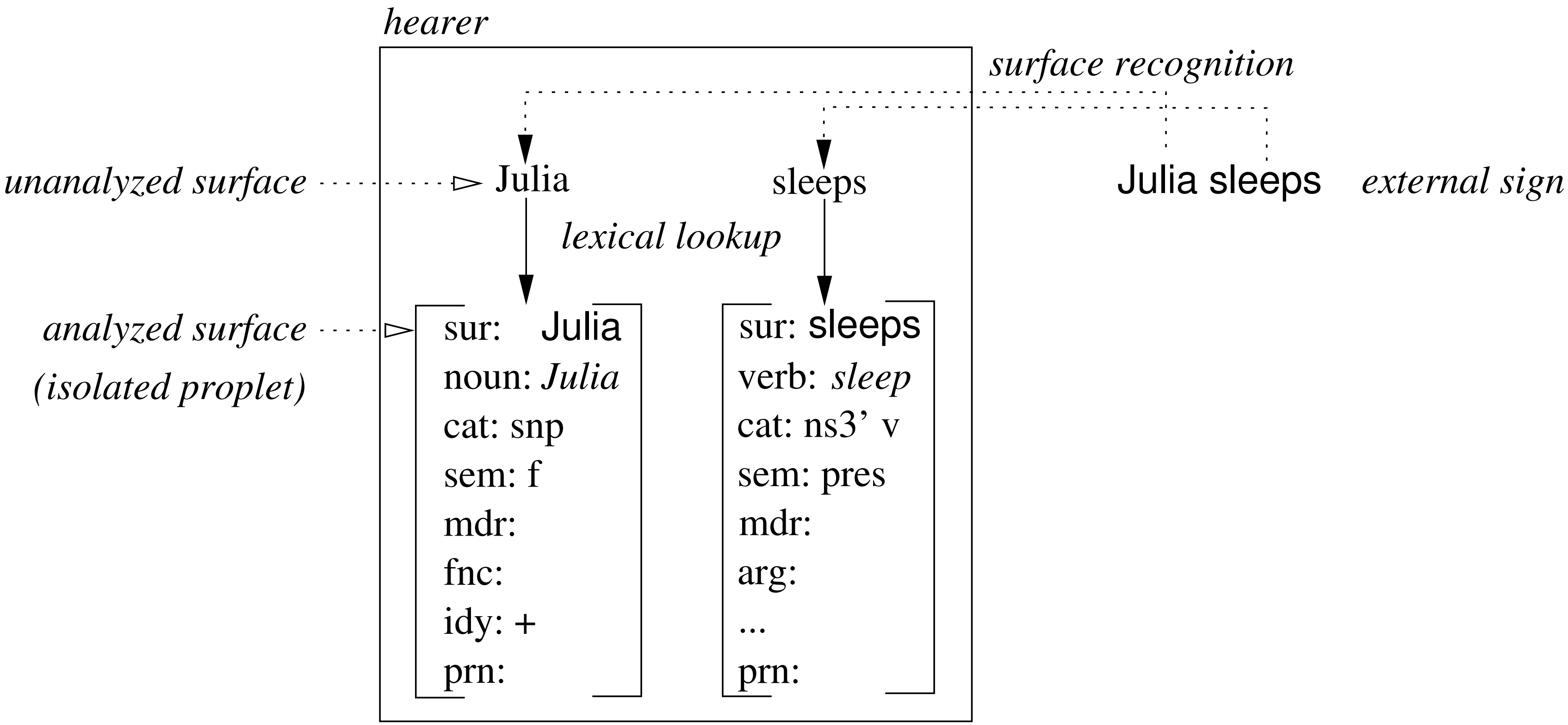
Part III.
The Declarative Specification of Formal Fragments

