Midterm test is coming up: in tutorial, October 19 & 20. Watch for announcements on Blackboard, the rooms might change.

- My office hours are cancelled for today (Oct. 8).
- I’ll be out of town this afternoon until Monday. I’ll have access to email, but responses will be delayed.
- No tutorials next week, due to Thanksgiving holiday
  - HW4 (Phonetics) answers to be posted Tuesday.
  - HW5 (Phonology) due in drop box by next Tuesday evening.
- Extended office hours next Thursday (11:30 - as long as people are there).
- Help lab next Thursday evening? If I can book a room. Watch for an announcement on Blackboard.
Phonology

- The study of systematic structure of sounds in languages.
- How sounds are organized in a language, in our minds, and in words.
The English plural rule

- Underlying /z/ is realized as [s] when the final consonant of the stem is voiceless and not a sibilant (/s zʃʒ/), and is realized as [əz] if the final stem is a sibilant.
Phonemes

- The **phonemes** of a language are **contrastive segments**, or **distinctive sounds**.

- **Contrastive sounds**: sounds for which their presence alone distinguishes between otherwise identical forms.

- **Minimal pair**: Two (or more) words that are identical except for a single **phoneme** which occurs in the same position in each word.
In-class exercise (FRHH #1, p. 295)

1. The following sets of minimal pairs show that English /p/ and /b/ contrast in initial, medial and final positions

<table>
<thead>
<tr>
<th>Initial</th>
<th>Medial</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>pit/bit</td>
<td>rapid/rabid</td>
<td>cap/cab</td>
</tr>
</tbody>
</table>

Find similar sets of minimal pairs for each pair of consonants given:

- a. /k/ – /g/
- b. /m/ – /n/
- c. /l/ – /r/  
- d. /b/ – /v/
- e. /b/ – /m/
- f. /p/ – /f/
- g. /s/ – /ʃ/  
- h. /tʃ/ – /dʒ/
- i. /s/ – /z/
Allophones

- Variants in **phonetic units**, or *pronunciation due to context*. Different ways of pronouncing one phoneme, depending on context.

- Allophones are **predictable**, and **non-contrastive**.
  
  - **Phonemes**: minimal info stored in lexicon to distinguish between words with different. Written between slashes: English plural /z/.
  
  - **Allophones**: how we actually pronounce things. The phonetic transcription, written between square brackets: English plural allophones [z], [s], [əz].
Broad vs. narrow transcription

- **Broad** transcription
  - Also known as a **phonemic** transcription
  - Less detail, minimum number of symbols, one for each phoneme.
  - Given between slashes: /tin/  *teen*

- **Narrow** transcription
  - Also known as a **phonetic** transcription
  - More detail, might show allophonic, non-contrastive details such as aspiration and nasalization (in English), vowel length, etc.
  - Given between square brackets: [thi:n]  *teen*
Another example

- Phonemes /i/ and /ɪ/ are **contrastive** in English
  - They are **minimal pairs** in words like /bid/ and /bɪd/.
- In /bid/ and /bin/, the high front vowel /i/ is represented *phonemically* to recognize that it is the same phoneme in the word, even though the vowel is *phonetically* pronounced different
  - [i] & [ɪ] are the phonetic transcriptions of the phoneme /i/.
  - aka “Allophones of the same phoneme”

![Phoneme Tree]

- /i/ can be pronounced nasal, as in [bīn], or not, as in [bid].
- Predictable: nasal allophone [ɪ] before a nasal consonant,
  - *Although nasalization is not contrastive in English, it is in other languages.*
Allophones of the same phoneme can be:

- **In complementary distribution**: one sound cannot appear where the other one does. They are non-contrastive, and predictable by some rule.
  - English aspiration (next slide)
  - The [ɪ] and [i] allophones on the previous slide
  - English (regular) plural and (regular) past tense

- **Free variation**: non-contrastive, can appear in the same environment, not predictable.
  - unreleased [õp] at the end of *mop* (lips stay closed)
  - sound can be released or not; no requirement either way
Aspirated vs. Unaspirated stops in English

**Phonetic fact:** There is a burst or puff of air after the /p/ in *pill*, *till*, and *kill*, that is absent in *spill*, *still*, and *skill*.

