Syllables and Phonotactics
Supplementary Readings

The following readings have been posted to the Moodle course site:

- Contemporary Linguistics: Chapter 3 (pp. 77-84)
- “Syllables” by Kyle Johnson
A Review of Where We Are

The Fundamental Question (for Linguists):
What is the system of rules and mental representations that underlies our ability to speak and understand a human language?

- Last Unit: IPA
  Notation that unambiguously represents the phones of all human languages.

- This Unit: Phonology
  Rules that operate over those representations, and thereby affect how words are pronounced.
Some Quick IPA Practice

First, let’s practice reading some IPA:

[maɪ bʌˈlɒwni hæz ə fɪrst nejm ɪts əʊ ɛs si ɛj ɔr]
Some Quick IPA Practice

First, let’s practice reading some IPA:

[maj bʌləʊnɪ hæk ə fɜːst nejɪm ɪts əʊv ɛs si ɛʃ ər]

(My bologna has a first name, it’s O-S-C-A-R)
Some Quick IPA Practice

Here’s another one:

\[
\text{[mǐnti plɛʒɪəz ɪŋklud pɛptow bɪzmal]}\]
Some Quick IPA Practice

Here’s another one:

[mínti pлеʒɪɾz ɪŋklud ɬɛptɔw bɪzmoːl]  
(Minty pleasures include Pepto Bismol)
Towards ‘Phonology’

IPA transcription represents *some* of our knowledge of how a word is pronounced:

- Phones making up the word
- Sequence in which those phones are produced

However, there is more to a word’s pronunciation than just this...

- There are also **general rules** governing English pronunciation.
Introducing Syllables

Key Example

When we pronounce ‘understanding’, we don’t pronounce (or perceive) it as a simple string of sounds...

- Rather, the phones are grouped together into ‘beats’
- These ‘beats’ making up the word give it a rhythm
- These ‘beats’ and rhythm come out naturally when we speak words slowly
  - [ʌn . dɪˌ ən . stæn . dɪŋ] ‘understanding’
  - [pɛp . təw . bɪz . mɔl] ‘Pepto Bismol’
  - [bʌ . lɔʊ . nɪ] ‘Bologna’
Introducing Syllables

Vocabulary:
These ‘beats’ making up the sound-structure of the word are called **syllables**.
Introducing Syllables

Vocabulary:
These ‘beats’ making up the sound-structure of the word are called **syllables**.

Key Fact:
For most English words, speakers only accept one way of breaking it up into syllables

- [ʌn . dɪr . stæn . dɪŋ] *[^ʌ . ndɪr̩ . tænd . ɪn̩]*
- [pɛp . toʊ . bɪz . mæl] *[^pɛpt . ow . bɪzm . əl]*
- [bʌ . lɔw . ni] *[^bʌl . əwn . ɪ]*
Introducing Syllables

Vocabulary:
These ‘beats’ making up the sound-structure of the word are called **syllables**.

Key Fact:
For most English words, speakers only accept one way of breaking it up into syllables

- [ʌn . dɪr . stæn . dɪŋ] *[^ʌ . ndɪrs . tænd . iŋ]*
- [pɛpt . tow . biz . mɔl] *[^pɛpt . ow . bɪzm . ɔl]*
- [bʌ . loʊ . ni] *[^bʌl . own . i]*

Conclusion:
Part of knowing English is knowing *how to divide words into syllables*

- So, this information is represented in our brains in some way.
Towards Syllabification

Question: How is this information represented in our brains?
Towards Syllabification

Question: How is this information represented in our brains?

Wrong Hypothesis: Maybe we just memorize it on a word-by-word basis?
- When we learn a word like ‘bologna’, we learn:
  - The phones that compose it: \([bələwni]\)
  - The word’s syllabification: \([bə . ləw . ni]\)

Vocabulary: The way that a word is broken down into syllables is called **syllabification**.
Towards Syllabification

Wrong Hypothesis:
The **syllabification** of word is memorized on a case-by-case basis.

Wrong Hypothesis:
The **syllabification** of word is memorized on a case-by-case basis.
Wrong Hypothesis: The syllabification of word is memorized on a case-by-case basis.

Problem for This Hypothesis: English speakers know how to syllabify words they’ve never heard spoken before.

