IA165

Combinatory Logic for Computational Semantics

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- Combinators allow to introduce and define new operators which mark the aspecto-temporal relation. → "aspecto-temporal operators"

We show the aspecto-temporal relation of the given text in the SDRT and define the aspecto-temporal operators by means of the combinators
→ propose a formal semantic analysis by taking into account of the aspecto-temporal relation in the text
→ establish the temporal relations between sentences

- Hypothesis for the computational and semantic representation of the temporality

The temporality of language can not be described without taking account of the aspectuality. All aspectual notions imply an underlying temporality;

→ most of situations require topological relations between open closed boundaries of intervals compounded by instants.

(show the examples of the topological relations on the board)

(i) $\mathbf{STATE}_{O}$ (Λ) is developed on the topological open interval 'O' and is true for each instant of 'O';

(ii) $\mathbf{EVEN}_{F}$ (Λ) is developed on the closed interval 'F' and is true at the right closed boundary '$\delta(F)$';

(iii) $\mathbf{PROC}_{J}$ (Λ) is developed on the interval 'J' with a left-closed boundary '$\gamma(J)$' and right-open boundary '$\delta(J)$' and is true at each instant 't' of 'J' before the right open boundary of '$\delta(J)$' $(t < \delta(J))$

(1) Fred had a great evening last night (π1). He had a great meal (π2). He ate salmon (π3). He devoured lots of cheese (π4). He then won a dancing competition (π5).

(Asher and Lascarides 2003)

π1.1. Last night (reform: All that follows occurred last night): Temporal Framework, $STATE_{O1}$ (state)

π1.2. Fred had a great evening : $EVEN_{F1}$ (event)

π2. He had a great meal: $EVEN_{F2}$ (event)

π3. He ate salmon: $EVEN_{F3}$ (event)

π4. He devoured lots of cheese: $EVEN_{F4}$ (event)

π5. He then won a dancing competition: $EVEN_{F5}$ (event)

Definition of the speech act operator "I-am-saying"

: a result of a functional composition of the two operators: "I-SAY" and "$PROC_{J0}$"

$$PROC_{J0}\ ((I\text{-}SAY)\ (\&\ (ASP_{I}\ (\Lambda))\ [I\ REP\ J^{0}]))$$

comment:

the aspectual process $PROC_{J0}$ is applied on the result of the application of (I-SAY) on a conjunction of an aspectualized predicative relation $ASP_{I}\ (\Lambda)$ and a temporal relation [I REP J^{0}] between the interval I related to the predicative relation and an interval J^{0} related to enunciative process.

p1.1. $PROC_{J0}$ (I-SAY (& ($STATE_{O1}$ (All that follows occurred last night)) [$\delta(O^1) < \delta(J^0)$])

p1.2. $PROC_{J0}$ (I-SAY (& ($EVEN_{F1}$ ((have (a great evening))(Fred))) [$\delta(F^1) < \delta(J^0)$])

p2. $PROC_{J0}$ (I-SAY (& ($EVEN_{F2}$ ((have (a great meal))(Fred))) [$\delta(F^2) < \delta(J^0)$])

p3. $PROC_{J0}$ (I-SAY (& ($EVEN_{F3}$ ((eat (salmon)) (x)))[$\delta(F^3) < \delta(J^0)$])

p4. $PROC_{J0}$ (I-SAY (& ($EVEN_{F4}$ ((devour (lots of cheese))(x))) [$\delta(F^4) < \delta(J^0)$])

p5. $PROC_{J0}$ (I-SAY (& ($EVEN_{F5}$ ((win (a dancing competition)) (x))) [$\delta(F^5) < \delta(J^0)$])

Fred devoured lots of cheese

p4. $PROC_{J0}$ (I-SAY (& ($EVEN_{F4}$ ((devour (lots of cheese))(x))) [$\delta(F^4) < \delta(J^0)$])

Definition the ascpecto-temporal marker in term of the combinators

-ed

COMPLETE-EVENT-PAST

-ed= past-suffix

Past-suffix=COMPLETE-EVENT-PAST

1/ Fred devoured lots of cheese

2/ ((devour-ed (lots of cheese))(Fred))

3/ past-suffix $P_2A^2A^1$

4/ COMPLETE-EVENT-PAST ($P_2A^2A^1$)

5/ [COMPLETE-EVENT-PAST=X & ([$\delta(F^4) < \delta(J^0)$]) I-am-saying $EVEN_{F4}$]

