Unbounded spreading is myopic

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Unbounded nasal spreading in Arabela

‘A vowel, a sequence of vowels, or a sequence of vowels separated by y [j] or w have nasalized allophones when following nasals’ (Rich 1963)

ˈmj̃æ̃nũ	‘swallow’	ˈh̃ũw̃ãʔ	‘a yellow bird’
ˈh̃ãnũʔ	‘to fly’	ˈnĩnj̃ũʔ	‘to come’
ˈmããnũʔ	‘to come’	ˈnũw̃ãʔ	‘partridge’
ˈh̃ĩj̃æ̃nĩʔ	‘old woman’	ˈnj̃æ̃æ̃ˈriʔ	‘he laid it down’
ˈh̃ẽẽɣiʔ	‘termites’	cf. ˈtukuru	‘palm leaf’

Note: h always surfaces as nasal

Unbounded spreading

- In principle, any number of segments can **undergo** spreading from a single **trigger**
  ex. ˈɦ̃ũw̃ãʔ ‘a yellow bird’

- Spreading applies until it reaches the edge of its domain (e.g., PrWd) or a **blocking** seg
  ex. ˈɦ̃ĩj̃æ̃ pʌˈɦ̃ãmʌ̃ˈɦ̃ĩnj̃ɛ̃ʔ
  ‘where the sun comes up’
  ex. ˈkaˈnããˈkɪʔ ‘our (excl.) father’

Contribution of Optimality Theory

- Rule-based analyses must build the blocking conditions into the spreading rules (or add filters / constraint on top of the rule system)
  ex. [–consonantal] $\rightarrow$ [+nasal] / [+nasal]__
  “spread [+nasal] to a following segment *except when* it is [+consonantal]”
- Given strict-domination ranking, it is possible to explain blocking with constraints that are independently motivated and active
  ex. *NasObstr/Liquid $\gg$ “Spread nasal”

Contribution of Optimality Theory

Hierarchical blocking effects (terminology from Walker 2000) are explained with substantively motivated constraint sets that potentially regulate multiple spreading processes (McCarthy 1997), govern the distribution of contrastive values for the spreading feature (Bakovic 2000, Kaun 1995, Walker 2000), and play other roles in phonology

ex. *NASOBSTRSTOP ≫ *NASFRIC ≫ *NASLIQUID ≫ *NASGLIDE ≫ *NASVOWEL ≫ *NASSONSTOP (hierarchy from Walker 2000)

Outline of the talk

- Generalization
  Unbounded spreading is myopic

- Formal analysis
  Positive and negative harmony in Optimality Theory with Targeted Constraints (TCOT)

  $$\text{nãw̃}\underset{-}{\text{a}}\text{ta} \longrightarrow \text{nãw̃}\underset{+}{\text{ã}}\underset{-}{\text{t}}\text{a} \succ \text{nãw̃}\underset{-}{\text{a}}\text{ta}$$

- General properties of TCOT grammars [and connection to opacity and the P-map]

Typology of unbounded spreading

- Nasal (Cohn 1993, Homer 1998, Hyman 1982, Piggott 1992, Safir 1979, Walker 2000)
- Vowel harmony (Beckman 1997, Clements 1980, Goldsmith 1985, Kaun 1995, Ringen 1975, Vago 1976, Walker 2001)
- ATR (Archangeli & Pulleyblank 1994, Bakovic 2000, Kaye 1982, Noske 2000)
- Emphasis (Bessell 1998, Davis 1995, McCarthy 1997, Watson 2002, Younes 1993)

Typology of unbounded spreading

- Long-distance consonant agreement (Gafos 1999, Hansson 2001, 2004, Poser 1982, Rose & Walker 2004)
- Regrettably nothing to say about tone spreading here — suggestions welcome!

Unbounded spreading is myopic

All attested unbounded spreading processes obey a myopia ("no look ahead") generalization

- LR$\longrightarrow$ spreading from T to U is independent of whether spreading can proceed into Z

  $\ldots$ T X U Z $\ldots$

- $\longleftarrow$RL spreading from T to U is independent of whether spreading can extend into Z

  $\ldots$ Z U X T $\ldots$

Unbounded spreading is myopic

- A generalization similar to myopia was first noted by Anderson (1982)
- Related to claims that certain feature values, such as [–nasal] and [–round], never spread unboundedly (Steriade 1995)
- Bakovic (2000) analyzes several cases of myopia with stem control

Myopic spreading in Arabela

- LR→ unbounded nasal spreading

  Triggers: nasal consonants [m n h̃]
  Undergoers: vowels [i e a o u], glides [j w]
  Blockers: obstruents [p t k s ʃ], rhotic [r]

- Spreading is myopic

  ˈh̃ẽẽgiʔ ‘termites’ *ˈh̃ẽegiʔ, *ˈh̃eegiʔ
  ˈh̃j̃ũũʃːˈʃænõʔ ‘where I fished’
  ˈpoˈkonãɣiʔ ‘yellow’
  ˈtinj̃ãˈkari ‘afternoon’ (cf. ˈnãˈĩʔ ‘stinging ant’)

AGREE is inconsistent with myopia

- AGREE(F) requires adjacent segments to have the same specification for [F] (Bakovic 2000, Butska 1999, Lombardi 1999)

- Because AGREE(F) cannot be satisfied in the presence of a blocker, it incorrectly fails to prefer myopic spreading (McCarthy 2003)

/h̃eegiʔ/	AGREE(nas)	IDENT(nas)
h̃eegiʔ	-1	
h̃ẽẽgiʔ	-1	-2 / -3!

ALIGN is consistent with myopia

- ALIGN-L/R(F) (variously named) assigns one violation for every segment before/after the trigger that has not undergone spreading (Akinlabi 1994, Cole & Kisseberth 1994, Kaun 1995, Kirchner 1993, McCarthy 1997, Padgett 1995, Pulleyblank 1996, Ringen & Vago 1995, Walker 2000)
- ALIGN correctly prefers myopic spreading, but predicts a range of unattested non-local effects, such as long-distance blocking of epenthesis (McCarthy 2004, Wilson 2003)

ALIGN blocks epenthesis non-locally

- Partial ranking
  ALIGN-R([+nasal]) $\gg$ *C# $\gg$ DEP-V
- Normal application of word-final epenthesis in words that contain no [+nasal] segment
  /latak/ $\rightarrow$ lataki
- Blocking of epenthesis when [+nasal] spreading cannot be complete

/natak/	ALIGN-R(nas)	*C#	DEP-V
nãtak	-3	-1	
nãtaki	-4!		-1

Additional approaches to spreading

- Directional evaluation (Eisner 2000)
  LR→ evaluation prefers violations **later** in the word, ←RL evaluation prefers **earlier** violns

  Non-myopic [+nasal] spreading predicted by
  *[+nasal][-nasal] (←RL) ex. nawata $\succ$ nãw̃ãta
  *[-nasal][+nasal] (LR→)

Additional approaches to spreading

- Headed Span Theory (Key to appear, McCarthy 2004, O'Keefe to appear) Spreading preferred by constraints against adjacent spans, with directionality governed by span-headedness constraints

  Non-myopic [+nasal] spreading predicted by *A-SP(nas) $\gg$ SPHDR(+nas) $\gg$ SPHDL(-nas)
  $\Rightarrow (\underline{\text{n}}\text{a}) \succ (\underline{\text{n}})(\text{a})$ but $(\underline{\text{n}})(\text{a}\underline{\text{t}}\text{a}) \succ (\underline{\text{n}}\text{a})(\underline{\text{t}}\text{a})$

Summary

- Myopia follows from iterative application of rules such as [–cons] $\rightarrow$ [+nasal]/[+nasal]___
ex. /ɦ̃uwaʔ/ $\rightarrow$ ɦ̃ũwaʔ $\rightarrow$ ɦ̃ũw̃aʔ $\rightarrow \cdots$

- Strict-domination ranking has the potential to reduce blocking to independent constraints

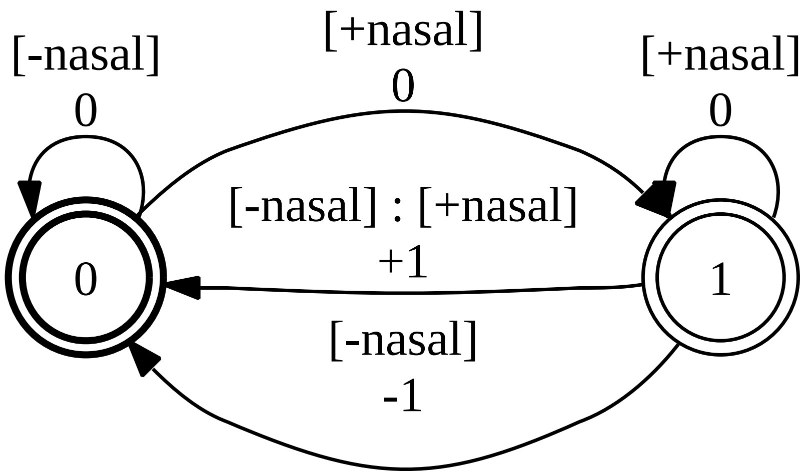
- None of the viable OT approaches to spreading predict myopia under all rankings

