1. **Introduction:**
   - Phonology is the study of the sound systems of human language.
   - When talking, people do not speak each sound separately. We put them together.
   - Speech is a very complex phenomenon.
   - When sounds are next to each other, they can affect each other.
   - As articulatory organs operate independently of each other, many adjustments have to be made in order to produce fast speech. As a result of these processes, the articulation of one sound affects the surrounding sounds.
   - Quite often, more than one articulator is active in order to allow the production of fast speech.
   - E.g. When we produce a sound sequence like [pl], we do not articulate the sound [p], then stop, and then articulate sound [l]. Instead, as the sequence [pl] is produced, the tongue tip will start to move toward the alveolar ridge before the lips separate. This is called **coarticulation**.

2. **Coarticulation:**
   - When more than one articulator is active, articulatory adjustments take place. This is called **(articulatory) processes**.
   - Articulatory processes change the nature of individual segments.

3. **Processes:**
   - The articulatory movements that occur during connected speech.
   - We have these processes to make it easier to articulate the sounds.
   - Types of Processes:
     1. Assimilation
        - Place Assimilation
        - Voicing Assimilation
           - Voicing
           - Devoicing
        - Manner Assimilation
           - Flapping
           - Nasalization
     2. Dissimilation
        - Deletion
        - Epenthesis/Insertion
     3. Metathesis
     4. Aspiration
     5. Canadian Raising

4. **Assimilation:**
   - A sound becoming more like a nearby sound in terms of one or more of its phonetic properties.
   - E.g. If a sound is voiced, and a voiceless sound beside it becomes voiced.
   - E.g. If a sound is bilabial and a non-bilabial sound beside it becomes bilabial.
   - Assimilation is either **regressive** (affecting the preceding sound) or **progressive** (affecting the following sound). <u>Note:</u> We need to specify if it's regressive or progressive assimilation.
   - Types of Assimilation:
     1. **Voicing Assimilation:**
        - Voicing assimilation is common across languages.
        - There are 2 types of voicing assimilation:
          1. Voicing
          2. Devoicing
        - **Voicing** occurs when a voiceless sound becomes a voiced sound because it's beside a voiced sound
        - **Devoicing** occurs when a voiced sound becomes a voiceless sound because it's beside a voiceless sound. This only affects liquids.
        - Liquids and glides are devoiced if they are after a voiceless stop.
        - When [l] and [r] is preceded by a voiceless sound, in particular, [k], [p] or [t], they become **devoiced**.
        - E.g. In "Lot", the [l] is voiced. In "Plot", the [l] is voiceless. This is called **devoicing**.
        - To transcribe devoicing, we put a little circle underneath the [l] or [r] sound.
        - E.g. Plan: [pl̥æn], Trick: [tr̥ɪk]
        - Here are some examples of voicing assimilation.
        - E.g. The plurals "S" in English is pronounced differently based on what word it's attached to.
        - Bag + s: "S" is now pronounced as [z], a voiced sound. This is because [g] is voiced, which affects "S". This is an example of progressive voicing assimilation.
        - Book + s: Here, both [k] and [s] are voiceless, so there is no voicing assimilation.
        - E.g. "ed" in English is pronounced differently based on what word it's attached to.

- Walk + ed: "ed" is now pronounced as [t], a voiceless sound. This is because [k] is voiceless, which affects "Ed." This is an example of progressive voicing assimilation.
- Beg + ed: Here, both [g] and [d] are voiced, so there is no voicing assimilation.

2. **Place Assimilation:**
- When the place of articulation of 2 sounds becomes similar, because they are next to each other.
- Consider the prefix "In".
    1. <u>In + Complete:</u> The pronunciation is [Iŋk…] Here, [k] is velar, which makes [n] velar, too. This is an example of place assimilation.
    [n] → [ŋ].
    2. <u>In + Tolerable:</u> Here, both [n] and [t] are alveolar, so everything stays the same.
    3. <u>In + Possible:</u> The pronunciation is [Imp…]. Here, [p] is bilabial, which makes [n] bilabial, too. This is an example of place assimilation.
    [n] → [m].

