Hungarian verbal complexes and the pre-verbal field: towards an MCTAG analysis

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Outlook

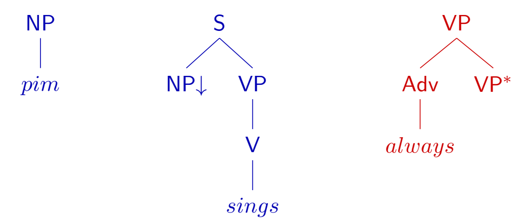
- goal: Hungarian grammar using TAG + XMG
  (Tree-Adjoining Grammar + eXtensible MetaGrammar)
- today: some problems and analysis around free word order
  - a very quick introduction to **(L)TAG**
    (Lexicalized TAG)
  - grammar writing with **XMG**
  - Hungarian data: verbal complexes and the pre-verbal field
  - some results and proposed analysis using XMG & **MCTAG**
    (Multi-component TAG)

Motivation fot (L)TAG

- TAGs are **mildly context-sensitive**
  - parsing in polynomial time
  - generation of crossing dependencies
  - constant growth property (semilinearity)
- **large coverage TAG grammars**
  - English and Korean (XTAG; Joshi et al.)
  - French TAG (Crabbé's PhD-thesis;)
  - German (GerTT; Kallmeyer & Lichte)
- **grammar implementation with TAG**
  - **XTAG tools** (UPenn) → parser, editor, viewer, ...
  - **XMG + TuLiPA** (Tübingen)
    - ★ XMG: eXtensible MetaGrammar (Duchier et al, 2004)
    - ★ TuLiPA: Tübingen Linguistic Parsing Architecture (Parmentier et al, 2008)

(L)TAG: Basics

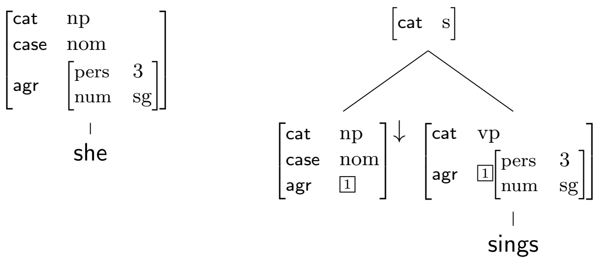
- Tree Adjoining Grammar (TAG) is a set of **elementary trees**
  - a finite set of initial trees
  - a finite set of auxiliary trees
- two **combinatorial operations**
  - substitution: replacing a non-terminal leaf with an initial tree
  - adjunction: replacing an internal node with an auxiliary tree



- **LTAG**: Lexicalized TAG
  - each elementary tree contains at least one lexical item

(L)TAG: Basics

- to increase the expressive power: **adjunction constraints**
  - whether adjunction is mandatory and which trees can be adjoined: Null Adjunction (NA), Obligatory Adjunction (OA), Selective Adjunction (SA)
- **feature structures** as non-terminal nodes; reasons wrt TAG:
  - generalizing agreement and case marking (via underspecification)
  - modeling adjunction constraints ⇒ smaller grammars that are easier to maintain



Linguistic analyses with LTAG

- the ideal grammar formalism → linguistically adequate:
  - **phenomena:** linearization, agreement, discontinuity, ellipsis, . . .
  - **generalizations:** valency, active/passive diathesis, alternations, . . .
  - intuitive implementation
- LTAG = set of elementary trees

What is an elementary tree, and what is its shape?

$\boxed{\text{elementary trees}} \overset{?}{\Longleftarrow} \boxed{\text{syntactic/semantic properties of linguistic objects}}$

⇒ Syntactic design principles (Frank, 2002):
  - Lexicalization
  - Condition on Elementary Tree Minimality (CETM)
  - Fundamental TAG Hypothesis (FTH)
  - θ-Criterion for TAG

⇒ Semantic design principles (Abeillé & Rambow, 2000)

⇒ Design principle of economy

Syntactic design principles

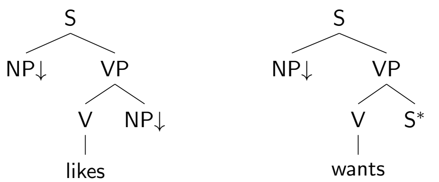
Fundamental TAG Hypothesis (FTH)

Every syntactic dependency (subcategorization, binding, ...) is expressed locally within an elementary tree.