- **Aspiration:** The period between the release of the closure of a consonant and the start of the vocal cord activity for the vowel that comes after it. This period is usually felt as a puff of air.

  - *pill* [pʰɪl]  
  - *spill* [spɪl]  
  - *till* [tʰɪl]  
  - *still* [stɪl]  
  - *kill* [kʰɪl]  
  - *skill* [skɪl]  

**Aspiration Rule in English:** Aspiration occurs on all voiceless stops occurring as the first sound in a stressed syllable.

- Although aspirated stops and unaspirated stops are phonetically and physically different, we consider both to be the same sound.
- In English, aspiration is not *contrastive*, (does not create a meaning difference)
- In English, [p] and [pʰ] are in complementary distribution, and are allophones of the same phoneme.
Different phonemes or allophones?

| Hindi: | [kʰəl] ‘wicked person’ | [kəl] ‘yesterday’ |
|        | [kapi] ‘copy’           | [kapʰi] ‘ample’   |
|        | [pʰəl] ‘fruit’          | [pəl] ‘moment’    |
|        | [bəl] ‘strength’        |                  |
| Thai:  | [paa] ‘forest’          | [pʰaa] ‘to split’ |
|        | [tam] ‘to pound’         | [tʰam] ‘to do’    |
|        | [kat] ‘to bite’          | [kʰat] ‘to interrupt’ |
| Korean:| [pʰul] ‘grass’          | [pul] ‘fire’     |
|        | [pəp] ‘law’             | [mubəp] ‘lawlessness’ |

Aspiration is phonemic (contrastive, different phonemes) in Hindi, Thai and Korean, but not in English.
More non-English examples: Vowel Length

<table>
<thead>
<tr>
<th>Language</th>
<th>Word</th>
<th>Pronunciation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fijian:</td>
<td>[oya] ‘he, she’</td>
<td>[oyaa] ‘that’</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[dredre] ‘to laugh’</td>
<td>[dreedree] ‘difficult’</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[vakariri] ‘to boil’</td>
<td>[vakaririi] ‘speedily’</td>
<td></td>
</tr>
<tr>
<td>Korean:</td>
<td>[il] ‘day’</td>
<td>[iːl] ‘word’</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[seda] ‘law’</td>
<td>[seːda] ‘strong’</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[kul] ‘oyster’</td>
<td>[kuːl] ‘tunnel’</td>
<td></td>
</tr>
<tr>
<td>Japanese:</td>
<td>[biro] ‘building’</td>
<td>[biːru] ‘beer’</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[tsuji] (proper name)</td>
<td>[tsuːji] ‘moving one’s bowels’</td>
<td></td>
</tr>
</tbody>
</table>

Vowel lengthening is phonemic (contrastive, different phonemes) in Fijian, Korean and Japanese, but not in English.
In-class exercise (FRHH #3, p. 296)

3. Consider the distribution of [r] and [l] in Korean in the following words:

[rupi] ‘ruby’  [mul] ‘water’
[kiri] ‘road’  [pal] ‘big’
[saram] ‘person’  [səul] ‘Seoul’
[irũmi] ‘name’  [ilkop] ‘seven’
[ratio] ‘radio’  [ipalsa] ‘barber’

Are [r] and [l] allophones of one or two phonemes?

a. Do they occur in minimal pairs? No.
b. Are they in complementary distribution? Yes.
c. In what environments do they occur?
   - [r] occurs before vowels and at the beginning of a word. [l] occurs before consonants and at the end of a word.
The phoneme in context

- So far, we’ve learned to describe phonemes by place and manner of articulation. But they can also be described by context.
  - Where does it appear in relation to other phonemes? In what context does a particular allophone surface?
- How do we show these variations, the connection between /phonemes/ and [allophones]? With a rule.
In-class exercise (FRHH #3, p. 296)

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[irũmi] ‘name’          [ilkop] ‘seven’
[ratio] ‘radio’         [ipalsa] ‘barber’

Are [r] and [l] allophones of one or two phonemes?

d. If you conclude that they are allophones of one phoneme, state the rule that can derive the phonetic allophonic forms.

