Morphotactics in an information-based model of realisational morphology

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Introduction

- Two traditions for dealing with morphotactics
  - Sequential templates
    - Standardly used for description of non-trivial systems
    - Linear order stated directly
    - Deviations from a rigid template commonly stated in prose
    - No agreed upon formal model
  - Stem-centric morphological composition
    - Most common approach in generative morphology
    - Linear order derived from composition structure
    - Implemented in various formal models, including (Anderson, 1992; Lieber, 1980; Stump, 2001, etc.)
- Our goals:
  - Investigate an extended typology, focusing on
    - Free and conditioned reordering
    - Indexing schemes (absolute, head-relative, edge-relative)
  - Provide a formal model of morphotactics where
    - Linear position is a descriptive primitive
    - There is no rule ordering of any kind
    - Morphotactics can be partially separated from exponence

Non-canonical morphotactics

- Canonical inflectional systems
  - are characterised by strictly ordered position classes
  - realise exponents that stand in paradigmatic opposition in the same surface slot
- Departure from canonical morphotactics
  - Parallel position classes (positional disambiguation)
  - Conditioned reordering
    - Individual classes
      - relative to stem (ambifixal): Swahili relative marking
      - independent of stem: Fula reversible classes, Swahili negative
      - relative to edge (Sorani Kurdish person markers)
    - Sequences of classes
      - Order preserving (Italian prominal affix clusters)
      - Order reversing (Huave; Kim, 2010)
  - Free permutation
    - unconstrained (Chintang)
    - partially constrained (Mari)

Positional disambiguation: Swahili (Stump, 1993)

- Swahili subject and object agreement are realised in distinct slots (2 and 5)
- Inventories for expressing person-number-gender combinations are largely identical across functions and slots
  Exceptions: 2/3 SG M/WA class
- Exponents largely underspecified as to grammatical function
- Morphotactic position disambiguates to subject or object functions

PER	GEN	SUBJECT		OBJECT	
		SG	PL	SG	PL
1		ni	tu	ni	tu
2		u	m	ku	wa
3	M/WA	a	wa	m	wa
	M/MI	u	i	u	i
	KI/VI	ki	vi	ki	vi
	JI/MA	li	ya	li	ya
	N/N	i	zi	i	zi
	U	u	—	u	—
	U/N	u	zi	u	zi
	KU	ku	—	ku	—

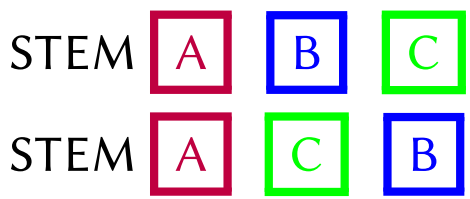
- Schematically: A B C D E STEM G H

Conditioned reordering: Fula (Stump, 1993)

- When suffixal, subject and object markers follow tense markers
- Standard (default) order is subject before object
- Singular objects, however, precede 1st singular subjects (reversal)

mball	u	ɗon	mo	'You (pl.) helped him.'
mball	u	mi	ɓe	'I helped them.'
mball	u	moo	mi	'I helped him.'

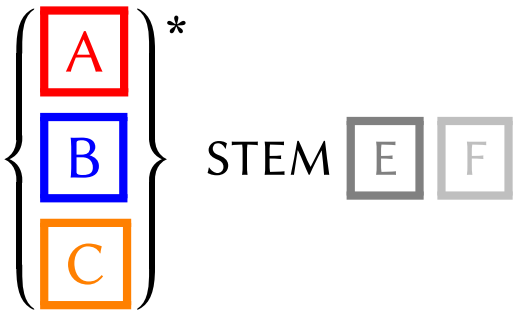
- Schematically:



Freely ordered position classes: Chintang

- Chintang verb prefixes (Bickel et al., 2007)
  - can be freely permuted
  - prefixes encode subject and object agreement, as well as negation
  - Suffixes in Chintang, however, are strictly ordered in position classes

u	kha	ma	cop	yokt	e	'They didn't see us.'
u	ma	kha	cop	yokt	e	'They didn't see us.'
kha	u	ma	cop	yokt	e	'They didn't see us.'
kha	ma	u	cop	yokt	e	'They didn't see us.'
ma	u	kha	cop	yokt	e	'They didn't see us.'
ma	kha	u	cop	yokt	e	'They didn't see us.'

- Schematically: 

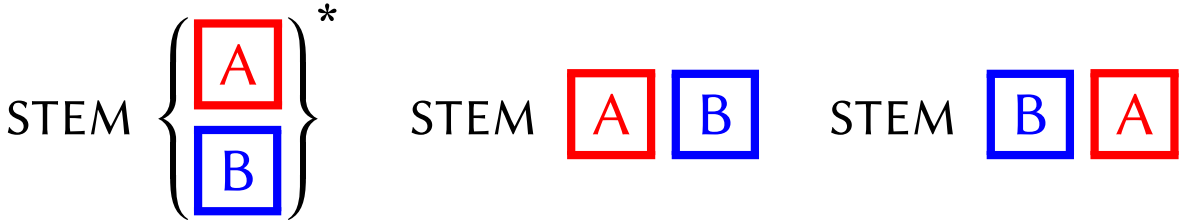
Free and conditioned reordering: Mari

- Order of possessive and case markers in Mari (Luutonen, 1997)
  - Some cases (like DAT) permute freely with possessive marker
  - Some case markers obligatorily follow the possessive marker (ACC)
  - Some case markers obligatorily precede the possessive marker (LAT)

	NOPOSS	1PL.POSS	
		POSS ≺ CASE	CASE ≺ POSS
NOM	пӧрт	пӧрт-на	
ACC	пӧрт-ым	пӧрт-на-м	*
DAT	пӧрт-лан	пӧрт-на-лан	пӧрт-лан-на
LAT	пӧрт-еш	*	пӧрт-еш-на

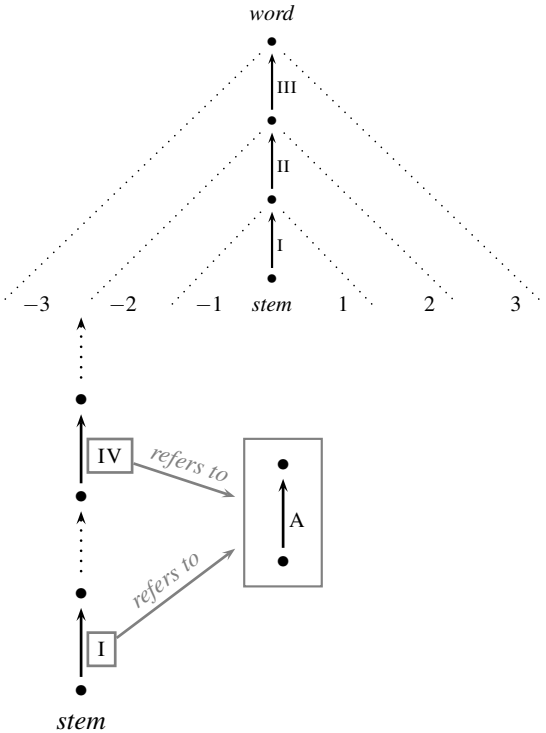
Table : Partial paradigm of Mari possessed nouns (Riese et al., 2010)

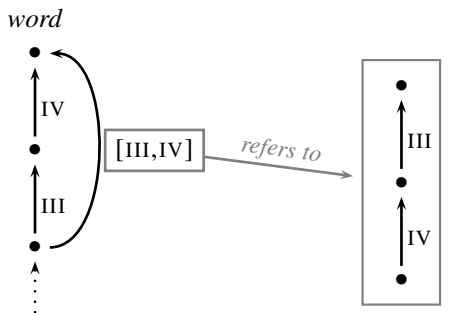
- Schematically:



Previous approaches: PFM (Stump, 1993, 2012)

- PFM invokes ordered rule blocks to
  - derive morph ordering inside-out, starting with the stem
  - ensure completeness of realisation
  - artificially limits Pāṇinian competition to same position class
- Canonical ordering follows rule block indices
- Variable morphotactics are captured by a variety of overrides
  - referral to unordered rule block (parallel position classes)
  - referral to inverted rule block sequence (reversible position classes)
  - underspecification of rule block indices (Chintang; Stump, 2012)
  - Conditioned pre-/suffixation within rule blocks (ambifixals)





Previous approaches: Crysmann and Bonami (2012)

- Crysmann and Bonami (2012) dissociate position class (PC) indices from classes of paradigmatic opposition (=rule blocks; POI)
- Variable morphotactics are captured by underspecification
  - Rules are organised in an inheritance hierarchy
  - Systematic alternation is modelled by Koenig-style online type construction
- Rule blocks serve to ensure morphological well-formedness (completeness)
- Major drawbacks (inherited from the PFM model):
  - Pāṇinian competition limited to single rule blocks
  - Paradigmatic opposition entirely stipulated
  - Two indexing schemes (POI and PC)

Information-based realisational morphology

- Similar in spirit to Paradigm Function Morphology
  - Fully lexicalist: no morphological structure visible to syntax, no syntactic operations or constraints in morphology.
  - Inferential and realisational
  - No ordering of morphosyntactic features
  - Arbitration between rules decided on the basis of Pāṇini's Principle
- Important differences
  - Position is a property of exponents, not a property of rules.
  - Order variation by underspecification
    - HPSG-style feature logic
    - Multiple inheritance hierarchies of realisation rules
  - Systematic separation between order and paradigmatic opposition
    - No rule ordering
    - No rule blocks
  - Distinction between *realising* a feature and being *conditioned* by a feature (cf. Carstairs 1987 or LFG's distinction between functional and constraining equations)