6/ [X= $B_6C_3C_3CB^2$]

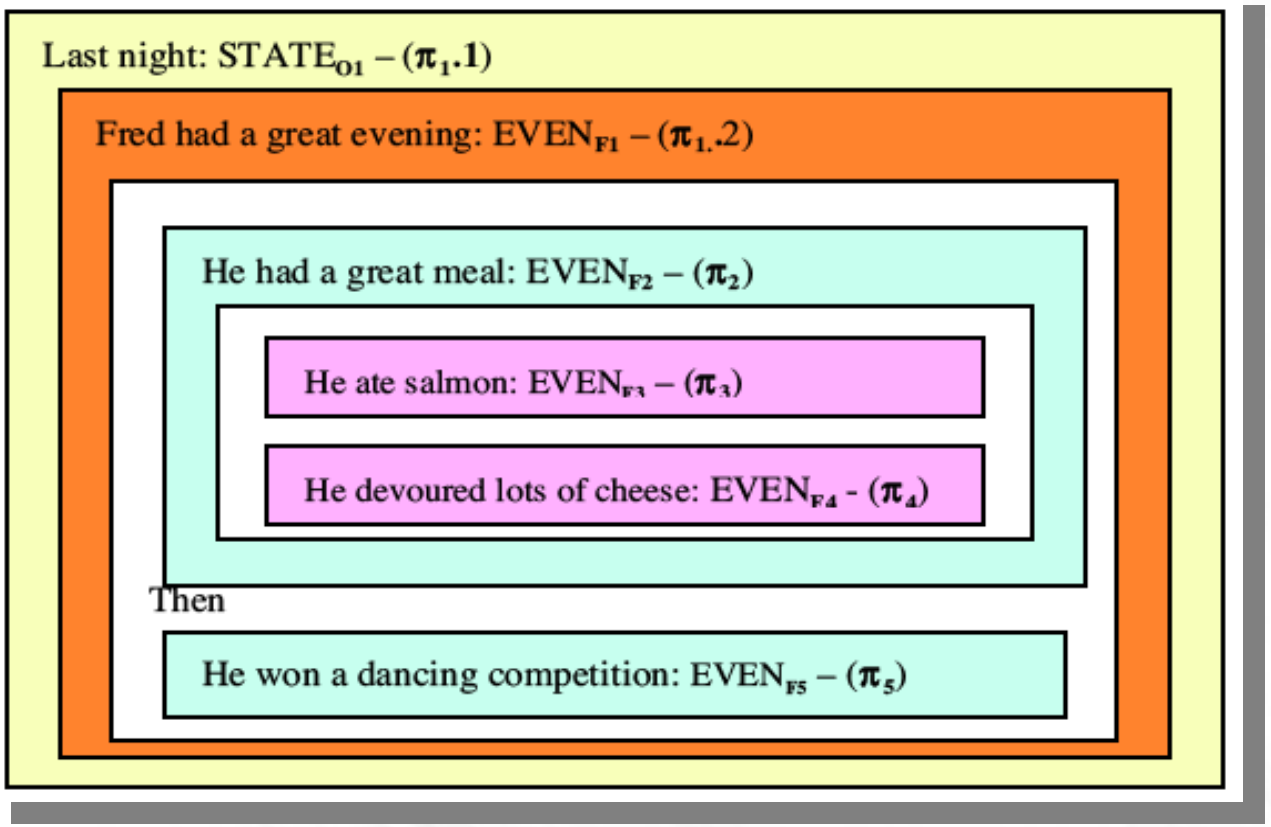
7/ I-am-saying (& ($EVEN_{F4}$($P_2A^2A^1$))([$\delta(F^4) < \delta(J^0)$]))

8/ [I-am-saying =**B** $PROC_{J0}$ (I-SAY)]

