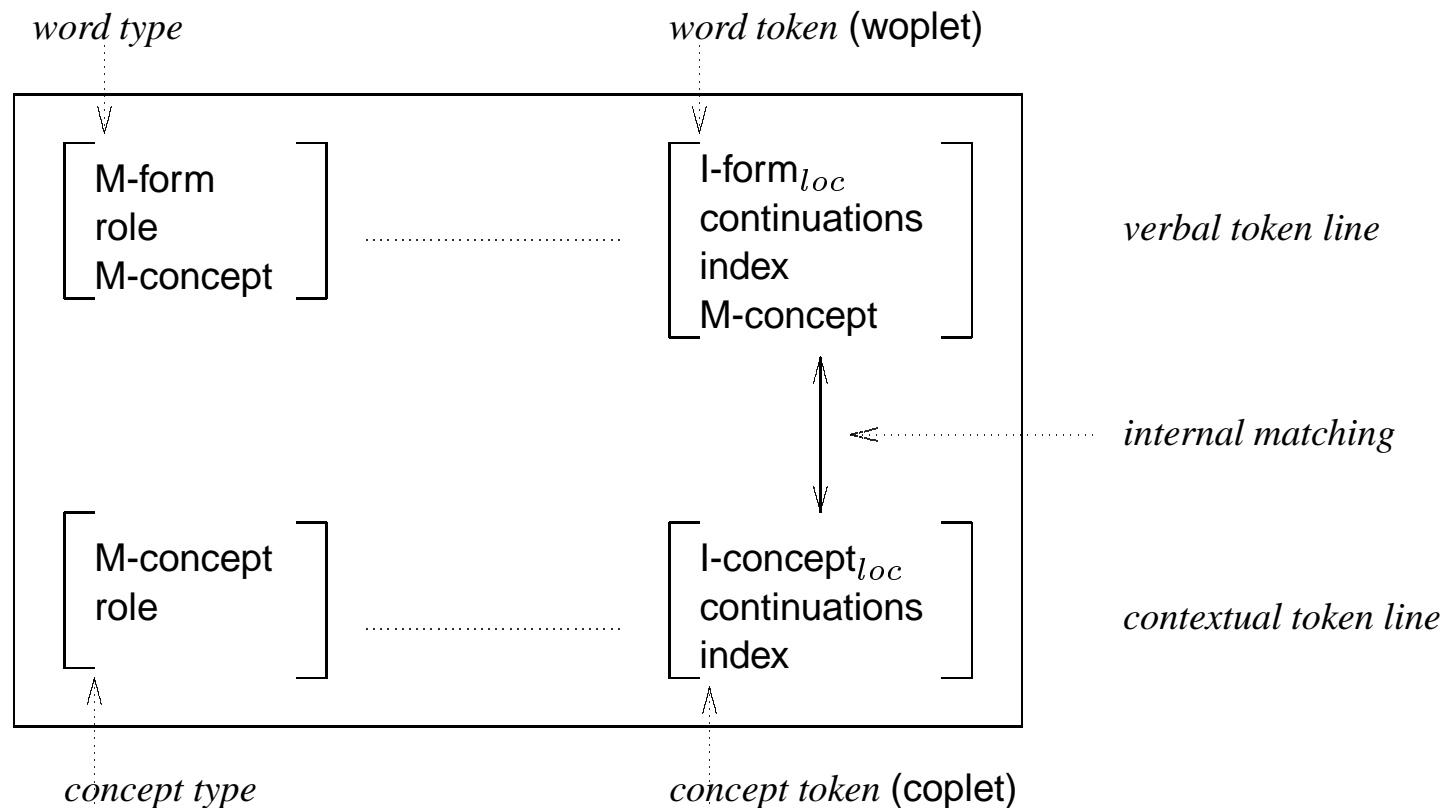


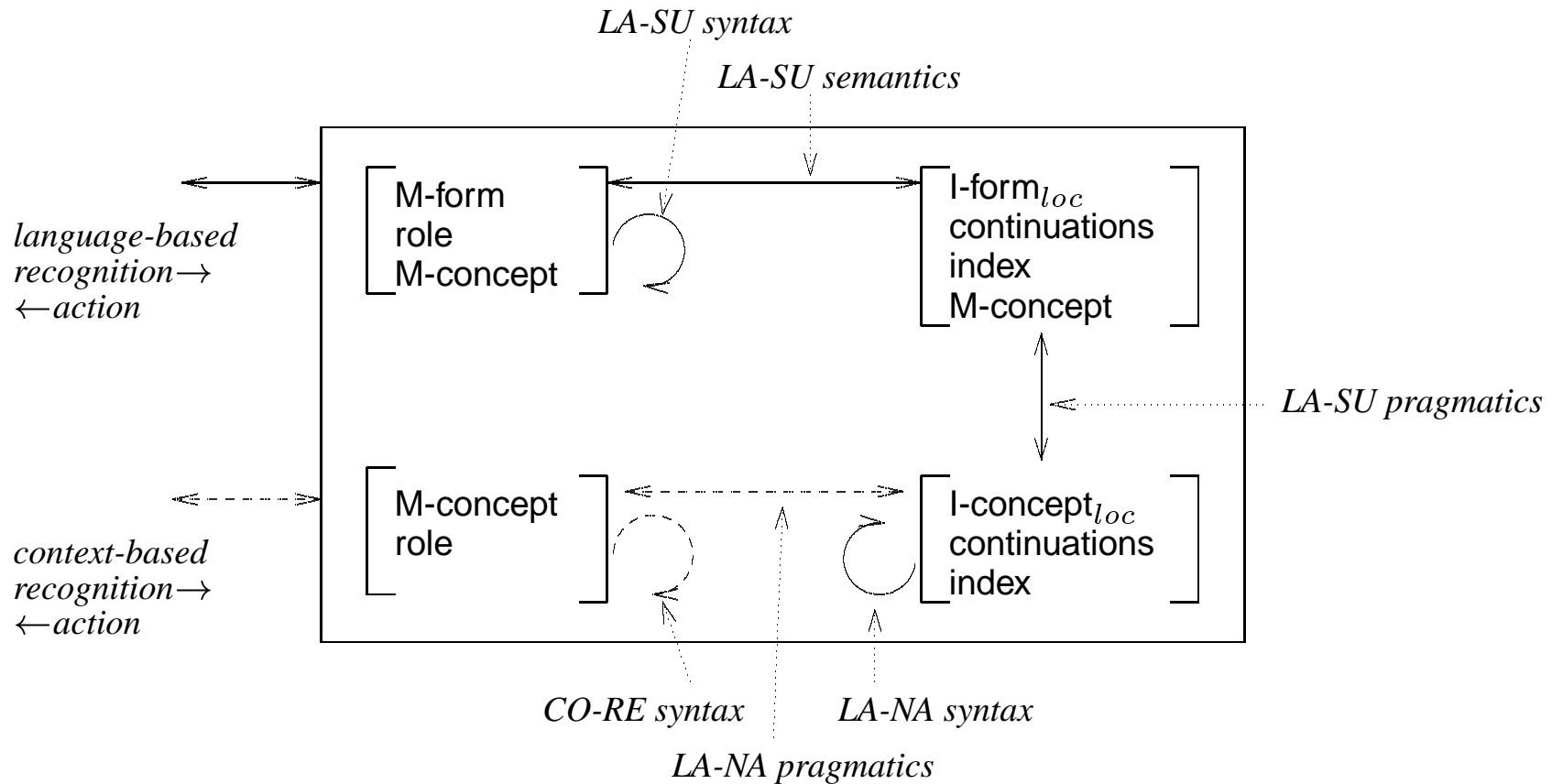
## 23. SLIM machine in the hearer mode

### 23.1 External connections and motor algorithms

#### 23.1.1 Static structures of the SLIM machine

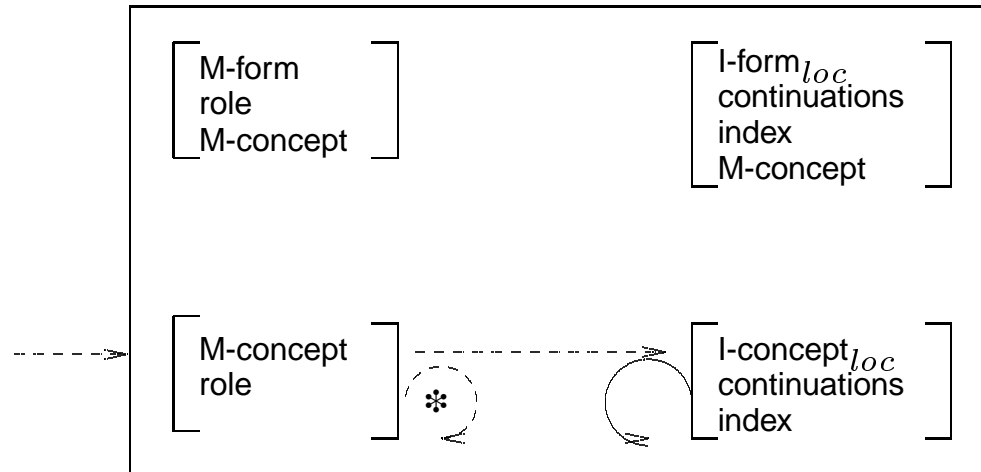


### 23.1.2 External connections and motor algorithms of the SLIM machine

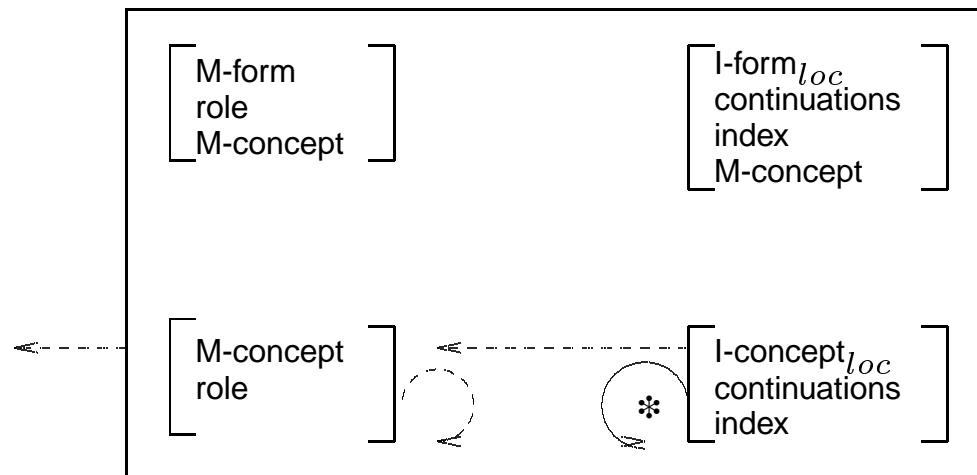


## 23.2 Ten SLIM states of cognition

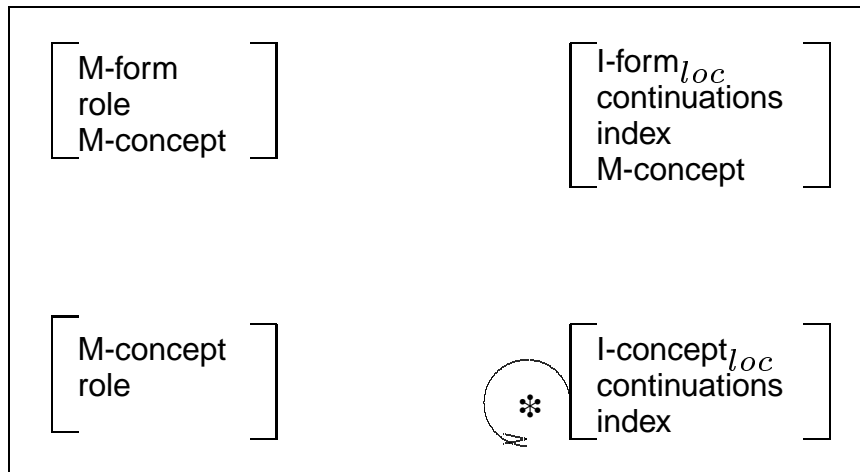
### 23.2.1 SLIM 1: Recognition (contextual)



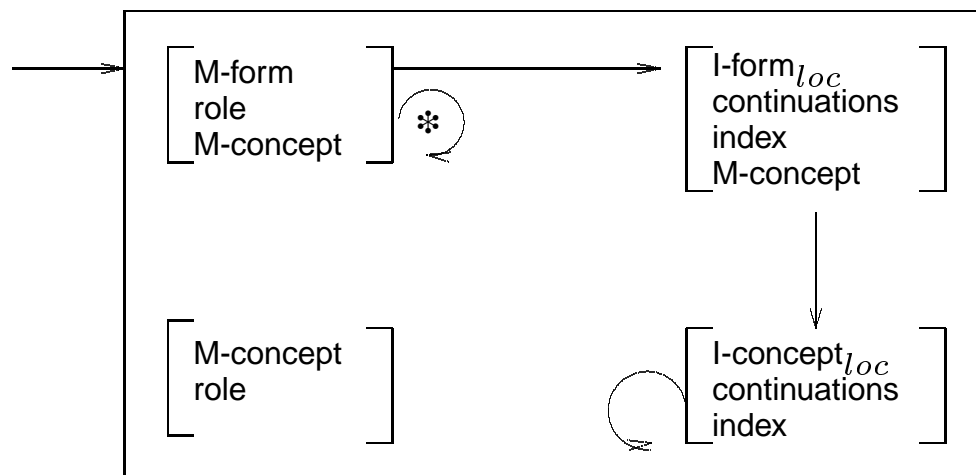
### 23.2.2 SLIM 2: Action (contextual)



### 23.2.3 SLIM 3: Inference (contextual)

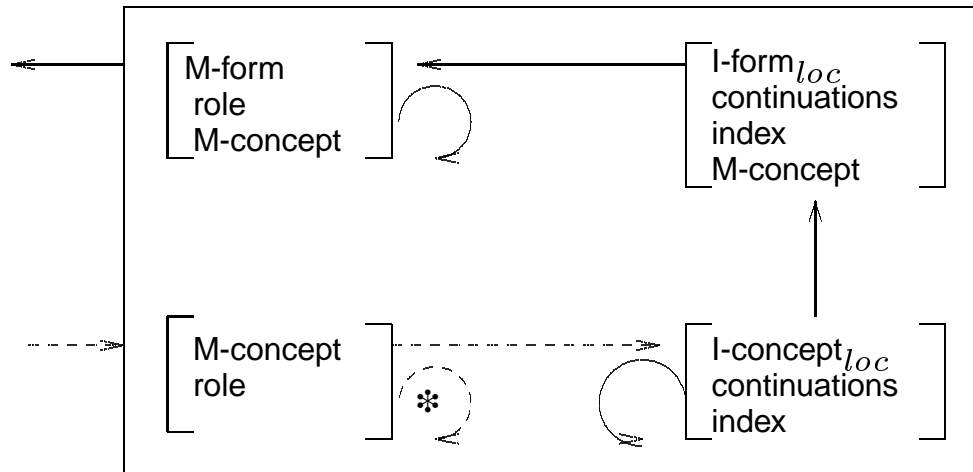