θ-Criterion for TAG

(a) If H is the lexical head of an elementary tree T, H assigns all of its θ-roles in T.
(b) If A is a frontier non-terminal in T, A must be assigned a θ-role in T.

⇒ Valency/subcategorization is expressed within the elementary tree of the predicate: either a substitution node or a footnode

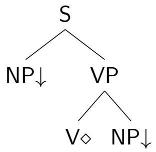


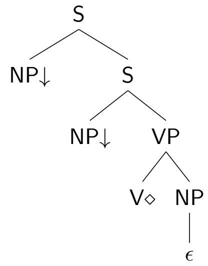
Grammar architecture

Morph Database	inflected form
Syntactic Database	root form, POS, inflectional information
Tree Database	list of **tree templates** and **tree families**

Tree templates and tree families

- **Tree templates**: e.g. for the declarative transitive verb and the transitive verb with object extraction
  - ⋄ marks the lexical insertion site





- **a tree family**
  - ▸ is a set of tree templates,
  - ▸ represents a subcategorization frame, and
  - ▸ unifies all syntactic configurations the subcategorization frame can be realized in

Hungarian

- flexible word order & discourse configurationality
- w.r.t. information structure: **post-verbal** and **pre-verbal field**
  - ▸ post-verbal field: "argument positions" ⇒ order is free

(1) Adott Pim egy könyvet Marinak.
gave Pim.nom a book.acc Mary.dat

(2) Adott Marinak Pim egy könyvet.
gave Mary.dat Pim.nom a book.acc

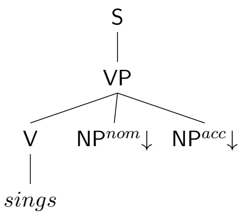
all 6 permutations: 'Pim gave a book to Mary.'

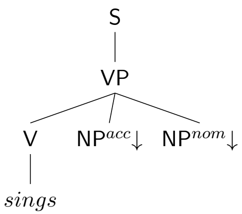
  - ▸ pre-verbal field: "functional projections" ⇒ fixed order
Topic* < Quantifier* < Focus < Verb < ...

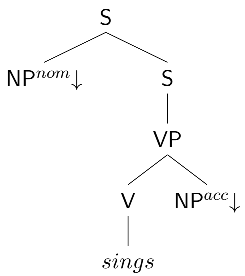
(3) Marinak mindenki egy KÖNYVET adott.
Mary.dat everyone.nom a book.acc gave
'It was a book, that everyone gave to Mary.'

Hungarian and LTAG

- LTAG → fixed positions for grammatical functions
- flexible word order?
- larger tree families, larger set of elementary trees; e.g.







... etc.

- grammar writing → using eXtensible MetaGrammar (XMG)
[Crabbé et al. (2012)]

XMG

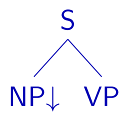
- eXtensible MetaGrammar ⇒ specifying an F-LTAG
  - ▸ LTAG set of elementary trees ⇒ most information contained in the elementary trees
  - ▸ XMG ⇒ generate the elementary trees for a given grammar
- meta-grammar ⇒ expressing generalizations
  - ▸ additional abstraction level
  - ▸ factoring out reusable tree-fragments: classes; e.g.
    - ★ *Subject* position in English or *Topic*/*Focus* positions in Hungarian ⇒ appearing in elementary trees of verbs with different subcategorization frames
  - ▸ classes (tree-fragments) can be combined by conjunction and disjunction

XMG

- by combining tree fragments → tree templates; e.g.

```
Subject  → CanSubject ∨ WhNpSubject
Object  → CanObject ∨ WhNpObject
ActiveTransVerb  → Subject ∧ ActiveVerb ∧ CanObject
```

- description language for tree fragments




```
class CanSubj
declare ?S ?VP ?NP
{ <syn> {
   node ?S (color=black) [cat=s] ;
   node ?NP (mark=subst,color=black) [cat=np] ;
   node ?VP (color=white) [cat=vp] ;
   ?S -> ?NP ; ?S -> ?VP ; ?NP >> ?VP } }
```