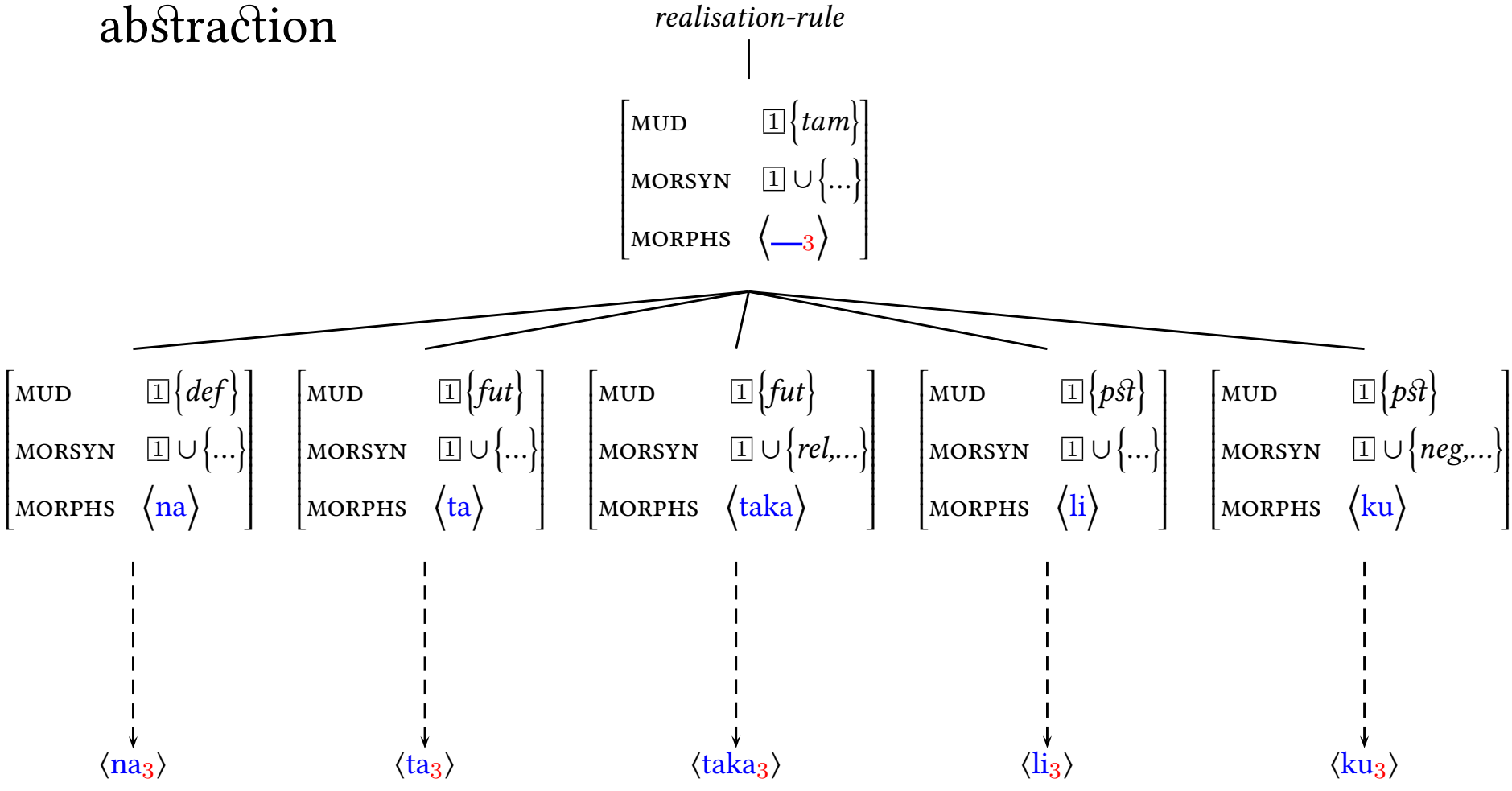
Realisation rules and rule interaction

- Realisation rules are triplets of
  - a description of a lexeme identifier
  - a description of a morphosyntactic property set
  - a description of a list of morphs

$$\begin{bmatrix} \textsc{lid} & \begin{bmatrix} \textsc{class} & \textit{weak} \end{bmatrix} \\ \textsc{mud} & \boxed{1}\{ppp\} \\ \textsc{morsyn} & \boxed{1} \cup \textit{set} \\ \textsc{morphs} & \left\langle \begin{bmatrix} \textsc{ph} & \text{<ge>} \\ \textsc{pc} & \textit{-1} \end{bmatrix}, \begin{bmatrix} \textsc{ph} & \text{<t>} \\ \textsc{pc} & \textit{1} \end{bmatrix} \right\rangle \end{bmatrix}$$

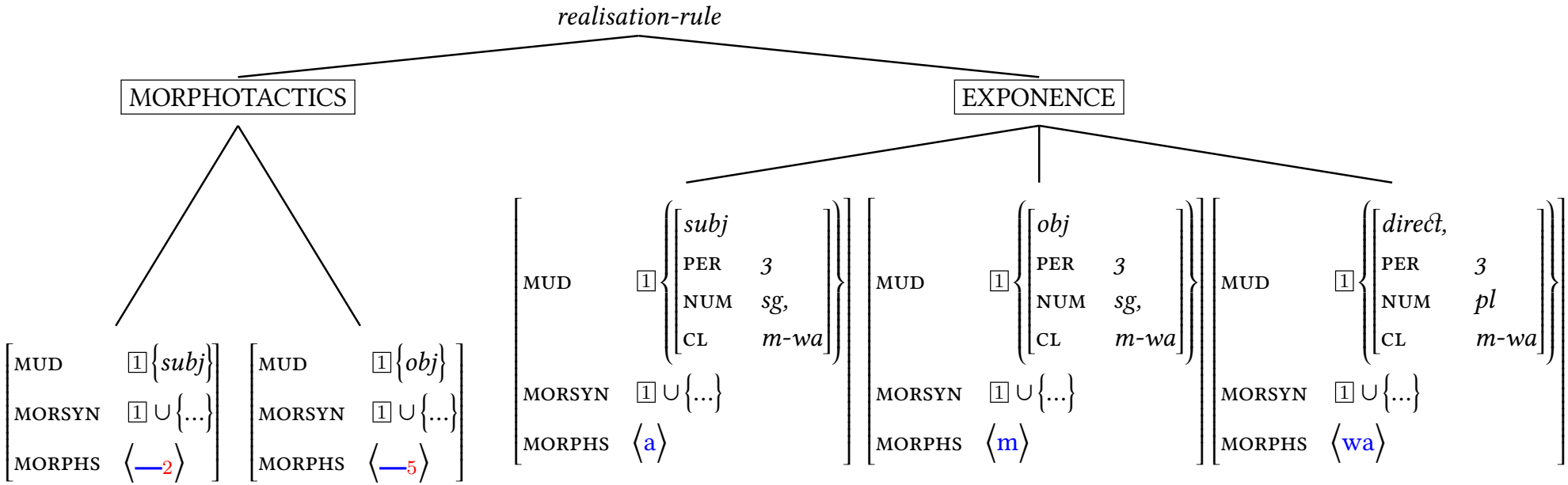
Underspecified descriptions of rules, part 1

- Rules are organized in a (monotonic) inheritance hierarchy permitting elimination of vertical redundancy by means of type abstraction



Underspecified descriptions of rules, part 2

- Online type construction (Koenig, 1999; Koenig and Jurafsky, 1994) permits elimination of horizontal redundancy (systematic alternation)



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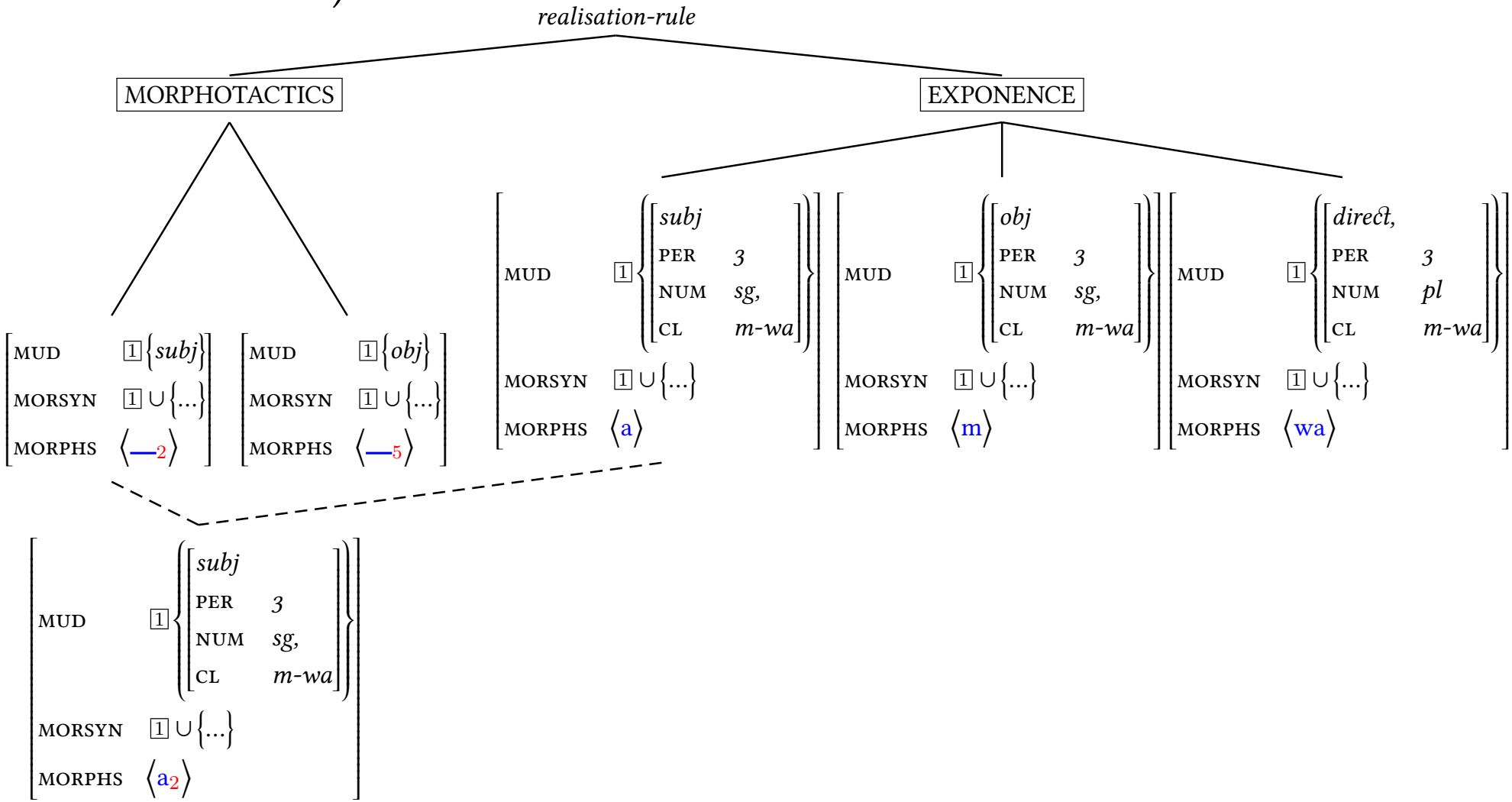