Targeted constraints

- A targeted constraint specifies both a marked configuration and a repair (Bakovic & Wilson 2000, Hansson 2001, Wilson 2001)
- Targeted constraints are formalized here as finite-state machines (see Hopcroft & Ullman 1979, Mohri 1997, Pereira & Riley 1997)
- Targeted spreading constraints resemble spreading rules but without built-in blocking

Targeted spreading constraint

±SPREAD-R(+nasal)



Negative marks (–1) are identical to OT viol'ns
Positive marks (+1) reward the designated repair

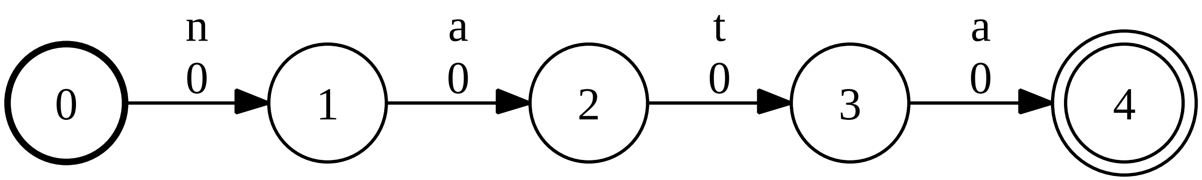
Harmonic ordering with pos marks

- Let C(X) stand for the sum of the marks (positive or negative) that C assigns to X
- Greater harmony is better
  C: X $\succ$ Y $\Leftrightarrow$ C(X) > C(Y)
- Example
  C(X) = +1 C(Y) = 0 C(Z) = -1
  $\Rightarrow$ C: X $\succ$ Y $\succ$ Z

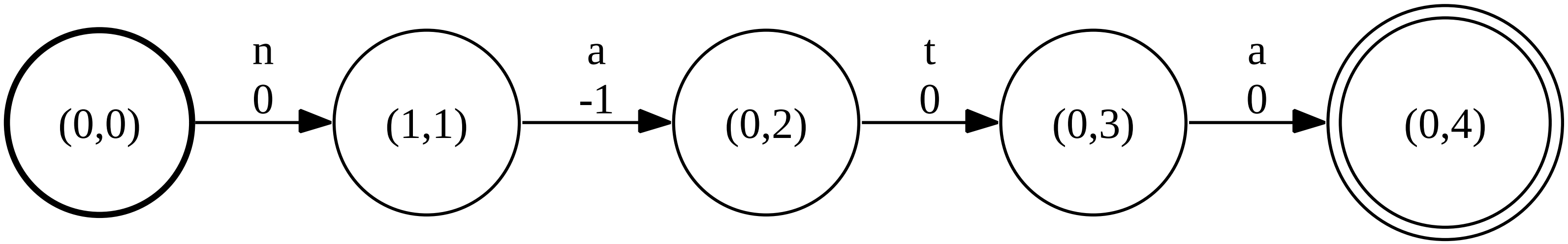
Targeted constraint as evaluator

EVAL(C, A) is the evaluation function, defined essentially as in classic finite-state OT (Albro 2003, Eisner 1997, Ellison 1994, Riggle 2004)

Ex. A =



EVAL($^{\pm}$SPREAD-R(+nasal), A) =



Definition of EVAL

Targeted constraint
for every transition (q, c, d, v, r) in C$_i$ s.t. $v \leq 0$
for every transition (q', x, y, w, r') in A s.t. $y \sqcup c$
construct $((q, q'), x, y, w_{[i \leftarrow v \textbf{ if } \textbf{v<0}]}, (r, r'))$

Mark indelibility
Existing positive and negative marks of a targeted constraint are not changed by EVAL

Definition of EVAL

Markedness constraint (non-targeted)
for every transition (q, c, d, v, r) in C$_i$
    for every transition (q', x, y, w, r') in A s.t. $y \sqcup c$
        construct $((q, q'), x, y, w_{[i \leftarrow v]}, (r, r'))$

Faithfulness constraint
for every (q, c, d, v, r) in C$_i$
    for every (q', x, y, w, r') in A s.t. $x \sqcup c$ and $y \sqcup d$
        construct $((q, q'), x, y, w_{[i \leftarrow v]}, (r, r'))$

(This definition ignores ϵ-transitions; see finite-state refs)

Extension to hierarchy evaluation

$\textsc{Eval}([\mathrm{C}_0, \mathrm{C}_1, \ldots, \mathrm{C}_n], \mathrm{A})$

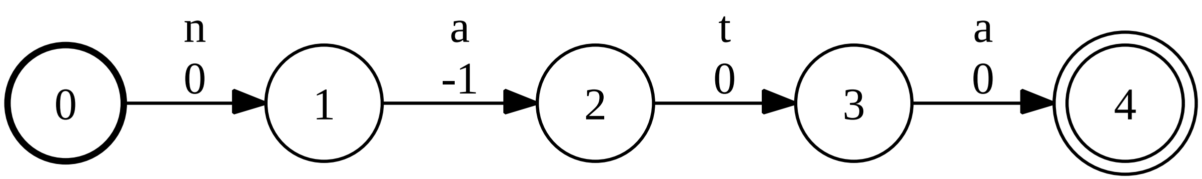
$= \textsc{Eval}(\mathrm{C}_n, \ldots \textsc{Eval}(\mathrm{C}_1, \textsc{Eval}(\mathrm{C}_0, \mathrm{A})))$

$= \textsc{Eval}(\mathrm{C}_0, \textsc{Eval}(\mathrm{C}_1, \ldots \textsc{Eval}(\mathrm{C}_n, \mathrm{A})))$

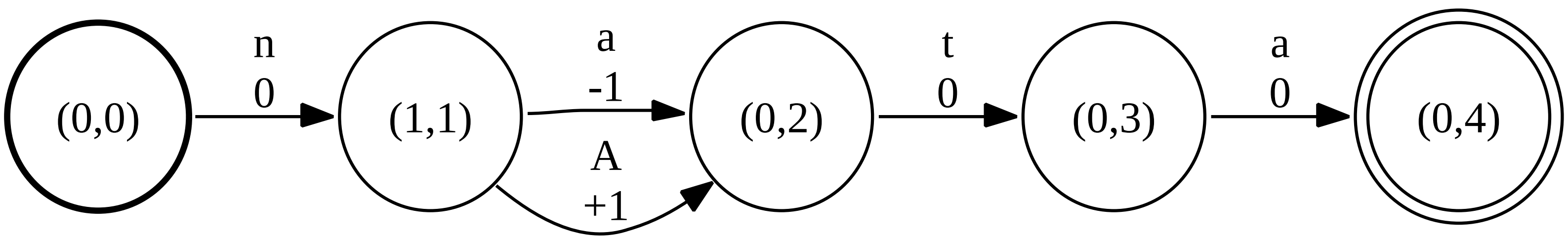
Targeted constraint as generator

GEN(C,A) is the generation function, another variant of finite-state intersection / composition

A =



GEN($^{\pm}$SPREAD-R(+nasal), A) =



Definition of GEN

Targeted constraint
for every transition (q, c, d, v, r) in C$_i$
    for every transition $(q', x, \text{-}, w, r')$ in A s.t. $x \sqcup c$
        if $v \leq 0$ // faithful mapping
            construct $((q, q'), x, x, w, (r, r'))$
        else // repair
            construct $((q, q'), x, d(x), w_{[i \leftarrow v]}, (r, r'))$

Mark conversion
Application of the designated repair converts a negative mark (–1) to a positive mark (+1)

TCOT framework

- CON = $\mathcal{T} \cup \mathcal{M} \cup \mathcal{F}$
- GEN is replaced by $\mathcal{T}$ except perhaps for creation of alternative prosodic parses
- H-EVAL is defined exactly as in OT (lexicographic ordering of viol’n vectors)
- I/O mapping is achieved by a version of harmonic serialism (see Prince & Smolensky 1993/2004, McCarthy 2000, 2006) . . .

