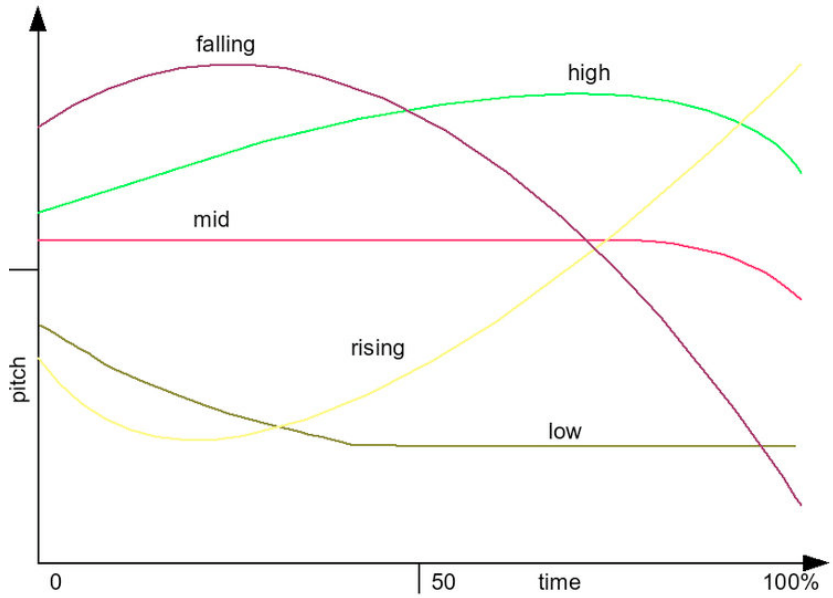
    (F0_demo, risingto80hz)
  - also Hz = # of periods in selection ÷ duration of selection
- Perceptual correlate is pitch (which is not always veridical)
  - JND (a.k.a. difference limen) (JND test)
  - Auditory illusions (e.g. pitch/volume, Shepard tone)
  - Octave, fifth, etc.

- At which frequency do sounds sound the loudest?



f0 ≠ vowel quality

- Different f0s, same quality
- Different qualities, same f0
- Independence of pitch & quality makes tone languages possible



(Thai; Lemmy Laffer)

Thai lexical tone

Five Thai tones

- [náː] ‘aunt’ ♪
- [nàː] (name) ♪
- [nâː] ‘face’ ♪
- [nǎː] ‘thick’ ♪
- [nāː] ‘field’ ♪

Mai mai mai mai mai?

“*New wood doesn’t burn, does it?*”

(high, low, falling, falling, high)

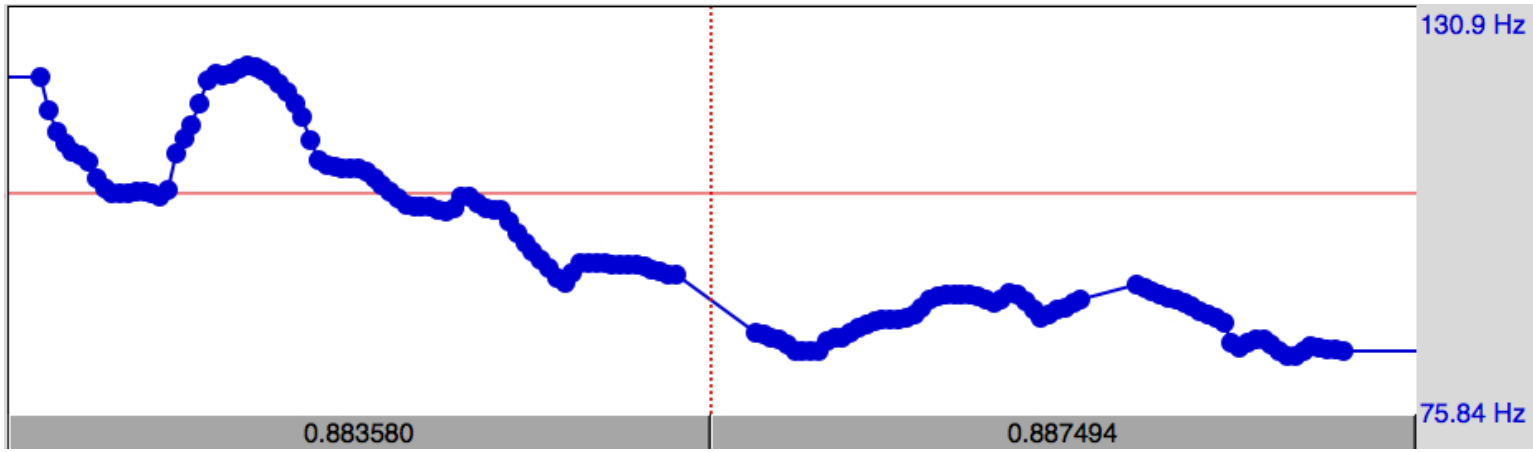
Source + Filter

- A Swazi sentence, as heard from the glottis: ♪ (Louis Goldstein)
- Recorded by EGG (electroglottograph)