11. DBS.1: Hearer-Mode

11.1 Automatic Word Form Recognition

11.1.1 Surface recognition and lexical lookup



11.2 Lexicon of LA-hear.1

11.2.1 The lexical entries of LA-hear.1

proper names:

$$\begin{bmatrix}\text{sur: Julia}\\ \text{noun: } \textit{Julia}\\ \text{cat: nm}\\ \text{sem: f}\\ \text{mdr:}\\ \text{fnc:}\\ \text{idy:}\\ \text{prn:}\end{bmatrix}\quad \begin{bmatrix}\text{sur: John}\\ \text{noun: } \textit{John}\\ \text{cat: nm}\\ \text{sem: m}\\ \text{mdr:}\\ \text{fnc:}\\ \text{idy:}\\ \text{prn:}\end{bmatrix}\quad \begin{bmatrix}\text{sur: Susanne}\\ \text{noun: } \textit{Susanne}\\ \text{cat: nm}\\ \text{sem: f}\\ \text{mdr:}\\ \text{fnc:}\\ \text{idy:}\\ \text{prn:}\end{bmatrix}$$

$$\begin{bmatrix}\text{sur: sleeps}\\ \text{erb: } \textit{sleep}\\ \text{cat: ns3}' \text{ v}\\ \text{sem: pres}\\ \text{mdr:}\\ \text{arg:}\\ \text{nc:}\\ \text{pc:}\\ \text{prn:}\end{bmatrix}\quad \begin{bmatrix}\text{sur: sings}\\ \text{verb: } \textit{sing}\\ \text{cat: ns3}' \text{ v}\\ \text{sem: pres}\\ \text{mdr:}\\ \text{arg:}\\ \text{nc:}\\ \text{pc:}\\ \text{prn:}\end{bmatrix}\quad \begin{bmatrix}\text{sur: dreams}\\ \text{verb: } \textit{dream}\\ \text{cat: ns3}' \text{ v}\\ \text{sem: pres}\\ \text{mdr:}\\ \text{arg:}\\ \text{nc:}\\ \text{pc:}\\ \text{prn:}\end{bmatrix}$$

punctuation sign

$$\begin{bmatrix}\text{sur: .}\\ \text{cat: v}' \text{ decl}\end{bmatrix}$$

11.2.2 Values of the cat attribute

decl	= declarative sentence
nm	= proper name
ns3′	= nominative third person singular valency position
v	= verb, unmarked for sentence mood
v′	= valency position for verb unmarked for sentence mood

11.2.3 Values of the sem attribute

f	= femininum
m	= masculinum
pres	= present tense

11.2.4 Intra-propositional continuation attributes

arg: specifies the arguments of verbs (list)
fnc: specifies the functor of nouns (atom)
mdr: specifies the modifiers of nouns and verbs (list)
mdd: specifies the modified of adnominals and adverbials (atom)

11.2.5 Extra-propositional continuation attributes

idy: identity between nouns. Takes a number as value.
nc: next conjunct. Takes an optional conjunction, a proposition number, and a verb concept as value.
pc: previous conjunct. Takes values similar to nc.

11.2.6 Book-keeping attribute of LA-hear.1

prn: proposition number

11.3 Preamble of LA-hear.1

11.3.1 List of binding variables

SM	= sentence mood
VT	= verb type filler
VT′	= verb type valency position
NP	= noun phrase filler
NP′	= noun phrase valency position
α, β, γ, etc.	= for individual concepts like *Julia, sleep, young,* etc.
i, j, k	= for number values of the prn and idy attributes

11.3.2 Restriction of binding variables

SM ϵ {decl}
VT ϵ {v}
VT′ ϵ {v′}
NP ϵ {nm}
NP′ ϵ {ns3′}

11.3.3 Matching between a variable and a constant

$$\begin{array}{rl} \textit{rule level:} & \begin{bmatrix} \text{cat: NP} \end{bmatrix} \\ & \qquad\quad \textit{matching?} \\ \textit{language level:} & \begin{bmatrix} \text{cat: nm} \end{bmatrix} \end{array}$$

If variable X has the values a, b, or c, then the variable Y must have the values p or q.