TCOT framework

Given hierarchy H = [C$_0$, C$_1$, . . . , C$_n$] and input in

$out_0 \leftarrow in$

$k \leftarrow 0$

do

$k \leftarrow k + 1$

$out_{k-1} \leftarrow$ EVAL(H, RESET(out_{k-1}))

for each targeted constraint C$_i$

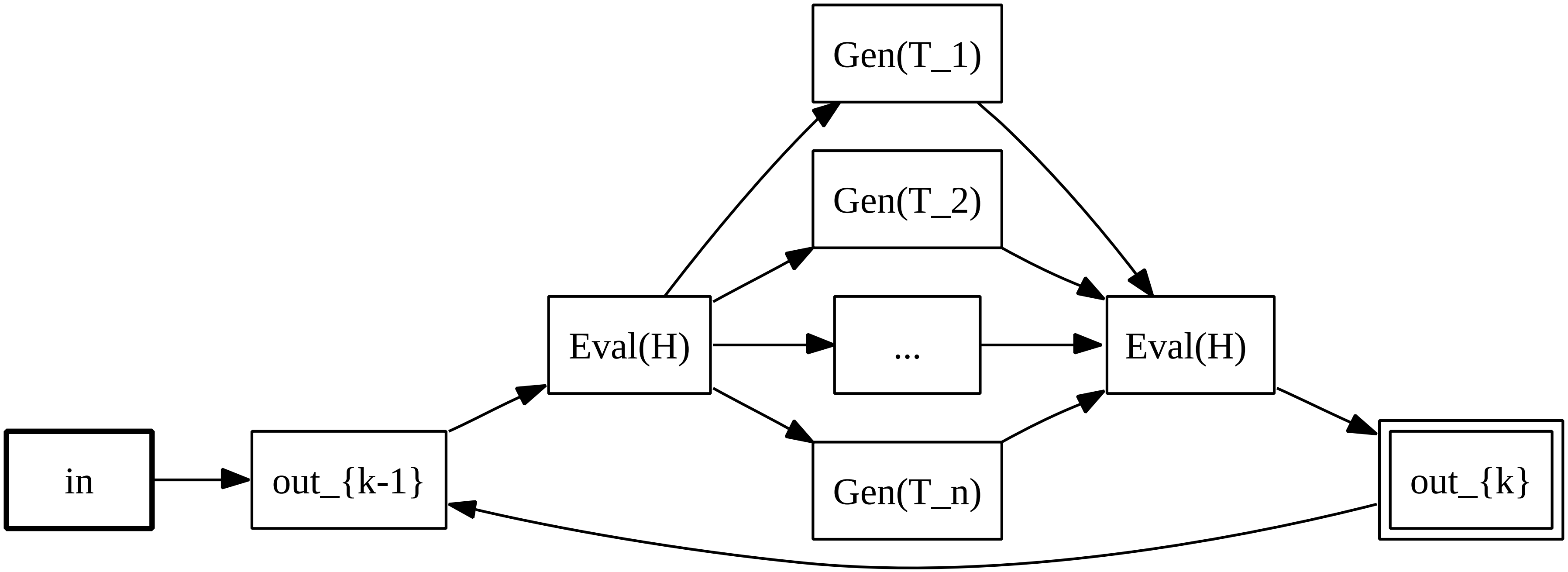
$out \leftarrow$ H-MAX(EVAL(H, GEN(C$_i$, out_{k-1})))

$out_k \leftarrow$ H-MAX$(\{out_k, out\})$

while $out_k \succ out_{k-1}$

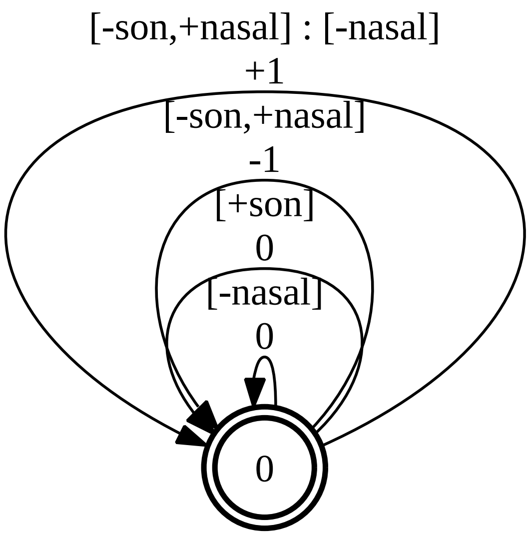
return out_k

TCOT framework

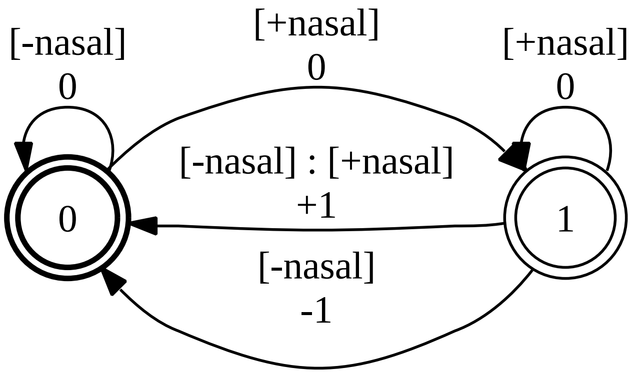


Example: constraints

±NoNasObstr

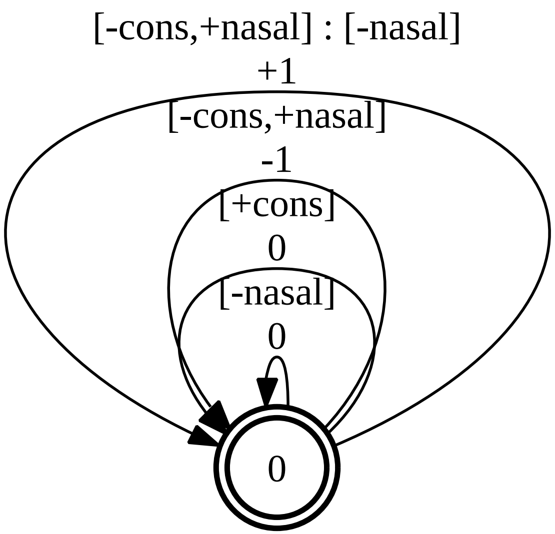


±Spread-R(+nasal)

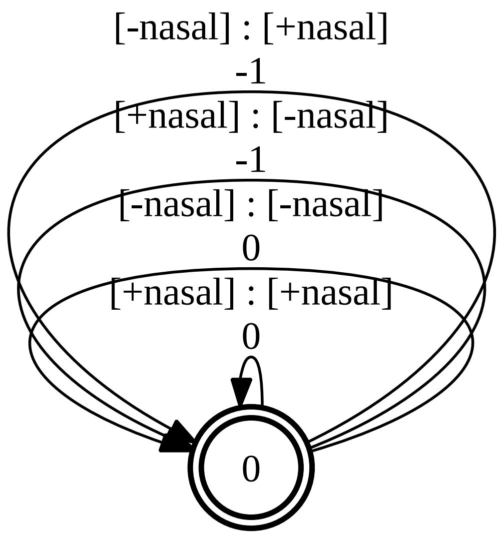


Example: constraints

±NoNasVoc



Ident(nasal)



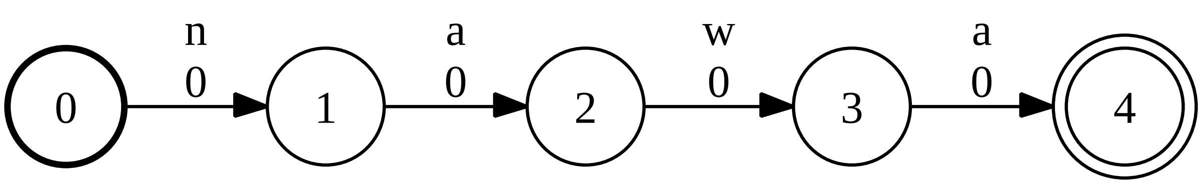
Example: hierarchy and inputs

Hierarchy

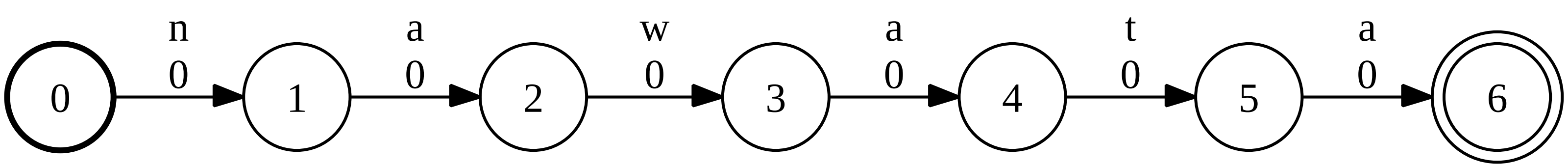
$^{\pm}$NoNasObstr $\gg$ $^{\pm}$Spread-R(+nasal)
$\gg$ $^{\pm}$NoNasVoc $\gg$ Ident(nasal)