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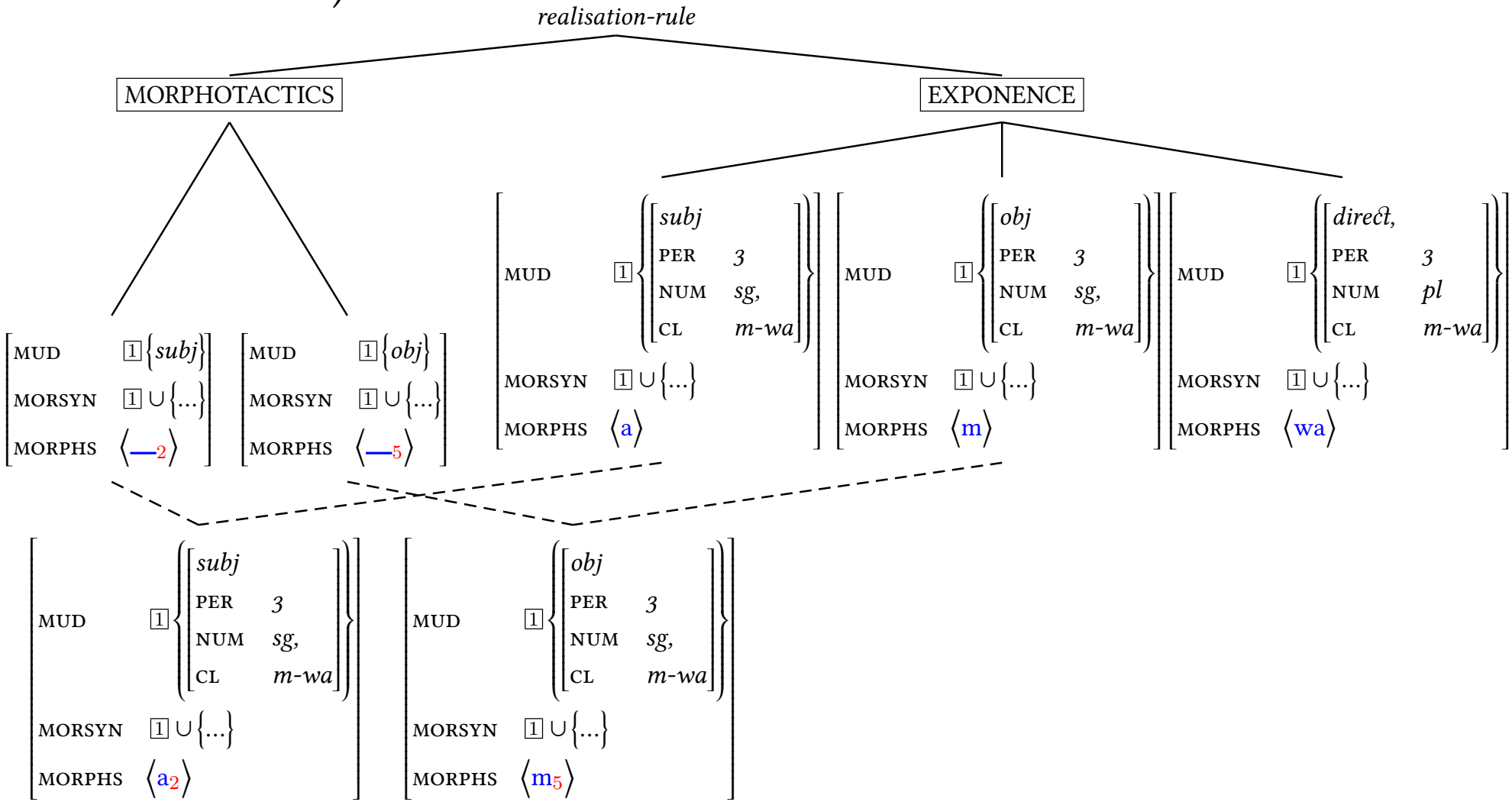

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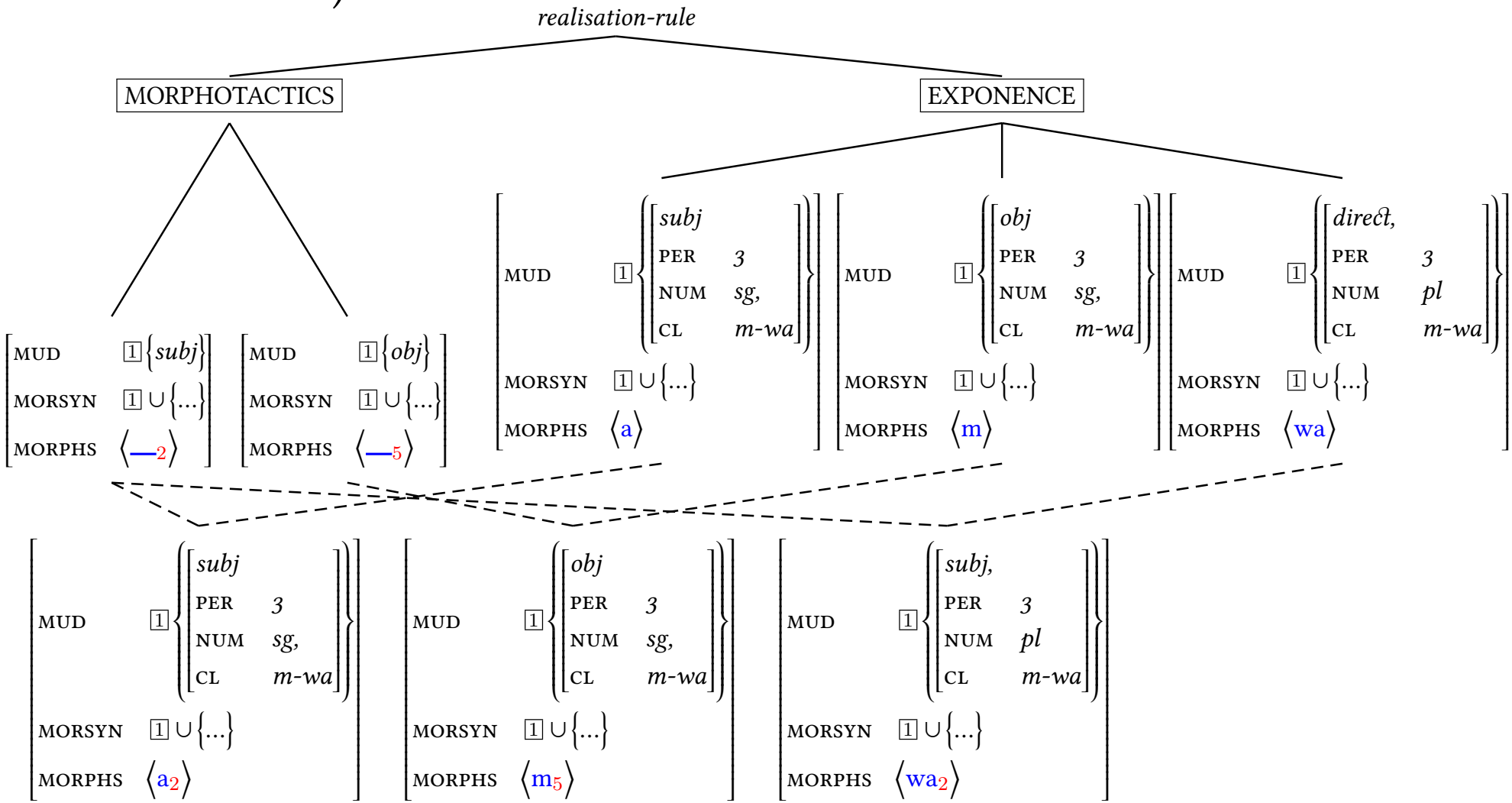

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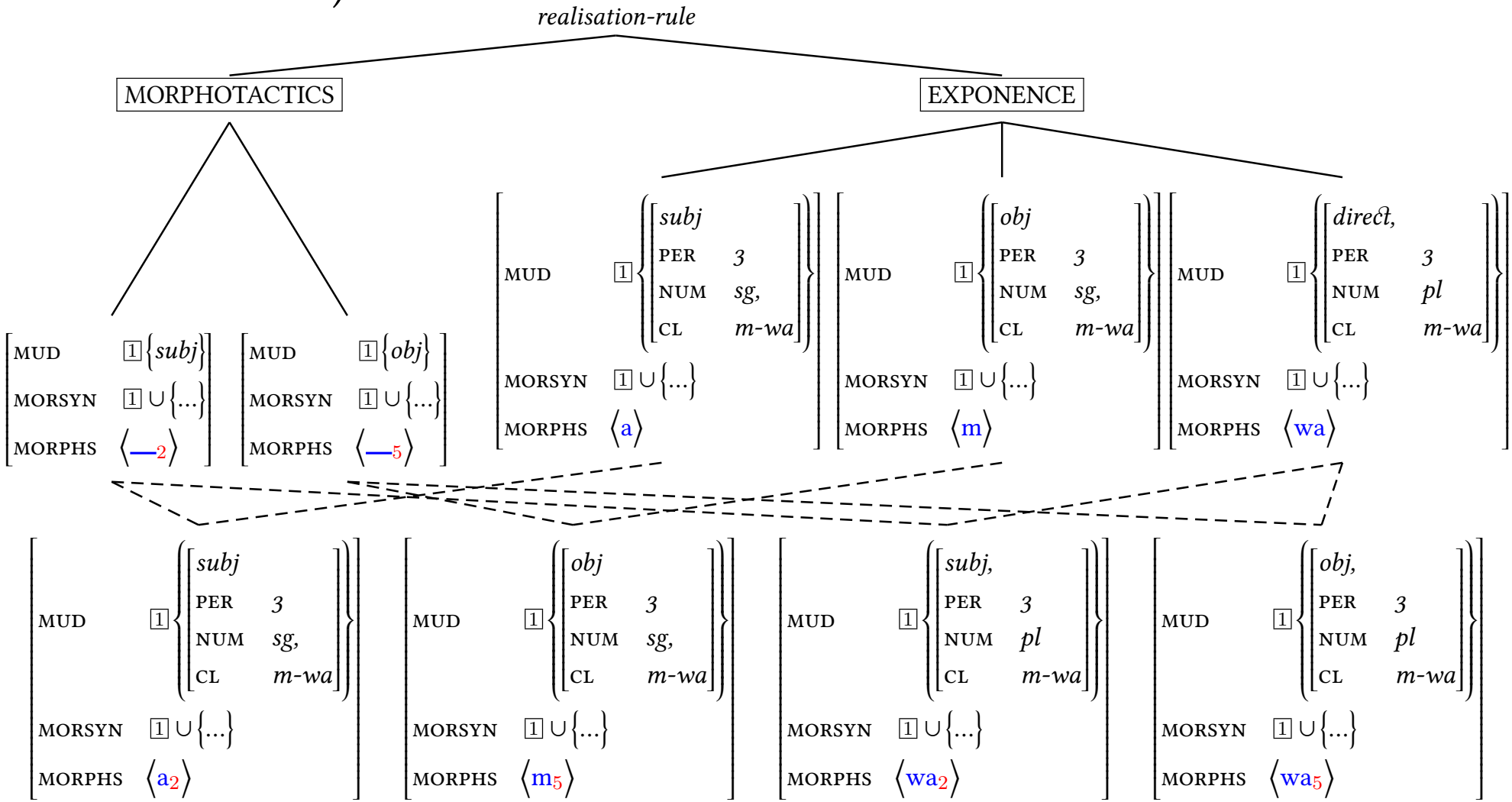