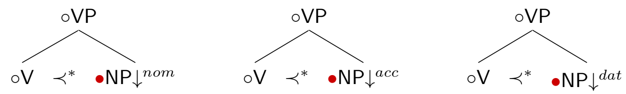
- dominance (->) and precedence (>>) also with transitive closure
- color codes for specifying node equations

XMG & Hungarian

- post-verbal field → free argument order
- example (without verbal prefixes); the tree fragments:
  - SProj, NoVMVerb

  - subject, object and oblique argument in post-verbal (argument) position

    SubjArg ObjArg OblArg

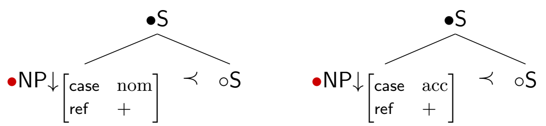


- DiTrVerbPV → SProj ∧ NoVMVerb ∧ SubjArg ∧ ObjArg
  - providing all 6 elementary trees

XMG & Hungarian

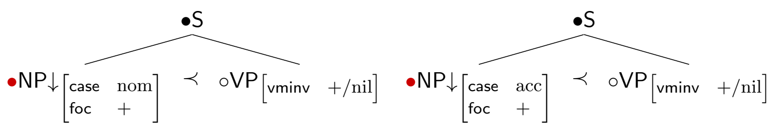
- pre-verbal field → fixed positions for topic & focus
- arguments can be in topic position

  SubjTop ObjTop ... etc.



- arguments can be in focus position

  SubjFoc ObjFoc ... etc.



- also implemented: verbal modifiers, sentential negation

Verbal complexes

- verb + verbal modifier (VM) → verbal complexes
- verbal modifiers: broad group
  - verbal prefixes

    (4) Pim meg-látogatta Marit.
        Pim Pref-visited Mary.acc
        'Pim visited Mary.'

  - infinitives without VM

    (5) Pim úszni akar.
        Pim swim.inf wants
        'Pim wants to swim.'

  - DPs, adjectives, bare nouns
- syntax: complementary distribution with negation and focus
- semantics: secondary predication, relation to aspect

Syntactic position

- in **neutral sentences** (without Foc and Neg)
  pre-verbal position

(6) Pim meg-látogatta Marit.
Pim Pref-visited Mary.acc
'Pim visited Mary.'

- in **non-neutral sentences** (with Foc and/or Neg)
  post-verbal position

(7) Pim nem látogatta meg Marit.
Pim not visited pref Mary.acc
'Pim did not visit Mary.'

(8) Pim MARIT (nem) látogatta meg .
Pim Mary.acc (not) visited pref
'It is Mary, whom Pim (did not) visited.'

XMG & Hungarian

- two positions of the verbal modifier

$\bullet$VP $\begin{bmatrix}\text{vcomp} & + \\ \text{vminv} & -\end{bmatrix}$ $\qquad$ $\bullet$VP $\begin{bmatrix}\text{vcomp} & + \\ \text{vminv} & +\end{bmatrix}$

$\bullet$VM$\diamond$ $\prec$ $\bullet$V$\diamond$ $\qquad$ $\bullet$V$\diamond$ $\prec$ $\bullet$VM$\diamond$

- tree templates
  - NeutSubj $\longrightarrow$ SubjArg $\vee$ SubjTop
    NeutObj $\longrightarrow$ ObjArg $\vee$ ObjTop
    SentProj $\longrightarrow$ SProj $\wedge$ (NoVMVerb $\vee$ VMVerb)
  - NeutTransVerb $\longrightarrow$ SentProj $\wedge$ NeutSubj $\wedge$ NeutObj
  - NonNeutTransVerb $\longrightarrow$
    SentProj $\wedge$ (
    (SubjFoc $\wedge$ NeutObj) $\vee$ (ObjFoc $\wedge$ NeutSubj)) $\vee$
    (SentNeg $\wedge$ NeutSubj $\wedge$ NeutObj) $\vee$
    (SentNeg $\wedge$ ((SubjFoc$\wedge$NeutObj) $\vee$ (ObjFoc$\wedge$NeutSubj))
)

Verbal complexes and clausal complements

- two types of control verbs
  - e.g. *fél* 'is afraid' $\rightarrow$ take main stress
  - e.g. *akar* 'want' $\rightarrow$ avoids main stress
- different behavior wrt the VM of the embedded infinitive

(9) Pim (el*) fél el-olvasni a levelet.
Pim (Pref) is-afraid Pref-read.inf the letter.acc
'Pim is afraid to read the letter.'

