


Phonology


t^hap najn sajnz yər nejbər ɪz mejkiŋ k^hlownz

9. juw ædmajr hiz dɔg. ɔfərz t^hə mejk juw wʌn.
8. t^howl k^həlektər spatəd fowr əv him in ðə k^hɑrp^huwl lejn.
7. ɔlweɪz æt k^hɪŋk^howz stɑdijŋ ðə ək^hwɪpmənt.
6. hiz ən ʌnmerid saɪəntɪst wiθ fɪftiθriː sʌnz.
5. jər p^hɪti suwɪr juw sɔ aɪnstajŋ, lɪŋkən, ænd hajdij k^hləm lawndʒɪŋ əraʊnd hiz p^huwl.
4. ðə k^hlʌmziː ət^hemptz t^hə mejk hiz k^hɪdz lʊk dɪfrənt juwziŋ hæts.
3. wɛn jər wajf hæz t^hwɪnz, hiː hawlz, "æmətsər!"
2. hiz sʌnz bɪrθdeɪ k^hejk rɪdz, "hæp^hɪː sɔwmætɪk sɛl dʒənɛtɪk mjuwt^hejʃən deɪ, dɛrən!"
1. juw lʊk awt jər wɪndəʊ ænd juw sɪː juw wɑʃɪŋ hiz k^hɑr.


phoneme


/p/ → [p] / s _ V


becomes


/p/ → [p] / s __ V

allophone


/p/ → [p] / s _ V

when it is...


/p/ → [p] / s _ V

here.

/p/ → [p] / s V

more generally:

$A \longrightarrow B / C _ D$

(and C and/or D can be absent...)

English

/p/ → [p] between [s] and a vowel
→ [p^h] elsewhere

Hindi

/p/ → [p]
/p^h/ → [p^h]

How do you know whether two sounds are allophones or distinct phonemes?

- look for **minimal pairs** (like Hindi *pal* and *p^hal*)
- if you can't find any, see if you can find a rule determining when you find which version of the sound.

Korean:

saram 'person'

rupi 'ruby'

irum 'name'

ratio 'radio'

mul 'water'

pal 'arm'

səul 'Seoul'

ilkop 'seven'

ipalsa 'barber'

Korean:

saram 'person'

rupi 'ruby'

irum 'name'

ratio 'radio'

mul 'water'

pal 'arm'

səul 'Seoul'

ilkop 'seven'

ipalsa 'barber'

/l/ → [r] / __ V

Korean:

saram 'person'

rupi 'ruby'

irum 'name'

ratio 'radio'

mul 'water'

pal 'arm'

səul 'Seoul'

ilkop 'seven'

ipalsa 'barber'

/l/ → [r] / ___ V
 → [l]

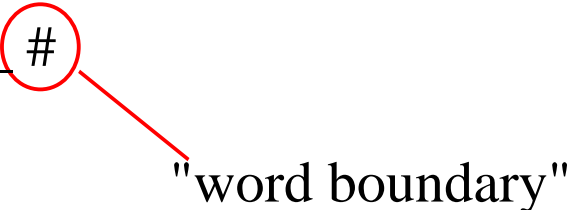
How about in English? Are [r] and [l] allophones, or are there distinct phonemes /r/ and /l/? How do we know?

Careful! Not all sound changes create allophones of a single phoneme.

Polish Plurals

jezy <u>k</u> 'language'	jezy <u>k</u> i 'languages'	jezy <u>k</u>
garne <u>k</u> 'pot'	garne <u>k</u> i 'pots'	garne <u>k</u>
sok <u>k</u> 'juice'	sok <u>i</u> 'juices'	sok <u>k</u>
wu <u>k</u> 'bow'	wu <u>k</u> i 'bows'	wu <u>k</u>
brze <u>k</u> 'bank of a river'	brze <u>g</u> i 'banks of a river'	brze <u>g</u>
dwu <u>k</u> 'debt'	dwu <u>g</u> i 'debts'	dwu <u>g</u>
wu <u>k</u> 'lye'	wu <u>g</u> i '(kinds of) lye'	wu <u>g</u>

plus a rule: [g]--> /k/ / __#



"word boundary"

Careful! Not all sound changes create allophones of a single phoneme.