3. **Manner Assimilation:**
- Least common type of assimilation.
- Types of Manner Assimilation:
    1. **Nasalization:**
    - When vowels are immediately followed by nasals, the nasal affects the pronunciation of the vowel and the vowel becomes nasalized.
    - This means that when pronouncing the vowel, part of the air flows through the nose.
    - Regressive in English, but progressive in Scottish Gaelic.
    - To show that a vowel is nasalized, we put ~ on top of the vowel.
    - E.g. Gone: [gɑ̃n]; E.g. Bond: [bõnd]
    2. **Flapping:**
    - Occurs when an alveolar stop turns into a flap [ɾ].
    - In North American English, when [t] and [d] occur between vowels, they usually sound like a flap [ɾ].
    - The flap/tap is produced when the tongue tip strikes the alveolar ridge, as it passes across it.
    - Recall that [ɾ] is a continuant, so this is assimilation because the stop becomes weakened between vowels.
    - E.g. bi**tt**er [bɪɾər]; ri**d**er [rajɾər]

5. **Dissimilation:**
   - Opposite of assimilation. Two sounds become less similar.
   - E.g. If both sounds are originally fricatives, and one of them becomes a stop.
   - E.g. Consider the word "fifths."
     Fifths: [fɪfθs] → [flfts]
     [θ] and [s] are fricatives, but [t] is a stop. The 2 sounds become less similar.
   - There are 2 types of dissimilation.
     1. **Deletion:**
        - This process removes a segment from a word. This often occurs in rapid speech.
        - The Schwa, [ə], is often deleted in English. Schwa usually gets deleted before liquids and nasals.
        - Vowels get deleted before liquids or nasals.
        - E.g. suppose: [səpowz] → [spowz].
        - Difficult consonant clusters are also often deleted in English.
          E.g. fifths: [fɪfθs] → [fɪfs]
     2. **Epenthesis/Insertion:**
        - Inserts a segment within the existing string of segments to make it easier to articulate the word.
        - E.g. Hamster: [hæmstər] → [hæmpstər]
        - Opposite of deletion.

6. **Metathesis:**
   - Reorders a sequence of segments to make a sequence easier to articulate.
   - E.g. Prescribe being pronounced as perscribe.

7. **Aspiration:**
   - Consider the words "peak", "pin", "car", "cat", "took". If you put your hand in front of your mouth when you are speaking, you will feel a puff of air. This puff of air is known as **aspiration**.
   - At the beginning of a stressed syllable, if a voiceless stop is immediately followed by a vowel, the voiceless stop becomes aspirated. This is why the word "speak" is not aspirated.
   - Sounds are NOT aspirated at the end of words.
   - Note: The voiceless stop does NOT have to be the first sound.
     The word "upon" is aspirated even though [p] is not the very first sound.
   - To show aspiration, we write a superscript h after the aspirated sound.
   - E.g. top: [tʰɑp]
   - If aspirated stops occur next to liquids and glides, coarticulation tends to affect the voicing of the said liquids and glides (devoicing).

8. **<u>Canada Raising:</u>**
   - In Canadian English, the diphthong /aj/ is pronounced as [ʌj] before voiceless consonants and [aj] elsewhere. Since [ʌ] is higher than [a], this characteristic is known as Canadian Raising.
   - In Canadian English, the diphthong /aw/ is pronounced as [ʌw] before voiceless consonants and [aw] elsewhere. Since [ʌ] is higher than [a], this characteristic is known as Canadian Raising.
   - E.g. rice [rʌjs]; right [rʌjt]; flight [flʌjt]

