Principles of Generative Phonology: An Introduction

Chapter 1: Phonetics

1.1   Give the phonetic symbol for each sound.

    a. Voiced uvular stop   [ɢ]

    b. Mid back round tense vowel   [o]

    c. Velar nasal   [ŋ]

    d. Front low tense unround vowel   [æ]

    e. Voiceless dental stop   [t̪]

1.2   Give a phonetic description for each symbol.

    a. ʎ   voiced palatal lateral approximantæ

    b. ʊ   high back round lax vowel

    c. ð   voiced dental approximant

    d. ɛ   mid front unround lax vowel

    e. χ   voiceless uvular fricative

1.3   Anticipation of natural classes

    a. Voiceless stop   {p, t̪, t, ṭ, c, k, q, ʔ, pʼ, t̪ʼ, tʼ, cʼ, kʼ, qʼ}

    b. Back rounded vowel   {u, ʊ, o, ɔ, ɒ�, ɒ}

    c. Voiced uvular   {ɢ, ɴ, ʀ, ʁ, ʁ Gʼ}

    d. High tense vowel   {u, ü, ɨ, u}

    e. Voiceless bilabial   {p, ɸ, pʼ}

1.4   1. ǰəǰ   use

        2. hɑws   hǝws   mule

        3. dɛt   hoe

        4. neyšǝn   neyšṇ   shove

5. ɹɑyt   ɹəyt   psychic

6. ðɛm   atom

7. θɪn   close, clothes

8. čək   Bach

9. sɪŋəɹ   sɪŋɚ   sɪɲɹ   uh-oh

10. əmeyz   pizza

11. θəm   Peter piper picked a peck of
                                              pickled peppers

12. θɪsəl   θɪsɫ̩   mares eat oats, and does eat
                                              oats, and little lambs eat ivy

1.5   [ˌækwɪˈzɪšən]

        [ˌdɪsəˈpʰiyəɹd]

        [ˌmɪθəˈlɒǰɪkəl]

        [ˌdɛzɪgˈneyšən]

        [ˈkɒnsɪˌkwɛnsɪz]

        [ɪˈnɒkyuəs]

        [ˈkwɑyətnɪs]

        [ɪˈǰɪpšən]

        [ˈmɪksčʊɹ]

        [ˈɹəyrəɹ]

Chapter 2: Contrast and Distribution

2.1   Turkish

        Voiceless [r̥] appears in word-final position; voiced [r] appears
        elsewhere. These two sounds are phonetically similar and in
        complementary distribution, hence belong to one phoneme.

2.2   English /l/

	#____	V____#	____C	C____#	V____V́	V____V̆
[l]	leap				allow	
[ɫ]		real	malt			pillow
[l̩]				syllable		

A solution in terms of syllable or foot structure is also possible. If a single consonant between vowels, the second of which is unstressed, is assumed to be ambisyllabic, we can say that a coda /l/ is dark anywhere in the coda. If we appeal to foot structure, we can say that dark l appears everywhere except initially in a foot. However, since we haven't covered syllables and feet, the chart above is adequate for the course at the present time.

2.3   Georgian

Light [l] appears before front vowels [i], [e]; dark [ɫ] appears elsewhere. Dark [ɫ] should be regarded as the basic (underlying) form since it appears in the widest range of environments. This permits the phonemic rule to be stated in its simplest form, viz.:

$$[ɫ] \rightarrow [l] / \underline{\hspace{1cm}} \begin{bmatrix} +syll \\ -back \end{bmatrix}$$

2.4   Canadian French

The lax member of each pair occurs before word-final consonant (including glides); the tense member occurs word finally or before a CV sequence. In syllable terms, the lax member occurs in closed syllables while the tense member occurs in open syllables. This illustrates pattern congruity, since all three pairs of high vowels pattern alike.

2.5   Sierra Popoluca

A voiceless stop (except glottal stop) is aspirated at the end of a word or before another consonant which is not homorganic. Alternatively, at the end of a syllable, except before a homorganic consonant. In

more advanced work, the lack of aspiration before a homorganic consonant could be explained in terms of Hayes's (1986) Linking Constraint.

2.6   Greenlandic Eskimo

Three underlying vowels are {i, u, ɑ}. High vowels are replaced by the corresponding mid vowels before a uvular consonant or at the end of a word.

$$V \rightarrow [-high] \: / \: \underline{\quad} \left\{ \begin{bmatrix} +cons \\ -cor \\ -ant \\ -high \\ +back \end{bmatrix} \atop \# \right\}$$

2.7   Mohawk

Stressed vowels are lengthened in the environment ____CV. Or, stressed vowels are lengthened in open syllables.

2.8   Sierra Miwok

The first syllable is stressed if it contains either a long vowel or a vowel followed by two consonants (including geminates); otherwise the second syllable is stressed. Or, stress the first heavy syllable counting from the left.

2.9   Hungarian

The labiodental nasal [ɱ] appears before labiodental consonants [f], [v]. The velar nasal [ŋ] appears before velar consonants. This is an example of assimilation; it also takes place across word boundaries.

2.10   Zulu

[o] appears if the following syllable has a high vowel [i] or [u]; otherwise [ɔ] appears. This is the first example of a segmental effect

induced by a segment that is not absolutely adjacent to the one affected. It is a kind of vowel harmony, amply attested in Uralic languages like Hungarian and Altaic languages like Turkish. It also illustrates pattern congruity.

2.11   Canadian French

The dental affricates appear before high vowels and glides; the stops appear elsewhere. Pattern congruity.

2.12   Cree

In each pair, he voiced obstruent appears between vowels and the voiceless obstruent appears elsewhere. Pattern congruity.

2.13   Brazilian Portuguese

In each pair, the palatal stop appears before high front vowels or glides [i], [y] and the dental stop appears elsewhere. Pattern congruity. [Erratum: [foˈnɛciku]]

2.14.   Brazilian Portuguese

Although there are no minimal pairs in the first two sets of data, we find the tense and lax members of each pair in similar environments, and so are likely separate phonemes in each case. In the third set of data [ə] appears before nasals, while [ɑ] appears elsewhere, so these two sounds belong to the same phoneme.

2.15   Lumasaaba

[c] and [ɟ] occur before front vowels as allophones of [k] and [g] respectively. [ŋ] and [ɲ] are allophones of [n] that occur before velar and palatal stops, respectively.