Polish Plurals

jezy <u>k</u> ‘language’	jezy <u>k</u> i ‘languages’	jezy<u>k</u>
garne <u>k</u> ‘pot’	garne <u>k</u> i ‘pots’	garne<u>k</u>
sok <u>k</u> ‘juice’	sok <u>k</u> i ‘juices’	sok<u>k</u>
wu <u>k</u> ‘bow’	wu <u>k</u> i ‘bows’	wu<u>k</u>
brze <u>k</u> ‘bank of a river’	brze <u>k</u> i ‘banks of a river’	brzeg
dwu <u>k</u> ‘debt’	dwu <u>k</u> i ‘debts’	dwug
wu <u>k</u> ‘lye’	wu <u>k</u> i ‘(kinds of) lye’	wug

plus a rule: [g]--> /k/ / __ #

Another rule: English /t/

sit

sitter

heat

heater

at

attic

/t/ becomes [ɾ] (in American English)

sit [sɪt]

sitter [sɪɾər]

heat [hit]

heater [hiɾər]

at [æt]

attic [æɾɪk]

/t/-->[ɾ] / v__v ?

but what about...

atone [ət^hon]

attack [ət^hæk]

detect [dɪt^hekt]

sit	[sɪt]
sitter	[sɪrər]
heat	[hit]
heater	[hiər]
at	[æt]
attic	[æɪk]
atone	[ət ^h on]
attack	[ət ^h æk]
detect	[dɪt ^h ekt]

sit	[sít]
sitter	[síɾər]
heat	[hít]
heater	[híɾər]
at	[æt]
attic	[æɾɪk]
atone	[ət ^h ón]
attack	[ət ^h æk]
detect	[dɪt ^h ékt]

t-->ɾ / ʋ__ ʋ

Rules like the Flapping Rule (and the other rules we've looked at) capture generalizations about the distributions of certain sounds.

If we just listed:

heat [hit]

heater [hírər]

...in the lexicon, we would miss these generalizations (i.e., we wouldn't succeed in predicting that there are no English words like [hir] or (in American English) [hitər]).

And these generalizations are part of our competence:

"gat" [gæt] + -er

--> "gatter" [gærər]

Phonological rules also allow us to simplify our statements about allomorphy:

"heat" --> [hit]
--> [hir] + -er

We don't need to state anywhere that 'heat' has these two allomorphs; it's covered by our phonological rule.

Compare:

"electric" --> [əlektrik]
--> [əlektris] + -ity

...which does have to be stated in the lexicon.

Polish plurals again

wuk 'bow'

wuki 'bows'

wuk

wuk 'lye'

wugi 'lyes'

wug

Final **g** becomes **k**

Polish plurals again

wuk 'bow'

wuki 'bows'

wuk

wuk 'lye'

wugi 'lyes'

wug

Final **g** becomes **k**

trup 'corpse'

trupi 'corpses'

klup 'club'

klubi 'clubs'

Polish plurals again

wuk 'bow' wuki 'bows' **wuḳ**

wuk 'lye' wugi 'lyes' **wug**

Final **g** becomes **k**

trup 'corpse' trupi 'corpses' **trup**

klup 'club' klubi 'clubs' **kluḅ**

Final **b** becomes **p**

Polish plurals again

wuk 'bow'	wuki 'bows'	wuk <u>̣</u>	
wuk 'lye'	wugi 'lyes'	wug	Final g becomes k
trup 'corpse'	trupi 'corpses'	trup <u>̣</u>	
klup 'club'	klubi 'clubs'	klub <u>̣</u>	Final b becomes p
kot 'cat'	koti 'cats'	kot <u>̣</u>	
trut 'labor'	trudi 'labors'	trud <u>̣</u>	Final d becomes t

Polish plurals again

wuk 'bow'	wuki 'bows'	wu<u>k</u>	
wuk 'lye'	wugi 'lyes'	wu<u>g</u>	Final g becomes <u>k</u>
trup 'corpse'	trupi 'corpses'	tru<u>p</u>	
klup 'club'	klubi 'clubs'	kl<u>u</u>b	Final b becomes <u>p</u>
kot 'cat'	koti 'cats'	ko<u>t</u>	
trut 'labor'	trudi 'labors'	tru<u>d</u>	Final d becomes <u>t</u>
nos 'nose'	nosi 'noses'	no<u>s</u>	
grus 'rubble'	gruzi 'rubbles'	gru<u>z</u>	Final z becomes <u>s</u>