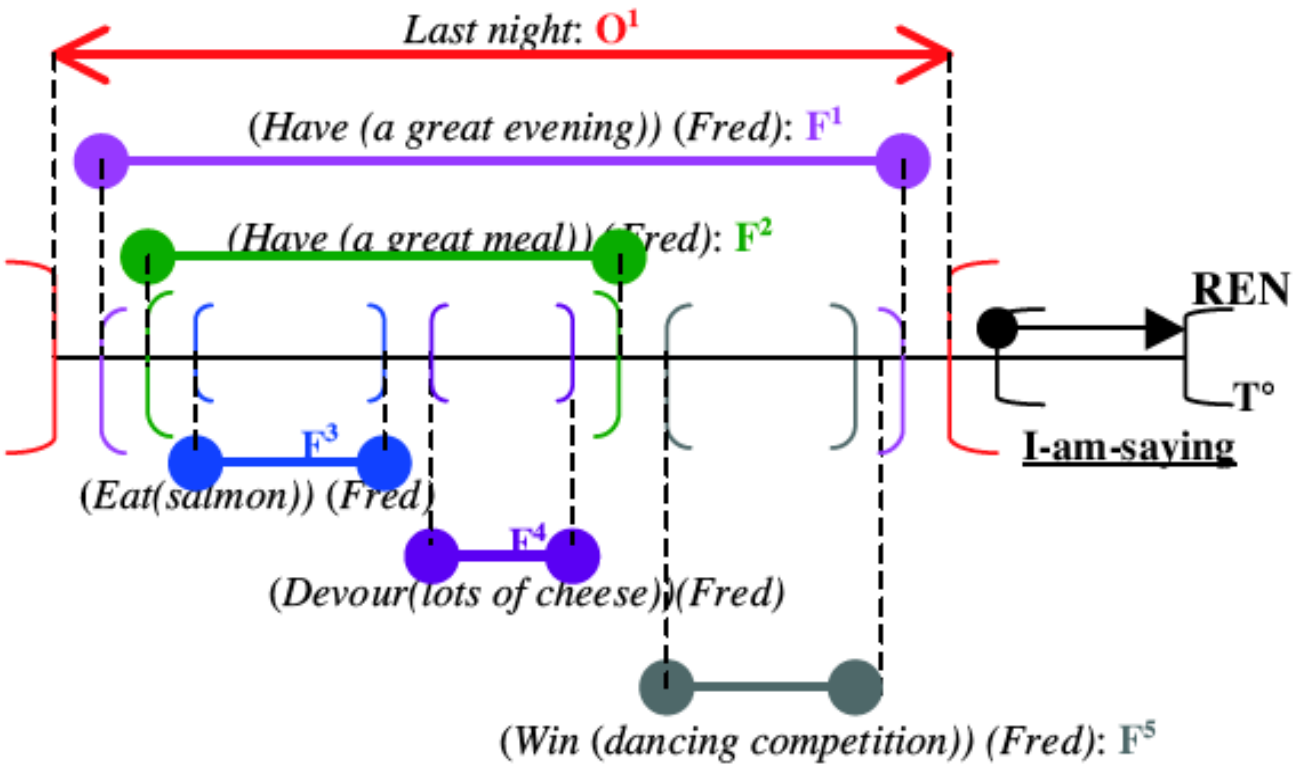
9/ $PROC_{J0}$ (I-SAY (& ($EVEN_{F4}$ ($P_2A^2A^1$)) ([$\delta(F^4) < \delta(J^0)$])))

10/ $PROC_{J0}$ (I-SAY (& ($EVEN_{F4}$ ((devour (lots of cheese))(x))) [$\delta(F^4) < \delta(J^0)$])

Discursive structure



Temporal relation of discourse in the enunciative referential framework



Incomplete present-process

- *The police chase the red car (at this moment)*

Definition of the aspect incomplete present

Aspectual operators

INC_PRST: grammaticalized aspectual operator

prst$_{\text{process}}$: pre-morphologic asepctual operator

INC_PRST: grammaticalized aspectual operator

prst$_{\text{\_process}}$: pre-morphologic asepctual operator

INC_PRST:

Not associated to the lexical predicate but concern the whole predicative relation

The linguistic trace can be expressed at the morpho-syntactic level in the form of the verbal morphemes (pre-verb, suffix, affix..)

prst$_{\text{\_process}}$:

Takes an unique lexical predicate as operande and expresses the verbal aspect being attached to the verb

- Hypothesis

(-e (chas-)) (the red car)(the police)

$(\text{prst}_{\text{–process}}\ (P_2)\ )\ A^2\ A^1$

$\text{INC\_PRST}\ (P_2\ A^2\ A^1)$

$\text{I-am-saying}_{J0}\ (\&\ (\text{PROC}_{J1}\ (P_2\ A^2\ A^1))\ ([\delta(J^1)=\delta(J^0)])\ )$

The police chase the red car (at this moment)

4/ $\underline{\text{I-am-saying}}_{J0}$ (& (PROC_{J1} (P_2 A^2 A^1)) ([$\delta(J^1)=\delta(J^0)$])) hyp.