2.16   Japanese

[t͡s] and [č] are allophones of /t/. [t͡s] occurs before the high back vowel [ɨ] while [č] occurs before the high front vowel [i].

$$t \rightarrow \begin{bmatrix} +\text{delrel} \\ +\text{strid} \\ <-\text{ant}> \end{bmatrix} / \underline{\qquad} \begin{bmatrix} +\text{syl} \\ +\text{hi} \\ <-\text{bk}> \end{bmatrix}$$

$$\text{or } t \rightarrow \begin{bmatrix} +\text{delrel} \\ +\text{strid} \\ \alpha\text{ant} \end{bmatrix} / \underline{\qquad} \begin{bmatrix} +\text{syl} \\ +\text{hi} \\ \alpha\text{bk} \end{bmatrix}$$

Chapter 3: Distinctive features

3.1
1.	χ		7.	ε
2.	ɑ		8.	pʸ
3.	z		9.	ŋ
4.	θ		10.	e
5.	u		11.	y
6.	d		12.	l̩

3.2
1.	u	[+ATR]
2.	d	[+cor]
3.	k	[+back]
4.	ž	[+strident]
5.	ü	[+high]
6.	z	[+ant]
7.	æ	[+low]
8.	ʌ	[+back]
9.	x	[+continuant]
10.	ɒ	[+round]
11.	ð	[+voice]
12.	l	[+lateral]
13.	ŋ	[+high]
14.	ɪ	[+syllabic]
15.	t͡s	[+strident]

3.3   Ignore [distributed] here also.
        1.   ɲ
        2.   i
        3.   ɨ
        4.   b
        5.   o
        6.   ɛ
        7.   i
        8.   f
        9.   x
        10.   t

3.4   Ignore [ATR] in the vowel chart. Ignore features not contrastive for
            the sounds given.
        The order in which features are listed is irrelevant.
        1.   [+high, –back, –round]
        2.   [+high, –back]
        3.   [+high]
        4.   [–back, –low]
        5.   [+back, –high]
        6.   [–low, +round]
        7.   [–high, –low, –round]
        8.   [+low, +round]
        9.   [+high, +round]
        10.   [+consonantal, –sonorant, –continuant, –voice, +anterior]
        11.   [+consonantal, –sonorant, –continuant, –voice]
        12.   [–sonorant, –continuant, –voice]
        13.   [+consonantal, –sonorant, –continuant, +voice, +anterior,
                    +coronal]
        14.   [+consonantal, –sonorant, –continuant, –anterior, –coronal]
        15.   [+consonantal, –sonorant, –coronal, –anterior]
        16.   [+consonantal, –sonorant, –continuant, –voice, +coronal,
                    +spread]
        17.   [+consonantal, –sonorant, +continuant, –voice, +coronal,
                    +anterior]
        18.   [+consonantal, –sonorant, +continuant, –voice, +coronal,
                    +strident]
        19.   [+consonantal, +sonorant, –continuant, +nasal, –anterior,
                    –coronal]

20.   [+consonantal, +sonorant, +coronal, +anterior]
21.   [+consonantal, +sonorant, +coronal, +anterior, –nasal]

3.5   The larger the class, the fewer features required to characterize it (as long as the classes are natural).

3.6   a. Hungarian fricatives

	f	v	s	z	š	ž
[ant]	⊕	⊕	+	+	−	−
[cor]	−	−	+	+	⊕	⊕
[voice]	−	+	−	+	−	+

[–ant] → [+cor]
[–cor] → [+ant]

b. English fricatives

	f	v	θ	ð	s	z	š	ž
[strid]	⊕	⊕	−	−	+	+	⊕	⊕
[ant]	⊕	⊕	⊕	⊕	+	+	−	−
[cor]	−	−	⊕	⊕	+	+	⊕	⊕
[voice]	−	+	−	+	−	+	−	+

$$[\text{–strid}] \rightarrow \begin{bmatrix} +\text{ant} \\ +\text{cor} \end{bmatrix}$$

$$[\text{–cor}] \rightarrow \begin{bmatrix} +\text{strid} \\ +\text{ant} \end{bmatrix}$$

$$[\text{–ant}] \rightarrow \begin{bmatrix} +\text{strid} \\ +\text{cor} \end{bmatrix}$$

c. German fricatives and affricates

	f	v	s	z	š	ž	x	p͡f	t͡s
[cont]	+	+	+	+	+	+	⊕	−	−
[delrel]	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊕	⊕
[ant]	+	+	+	+	−	−	⊖	⊕	⊕
[cor]	−	−	+	+	+	+	⊖	−	+
[strid]	⊕	⊕	⊕	⊕	⊕	⊕	−	⊕	⊕
[voice]	−	+	−	+	−	+	⊖	⊖	⊖

$$[+cont] \rightarrow [-delrel\}$$

$$[-cont] \rightarrow \begin{bmatrix} +delrel \\ +strid \\ -voice \end{bmatrix}$$

$$[+ant] \rightarrow [+strid]$$
$$[-strid] \rightarrow [-voice]$$
$$[+cor] \rightarrow [+strid]$$

$$[-strid] \rightarrow \begin{bmatrix} -cor \\ -ant \\ +cont \end{bmatrix}$$

d. Estonian vowels
    [typo: [low] should be + for [ɑ] and − for [u]]

	i	ε	æ	ü	ö	ə	ɑ	u	ɔ
[high]	+	−	⊖	+	−	−	⊖	+	−
[low]	⊖	−	+	⊖	⊖	−	+	⊖	⊖
[back]	−	−	−	−	−	+	+	+	+
[round]	−	−	⊖	+	+	−	⊖	+	+
[ATR]	⊕	⊖	⊖	⊕	⊖	⊖	⊖	⊕	⊖

$$[+hi] \rightarrow \begin{bmatrix} -lo \\ +ATR \end{bmatrix}$$

$$[+lo] \rightarrow \begin{bmatrix} -hi \\ -rd \\ -ATR \end{bmatrix}$$

$$[-hi] \rightarrow [-ATR]$$
$$[+rd] \rightarrow [-lo]$$

3.7   a. Yoruba vowels

	i	e	ε	ɑ	u	o	ɔ
[high]	+	–	–	–	+	–	–
[ATR]	+	+	–	–	+	+	–
[back]	–	–	–	+	+	+	+
[round]	–	–	–	–	+	+	+

[low] could be used in place of [back] or in place of [round]

The minimal contrasts [i]/[u] and [u]/[o] show that [high] is necessary. The minimal contrasts [e]/[ε] and [o]/[ɔ] show that [ATR] is necessary. These two plus [back] would not distinguish [ɑ]/[ɔ]. Further experimentation shows that no three features can make all the distinctions. So four are needed, even though there are only 7 vowels.

b. Latvian underlying vowels

	i	u	æ	ɑ
[high]	+	+	–	–
[back]	–	+	–	+

[ATR] could be used in place of [hi]

c. Samoan consonants

	p	t	f	s	v	m	n	ŋ	l
[cor]	–	+	–	+	–	–	+	–	+
[son]	–	–	–	–	–	+	+	+	+
[voice]	–	–	–	–	+	+	+	+	+
[ant]	+	+	+	+	+	+	+	–	+
[cont]	–	–	+	+	+	–	–	–	+

(Other solutions are possible.)

d. Spanish obstruents (European)

	p	ṭ	k	b	ḍ	g	f	θ	ṣ	x
[cor]	−	+	−	−	+	−	−	+	+	−
[ant]	+	+	−	+	+	−	+	+	+	−
[voice]	−	−	−	+	+	+	−	−	−	−
[strid]	−	−	−	−	−	−	−	−	+	−
[cont]	−	−	−	−	−	−	+	+	+	+

[back] could be used in place of [ant]

Chapter 4: Alternations

4.1   Lac Simon

Underlying representations of stems:

de:šɨbɨwɑ:gɨn   'chair'

jĭ:mɑ:n   'canoe'

bi:goškɑ: 'break'

žo:škose: 'slide'

kɨn   'bone'

šogonɑ: 'nose'

towɨk   'ear'

kon   'liver'

kɑ:t   'leg'

[−son] → [−voice] / # _____

An analysis with a rule voicing obstruents between vowels would not conform to the criterion of predictability.