Inputs

/nawa/



/nawata/



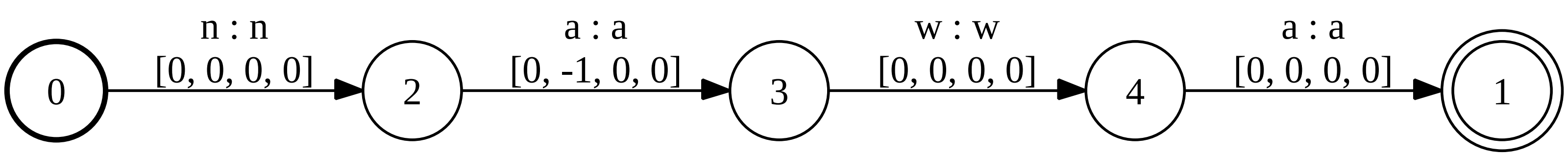
Example: unbounded spreading

$^{\pm}$NoNasObs $\gg$ $^{\pm}$Sprd-R(+nas) $\gg$ $^{\pm}$NoNasV $\gg$ Id(nas)

Example: unbounded spreading

$^{\pm}$NoNasObs $\gg$ $^{\pm}$Sprd-R(+nas) $\gg$ $^{\pm}$NoNasV $\gg$ Id(nas)

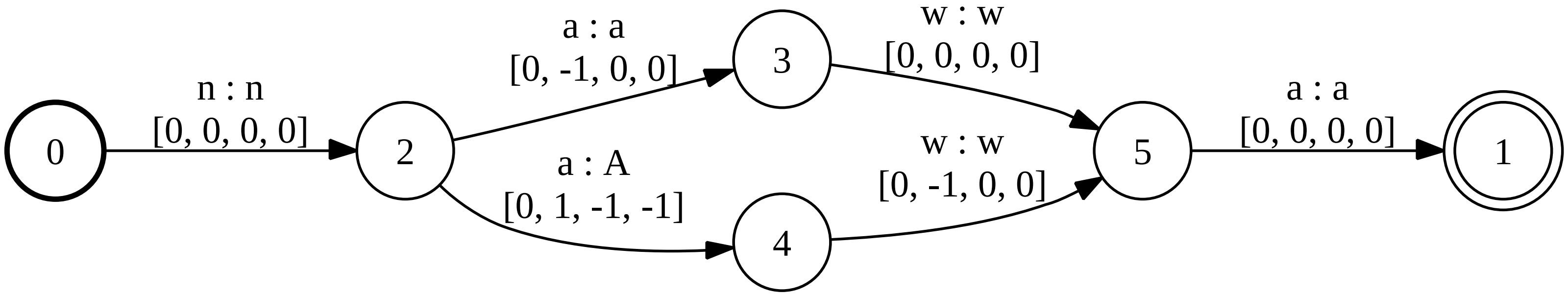
out_0 = Eval(H, nawa) =



Example: unbounded spreading

$^{\pm}$NoNasObs $\gg$ $^{\pm}$Sprd-R(+nas) $\gg$ $^{\pm}$NoNasV $\gg$ Id(nas)

Eval(H, Gen($^{\pm}$Sprd-R(+nas), out_0)) =

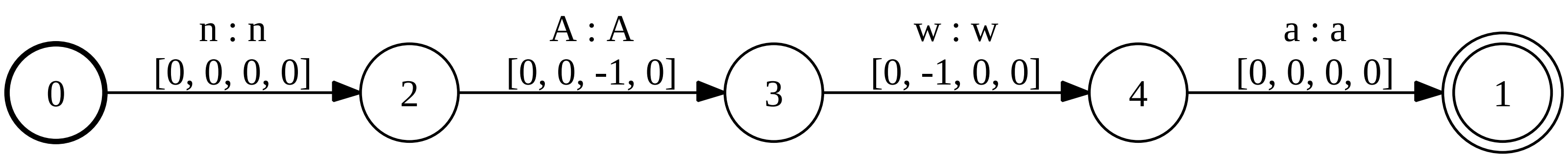


/nawa/	$^{\pm}$NoNasObs	$^{\pm}$Sprd-R(+nas)	$^{\pm}$NoNasV	Id(nas)
nawa		-1!		
nAwa		(+1) + (-1) = 0	-1	-1

Example: unbounded spreading

$^{\pm}$NoNasObs $\gg$ $^{\pm}$Sprd-R(+nas) $\gg$ $^{\pm}$NoNasV $\gg$ Id(nas)

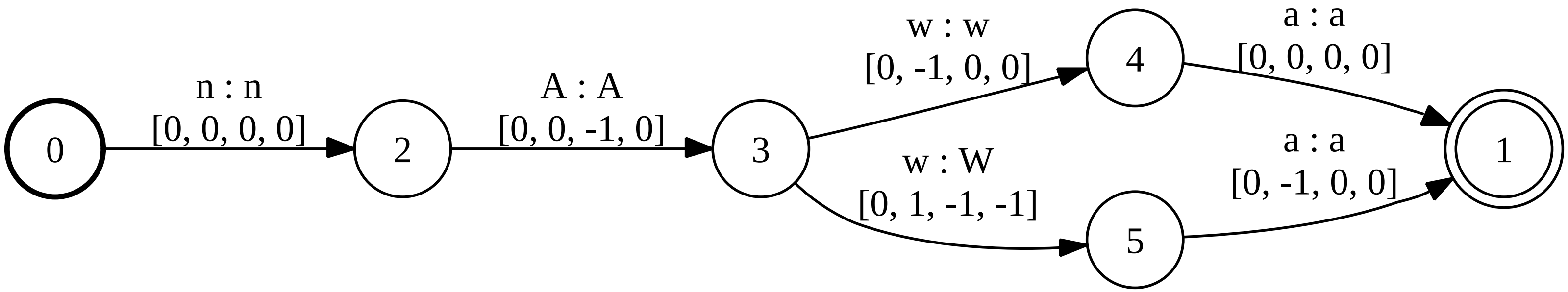
out_1 = Eval(H, nAwa) =



Example: unbounded spreading

$^{\pm}$NONASOBS ≫ $^{\pm}$SPRD-R(+nas) ≫ $^{\pm}$NONASV ≫ ID(nas)

EVAL(H, GEN($^{\pm}$SPRD-R(+nas), out_1)) =

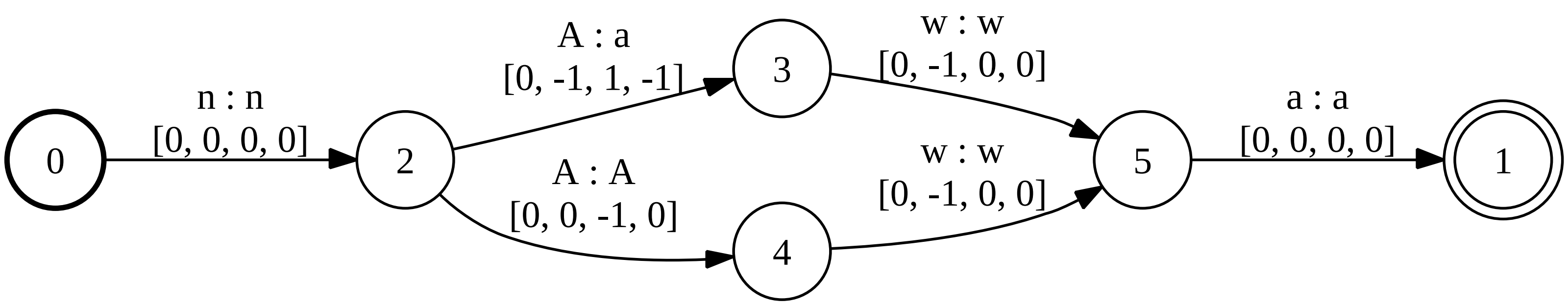


/nAwa/	$^{\pm}$NONASOBS	$^{\pm}$SPRD-R(+nas)	$^{\pm}$NONASV	ID(nas)
nAwa		-1!	-1	
nAWa		(+1) + (-1) = 0	-2	-1

Example: unbounded spreading

$^{\pm}$NoNasObs $\gg$ $^{\pm}$Sprd-R(+nas) $\gg$ $^{\pm}$NoNasV $\gg$ Id(nas)