11.3.4 Agreement conditions

if $\mathsf{VT} \in \{\mathsf{v}\}$, then $\mathsf{VT}' \in \{\mathsf{v}'\}$
if $\mathsf{NP} \in \{\mathsf{nm}\}$, then $\mathsf{NP}' \in \{\mathsf{ns3}'\}$

11.4 Definition of LA-hear.1

11.4.1 Formal Definition of LA-hear.1

ST$_S$ $=_{def}$ { ([cat: X] {1 NOM+FV}) }

NOM+FV {2 S+IP}

$$\begin{bmatrix}\text{noun: } \alpha\\ \text{cat: NP}\\ \text{fnc:}\\ \text{prn: k}\end{bmatrix} \begin{bmatrix}\text{verb: } \beta\\ \text{cat: NP}' \text{ X VT}\\ \text{arg:}\\ \text{nc:}\\ \text{pc:}\end{bmatrix}$$

delete NP′ nw.cat
acopy α nw.arg
ecopy β ss.fnc
ecopy PC nw.pc
acopy PCV nw.pc
set β NCV
copy$_{ss}$ copy$_{nw}$

S+IP {3 IP+START}

$$\begin{bmatrix}\text{verb: } \alpha\\ \text{cat: VT}\\ \text{prn: k}\end{bmatrix} \begin{bmatrix}\text{cat: VT}' \text{ SM}\end{bmatrix}$$

replace SM VT
set k PC
set α PCV
copy$_{ss}$

IP+START {1 NOM+FV}

$$\begin{bmatrix}\text{verb: } \alpha\\ \text{cat: SM}\\ \text{nc:}\end{bmatrix} \begin{bmatrix}\text{noun: } \beta\\ \text{cat: NP}\\ \text{prn: k}\end{bmatrix}$$

increment nw.prn
ecopy k ss.nc
acopy ‘NCV’ ss.nc
copy$_{ss}$ copy$_{nw}$

ST$_F$ $=_{def}$ {([cat: decl] rp$_{\text{S+IP}}$)}

11.4.2 Definitions of the operations

delete variable proplet-attr. =	delete the value corresponding to the variable in the corresponding attribute of the corresponding proplet at the level of language.
example:	delete NP$'$ nw.cat (in NOM+FV)
acopy variable proplet-attr. =	additively copy value(s) corresponding to the variable into the specified target slot; default position is at the end of the target slot.
examples:	acopy α nw.arg (in NOM+FV) acopy PCV nw.pc (in NOM+FV) acopy 'NCV' ss.nc (in IP+START)
ecopy variable proplet-attr. =	exclusively copy value(s) corresponding to the variable into the specified proplet attribute.
examples:	ecopy β ss.fnc (in NOM+FV) ecopy PC nw.pc (in NOM+FV) ecopy k ss.nc (in IP+START)
set value variable =	rule-based (rather than matching-based) binding of a variable to a value.
examples:	set β NCV (in NOM+FV) set k PC (in S+IP) set α PCV (in S+IP)
replace variable2 variable1 =	replace value of variable1 with value of variable2.
examples:	replace SM VT (in S+IP)
increment proplet-attr. =	increment numerical value of corresponding attribute by one.
example:	increment nw.prn (in IP+START)
copy$_{ss}$ =	include the proplets of the sentence start in the result.
examples:	NOM+FV, S+IP, IP+START
copy$_{nw}$ =	include the proplet of the next word in the result.
examples:	NOM+FV, IP+START