Polish plurals again

wuk 'bow'	wuki 'bows'	wuk <u>̲</u>	
wuk 'lye'	wugi 'lyes'	wug	Final g becomes k
trup 'corpse'	trupi 'corpses'	trup <u>̲</u>	
klup 'club'	klubi 'clubs'	klub <u>̲</u>	Final b becomes p
kot 'cat'	koti 'cats'	kot <u>̲</u>	
trut 'labor'	trudi 'labors'	trud <u>̲</u>	Final d becomes t
nos 'nose'	nosi 'noses'	nos <u>̲</u>	
grus 'rubble'	gruzi 'rubbles'	gruz <u>̲</u>	Final z becomes s

final consonants become voiceless

Polish plurals again

wuk 'bow'	wuki 'bows'	wuk <u>̲</u>	
wuk 'lye'	wugi 'lyes'	wug	Final g becomes k
trup 'corpse'	trupi 'corpses'	trup <u>̲</u>	
klup 'club'	klubi 'clubs'	klub <u>̲</u>	Final b becomes p
kot 'cat'	koti 'cats'	kot <u>̲</u>	
trut 'labor'	trudi 'labors'	trud <u>̲</u>	Final d becomes t
nos 'nose'	nosi 'noses'	nos <u>̲</u>	
grus 'rubble'	gruzi 'rubbles'	gruz <u>̲</u>	Final z becomes s

final consonants become voiceless

C --> [-voice] / __ #

Polish plurals again

wuk 'bow'	wuki 'bows'	wuk <u>̲</u>	
wuk 'lye'	wugi 'lyes'	wug	Final g becomes k
trup 'corpse'	trupi 'corpses'	trup <u>̲</u>	
klup 'club'	klubi 'clubs'	klub <u>̲</u>	Final b becomes p
kot 'cat'	koti 'cats'	kot <u>̲</u>	
trut 'labor'	trudi 'labors'	trud <u>̲</u>	Final d becomes t
nos 'nose'	nosi 'noses'	nos <u>̲</u>	
grus 'rubble'	gruzi 'rubbles'	gruz <u>̲</u>	Final z becomes s

final consonants become voiceless

C --> [-voice] / __ # **feature**

Polish plurals again

Polish:

Final **g** becomes **k**

Final **b** becomes **p**

Final **d** becomes **t**

Final **z** becomes **s**

C --> [-voice] / ___ #

Polish plurals again

Polish:

Final **g** becomes **k**

Final **b** becomes **p**

Final **d** becomes **t**

Final **z** becomes **s**

C --> [-voice] / #

"Qolish":

Final **g** becomes **p**

Final **b** becomes **s**

Final **d** becomes **k**

Final **z** becomes **t**

????????????????????

What features are there?

	p	l	n	f
[Place]	bilabial	alveolar	alveolar	labiodental
[consonantal]	+	+	+	+
[continuant]	-	+	+	+
[sonorant]	-	+	+	-
[nasal]	-	-	+	-
[voice]	-	+	+	-

What features are there?

	p	l	n	f
[Place]	bilabial	alveolar	alveolar	labiodental
[consonantal]	+	+	+	+
[continuant]	-	+	+	+
[sonorant]	-	+	+	-
[nasal]	-	-	+	-
[voice]	-	+	+	-

[consonantal]: + for consonants, - for vowels

What features are there?

	p	l	n	f
[Place]	bilabial	alveolar	alveolar	labiodental
[consonantal]	+	+	+	+
[continuant]	-	+	+	+
[sonorant]	-	+	+	-
[nasal]	-	-	+	-
[voice]	-	+	+	-

[consonantal]: + for consonants, - for vowels

[continuant]: + for sounds you can 'hold' and keep making noise
(everything but oral stops)

What features are there?

	p	l	n	f
[Place]	bilabial	alveolar	alveolar	labiodental
[consonantal]	+	+	+	+
[continuant]	-	+	+	+
[sonorant]	-	+	+	-
[nasal]	-	-	+	-
[voice]	-	+	+	-

[consonantal]: + for consonants, - for vowels

[continuant]: + for sounds you can 'hold' and keep making noise
(everything but oral stops)

[sonorant]: - for sounds that involve buildup of pressure in the
mouth (oral stops, fricatives--"obstruents")

What features are there?

	p	l	n	f
[Place]	bilabial	alveolar	alveolar	labiodental
[consonantal]	+	+	+	+
[continuant]	-	+	+	+
[sonorant]	-	+	+	-
[nasal]	-	-	+	-
[voice]	-	+	+	-

[consonantal]: + for consonants, - for vowels

[continuant]: + for sounds you can 'hold' and keep making noise
(everything but oral stops)

[sonorant]: - for sounds that involve buildup of pressure in the
mouth (oral stops, fricatives--"obstruents")

[nasal]: + if the velum is lowered to allow air to flow
through nasal passages

What features are there?

