Quiz 1 First!

APPLIED PHONOLOGY

What did Yuli produce in place of *banana*?

$$[b] + [n] = [m]?$$

[b] + [n] = [m]

[+labial] + [nasal] = [+labial, +nasal]

Features continued

Laryngeal features

These describe what the larynx is doing:

[+voice]: vocal folds are vibrating

[+spread glottis]: vocal folds are spread wide apart (though maybe not as wide as in breathing)

- Vocal folds not touching at all → [h] and aspirated consonants, e.g. [t^h]
- Back end of folds are vibrating but front end is spread apart → breathy-voiced sounds, e.g. [h], [a̤]

[+constricted glottis]: vocal folds are pressed together

- Vocal folds are completely closed (which cuts off airflow) → [ʔ] or ejectives, e.g. [p’]
- Vocal folds are pressed together, but not enough to prevent vibration entirely → creaky-voiced sounds, e.g. [a̰]

Review

Manner features

Sonorants				**Obstruents**		
Vowels	*Glides*	*Liquids*	*Nasals*	*Fricatives*	*Affricates*	*Stops*
[+syllabic]	[–syllabic]					
[–consonantal]	[+consonantal]					
[+approximant]			[–approximant]			
[+sonorant]				[–sonorant]		

Manner features

Sonorants				**Obstruents**		
Vowels	*Glides*	*Liquids*	*Nasals*	*Fricatives*	*Affricates*	*Stops*
[+continuant]			[–continuant]	[+continuant]	[–continuant]	
no value for [delayed release]				[+delayed release]		[–delayed release]
[–nasal]			[+nasal]	[–nasal]		

Manner features

A couple others:

- [lateral] — for lateral sounds
- [strident] — some coronal affricates and fricatives

Phonetic/articulatory basis:

[sonorant]: non-turbulent airflow

[continuant]: air flowing out of mouth

[approximant]: non-turbulent airflow out of mouth

[delayed release]: referring to the fact that tight constriction in affricates/fricatives is held briefly before being released

Vowel features

				Front		Central		Back	
				[–back]				[+back]	
				[+front]		[–front]			
				[–round]	[+round]	[–round]	[+round]	[–round]	[+round]
upper-high	[+high]	[–low]	[+tense]	i	y	ɨ	ʉ	ɯ	u
lower-high			[–tense]	ɪ	ʏ				ʊ
upper-mid	[–high]		[+tense]	e	ø	ɘ	ɵ	ɤ	o
lower-mid			[–tense]	ɛ	œ	ə	ɞ	ʌ	ɔ
low		[+low]	*no value for tense*	æ	Œ	a		ɑ	ɒ

Labial-specific features

Just [labiodental]

Coronal-specific features

(lamino-)dental = tongue **blade** to **teeth**	*(apico-)alveolar* = tongue **tip** to **alveolar ridge**	*palato-alveolar* = tongue **blade** to **behind alveolar ridge** (aka post-alveolar)	*retroflex* = tongue **tip** to **behind alveolar ridge**
t̪ θ	t z	ʧ ʒ	ʈ ʂ
[+Coronal]			
[+anterior]		[–anterior]	
[+distributed]	[–distributed]	[+distributed]	[–distributed]

Phonetic/articulatory basis:

[+anterior]: **at or before** alveolar ridge

[+distributed]: **longer** segment of tongue (= tongue blade) is active

Dorsal-specific features

Palatals	*Fronted velars*	*Central (regular) velars*	*Backed velars*	*Uvulars*	*Pharyngeals*
c, j	k̟, g̟	g, x	k̠, ɣ̠	q, ɴ	ʕ, ħ
[+front]		[–front]			
[–back]			[+back]		
[+high]				[–high]	
[–low]					[+low]

Larygneal features

[voice] — vocal folds vibrating?
[spread glottis] — vocal folds spread wide apart?
[constricted glottis] — vocal folds pressed together?

Features in rules

Now that we know what the features are, we're going to focus in on how to use them in writing our phonological rules.

English tapping

\We saw last week that in English, /t/ and /d/ both become [ɾ] when between two vowels.

- If we were looking at more data, we'd also find that there was a condition on the second vowel, namely that it has to be unstressed.
- Compare atom [ˈærəm] (undergoes the rule) to atomic [əˈtʰamɪk] (doesn't undergo the rule).