### 23.2.4 SLIM 4: Interpretation of language (mediated reference)

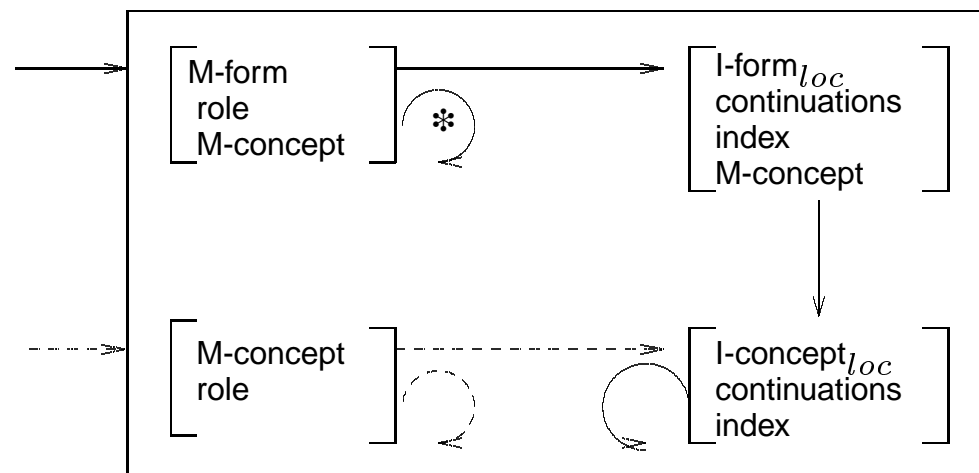




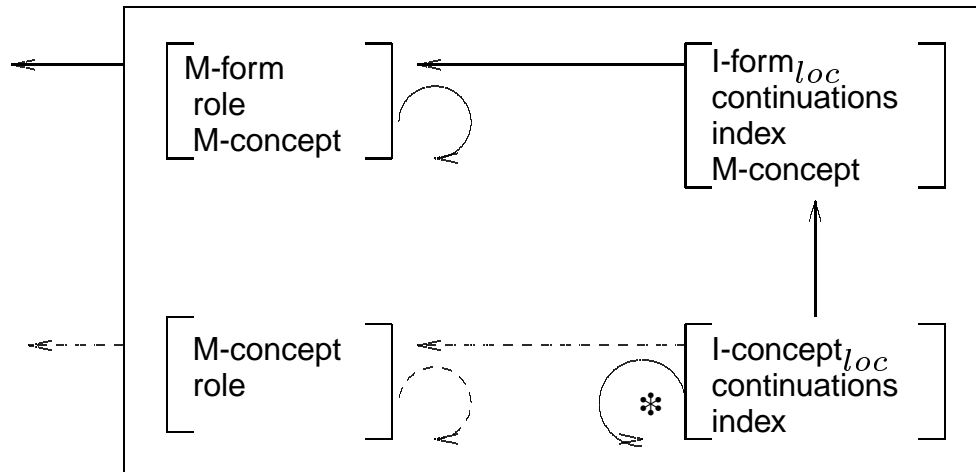
### 23.2.7 SLIM 7: Commented recognition (immediate reference)



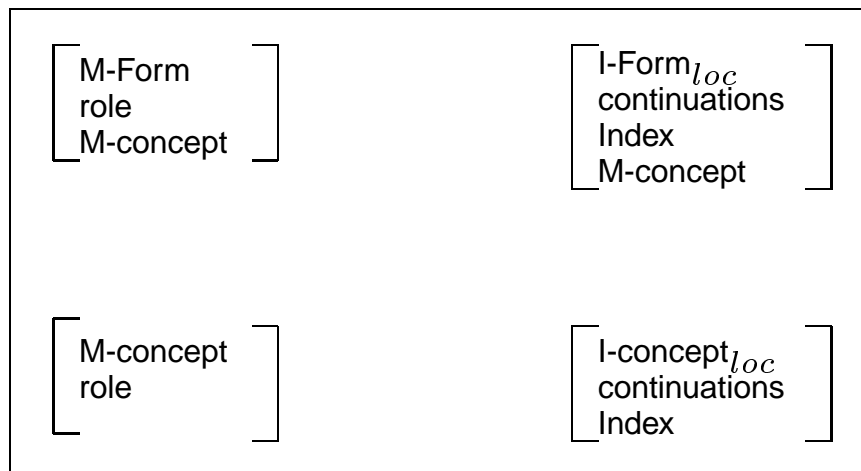
### 23.2.8 SLIM 8: Language-controlled recognition (immediate reference)



### 23.2.9 SLIM 9: Commented action (immediate reference)



### 23.2.10 SLIM 10: Cognitive stillstand



### 23.2.11 Notions grounded in the ten SLIM states

*Context-based* cognition is represented by SLIM 1 to SLIM 3,

*Language-based* cognition is represented by SLIM 4 and SLIM 5,

*Simultaneous context- and language-based* cognition is represented by SLIM 6 to SLIM 9.