**Rule:** /l/ → [r] / ___V (Do not need to specify /l/ → [l] / elsewhere, as it is redundant).

Why not /r/ → [l] / ___{C, #}? The former is the simpler rule.
Solve phonology problems

- This and other helpful links on Blackboard, see also FRHH pg. 292 (but I like this description better):

### Solving Phonology Problems

The basic goal in solving a phonology problem is to determine if the sounds being examined belong to the same phoneme or to separate phonemes.

<table>
<thead>
<tr>
<th>WHEN ALLOPHONES BELONG TO SEPARATE PHONEMES, THEY ARE:</th>
<th>WHEN ALLOPHONES BELONG TO THE SAME PHONEME, THEY ARE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Contrastive/distinctive</td>
<td>1. Non-contrastive/rule-governed</td>
</tr>
<tr>
<td>2. In unpredictable distribution</td>
<td>2. In predictable distribution</td>
</tr>
<tr>
<td>3. Easily perceived as different</td>
<td>3. Not easily perceived as different</td>
</tr>
<tr>
<td>4. Not necessarily phonetically similar</td>
<td>4. Always phonetically similar</td>
</tr>
</tbody>
</table>
Solve phonology problems

**Problem Solving Flowchart**

1. **CHECK FOR MINIMAL PAIRS**
   - Minimal Pairs:
     - Phonemic forms which vary by one sound that is in the same position in both forms, and which have different meanings.
   - **YES**
   - **NO**

2. **CHECK FOR COMPLEMENTARY DISTRIBUTION**
   - Complementary Distribution:
     - Sounds which never occur in the same phonetic environment. Where one is, the other never is.
   - **YES**
   - **NO**

3. **Allophones of Separate Phonemes**
   - **YES**
   - **NO**

4. **Allophones of the Same Phoneme**
   - **NO**

5. **Allophones of Separate Phonemes**

6. **Repeat the above for each pair of sounds you are investigating.**
Rule notation

/underlying form, phoneme/  # = word boundary
[surface form, allophone]  \( \rightarrow \) = “becomes”
/ = “in the environment of”  C = consonant; (C) = optional consonant
\$ = syllable boundary  V = vowel

Can also specific articulatory description of phonemes (see distinctive feature chart on pg. 258, but no need to specify binary features in your rules)

**How would we read these?**

\(/p/ \rightarrow \left[p^h\right]/ \#___ /l/ \rightarrow \left[r\right]/ ___V \quad V \rightarrow [+nasal]/____[+nasal] \quad (C) \ \$\)

**How would we simplify this rule?**

\(/a, \ e, \ i, \ o, \ u.../ \rightarrow \left[\ddot{a}, \ \ddot{e}, \ \ddot{i}, \ \ddot{o}, \ \ddot{u}\right] / __ n, \ m, \ \eta, \ \eta/ \)

- “A vowel becomes nasalized in the environment before a nasal segment, possibly followed by a consonant, in the same syllable”
In-class exercise (FRHH #8, p. 298)

8. Here are some words in Japanese. Consider [ʧ] and [ts] to be a single phoneme.

[tatami] ‘meat’       [tomodatʃi] ‘friend’       [utʃi] ‘house’
[natsu] ‘summer’      [tsutsumu] ‘wrap’        [tʃizu] ‘map’

a. Based on these data, are [t], [ʧ] and [ts] in complementary distribution (do they ever occur in the same environment)?

- No, they do not occur in the same environments. They are in complementary distribution.

b. State the distribution of these phones, first in words, then using a rule.

   Distribution: [ʧ] is found before [i], [ts] is found before [u], and [t] elsewhere.