Our first pass at writing the rule looked something like this (adding stress per the above notes):

$$\{t, d\} \rightarrow ɾ \,/\, [+\text{syllabic}] \_\_ \begin{bmatrix} +\text{syllabic} \\ -\text{stress} \end{bmatrix}$$

Grouping sounds with features

- What feature(s) do we need to pick out alveolar sounds?
- And what feature(s) do we need to pick out stops?
- Thinking about the sound inventory of English, do we need all of these features to pick out the set {t, d}?

Grouping sounds with features

- What feature(s) do we need to pick out alveolar sounds?
  [+coronal, +anterior, –distributed]
- And what feature(s) do we need to pick out stops?
  [–delayed release]
- Thinking about the sound inventory of English, do we need all of these features to pick out the set {t, d}?
  No. {t, d} are the only coronal stops, so we can get by with:
  [+coronal, –delayed release]

Feature matrices

To pick out a group of sounds sharing multiple feature values, we can just put those features together in a **feature matrix**.

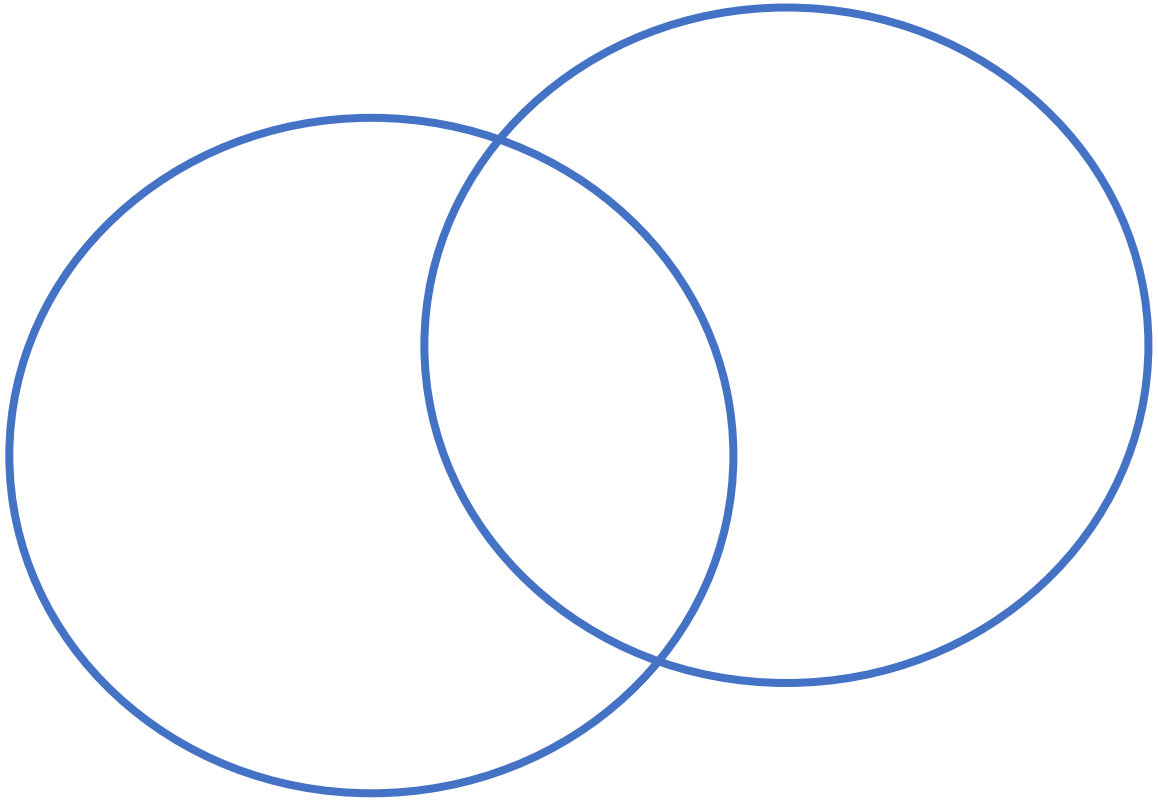
- When multiple features are combined in a feature matrix, the matrix picks out the group of sounds that have all of the values listed.

In set-theoretical terms, the list of features in a matrix is **intersective**: the set picked out by the whole matrix is the **intersection** of the sets for each individual feature.