*Context-based* cognition distinguishes between *recognition* (SLIM 1), *action* (SLIM 2), and *inferencing* (SLIM 3).

*Language-based* cognition distinguishes between the *hearer mode* (SLIM 4, SLIM 6, SLIM 8), and the *speaker mode* (SLIM 5, SLIM 7, SLIM 9).

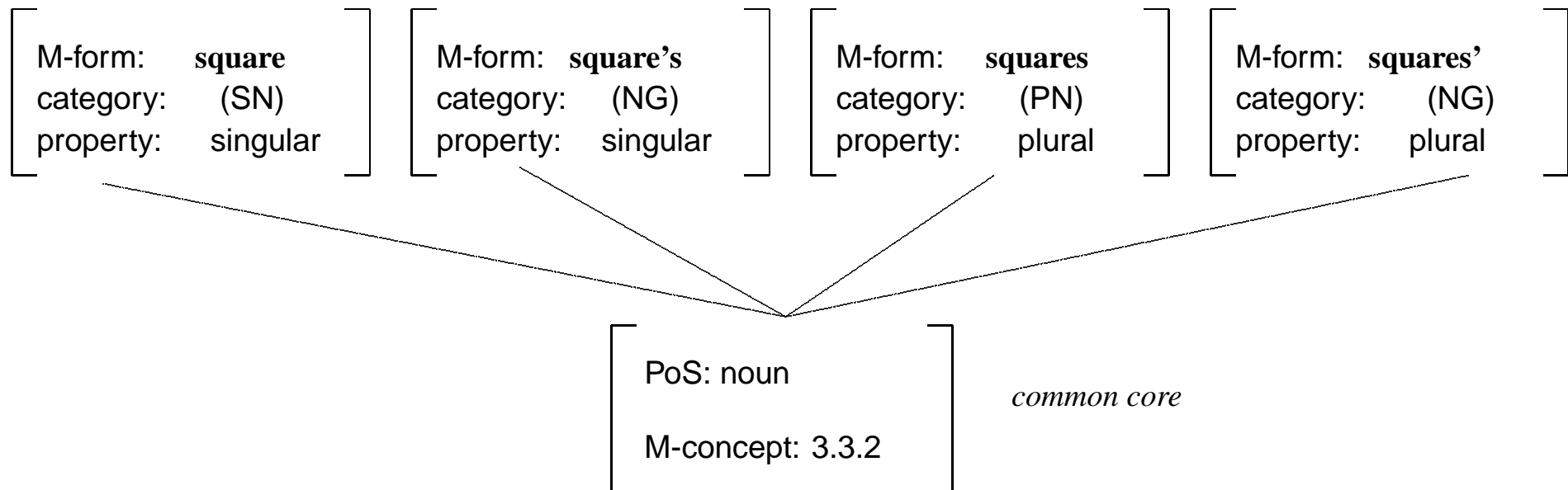
*Mediated reference* (SLIM 6 to SLIM 9) is distinguished from *immediate* reference (SLIM 4, SLIM 5).

In *immediate reference*, language-based *control* (SLIM 6, SLIM 8) is distinguished from context-based *commenting* (SLIM 7, SLIM 9).

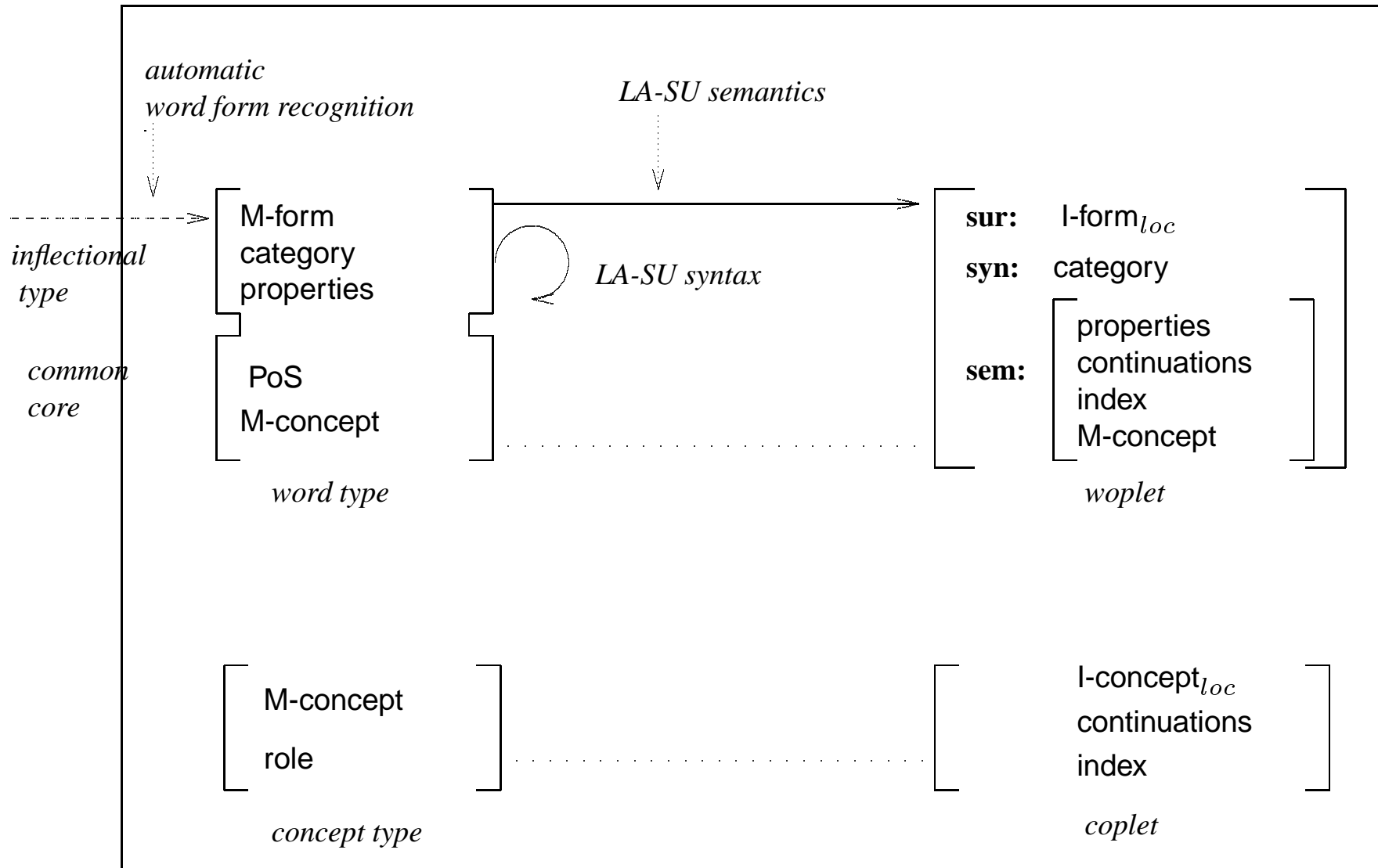


## 23.3 Semantic interpretation of LA-SU syntax

### 23.3.1 Representing inflectional variants in a word type

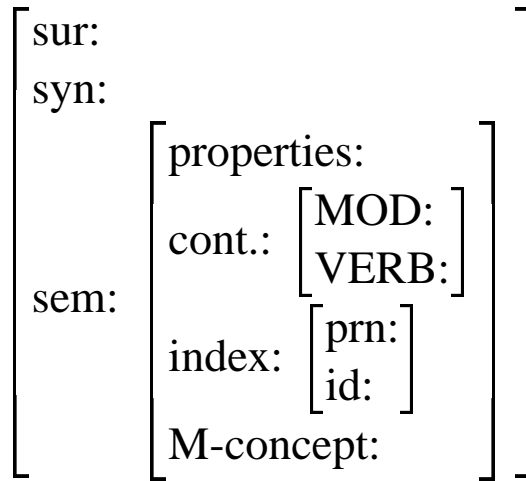


### 23.3.2 Word form recognition and derivation of a woplet

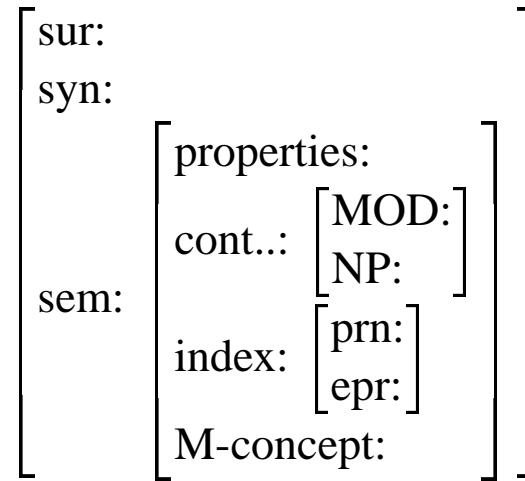


### 23.3.3 Nominal, verbal, and adjectival woplet structures

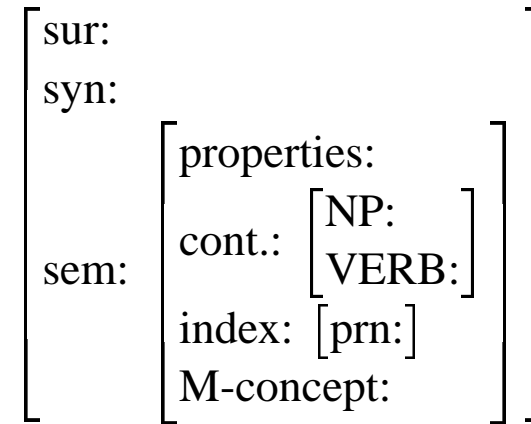
*nominal woplet*



*verbal woplet*



*adjectival woplet*



### 23.3.4 Schema of semantically interpreted LA-SU rule

rule:

syn:  $\langle ss\text{-pattern} \rangle$                        $\langle nw\text{-pattern} \rangle \implies \langle ss'\text{-pattern} \rangle$   
 sem:    semantic operations

input:

$$\begin{bmatrix} \text{sur:} \\ \text{syn: } \langle a \rangle \\ \text{sem: } b \end{bmatrix}_1 \dots \begin{bmatrix} \text{sur: } m \\ \text{syn: } \langle c \rangle \\ \text{sem: } d \end{bmatrix}_i + \begin{bmatrix} \text{sur: } n \\ \text{syn: } \langle e \rangle \\ \text{sem: } f \end{bmatrix}_{i+1}$$

output:

$$\begin{bmatrix} \text{sur:} \\ \text{syn: } \langle a \rangle \\ \text{sem: } b \end{bmatrix}_1 \dots \begin{bmatrix} \text{sur: } m+n \\ \text{syn: } \langle g \rangle \\ \text{sem: } h \end{bmatrix}_{i+1}$$

### 23.3.5 The six basic operations of the LA-SU semantics

1.  $\text{copy}_{ss}$ : include the woplets of the sentence start in the result.
2.  $\text{copy}_{nw}$ : include the woplet of the next word in the result.
3.  $n_1.x - \boxed{a} \rightarrow n_2.y$ : copy the values of the source feature  $x$  in  $n_1$  additively into the goal feature  $y$  in  $n_2$ , whereby  $n_1$  and  $n_2$  may be the woplets of the sentence start or the next word.
4.  $n_1.x - \boxed{e} \rightarrow n_2.y$ : copy the values of the source feature  $x$  in  $n_1$  exclusively into the goal feature  $y$  in  $n_2$ , whereby the value of  $y$  must be NIL (empty value).
5.  $n_1.x - \boxed{r} \rightarrow n_2.\textcircled{1}$ : substitute all occurrences of the variable  $\textcircled{1}$  in  $n_2$  simultaneously with the value of the source feature  $x$  in  $n_1$ .
6.  $n.x - \boxed{m} \rightarrow n.X$ : mark the first value of the source feature  $x$  in  $n$ , whereby the value of  $x$  must be a list.

### 23.3.6 Comparison of additive and exclusive copying

Additive:  $\text{nw.y} - \boxed{\text{a}} \rightarrow \text{ss.x}$   
 $\text{copy}_{ss}$

$$[x: a]_1 [x:]_2 + [y: b]_3 \Longrightarrow [\star x: a b]_1 [\star x: b]_2$$

Exclusive:  $\text{nw.y} - \boxed{\text{e}} \rightarrow \text{ss.x}$   
 $\text{copy}_{ss}$

$$[x: a]_1 [x:]_2 + [y: b]_3 \Longrightarrow [x: a]_1 [\star x: b]_2$$

## 23.4 Example of syntactic-semantic derivation (*LA-E4*)

23.4.1 The man gave Mary a flower because he loves her.

### 23.4.2 *LA-E4* for adverbial subclauses of English

LX = LX of *LA-E3* plus {(slowly (ADP) \*), (because (# ADP) \*)}

Variable definitions = those of *LA-E3* plus  $mn \in \{np \cup \{V, VI\}\}$

$ST_S =_{def} \{ [(x) \{ 1 \text{ DET+ADJ}, 2 \text{ DET+N}, 3 \text{ NOM+FV}, 4 \text{ AUX+MAIN}, 5 \text{ STRT-SBCL} \}] \}$

DET+ADJ:  $(n \ x) \ (\text{ADJ}) \Rightarrow (n \ x) \ \{ 6 \text{ DET+ADJ}, 7 \text{ DET+N} \}$

DET+N:  $(n \ x) \ (n) \Rightarrow (x) \ \{ 8 \text{ NOM+FV}, 9 \text{ FV+MAIN}, 10 \text{ AUX+NFV}, 11 \text{ ADD-ADP}, 12 \text{ IP} \}$

NOM+FV:  $(np \ \# \ x) \ (np' \ y \ V) \Rightarrow (y \ \# \ x)$   
 $(np) \ (np' \ x \ V) \Rightarrow (x \ V) \ \{ 13 \text{ FV+MAIN}, 14 \text{ AUX+NFV}, 15 \text{ ADD-ADP}, 16 \text{ IP} \}$

FV+MAIN:  $(np' \ \# \ x) \ (y \ np) \Rightarrow (y \ x)$   
 $(np' \ x \ \# \ y) \ (z \ np) \Rightarrow (z \ x \ \# \ y)$   
 $(np' \ x \ V) \ (y \ np) \Rightarrow (y \ x \ V) \ \{ 17 \text{ DET+ADJ}, 18 \text{ DET+N}, 19 \text{ FV+MAIN}, 20 \text{ IP} \}$

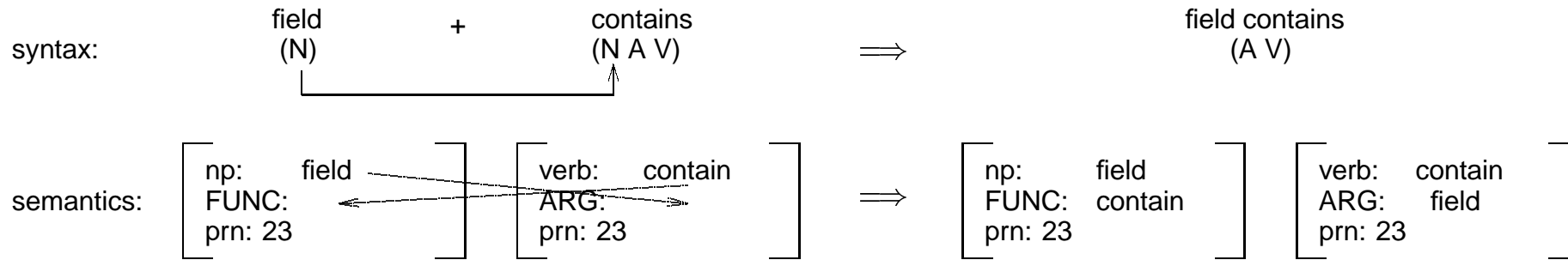
AUX+NFV:  $(aux \ \# \ x \ V) \ (aux) \Rightarrow (x \ V)$   
 $(aux \ \# \ x \ V) \ (y \ aux) \Rightarrow (y \ \# \ x \ V)$

$$\begin{array}{ll}
 (aux\ V)\ (x\ aux) & \Rightarrow (x\ V)\ \{21\ FV+MAIN,\ 22\ IP\} \\
 AUX+MAIN:(np\ aux\ V)\ (x\ np') & \Rightarrow (x\ aux\ VI)\ \{23\ AUX+NFV,\ 24\ DET+ADJ,\ 25\ DET+N\} \\
 ADD-ADP:\ (x\ ADP)\ (mn\ y) & \Rightarrow (x\ mn\ y) \\
 (mn\ y)\ (x\ ADP) & \Rightarrow (x\ mn\ y)\ \{26\ STRT-SBCL,\ 27\ NOM+FV,\ 28\ FV+MAIN\} \\
 STRT-SBCL:\ (\# x)\ (y\ np) & \Rightarrow (y\ np\ \# x)\ \{29\ DET+ADJ,\ 30\ DET+N,\ 31\ NOM+FV,\ \\
 & \qquad\qquad\qquad 32\ ADD-ADP\} \\
 IP:\ (vt)\ (vt\ x) & \Rightarrow (x)\ \{\} \\
 ST_F =_{def} \{ [(V)\ rp_{ip}], [(VI)\ rp_{ip}] \}
 \end{array}$$

