What is phonetics?

- The study of speech sounds
  - From production to perception

From Denes & Pinson, 1993
Three branches of phonetics

- Articulatory
  - How speech is produced
- Acoustic
  - Acoustic properties of speech
- Auditory
  - How speech sounds are received and perceived
Articulatory Phonetics

- How are speech sounds produced?
The Vocal Tract

Nasal cavity:

Oral cavity:

Pharynx:

Larynx: (vocal folds are within the larynx)

Lungs:
The Larynx

- Contains the vocal folds (or cords)
- Air from the lungs passes through these folds
- When they are closed, the airflow causes them to vibrate
The Vocal Folds in Action

“Inside the Voice”
http://www.youtube.com/watch?v=Z_ZGqn1tZn8&feature=player_embedded

“High Speed Video of the Vocal Folds”
http://www.youtube.com/watch?v=9kHdhbEnhoA&feature=player_embedded
The Articulators

- The parts of the vocal tract which are used to shape the sound
Consonants

- Place of Articulation
  - Which parts of the vocal tract are involved?

- Manner of Articulation
  - What type of closure is created by the articulators?
Place of Articulation

- Bilabial:
  made with both lips
  - [p b m]

- Labiodental:
  made with lower lip and upper teeth
  - [f v]
Place of Articulation

- **Dental:**
  - Tongue & upper front teeth
    - \[\dd  \theta\]

- **Alveolar:**
  - Tongue & alveolar ridge
    - \[t \ d \ n \ s \ z\]
Place of Articulation

- **Post-Alveolar**: (palato-alveolar)
  Tongue & back of the alveolar ridge
  - [ʃ ʒ]

- **Palatal**:
  Tongue & hard palate
  - [j]

- **Velar**:
  Tongue & soft palate (velum)
  - [k ɡ ɲ]
Manner of Articulation

- **Stop**: (plosive) complete closure, no air escapes through the mouth
  - **Oral Stop**: Velum is raised; air cannot escape through the nose or mouth until released
    - [p b t d g k]
  - **Nasal Stop**: Velum is lowered; air can escape through the nose
    - [m n ŋ]
Manner of Articulation

- **Fricative:** articulators are close, but not touching
  - Creates a turbulent, hissing airflow
    - $[f \, v \, \theta \, \delta \, s \, z \, \theta \, \lambda]$

- **Approximant:** articulators are close, but create less obstruction than in fricatives
  - $[j \, w \, r \, l]$
Manner of Articulation

- Special cases to remember:
  - Tap / flap: tongue makes a quick tap against the alveolar ridge
    - [ɾ]
  - Affricate: stop + fricative
    - [tʃ dʒ]
Putting it all together

Now we can refer to specific consonant sounds by their voicing, place, and manner of articulation

- [b] is the voiced bilabial stop
- [f] is the voiceless labiodental fricative
- [j] is the voiced palatal approximant
- [k] is the voiceless velar stop
IPA recall

### THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993)

#### CONSONANTS (PULMONIC)

<table>
<thead>
<tr>
<th></th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Dental</th>
<th>Alveolar</th>
<th>Postalveolar</th>
<th>Retroflex</th>
<th>Palatal</th>
<th>Velar</th>
<th>Uvular</th>
<th>Pharyngeal</th>
<th>Glottal</th>
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<tbody>
<tr>
<td>Plosive</td>
<td>p b</td>
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<td>t d</td>
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<td>Tap or Flap</td>
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<td>Fricative</td>
<td>f v θ ð s z</td>
<td>j 3</td>
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Where symbols appear in pairs, the one to the right represents a voiced consonant. Shaded areas denote articulations judged impossible.
Vowels

- Three dimensions
  - Position of the tongue:
    - Front vs. Back
    - High vs. Low (Close vs. Open)
  - Position of the lips:
    - Rounded vs. Unrounded
So according to this system...

- [i] is the high front unrounded vowel
- [u] is the high back rounded vowel
- [a] is the low front unrounded vowel
- Etc.
X-ray showing articulation

- Ken Stevens x-ray film
- http://www.youtube.com/watch?v=DcNMCB-Gsn8&feature=player_embedded
Brief intro to acoustic phonetics

- Articulatory phonetics looks at how sounds are produced.
- Acoustic phonetics looks at the acoustic properties of those sounds.
  - How?
Acoustic Phonetics

- Sounds travel in waves
  - Waveforms are a visual representation of those waves
- Vowels are made up of multiple pitches, or *overtones*, which give each vowel its unique quality
  - Spectrograms allow us to see the frequencies of a vowel’s overtones, also called *formants*
“Back in January”
The same spectrogram, with pitch tracking.
Reminders

- Homework 3 is due Wednesday
- Professor Liberman will be back on Wednesday to give the phonology lecture