

M.Sc. LST

Laboratory Phonology

Prosody

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Tone languages

- Tone languages: e.g. Yoruba, Igbo, Thai, Vietnamese, Mandarin-Chinese (example below)

Word		Tone contour	Meaning
ma1	mā	high-level	mother
ma2	má	high-rising	hemp
ma3	mǎ	low or low-rising	horse
ma4	mà	falling	scold
ma	ma	neutral	(particle)

- Chinese tones (UCLA Sounds of the World's Languages)
- In tone languages, the tone contour is part of the lexical specification of *all* syllables.

Pitch accent languages

- Pitch accent languages: Japanese, Serbian, Croatian, Lithuanian, Latvian, Norwegian, Swedish (example below)

Word	Tone contour	Meaning
anden1	rising-falling 1st syllable	duck
anden2	rising-falling 1st and 2nd syllable	ghost

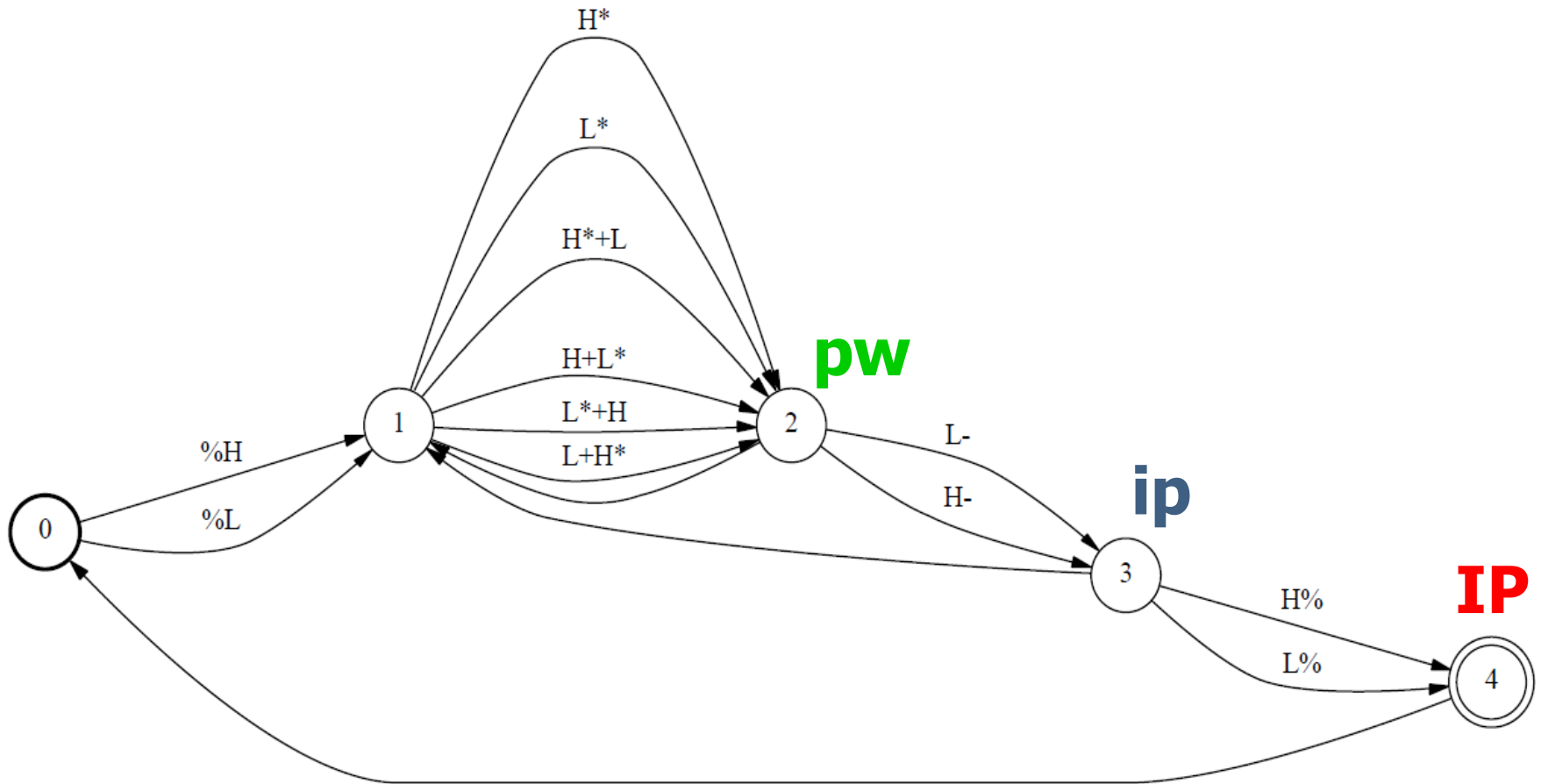
- Swedish pitch accents (Wikipedia)
- In pitch accent languages, the tone contour is part of the specification of syllables and words only in parts of the lexicon.