9. **<u>Phonemes:</u>**
   - Abstract sounds that exist in the head of native speakers.
   - Denoted by "//." E.g. /i/.
   - E.g. In "book', there are 3 phonemes and the combination is stored in our mental lexicon.
   - Once a phoneme is pronounced, it becomes physical and becomes an **allophone**. Allophone is another word for pronunciation or realization. I.e. Once you pronounce a sound, it becomes physical and an allophone.
   - Consider aspirations. In our mental lexicon, the phoneme /p/ is stored. However, p has 2 pronunciations, [p] and [pʰ]. They are allophones.
   - Consider nasalization. In our mental lexicon, the phoneme /æ/ is stored. However, /æ/ has 2 pronunciations, [æ] and [æ̃]. [æ] and [æ̃] are allophones.
   - We say that an allophone is predictable if there is a specific rule to when that sound is produced. Usually, predictable allophones have a limited environment. Aspiration and nasalization are predictable. We say that the other allophone is elsewhere because it has a wider environment.
   - E.g. [æ̃] is predictable and [æ] is elsewhere.
   - When two sounds occur in different environments (i.e. cannot occur in the same environment), they are said to be in **complementary distribution**.
   - E.g. [pʰ] and [p] are complementary.
   - **Phonetic transcriptions** are the actual sounds you hear. This includes the processes.
   - **Phonemic transcriptions** are the abstract sounds that exist in the head of native speakers.
   - E.g. Consider the word peak.
     /pik/ is the phonemic transcription.
     [pʰik] is the phonetic transcription.

10. **Sonorant/Obstruent Sounds:**
   - Vowels, glides, liquids, and nasals are **sonorant sounds**.
   - A **sonorant** is a voiced speech sound produced with an air flow that is neither interrupted nor turbulent. I.e. The air flows easily.
   - Sonorous sounds are usually louder.
   - Vowels are the most sonorous. Because of this, usually consonants are formed around vowels.
   - In a syllable, the vowel is the peak (center) of the syllable. This is why the number of syllables equals the number of vowels.
     I.e. If there are 4 vowels in a word, then there are 4 syllables.
   - Note: Not every syllable will have both vowels and consonants.
     E.g. In the word "Upon" the first syllable is U, a vowel and there are no consonants.
   - Stops, fricatives, affricates are **obstruent sounds**.
   - An **obstruent** is a speech **sound** that is formed by obstructing airflow.
   - All obstruents are consonants, but sonorants include both vowels and consonants.
   - Obstruents are the least sonorant sounds. Their sonorous capacity allows vowels, as well as glides, liquids and nasals, to support segment groups, that is to form the peak of syllables.
   - Here is a list of sounds from the most sonorous (vowels) to the least sonorous (obstruents).
     Vowels > Glides > Liquids > Nasals > Stops, Fricatives, Affricates

11. **Syllables:**
   - Syllables are groups of segments with internal organization.
   - If you're a native speaker of a language, based on your intuition, you can tell how many syllables are in a certain word.
   - We can show the internal structure of a syllable using a diagram (tree).
   - The structure of a syllable tree.
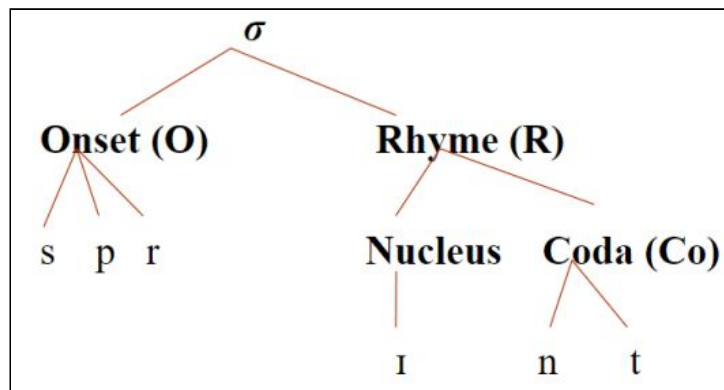
   - **Onset**, denoted by O, is the initial consonants.
   - **Rhyme**, denoted by R, is the nucleus plus the code.
     - **Nucleus**, denoted by N, is the vowels.