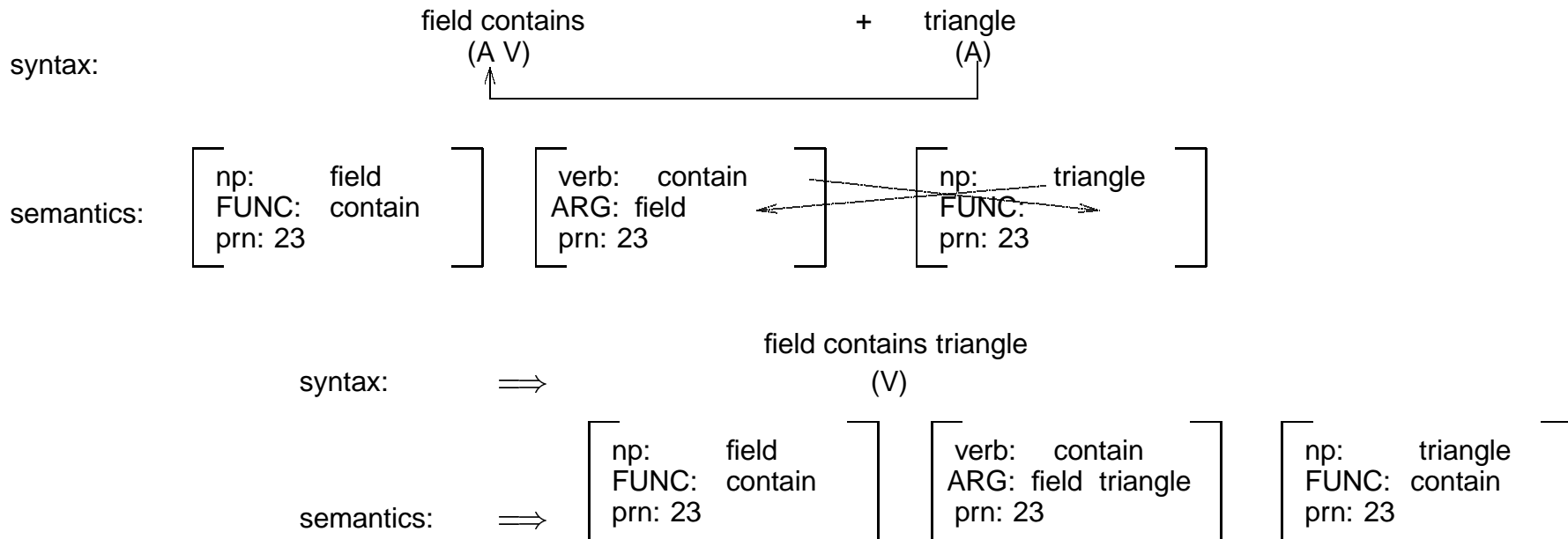


### 23.4.3 SYNTACTICO-SEMANTIC ANALYSIS OF field contains triangle

combination step 1:



combination step 2:

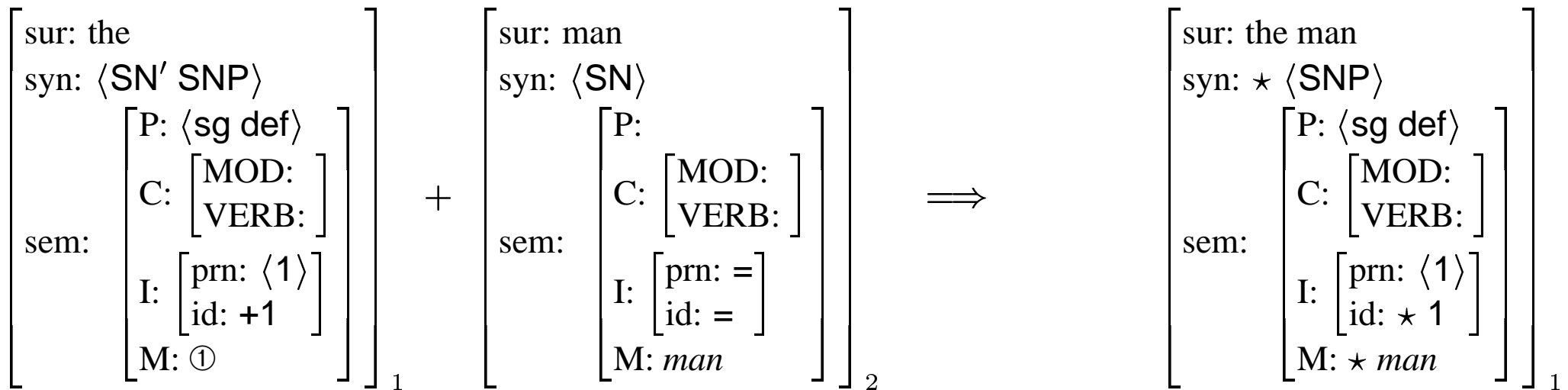


### 23.4.4 The man gave Mary a flower because he loves her.

#### 23.4.5 Applying DET+N to *the + man*

syn:  $\langle n \ x \rangle$  $\langle n \rangle$ 

sem:

 $\Rightarrow$   $\langle x \rangle$ nw.M  $\xrightarrow{\boxed{r}}$  ss.①copy<sub>ss</sub>

### 23.4.6 Applying NOM+FV to *the man + gave*

syn: ⟨np⟩

⟨np' x V⟩

⇒

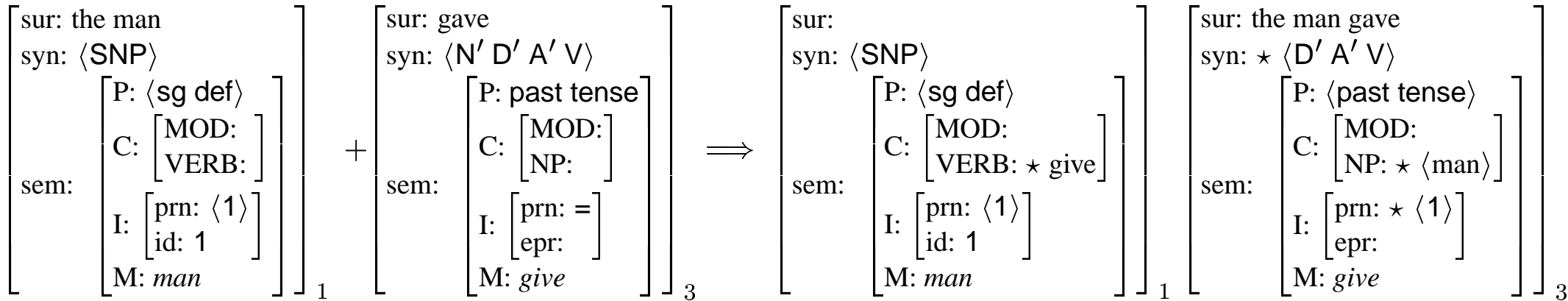
⟨x V⟩

sem:

nw.M — e → ss.VERB

ss.M — a → nw.NP

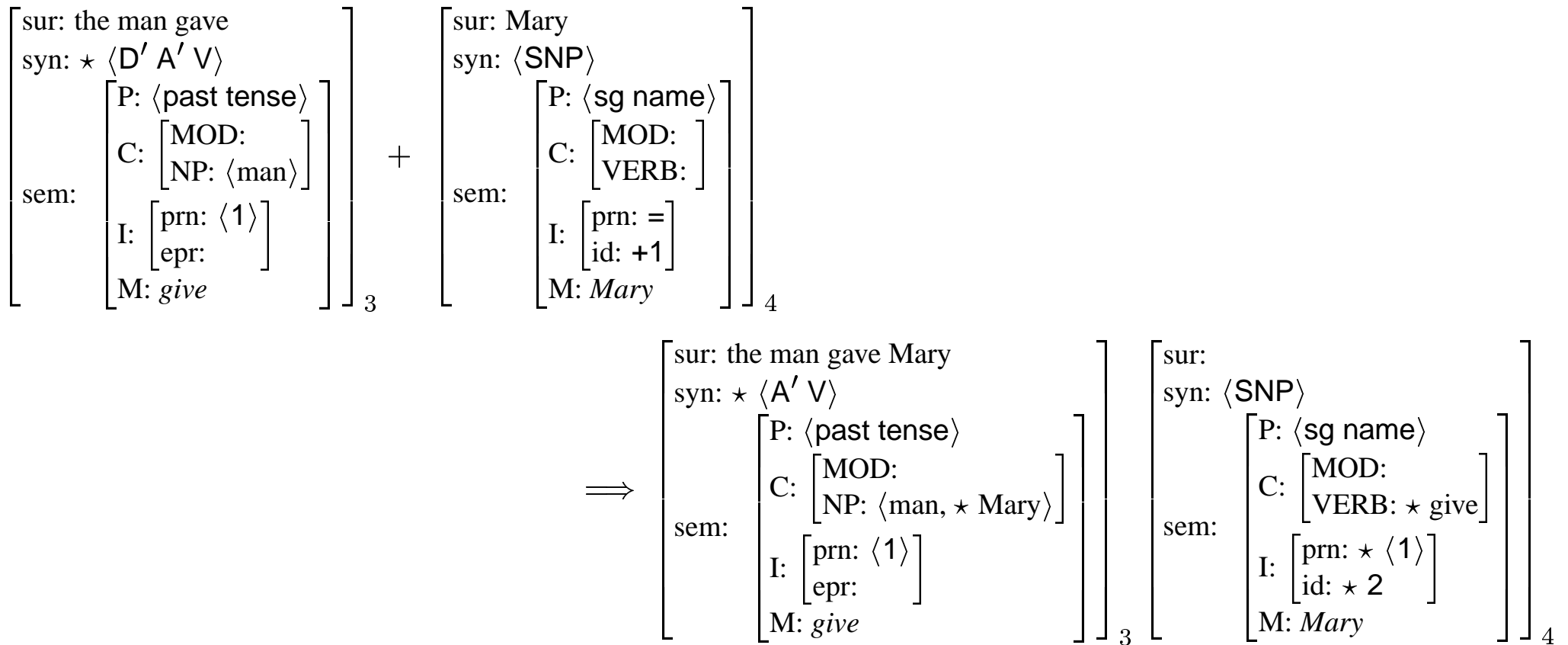
copy<sub>ss</sub> copy<sub>nw</sub>



### 23.4.7 Applying FV+MAIN to *the man gave + Mary*

syn:  $\langle np' \ x \ V \rangle$  $\langle y \ np \rangle$  $\implies$  $\langle y \ x \ V \rangle$ 