Example:

- Read the following word to yourself silently: “badartogly”
- Say the word to yourself slowly, breaking it into syllables...
Towards Syllabification

Wrong Hypothesis:
The **syllabification** of word is memorized on a case-by-case basis.

Problem for This Hypothesis:
English speakers know how to syllabify words they’ve never heard spoken before.

Example:

- Read the following word to yourself silently: “badartogly”
- Say the word to yourself slowly, breaking it into syllables...
- I would bet that you syllabified it as follows:
  - [bæ . dəʊ . tə . gli ]
- I would bet that you *didn’t* syllabify it this way:
  - [ bæd . ər . ag . lɪ ]
Towards Syllabification

Conclusion:
Since you’d never heard “badartogly” before, your syllabification couldn’t have been memorized...

▶ So the ‘Wrong Hypothesis’ is wrong...
Towards Syllabification

Conclusion:
Since you'd never heard "badartogly" before, your syllabification couldn't have been memorized...

Right Hypothesis:
This rule tells you how to syllabify any imaginable word of English.

So the 'Wrong Hypothesis' is wrong...

Vocabulary:
Phonology = the study of the general rules that govern how words are pronounced in a language.

The Burning Question:
What are the rules for syllabifying a word of English?
Towards Syllabification

Conclusion:
Since you’d never heard “badartogly” before, your syllabification couldn’t have been memorized...

- So the ‘Wrong Hypothesis’ is wrong...

Right Hypothesis:
English syllabification is based on a general rule.
- This rule tells you how to syllabify any imaginable word of English.

Vocabulary:
**Phonology** = the study of the general rules that govern how words are pronounced in a language.
Towards Syllabification

Conclusion:
Since you’d never heard “badartogly” before, your syllabification couldn’t have been memorized...
  ▶ So the ‘Wrong Hypothesis’ is wrong...

Right Hypothesis:
English syllabification is based on a general rule.
  ▶ This rule tells you how to syllabify any imaginable word of English.

Vocabulary:
Phonology = the study of the general rules that govern how words are pronounced in a language.

The Burning Question:
What are the rules for syllabifying a word of English?
Before we can state the rule, we need to talk a bit more about the internal structure of syllables...
The Structure of Syllables

- Every syllable is made up of (at most) three parts:
  - **Onset**: the consonants that begin the syllable
  - **Nucleus**: the sound in the middle of the syllable (usually a vowel)
  - **Coda**: the consonants that end the syllable

- Syllables can differ in size:
  - Some syllables do not have onsets (e.g. [it])
  - Some syllables do not have codas (e.g. [ti])
  - But, *every* syllable has a nucleus
The Structure of Syllables

Here are some syllables, broken down into their parts:

<table>
<thead>
<tr>
<th>Syllable</th>
<th>Onset</th>
<th>Nucleus</th>
<th>Coda</th>
</tr>
</thead>
<tbody>
<tr>
<td>[bæn]</td>
<td>[b]</td>
<td>[æ]</td>
<td>[n]</td>
</tr>
<tr>
<td>[bi]</td>
<td>[b]</td>
<td>[i]</td>
<td>NONE</td>
</tr>
<tr>
<td>[æn]</td>
<td>NONE</td>
<td>[æ]</td>
<td>[n]</td>
</tr>
<tr>
<td>[stænd]</td>
<td>[st]</td>
<td>[æ]</td>
<td>[nd]</td>
</tr>
<tr>
<td>[plæŋk]</td>
<td>[pl]</td>
<td>[æ]</td>
<td>[ŋk]</td>
</tr>
<tr>
<td>[bɔj]</td>
<td>[b]</td>
<td>[ɔj]</td>
<td>NONE</td>
</tr>
<tr>
<td>[spɔej]</td>
<td>[spɔ]</td>
<td>[ɛj]</td>
<td>NONE</td>
</tr>
<tr>
<td>[aj]</td>
<td>NONE</td>
<td>[aj]</td>
<td>NONE</td>
</tr>
</tbody>
</table>

Note:
Both parts of a diphthong count as being in the ‘nucleus’ of the syllable.
Towards ‘Phonotactics’

Key Fact:
Not every sequence of phones is a possible onset or coda in English.