Morphological well-formedness

- Realisation rules specify
  - which features they express (MUD)
  - which features they are conditioned by (MORSYN)
  - which exponents they introduce (MORPH)

(1)
$$\begin{bmatrix} \textsc{mud} & \langle neg \rangle \\ \textsc{morph} & \left\langle \begin{bmatrix} \textsc{ph} & \langle \text{ha} \rangle \\ \textsc{pc} & 1 \end{bmatrix} \right\rangle \end{bmatrix}$$

- Word-level wellformedness definable as exhaustion of morphosyntactic input

(2)
$$word \rightarrow \begin{bmatrix} \textsc{morphs} & \boxed{e_1} \bigcirc \cdots \bigcirc \boxed{e_n} \\ \textsc{morsyn} & \boxed{0} \left(\boxed{m_1} \uplus \cdots \uplus \boxed{m_n} \right) \\ \textsc{rules} & \left\langle \begin{bmatrix} \textsc{morph} & \boxed{e_1} \\ \textsc{mud} & \boxed{m_1} \\ \textsc{morsyn} & \boxed{0} \end{bmatrix}, \ldots, \begin{bmatrix} \textsc{morph} & \boxed{e_n} \\ \textsc{mud} & \boxed{m_n} \\ \textsc{morsyn} & \boxed{0} \end{bmatrix} \right\rangle \end{bmatrix}$$

Morphotactic well-formedness

- Morph-ordering principle

(3) $$word \rightarrow \neg \left(\left[\textsc{morphs} \quad \left\langle \ldots \left[\textsc{pc} \quad \boxed{0} \right], \left[\textsc{pc} \quad \boxed{1} \right] \ldots \right\rangle \right] \wedge \boxed{0} \geq \boxed{1} \right)$$

NB: position class indices can be modelled in terms of lists

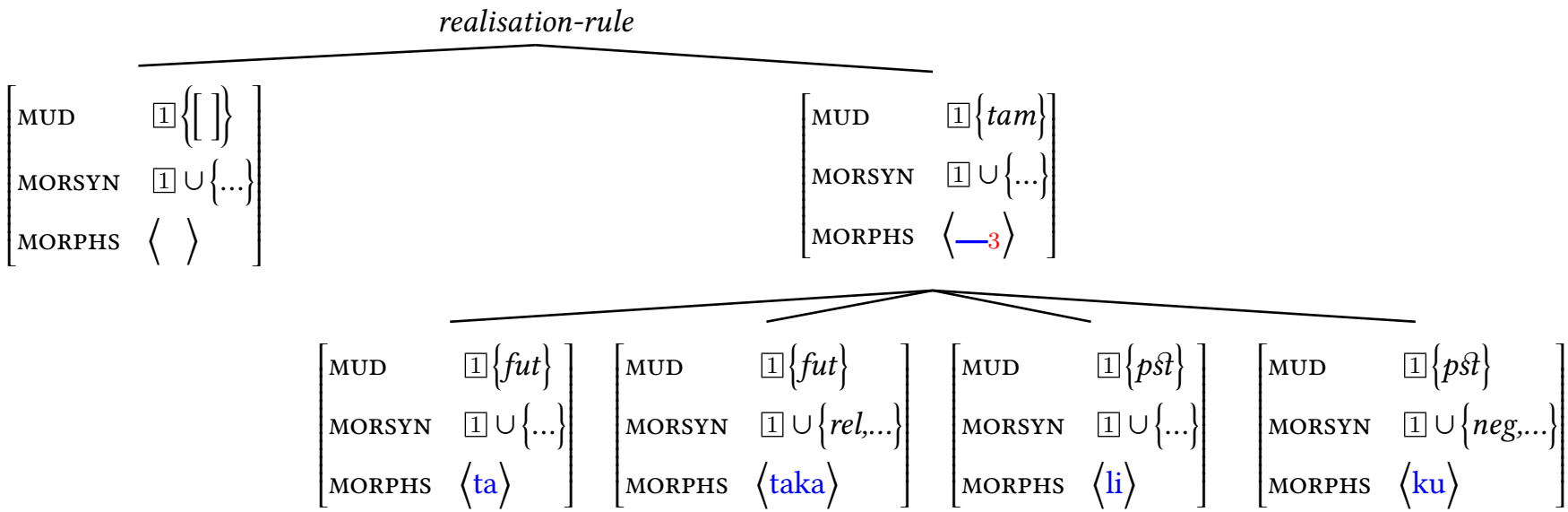
- STM feature provides a key to the stem's position class
- Position class of the stem is distributed over all morphs:

(4) $$word \rightarrow \left[\textsc{morphs} \quad \left\langle \left[\textsc{stm} \boxed{s} \right], \left[\textsc{stm} \boxed{s} \right], \ldots, \left[\textsc{stm} \boxed{s} \right] \right\rangle \right]$$

Pāṇinian competition

(5) a. For any leaf type t_1[MUD μ_1,MORSYN σ], t_2[MUD μ_2,MORSYN $\sigma \wedge \tau$] is a morphological competitor, iff $\mu_1 \subseteq \mu_2$.

b. For any leaf type t_1 with competitor t_2, expand t_1's MORSYN σ with the negation of t_2's MORSYN $\sigma \wedge \tau$: $\sigma \wedge \neg(\sigma \wedge \tau) \equiv \sigma \wedge \neg\tau$.



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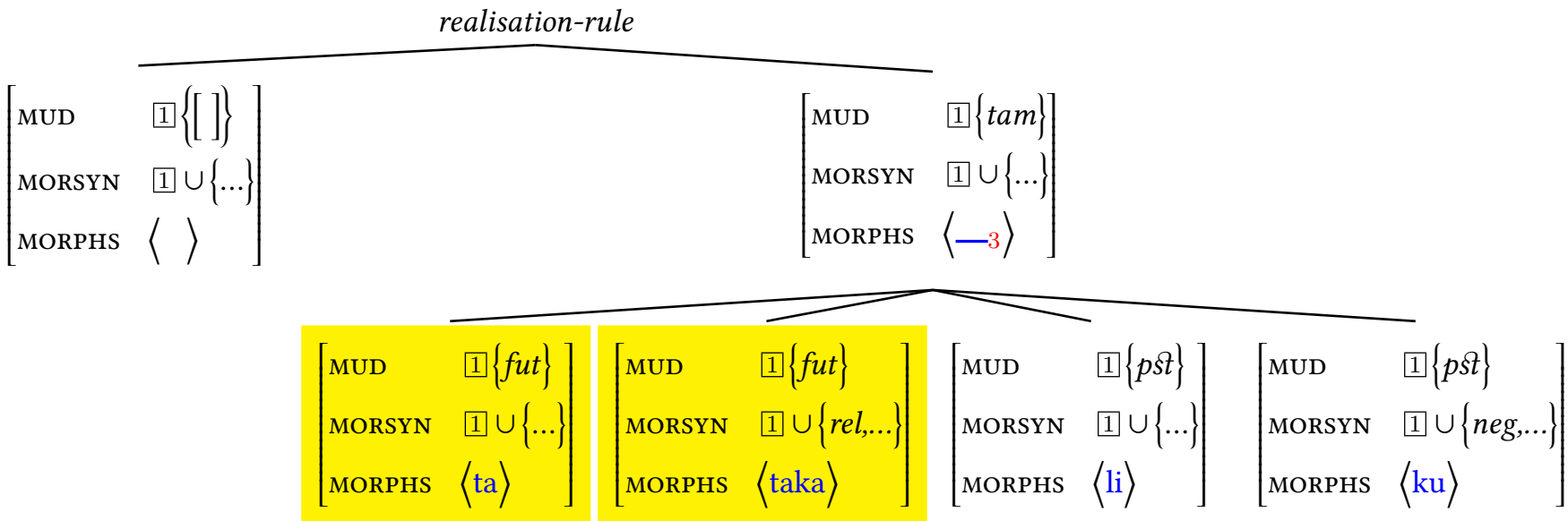