	ɑ	ə	ẽ	ɯ	ʊ
[Place]					
[consonantal]	-	-	-	-	-
[continuant]	+	+	+	+	+
[sonorant]	+	+	+	+	+
[nasal]	-	-	+	-	-
[voice]	+	+	+	+	+
[high]	-	-	-	+	+
[low]	+	-	-	-	-
[front]	-	-	+	-	-
[back]	+	-	-	+	+
[round]	-	-	-	-	+
[tense]	-	-	-	+	-

Polish plurals yet again

wuk 'bow'	wuki 'bows'	wuk <u>̲</u>	
wuk 'lye'	wugi 'lyes'	wug	Final g becomes k
trup 'corpse'	trupi 'corpses'	trup <u>̲</u>	
klup 'club'	klubi 'clubs'	klub <u>̲</u>	Final b becomes p
nos 'nose'	nosi 'noses'	nos <u>̲</u>	
grus 'rubble'	gruzi 'rubbles'	gruz <u>̲</u>	Final z becomes s
dom 'house'	domi 'houses'	dom <u>̲</u>	Final m

final consonants become voiceless?

C --> [-voice] / ___ #

Polish plurals yet again

wuk 'bow'	wuki 'bows'	wuk <u>̲</u>	
wuk 'lye'	wugi 'lyes'	wug	Final g becomes k
trup 'corpse'	trupi 'corpses'	trup <u>̲</u>	
klup 'club'	klubi 'clubs'	klub <u>̲</u>	Final b becomes p
nos 'nose'	nosi 'noses'	nos <u>̲</u>	
grus 'rubble'	gruzi 'rubbles'	gruz <u>̲</u>	Final z becomes s
dom 'house'	domi 'houses'	dom <u>̲</u>	Final m just sits there

final **obstruents** become voiceless

[-sonorant] --> [-voice] / ___ #

Mokilese

pisan	'full of leaves'
dupukda	'bought'
puko	'basket'
kisa	'we two'
supwo	'firewood'
kamwokiti	'to move'
uduk	'flesh'
kaskas	'to throw'
poki	'to strike something'
pil	'water'
apid	'outrigger support'
ludzuk	'to tackle'

Mokilese

p _o isan	'full of leaves'	v _o
dup _o ukda	'bought'	p__s
p _o uko	'basket'	p__k
k _o isa	'we two'	k__s
supwo	'firewood'	s__p
kamw _o k _o iti	'to move'	k__t
uduk	'flesh'	
kaskas	'to throw'	
poki	'to strike something'	
pil	'water'	
apid	'outrigger support'	
ludzuk	'to tackle'	

Mokilese

		v̥	v
p̥isan	'full of leaves'	p__s	
dup̥ukda	'bought'	p__k	d__p
p̥uko	'basket'		
k̥isa	'we two'	k__s	
sup̥wo	'firewood'	s__p	
kamw̥ok̥iti	'to move'	k__t	t__#
uduk	'flesh'		d__k
kaskas	'to throw'		
poki	'to strike something'		k__#
pil	'water'		p__l
apid	'outrigger support'		p__d
ludzuk	'to tackle'		l__dʒ, dʒ__k

Mokilese

		v̥	v
p̥isan	'full of leaves'	p__s	
dup̥ukda	'bought'	p__k	d__p
p̥uko	'basket'		
k̥isa	'we two'	k__s	
sup̥wo	'firewood'	s__p	
kamw̥ok̥iti	'to move'	k__t	t__#
uduk	'flesh'		d__k
kaskas	'to throw'		
poki	'to strike something'		k__#
pil	'water'		p__l
apid	'outrigger support'		p__d
ludzuk	'to tackle'		l__dʒ, dʒ__k

[-consonantal, +high]-->[-voice] / [-voice] __ [-voice]

Rule Ordering: Tangale

	<u>'N'</u>	<u>'the N'</u>
'meat'	loo	loo-í
'window'	bugat	bugat-í
'berry'	tugat	tugad-í
'load'	aduk	aduk-í
'harp'	kúluk	kúlug-í