- **Coda**, denoted by C, is the consonants that come after the nucleus.
- Note: Never write out the full word in the tree. Write its shortened form.
- Note: The diagram shown above is only for 1 syllable. We need to draw a tree for every syllable a word has. I.e. If a word has 5 syllables, we need to draw 5 of those trees.
- All languages have syllables.
- In all languages syllable structure is subject to constraints.
- Universal tendencies are observable:
  1. Syllable nuclei usually consists of one vowel.
  2. Syllables usually begin with onsets.
  3. Syllables often end with codas.
  4. Onsets and codas usually consist of one consonant.
- E.g. Draw the syllable tree for the word upon.
  Step 1: Write out the phonemic transcription of the word.
  The phonemic transcription of upon is /əpɑn/.
  Step 2: Count the number of syllables in the word.
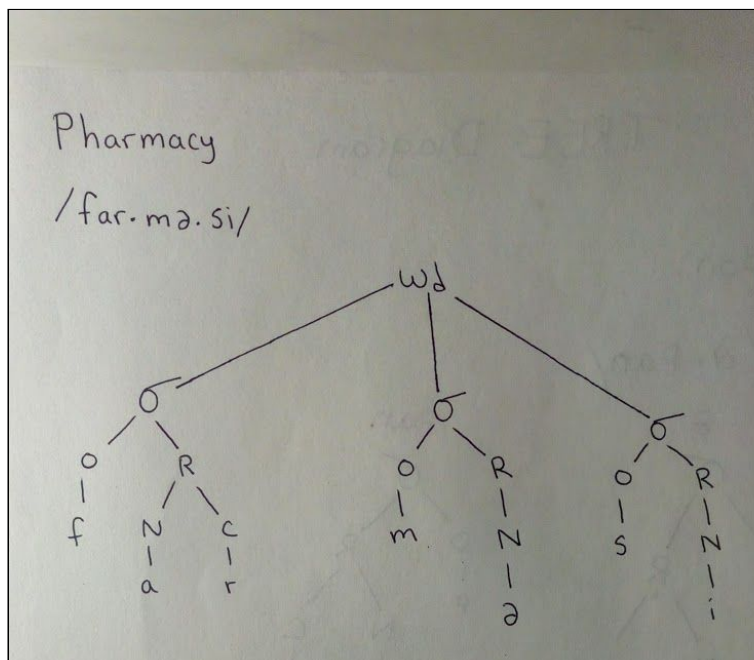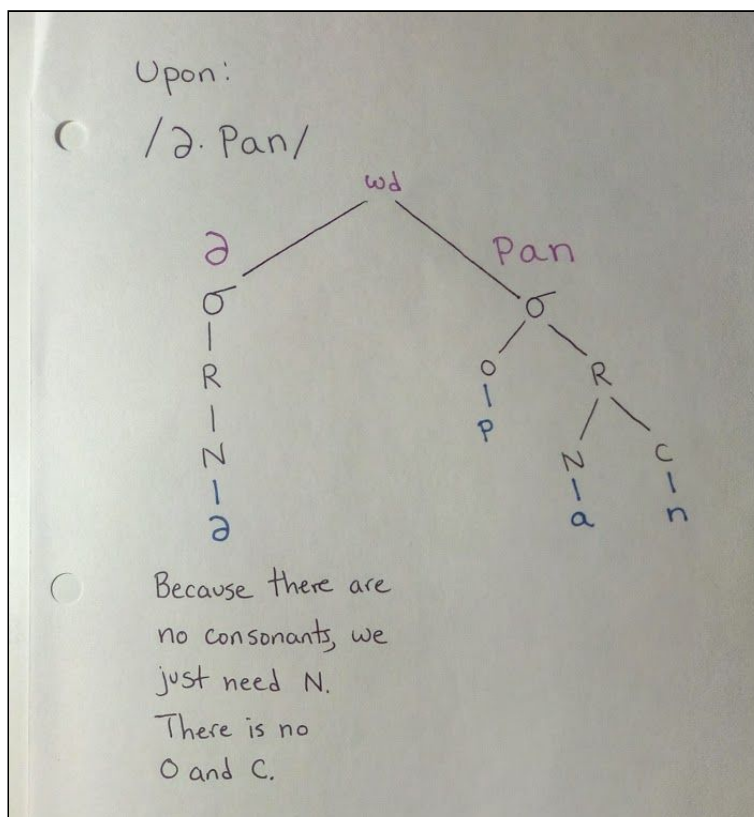 In upon, there are 2 syllables.
  Step 3: Show the syllables in the word. We use a dot, •, to show separation between syllables. The dot is called the syllable boundary. It shows where a syllable ends and where a syllable starts.
  /ə•pɑn/
  Step 4: Draw all of the trees. The very first step after you draw out the basic structure of the tree is to write out the nucleus.
  Since upon has 2 syllables, we need to draw 2 trees.
  Step 5: Connect all the trees at the top, and write **wd**. This means that the syllables form a word.