Intonational phonology

- Intonation languages: English, German, French, Spanish, ...
- The domain of distinctive tone contours is the prosodic word, the phonological phrase, the intermediate phrase, and the intonation phrase.
- Autosegmental-metrical theory of intonation (Pierrehumbert 1980)
 - intonation is represented by sequence of high (H) and low (L) tones
 - H and L are members of a primary phonological contrast
 - hierarchy of intonational domains
 - **IP** – Intonation Phrase; boundary tones: H%, L%
 - **ip** – intermediary phrase; phrase tones: H-, L-
 - **pw** – prosodic word; pitch accents: H*, H*L, L*H, ...

Intonation phonology

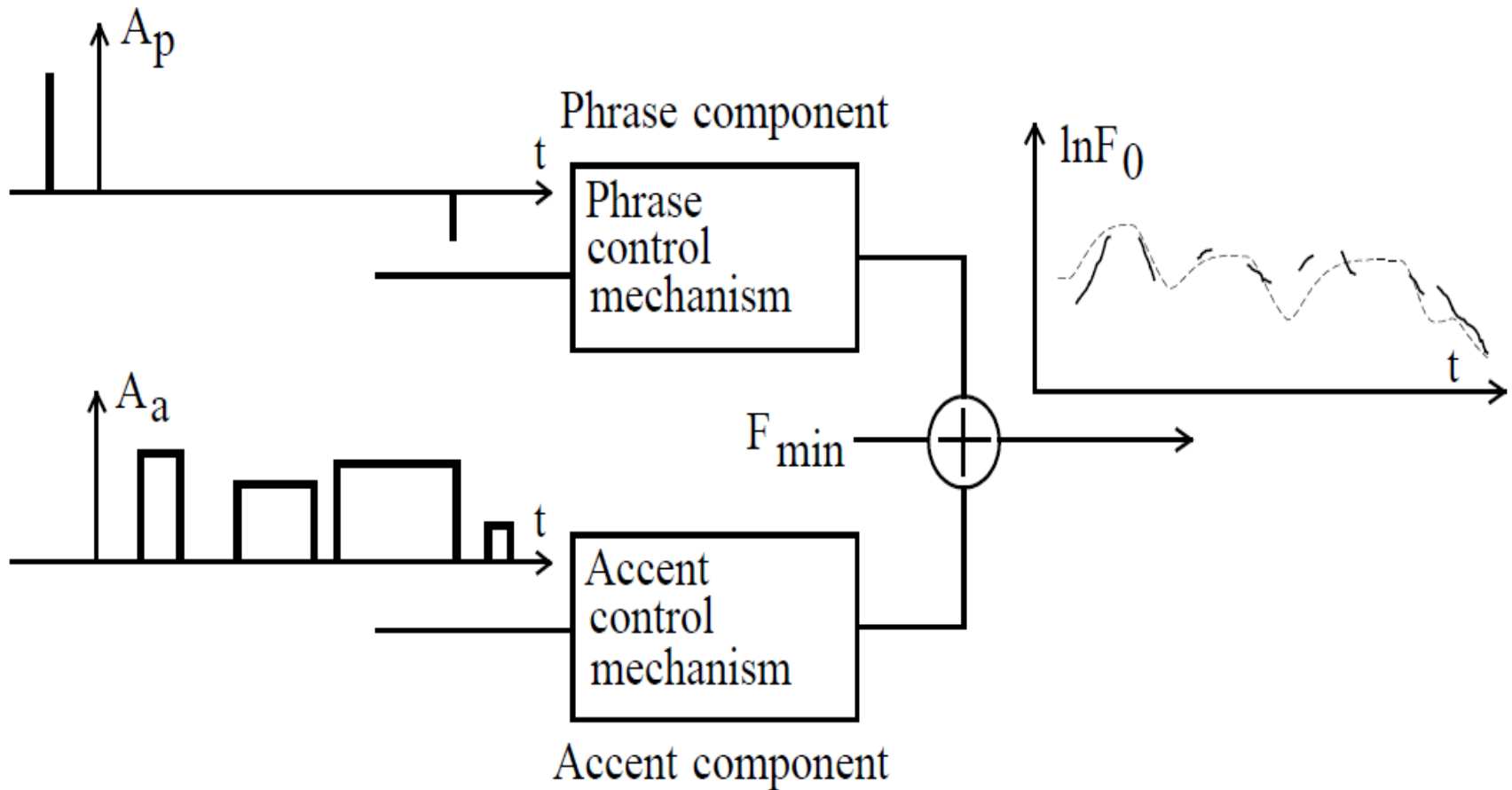