▶ Consider the following sequences of phones:
  ◀ [mba . ka]
  ◀ [ŋa . to]
  ◀ [tsa]
  ◀ [nuktʃ]
  ◀ [tæg . nɪsp]

▶ Which one sounds most like an English word?
Towards ‘Phonotactics’

Key Fact:
Not every sequence of phones is a possible onset or coda in English.

- Consider the following sequences of phones:
  - [mba . ka]
  - [ŋa . to]
  - [tsɑ]
  - [nuktʃ]
  - [tæɡ . nɪsp]

- Which one sounds *most* like an English word?
- You probably said [tæɡ . nɪsp]
  - After all, *it’s the only one that English speakers can easily pronounce.*
Towards ‘Phonotactics’

But why don’t those other words sound like English?
Towards ‘Phonotactics’

But why don’t those other words sound like English?

- [mba . ka]
  - The first syllable starts with [mb]
  - *No English word or syllable can start with [mb]*
  - The sequence [mb] is not a possible onset
Towards ‘Phonotactics’

But why don’t those other words sound like English?

► [mba . ka]
  ► The first syllable starts with [mb]
  ► *No English word or syllable can start with [mb]*
  ► The sequence [mb] is not a possible onset

► [ŋa . to]
  ► The first syllable starts with [ŋ]
  ► *No English word or syllable can start with [ŋ]*
  ► The sequence [ŋ] is not a possible onset
Towards ‘Phonotactics’

But why don’t those other words sound like English?

- [mba . ka]
  - The first syllable starts with [mb]
  - *No English word or syllable can start with [mb]*
  - The sequence [mb] is not a possible onset

- [ŋa . to]
  - The first syllable starts with [ŋ]
  - *No English word or syllable can start with [ŋ]*
  - The sequence [ŋ] is not a possible onset

- [tsq]
  - The first syllable starts with [ts]
  - *No English word or syllable can start with [ts]*
  - The sequence [ts] is not a possible onset
Towards ‘Phonotactics’

But why don’t those other words sound like English?

- [mba . ka]
  - The first syllable starts with [mb]
  - *No English word or syllable can start with [mb]*
  - The sequence [mb] is not a possible onset

- [ŋa . to]
  - The first syllable starts with [ŋ]
  - *No English word or syllable can start with [ŋ]*
  - The sequence [ŋ] is not a possible onset

- [tsa]
  - The first syllable starts with [ts]
  - *No English word or syllable can start with [ts]*
  - The sequence [ts] is not a possible onset

- [nuktf]
  - The first syllable ends with [ktʃ]
  - *No English word or syllable can end with [ktʃ]*
  - The sequence [ktʃ] is not a possible coda
Phonotactic Constraints

Vocabulary:
The rules that determine the possible onsets or codas are called **phonotactics constraints** (a.k.a **phonotactics**).

- ‘phono’ = sounds ; ‘tactic’ = arrangement (how the sounds can be arranged)

> In Dholuo, \[mb\] and \[N\] are possible onsets:
> \[mba . ka\] = story
> \[Na . to\] = person

> In Tlingit, \[ts\] is a possible onset, and \[kÙ\] a possible coda:
> \[tsA\] = seal
> \[nukÙ\] = to do
Phonotactic Constraints

Vocabulary:
The rules that determine the possible onsets or codas are called **phonotactics constraints** (a.k.a **phonotactics**).

- ‘phono’ = sounds  ;  ‘tactic’ = arrangement  
  (how the sounds can be arranged)

Key Fact:
Different languages have different phonotactic constraints.

- In Dholuo, [mb] and [ŋ] are possible onsets:
  - [mba . ka] = story
  - [ŋa . to] = person

- In Tlingit, [ts] is a possible onset, and [ktʃ] a possible coda:
  - [tsa] = seal
  - [nuktʃ] = to do
Phonotactics and Syllabification

Fun Fact:
Phonotactic constraints play a major role in syllabification.

- What’s wrong with: *[^\ . \ nd\i\s\ . \ tænd\ . \ i\ŋ]\n  - [nd] is not a possible onset of English
    (No word of English begins with [nd])

- Why not this: *[pɛpt\ . \ ow\ . \ bizm\ . \ al]\n  - [zm] is not a possible coda of English
    (No word of English ends in [zm])
Toward the Syllabification Rule

But, phonotactic constraints don’t explain *everything*...

