1 Admistrivia

- I posted homework 2. Due it two weeks. On n-grams.

2 The telephone

Suppose I tell someone my home phone number while talking to them on my cell phone:

- The thoughts are digital
- But are implemented on a analogue computer called the brain
- they are then translated into Words (which are digital)
- Sound is analogue
- encoded to digital packets by phone
- carried by wire as analogue
3 Basic physics: limits of encoding

- Shannon theory:
  \[ C = B \log_2(1 + S/N) \]
  
  C = bits per second (hence log base 2). B is bandwidth (in per seconds).

- Nyquest:
  \[ f_p \leq 2B \]
  
  Can be thought of either as dot-dashes in Morse code, or as coding analog to digital.

- Humans are trying to solve the same questions using much less quality equipment

4 What does the human equipment look like?

Tools we use:

- Nasal
- Labial
- dental
- alveolar (ridge behind teeth)
- Palatal (from palate) roof of mouth
• Velar (soft palate)
• Glottal (for stops)

Different consonants often touch at different places.
Different vowels are constricted at different places.

5 Vowel space

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6 Notation

IPA and ARPAbet.

7 Aside why can’t spelling make sense?

Visit “speech accent archive”
Look at notation

8 Alternative: bad mathematical representations

• Wave form (hard to visualize)
• Spectrogram (hard to define–i.e. redundant overlapping windows)
• Wavelets would be a good alternative—but discrete time—so not shift invariant.
• No good answer

9 The correct model

• What is the mouth doing?
• Where is the tongue?
• etc
• From these, build model of “gestural phonology”
• Helps build in transitions that are difficult

10 Automatic speech generation (i.e. computers talking)

First puzzle: convert text to phonemes:

• 1750 is pronounced differently if it is a date, a password, a dollar amount, a number of people, etc.
• Names don’t follow standard rules—so need to be memorized

Second puzzle: stringing these together:

• Easy—just memorize each phoneme
• Totally ugly! It sounds like a 1970’s computer

• Better: memorize pairs of phonemes

• Now it is hard to glue them together

Third puzzle: Making it sound human

• Humans change phonemes by context (due to physical constraints)

• Humans change phonemes by importance (due to modeling the receiver)

• Humans change phonemes to slow themselves down (due to stupi-tidy / disfluencies)