Deriving Harmony Patterns from Graph Geometries
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This paper aims to give a representational analysis of harmony patterns by deriving long-distance phonological phenomena from the representational power allowed by the so-called multiprecedence representation of Raimy (2000). This is one piece of a long-term project aiming to attribute most phonological and morphological patterns to properties of this single representation.

Throughout the history of Generative Linguistics, the representation of phonology, originally assumed to be a string, has been progressively enriched with novel representational power so as to encode more powerful phenomena that go beyond simple linear effects like long-distance phenomena and non-concatenative morphology. Autosegmental theory (Goldsmith 1976), reduplicative brackets (Frampton 2004, 2009), morpheme planes (Cole 1987) or correspondence theory indices (McCarthy & Prince 1995) are all enrichments of strings in that they assume some “core” string structure and other things dangling from it. These richer models have been used to make strings more powerful.

There is however an alternative to consider: reducing the complexity of the representation by going from strings to directed graphs, and deploying the additional representational freedom given for free by such a simplification to explain the same phenomena. Raimy (2000) suggested to replace strings such as (1) with graphs like (2), where # and % are explicit beginning- and end-of-word markers respectively. The difference being that in such a representation single segments can immediately precede or follow multiple others. This allowed him to analyse reduplication as “loops” in the directed graph. Indonesian plural reduplication as in (3) is linearized as (4). This structure then allowed Raimy to tame a number of complicated patterns of over- and underapplication of phonological rules interacting with reduplication and infixes

\[
(1) \text{kæt} \quad (3) \quad \# \quad \text{b} \quad \text{u} \quad \text{k} \quad \text{u} \quad \% \\
(2) \quad \# \quad \text{k} \quad \text{æ} \quad \text{t} \quad \% \\
(4) \quad \# \text{bukubuku\%} \quad \text{“books”}
\]

Pursuing the project of extending this representation to more phenomena like subtractive morphology (Gagnon & Piché 2007) and Templatic Morphology in Semitic (Raimy 2007), this paper works out how to use this multiprecedence representation to formalize long-distance phonological phenomena as parallel geometry. The basic geometry to exploit is parallel streams throughout a graph, with multiple non-conflicting paths. A graph like (5) would be linearized with feature [+F] realized on every segment parallel to it that can be specified as [+F].

\[
(5) \quad \# \quad \text{a} \quad \text{b} \quad \text{c} \quad \text{d} \quad \% \\
(6) \quad \# \text{a}_\text{+F} \text{b}_\text{+F} \text{c}_\text{+F} \text{d}_\text{+F}\% 
\]
Given this geometry for the harmonization of a single feature over multiple segments and taking Raimy’s (2000) representation for affixes off the shelf, phenomena of root controlled harmony fall out automatically. For instance in Turkish the root comes specified with features that suffixes eventually take, roots is underlying stored as in (7) and affixes append to this graph as in (8), going parallel to the \([\alphaBk, \betaHi]\) feature introduced by the root. Suffixes can also contain such parallel streams and the serialization algorithm has to resolve these graphs.

(7) \[ 
\begin{array}{c}
\# \rightarrow k \rightarrow [+hi] \rightarrow z \rightarrow \% \rightarrow kiz \\
\end{array} \]

⇒ kiz “girl” Nom.sg.

(8) \[ 
\begin{array}{c}
\# \rightarrow k \rightarrow [+hi] \rightarrow z \rightarrow \% \rightarrow kizin \\
\end{array} \]

⇒ kizin “girl” Gen.sg

I \rightarrow n

(9) \[ 
\begin{array}{c}
\# \rightarrow j \rightarrow [+hi] \rightarrow z \rightarrow \% \rightarrow jyzlerin \\
\end{array} \]

⇒ jyzlerin “face” Gen.pl.

The presentation will define the properties of these graphs, explain how they are mathematically simpler than strings despite the representational power, expand on the formalism, and account for the variety of facts that harmony patterns display, including directionality and its typology, transparent and opaque segments, locality, and extension to tonal patterns, making them all follow for free from properties of graphs. The relationship with “spreading” vs. “search-and-copy” (Nevins 2010) models will be discussed in sketching the serialization algorithm.