4.2   Maori
The passive suffix is *-ia* and the gerundive is *-aŋa*. The roots are /ɑwhit/ etc. A rule deletes word-final consonants. The last two roots are vowel final /pɑtu/, /kite/ and a rule deletes a vowel in V+_____. See section 6.7.7 in chapter 6 for an alternative view.

4.3   German

Underlying representations of the stems: /liːd/, /kriːɡ/, /šrɛk/, /bɛrg/, /kalk/, /muːz/, /špiːs/, /alt/, /muːt/, /man/, /haːr/, /dɔrn/, /talk/, /talg/ Underlying representation of the genitive suffix: /-əs/.

[–son] → [–voice] / ____ #

4.4   Russian

Underlying representations of the stems: /bok/, /snʸeg/, lʸes/, /glaz/, /gorad/, /ostrav/, /pogrʸib/, /lug/, /učitʸilʸ/.

    Those who know Russian might want /gorod/, /ostrov/, /učitʸelʸʔ/ as URs. This will work, but, since the stem-final vowel does not alternate in the data as given, there is no justification for any vowel other than /ɑ/ in 'city' or /i/ in the last syllable of 'teacher.' Notice that an UR such as /snʸeg/ is somewhat abstract, since it never appears unchanged in the phonetic representations here.
    Underlying representation of the plural: /-á/.

Unstressed /o/ → [ɑ]
Unstressed /e/ → [i]
[–son] → [–voice] / ____#

Rules of vowel reduction are common. The set of vowels that appear in unstressed position is a subset of those that appear in stressed position. It is easy to predict the unstressed vowel if the stressed version appears in the URs (even if stress itself is not part of the UR, as we assume here). It would not be possible to predict the stressed vowel if the underlying vowels were the ones that appear when unstressed.

4.5 Palauan

Underlying representations of the stems: /silok/, /sesob/, /dɑŋob/, /teʔib/, /ŋatɑʔ/, /leʔot/. Of the affixes: /mə-/, /-ɑll, /-l/.

Unstressed vowels → [ə]

Assuming any other vowel for the prefix /mə-/ would also work, since this morpheme is never stressed in the data given. We prefer to assume the phonetic vowel in the UR in this case, since otherwise it would be indeterminate which other vowel to postulate.

4.6 Tibetan numerals
1. The teens are formed from 'ten' followed by the unit (one, four, five, nine). The tens have the multiple followed by 'ten.'
2. URs: /bǰu/ 'ten,' /gǰig/ 'one,' /bši / 'four,' /rgu/ 'nine,' /ŋɑ/ 'five.' Except for 'five,' these URs are not the same as any actually occurring word.

3. C → Ø /#____C

4.7 Yawelmani

URs of the stems: //xɑt/, /giy'/, /me:k'/, /ṣɑ:p/, /pɑʔṭ/, /ʔilk/, /lihm/, /ʔayy/, /ʔɑ:ml/, /ṣɑ:lk'/, /ṣe:nṭ/. URs of the suffixes: /-ɑl, /-hin/

a. V → [–long] / ____CC
b. Ø → i / C____CC
b>a

A rule of vowel lengthening (say, in the environment ____CV) is falsified by data such as *xatal*. An analysis assuming URs like /pɑʔiṭ/ 'fight' and a deletion rule such as V → Ø / VC____CV is possible for the data given, but further information about the language shows that the solution given is correct. For example there are no roots of the form CVCVC, where the second vowel is short, except for the ones in CVCiC demanded by this analysis. See chapter 5, section 5.6, for further discussion.

4.8   Palauan

[errata: 'his abiliy' [ðəˈʔɑl]; 'medicine' [ˈkɑɾ].
URs of the stems: /ʔuɾɑ/, /ðuʔɑ/, /keri/, /ʔuri/, /buʔi/, /ʔɑɾɑ/, /kɑɾu/, /ʔuɾu/.
Suffixes: /-l/ 'his/her/its,' /-mɑm/ 'our'

In addition to the rule developed in 4.5 we need the rule

V → Ø / _____#

4.9   Hungarian

The underlying representations of the stems are as in the left column. The suffix for 'in' is /-bɒn/ and for 'from' /to:l/. An obstruent assimilates in voicing to an immediately following obstruent:

$$[-\text{son}] \rightarrow [\alpha\text{voice}] / \_\_\_\_ \begin{bmatrix} -\text{son} \\ \alpha\text{voice} \end{bmatrix}$$

Vowel Harmony

$$\begin{bmatrix} +\text{syl} \\ <+\text{lo}> \end{bmatrix} \rightarrow \begin{bmatrix} -\text{bk} \\ -\text{lo} \\ <-\text{rd}> \end{bmatrix} / \begin{bmatrix} +\text{syl} \\ -\text{bk} \end{bmatrix} C_0 \_\_\_\_$$

This rule will need to be revised in exercise 6.1.

4.10   Spanish

Underlying representations of the stems: /ɑblɑ, kome, biβi/ and of the suffixes: /-o, -s, Ø, -mos, n/.

V → Ø / _____ +V
V → [−high] / + _____ (C)#

4.11   Old Norse

Underlying representations of the stems: /laŋg, gɑml, miðy, glöggw/
and of the suffixes: /-r, -s, -um, -ɑn, -ir, -rɑ, -um, -ɑ/

Vowel Epenthesis

$$\emptyset \rightarrow \textrm{ɑ} \ / \begin{bmatrix} +\textrm{cons} \\ +\textrm{son} \end{bmatrix} \underline{\hspace{1.5em}} \begin{bmatrix} +\textrm{cons} \\ +\textrm{son} \\ -\textrm{nas} \end{bmatrix} \textrm{C}$$

Liquid Assimilation
r → l / l ____

Preconsonantal Glide Deletion

$$\begin{bmatrix} -\textrm{syll} \\ -\textrm{cons} \\ +\textrm{son} \end{bmatrix} \rightarrow \emptyset \ / \underline{\hspace{1.5em}} \textrm{C}$$

Homorganic Glide Deletion

$$\begin{bmatrix} -\textrm{syll} \\ -\textrm{cons} \\ +\textrm{son} \\ \alpha\textrm{back} \\ \alpha\textrm{round} \end{bmatrix} \rightarrow \emptyset \ / \underline{\hspace{1.5em}} \begin{bmatrix} +\textrm{syll} \\ +\textrm{high} \\ \alpha\textrm{back} \\ \alpha\textrm{round} \end{bmatrix}$$

u-*umlaut*

$$\begin{bmatrix} +\textrm{syll} \\ +\textrm{lo} \end{bmatrix} \rightarrow \begin{bmatrix} +\textrm{rd} \\ -\textrm{lo} \end{bmatrix} \ / \underline{\hspace{1.5em}} \textrm{C} \begin{bmatrix} +\textrm{syll} \\ +\textrm{hi} \\ +\textrm{rd} \end{bmatrix}$$

The two glide deletion rules can be collapsed as:

$$\begin{bmatrix} -\textrm{syll} \\ -\textrm{cons} \\ +\textrm{son} \\ \alpha\textrm{back} \\ \alpha\textrm{round} \end{bmatrix} \rightarrow \emptyset \ / \underline{\hspace{1.5em}} \left\{ \begin{matrix} \begin{bmatrix} +\textrm{syll} \\ +\textrm{high} \\ \alpha\textrm{back} \\ \alpha\textrm{round} \end{bmatrix} \\ \textrm{C} \end{matrix} \right\}$$

An alternative analysis with the underlying representation /gɑmɑl/ and a rule of vowel deletion instead of vowel epenthesis is also possible.