Rule Ordering: Tangale

	<u>'N'</u>	<u>'the N'</u>
'meat'	loo	loo-í
'window'	bugat	bugat-í
'berry'	tugat	tugad-í
'load'	aduk	aduk-í
'harp'	kúluk	kúlug-í

final devoicing: C--> [-voice] / ____ #

Rule Ordering: Tangale

	<u>'N'</u>	<u>'the N'</u>	<u>'my N'</u>
'meat'	loo	loo-í	loo-nó
'window'	bugat	bugat-í	bugad-nó
'berry'	tugat	tugad-í	tugad-nó
'load'	aduk	aduk-í	adug-nó
'harp'	kúluk	kúlug-í	kúlug-nó

C--> [-voice] / ____ #

Rule Ordering: Tangale

	<u>'N'</u>	<u>'the N'</u>	<u>'my N'</u>
'meat'	loo	loo-í	loo-nó
'window'	bugat	bugat-í	bugad-nó
'berry'	tugat	tugad-í	tugad-nó
'load'	aduk	aduk-í	adug-nó
'harp'	kúluk	kúlug-í	kúlug-nó

C--> [-voice] / ____ #

C--> [+voice] / ____ [+nasal]

Rule Ordering: Tangale

	<u>'N'</u>	<u>'the N'</u>	<u>'my N'</u>
'meat'	loo	loo-í	loo-nó
'window'	bugat	bugat-í	bugad-nó
'berry'	tugat	tugad-í	tugad-nó
'load'	aduk	aduk-í	adug-nó
'harp'	kúluk	kúlug-í	kúlug-nó
'tooth'	wudó	wud-í	
'bag'	lútu	lút-í	
'shoe'	taga	tag-í	
'salt'	duka	duk-í	
'spoon'	kagá	kag-í	

C--> [-voice] / ____ #

C--> [+voice] / ____ [+nasal]

Rule Ordering: Tangale

	<u>'N'</u>	<u>'the N'</u>	<u>'my N'</u>
'meat'	loo	loo-í	loo-nó
'window'	bugat	bugat-í	bugad-nó
'berry'	tugat	tugad-í	tugad-nó
'load'	aduk	aduk-í	adug-nó
'harp'	kúluk	kúlug-í	kúlug-nó
'tooth'	wudó	wud-í	
'bag'	lútu	lút-í	
'shoe'	taga	tag-í	
'salt'	duka	duk-í	
'spoon'	kagá	kag-í	

pedagogically unfortunate
rule. Don't try this at
home....

C--> [-voice] / ____ #

C--> [+voice] / ____ [+nasal]

vowel drops before a suffix

Rule Ordering: Tangale

	<u>'N'</u>	<u>'the N'</u>	<u>'my N'</u>
'meat'	loo	loo-í	loo-nó
'window'	bugat	bugat-í	bugad-nó
'berry'	tugat	tugad-í	tugad-nó
'load'	aduk	aduk-í	adug-nó
'harp'	kúluk	kúlug-í	kúlug-nó
'tooth'	wudó	wud-í	wud-nó
'bag'	lútu	lút-í	lút-nó
'shoe'	taga	tag-í	tag-nó
'salt'	duka	duk-í	duk-nó
'spoon'	kagá	kag-í	kag-nó

C--> [-voice] / ____ #  **vowel drops before suffix**

C--> [+voice] / ____ [+nasal] 

Rule Ordering: Tangale

UR

vowel drops before suffix

C--> [+voice] / ____ [+nasal]

lútu-nó

lút-nó

lúd-nó

UR

C--> [+voice] / ____ [+nasal]

vowel drops before suffix

lútu-nó

--

lút-nó

Rule Ordering: Tangale

UR

vowel drops before suffix

C--> [+voice] / ____ [+nasal]

lútu-nó

lút-nó

lúd-nó

UR

C--> [+voice] / ____ [+nasal]

vowel drops before suffix

lútu-nó

--

lút-nó

the winner!

our friend the syllable

Some facts about English phonotactics:

English words can begin with:

/tr/ (*track*)
/kr/ (*crunch*)
/str/ (*strength*)
/θr/ (*three*)

but not with:

/tl/ (**tlack*)
/rk/ (**rcunch*)
/nt/ (**ntength*)
/rθr/ (**rthree*)

our friend the syllable

Some facts about English phonotactics:

English words can begin with:

/tr/ (*track*)
/kr/ (*crunch*)
/str/ (*strength*)
/θr/ (*three*)

but not with:

/tl/ (**tlack*)
/rk/ (**rcunch*)
/nt/ (**ntength*)
/rθr/ (**rthree*)

The clusters on the right can appear between vowels:

Atlantic

arcade

Montana

arthritic

possible story: the phonotactic generalizations above are really about English **syllables**.