5/ B^2 $\underline{\text{I-am-saying}}_{J0}$ & (PROC_{J1} (P_2 A^2 A^1)) ([$\delta(J^1)=\delta(J^0)$]) int. B^2

6/ B (B^2 $\underline{\text{I-am-saying}}_{J0}$ &) PROC_{J1} (P_2 A^2 A^1) ([$\delta(J^1)=\delta()$]) int. B

7/ C_2 B (B^2 $\underline{\text{I-am-saying}}_{J0}$ &) PROC_{J1} ([$\delta(J^1)=\delta(J^0)$]) (P_2 A^2 A^1) int. C_2

8/ B^2 (C_2 B) B^2 $\underline{\text{I-am-saying}}_{J0}$ & PROC_{J1} ([$\delta(J^1)=\delta(J^0)$]) (P_2 A^2 A^1) int. B^2

9/ [$\underline{\text{INC\_PRST}}_{J1\ J0}$ =déf B^2 (C_2 B) B^2 $\underline{\text{I-am-saying}}_{J0}$ & PROC_{J1} ([$\delta(J^1)=\delta(J^y)$])] def.

10/ [$\underline{\text{INC\_PRST}}$=déf ∃ J^0 J^1{B^2(C_2 B) B^2 $\underline{\text{I-am-saying}}_{J0}$ & PROC_{J1} ([$\delta(J^1)=\delta(J^0)$])}] int. ∃

11/ $\underline{\text{INC\_PRST}}$ (P_2 A^2 A^1) rempl. 6, 5

12/ B^2 $\underline{\text{INC\_PRST}}$ P_2 A^2 A^1 int. B^2

13/ [$\underline{\textbf{prst}}_{\textbf{–process}}$ = déf $B^2\underline{\text{INC\_PRST}}$] def.

14/ ($\underline{\text{prst}}_{\text{–process}}$ (P_2)) A^2 A^1 rempl. 10, 9

A. Definition of the INC_PRST (Incomplete process)

9/ $[\underline{\text{INC\_PRST}}_{J1\ J0} =\text{déf}\ B^2\ (C_2\ B)\ B^2\ \underline{\text{I-am-saying}}_{J0}\ \&\ \text{PROC}_{J1}\ ([\delta(J^1)=\delta(J^y)])]$

B. Introduction of the existential quantificator ∃

10/ $[\underline{\text{INC\_PRST}}=\text{déf}\ \exists\ J^0\ J^1\{B^2(C_2\ B)\ B^2\ \underline{\text{I-am-saying}}_{J0}\ \&\ \text{PROC}_{J1}\ ([\delta(J^1)=\delta(J^0)])\}]$

Comment:

The operator **INC_PRST** depends on intervals 'J^1' and 'J^0'. It is thus necessary to abstract from the operator **INC_PRST** by supposing simply the existence of such intervals which respect a temporal condition. To do this, we introduce the operator of the existential quantification at the step 10.

Temporal scheme of the incomplete present process

J^0 *I am saying....*

J_1 *The police chase the car at this moment....*

T^0 *The real present moment...now...*

Summing up–1

- Operators of the aspectuality

a. **COMPLETE–EVENT–PAST**: e.g. Verbal ending *–ed*

$[\underline{\text{COMPLETE-EVENT-PAST}}=X \;\&\; ([\delta(F^4) < \delta(J^0)])\; \underline{\text{I-am-saying}}\; \text{EVEN}_{F4}]$

where X is $B_6C_3C_3CB^2$

b. **INC–PRST**: verbal ending *–e*

$[\text{INC\_PRST}_{J1\ J0} =\text{déf}\ B^2\ (C_2\ B)\ B^2\ \text{I-am-saying}_{J0} \;\&\; \text{PROC}_{J1}\ ([\delta(J^1)=\delta(J^y)])]$

Summing up–2

Computaional semantic representation of the asepcto-temporality

1. morpho-syntactic representation

*Peter devour **-ed** lots of cheese*

-ed is a verbal morpheme which mark the aspecto-temporal relation

2. logico-grammatical representation

(COMPLETE-EVENT-PAST devour) (lots-of-cheese)(Peter)

3. discursive representation

$PROC_{J0}$ (I-SAY (& ($EVEN_{F4}$ ((devour (lots of cheese))(x))) [$\delta(F^4) < \delta(J^0)$])

Next week...

- Continue about the application of the combinators to natural language analysis: **Quantification**