Chapter 5: Rule Order

5.1   Indonesian

Underlying representation of the prefix: /məŋ-/. Stems as in first column.

1. $\eta \rightarrow \varnothing$ / ____ $\begin{bmatrix} +\text{son} \\ -\text{syll} \end{bmatrix}$

2. $\eta \rightarrow \begin{bmatrix} \alpha\text{ant} \\ \beta\text{cor} \end{bmatrix}$ / ____ $\begin{bmatrix} -\text{syll} \\ -\text{cont} \\ -\text{son} \\ \alpha\text{ant} \\ \beta\text{cor} \end{bmatrix}$

3. $\begin{bmatrix} -\text{syl} \\ -\text{son} \\ -\text{cont} \\ -\text{strid} \\ -\text{voice} \end{bmatrix} \rightarrow \varnothing$ / [+nas] ____

2>3

5.2   Polish

Underlying representations /klub/, /trup/, /rob/, etc. Words with invariant [u] have /u/ in the UR; words showing the o~u alternation have /o/ in the UR. Words with invariant stem-final voiceless consonants have underlying voiceless consonants; words showing voicing alternation have underlying voiced consonants. Underlying representation of the plural suffix is /-ɨ/, which is converted to [e] after alveopalatals and palatals and to [i] after velars.

(1)   o → u / ____ $\begin{bmatrix} C \\ +voice \\ -nasal \end{bmatrix}$ #

(2)   [−son] → [−voice] / ____#

(3)   ɨ → e / $\begin{bmatrix} -syll \\ +hi \\ -back \end{bmatrix}$ ____

   ɨ → i / $\begin{bmatrix} -syll \\ +hi \\ +back \\ -round \end{bmatrix}$

   collapsed as ɨ → $\begin{bmatrix} -back \\ \alpha high \end{bmatrix}$ / $\begin{bmatrix} -syll \\ +hi \\ \alpha back \\ -round \end{bmatrix}$ ____

(1) > (2)

5.3   Hanunoo

Affixes: /kɑ-/ 'times' /-hi/ 'make it'

Stems: /sʔɑ/ 'one,' /dwɑ/ 'two,' /tlu/ '3,' /pʔɑt/ '4,' /limɑ/ '5,' /nʔum/ '6,' /pitu/ '7.'

1.   #   C   ʔ
      1   2   3   ⇒   1   3   2

2.   ∅ → u #C____C

3.   h → ∅ / C____

1 > 2

5.4   Chamorro

a. The underlying representations of the stems in the first part

gwihæn 'fish' (the second vowel is determined from the second part)
gumə   'house'
tunuʔ   'to know,' etc.

The second vowel of some of these forms might be otherwise, since it is always unstressed in these examples. House might be *guma* or *gumæ*, 'to know' might be *tunoʔ*. Examples are needed where these vowels appear stressed to make a final decision.

(1)   *Fronting rule*

First vowel of root $\rightarrow \begin{bmatrix} -\text{back} \\ -\text{round} \end{bmatrix} / \begin{bmatrix} +\text{syll} \\ -\text{back} \end{bmatrix} C_0$ ____

b. Underlying representations of the stems in the second part
dægi   'lie'
gode   'tie'
dɑgu   'yam'
petso   'chest'
gwihæn   'fish'
pigwɑ   'betel nut'

(2)   *Main Stress rule*
$V \rightarrow [+\text{stress}] /$ ____ $C_0 V C_0\#$
Particles and affixes can be regarded as having underlying stress.

That 'fish' has an underlying *æ* in the second syllable is shown by 'my fish,' where this vowel appears stressed.

(3)   *Vowel Reduction*

unstressed i, e → ɪ

unstressed u, o → ʊ

unstressed ɑ, æ → ə

In features:
$$\begin{bmatrix} +\text{syll} \\ -\text{stress} \\ \alpha\text{low} \\ < +\text{low} > \end{bmatrix} \rightarrow \begin{bmatrix} -\text{low} \\ -\text{ATR} \\ \alpha\text{high} \\ < +\text{back} > \end{bmatrix}$$

1>3; 2>3

5.5   Tonkawa

a.   Underlying representations of the stems: /yɑkɑpo/, /yɑmɑxɑ/,
       /netɑle/, /notoxo/, /pi͡tsenɑ/, /yɑweye/. The derived nouns [notox],
       [pi͡tsen], [yɑwey] are unaffixed.

b.   Order of morphemes

(object)	(causative)	stem	(progressive)	(subject)
ke- 'me'	-nes-		-n-	oʔ '3 sg.'
we- 'them'				oʔs '1 sg.'
kew- 'us'				

Rules required:

(1)   *Apocope:*   V → ∅ / ____#
(2)   *Elision:*   V → ∅ / VC ____ CV (L-R iterative)
(3)   *Truncation:*   V → ∅ / ____V

Apocope must be ordered before Elision.

5.6   Lamba
       Underlying representations of the suffixes: --ɑ, -wɑ, -ikɑ, -ilɑ, -ɑnɑ

(1)   i → e / $\begin{bmatrix} +\text{syll} \\ -\text{high} \\ -\text{low} \end{bmatrix}$ C ____

(2)   k → č ____i and s → š/ ____i

       combined, in features: $\begin{bmatrix} -\text{son} \\ -\text{voice} \\ \alpha\text{ant} \\ \alpha\text{cont} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{ant} \\ -\text{back} \\ -\alpha\text{delrel} \end{bmatrix}$ / ____ i

(3)   l → n / $\begin{bmatrix} C \\ +\text{nas} \end{bmatrix}$ V ____

(1) > (2)

/fis-ikɑ/	/kos-ikɑ/	/men-ilɑ/	underlying representations
— — —			Vowel Lowering
	— — —	— — —	Palatalization
			Lateral Nasalization
[fišikɑ]	[kosekɑ]	[menenɑ]	phonetic representations

5.7   Serbo-Croatian
       stems: /greb/, /nes/, /pek/, /plet/, /krɑd/, /pɑs/, /pis/, /rɑst/
       suffixes: /-em/ '1 sg.,' /-l/ 'masculine participle,' /-lɑ 'feminine
       participle' (feminine participle analyzed as l plus feminine ending -ɑ.)

       rules
(1)   ∅ → / C____C#
(2)   t/d → ∅ / ____ l
(3)   l → o / ____#
(4)   s → š, k → č / $\begin{bmatrix} +\text{syl} \\ -\text{back} \end{bmatrix}$ ____ $\begin{bmatrix} +\text{syl} \\ -\text{back} \end{bmatrix}$
       (1) > (3), (2) > (3)

5.8   Karok

URs for stems in the first part: //pɑsip/, /si:tvɑ/, /kifnuk/, /suprih/, /ʔifik/, /ʔɑktuv/. URs of the prefixes are /ni-/, /ʔu-/. A palatalization rule turns /s/ to [š] after /i/.