Eval(H, Gen($^{\pm}$NoNasV, out_1)) =

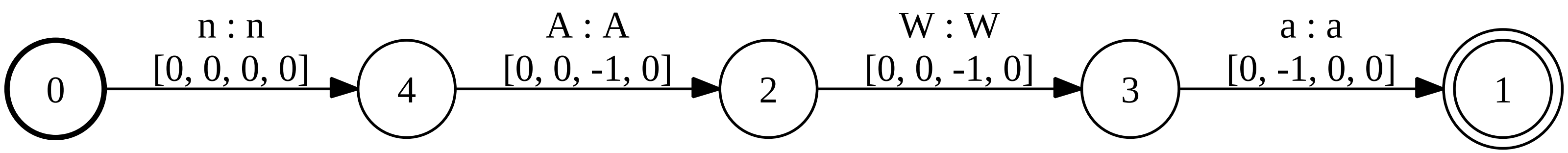


/nAwa/	$^{\pm}$NoNasObs	$^{\pm}$Sprd-R(+nas)	$^{\pm}$NoNasV	Id(nas)
nawa		-2!	+1	-1
nAwa		-1	-1	

Example: unbounded spreading

$^{\pm}$NoNasObs $\gg$ $^{\pm}$Sprd-R(+nas) $\gg$ $^{\pm}$NoNasV $\gg$ Id(nas)

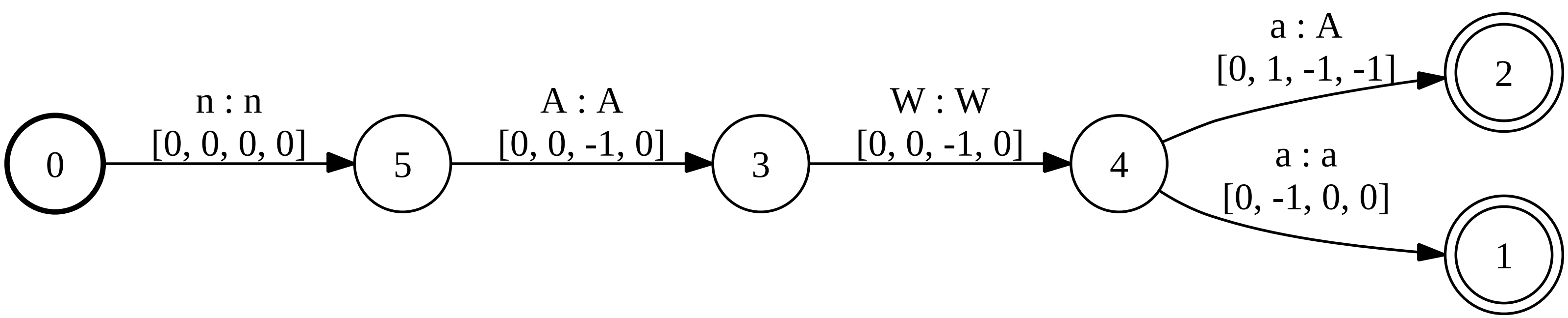
out_2 = Eval(H, nAWa) =



Example: unbounded spreading

$^{\pm}$NoNasObs ≫ $^{\pm}$Sprd-R(+nas) ≫ $^{\pm}$NoNasV ≫ Id(nas)

Eval(H, Gen($^{\pm}$Sprd-R(+nas), out_2)) =

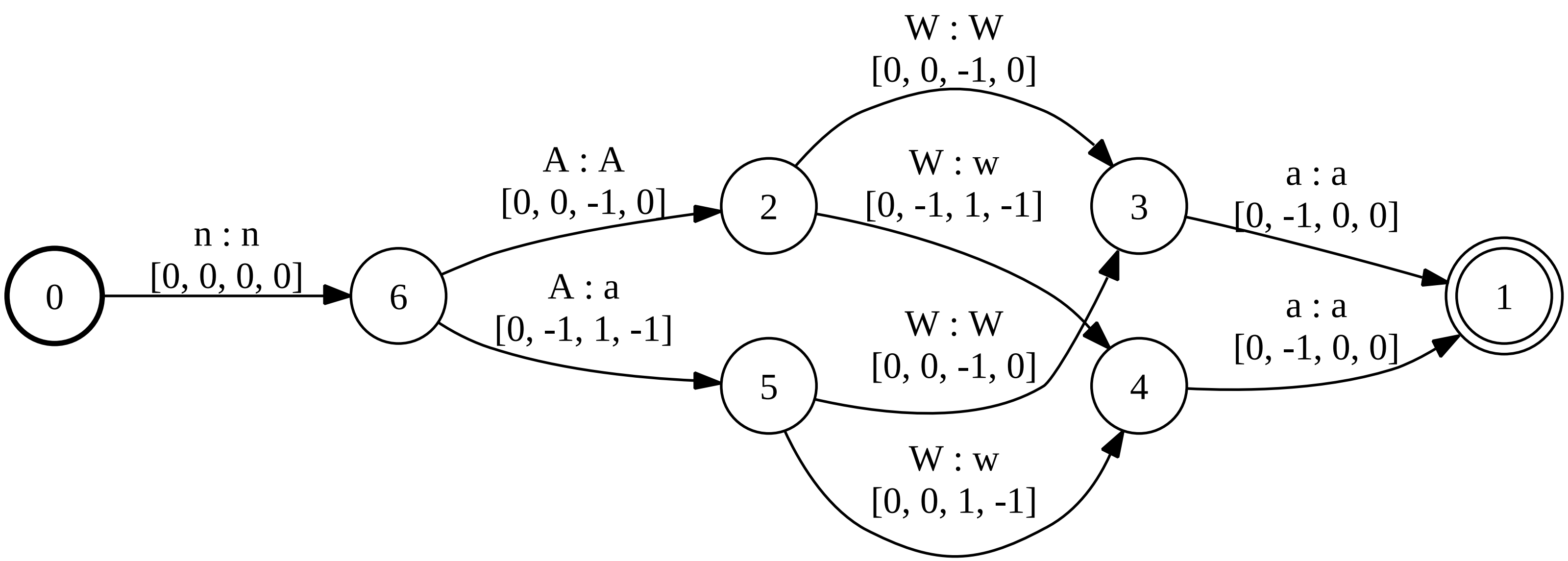


/nAWa/	$^{\pm}$NoNasObs	$^{\pm}$Sprd-R(+nas)	$^{\pm}$NoNasV	Id(nas)
nAWA		+1	-3	-1
nAWa		-1!	-2	

Example: unbounded spreading

$^{\pm}$NoNasObs $\gg$ $^{\pm}$Sprd-R(+nas) $\gg$ $^{\pm}$NoNasV $\gg$ Id(nas)

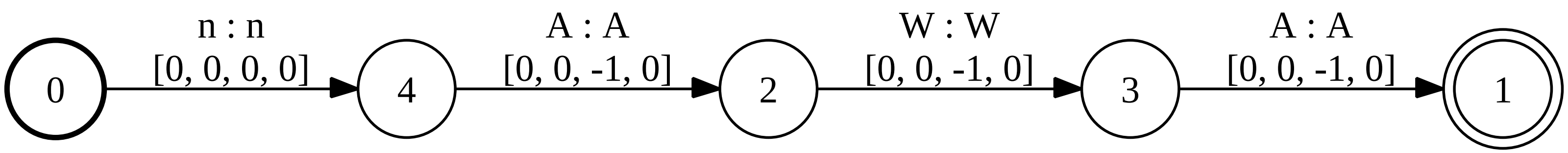
Eval(H, Gen($^{\pm}$NoNasV, out_2)) =



Example: unbounded spreading

$^{\pm}$NoNasObs $\gg$ $^{\pm}$Sprd-R(+nas) $\gg$ $^{\pm}$NoNasV $\gg$ Id(nas)

out_3 = Eval(H, nAWA) =



How it works

- $^{\pm}$SPREAD-R(+nasal) assigns -1 to a [-nasal] segment immed. after a [+nasal] segment

  $\underset{}{\text{n}}\underset{-}{\text{a}}\text{wa}$

- Application of the spreading repair converts the negative mark to a positive mark +1

  $\text{n}\underset{-}{\text{a}}\text{wa} \longrightarrow \text{n}\underset{+}{\text{A}}\text{wa}$

- Negative and positive marks cancel, making partial spreading better than "sour grapes"

  $\text{n}\underset{-}{\text{a}}\text{wa} \longrightarrow \text{n}\underset{+}{\text{A}}\underset{-}{\text{w}}\text{a} \succ \text{n}\underset{-}{\text{a}}\text{wa}$