- Why don’t we syllabify like this: *[bʌl . own . i]*
  - This syllabification is totally consistent with English phonotactics.
    - *[bʌl]* is a possible English syllable
    - *[own]* is a possible English syllable
    - *[i]* is a possible English syllable

- The answer will come from a concrete rule (algorithm) for syllabifying an English word...
The Syllabification Algorithm

- There are four main steps to the ‘syllabification rule’ ('syllabification procedure', 'syllabification algorithm')

- We will illustrate each step with our made-up words [bædɔmtɑglɪ] and [tægnɪsp].
Step 1: Label the Nuclei

- Every syllable has a nucleus.
- **Key Fact:** *All vowels serve as syllabic nuclei.*
- So, Step One of our syllabification procedure is:
  - Identify all the vowels in the word, and...
  - Label those vowels as ‘nuclei’ (N)

\[
\text{b æ d a r t a g l i} \quad \text{t æ g n i s p}
\]
Step 1: Label the Nuclei

- Every syllable has a nucleus.
- **Key Fact:** *All vowels serve as syllabic nuclei.*
- So, Step One of our syllabification procedure is:
  - Identify all the vowels in the word, and...
  - Label those vowels as ‘nuclei’ (N)

```
N N N N N
N N
b æ d æ t æ g l i
t æ g n i s p
```
Step 2: Label the Onsets

Step 2:
To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

- Look at the consonants preceding each ‘N’
- Find the *largest* continuous sequence that English phonotactics allows to be an onset.
- Write an ‘O’ above that sequence and connect each phone to that ‘O’ with a line.

\[
\begin{array}{llllll}
N & N & N & N & N & N \\
\mid & \mid & \mid & \mid & \mid & \mid \\
b & \text{æ} & d & a & t & a & g \\
\text{i} & & & & & & \\
\end{array}
\quad \quad \quad
\begin{array}{llllll}
N & N & N & N & N & N \\
\mid & \mid & \mid & \mid & \mid & \mid \\
t & \text{æ} & g & n & i & s & p
\end{array}
\]
Step 2: Label the Onsets

Step 2:
To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

- Look at the consonants preceding each ‘N’
- Find the *largest* continuous sequence that English phonotactics allows to be an onset.
- Write an ‘O’ above that sequence and connect each phone to that ‘O’ with a line.

```
ONNNNN
 b æ d a j t a g l i
 NNN
 t æ g n i s p
```
Step 2: Label the Onsets

To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

- Look at the consonants preceding each ‘N’
- Find the *largest* continuous sequence that English phonotactics allows to be an onset.
- Write an ‘O’ above that sequence and connect each phone to that ‘O’ with a line.

```
ONONNN
bædątągļi
N
N
tægŋispl
```
Step 2: Label the Onsets

Step 2:
To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

- Look at the consonants preceding each ‘N’
- Find the *largest* continuous sequence that English phonotactics allows to be an onset.
- Write an ‘O’ above that sequence and connect each phone to that ‘O’ with a line.

```
ONON
   |ædærtægl
O
   |
NN
   |tægниsṗ
```
Step 2: Label the Onsets

To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

- Look at the consonants preceding each ‘N’
- Find the largest continuous sequence that English phonotactics allows to be an onset.
- Write an ‘O’ above that sequence and connect each phone to that ‘O’ with a line.

* [öt] is not a possible onset of English (no word starts with [öt]*
Step 2: Label the Onsets

To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

- Look at the consonants preceding each ‘N’
- Find the *largest* continuous sequence that English phonotactics allows to be an onset.
- Write an ‘O’ above that sequence and connect each phone to that ‘O’ with a line.

\[ \text{b æ d ə r t ə g l i } \quad \text{t æ g n l s p} \]

- [\text{t}] is not a possible onset of English (no word starts with [\text{t}])]
Step 2: Label the Onsets

Step 2:
To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

- Look at the consonants preceding each ‘N’
- Find the *largest* continuous sequence that English phonotactics allows to be an onset.
- Write an ‘O’ above that sequence and connect each phone to that ‘O’ with a line.

\[ \text{O N O N O N O N} \quad \text{N N} \]
\[ \text{b æ d ɑ r t ɑ g l i} \quad \text{t æ g n i s p} \]