URs for the stems in the second part: /ɑxyɑr/, /imnis/, /iskɑk/, /iksɑh/, /isriv/, /uksup/. The palatalization rule must be revised to allow an intervening consonant. The UR of the third singular prefix could be /u-/, since rule (3) would insert the initial glottal stop. The final set of rules is:

(1)   V →Ø / V ____
(2)   s → [−ant] / i(C) ____ (Palatalization)
(3)   Ø ?→ ? / #____V

(1) > (2)

5.9   Basque

1.   *Glide Insertion*   Ø → y / i____V
                                 Ø → w / u____V

in features: $\varnothing \rightarrow \begin{bmatrix} -\text{syll} \\ -\text{cons} \\ +\text{high} \\ \alpha\text{back} \\ \alpha\text{round} \end{bmatrix} / \begin{bmatrix} +\text{syll} \\ +\text{high} \\ \alpha\text{back} \\ \alpha\text{round} \end{bmatrix}$ ____ V

2.   *Vowel Raising* $V \rightarrow \begin{bmatrix} -\text{low} \\ -\text{back} \end{bmatrix} / \begin{bmatrix} V \\ +\text{high} \end{bmatrix}(C)(\#)(C)$ ____

3.   *Low Vowel Dissimilation* $\alpha \rightarrow e / $ ____ $\begin{bmatrix} V \\ +\text{low} \end{bmatrix}$

4.   Mid Vowel Dissimilation $\begin{bmatrix} V \\ -\text{low} \end{bmatrix} \rightarrow [+\text{high}] / $ ____ $\begin{bmatrix} V \\ +\text{low} \end{bmatrix}$

Rules 3 and 4 could be combined using subscripted angle brackets as

follows:
$$\begin{bmatrix} +\text{syl} \\ <\text{lo}>_1 \\ <+\text{lo}>_2 \end{bmatrix} \rightarrow \begin{bmatrix} -\text{lo} \\ <+\text{hi}>_1 \\ <-\text{bk}>_2 \end{bmatrix} / \underline{\quad\quad} \begin{bmatrix} V \\ +\text{low} \end{bmatrix}$$

5.   *Nasal Assimilation* $n \rightarrow m / \underline{\quad\quad}(\#)\begin{bmatrix} C \\ +\text{ant} \\ -\text{cor} \end{bmatrix}$

1>2; 2>4; 1>4

Speakers who say *alabie, semie, astue* have reordered rules 2 and 4,
that is, into a feeding order.

5.10   Japanese

Underlying representations of the suffixes:

-ɾu   'present'   -anai   'negative'
-ta   'past'   -itai   'desiderative'

Underlying representations of the stems:
(Although 'die' always has [š], this sound occurs only before [i], so
should be analyzed as underlying /s/ even when it does not alternate.)

mi	iw	kas	yob
ki	kas	hanas	tob
tabe	hik	kat	yom
kae	kag	ʔut	sum
kaw	isog	sin	yoɾ
			kiɾ

Rules

1.   V Deletion $V \rightarrow \varnothing / V+\underline{\quad\quad}$

2. *r*-Deletion $r \rightarrow \emptyset / C+\underline{\quad}$

3. *b*-Nasalization $b \rightarrow \begin{bmatrix} +nas \\ +son \end{bmatrix} / \underline{\quad} + [-son]$

4. Nasal Assimilation $\begin{bmatrix} C \\ +nas \end{bmatrix} \rightarrow \begin{bmatrix} \alpha ant \\ \beta cor \end{bmatrix} / \underline{\quad} \begin{bmatrix} -son \\ \alpha ant \\ \beta cor \end{bmatrix}$

    (In fact only m → n, but the rule is formulated more generally)

5. Obstruent Voicing $[-son] \rightarrow [+voice] / \begin{bmatrix} +cons \\ +voice \end{bmatrix} \underline{\quad}$

6. *t*-Affrication $t \rightarrow \begin{bmatrix} +delrel \\ +strid \\ < -ant > \end{bmatrix} / \underline{\quad} \begin{bmatrix} V \\ +high \\ < -back > \end{bmatrix}$ (cf. ex. 2.17)

7. *i*-Insertion $\emptyset \rightarrow i / s \underline{\quad} [-son]$

8. *s*-Palatalization $s \rightarrow [-anterior] / \underline{\quad} i$

9. Velar Vocalization $\begin{bmatrix} -son \\ -ant \end{bmatrix} \rightarrow i / \underline{\quad} [-son]$

10. Desonorization $\begin{bmatrix} C \\ +son \end{bmatrix} \qquad t$

                         1   2 $\Rightarrow$ 2   2

11. *w*-Deletion $w \rightarrow \emptyset / \underline{\quad} \begin{bmatrix} V \\ +high \end{bmatrix}$

3>4; 7>8; 5>9; 2>11

5.11 Latin

Underlying representations of the suffixes: *-s* 'nominative,' *-is* 'genitive.'
Underlying representations 1–4; Stress rule
Stress is predictable: it falls on the only syllable of monosyllables, on the penultimate syllable of disyllables, and on the penultimate of

longer words if this syllable contains a long vowel or is closed by a consonant, otherwise on the third from last syllable.

/pɑːk, duk, seːp, dɑp/

Underlying representations 5–8; Rule of *s*-Deletion

/mɑrmor, weːr, wigil, sɑːl/

Underlying representations 9–13; Rule of Voicing Assimilation

/reːg/, striːg, urb, pleːb/

Underlying representations 14–15, Rule of Dental Deletion (ordered after *s*-Deletion)

/ɑyt ɑːt, lɑwd/

Underlying representations 16–25, Vowel Lengthening and Shortening

/front, dent, ɑrt, nokt, frond, nepoːt, iŋkuːd, kɑlik, rɑdiːk, merkeːd/

Underlying representations 26–31; Rule of Vowel Raising

/forkeːp, pollek. ekwet, lɑpid, obsed, nomen/

Underlying representations 32–34; Rule of Degemination (brace notation)

/mell, oss, ɑss/

Underlying representations 35–36; Rule of Rhotacism

floːs, yuːs/

Underlying representations 35–39, Rule of *n*-Deletion (ordered after *s*-Deletion)

/leo:n, prɑydo:n, opi:nio:n/

1. *Latin Stress Rule*
   $$V \rightarrow [+\text{stress}] / \underline{\quad} C_0((\breve{V} C_0^1)\breve{V} C_0)\#$$

2. *Voicing Assimilation*
   $$[-\text{son}] \rightarrow [-\text{voice}] / \underline{\quad}\begin{bmatrix} -\text{son} \\ -\text{voice} \end{bmatrix}$$

3. *Vowel Shortening*
   $$V \rightarrow [-\text{long}] / \underline{\quad}\begin{Bmatrix} \text{nt} \\ \text{nd} \end{Bmatrix}$$

4. s-*Deletion*
   $$s \rightarrow \varnothing / \begin{bmatrix} C \\ +\text{son} \end{bmatrix} + \underline{\quad}\#$$

5. *Alveolar Deletion*
   $$\begin{bmatrix} -\text{son} \\ -\text{cont} \\ +\text{cor} \end{bmatrix} \rightarrow \varnothing / \underline{\quad}+s$$

6. *Vowel Lengthening*   (cf. p. 79)
   $$V \rightarrow [+\text{long}] / \underline{\quad} \text{ns}$$

7. *Vowel Raising*
   $$e \rightarrow i / \acute{V} \ C_0 \underline{\quad} C_0V$$

8. *Degemination*   C C $\begin{Bmatrix} C \\ \# \end{Bmatrix}$

                      1 2 3 ⇒ 1 Ø 3 (*or* Ø 2 3)

            Condition: 1=2

(Term 3 could also be just #, with the rule specified as iterative right to left.)