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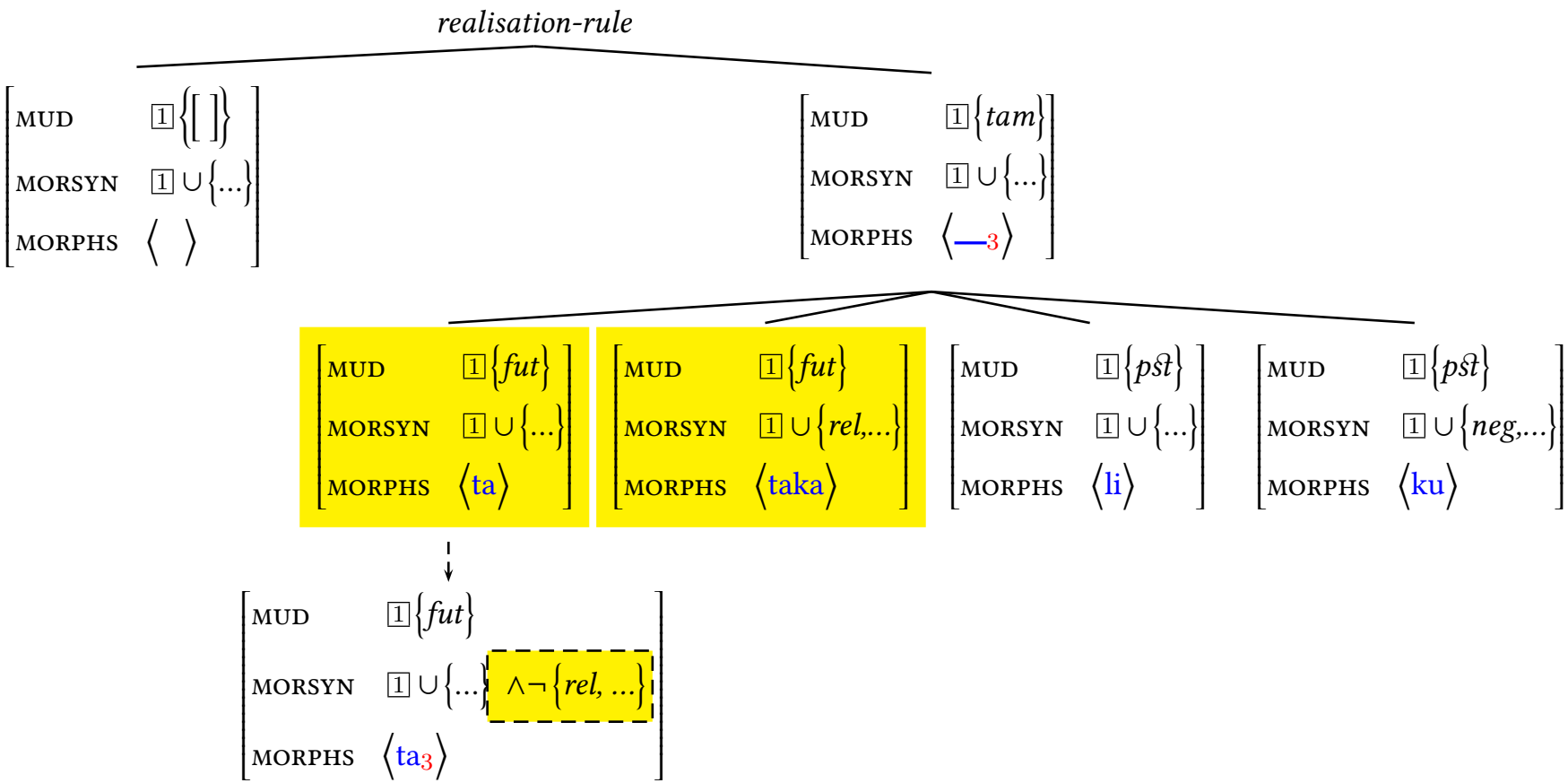

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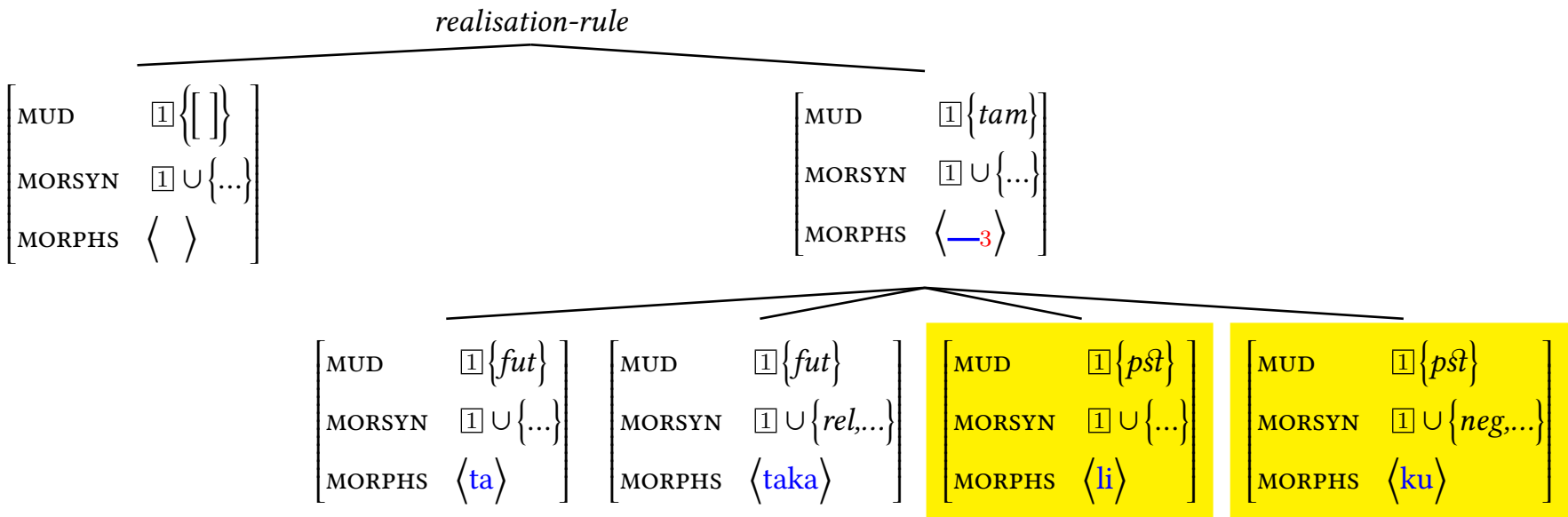

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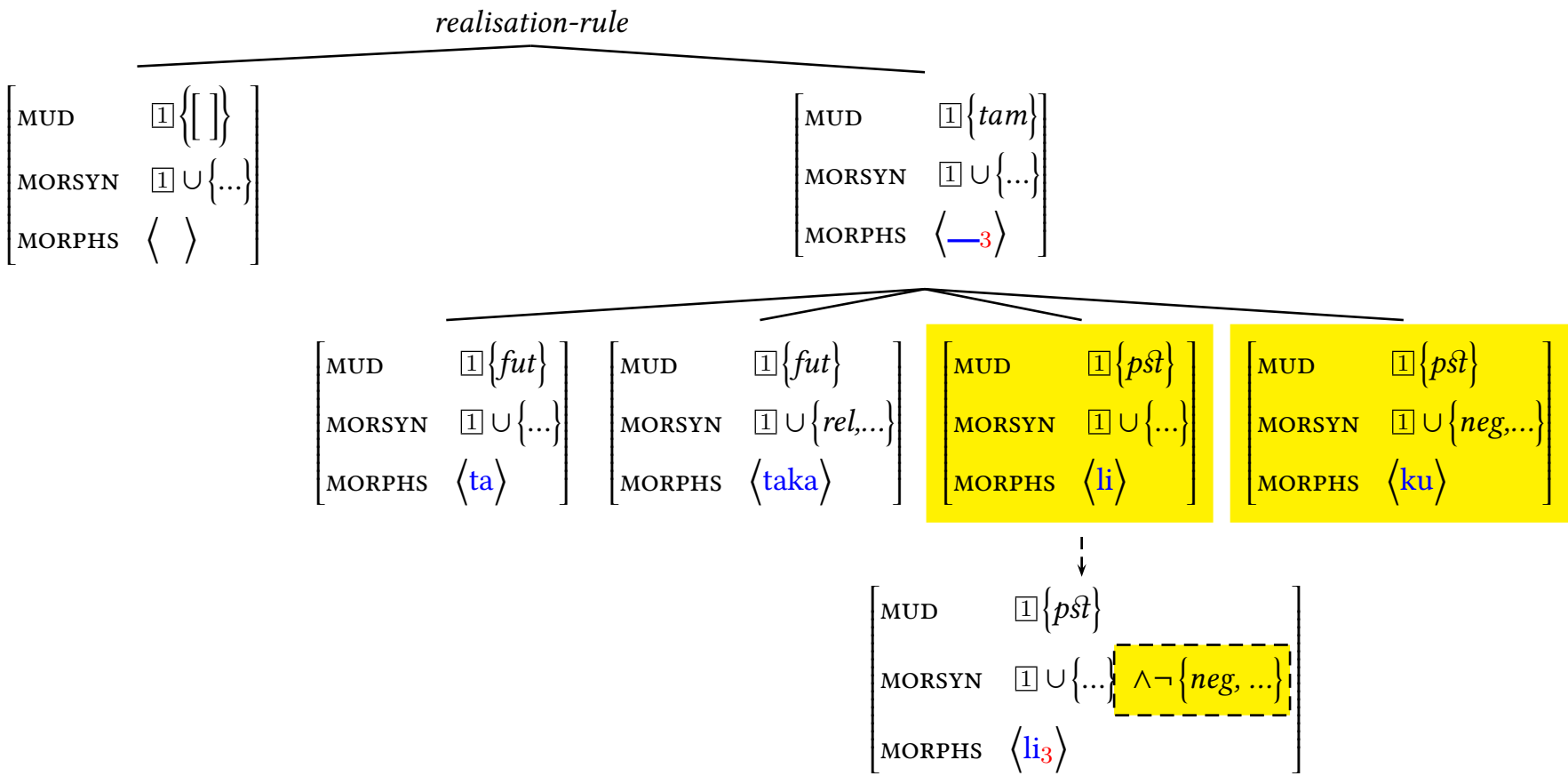

Pāṇini's principle and Swahili negation I

(6) a. *ha- wa- ta- taka*
NEG 3PL FUT want
'they will not want'

b. *watu wa- si- o- soma*
people 3PL NEG.REL REL.PL read
'people who do not read'

c. * *watu ha- wa- o- soma*
people NEG 3PL REL.PL read

d. * *watu ha- wa- si- o- soma*
people NEG 3PL NEG.REL REL.PL read

(7) a.
$$\begin{bmatrix} \text{MUD} & \{neg\} \\ \text{MORSYN} & set \\ \text{MORPHS} & \left\langle \begin{bmatrix} \text{PH} & \text{<ha>} \\ \text{PC} & 1 \end{bmatrix} \right\rangle \end{bmatrix}$$

b.
$$\begin{bmatrix} \text{MUD} & \{neg\} \\ \text{MORSYN} & \{rel\} \cup set \\ \text{MORPHS} & \left\langle \begin{bmatrix} \text{PH} & \text{<si>} \\ \text{PC} & 3 \end{bmatrix} \right\rangle \end{bmatrix}$$

Pāṇini's principle and Swahili negation II

(8) a. *ha-* *a-* *ta-* *ku-* *taka*
(NEG) 3SG.SUBJ FUT 2SG.OBJ pay
'He will not pay you.'

b. * *ha-* *ni-* *ta-* *ku-* *taka*
NEG 1SG.SUBJ FUT 2SG.OBJ pay

c. *si-* *ta-* *ku-* *taka*
NEG.1SG.SUBJ FUT 2SG.OBJ pay
'I will not pay you.'

