T-Layer of PDT: Coreference

Markéta Lopatková

Institute of Formal and Applied Linguistics, MFF UK

lopatkova@ufal.mff.cuni.cz
Coreference in PDT: Outline

• basic terms
• grammatical coreference
• textual coreference
• bridging anaphora

PDiT 1.0, PDT 3.0

Coreference in PDT: Basic Concepts

• reference
  ~ a relation of a language expression to a real world object or situation (referent)
• exophoric r.: referring to a situation or entities outside the text
• endophoric r.: referring to another expression (within the same text) having the same referent (entity, situation)

• coreferring expression vs. coreferred expression:
  anaphoric reference: anaphor vs. antecedent
  cataphoric reference: cataphor vs. postcedent

  Near him, John saw a snake.

  controlee vs. controller

• coherence / cohesion (cz návaznost)
Coreference in the Tectogrammatical Tree

• coreference ~ a link between a t-node to another t-node(s)
  • within a single sentence
  • crossing a sentence boundary

• coreferring node:
  • the ID of the coreferred node (leaf / root of a subtree)
  • a list of ID(s) (typically in the same subtree) … for textual coreference

Vlasta, kterou dobře znáš, šla do divadla. Vlasta, whom you very well know, went to the theater.

Marie vzala Vlastu do kavárny, tam na ně už čekal Marek.
Marie took Vlasta to the caffé, where Marek already waited for them.

• attributes for coreference
  • coref_gram.rf
  • compl.rf
  • coref_text
  • coref_special … special values (special type of a textual coreference, later)
  • bridging
Coreference in the Tectogrammatical Tree

Pro zásobování Ostravska a Frýdeckomístecka potřebuje firma svá jatka.
For supplying Ostravsko a Frýdeckomístecko [the firm] needs its slaughterhouse.
Grammatical vs. Textual Coreference

- grammatical coreference
  - based on grammatical rules
  - typically involves a transfer of morphological info (e.g., agreement)
  - (mostly) within a single sentence
  - may by ambiguous $\Rightarrow$ disambiguated at the t-layer
Grammatical vs. Textual Coreference

• grammatical coreference
  • based on grammatical rules
  • typically involves a transfer of morphological info (e.g., agreement)
  • (mostly) within a single sentence
  • may by ambiguous ⇒ disambiguated at the t-layer

• textual coreference
  • not realized by grammatical means alone, but also via context,
  • including references across a sentence boundary
  • vague (indistinct) devices (e.g. personal pronouns)
• "bridging anaphora" as a subtype … only in PDT 3.0 and later (e.g., synonyms, generalizing nouns etc.)
Grammatical Coreference – overview

• reflexive pronouns  se/si/svůj

• relative pronouns and pronominal adverbs
  * který, jaká, čí, …; kam, kde, jak, …; což

• control
  Potřebujete poradit {#Cor.ADDR}?  Do you need an advice (lit. to be advised)?

• quasi-control  … multi-word predicates with a noun with valency requirements
  * Karel podal {#QCor.ACT} stížnost policii.  Karel filed a complaint to police.

• complementations with a dual dependency expressed by a verbal form
  Honza zastihl Hanka, jak {#Cor.ADDR} běhá kolem rybníka.
  Honza saw Hanka running (lit. how she was running) around the lake

• reciprocity
  * Sultáni se vystřídali {#Rcp.PAT} na trůnu.  lit. Sultans REFL changed (each other) on the throne.
Grammatical Coreference

- **reflexive pronouns in Czech ... se / si**
  - does not distinguish gender, number and person
  - 'short' and 'long' forms
  - se / si ... (dat, acc):
    - without stress, not with prepositions
      - (TFA: contextually bound, not contrastive)
  - sebe, sobě, sebe, sobě, sebou ... (gen, dat, acc, loc, instr)
    - stressed and/or in prep. groups

- typically corefer with subject
  
  *Pavel* vypravoval *Martinovi* tu historku o sobě / o něm.  
  Pavel told to Martin a story on himself (on Pavel) / on him (= on Martin).