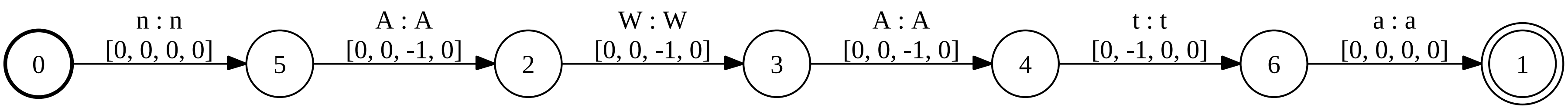
Example: myopia

$^{\pm}$NoNasObs $\gg$ $^{\pm}$Sprd-R(+nas) $\gg$ $^{\pm}$NoNasV $\gg$ Id(nas)

Example: myopia

$^{\pm}$NoNasObs $\gg$ $^{\pm}$Sprd-R(+nas) $\gg$ $^{\pm}$NoNasV $\gg$ Id(nas)

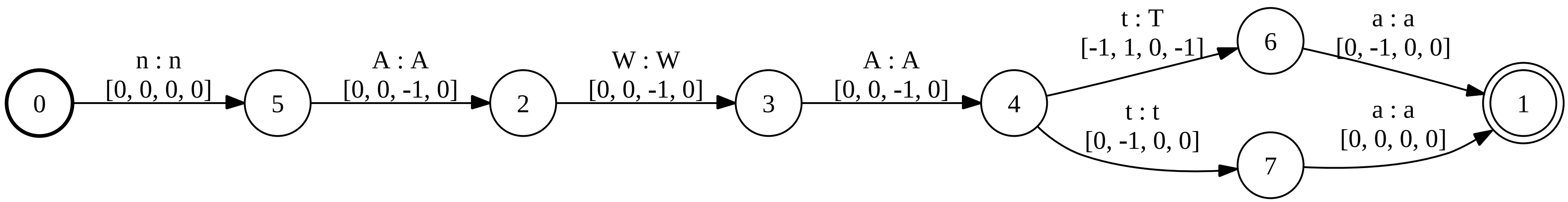
out_3 = Eval(H, nAWAta) =



Example: myopia

$^{\pm}$NoNasObs $\gg$ $^{\pm}$Sprd-R(+nas) $\gg$ $^{\pm}$NoNasV $\gg$ Id(nas)

Eval(H, Gen($^{\pm}$Sprd-R(+nas), out_3)) =

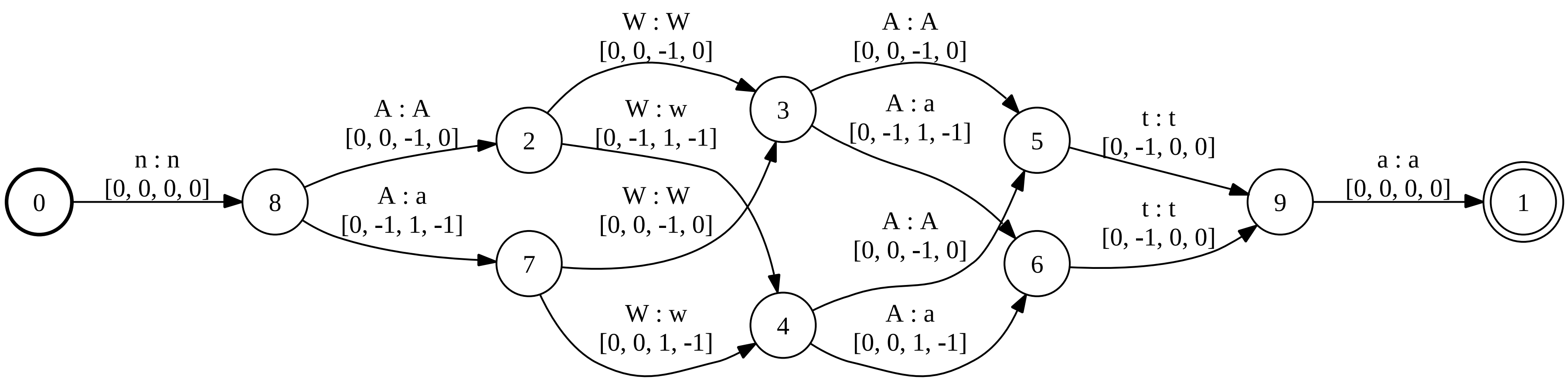


/nAWAta/	$^{\pm}$NoNasObs	$^{\pm}$Sprd-R(+nas)	$^{\pm}$NoNasV	Id(nas)
nAWATa	-1!		-3	-1
nAWAta		-1	-3	

Example: myopia

$^{\pm}$NoNasObs $\gg$ $^{\pm}$Sprd-R(+nas) $\gg$ $^{\pm}$NoNasV $\gg$ Id(nas)

Eval(H, Gen($^{\pm}$NoNasV, out_3)) =



How it works

- Evaluation by $^{\pm}$SPRD-R(+nas) does not "look ahead" to the blocking segment

- **Mark conversion** ensures that partial spreading beats non-spreading

  $\text{nAW}\underset{-}{\text{a}}\text{ta} \rightarrow \text{nAW}\underset{+}{\text{A}}\underset{-}{\text{t}}\text{a} \succ \text{nAW}\underset{-}{\text{a}}\text{ta}$

- **Mark indelibility** ensures that retraction of partial spreading is worse than no change

  $\text{nAWA}\underset{-}{\text{t}}\text{a} \rightarrow \text{nAWA}\underset{-}{\text{t}}\text{a} \succ \text{nAW}\underset{-}{\text{a}}\underset{-}{\text{t}}\text{a}$

Factorial typology

- Blockers
  $^{\pm}$NoX[αF] $\gg$ $^{\pm}$Spread-R(αF)

- Undergoers
  $^{\pm}$Spread-R(αF) $\gg$ $^{\pm}$NoY[αF]

- Transparent segments require additional assumptions of the TCOT account of opacity

Ranking for Arabela

$^{\pm}$NoNasObstrStop

|

$^{\pm}$NoNasFric

|

$^{\pm}$NoNasLiquid

|

$^{\pm}$Spread-R(+nasal)

|

$^{\pm}$NoNasGlide

|

$^{\pm}$NoNasVowel

Summary

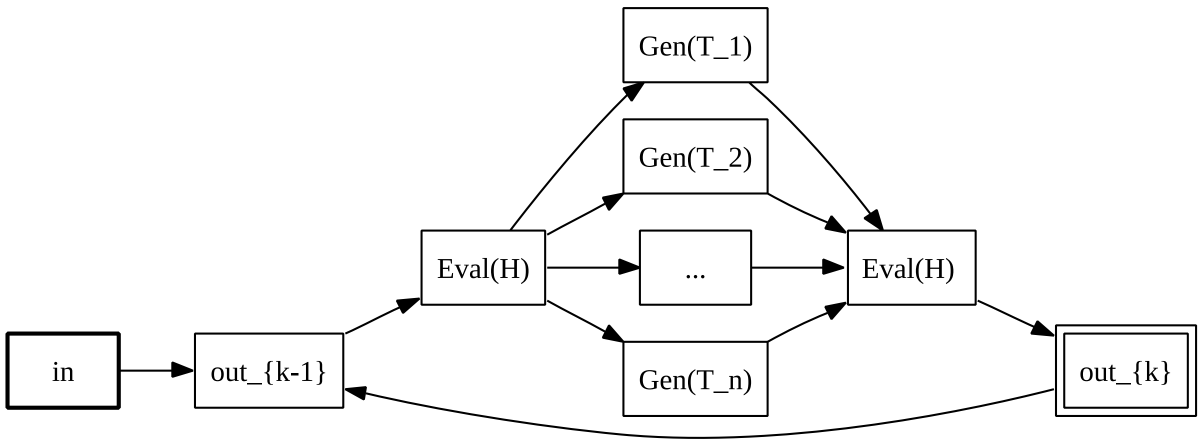
- Myopia is a universal property of unbounded spreading not accounted for within OT
- TCOT combines the strengths of rule-based analyses, which easily capture myopia, and OT, which is more explanatory w.r.t. blocking
- Key to the TCOT analysis is the regulation of positive and negative marks, and iterative opt

General properties of TCOT

- No global constraints on derivations
- Computational complexity
- Proving convergence

No global constraints

- Optimization in TCOT is strictly iterative: no constraint evaluates entire derivations



- This is a point of difference between TCOT and Candidate Chain OT (McCarthy 2006)

Computational complexity

- OT: **Exponential** in |Con|, **polynomial** in |input| (at best; see Eisner 2000); some grammars can be compiled to linear-time transducers (Riggle 2004)

- TCOT: **Exponential** in |Con|, **polynomial** in |input| at each iteration (at best); should be possible to extend grammar compilation to this case — working on the details

Computational complexity

- CC-OT: Literal implementation of Becker (2006) is easily **factorial** in |input| (because it enumerates all $n!$ orderings of n steps)

$$
\begin{array}{lcccc}
10! \approx 3,600,00 & > & 2^{10} \approx 1024 & > & 10^2 \\
20! \approx 2.4 \times 10^{18} & > & 2^{20} \approx 1 \times 10^6 & > & 20^2
\end{array}
$$

- Candidate sets in CC-OT and TCOT (under sensible conditions) are finite — but current implementations are either demonstrably intractable (NP) or not known to be tractable

Proving convergence

- Proof of convergence follows from a bound on iteration by individual targeted constraints
- For every targeted constraint T and every representation A, there must be a $k \geq 0$ s.t. H-MAX(GEN^{k+1}(T,A)) = H-MAX(GEN^{k}(T,A))
- Equivalently, for every targeted constraint T there is a function f bounded below by 0 s.t. for all A, f(GEN(T,A)) < f(A) or GEN(T,A)=A

Proving convergence

- $^{\pm}$SPREAD-R(+nasal)
  A suitable function f sums the number of segments intervening between each [+nasal] segment and the right edge of the domain (= the eval function for ALIGN-R(+nasal)!)