- Is the first vowel [e] or [o]? ♪
- The original sentence: ♪

Acoustic manipulation

- *Many lemons are in the barrel*
  - Original ♪
  - f0 extracted ♪
  - f0 flattened ♪



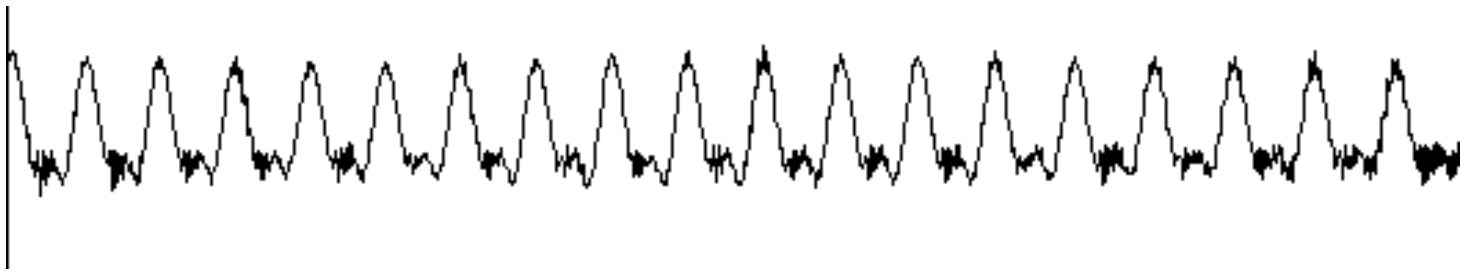
Acoustic manipulation

- *Permit*
  - Original ♪
  - f0 extracted ♪
  - f0 flattened ♪

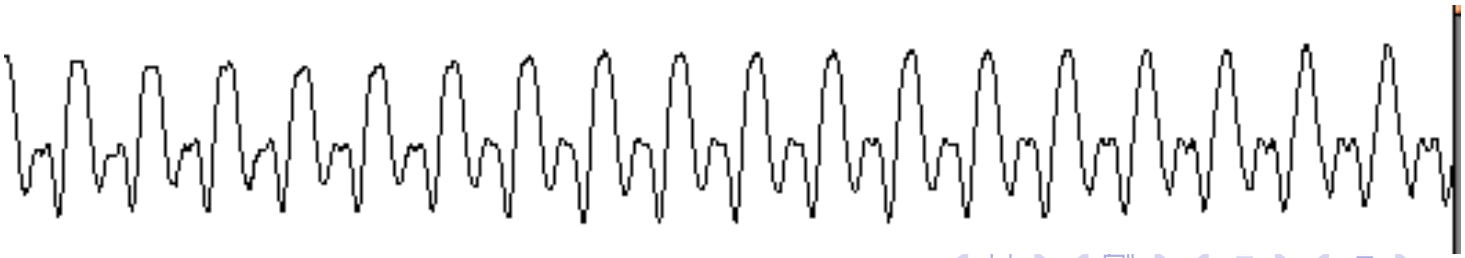
Acoustic manipulation

- The source (EGG) ♪

- Manipulated to be [i]-colored ♪

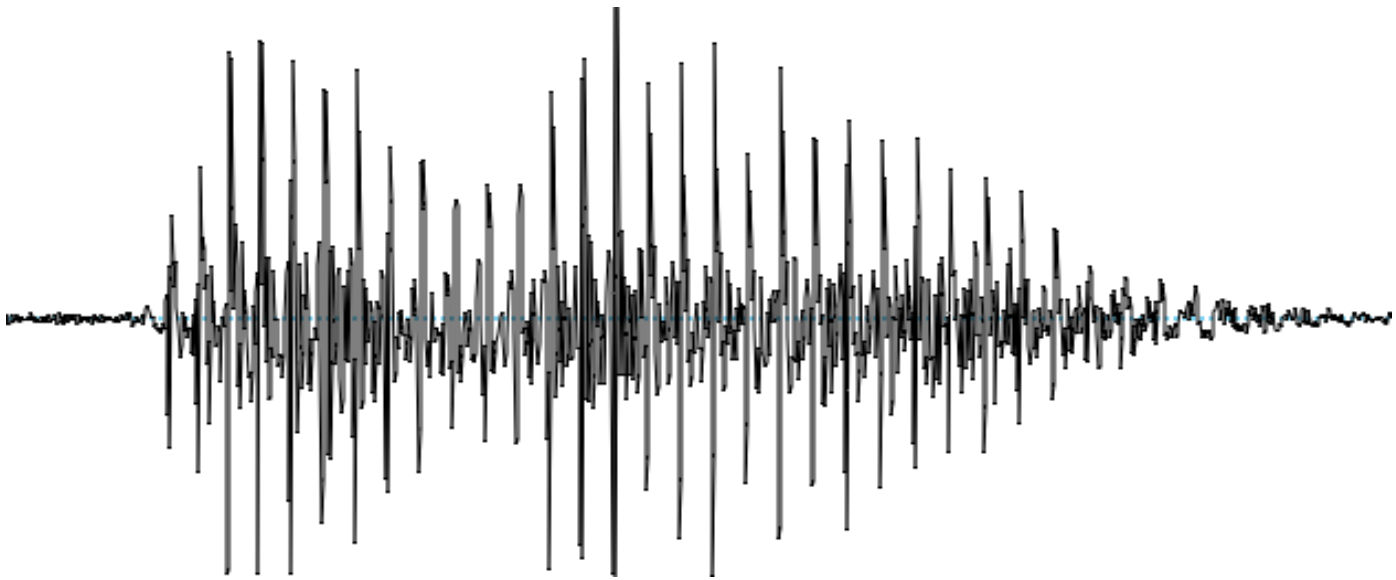


- Manipulated to be [u]-colored ♪



Waveform

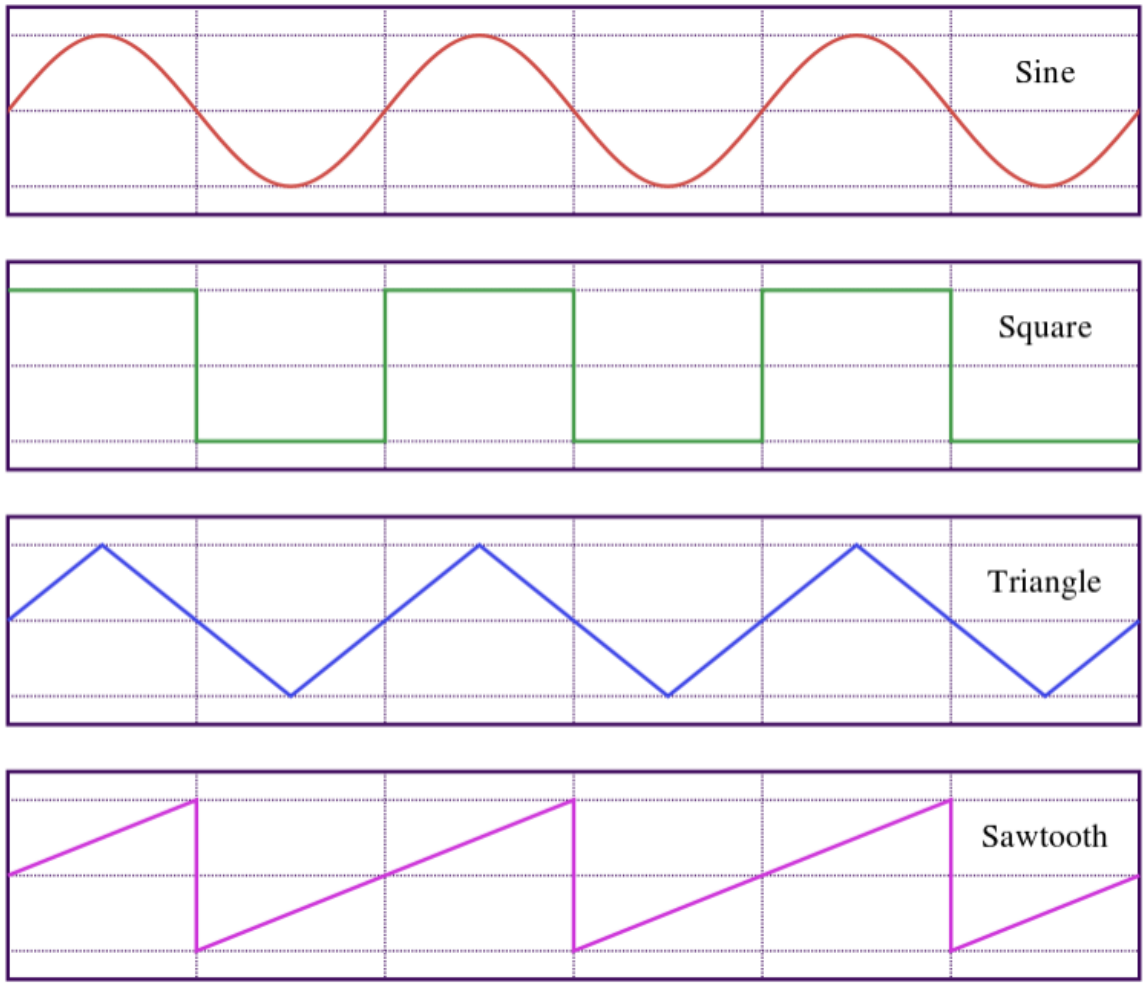
- x = time (s or ms); y = amplitude (dB)



Wave synthesis & the missing fundamental

- Wave shapes (e.g. square, sawtooth, triangle, sinusoid)
  - Which is most typical of sound?
- What is sin(x) in Hz?
- Google, Praat: sin(200*2*pi*x) for a 200 Hz tone (add outer multiplier to amplify)
- Generate two tones, 200 Hz and 300 Hz
  - Wavelengths?
- If combined, what is the new f0?
  - Listen in Audacity
  - Rule for missing fundamental of two frequencies
  - By formula in Praat

Some wave types



Missing fundamental

- These waves come into sync every 10 ms
- Highest common factor of 200 and 300 is 100