- \([\ddot{u}t]\) is not a possible onset of English (no word starts with \([\ddot{u}t]\))
- \([gl]\) is a possible onset of English (e.g. \([glow]\))
Step 2: Label the Onsets

Step 2:
To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

- Look at the consonants preceding each ‘N’
- Find the *largest* continuous sequence that English phonotactics allows to be an onset.
- Write an ‘O’ above that sequence and connect each phone to that ‘O’ with a line.

\[
\begin{align*}
\text{b} & \quad \text{æ} & \quad \text{d} & \quad \text{æ} & \quad \text{t} & \quad \text{æ} & \quad \text{g} & \quad \text{l} & \quad \text{i} \\
\text{ONONONON} & & \text{ONON} & & \text{ON} & & \text{ONT} & & \text{æg} & & \text{ni} & & \text{sp} \\
\end{align*}
\]

- \([\text{ut}]\) is not a possible onset of English (no word starts with \([\text{ut}]\))
- \([\text{gl}]\) *is* a possible onset of English (e.g. \([\text{glow}]\))
Step 2: Label the Onsets

Step 2:
To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

- Look at the consonants preceding each ‘N’
- Find the largest continuous sequence that English phonotactics allows to be an onset.
- Write an ‘O’ above that sequence and connect each phone to that ‘O’ with a line.

\[
\begin{align*}
\text{O} & \quad \text{N} & \quad \text{O} & \quad \text{N} & \quad \text{O} & \quad \text{N} & \quad \text{O} & \quad \text{N} \\
\text{b} & \quad \text{æ} & \quad \text{d} & \quad \text{a} & \quad \text{t} & \quad \text{æ} & \quad \text{g} & \quad \text{l} & \quad \text{i} \\
\end{align*}
\]

\[
\begin{align*}
\text{O} & \quad \text{N} & \quad \text{O} & \quad \text{N} & \quad \text{O} & \quad \text{N} \\
\text{t} & \quad \text{æ} & \quad \text{g} & \quad \text{n} & \quad \text{i} & \quad \text{s} & \quad \text{p} \\
\end{align*}
\]

- [ut] is not a possible onset of English (no word starts with [ut])
- [gl] is a possible onset of English (e.g. [glow])
Step 2: Label the Onsets

Step 2: To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

- Look at the consonants preceding each ‘N’
- Find the *largest* continuous sequence that English phonotactics allows to be an onset.
- Write an ‘O’ above that sequence and connect each phone to that ‘O’ with a line.

\[
\begin{array}{ccccccccccc}
O & N & O & N & O & N & O & N & O & N & O & N \\
\mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid \\
b & æ & d & a & r & t & æ & g & l & i & t & æ & g & n & i & s & p
\end{array}
\]

- [\(\texttt{\lact}\)] is not a possible onset of English (no word starts with [\(\texttt{\lact}\)]
- [\(\texttt{\gl}\)] is a possible onset of English (e.g. [\(\texttt{\glow}\)])
- [\(\texttt{\gn}\)] is not a possible onset of English (no word starts with [\(\texttt{\gn}\)])
Finding the Onsets

- A major part of ‘Step 2’ is figuring out “Can this sequence of phones be an onset in English?”

- To answer this, either:
  - Use your own ‘intuitions’ as a native speaker (if you are one)
  - Team up with a friend who is a native speaker (if you aren’t one)

- Either way, you ask “can a *word* of English *start* with this sequence of phones?”
Step 3: Label the Codas

To the extent allowed by the phonotactics, gather up the remaining unlabeled phones following a nucleus, and label them as a coda.

- Look at the consonants following each ‘N’ (that aren’t already labeled as ‘O’s)
- Find the *largest* continuous sequence that English phonotactics allows to be a coda.
- Write a ‘C’ above that sequence and connect each phone to that ‘C’ with a line.
Step 3: Label the Codas

Step 3:
To the extent allowed by the phonotactics, gather up the remaining unlabeled phones following a nucleus, and label them as a coda.