(9) a.
$$\begin{bmatrix} \text{MUD} & \left\{ \begin{bmatrix} \textit{subj} & \\ \text{PER} & \textit{1} \\ \text{NUM} & \textit{sg} \end{bmatrix} \right\} \\ \text{MORPHS} & \left\langle \begin{bmatrix} \text{PH} & \text{<ni>} \\ \text{PC} & \textit{2} \end{bmatrix} \right\rangle \end{bmatrix}$$

b.
$$\begin{bmatrix} \text{MUD} & \left\{ \textit{neg}, \begin{bmatrix} \textit{subj} & \\ \text{PER} & \textit{1} \\ \text{NUM} & \textit{sg} \end{bmatrix} \right\} \\ \text{MORPHS} & \left\langle \begin{bmatrix} \text{PH} & \text{<si>} \\ \text{PC} & \textit{1} \vee \textit{2} \end{bmatrix} \right\rangle \end{bmatrix}$$

Extended exponence in Swahili negation

(10) a. *tu- ta- taka*
1PL FUT want
'we will want'

b. *ha- tu- ta- taka*
NEG 1PL FUT want
'we will not want'

(11) a. *tu- li- taka*
1PL PST want
'we wanted'

b. *ha- tu- ku- taka*
NEG 1PL PST.NEG want
'we did not want'

(12)

a.
$$\begin{bmatrix} \text{MUD} & \{past\} \\ \text{MORSYN} & set \\ \text{MORPHS} & \left\langle \begin{bmatrix} \text{PH} & \langle \text{li} \rangle \\ \text{PC} & 3 \end{bmatrix} \right\rangle \end{bmatrix}$$

b.
$$\begin{bmatrix} \text{MUD} & \{past\} \\ \text{MORSYN} & \{neg\} \cup set \\ \text{MORPHS} & \left\langle \begin{bmatrix} \text{PH} & \langle \text{ku} \rangle \\ \text{PC} & 3 \end{bmatrix} \right\rangle \end{bmatrix}$$

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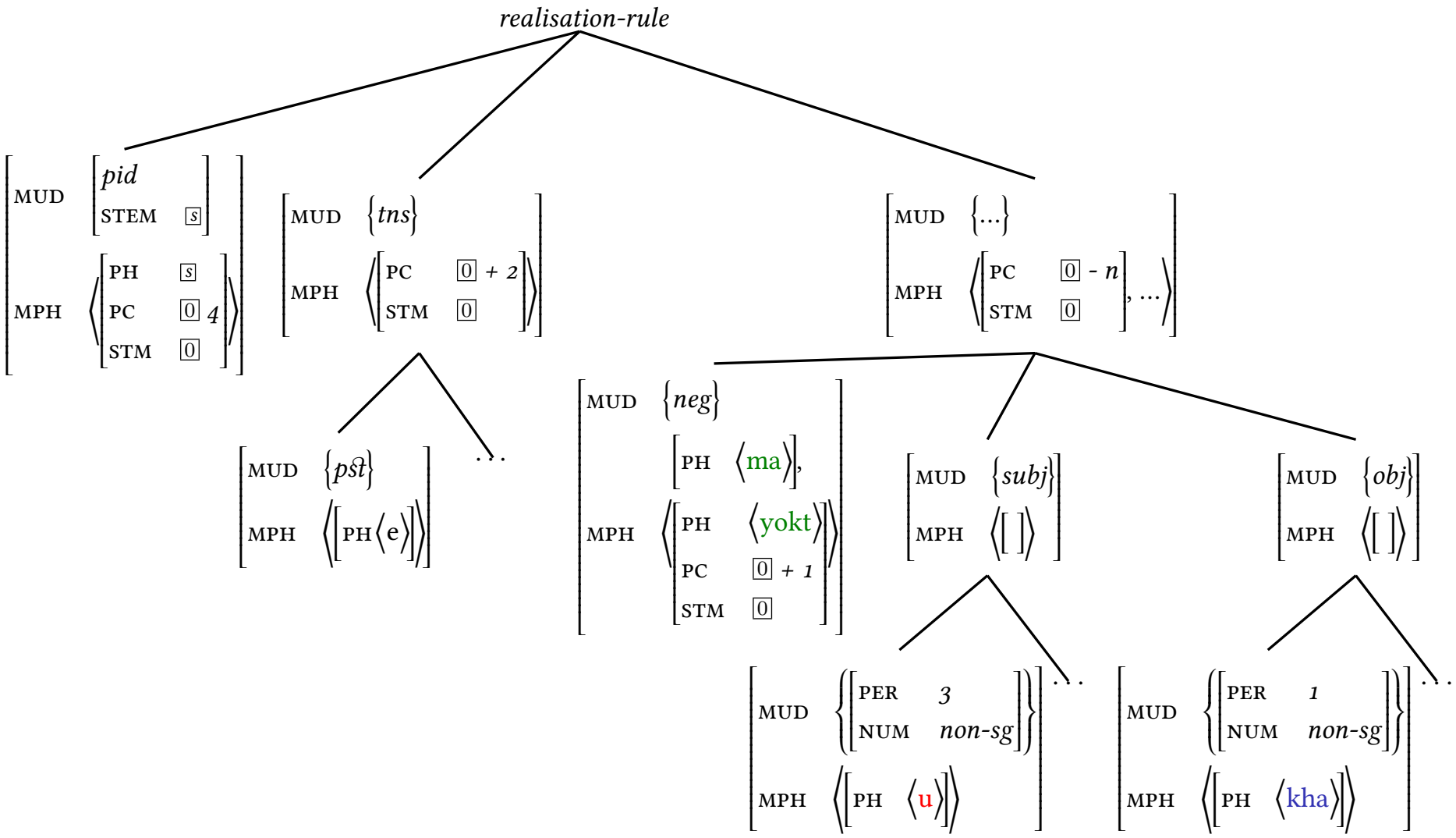
b.
$$\begin{bmatrix} \text{MUD} & \{past\} \\ \text{MORSYN} & \{neg\} \cup set \\ \text{MORPHS} & \left\langle \begin{bmatrix} \text{PH} & \langle \text{ku} \rangle \\ \text{PC} & 3 \end{bmatrix} \right\rangle \end{bmatrix}$$

Chintang



u kha ma cop yokt e ‘They didn’t see us.’

ma u kha cop yokt e ‘They didn’t see us.’

...

Mari

(13) Variable position affixes

a.
$$\begin{bmatrix} \textsc{morphs} & \left\langle \begin{bmatrix} \textsc{pc} & 1+n \\ \textsc{phon} & \text{<на>} \end{bmatrix} \right\rangle \\ \textsc{mud} & \left\{ \begin{bmatrix} \textit{poss} & \\ \textsc{per} & \textit{1} \\ \textsc{num} & \textit{pl} \end{bmatrix} \right\} \end{bmatrix}$$

b.
$$\begin{bmatrix} \textsc{morphs} & \left\langle \begin{bmatrix} \textsc{pc} & 1+n \\ \textsc{phon} & \text{<лан>} \end{bmatrix} \right\rangle \\ \textsc{mud} & \left\{ \begin{bmatrix} \textsc{case} & \textit{dat} \end{bmatrix} \right\} \end{bmatrix}$$

(14) Fixed position affixes

a.
$$\begin{bmatrix} \textsc{morphs} & \left\langle \begin{bmatrix} \textsc{pc} & 3 \\ \textsc{phon} & \text{<м>} \end{bmatrix} \right\rangle \\ \textsc{mud} & \left\{ \begin{bmatrix} \textsc{case} & \textit{acc} \end{bmatrix} \right\} \end{bmatrix}$$

b.
$$\begin{bmatrix} \textsc{morphs} & \left\langle \begin{bmatrix} \textsc{pc} & 2 \\ \textsc{phon} & \text{<еш>} \end{bmatrix} \right\rangle \\ \textsc{mud} & \left\{ \begin{bmatrix} \textsc{case} & \textit{lat} \end{bmatrix} \right\} \end{bmatrix}$$

Absolute and relative placement in Italian

- Italian pronominal affixes (Monachesi, 1999):
  - Occur in a fixed order of 6 positions