- Finite-state graph



ToBI: Tones and Break Indices

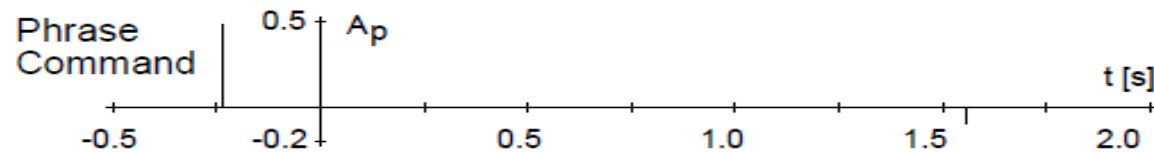
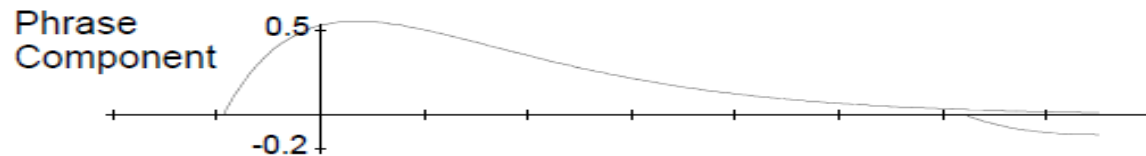
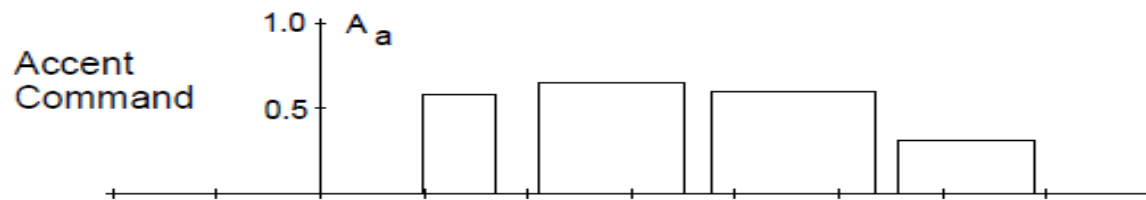
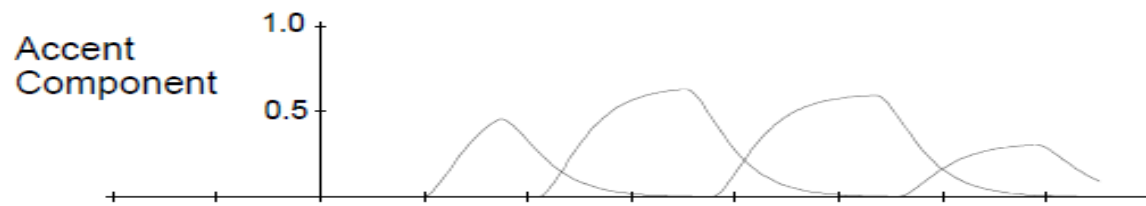
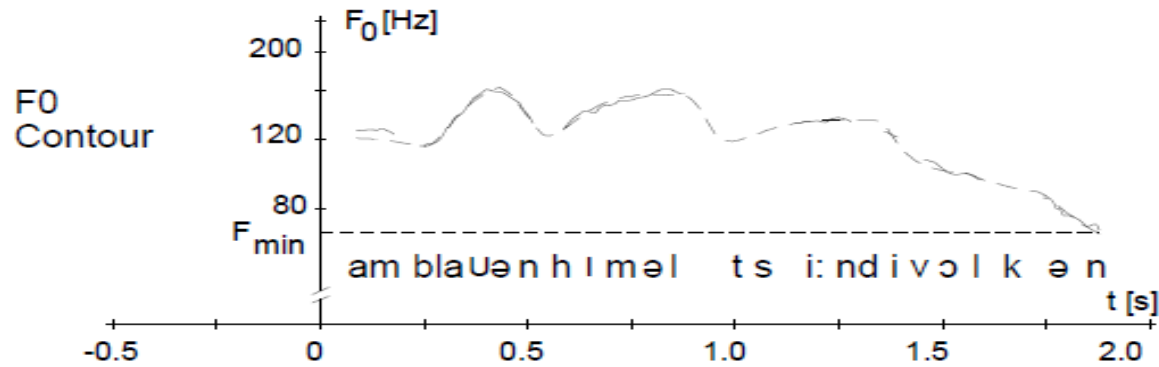
- Formalization of intonation model as transcription system [Silverman et al. 1992]
 - phonemic (=broad phonetic) transcription
 - originally designed for American English
 - limited applicability to other varieties/languages
 - language-specific inventory of phonological units
 - language-specific details of F0 contours
 - adapted to many languages (e.g. GToBI, JToBI, KToBI)
 - implemented in many TTS systems