11.5 Interpreting a Sequence of Sentences

11.5.1 Combining Julia and sleeps

NOM+FV {2 S+IP}

$$\left[\begin{array}{l}\text{noun: } \alpha\\ \text{cat: NP}\\ \text{fnc:}\\ \text{prn: k}\end{array}\right]\quad\left[\begin{array}{l}\text{verb: } \beta\\ \text{cat: NP}'\text{ X VT}\\ \text{arg:}\\ \text{nc:}\\ \text{pc:}\end{array}\right]$$

delete NP′ nw.cat
acopy α nw.arg
ecopy β ss.fnc
ecopy PC nw.pc
acopy PCV nw.pc
set β NCV
copy$_{ss}$ copy$_{nw}$

$$\left[\begin{array}{l}\text{sur: 1.1 Julia}\\ \text{noun: } \textit{Julia}\\ \text{cat: nm}\\ \text{sem: f}\\ \text{mdr:}\\ \text{fnc:}\\ \text{idy: 1}\\ \text{prn: 1}\end{array}\right]_1\left[\begin{array}{l}\text{sur: 1.2 sleeps}\\ \text{verb: } \textit{sleep}\\ \text{cat: ns3}'\text{ v}\\ \text{sem: pres}\\ \text{mdr:}\\ \text{arg:}\\ \text{nc:}\\ \text{pc:}\\ \text{prn:}\end{array}\right]_2 \Longrightarrow \left[\begin{array}{l}\text{sur:}\\ \text{noun: } \textit{Julia}\\ \text{cat: nm}\\ \text{sem: f}\\ \text{mdr:}\\ \text{fnc: sleep}\\ \text{idy: 1}\\ \text{prn: 1}\end{array}\right]_1\left[\begin{array}{l}\text{sur:}\\ \text{verb: } \textit{sleep}\\ \text{cat: v}\\ \text{sem: pres}\\ \text{mdr:}\\ \text{arg: Julia}\\ \text{nc:}\\ \text{pc:}\\ \text{prn: 1}\end{array}\right]_2$$

11.5.2 Combining Julia sleeps and .

S+IP {3 IP+START}

$$
\begin{bmatrix}\text{verb: } \alpha \\ \text{cat: VT} \\ \text{prn: k}\end{bmatrix}
\quad
\begin{bmatrix}\text{cat: VT}' \text{ SM}\end{bmatrix}
\qquad
\begin{array}{l}\text{replace SM VT} \\ \text{set k PC} \\ \text{set } \alpha \text{ PCV} \\ \text{copy}_{ss}\end{array}
$$

$$
\begin{bmatrix}\text{sur: } \\ \text{noun: } \textit{Julia} \\ \text{cat: nm} \\ \text{sem: f} \\ \text{mdr: } \\ \text{fnc: sleep} \\ \text{idy: 1} \\ \text{prn: 1}\end{bmatrix}_1
\begin{bmatrix}\text{sur: } \\ \text{verb: } \textit{sleep} \\ \text{cat: v} \\ \text{sem: pres} \\ \text{mdr: } \\ \text{arg: Julia} \\ \text{nc: } \\ \text{pc: } \\ \text{prn: 1}\end{bmatrix}_2
\quad
\begin{bmatrix}\text{sur: 1.3 .} \\ \text{cat: v}' \text{ decl}\end{bmatrix}_3
\Longrightarrow
\begin{bmatrix}\text{sur: } \\ \text{noun: } \textit{Julia} \\ \text{cat: nm} \\ \text{sem: f} \\ \text{mdr: } \\ \text{fnc: sleep} \\ \text{idy: 1} \\ \text{prn: 1}\end{bmatrix}_1
\begin{bmatrix}\text{sur: } \\ \text{verb: } \textit{sleep} \\ \text{cat: decl} \\ \text{sem: pres} \\ \text{mdr: } \\ \text{arg: Julia} \\ \text{nc: } \\ \text{pc: } \\ \text{prn: 1}\end{bmatrix}_2
$$