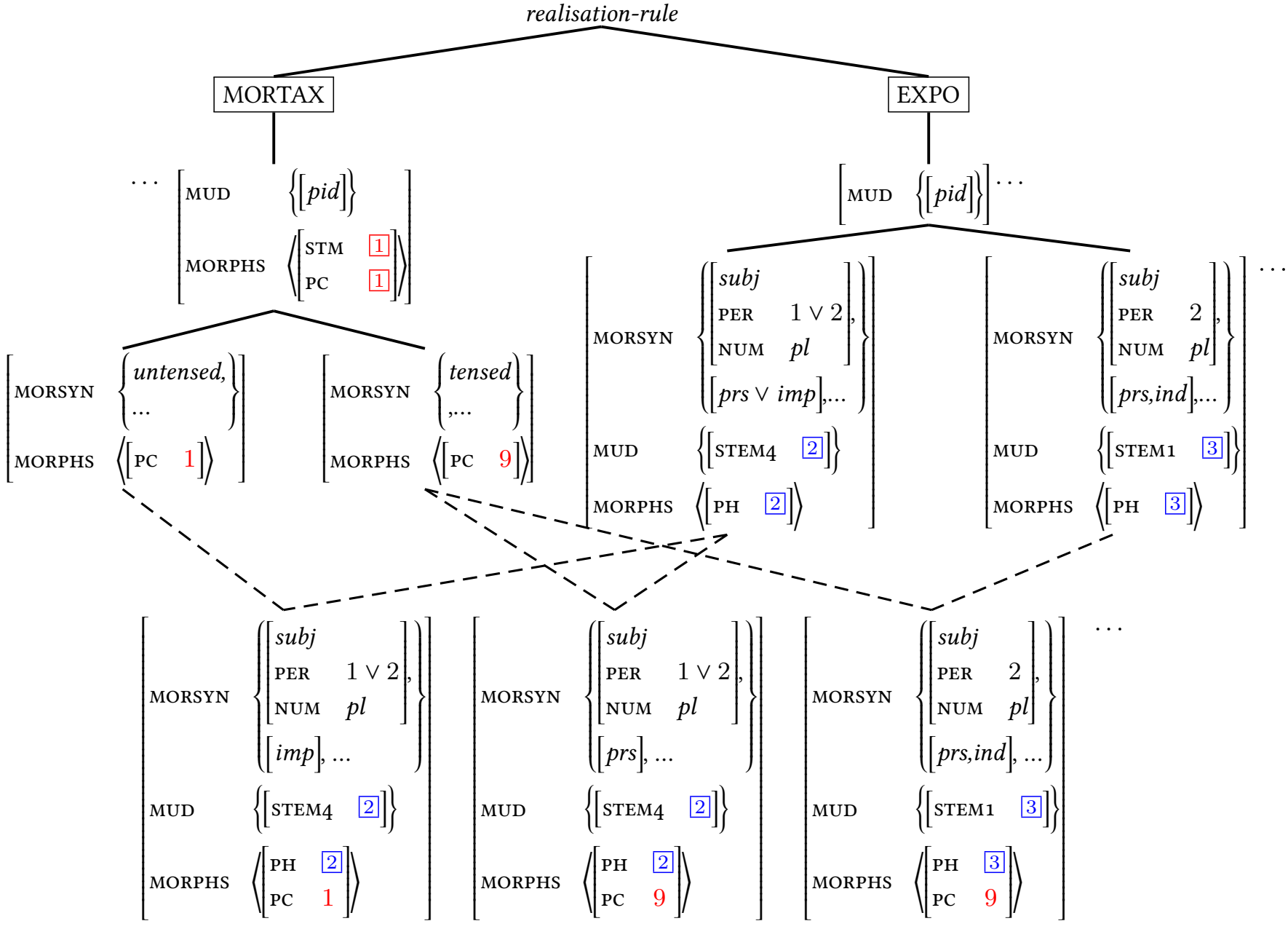
A	B	C	D	E	F
[*obj,1sg*]:	[*loc*]:	[*obj, 3, refl*]:	[*d-obj,3sg,m*]:	[*obj, imp*]:	[*part*]:
mi	ci	si	lo	si	ne
...			...		

  - Occur on either side of the stem depending on context
  - Order within the cluster is the same on either side of the stem

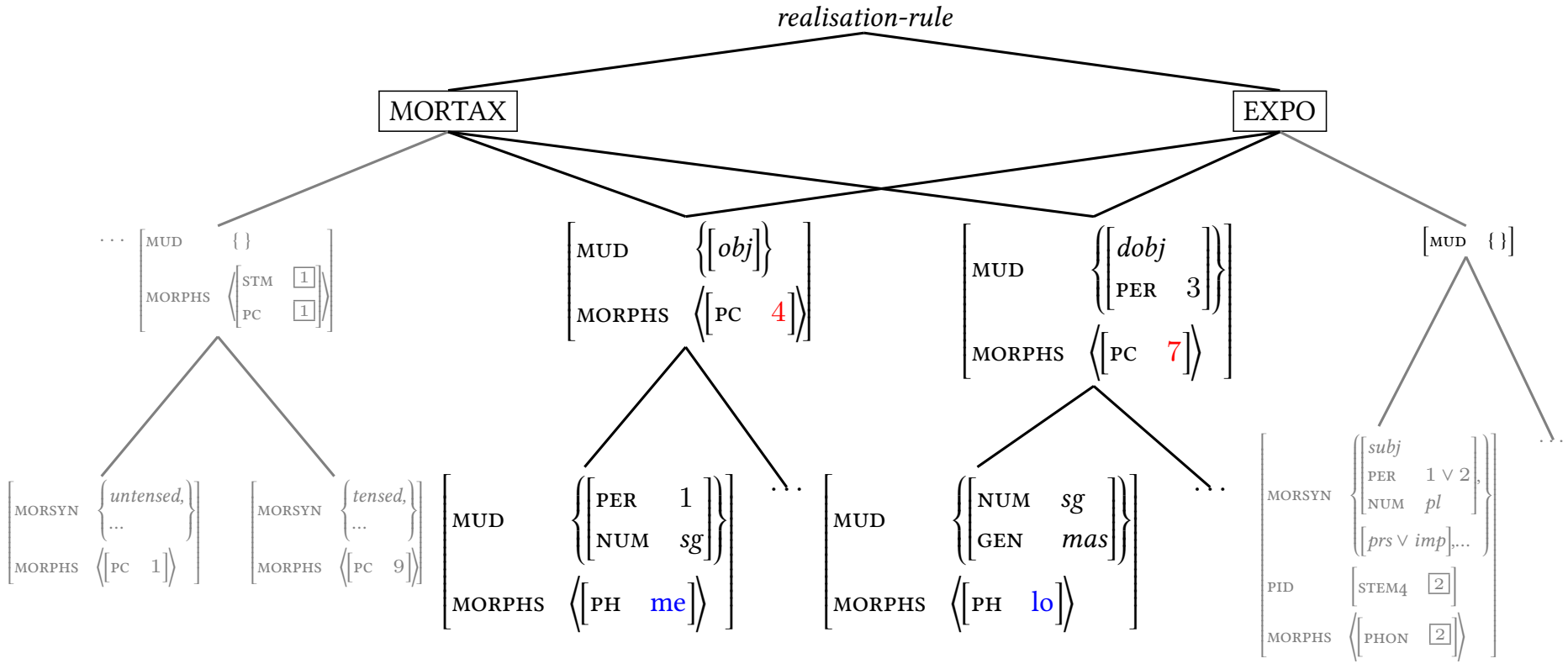
	me	lo	da te	‘You give it to me.’
			da te me lo!	‘Give it to me!’
*			da te lo me!	
*	lo	me	da te!	

- Schematically:

Absolute and relative placement in Italian



Absolute and relative placement in Italian



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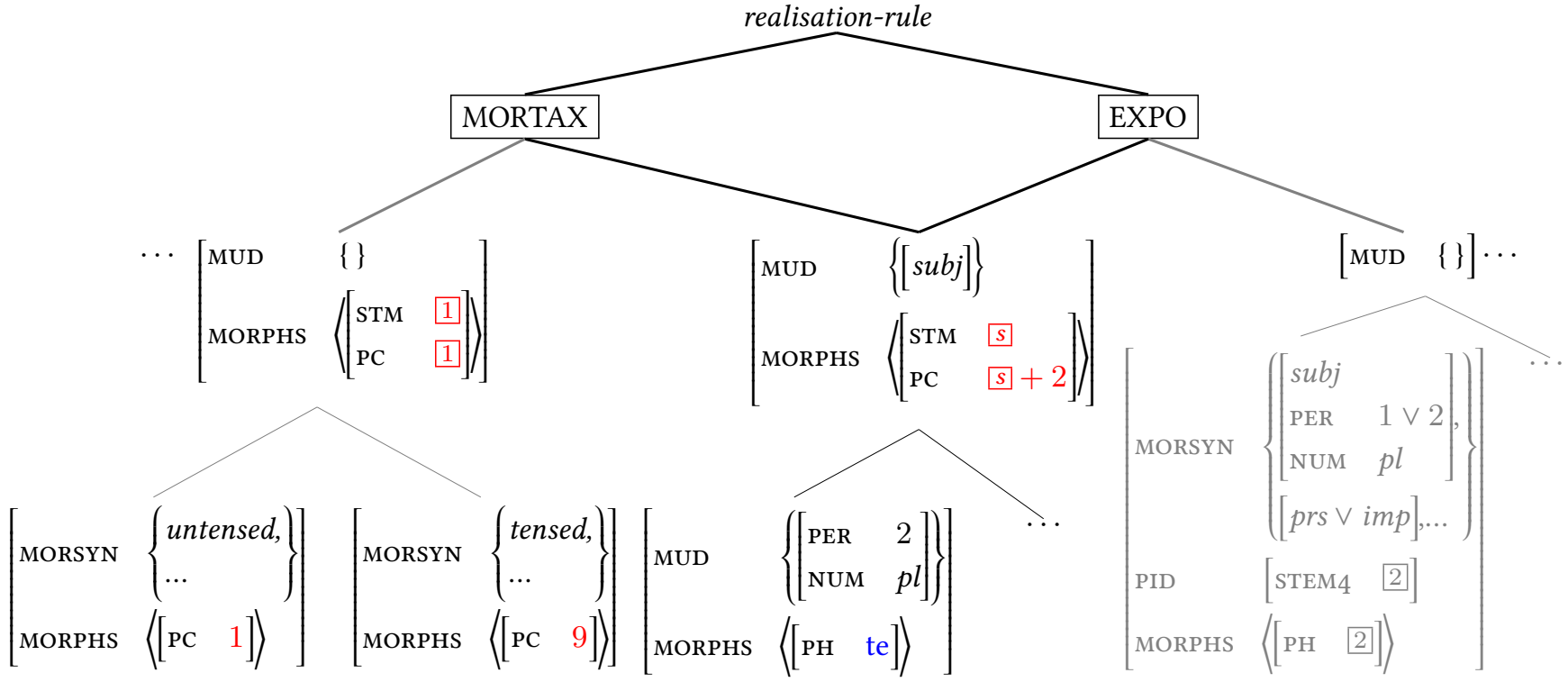

A new challenge: Wackernagel affixes in Sorani

- Sorani Kurdish mobile person markers (MPM) appear in one of two positions in the verb:
  - right after the first realised exponent (default)
    - stem (slot 3)
    - negative prefix (slot 1)
    - progressive marker (slot 2)

1	2	3	4	
		nard=jân	im	'they sent me'
na=jân		nard	im	'they did not send me'
	da=jân	nard	im	'they were sending me'
na=jân	da	nard	im	'they were not sending me'

Table : Sorani Kurdish past person markers

  - verb-finally
    - 3rd singular MPM *-î*
    - Plural MPMs, in the presence of 1SG verbal person ending (VPE)

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(15) a. *kirî-n-î.*
buy.PST-3PL=3SG
'He bought them.'

b. *kirî-m-tân.*
buy.PST-1SG=2PL
'You (pl.) bought me.'