- Look at the consonants following each ‘N’ (that aren’t already labeled as ‘O’s)
- Find the *largest* continuous sequence that English phonotactics allows to be a coda.
- Write a ‘C’ above that sequence and connect each phone to that ‘C’ with a line.

```
<table>
<thead>
<tr>
<th>O</th>
<th>N</th>
<th>O</th>
<th>N</th>
<th>C</th>
<th>O</th>
<th>N</th>
<th>O</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>æ</td>
<td>d</td>
<td>a</td>
<td>t</td>
<td>a</td>
<td>g</td>
<td>l</td>
<td>i</td>
</tr>
<tr>
<td>O</td>
<td>N</td>
<td>O</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>æ</td>
<td>g</td>
<td>n</td>
<td>i</td>
<td>s</td>
<td>p</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```
Step 3: Label the Codas

Step 3:
To the extent allowed by the phonotactics, gather up the remaining unlabeled phones following a nucleus, and label them as a coda.

- Look at the consonants following each ‘N’ (that aren’t already labeled as ‘O’s)
- Find the *largest* continuous sequence that English phonotactics allows to be a coda.
- Write a ‘C’ above that sequence and connect each phone to that ‘C’ with a line.

```
ONONCONON
\___/
badartagli
```

```
ONON
\___/
tægnisp
```
Step 3: Label the Codas

Step 3:
To the extent allowed by the phonotactics, gather up the remaining unlabeled phones following a nucleus, and label them as a coda.

- Look at the consonants following each ‘N’ (that aren’t already labeled as ‘O’s)
- Find the largest continuous sequence that English phonotactics allows to be a coda.
- Write a ‘C’ above that sequence and connect each phone to that ‘C’ with a line.
Step 3: Label the Codas

Step 3:
To the extent allowed by the phonotactics, gather up the remaining unlabeled phones following a nucleus, and label them as a coda.

- Look at the consonants following each ‘N’ (that aren’t already labeled as ‘O’s)
- Find the *largest* continuous sequence that English phonotactics allows to be a coda.
- Write a ‘C’ above that sequence and connect each phone to that ‘C’ with a line.