11.5.3 Combining Julia sleeps. and John

3 IP+START {1 NOM+FV }

$$\begin{bmatrix}\text{verb: } \alpha \\ \text{cat: SM} \\ \text{nc: }\end{bmatrix} \quad \begin{bmatrix}\text{noun: } \beta \\ \text{cat: NP} \\ \text{prn: k}\end{bmatrix}$$

increment nw.prn

ecopy k ss.nc
acopy ‘NCV’ ss.nc
copy$_{ss}$ copy$_{nw}$

$$\begin{bmatrix}\text{sur: } \\ \text{verb: } \textit{sleep} \\ \text{cat: decl} \\ \text{sem: pres} \\ \text{mdr: } \\ \text{arg: Julia} \\ \text{nc: } \\ \text{pc: } \\ \text{prn: 1}\end{bmatrix}_2 \quad \begin{bmatrix}\text{sur: 2.1 John} \\ \text{noun: } \textit{John} \\ \text{cat: nm} \\ \text{sem: m} \\ \text{mdr: } \\ \text{fnc: } \\ \text{idy: } \\ \text{prn: }\end{bmatrix}_4 \Longrightarrow \begin{bmatrix}\text{sur: } \\ \text{verb: } \textit{sleep} \\ \text{cat: decl} \\ \text{sem: pres} \\ \text{mdr: } \\ \text{arg: Julia} \\ \text{nc: 2 NCV} \\ \text{pc: } \\ \text{prn: 1}\end{bmatrix}_2 \quad \begin{bmatrix}\text{sur: } \\ \text{noun: } \textit{John} \\ \text{cat: nm} \\ \text{sem: m} \\ \text{mdr: } \\ \text{fnc: } \\ \text{idy: 2} \\ \text{prn: 2}\end{bmatrix}_4$$

11.5.4 Combining Julia sleeps. John and sings

1 NOM+FV {2 S+IP}

$$\begin{bmatrix} \text{noun: } \alpha \\ \text{cat: NP} \\ \text{fnc:} \\ \text{prn: k} \end{bmatrix} \quad \begin{bmatrix} \text{verb: } \beta \\ \text{cat: NP}' \text{ X VT} \\ \text{arg:} \\ \text{nc:} \\ \text{pc:} \end{bmatrix}$$

delete NP$'$ nw.cat
acopy α nw.arg
ecopy β ss.fnc
ecopy PC nw.pc
acopy PCV nw.pc
set β NCV
copy$_{ss}$ copy$_{nw}$

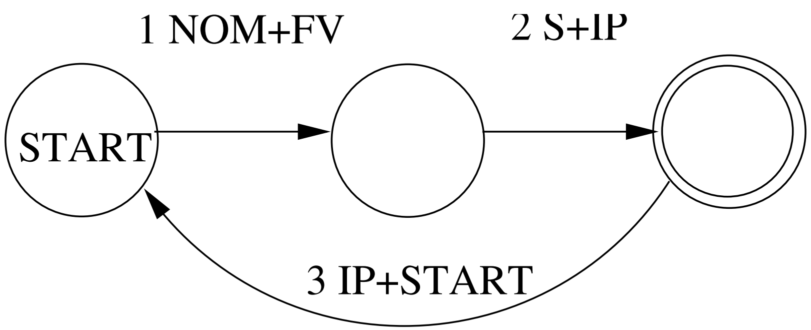
$$\begin{bmatrix} \text{sur:} \\ \text{noun: } \textit{Julia} \\ \text{cat: nm} \\ \text{sem: f} \\ \text{mdr:} \\ \text{fnc: sleep} \\ \text{idy: 1} \\ \text{prn: 1} \end{bmatrix}_1 \begin{bmatrix} \text{sur:} \\ \text{verb: } \textit{sleep} \\ \text{cat: decl} \\ \text{sem: pres} \\ \text{mdr:} \\ \text{arg: Julia} \\ \text{nc: 2 NCV} \\ \text{pc:} \\ \text{prn: 1} \end{bmatrix}_2 \begin{bmatrix} \text{sur:} \\ \text{noun: } \textit{John} \\ \text{cat: nm} \\ \text{sem: m} \\ \text{mdr:} \\ \text{fnc:} \\ \text{idy: 2} \\ \text{prn: 2} \end{bmatrix}_4 \begin{bmatrix} \text{sur: 2.2 sings} \\ \text{verb: } \textit{sing} \\ \text{cat: ns3}' \text{ v} \\ \text{sem: pres} \\ \text{mdr:} \\ \text{arg:} \\ \text{nc:} \\ \text{pc:} \\ \text{prn:} \end{bmatrix}_5 \Longrightarrow \begin{bmatrix} \text{sur:} \\ \text{noun: } \textit{Julia} \\ \text{cat: nm} \\ \text{sem: f} \\ \text{mdr:} \\ \text{fnc: sleep} \\ \text{idy: 1} \\ \text{prn: 1} \end{bmatrix}_1 \begin{bmatrix} \text{sur:} \\ \text{verb: } \textit{sleep} \\ \text{cat: decl} \\ \text{sem: pres} \\ \text{mdr:} \\ \text{arg: Julia} \\ \text{nc: 2 sing} \\ \text{pc:} \\ \text{prn: 1} \end{bmatrix}_2$$