(10) Pim el akarja (el-*)olvasni a levelet.
Pim Pref wants (Pref-)read.inf the letter.acc
'Pim wants to read the letter.'

- Koopman-Szabolcsi (2004) classification:
  - **Auxiliaries**: no main accent, VM-climbing (e.g. *akar* 'want')
  - **Nonauxiliaries 1**: main accent, no VM-climbing (e.g. *fél* 'is-afraid')

Infinitival complements

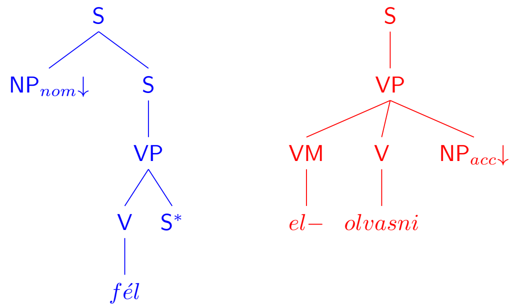
- two verbs $\Rightarrow$ both with pre-verbal and post-verbal fields
  [... pre-V ...] matrix-V [... post-V ...] [... pre-V ...] inf-V [... post-V ...]
- preferred position of a focused/topicalized argument of the embedded verb is in the pre-verbal field of the matrix verb
- need to deal with scrambling $\Rightarrow$ **Multi-component TAG (MCTAG)**

Nonauxiliaries

Example: *fél* ‘is afraid’

(11) Pim fél el-olvasni a levelet.
Pim is-afraid Pref-read.inf the letter.acc
‘Pim is afraid to read the letter.’

- neutral sentences (no Foc) → standard LTAG analysis



Nonauxiliaries

(12) ?Pim fél [a levelet]^T el-olvasni.
Pim is-afraid the letter.acc Pref-read.inf

(13) Pim [a levelet]^T fél el-olvasni.
Pim the letter.acc is-afraid Pref-read.inf
‘Pim is afraid to read the letter.’

(14) *Pim fél [a LEVELET]^F olvasni el.
Pim is-afraid the letter.acc read.inf Pref

(15) Pim [a LEVELET]^F fél el-olvasni.
Pim the letter.acc is-afraid Pref-read.inf
‘It is the letter, that Pim is afraid the read. ’

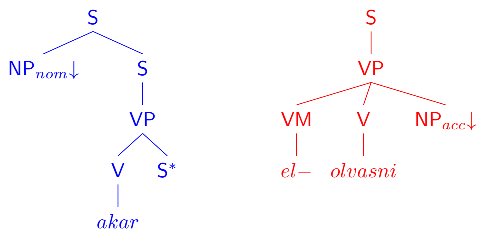
Auxiliaries

Example: *akar* ‘want’

(16) Pim el akarja olvasni a levelet.
Pim Pref wants read.inf the letter.acc
‘Pim wants to read the letter.’

(17) *Pim akarja el-olvasni a levelet.
Pim wants Pref-read.inf the letter.acc

- standard LTAG analysis cannot derive the ‘VM-climbing’



Auxiliaries

(18) ?Pim el akarja [a levelet]^T olvasni.
Pim Pref wants the letter.acc read.inf

(19) Pim [a levelet]^T el akarja olvasni.
Pim the letter.acc Pref wants read.inf
‘Pim wants to read the letter.’

(20) *Pim el akarja [a LEVELET]^F olvasni.
Pim Pref wants the letter.acc read.inf

(21) Pim [a LEVELET]^F akarja el-olvasni.
Pim the letter.acc wants Pref-read.inf
‘It is the letter, what Pim wants to read.’