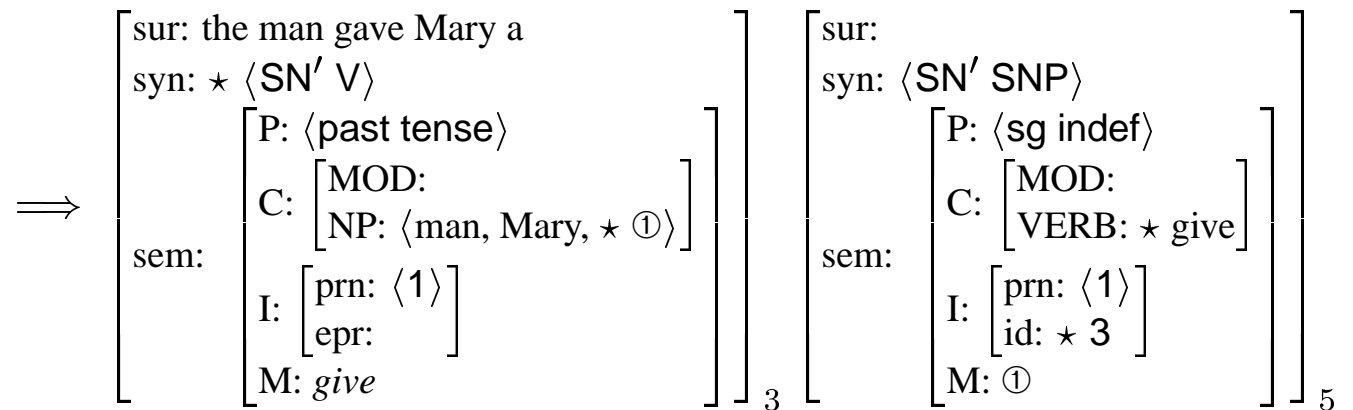
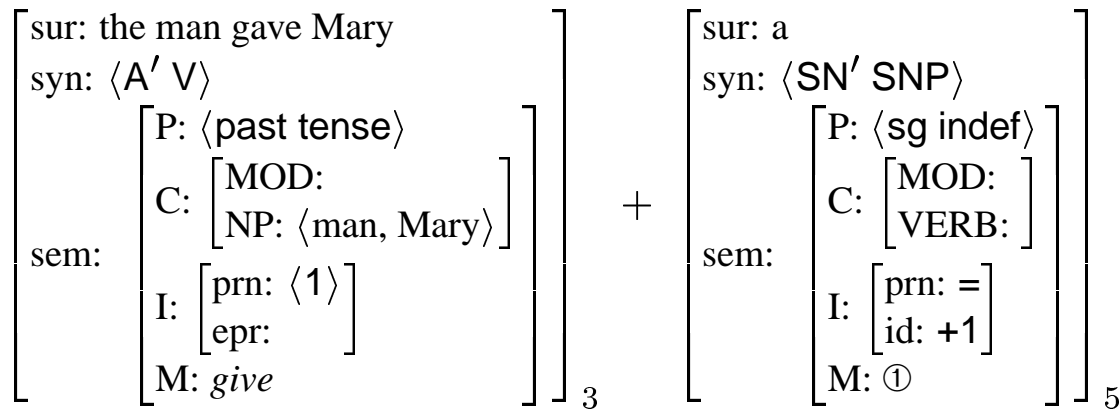
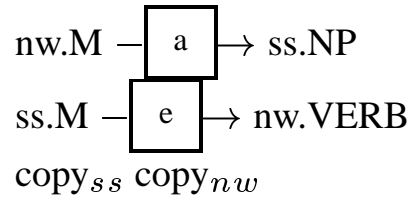
sem:

nw.M — a → ss.NPss.M — e → nw.VERBcopy<sub>ss</sub> copy<sub>nw</sub>

### 23.4.8 Applying FV+MAIN to *the man gave Mary + a*

syn:  $\langle \text{np}' \text{ x V} \rangle$  $\langle \text{y np} \rangle$  $\implies$  $\langle \text{y x V} \rangle$ 

sem:



### 23.4.9 Applying DET+N to *The man gave Mary a + flower*

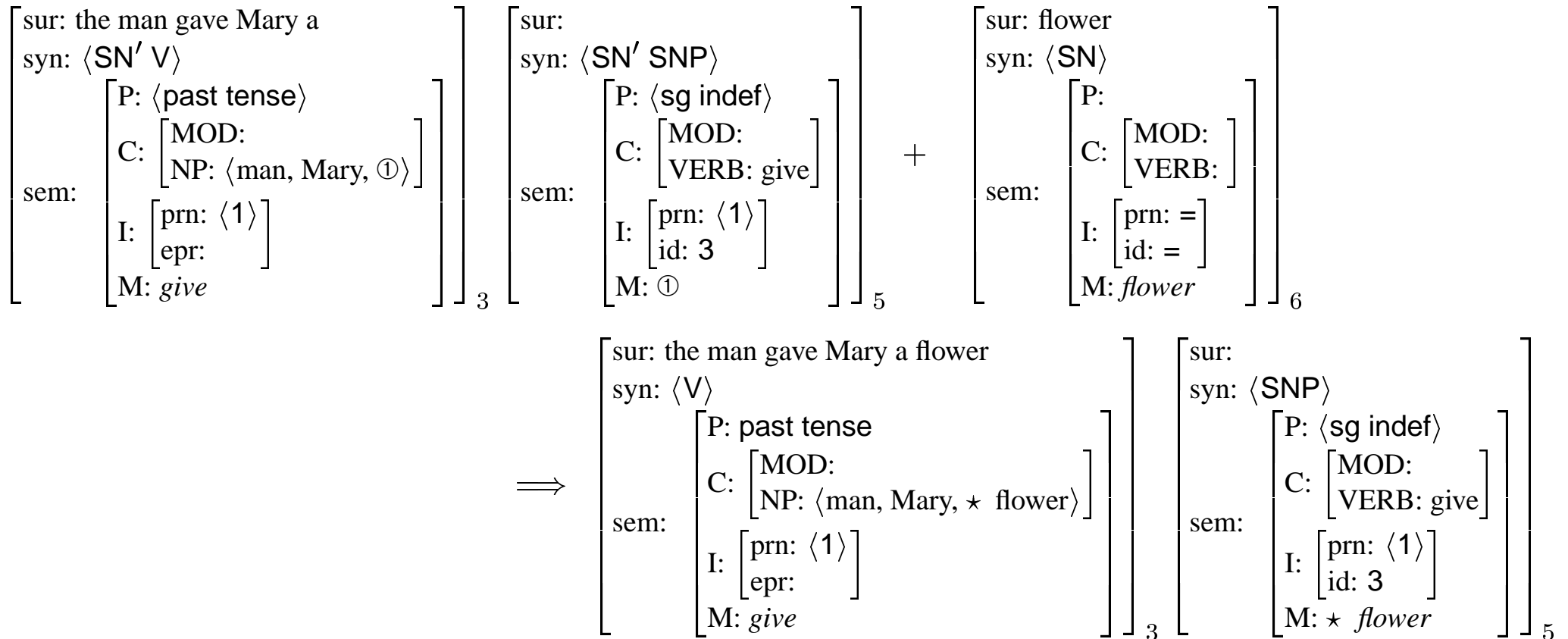
syn:  $\langle n \ x \rangle$ 

sem:

 $\langle n \rangle$  $\Rightarrow$  $\langle x \rangle$ 

$$\text{nw.M} \xrightarrow{\boxed{r}} \text{ss.}\textcircled{1}$$

copy<sub>ss</sub>



### 23.4.10 Applying ADD-ADP to *The man gave Mary a flower + because*

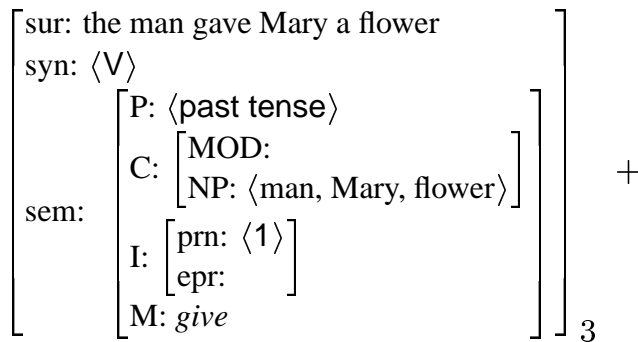
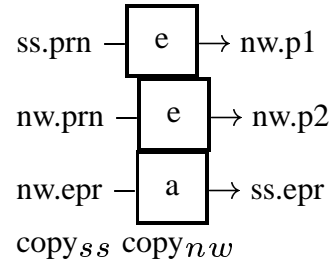
syn: ⟨mn y⟩