$$\begin{bmatrix} \text{sur:} \\ \text{noun: } \textit{John} \\ \text{cat: nm} \\ \text{sem: m} \\ \text{mdr:} \\ \text{fnc: sing} \\ \text{idy: 2} \\ \text{prn: 2} \end{bmatrix}_4 \begin{bmatrix} \text{sur:} \\ \text{verb: } \textit{sing} \\ \text{cat: v} \\ \text{sem: pres} \\ \text{mdr:} \\ \text{arg: John} \\ \text{nc:} \\ \text{pc: 1 sleep} \\ \text{prn: 2} \end{bmatrix}_5$$

11.5.5 Sequence of rule applications in deriving the sample of dbs-1

	1.1 Julia
1 NOM+FV	1.2 sleeps
2 S+IP	1.3 .
3 IP+START	2.1 John
1 NOM+FV	2.2 sings
2 S+IP	2.3 .
3 IP+START	3.1 Susanne
1 NOM+FV	3.2 dreams
2 S+IP	3.3 .

11.5.6 Finite state transition network of LA-hear.1



11.6 Storing the Output of LA-hear.1 in a Word Bank

11.6.1 Sorting an LA-hear derivation into a Word Bank

owner records (isolated proplets)	*member records* (connected proplets)
sur: verb: *dream* cat: n-s3’ v sem: pres mdr: arg: nc: pc: prn:	sur: verb: *dream* cat: decl sem: pres mdr: arg: Susanne nc: pc: 2 sing prn: 3
sur: noun: *John* cat: nm sem: m mdr: fnc: idy: prn:	sur: noun: *John* cat: nm sem: m mdr: fnc: sing idy: 2 prn: 2

owner records (isolated proplets)	*member records* (connected proplets)
sur: noun: *Julia* cat: nm sem: f mdr: fnc: idy: prn:	sur: noun: *Julia* cat: nm sem: f mdr: fnc: sleep idy: 1 prn: 1
sur: verb: *sing* cat: n-s3’ v sem: pres mdr: arg: nc: pc: prn:	sur: verb: *sing* cat: decl sem: pres mdr: arg: John nc: 3 dream pc: 1 sleep prn: 2

owner records (isolated proplets)	*member records* (connected proplets)
sur:	sur:
verb: *sleep*	verb: *sleep*
cat: n-s3’ v	cat: decl
sem: pres	sem: pres
mdr:	mdr:
arg:	arg: Julia
nc:	nc: 2 sing
pc:	pc:
prn:	prn: 1
sur:	sur:
noun: *Susanne*	noun: *Susanne*
cat: nm	cat: nm
sem: f	sem: f
mdr:	mdr:
fnc:	fnc: dream
idy:	idy: 3
prn:	prn: 3