Set intersection

What are the IPA symbols for English consonants that go in each set in the diagram below?

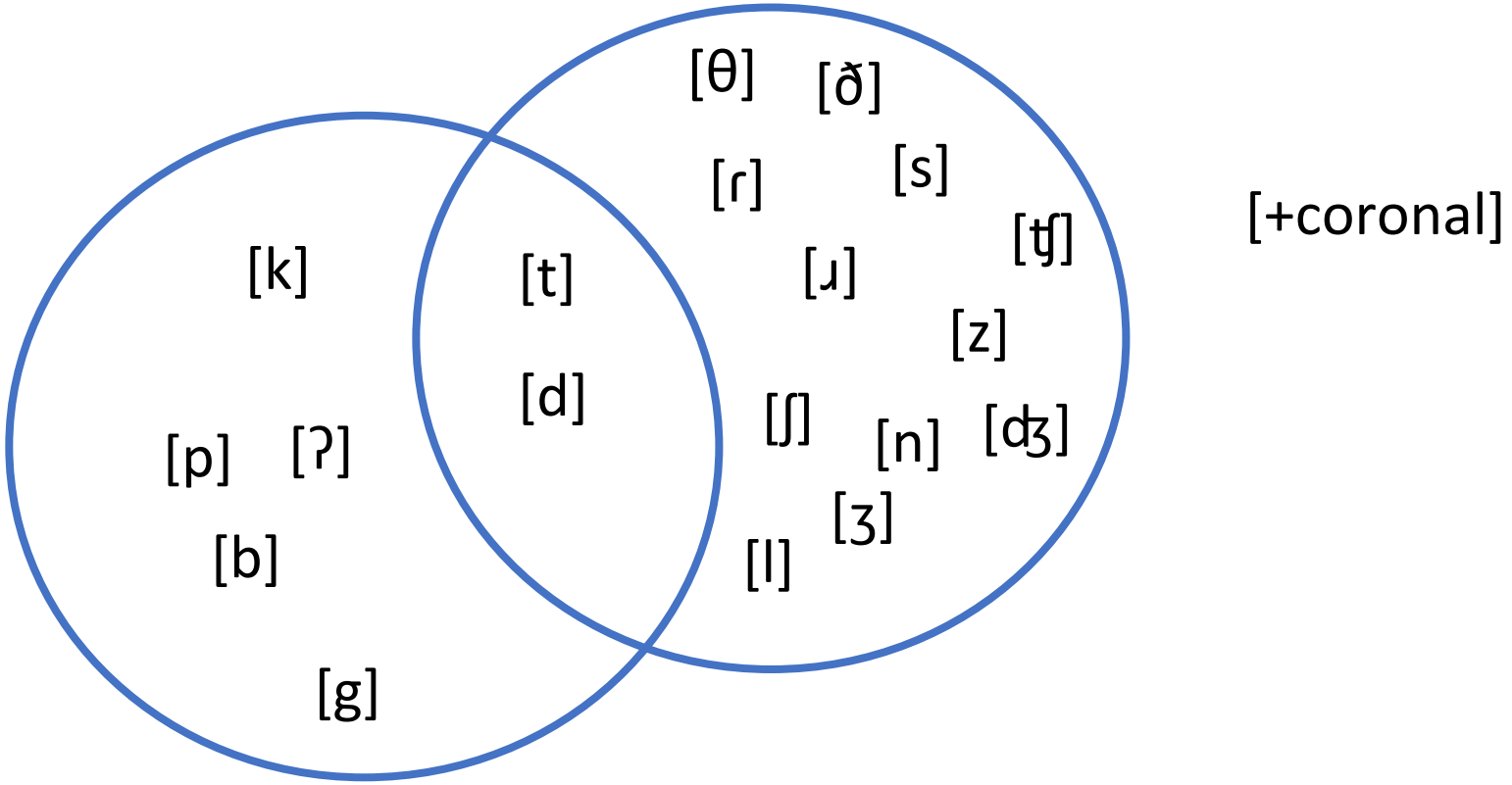
[–delayed release]



[+coronal]

Set intersection

What are the IPA symbols for English consonants that go in each set in the diagram below?