9. *Rhotacism*
    s → r / V____V

10.   n-*Deletion*   n → ∅ / V:____#

1>7; 4>5; 4>10; 5>6

Sample derivations [typo: give the derivation of [ˈɑs], not *[ˈɑss]]

	/weːr+s/	/nokt+s/	/merkeːd+s/
Stress	ˈeː	ˈno	ˈme
s-Deletion	∅	——	——
Alveolar Deletion	——	∅	∅
	[ˈweːr]	[ˈnoks]	[ˈmerkeːs]

	/oss+s/	/ɑss+s/	
Stress	ˈo	ˈɑ	
Degemination (i)	∅	∅	Both parts apply: conjunctive
			application of rules
			abbreviated by
(ii)	∅	∅	brace notation.
	[ˈos]	[ˈɑs]	

	/oss+is/
Stress	ˈo
Degemination	———
	[ˈossis]

	/floːs+s/	/floːs+is/	/leoːn+s/
Stress	ˈoː	ˈoː	ˈe
s-Deletion	——	——	∅
Degemination	∅	——	——
Rhotacism	——	r	——
n-Deletion	——	——	∅
	[ˈfloːs]	[ˈfloːris]	[ˈleoː]

Chapter 6: Abstractness

6.1   Nupe

Underlying representations (first part)

èdé	'cloth'	yèkó	'road'
ēgē	'beer'	ēgó	'grass'
ēgī̄	'child'	ēgṹ	'mud'

Palatalization and labialization

$$[+cons] \rightarrow \begin{bmatrix} +high \\ \alpha round \\ \alpha back \end{bmatrix} / \underline{\hspace{1cm}} \begin{bmatrix} +syll \\ \alpha round \\ \alpha back \end{bmatrix}$$

Underlying representations (second part)

ēgǣ	'blood'	ēgɔ̄	'hand'
ètʸǣ	'is/are mild'	étɔ́	'is/are trimming'
ēgā	'stranger'	tá	'to tell'

Underlying low vowels are neutralized to back and nonround by *Absolute Neutralization:*

$$\begin{bmatrix} +syll \\ +low \end{bmatrix} \rightarrow \begin{bmatrix} +back \\ -round \end{bmatrix}$$

Reduplication (morphological)

C   V   X
1   2   3   ⇒   1   2   1   2   3

[αround] $$\begin{bmatrix} +high \\ \alpha round \\ \alpha back \\ mid\ tone \end{bmatrix}$$

Reduplication copies the first CV of the root, changing the vowel to [+high] and mid tone and round and back if the root vowel is round, otherwise nonround and nonback. If the root vowel is low, the reduplicated vowel depends on its underlying roundness; Palatalization and labialization and Absolute Neutralization follow in that order.

Nupe speakers interpret Yoruba [ɛ] after a consonant as /æ/; likewise they interpret Yoruba [ɔ] as /ɒ/.

6.2   Hungarian

Underlying representations of the suffixes:
næk 'to,' tö:l 'from,' nɑ:l 'by,' ro:l 'from off'
The underlying representations are shown by the last two rows, where the suffixes act as roots and take personal suffixes. Note that the first two have underlying front vowels and the last two have underlying back vowels.

Underlying representations of the noun roots:
Identical to the nominative for the first nine nouns

Vowel Harmony rule:

$$V \rightarrow [\alpha back] / \begin{bmatrix} +syll \\ \alpha back \end{bmatrix} C_0 \underline{\hspace{1cm}}$$

Left-to-right iterative

In this formulation the rule accounts for the uniformity of [back] within roots of more than one syllable as well accounting for the suffix alternation. The rule also accounts for the uniformity of [back] with multiple suffixes, not illustrated in these data. See exercise 4.9 for the voicing assimilation in *ha:sto:l.*

Vowel adjustments (ordered after Vowel Harmony):

$$\begin{bmatrix} +syll \\ +long \\ -back \\ -round \end{bmatrix} \rightarrow [-low] \qquad æ: \rightarrow e:$$

$$\begin{bmatrix} +syll \\ -long \\ +low \\ +back \end{bmatrix} \rightarrow [+round] \qquad ɑ \rightarrow ɒ$$

$$\begin{bmatrix} +\text{syll} \\ -\text{long} \\ +\text{low} \\ -\text{back} \end{bmatrix} \rightarrow [-\text{hi}] \qquad \text{æ} \rightarrow \text{ɛ}$$

Underlying representations of the last three nouns:
/hɨ:d// 'bridge, /ɲɨ:l/'arrow,' /t͡sʌ:l/ 'goal'

These roots contain abstract back vowels that never appear phonetically. A rule of *Absolute Neutralization* ordered after Vowel Harmony accounts for their phonetic form:

$$\begin{bmatrix} +\text{syll} \\ -\text{low} \\ -\text{round} \end{bmatrix} \rightarrow [-\text{back}]$$

These three roots cannot simply be considered exceptions to Vowel Harmony because they induce harmony in suffixes that are underlyingly front *(nœk, töːl)*. Note that the second root vowel of *rɒdiːr* is also made [+back] by Vowel Harmony on the first iteration, but this vowel is subsequently refronted by Absolute Neutralization.

6.3   Okpe

Morphology:

Imperative:	bare root
Infinitive	e-…-o
3 sg. past	o-…-ri
1 sg. past	mi-…-ri
3 sg. contin.	o-…-e

Vowel Harmony:

ATR harmony affects both prefixes and suffixes, and can be expressed using the mirror image convention introduced in section 4.9.5 of chapter 4:

ATR Harmony

$$\begin{bmatrix} +\text{syll} \\ -\text{low} \end{bmatrix} \rightarrow [\alpha\text{ATR}] \; \% \; \underline{\quad} C_0 \begin{bmatrix} +\text{syll} \\ \alpha\text{ATR} \end{bmatrix}$$

Harmony in [back], [round], and [nasal] proceeds from left-to-right only. Only [+high] vowels are affected by [back] and [round] harmony.

Nasal Harmony

$$V \rightarrow [+\text{nasal}] \; / \begin{bmatrix} +\text{syll} \\ +\text{nasal} \end{bmatrix} C_0 \underline{\quad}$$

Round Harmony

$$\begin{bmatrix} +\text{syll} \\ +\text{high} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{back} \\ +\text{round} \end{bmatrix} \; / \begin{bmatrix} +\text{syll} \\ +\text{back} \\ +\text{round} \end{bmatrix} C_0 \underline{\quad}$$

Other processes affecting vowels:

High vowels become glides before another vowel, and lose their nasality if any. This or ordered after the Nasal Harmony rule.