- $^{\pm}$NONASGLIDE
  Obvious function f counts the number of nasal glides (= –(negative violations))

Thank you!

Selected references

Hopcroft, J.E. and J.D. Ullman. 1979. Introduction to automata, languages and computation. Reading, MA: Addison-Wesley

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Rich, Furne. 1963. Arabela Phonemes and High-Level Phonology. In Benjamin F. Elson (ed.), *Studies in Peruvian Indian Languages: I*. University of Oklahoma: SIL

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Extensions

Phonological opacity in TCOT

Projecting targeted constraints from the P-map

Phonological opacity in TCOT

- **Conservation of harmony** (assumed above)
  Positive and negative marks occupy the same position in the hierarchy

- Phonological opacity results from rankings in which **harmony is not conserved**

- A **monotonicity** condition prevents iterative optimization from cycling endlessly

Example: transparent obstructions

$^{+}$NONASVOC

|

$^{+}$SPREAD-R(+nasal)

|

$^{\pm}$NONASOBSTR

|

$^{-}$SPREAD-R(+nasal)

|

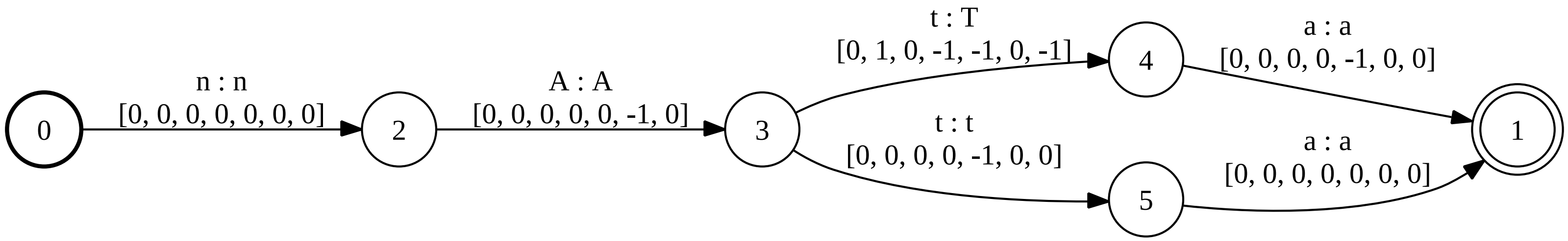
$^{-}$NONASVOC

|

IDENT(nasal)

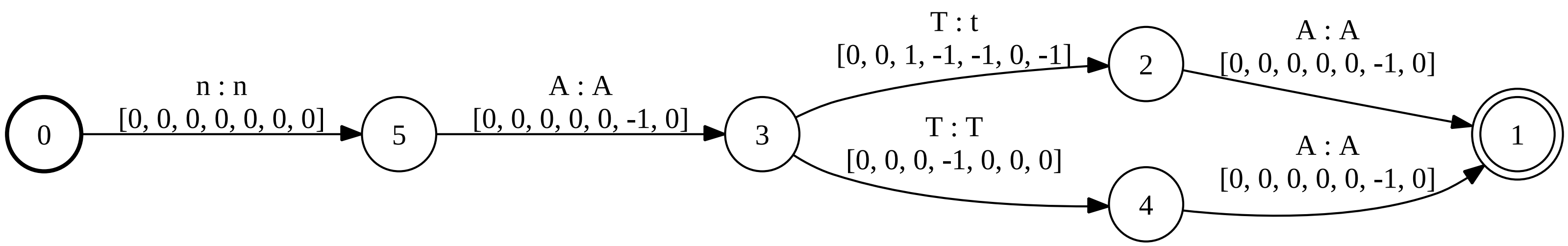
Example: transparent obstruents

$^{+}$SPREAD-R(+nasal) $\gg$ $^{\pm}$NONASOBSTR



Example: transparent obstruents

$^{\pm}$NoNasObstr $\gg$ $^{-}$Spread-R(+nasal)



Monotonicity condition

- A single extrinsic order (ranking) controls both harmonic ordering and generation

- Given derivation $out_0, out_1, \ldots, out_n$ and corresponding sequence $T_1, \ldots, T_n$ of generating constraints

  $T_i \gg T_{i+1}$ or $T_i = T_{i+1}$ for all $1 \leq i < n$

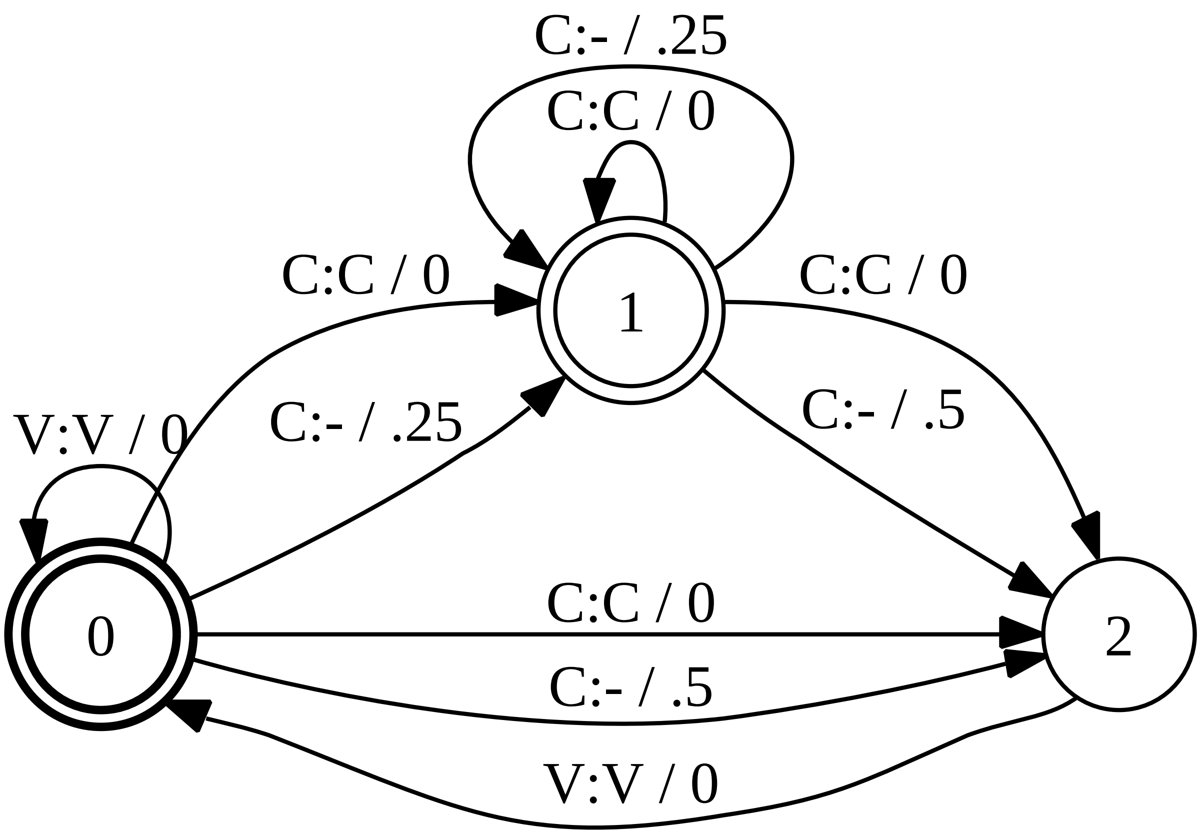
- Computational cost is trivial: store a pointer to the most recent generating constraint

Projecting targeted constraints

- P-map (Steriade 2001) encodes perceptual similarity relations in phonological contexts
- Targeted constraints can be projected from the P-map if the latter is formalized as a fsm that is unambiguous on the input side
- Select marked structure X and perceptibility threshold θ, prune unfaithful arcs above θ