  *Marii* Karel spatřil nedaleko od sebe / od něho.  
  Karel saw Marie near himself / near him

  passivization:

  *Marie* byla Karlem spatřena nedaleko od něho / *od sebe*
  Marie was seen (by Karel) near him / *herself*
Grammatical Coreference

- reflexive pronouns in Czech ... se / si
- typically corefer with subject

Informace o tom, co o sobě, dva roky po rozvodu, už nevíme {#PersPron.ACT}.
Information about the things we don't know about each other two years after the divorce.
Grammatical Coreference

- reflexive possessive pronoun in Czech ... svůj
- typically corefer with the subject

Neschopnost opozičních stran
{k#Cor.ACT} vzdorovat své vlastní lenosti.
An inability of oppositional parties
to resist their own laziness
Grammatical Coreference

- reflexive possessive pronoun in Czech ... svůj
- typically coreference with the subject
  - BUT more complex
    (e.g., subject of the governing clause)

Mnohá ze svých děl Reich nedovoluje provozovat bez vlastní hráčské účasti. Many of his pieces Reich does not allows to perform without his (own) player's presence.
Grammatical Coreference

- **relative pronouns and pronominal adverbs**
  - který, jaká, čí, …; kam, kde, jak, …
- the relative element corefers with the noun modified by the dependent clause

*Film se odehrává na venkově, v městečku Sardent, kam se po letech vrací - … - tamější rodák.*
The film takes place in a town, to which - … - a native returns after many years.
Grammatical Coreference

- **control**: verbs of control (equi verbs)
- control ~ the (understood, unexpressed) subject of a given predicate is determined by some expression in context
  = superordinate verb "controls" the arguments of a subordinate, nonfinite verb

Susan promised us to help.  ... subject control with the obligatory control, predicate *promise*
Fred stopped laughing.    ... subject control with the obligatory control, predicate *stop*
We tried to leave.                                 ... subject control with the obligatory control, predicate *try*
Sue asked Bill to stop.    ... object control with the obligatory control, predicate *ask*
They told you to support the effort.    ... object control with the obligatory control, predicate *tell*
Someone forced him to do it.       ... object control with the obligatory control, predicate *force*
Grammatical Coreference

• **control: verbs of control (equi verbs)**

• control ~ the (understood, unexpressed) subject of a given predicate is determined by some expression in context

= superordinate verb "controls" the arguments of a subordinate, nonfinite verb

Susan promised us to help. ... subject control with the obligatory control, predicate promise
Fred stopped laughing. ... subject control with the obligatory control, predicate stop
We tried to leave. ... subject control with the obligatory control, predicate try

Sue asked Bill to stop. ... object control with the obligatory control, predicate ask
They told you to support the effort. ... object control with the obligatory control, predicate tell
Someone forced him to do it. ... object control with the obligatory control, predicate force

• **control predicates** semantically select their arguments

  Fred asked you to read it. ... asked is an object control verb
  Jim forced her to say it ... forced is an object control verb

• **raising predicates** do not semantically select (at least) one of their dependents

  Fred expects you to read it. ... expects is a raising-to-object verb
  Jim believed her to have said it. ... believes is a raising-to-object verb
Grammatical Coreference

- **control**: verbs of control (equi verbs)
  - the **controller** is a member of the valency frame of the governing verb
  - the **controllee** is a member of the valency frame of the infinitive / deverb. noun dependent on the control verb (usually unexpressed subject)
  - the infinitive / deverb. noun is a valency complementation of the control verb

*Potřebujete poradit {#Cor.ADDR}?*  
*Do you need advice (lit. to be advised)?*

**PDT-VALLEX**

*potřebovat*

**ACT** (.1) **PAT** (.4, f, aby [.v], c) v-w4096f1 **Used**: 183x

*nepotřebove, co vidí; p. se k životu.*

*to p. čas; ta věc p. uvážit*

*poradit*

**ACT** (.1) **PAT** (.4, f, že [.v], aby [.v], atť [.v], s-1[.7], c) **ADDR** (.3)  

*v-w3902f1 **Used**: 19x

*poradil Petrovi, aby se myl pravidelně  
p. mu se vším; p. mi, podle čeho se mám rozhodnout*
Grammatical Coreference

- **control**: subjects of infinitives: possible t-lemmas

<table>
<thead>
<tr>
<th>#Cor</th>
<th>the subject cannot be expressed</th>
<th>the subject of the infinitive is in a control relation with a modification of the main verb</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Petr přišel</strong> {#Cor.ACT = Petr} pomoci. lit. Petr came to help.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#Gen</th>
<th>the subject is not expressed</th>
<th>the subject of the infinitive is a general argument</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ten nápad</strong> {#Gen.ACT = sb} založit nadaci se Pavlovi líbí. Pavel likes the idea to found a foundation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#PersPron</th>
<th>the subject is not expressed</th>
<th>it is possible to find the antecedent of the subject but it is not grammatical but rather textual coreference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pavel likes Peter's idea to found a foundation</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| t-lemma of a noun / #PersPron | the subject is expressed | the subject of the infinitive is expressed by a full noun or personal pronoun; these are the cases of infinitives expressing a condition |
Grammatical Coreference

- **quasi-control**
  - multi-word predicates
    - the dependent part of which is a noun with valency requirements
  - partially also verbonominal predicates (with the copula "být")

*Karel* podal **{#QCor.ACT}** stížnost policii.