⟨x ADP⟩

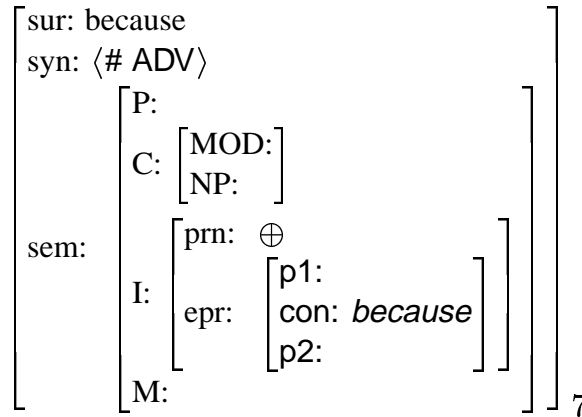
⇒

⟨x mn y⟩

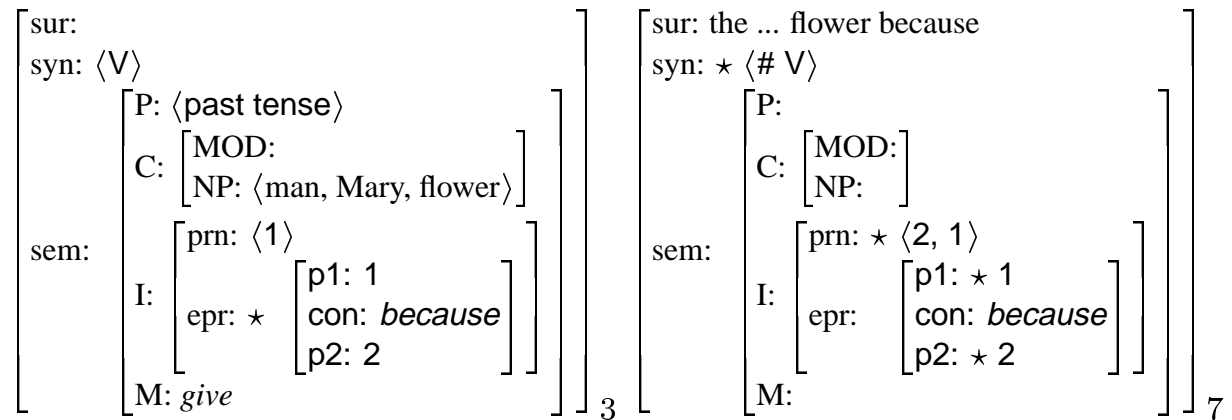
sem:



+



⇒



### 23.4.11 The epr feature structure introduced by the The conjunction because

$$\left[ \begin{array}{l} \text{epr:} \\ \left[ \begin{array}{l} \text{p1:} \\ \text{con: } \textit{because} \\ \text{p2:} \end{array} \right] \end{array} \right]$$

### 23.4.12 Applying START-SUBCL to *The man gave Mary a flower because + he*

$$\begin{array}{l} \text{syn: } \langle \# \text{ x} \rangle \\ \text{sem:} \end{array} \quad \langle \text{y np} \rangle \quad \Rightarrow \quad \begin{array}{l} \text{copy}_{ss} \text{ copy}_{nw} \\ \langle \text{y np } \# \text{ x} \rangle \end{array}$$

$$\begin{array}{l} \left[ \begin{array}{l} \text{sur: the man gave M. a f. because} \\ \text{syn: } \langle \# \text{ V} \rangle \\ \text{sem:} \\ \left[ \begin{array}{l} \text{P:} \\ \text{C:} \left[ \begin{array}{l} \text{MOD:} \\ \text{NP:} \end{array} \right] \\ \text{I:} \left[ \begin{array}{l} \text{prn: } \langle 2, 1 \rangle \\ \text{epr: } 1 \textit{ bec } 2 \end{array} \right] \\ \text{M:} \end{array} \right] \end{array} \right]_7 \end{array} + \begin{array}{l} \left[ \begin{array}{l} \text{sur: he} \\ \text{syn: } \langle \text{SNP} \rangle \\ \text{sem:} \\ \left[ \begin{array}{l} \text{P: } \langle \text{nom sg} \rangle \\ \text{C:} \left[ \begin{array}{l} \text{MOD:} \\ \text{VERB:} \end{array} \right] \\ \text{I:} \left[ \begin{array}{l} \text{prn: } = \\ \text{id: } +1 \end{array} \right] \\ \text{M: } \textit{pro-1} \end{array} \right] \end{array} \right]_8 \end{array} \end{array} \Rightarrow \begin{array}{l} \left[ \begin{array}{l} \text{sur: the man gave M. a f. because he} \\ \text{syn: } \star \langle \text{SNP } \# \text{ V} \rangle \\ \text{sem:} \\ \left[ \begin{array}{l} \text{P:} \\ \text{C:} \left[ \begin{array}{l} \text{MOD:} \\ \text{NP:} \end{array} \right] \\ \text{I:} \left[ \begin{array}{l} \text{prn: } \langle 2, 1 \rangle \\ \text{epr: } 1 \textit{ bec } 2 \end{array} \right] \\ \text{M:} \end{array} \right] \end{array} \right]_7 \end{array} \left[ \begin{array}{l} \text{sur:} \\ \text{syn: } \langle \text{SNP} \rangle \\ \text{sem:} \\ \left[ \begin{array}{l} \text{P: } \langle \text{nom sg} \rangle \\ \text{C:} \left[ \begin{array}{l} \text{MOD:} \\ \text{VERB:} \end{array} \right] \\ \text{I:} \left[ \begin{array}{l} \text{prn: } \star \langle 2, 1 \rangle \\ \text{id: } \star 1 \end{array} \right] \\ \text{M: } \textit{pro-1} \end{array} \right] \end{array} \right]_8 \end{array}$$



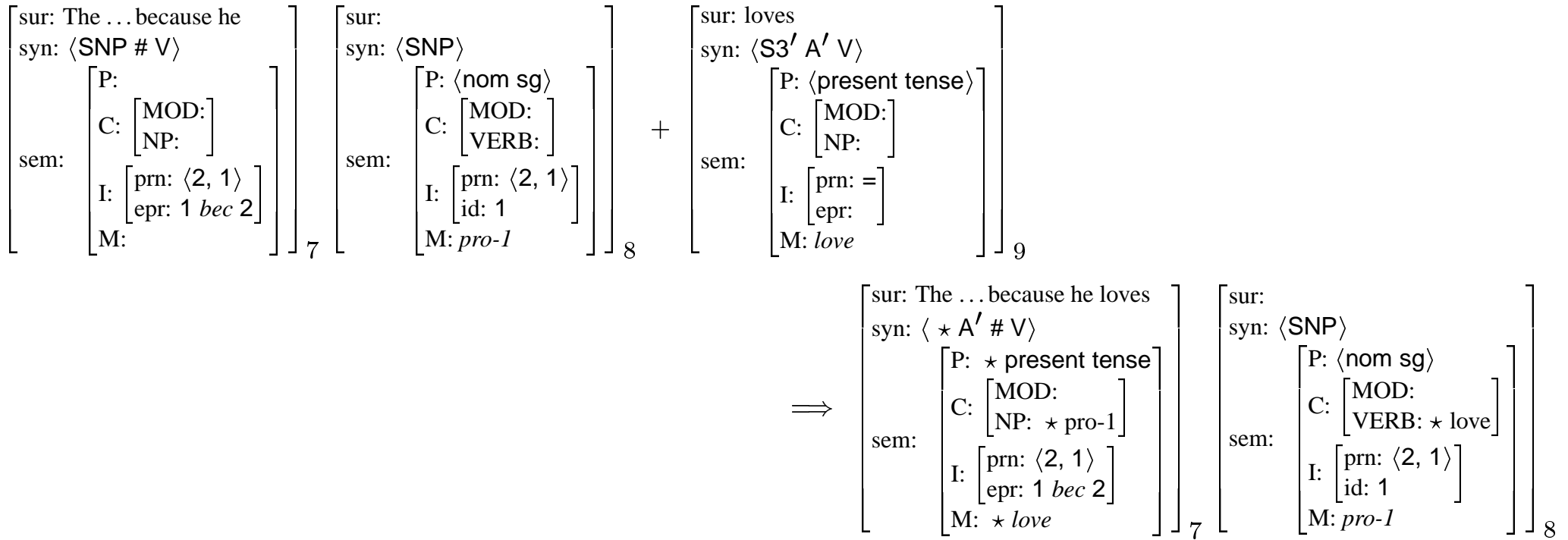
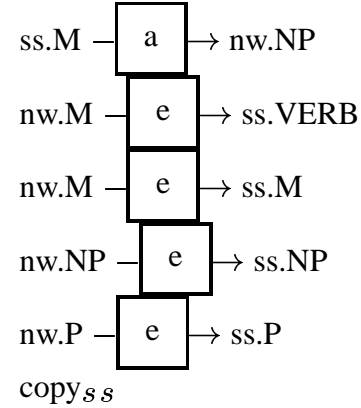
### 23.4.13 Application of NOM+FV to *The man g. M. a f. because he + loves*

syn:  $\langle np \# x \rangle$

$\langle np' y V \rangle$

$\implies \langle y \# x \rangle$

sem:



### 23.4.14 Application of FV+MAIN to *The m. g. M. a f. because he loves + her*

syn:  $\langle np' \# x \rangle$ 

sem:

 $\langle y \ np \rangle \implies \langle y \ x \rangle$ nw.np — 

a
---

 → ss.NPss.verb — 

e
---

 → nw.VERBss.prn — 

m
---

 → ss.prncopy<sub>ss</sub> copy<sub>nw</sub>

[	sur: The ... because he loves	]	+	[	sur: her	]	
syn:	$\langle A' \# V \rangle$			syn:	$\langle \text{SNP} \rangle$		
sem:	[	P: present tense	]	sem:	[	P: $\langle \text{obl sg} \rangle$	]
	C:	[	MOD:		C:	[	MOD:
		NP: pro-1	]			VERB:	]
	I:	[	prn: $\langle 2, 1 \rangle$	]		I:	[
		epr: 1 bec 2	]			id: +1	]
	M: love	]	]		M: pro-2	]	]
			7				10

	$\implies$	[	sur: The ... because he loves her	]	[	sur:	]
		syn:	$\langle \star V \rangle$		syn:	$\langle \text{SNP} \rangle$	
		sem:	[	P: present tense	]	sem:	[
			C:	[	MOD:		C:
				NP: pro-1 $\star$ pro-2	]		[
			I:	[	prn: $\star \langle 2-, 1 \rangle$	]	I:
				epr: 1 bec 2	]		[
			M: love	]	]	M: pro-2	]