High Vowel Gliding

$$\begin{bmatrix} -\text{cons} \\ +\text{high} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{syll} \\ -\text{nas} \end{bmatrix} \; / \underline{\quad} V$$

A mid vowel is deleted after another vowel. If ordered after the gliding rule, this can be stated in maximally general form.

$$V \rightarrow \varnothing \; / \; V \underline{\quad}$$

Word-final front mid suffix vowels undergo some adjustments:

$$\begin{bmatrix} +\text{syll} \\ -\text{high} \\ -\text{back} \\ -\text{ATR} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{low} \\ +\text{back} \end{bmatrix} \; / + \underline{\quad} \#$$

$$\begin{bmatrix} +\text{syll} \\ -\text{high} \\ +\text{ATR} \end{bmatrix} \rightarrow [-\text{ATR}] \, / + \underline{\qquad} \, \#$$

Underlying representations of the roots:
Same as the imperative, except for the last four, which are:
/rɪ, rhɪ, fɪ, sʊ/

Although the vowels of these roots always appear phonetically as mid and tense, they have the behaviour of high lax vowels. Specifically they undergo High Vowel Gliding and they require [–ATR] harmony on their prefixes and suffixes. Their phonetic quality is produced by a rule of Absolute Neutralization

Absolute Neutralization

$$\begin{bmatrix} +\text{syll} \\ +\text{high} \\ -\text{ATR} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{high} \\ +\text{ATR} \end{bmatrix}$$

Absolute Neutralization also affects the high vowel of the suffix *-ri*, which turns to *–rɪ* in a [–ATR] environment, then subsequently turns to *-re* by AN.

6.4 Ukrainian

Underlying representations of the roots:

Masculine	Neuter
brɑt	lit
xlɪ̇b	lɪ̇t͡s
lɪst	pol
svit	dil
misʸa͡ts	ozer
odʸɑh	sel
dom	slov
stol	

nos

kɨyev

korenʸ

kolorʸ

učitelʸ

Suffixes with masculine nouns:

-∅ 'nom sg.,' -*a* 'gen. sg.,' -*i, ovi* 'loc. sg.' -*iw* 'gen. pl.,' -*am* 'dat. pl.,'

Suffixes with neuter nouns:
-*o* 'nom. sg.,' -*a* 'gen. sg.,' -*u* 'dat. sg.,' -*i* 'loc. sg.,' - ∅ -gen. pl.'

Rules:

1.   *Palatalization*

$$C \rightarrow \begin{bmatrix} +\text{high} \\ -\text{back} \end{bmatrix} / \underline{\quad\quad} i$$

2.   *Vowel Neutralization*

$$\begin{bmatrix} +\text{syll} \\ -\text{high} \\ -\text{low} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{high} \\ -\text{back} \\ -\text{round} \end{bmatrix} / \underline{\quad\quad} C_1\#$$

4.   *Depalatalization*

$$C \rightarrow [-\text{high}] / \underline{\quad\quad} \{e, ɨ\}$$

5.   *Gliding*

$$\begin{Bmatrix} l \\ v \end{Bmatrix} \rightarrow w / \underline{\quad\quad} \#$$

1>2, 2>3

The dialects that say *dʸim, nʸis* have reordered Vowel Neutralization so that it applies before Palatalization (feeding). These dialects are likely to be innovative, on the basis of Kiparsky's principle that rules

tend to be reordered into feeding or counterbleeding orders (section 6.7.6).

6.5   Land Dayak

Underlying representations:

mɑlu	sampɛ:	əmbun
umɔ	in͡tseh	məndam
nɑbur	suntɔk	ɔndɑ:ŋ
ənɑk	suŋkoi	
siŋɑu	mpɑhit	bɑnduŋ
ntakɑn	kiňɑm	girunduŋ
pəlɑm	pimɑin	kənɑŋ
kɑin	pəmiŋ	
pɑdɑŋ	tɑnin	
tuʔɑ:n		
pəʔɑn		

Rules:

(1)   Vowel Nasalization

V → [+nasal] / [+nasal] (ʔ) _____   (left-to-right iterative)

(2)   Stop Deletion

$$\begin{bmatrix} -son \\ -cont \\ +voice \end{bmatrix} \rightarrow \varnothing \ / \begin{bmatrix} -syll \\ +nas \end{bmatrix} \_\_\_\_$$

(3)   Prestopping

$$\varnothing \rightarrow \begin{bmatrix} -son \\ -cont \\ +voice \\ \alpha cor \\ \beta ant \end{bmatrix} / \begin{bmatrix} +syll \\ -nas \end{bmatrix} \_\_\_\_ \begin{bmatrix} -syll \\ +nas \\ \alpha cor \\ \beta ant \end{bmatrix} \#$$

(1) > (2) (counterfeeding); (1) > (3) (bleeding)

6.6   Estonian

Underlying representations of the stems

/mɑk:sɑ/	'liver'
/lin:nɑ/	'city'
/nuk:kɑ/	'corner'
/lɑe̯:vɑ/	'ship'
/isɑ/	'father'
/mɑk:su/	'payment'
/nuk:ku/	'doll'
/lɑu̯:lu/	'song'
/tɑlu/	'farm'
/lil:le/	'flower' [not 'song']
/nime/	'name'
/kɑss:i/	'cat'
/ron:gi/	'train'
/koo̯:li/	'school'
/kivi/	'stone'
/tupɑ/	'room'
/lei̯:pɑ/	'bread'
/rɑu̯:ɑ/	'iron'
/silltɑ/	'bridge'
/ləu̯:kɑ/	'chin'
/yɑllkɑ/	'leg'
/or:pu/	'orphan'
/itu/	'germ'
/mɑtu/	'snake'
/linntu/	'bird'
/oi:tu/	'intelligence'

Rules in order

e-Raising $\quad$ e → [+high] / ____ #

t-Chopping $\quad$ $\begin{bmatrix} -\text{cont} \\ +\text{cor} \end{bmatrix} \rightarrow \varnothing / \begin{bmatrix} +\text{syl} \\ +\text{stress} \end{bmatrix} C_0 \begin{bmatrix} +\text{syll} \\ -\text{stress} \end{bmatrix}$ ____ V#

Palatalization $\quad$ $\begin{bmatrix} +\text{cons} \\ +\text{cor} \end{bmatrix} \rightarrow$ [+hi] / ____ y

Apocope $\quad$ V → $\varnothing$ / ____ #
(subject to 2 mora minimum word)

Gradation $\quad$ a. $\quad$ p → v / $\begin{bmatrix} +\text{son} \\ +\text{long} \end{bmatrix}$ ____ VC$\left\{ \begin{matrix} C \\ \# \end{matrix} \right\}$

b. $\quad$ $\begin{bmatrix} -\text{son} \\ -\text{cont} \end{bmatrix} \rightarrow \varnothing / \begin{bmatrix} +\text{syll} \\ +\text{stress} \end{bmatrix}$ ____ VC$\left\{ \begin{matrix} C \\ \# \end{matrix} \right\}$

c. $\quad$ $\left\{ \begin{matrix} lt \rightarrow l \\ nt \rightarrow n \\ mp \rightarrow m \end{matrix} \right\}$ / ____ VC$\left\{ \begin{matrix} C \\ \# \end{matrix} \right\}$

d. $\quad$ $\left\{ \begin{matrix} lk \rightarrow \varnothing \\ rk \rightarrow y \end{matrix} \right\}$ / ____ VC$\left\{ \begin{matrix} C \\ \# \end{matrix} \right\}$

e. $\quad$ $\begin{bmatrix} -\text{syll} \\ +\text{cons} \end{bmatrix} \rightarrow$ [−long] / $\begin{bmatrix} +\text{syll} \\ +\text{stress} \end{bmatrix}$ ____ (C)VC$\left\{ \begin{matrix} C \\ \# \end{matrix} \right\}$