Karel filed a complaint to the police.

i.e. Karel si stěžoval (policii)
Karel complained (to the police)
Grammatical Coreference

- **complementations with a dual dependency**
  expressed by a verbal form

  Honza zastihl **Hanku**, jak {#Cor.ACT} běhá kolem rybníka.

  *Honza saw Hanka running (lit. how she was running) around the lake.*

- verbal forms with dual dependencies
  - passive participium
  - transgressive
  - infinitive
  - finite verb form in dependent clause

- function of the verbal form
  - COMPLement
  - PATient, EFFfect with agreement
Grammatical Coreference

- **reciprocity** (cz vzájemnost)
  ~ the syntactic operation on valency frames that puts two different valency modifications in a symmetric relation
  ~ the two valency modifications have to be homogeneous
  ~ reflexive pronoun (if ACT is involved)

*Sultáni* se vystřídali {#Rcp.PAT} na trůnu.
  lit. Sultans REFL changed (each other) on the throne.

*Starý sultán a nový sultán* se vystřídali {#Rcp.PAT} na trůnu.
  lit. The old sultan and the new sultan REFL changed (each other) on the throne.

*Starý sultán s novým sultánem* ACMP se vystřídali {#Rcp.PAT} na trůnu.
  lit. The old sultan with the new sultan REFL changed (each other) on the throne.

PDT-VALLEX

* vystřídat se
  ACT(.1) PAT(s-1[.7]) v-w8405f1 Used: 1x
  starý sultán se vystřídal s novým sultánem
  vlády se v. Rcp. PAT

PDT: coreference
Grammatical Coreference

- **reciprocity** (cz vzájemnost)
  - the syntactic operation on valency frames that puts two different valency modifications in a symmetric relation
  - the two valency modifications have to be homogeneous
  - reflexive pronoun (if ACT is involved)

\[\text{jednání vlády}.\text{ACT}s\text{ prezidentem}.\text{ADDR}\
\text{negotiations (of) government with president}\]
\[\text{jednání vlády}.\text{ACT}a\text{ prezidenta}.\text{ACT} \{\#\text{Rcp}.\text{ADDR}\}\
\text{lit. negotiations (of) government and president}\]
\[\text{jednání mezi vládou}.\text{ACT}a\text{ prezidentem}.\text{ACT} \{\#\text{Rcp}.\text{ADDR}\}\
\text{lit. negotiations between government and president}\]

PDT-VALLEX

\[\text{jednání}\
\text{ACT}(.2,.u)\text{ PAT}(o+6,\text{ohledně}[.2],\text{věc}:/\text{AuxP}[v-1,.2],\]
\[v-1[\text{věc}.6[\text{tento}.#]],\text{jestli}[,\text{aby}[,v]})\text{ ADDR}(s+7)\]
Grammatical Coreference

- t-lemmas of the coreferring nodes

<table>
<thead>
<tr>
<th>t-lemma</th>
<th>type of coreference</th>
<th>surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>#PersPron</td>
<td>refl. pronouns</td>
<td>se, si, svůj</td>
</tr>
<tr>
<td>který, jaký, co kdy, kde co</td>
<td>relative pronouns relative adverbs</td>
<td>který, jaký, jenž, co kdy, kde, kam, odkud což</td>
</tr>
<tr>
<td>#Cor</td>
<td>two dependencies</td>
<td>Ø</td>
</tr>
<tr>
<td>#Cor, #GEN, #PersPron</td>
<td>control</td>
<td>Ø</td>
</tr>
<tr>
<td>#QCor, #GEN</td>
<td>quasi-control</td>
<td>Ø</td>
</tr>
<tr>
<td>#Rcp</td>
<td>reciprocity</td>
<td>se / Ø</td>
</tr>
</tbody>
</table>
References

• Manual for Tectogrammatical Annotation

• Documentation for PDT 3.0


Textual Coreference

- personal and possessive pronouns, 3rd person
- demonstrative pronouns *ten, ta, to*
- (actual ellipses, where a new node with the t-lemma substitute #PersPron is added)
Textual Coreference

Dobiaš skoro všechno dělá s námi, jeho pověstná impulzivnost se přenáší i na nás, a to je dobře. // Dobiaš does almost everything with us; his notorious spontaneity carries over to us as well, and that is a good thing.
Dobiaš skoro všechno dělá s námi, jeho pověstná impulsivnost se přenáší i na nás, a to je dobře. // Dobiaš does almost everything with us; his notorious spontaneity carries over to us as well, and that is a good thing.

Dobiaš skoro všechno dělá s námi, **jeho pověstná impulsivnost se přenáší i na nás**, a **to je dobře.** // Dobiaš does almost everything with us; **his notorious spontaneity carries over to us as well, and that is a good thing.**
Marie vzala Vlastu do divadla, kde na ně čekal Marek.
lit. Marie took Vlasta to the theatre, where Marek was waiting for them.