Sorani Kurdish: Types of agreement

- Sorani Kurdish provides two sets of agreement markers:
  - verb-person endings (VPE)
  - mobile person markers (MPM)
- Alignment of agreement sets with grammatical function

TENSE	SUBJECT AGREEMENT	PRONOMINAL OBJECT
pres	VPE	—
	VPE	MPM
past	VPE	—
	MPM	VPE

(16) a. *Bâzirgân-akân asp-akân da-kir-in.*
merchant-DEF.PL horse-DEF.PL IPFV-buy.PRS-3PL
'Narmin is buying the horses.'

b. *Bâzirgân-akân da=jân=kir-in*
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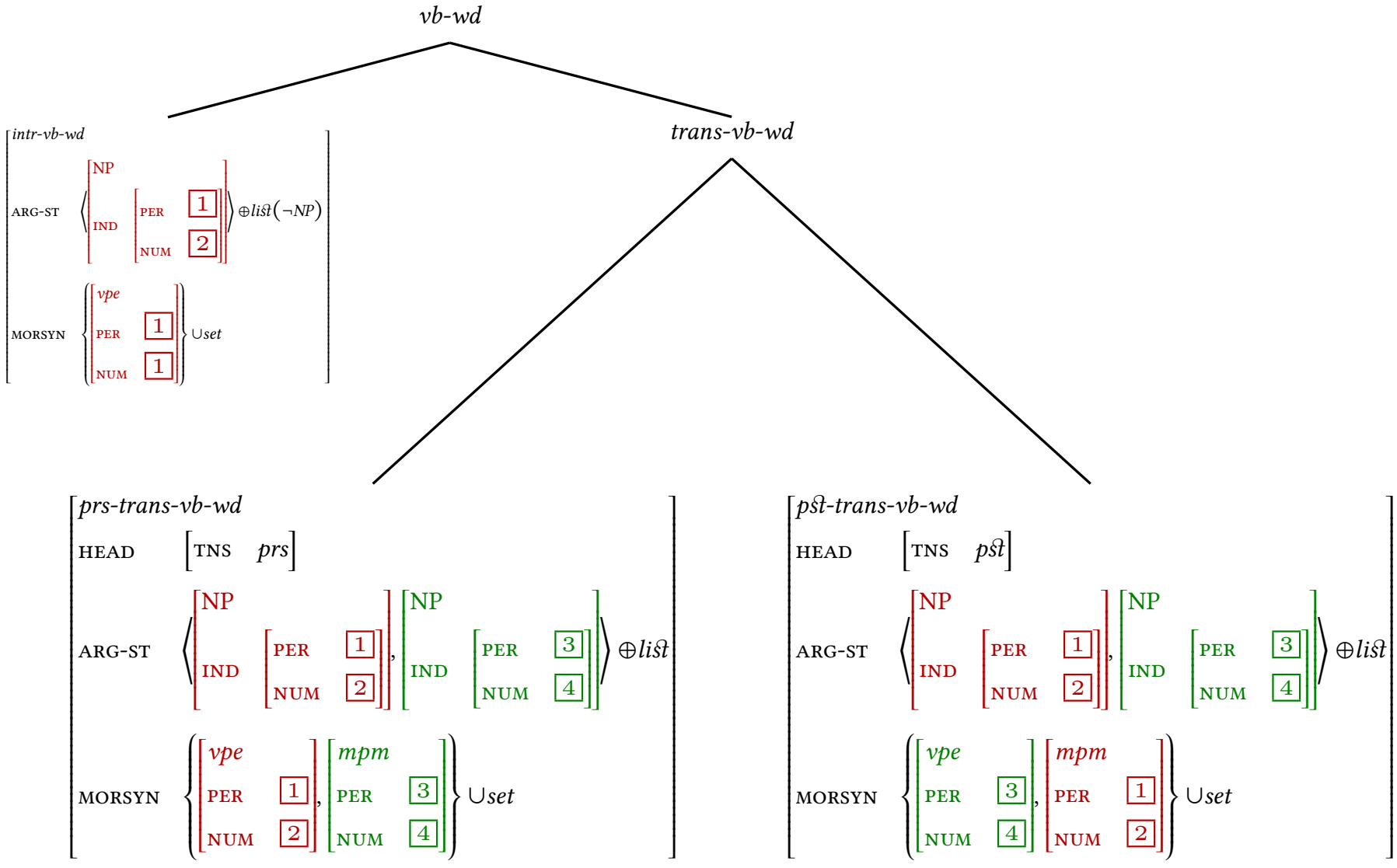
Sorani Kurdish: argument reversal



Wackernagel affixes: another type of relative positioning

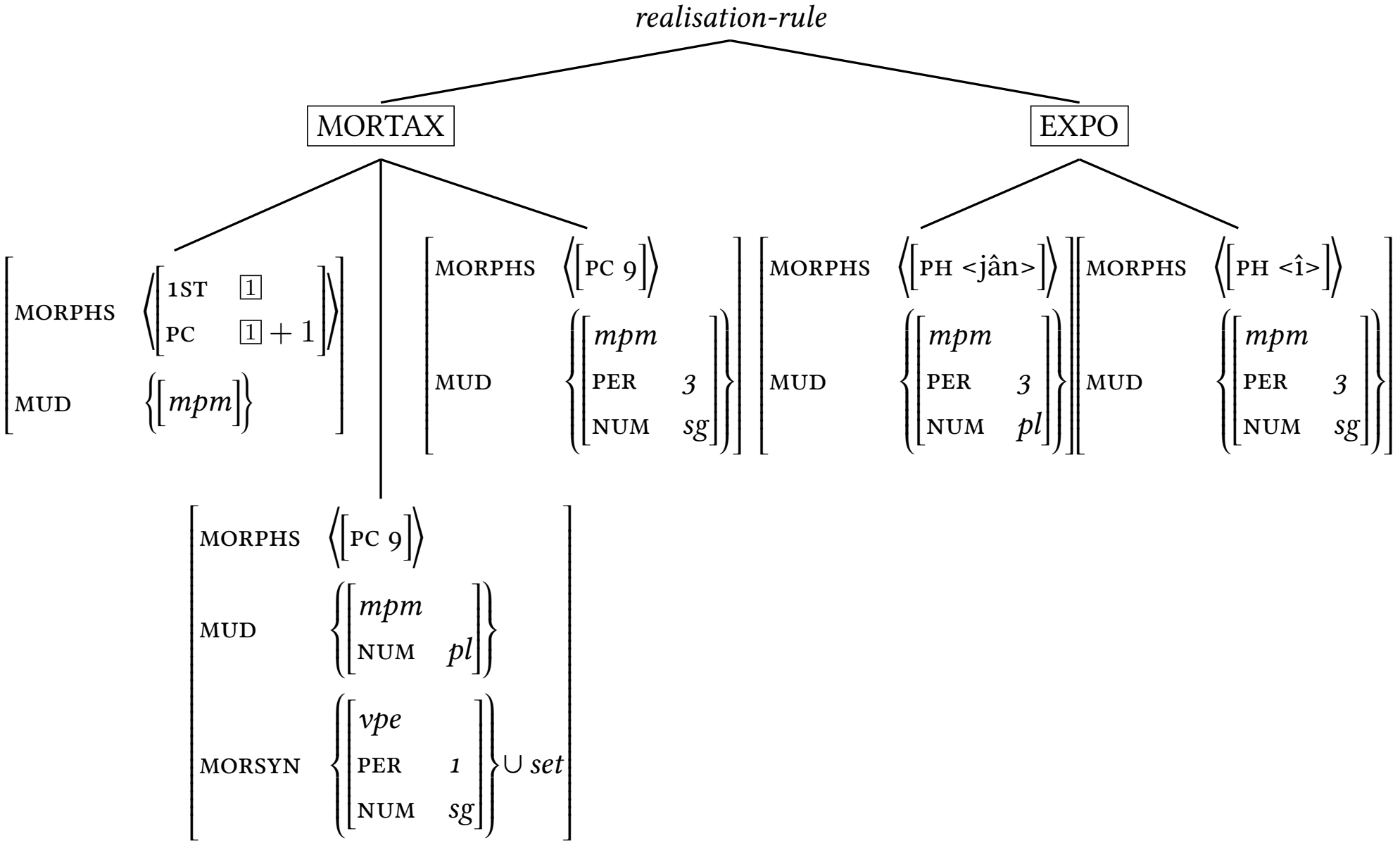
- Most position class systems are compatible with either absolute or a stem-relative positioning
- Italian mobile stems already necessitate reference to both absolute and stem-relative position (Crysmann and Bonami, 2012)
  - pronominal affixes are in absolute positions
  - tense/agreement affixes are positioned relative to an alternating stem
- Position class of the stem is made accessible by principle:

(17) $$\textit{word} \rightarrow \left[\textsc{morphs} \quad \left\langle \left[\textsc{stm}\ \boxed{s}\right], \left[\textsc{stm}\ \boxed{s}\right], \ldots, \left[\textsc{stm}\ \boxed{s}\right] \right\rangle\right]$$

- Wackernagel affixes need access to the first *instantiated* position class index:

(18) $$\textit{word} \rightarrow \left[\textsc{morphs} \quad \left\langle \begin{bmatrix}\textsc{1st} & \boxed{1}\\ \textsc{pc} & \boxed{1}\end{bmatrix}, \left[\textsc{1st}\ \boxed{1}\right], \ldots, \left[\textsc{1st}\ \boxed{1}\right] \right\rangle\right]$$

Sorani Kurdish variable morphotactics



Conclusion

- Information-based model of realisational morphology
  - completely eliminates extrinsic rule ordering
  - integrates more seamlessly with information-based syntax and semantics
  - extends the scope to Pāṇini's principle
  - does away with block-specific instances of the *identity function default*
- Constraint-based perspective on variable morphotactics
  - uses a single indexing scheme reflecting surface order alone
  - recognises stem and left edge as privilidged pivots for relative placement
  - provides a unified perspective on
    - free and conditioned reordering
    - parallel position classes
  - reduces order alternation to underspecification, captured by inheritance and online type construction

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