```
O N O N C O N O N
|   |   |   |   |   |   |   |
| b æ d a t a g l i |
```

```
O N C O N C
|   |   |   |   |
| t æ g n i s p |
```

- [sp] is a possible coda of English (e.g. [kʌsp])
Finding the Codas

- As with Step 2, a major part of ‘Step 3’ is the question “Can this sequence of phones be a coda in English?”

- To answer this question, either:
  - Use your own intuitions as a native speaker (if you are one)
  - Team up with a friend who is a native speaker (if you aren’t one)

- Either way, you ask “can a word of English end with this sequence of phones?”
Step 4: Add the Syllable Labels

Step 4:
Group together the ‘O’s, ‘N’s and ‘C’s into syllables.

- Above each N, write a ‘σ’ (for syllable), and draw a line connecting them.
- If there is an O preceding an N, connect that O to the σ that N is connected to.
- If there is a C following an N, connect that C to the σ that the N is connected to.

O N O N C O N O N
| | | | | | | | | | |
b æ d a r t a g l i

O N C O N C
| | | | | | |
t æ g n i s p
Step 4: Add the Syllable Labels

Step 4:
Group together the ‘O’s, ‘N’s and ‘C’s into syllables.

- Above each N, write a ‘σ’ (for syllable), and draw a line connecting them.
- If there is an O preceding an N, connect that O to the σ that N is connected to.
- If there is a C following an N, connect that C to the σ that the N is connected to
Step 4: Add the Syllable Labels

Step 4:
Group together the ‘O’s, ‘N’s and ‘C’s into syllables.

- Above each N, write a ‘σ’ (for syllable), and draw a line connecting them.
- If there is an O preceding an N, connect that O to the σ that N is connected to.
- If there is a C following an N, connect that C to the σ that the N is connected to.

\[
\begin{align*}
\sigma & \sigma & \sigma & \sigma \\
\overset{\text{ON}}{\text{ON}} & \overset{\text{ON}}{\text{ON}} & \overset{\text{ON}}{\text{ON}} & \overset{\text{ON}}{\text{ON}} \\
\text{b æ d a ſ t a g l i} & \text{t æ g n i s p}
\end{align*}
\]
Step 4: Add the Syllable Labels

Step 4:
Group together the ‘O’s, ‘N’s and ‘C’s into syllables.

- Above each N, write a ‘σ’ (for syllable), and draw a line connecting them.
- If there is an O preceding an N, connect that O to the σ that N is connected to.
- If there is a C following an N, connect that C to the σ that the N is connected to
Study Exercise:

- At home, try running this procedure on the following words:
  - [ʌndɪʃtændɪŋ] ("understanding")
  - [pɛptɔw bɪzmaɫ] ("Pepto Bismol")
  - [bʌlɔwni] ("Bologna")

- Confirm that our rule will predict the correct syllabification for these words.
Summing Up

What We’ve Done So Far:

- We’ve laid out a rule that will correctly syllabify English words.
- This rule, then, is one (very small) part of an answer to our ‘fundamental question’.

The Fundamental Question (for Linguists):
What is the system of **rules** and **mental representations** that underlies our ability to speak and understand a human language?
Problem: Syllabic Consonants

But, there’s a problem for our syllabification rule...

- If we follow this rule, the only possible nuclei we will get will be vowels
- However, although every vowel is a nucleus...
- ...some nuclei are not vowels.
Syllabic Consonants in English

Key Fact:
The consonants [l], [n], and [r], can be nuclei in English.

Words With Consonants as Syllabic Nuclei:

- “kitten” [kɪ . tn]
- “cuddle” [kʌ . dl]
- “banner” [bær . nɐ]

Question: Why do we say they are the nucleus of a syllable?
Syllabic Consonants in English

Key Fact:
The consonants [l], [n], and [r], can be nuclei in English.

Words With Consonants as Syllabic Nuclei:

- “kitten” [kɪ . tn]
- “cuddle” [kʌ . dl]
- “banner” [bæ . nə]

Question: Why do we say they are the nucleus of a syllable?

Answer: We hear these words as having two syllables, but there is no ‘second vowel’ before the final consonant.

- “kitten” and “cuddle”: tongue never leaves alveolar ridge after [t]/[d].
- “banner”: you go immediately from [n] to [r], with no intervening vowel.
Vocabulary:
When a consonant serves as a syllabic nucleus, it is said to be a **syllabic consonant**

IPA Representation:
In IPA, syllabic consonants are indicated by putting a little vertical line beneath them:

- “kitten”      [ kɪ . tɪ ]
- “cuddle”      [ kʌ . dɪ ]
- “banner”      [ bæ . nɪ ]
Syllabic Consonants in English

It seems, then, that the real syllabification rule for English outputs representations like these:

\[
\begin{array}{ccc}
\sigma & \sigma \\
\Lambda & \Lambda & \Lambda \\
O & N & O & N \\
| & | & | & |
\end{array} 
\quad 
\begin{array}{ccc}
\sigma & \sigma \\
\Lambda & \Lambda & \Lambda \\
O & N & O & N \\
| & | & | & |
\end{array} 
\quad 
\begin{array}{ccc}
\sigma & \sigma \\
\Lambda & \Lambda & \Lambda \\
O & N & O & N \\
| & | & | & |
\end{array}
\]

The Problem:

- Our current rule won’t make representations like this
- so, we have to fix our rule...
- ... but it goes beyond ‘201’ to explain how.
Question:
Why don’t we syllabify “bologna” like this: *[bʌl . oun . ɪ]*

- This syllabification is totally consistent with English phonotactics.
  - *[bʌl]* is a possible English syllable
  - *[oun]* is a possible English syllable
  - *[ɪ]* is a possible English syllable

The answer comes from an important feature of our rule...
Onsets Over Codas

A Prediction of Our Rule:
If phonotactics allow a consonant to be either an onset or a coda, then *it will be an onset.*

▶ \([b \mathord{\text{-}} w . \ o n . i]\), \(*[b \mathord{\text{-}} i . o w . n . i]\)

**Question:** How, exactly, does our rule predict this?
Onsets Over Codas

A Prediction of Our Rule:
If phonotactics allow a consonant to be either an onset or a coda, then it will be an onset.

- $[b\lambda \ . \ \text{low} \ . \ \text{ni}]$, $\textit{not} \ *[b\lambda l \ . \ \text{own} \ . \ i]$

**Question:** How, exactly, does our rule predict this?

**Answer:** Because our rule determines the onsets $\textit{first}$.

- **Step 2:**
  Gather up all the consonants that can form an onset, and label them as such.

- **Step 3:**
  Of the remaining consonants, gather up all those that can form a coda, and label them as such.

Since our algorithm creates the onsets first...
...the codas are made out of only those consonants that $\textit{couldn’t}$ form onsets...
Illustrative Derivation

Let’s see in detail how this works, by using our algorithm to syllabify “bologna”
Illustrative Derivation

Let’s see in detail how this works, by using our algorithm to syllabify “bologna”

Step 1:
Label every vowel as a nucleus.
Illustrative Derivation

Let’s see in detail how this works, by using our algorithm to syllabify “bologna”

Step 1:
Label every vowel as a nucleus.

b l o w n i
Illustrative Derivation

Let’s see in detail how this works, by using our algorithm to syllabify “bologna”

Step 1:
Label every vowel as a nucleus.

N  N  N
  |  |  |
 b l o w n i
Illustrative Derivation

Let’s see in detail how this works, by using our algorithm to syllabify “bologna”

Step 2:
To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

\[ \text{N N N} \]
\[ \text{b l ow n i} \]
Illustrative Derivation

Let’s see in detail how this works, by using our algorithm to syllabify “bologna”

Step 2:
To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