   Rules: [t] \(\rightarrow\) [ʧ] / ___V[high, front]; [t] \(\rightarrow\) [ts] / ___V [high, back]
The phoneme as an abstract concept

- You can’t pronounce a phoneme, you can only pronounce one of its allophones.
- Need two levels: phonetic vs. phonemic
- “Phonemes are mental entities and phones are physical events.”
Types of phonological rules

- Feature changing rules
  - Assimilation (ex. English nasal rule)
  - Dissimilation (ex. *fifth* → *[fift]*, *[fifθ]* *sixth* → *[sıkst]*, *[sıksθ]*)
  - Why to such processes happen?
    - Ease of articulation
    - Ease of perception (to make the contrast between segments stronger)

- Feature addition rules (Ex. English aspiration)
- Insertion/epenthesis: (Ex. *film* → *[filəm]*)
- Deletion: (Ex. *sign* – *signature*: *g* → Ø / nasal in the same syllable
- Metathesis: (Ex. *ask* /æsk/ → *[æks]*, *breakfast* → “brefkast”)
/Underlying/ vs. [surface] forms and rule ordering

- **Flapping**: *attitude, writer* have a flap when spoken (transcribed [ɾ] or [D]), not [t] or [d]: [æɾətud], [rajɾər]
  - “Flap” = a voiced, alveolar C, quicker than a stop (sometimes called a “tap”).
  - This alternation found in pairs like *writer/rider, liter/leader, seater/seeder, rooter/ruder.*
  - No flap: *toot, dud(e), tatóo adépt*
  - Flapping rule: alveolar stop \( \rightarrow \) (voiced) flap / V \_\_ unstressed V

This interacts with vowel length in English. Do a broad /phonemic/ transcription of the minimal pairs: *write/ride, neat/need, treat/treed, lack/lag*

/rajt/ \~\rajd/ /nit/ \~\nid/ /trit/ \~\trid/ /læk/ \~\læg/  

- Now compare the **vowel length** in each pair. Give a narrow [phonetic] transcription

[rajt] \~ [rajːd] [nit] \~ [niːd] /trit/ \~ /trɪːd/ /læk/ \~ /læːɡ/

- V \( \rightarrow \) V: / __ C [+voice]

- The variants of the vowels here (longer vs. shorter) are **allophones**; there are no minimal pairs in English with a vowel length distinction
## Rule ordering

<table>
<thead>
<tr>
<th>Derivation</th>
<th>Writer</th>
<th>Rider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underlying form</td>
<td>/rajtər/</td>
<td>/rajdər/</td>
</tr>
<tr>
<td>Length. Rule</td>
<td>DNA</td>
<td>a:</td>
</tr>
<tr>
<td>Derived form</td>
<td>[rajtəɾ]</td>
<td>[raːjtəɾ]</td>
</tr>
<tr>
<td>Flapping rule</td>
<td>ɾ</td>
<td>ɾ</td>
</tr>
<tr>
<td>Surface form</td>
<td>[rajɾəɾ]</td>
<td>[raːjɾəɾ]</td>
</tr>
</tbody>
</table>

*BUT! Different phonetic outputs can result, depending on how rules are ordered:*

<table>
<thead>
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<th>Rider</th>
</tr>
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<tbody>
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<td>Derived form</td>
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<td>[raːjɾəɾ]</td>
</tr>
<tr>
<td>Length. Rule</td>
<td>a:</td>
<td>a:</td>
</tr>
<tr>
<td>*Surface form</td>
<td>[raːjɾəɾ]</td>
<td>[raːjɾəɾ]</td>
</tr>
</tbody>
</table>

Also see the **Canadian Raising** rule (p. 272) that affects diphthongs before [–voiced]. That will probably help you with one of your HW questions.
Phonotactic Constraints (Sequential constraints)

Your knowledge of English tells you that certain strings of phonemes are allowed and others are not.
- You cannot follow a stop with another stop in English.
- If a word begins with /l/, /r/, /ʧ/ or /ʤ/, the next sound must be a vowel.

All languages have these types of constraints, and all languages have different constraints.
Homework and More Exercises:

- Any exercises which have an asterisk by the number have the answers in the back of the book. These are excellent for practice. If you can do #13 (pp. 301-2), you’re doing well.

- **Homework** for Tuesday, October 13: FRHH (your textbook), Ch. 6, #2, #4, #6, #10 (pp. 295–300).
  - Due in the Linguistics drop box (North Building stairwell, second floor) by 6pm that day.

- More phonology problems for practice are posted in Blackboard. The answers for these will not be posted.