Lowering $\quad$ $\begin{bmatrix} +\text{syll} \\ -\text{long} \end{bmatrix} \rightarrow$ [−high] % V

Nasal Assimilation $\quad$ n → ŋ / ____ $\begin{bmatrix} -\text{son} \\ -\text{ant} \\ -\text{cor} \end{bmatrix}$

Vowel Gradation $\quad$ VV: → VV / ____CVC$\left\{ \begin{matrix} C \\ \# \end{matrix} \right\}$

h-Deletion   h → Ø / _____ #

Chapter 7: Multilinear phonology

7.1   Tiv

The tone (high or low) associated with a stem is floating (not
    associated underlyingly)
The General Past morpheme is a prefix consisting of low tone only.
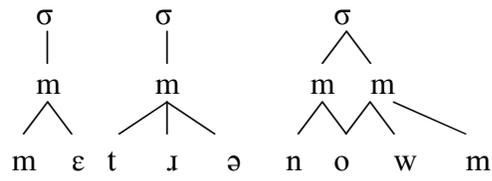The Recent Past morpheme is a suffix consisting of high tone only.
The tone associated with a stem is linked to the first vowel of the stem
    on the first cycle, but does not spread.
The tone associated with a prefix or suffix is linked to an appropriate
    vowel. In the General Past, it cannot link due to the linking of
    the stem vowel to its own tone. Thus the prefix tone has no
    effect on low-tone stems, but induces downstep in high-tone
    stems.
The tone associated with the Recent Past suffix attaches to the second
    vowel of the stem, if any. If it cannot attach, as in
    monosyllables, it remains floating. A special rule of Raising is
    required to convert a Low tone to a High tone when it is
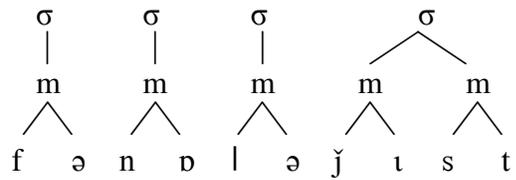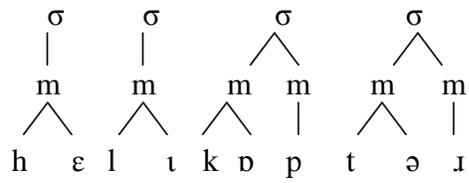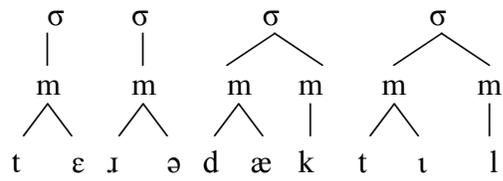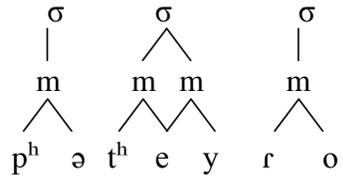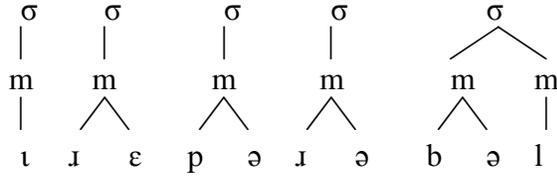   followed by a floating high tone (Pulleyblank 1986, 70).
Any vowels with no tone assigned by these procedures (remember
    that spreading is not automatic) is asigned a Low tone by
    default.

7.2   Hungarian

The harmonic feature [+back] appears on a separate tier. It appears in
the underlying representation of back-vowel stems like *ha:z,* and links
to the stem and suffix vowels by rule. It is not present in front-vowel
stems like *öröm.* All vowels to which [+back] have not been attached
receive [–back] by default. A constraint disallows linking [+back] to
any vowel that is [–low, –round] so that the second vowel in *rɒdi:r* is
unaffected; the [+back] feature of this stem, however, spreads to
suffixes associated with this stem and the second vowel is assigned
[–back] by default. Stems like *hi:d* also have a floating [+back] which
cannot attach to the stem vowel (which is realized [–back] by default)
but which can attach to suffix vowels.

7.3   English

æ k n ɒ l ɩ ǰ ɩ z

ə pʰ i ɹ ə n s

ə pʰ l ạ y ə n s

m ɛ t ɹ ə n o w m

æ t l æ n t ɩ k

ɛ ɹ y ʊ d ɩ š ə n

σ σ σ σ σ

m m m m m m

ɪ ɹ ɛ p ə ɹ ə b ə l

σ σ σ

m m m m

pʰ ə tʰ e y ɾ o

σ σ σ σ

m m m m m m

t ɛ ɹ ə d æ k t ɪ l

σ σ σ σ

m m m m m m

h ɛ l ɪ k ɒ p t ə ɹ

σ σ σ σ

m m m m m

f ə n ɒ l ə ǰ ɪ s t
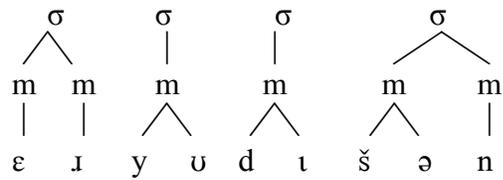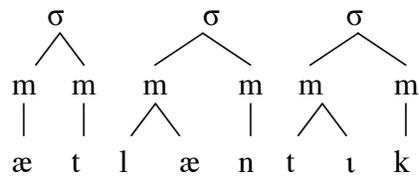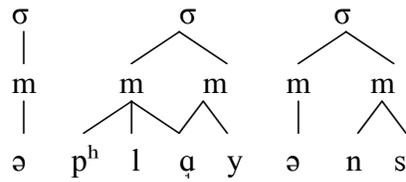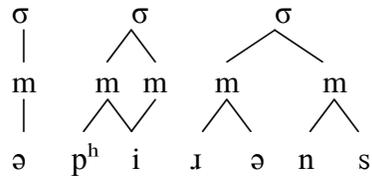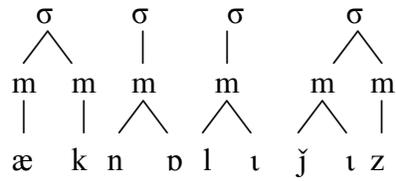
7.4   Pulaar

Maximally underspecified underlying vowel matrix:

	i	e	ε	a	ɔ	o	u
[high]	+						+
[low]				+			
[back]				+	+	+	
[round]							
[ATR]							

Rules:

1.   R: $\begin{bmatrix} V \\ +\text{high} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{low} \\ +\text{ATR} \end{bmatrix}$ (ordered before +ATR spread by RROC)

2.   ATR Spread: Spread [+ATR] from right to left to adjacent vowels.
      Condition: $*\begin{bmatrix} +\text{low} \\ +\text{ATR} \end{bmatrix}$

3.   R: $[+\text{low}] \rightarrow \begin{bmatrix} -\text{high} \\ +\text{back} \\ -\text{round} \\ -\text{ATR} \end{bmatrix}$

4.   R: $[+\text{back}] \rightarrow [+\text{round}]$

5.   R: $[\ ] \rightarrow \begin{bmatrix} -\text{high} \\ -\text{low} \\ -\text{back} \\ -\text{round} \\ -\text{ATR} \end{bmatrix}$