Včera přišli tatínek s maminkou, těšili jsme na ně. …
lit. Yesterday, Daddy with mama came, we were looking forward for them
Special Types of Coreference

- coref_special
  - segm … the coreferred element comprises two or more sentences or it may be inferred from them (the segment is not specified)

*Rozprava o podobě reformy veřejných financí bude zahájena ve středu. Všechna jednání proběhnou za zavřenými dveřmi. Lidovým novinám *to* sdělil včera ministr financí.*

*The discussion about the nature of the reform of public finance will begin on Wednesday. All negotiations will take place behind closed doors. Lidové noviny (The People's Daily) was informed of *this* yesterday by the Finance Minister.*
Special Types of Coreference

• coref_special
  • segm … the coreferred element comprises two or more sentences or it may be inferred from them (the segment is not specified)

The discussion about the nature of the reform of public finance will begin on Wednesday. All negotiations will take place behind closed doors. Lidové noviny (The People's Daily) was informed of this yesterday by the Finance Minister.

• exoph … a pronoun refers to situations or reality external to the text

After the critical summer months of 1939 hardly anyone in Europe could now lend credence to the optimistic words of the British prime minister Chamberlain spoken from the balcony of Buckingham Palace on his return from Munich: I believe it is peace in our time.

Rozprava o podobě reformy veřejných financí bude zahájena ve středu. Všechna jednání proběhnou za zavřenými dveřmi. Lidovým novinám to sdělil včera ministr financí.

After the critical summer months of 1939 hardly anyone in Europe could now lend credence to the optimistic words of the British prime minister Chamberlain spoken from the balcony of Buckingham Palace on his return from Munich: I believe it is peace in our time.
Extended Textual Coreference (in PDT 3.0)

• non-pronominal coreference
  • full NPs   e.g. *Prague – the capital of the Czech Republic*
  • anaphoric adverbs   e.g. *the capital of the Czech Republic – there*
  • numerals   e.g. 2010 – that year
  • clauses and sentences if coreferring with NPs
    e.g. *They tried to teach him to read – The attempt was not successful*
  • some adjectives   e.g. *Germany – German*

which have explicit antecedents in previous (ev. subsequent) context

• two types:
  • SPEC - coreference of noun phrases with specific reference (Germany – the state)
  • GEN - coreference of noun phrases with generic reference

*Droga* je tak účinná, že ten, kdo *ji.GEN* užívá, se snadno dostane do „pohody“ kouřením nebo šňupáním. The drug is so effective that one can easily achieve the state of “coolness” by smoking or snorting *it.GEN*. 
Bridging Anaphora (in PDT 3.0)

• bridging ~ a relation between two elements
  the second element is interpreted by an inferential process ("bridge")
  on the basis of the first one
• PDT 3.0: restriction to relations between nominal expressions
Bridging Anaphora (not in PDT 2.0)

• bridging ~ a relation between two elements
  the second element is interpreted by an inferential process (“bridge”) on the basis of the first one
• PDT 3.0: restriction to relations between nominal expressions
• types of relations:
  • PART_WHOLE // WHOLE_PART  e.g. room – ceiling; Germany – Bavaria – Munich
  • SET_SUB // SUB_SET  e.g. participants – some participants – one of participants
  • P_FUNCT // FUNCT_P  e.g. government – prime minister
  • CONTRAST… coherence-relevant discourse opposites

Oсуд ČR bude stále více spojený s Německem … a osud Slovenska.CONTRAST s Ruskem.
The future of the Czech Republic will become more associated with Germany, while the future of Slovakia.CONTRAS will be more associated with Russia.

• ANAF
  Je třeba mít vysoké cíle a s malými [cíli.ANAF] se nespokojit
  It is necessary to have lofty aims and not to be satisfied with small [ones.ANAF].

• REST  e.g., location – resident, mother – son, listening – listener, …
Coreference and Bridging for pronouns (PDT 3.0)

• 1st and 2nd person

Potřebu dalších investic \texttt{[#PersPron.ACT]} odhaduji do roku dva tisíce na více jak dvě miliardy korun, říká ředitel Nováček.

I estimate the need for further investment in the year two thousand to more than two billion, says the director Nováček.

• generic use:


The Škoda’s branch in Pilsen owes the foundry Skoda in České Budejovice 61 million crowns. We need them now, and on the table. The situation is serious and almost unsolvable from our side. We will not manage [to resolve] it without funds," Milan Fucik said yesterday.
References

- Manual for Tectogrammatical Annotation
- Documentation for PDT 3.0