Features in the input

Now that we have the features that pick out alveolar stops as a natural class in English, we can rewrite our rule as:

$$\begin{bmatrix} +\text{CORONAL} \\ -\text{delayed release} \end{bmatrix} \rightarrow \text{ɾ} \; / \; [+\text{syllabic}] \_\_ \begin{bmatrix} +\text{syllabic} \\ -\text{stress} \end{bmatrix}$$

This rule says that alveolar stops become a tap between vowels (the second of which is unstressed).

- We can just write **one rule** instead of two.
- This isn't just convenient! Tapping is something that happens to alveolar stops. Writing two individual rules (i.e., one for /t/, one for /d/) fails to reflect the generalization!

Specifying feature changes

Consider English n-dentalization:

n → n̪ / {θ, ð}

The rule targets a voiced alveolar nasal stop and turns it into a voiced dental nasal stop.

Sounds a bit redundant, no?

Specifying feature changes

We'd like to say that the rule targets a voiced **alveolar** nasal stop, and just makes it **dental**. All other properties of the sound remain the same.

How to do this with features?

What is the feature difference between an alveolar and a dental? (Check your feature chart if you need to.)

Practice

How can we change n → n̪ / {θ, ð} into features?

Practice

How can we change n → n̪ / {θ, ð} into features?

$$\begin{bmatrix} +\text{coronal} \\ +\text{nasal} \end{bmatrix} \rightarrow [+\text{distributed}] \,/\, \_ \begin{bmatrix} +\text{distributed} \\ +\text{anterior} \end{bmatrix}$$

Practice

What's wrong with this rule?

/n/ → $\begin{bmatrix} \text{+distributed} \\ \text{+nasal} \end{bmatrix}$ / …

Practice

What's wrong with this rule?

/n/ → $\begin{bmatrix} \text{+distributed} \\ \text{+nasal} \end{bmatrix}$ / …

Practice

What's wrong with this rule?

$$/n/ \rightarrow \begin{bmatrix} +\text{distributed} \\ +\text{nasal} \end{bmatrix} / \ldots$$

The change lists a feature value of +nasal, but that feature value is already present in the input, so there is no change of value. Listing that value in the change is redundant.

Summary

A feature matrix in the **target** or **environment** of a rule describes a natural class.

- Find a sound with the required features, in the environment of sounds with the required features.

A feature matrix on the right side of the arrow — the **change** — is different.

- Make the specified changes to the target.
- Leave the other features unchanged.

Representations

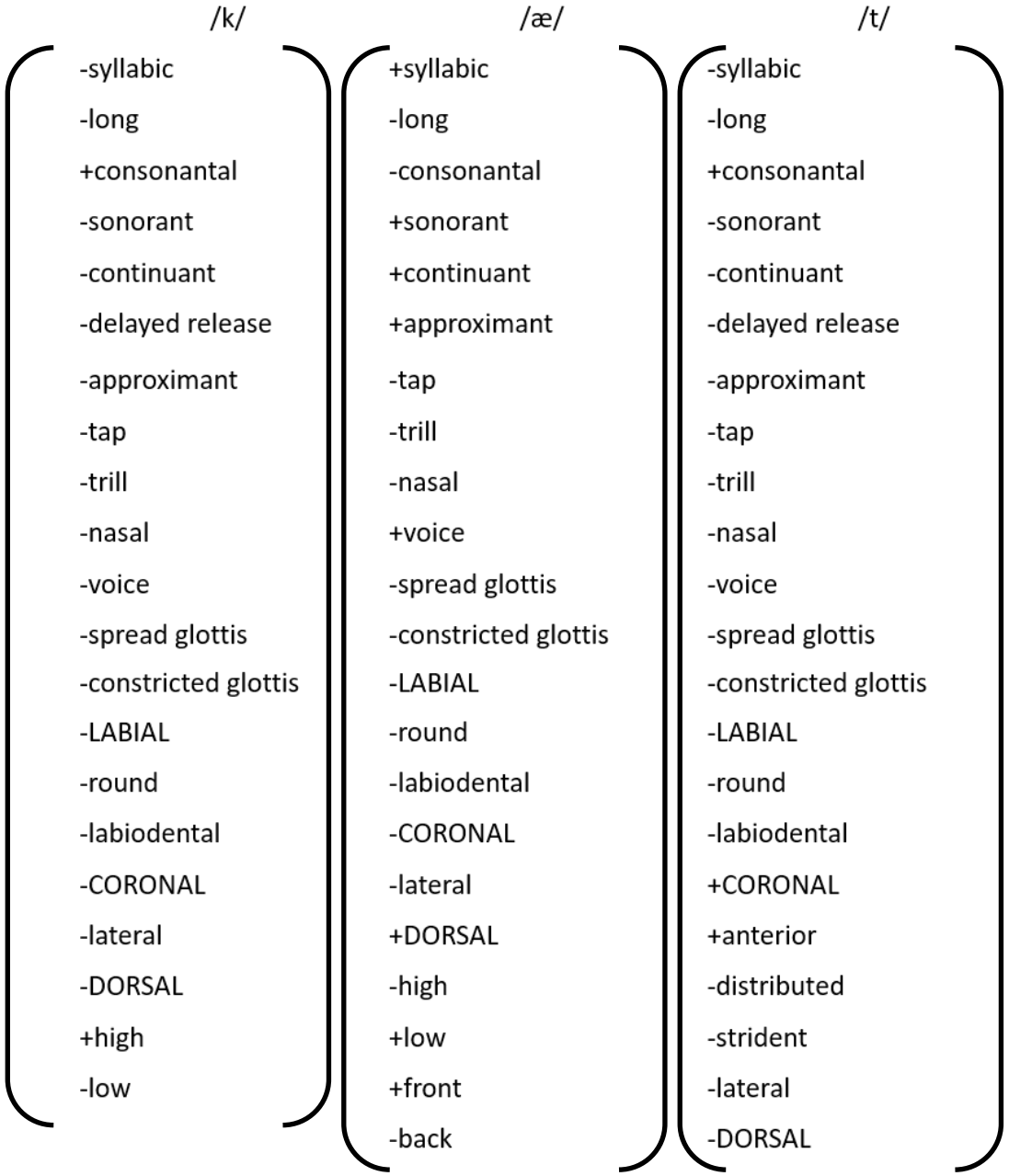
We have seen that there are different levels of phonological **representations**:

- underlying form
- surface form
- intermediate form (in the middle of a derivation)

Regardless of the level, a phonological representation, formally speaking, is a sequence of feature matrices.

Representations

The IPA string /kæt/ is an abbreviation for a sequence of three full feature matrices:



Natural class

A set of sounds that you can pick out with a set of features is called a natural class.

For example, the feature matrix $\begin{bmatrix} \text{+syllabic} \\ \text{+high} \end{bmatrix}$ picks out the natural class of high vowels.

Language-specific sets

The members of a natural class in a given language depend on the language's inventory of sounds:

In Spanish, the $\begin{bmatrix} \text{+syllabic} \\ \text{+high} \end{bmatrix}$ sounds are {i, u}. So {i, u} is a natural class in Spanish.

In French, the $\begin{bmatrix} \text{+syllabic} \\ \text{+high} \end{bmatrix}$ sounds are {i, y, u}.

The set {i, u} is not a natural class in French, because there is no set of features that picks it out.

Practice

The set {y, u} is a natural class in French. Can you identify the features that pick it out?

Practice

The set {y, u} is a natural class in French. Can you identify the features that pick it out?

[+syllabic
+high
+round]

Analogy

An analogy from phonologist Charles Reiss:

- In my apartment today, *lemons* and *oranges* form a natural class: the citrus fruits. Because those are the only citruses I have.
- But at Ralph's, which has lots of other citrus fruits, they probably don't form a natural class — I can't think of features that pick out just *lemons* and *oranges* from all the fruits available there.
- *Lemons* and *grapefruits* might form a natural class there (yellow citrus fruits? Unless they have pomelos…)

Selecting Features

How did we decide what the features should be?

Phonologists have developed a more-or-less consensus set of features (as in your textbook), based on the rules seen in the languages of the world.

Any two phonemes of any language must differ in **at least one feature**.

Example: if tap [r] and trill [r] are separate phonemes in Spanish, we need a feature to distinguish them, like [trill].

Selecting Features

If we see a rule like {A, B, C, D} → blah / blah, or blah → blah / {A, B, C, D} , especially in more than one language, then {A, B, C, D} should be a natural class.

- Example: If lots of languages nasalize a vowel before any consonant with nasal airflow (like [m, n, ŋ]), then [+nasal] seems like a good feature.

A feature should correspond to some phonetic property.

- Most are articulatory, but they can be acoustic too.