Fujisaki's model



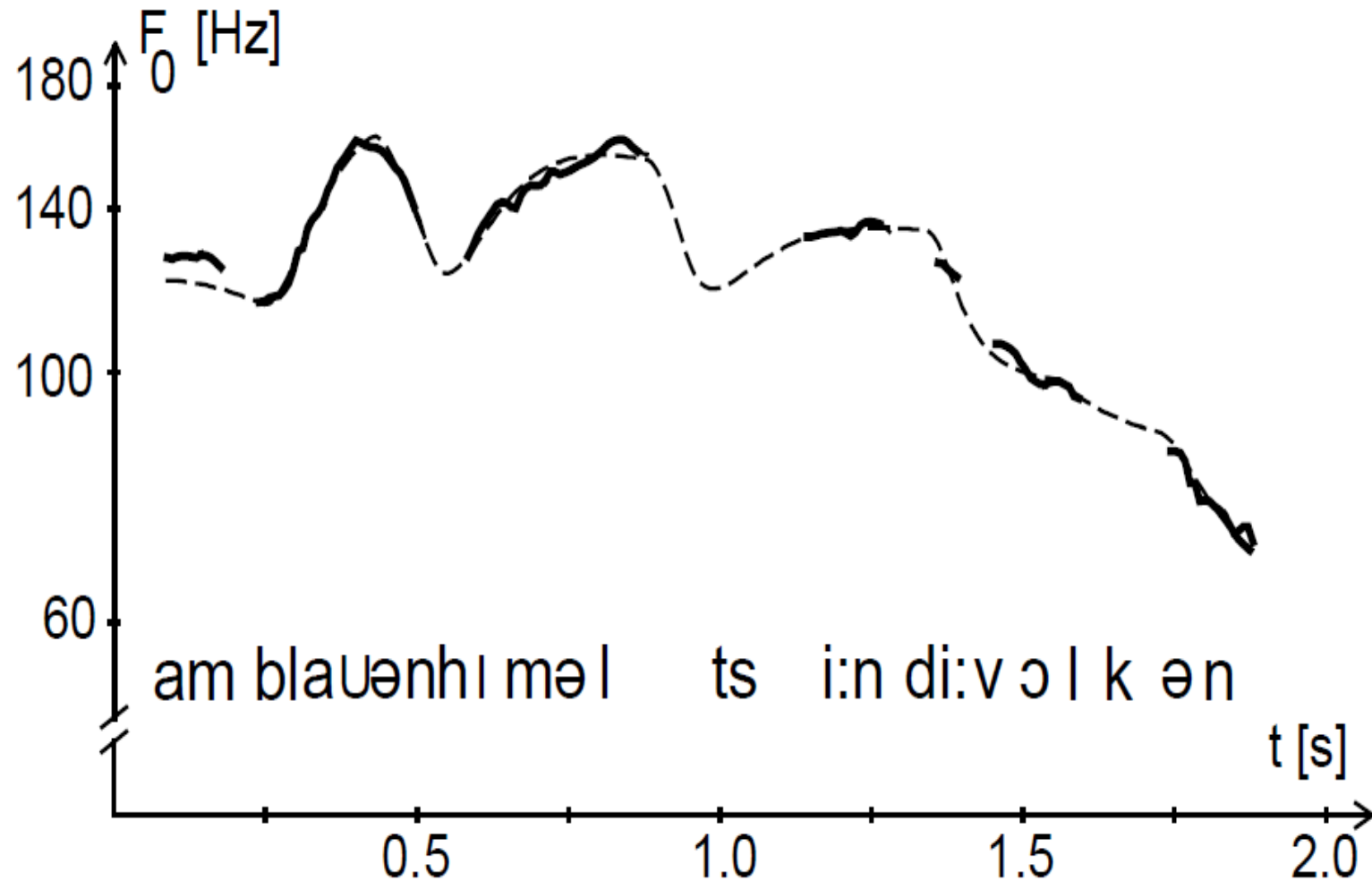
[Fujisaki 1983, 1988; Möbius 1993]