* <u>t</u> lack	At. <u>l</u> an.tic
* <u>r</u> cunch	ar. <u>c</u> ade
* <u>n</u> tength	Mon. <u>t</u> a.na
* <u>r</u> three	ar. <u>th</u> ri.tic

argument #1: syllable structure affects realization of /t/:

top

stop

pot

atrocious

astronomy

Atlantic

possible story: the phonotactic generalizations above are really about English **syllables**.

* <u>t</u> lack	<i>At<u>.l</u>an.tic</i>
* <u>r</u> cunch	<i>ar<u>.c</u>ade</i>
* <u>n</u> tength	<i>Mon<u>.t</u>a.na</i>
* <u>r</u> three	<i>ar<u>.th</u>ri.tic</i>

argument #1: syllable structure affects realization of /t/:

t ^h op	[-cont]-->[+aspirated] / σ __
stop	[-cont]-->[+glottalized] / __ σ
pot ^ʔ	(ordered before or after Flapping?)
a.t ^h ro.cious	
a.stro.no.my	
At ^ʔ .lan.tic	

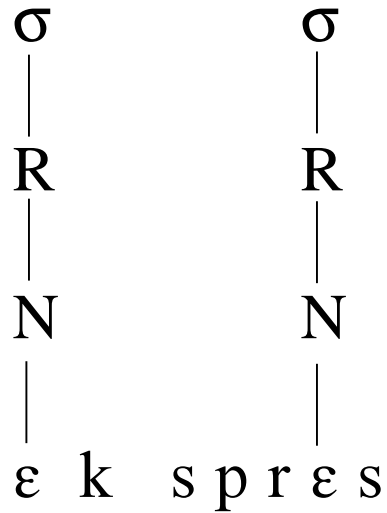
argument #2: syllable structure affects stress:

a.ccrúe	à <u>r.c</u> áde
A.mérica	Mò <u>n.t</u> ána
a.strónomy	à <u>r.thr</u> ític

-->syllable ending in a consonant gets a secondary stress

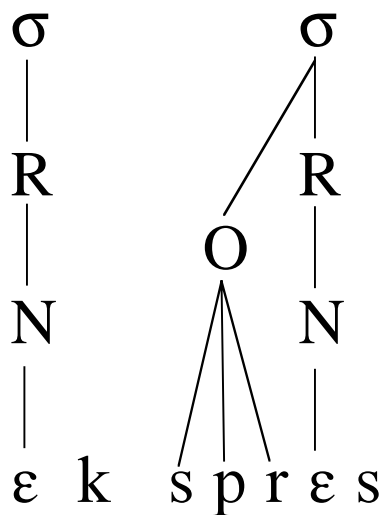
algorithm for creating syllables:

(1) make each vowel into a **nucleus** (part of the **rime**)



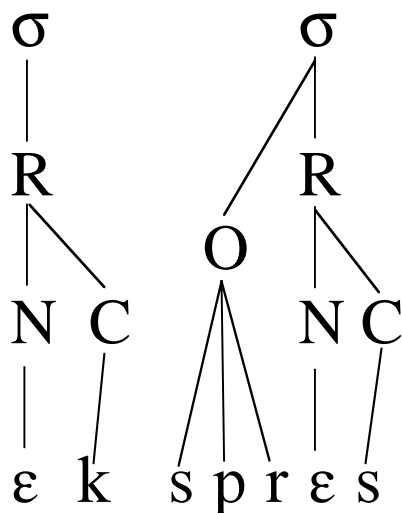
algorithm for creating syllables:

(2) add consonants to the onset, until stopped by phonotactics



algorithm for creating syllables:

(3) add remaining consonants to the **coda** (also part of the rime)



Note that phonotactics are a locus of language variation:

Czech

pʃtros	'ostrich'
fsplane	'will go up in flames'
kʃtjice	'lock of hair'

Hawaiian

kahuna	'priest'
hoaha:nau	'cousin'
ku:konukonu	'excessive'

...but not the algorithm for syllable construction,
which is universal.

And when words are borrowed, the phonotactics sometimes have to be altered to fit the new language:

Greek *pter-* 'wing' --> English [t/erodactyl, helico[pt]/er

English *appointment* --> Japanese *appointomento*