```
O N O N O N
\________\________\________\________
b  \   \  ow  n  i
```
Illustrative Derivation

Let’s see in detail how this works, by using our algorithm to syllabify “bologna”

Step 2:
To the extent allowed by the phonotactics, gather up all the phones preceding a nucleus, and label them as an onset.

- Notice that on this step, we are forced to group [l] and [n] as onsets
- The rule won’t let us “wait” to Step 3 to group them as codas
Illustrative Derivation

Let’s see in detail how this works, by using our algorithm to syllabify “bologna”

Step 3:
To the extent allowed by the phonotactics, gather up the remaining unlabeled phones following a nucleus, and label them as a coda.

\[
\begin{align*}
\text{O} & \quad \text{N} & \quad \text{O} & \quad \text{N} & \quad \text{O} & \quad \text{N} \\
| & & | & & | & & | \\
\text{b} & \quad \& & \quad \text{ow} & \quad \text{n} & \quad \text{i}
\end{align*}
\]
Illustrative Derivation

Let’s see in detail how this works, by using our algorithm to syllabify “bologna”

Step 3:
To the extent allowed by the phonotactics, gather up the remaining unlabeled phones following a nucleus, and label them as a coda.

Nothing happens at this step, since there are no ‘remaining unlabeled phones’.
Illustrative Derivation

Let’s see in detail how this works, by using our algorithm to syllabify “bologna”

Step 4:  
Group together the ‘O’s, ‘N’s and ‘C’s into syllables.

\[\text{b} \quad \text{O} \quad \text{N} \quad \text{O} \quad \text{N} \quad \text{O} \quad \text{N}\]
Illustrative Derivation

Let’s see in detail how this works, by using our algorithm to syllabify “bologna”

Step 4:
Group together the ‘O’s, ‘N’s and ‘C’s into syllables.

\[
\begin{array}{cccc}
\sigma & \sigma & \sigma \\
O & N & O & N \\
\sigma & \sigma & \sigma & \sigma \\
b \land \ OW \ n \ i \\
\end{array}
\]
Illustrative Derivation

Let’s see in detail how this works, by using our algorithm to syllabify “bologna”

Step 4:
Group together the ‘O’s, ‘N’s and ‘C’s into syllables.

\[
\sigma \quad \sigma \quad \sigma \\
\wedge \quad \wedge \quad \wedge \\
ON \quad ON \quad ON \\
| \quad | \quad | \quad | \quad | \\
b \wedge \ low \ n \ i
\]
Summing Up:

- There is a general ‘preference’ for consonants to be onsets, rather than codas.

- That is, if the phonotactics allow a particular consonant to be either an onset or a coda, then it will be an onset.
  - \([\text{b\^} \cdot \text{low} \cdot \text{ni}], \text{not } *[\text{b\^}l \cdot \text{own} \cdot \text{i}]\)

- Our syllabification algorithm captures this fact, by ordering the labeling of onsets before the codas.
  - The codas will only be made out of those consonants that couldn’t be onsets.