- Examples:

Upon:

○ /ə. Pan/

wd

ə — σ — R — I — N — ə

Pan — σ

O — P

R

N — a

C — n

○ Because there are
no consonants, we
just need N.
There is no
O and C.

Pharmacy

/far.mə.si/

wd

σ

O — f

R

N — a

C — r

σ

O — m

R

N — ə

σ

O — s

R

N — i

- Sometimes, the schwa, or another vowel gets deleted. Then, non-vowel sonorants, like liquids and nasals take over the vowel. In that case, in the tree diagram, you must be a dash above and after the item that took over the vowel. We call the item that took over the vowel **syllabic**.
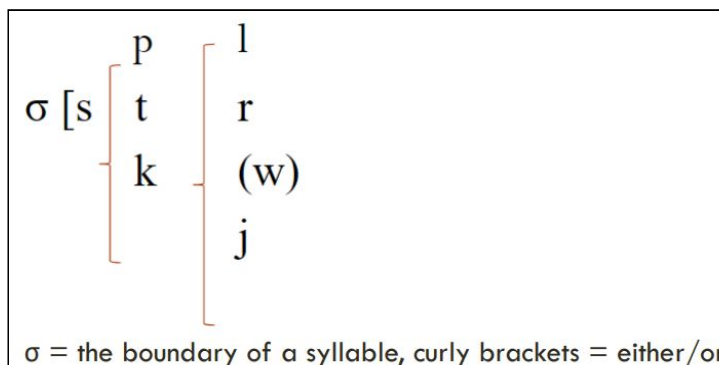Note, we don't have to delete the schwa.

- E.g. Compare the word 'kitten' in slow and fast speech: [kɪɾən] and [kɪɾn̩]. Notice that the vowel in the final syllable is deleted, forcing the final nasal stop [n] to become syllabified. I.e. Become the nucleus or the most sonorous element of the syllable.

12. **Maximize Onset Principle (MOP):**
   - Onsets can be as large as possible.
   - If there is a consonant in the coda of a syllable that can be moved to the onset of the next syllable, we have to move the consonant to the onset of the next syllable. This means that the if we move the consonant to the next syllable, it is a possible syllable.
   - E.g. Consider the word explain:
   We can have either /ɪk•sple(j)n/ or /ɪks•ple(j)n/. However, by MOP, /ɪk•sple(j)n/ is the version that we will use for the tree diagram.
   - **Consonant cluster** is when there is more than 1 consonant next to each other.

13. **Phonotactics:**
   - The set of constraints on how sequences of segments pattern, and which forms part of the speaker's knowledge of her native language phonology.
   - In English, onsets are allowed to contain more than one consonant. Nevertheless, there are very strict phonotactic constraints on the shapes of English onsets.
   - If an onset in English contains three consonants, the structure is the following:
      1. The first segment is always [s].
      2. The second segment is always a voiceless stop.
      3. The third segment is either a liquid or a glide.
   - The sound pattern can be formally represented in this way:

$$\sigma \left[s \begin{bmatrix} p \\ t \\ k \end{bmatrix} \begin{bmatrix} l \\ r \\ (w) \\ j \end{bmatrix} \right.$$

σ = the boundary of a syllable, curly brackets = either/or

   - The consonant combinations allowed in English onsets are not random.
   - They are dependent on:
      1. The manners of articulation of the consonants.

2. The position of the sonorant consonants (liquids and glides) being closer to the nucleus than that of stops and fricatives.