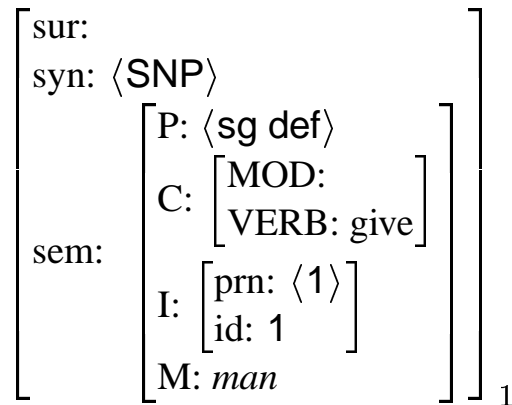
### 23.4.15 Proposition number of embedded subclause

the man,	gave her a flower.
prn: ⟨1⟩ because he loves Mary	prn: ⟨2-, 1⟩
prn: ⟨2, 1⟩	

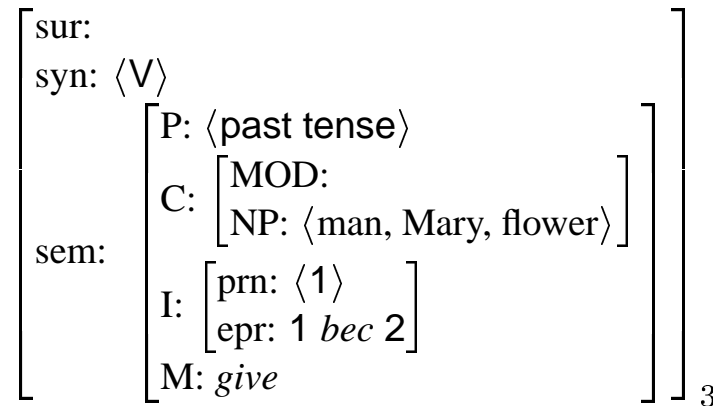
## 23.5 From SLIM semantics to SLIM pragmatics

### 23.5.1 SLIM semantic representation of example 23.4.1

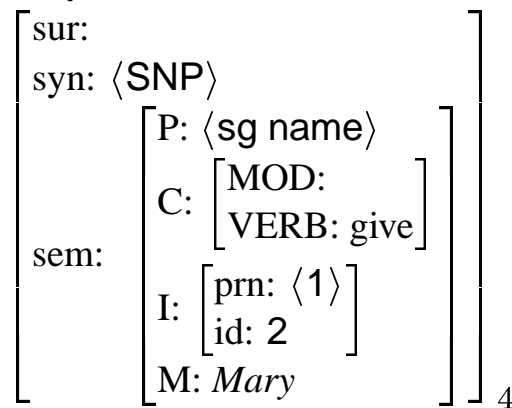
the man



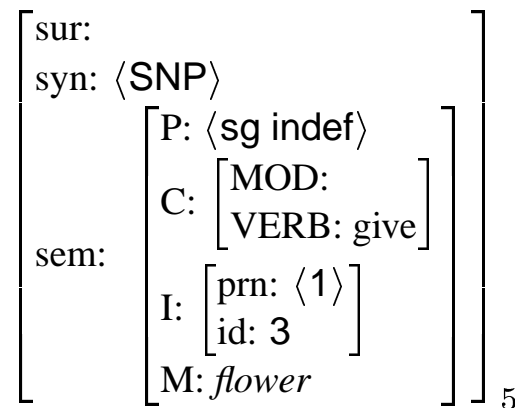
gave



Mary



a flower



because loves

$$\left[ \begin{array}{l} \text{sur:} \\ \text{syn: } \langle V \rangle \\ \\ \text{sem:} \left[ \begin{array}{l} \text{P: } \langle 3\text{sg, present tense} \rangle \\ \text{C: } \left[ \begin{array}{l} \text{MOD:} \\ \text{NP: } \text{pro-1, pro-2} \end{array} \right] \\ \text{I: } \left[ \begin{array}{l} \text{prn: } \langle 2-, 1 \rangle \\ \text{epr: } 1 \text{ bec } 2 \end{array} \right] \\ \text{M: } \textit{love} \end{array} \right] \end{array} \right]_7$$

he

$$\left[ \begin{array}{l} \text{sur:} \\ \text{syn: } \langle \text{SNP} \rangle \\ \\ \text{sem:} \left[ \begin{array}{l} \text{P: } \langle \text{nom sg} \rangle \\ \text{C: } \left[ \begin{array}{l} \text{MOD:} \\ \text{VERB: } \textit{love} \end{array} \right] \\ \text{I: } \left[ \begin{array}{l} \text{prn: } \langle 2-, 1 \rangle \\ \text{id: } 1 \end{array} \right] \\ \text{M: } \textit{pro-1} \end{array} \right] \end{array} \right]_8$$

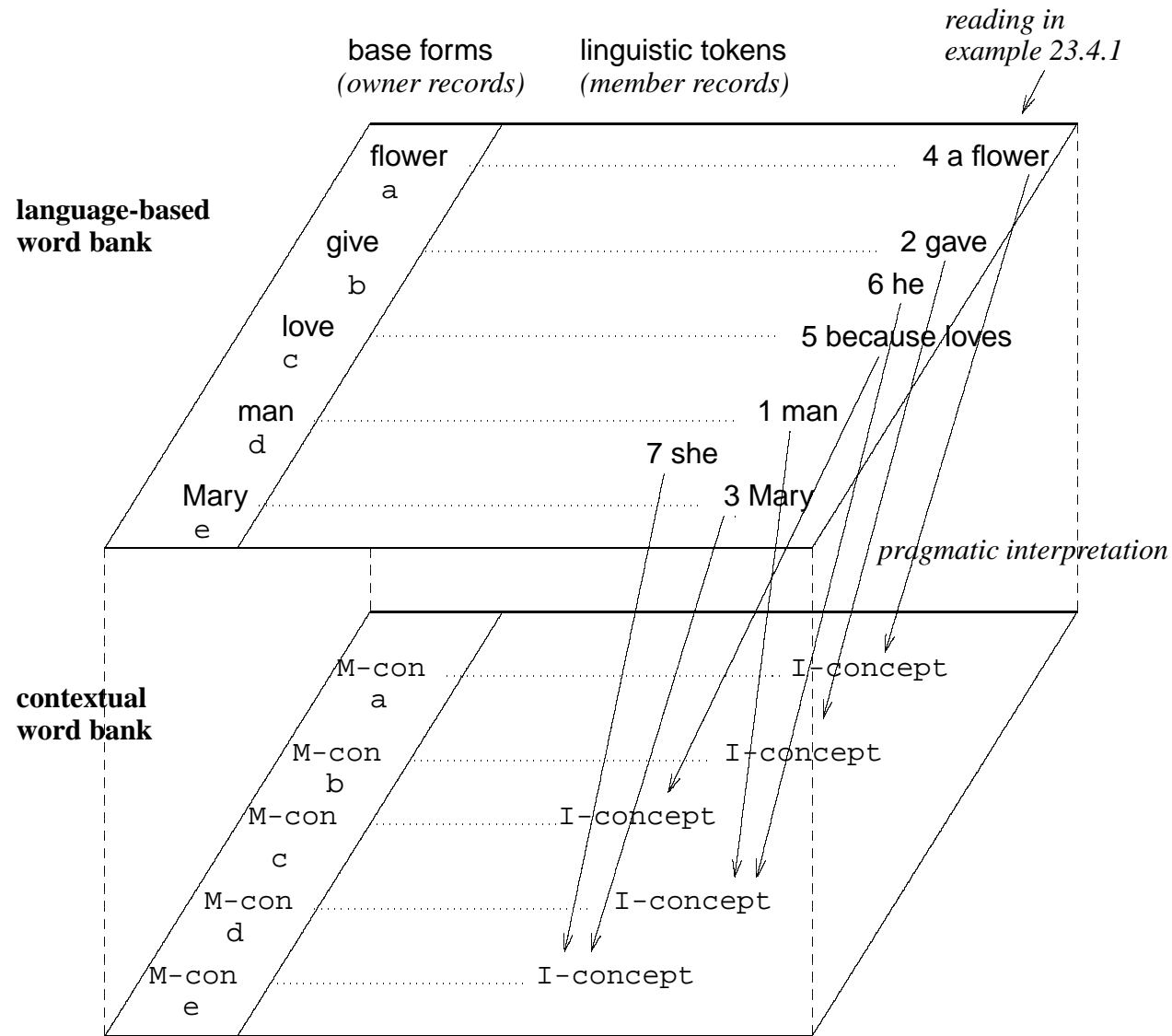
her

$$\left[ \begin{array}{l} \text{sur:} \\ \text{syn: } \langle \text{SNP} \rangle \\ \\ \text{sem:} \left[ \begin{array}{l} \text{P: } \langle \text{obl sg} \rangle \\ \text{C: } \left[ \begin{array}{l} \text{MOD:} \\ \text{VERB: } \textit{love} \end{array} \right] \\ \text{I: } \left[ \begin{array}{l} \text{prn: } \langle 2-, 1 \rangle \\ \text{id: } 2 \end{array} \right] \\ \text{M: } \textit{pro-2} \end{array} \right] \end{array} \right]_9$$

### 23.5.2 Components of meaning<sub>1</sub>

- Compositional semantics (sentence semantics)
  1. Decomposition of input into elementary propositions.
  2. Functor-argument structure within an elementary proposition.
  3. Extrapositional relations among elementary propositions.
- Lexical semantics (word semantics)
  1. Properties and M-concepts of woplets.
  2. Extrapositional relations between word types by means of *absolute propositions*.

### 23.5.3 Embedding 23.5.1 into the contextual word bank



### 23.5.4 Contextual reconstruction of language information