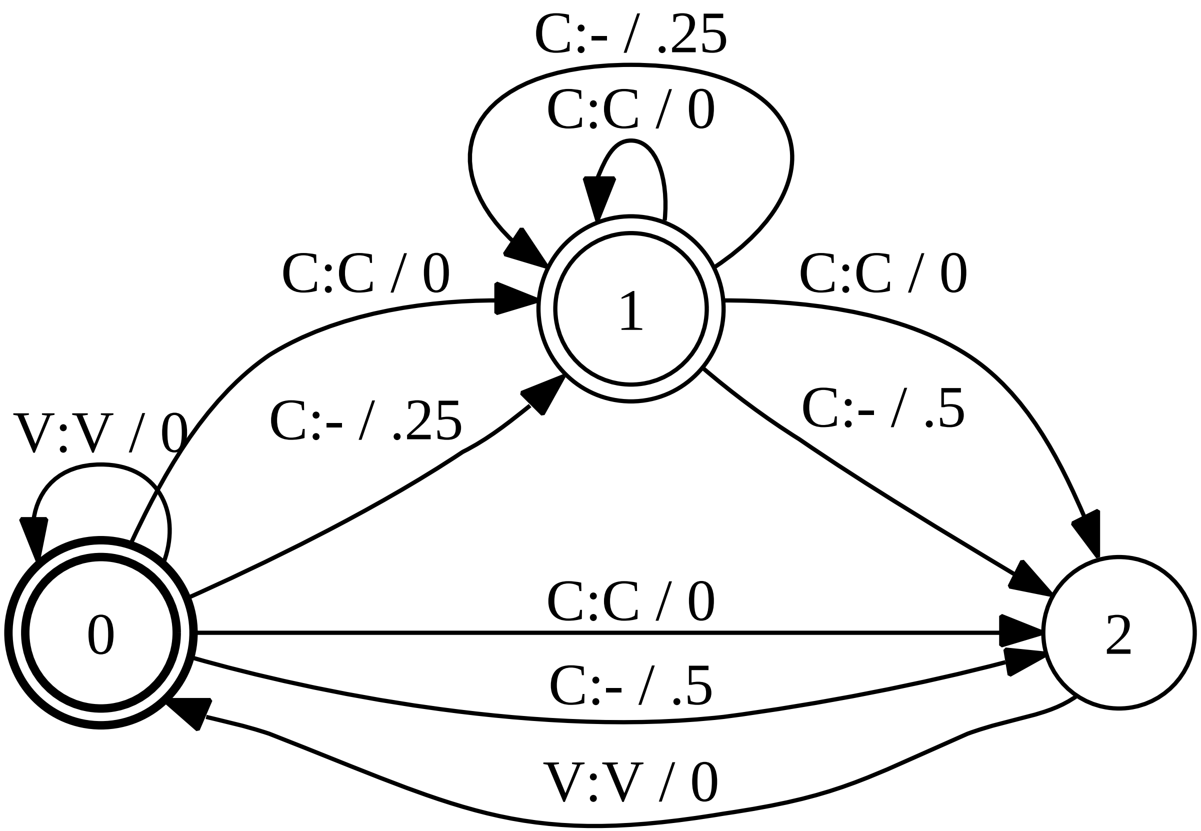
Projecting targeted constraints

P-map fragment



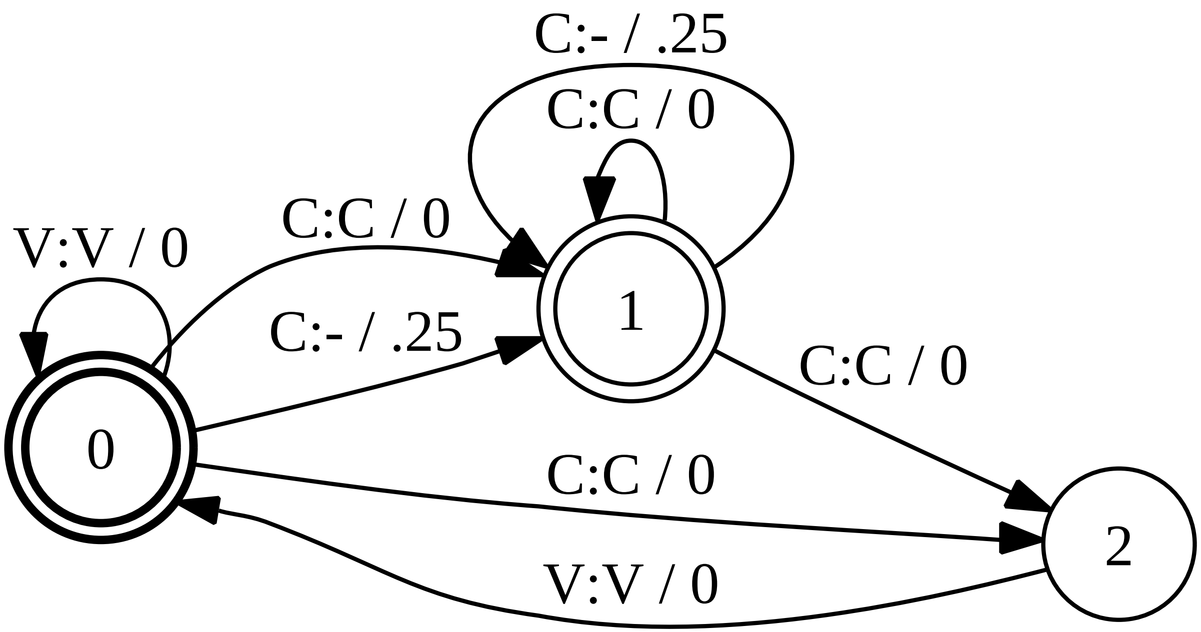
Projecting targeted constraints

X = C, θ = .3



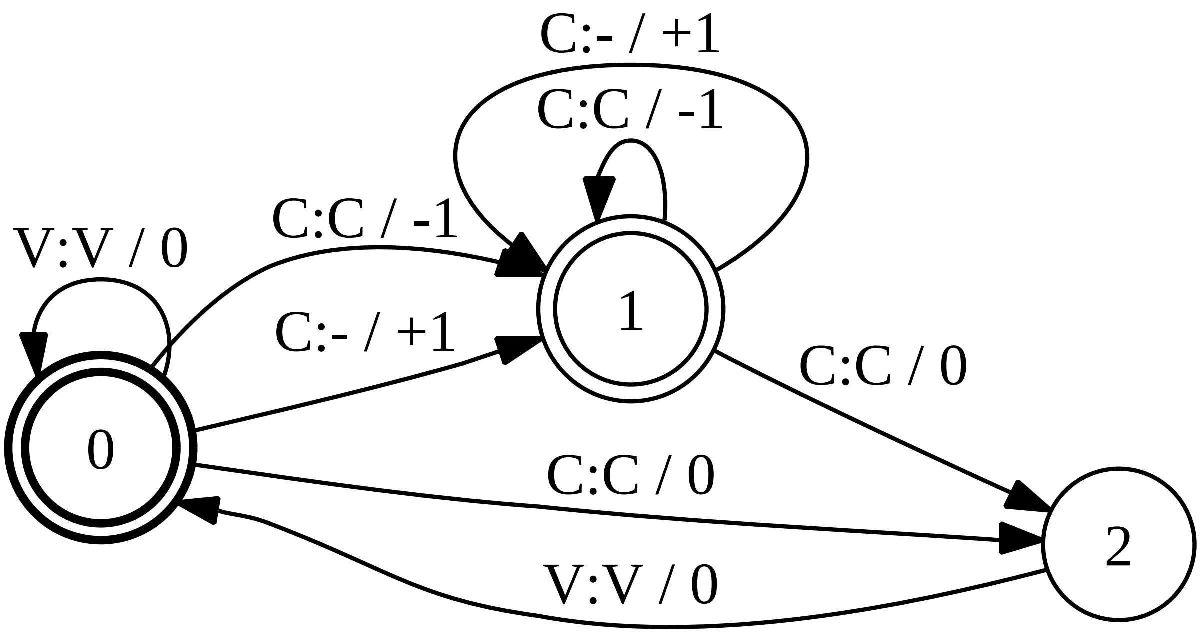
Projecting targeted constraints

X = C, θ = .3



Projecting targeted constraints

X = C, θ = .3



Projecting targeted constraints

- P-map fragment needed to project $^{\pm}$SPREAD-R(+nasal) would reflect perseveratory nasal coarticulation
- In general, need internal domination (Prince 2001) to prefer higher-similarity repairs among those that fall below threshold θ