Fujisaki's model



[Möbius 1993]

Fujisaki's model



Approximation of natural F_0 by optimal parameter values within linguistic constraints (accents, phrase structure) [Möbius 1993]

Many functions of F_0

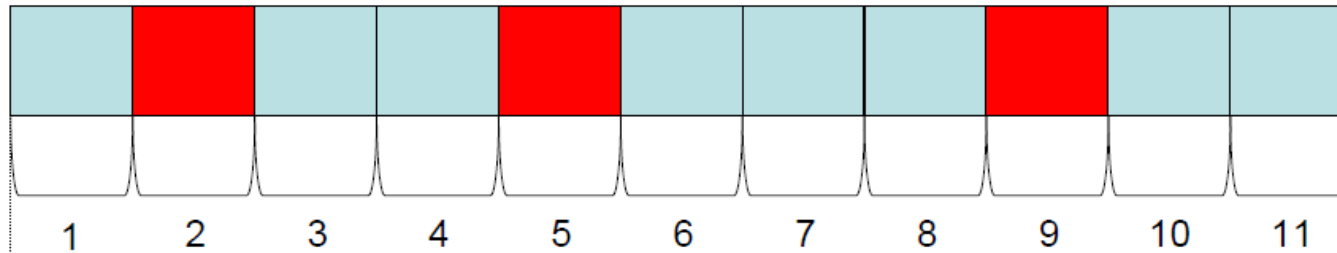
- F_0 serves as a cue for many linguistic, paralinguistic, and extralinguistic factors, including:
 - lexical tones
 - word accent, syllabic stress
 - stress or accent groups
 - prosodic phrasing
 - sentence mode
 - information structure
 - discourse structure
 - pitch range, register
 - phonation type, voice quality
 - microprosody: intrinsic and coarticulatory F_0

Speech rhythm

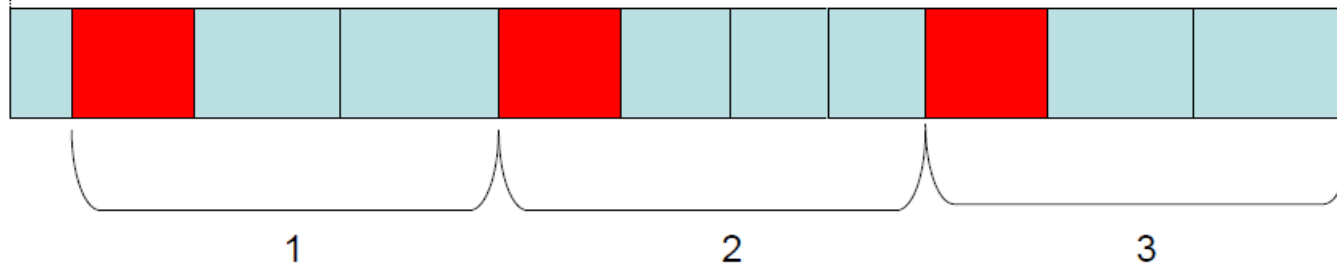
- Systematic organization of prominent and less prominent units of speech over time
 - units: syllables, vocalic intervals
 - more prominence: higher F₀, increased intensity, longer duration
- Isochrony hypothesis (after Pike 1945, Abercrombie 1967): rhythm-based classification of languages
 - based on stress intervals: equal temporal distance between every two stressed syllables (Morse code rhythm)
 - e.g. German, English, Dutch (West Germanic languages)
 - based in syllable intervals: equal temporal distance between every two syllable onsets (machine-gun rhythm)
 - e.g. French, Spanish, Italian (Romance languages)



The nature of syllable & stress timing

syllable timing: (syllable isochrony = here: 11 equally timed syllables)



stress timing: (foot or interstress isochrony = here: 3 equally timed feet)



 = prominent syllable  = non-prominent syllable

Adapted from Volker Dellwo (UCL, now U Zürich)

Speech rhythm

- Evidence for isochrony
 - experimental (acoustic, perceptual): rather weak tendency
 - many measures to quantify rhythm proposed and tested
 - continuum rather than binary (cf. Polish)
- Rhythm not a well-defined concept in speech