Multi-component TAG

- standard (L)TAG cannot analyze
  - discontinuity (extraposition, extraction, **scrambling**)
  - ellipsis (gapping, subject deletion, right node raising)
- **Scrambling**: challenge ⇒ variability in word order; German example:
  - daß ihm Peter den Kühlschrank heute zu reparieren versprach
    daß ihm den Kühlschrank Peter heute zu reparieren versprach
    ...
    ('that Peter promised him to repair the fridge today')
  - **Problem:** if *ihm* is considered to be an argument/complement of *versprach*, the tree for *versprach* has to split into three pieces when conjoined with the tree of *zu reparieren*
- possibilities in an **(L)TAG-Analysis**:
  - *zu reparieren* adjoins to *versprach* ⇒ contradicts θ-criterion
  - *ihm* adjoins to *zu reparieren* ⇒ contradicts θ-criterion

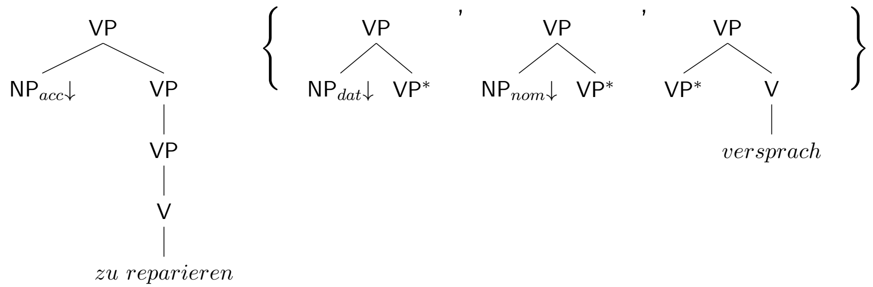
MCTAG - Basics

- multi-component TAG → elementary structures are sets of trees
- **tree-local MCTAG** (TT-MCTAG)
  - all trees in the set have to attach to the same elementary tree
  - strongly equivalent to TAG
- **set-local MCTAG**
  - all trees in the set have to attach to the same elementary tree set
  - weakly equivalent to LCFRS and simple RCG
- **non-local MCTAG**
  - the fixed recognition problem is NP-complete (even with lexicalization and dominance links)
- mainly TT-MCTAGs are considered for natural language grammars due to complexity issues

MCTAG - German scrambling

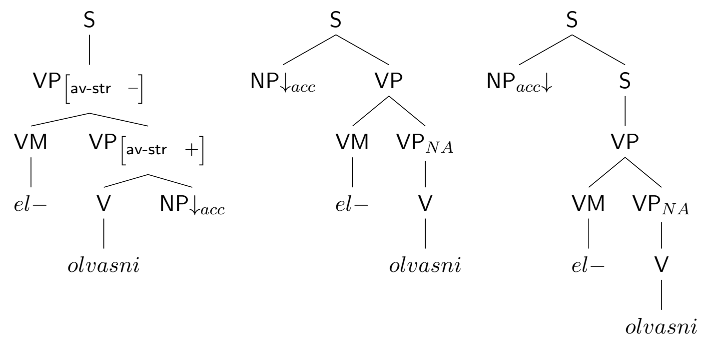
TT-MCTAG can handle scrambling **up to two levels of embedding**, i.e. three verbs with one complement each forming a coherent construction. [Joshi et. al 2000]

daß ihm den Kühlschrank Peter zu reparieren versprach
('that Peter promised him to repair the fridge')



TT-MCTAG for Hungarian

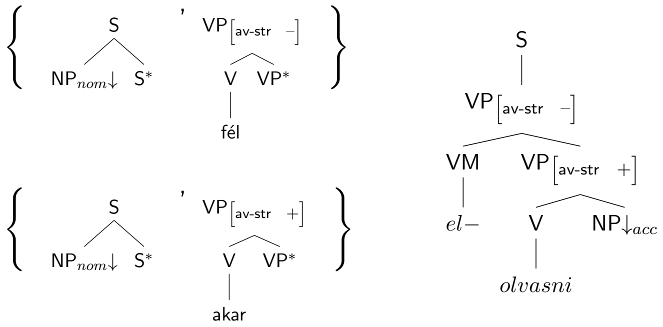
- Auxiliaries vs. Nonauxiliaries (*fél* 'is-afraid' vs. *akar* 'want')
- proposal using TT-MCTAG
- elementary trees of the infinitival verb *el-olvasni* 'Pref-read.inf'



- obtained by XMG as before

TT-MCTAG for Hungarian

- tree sets for *fél* ‘is-afraid’ and *want* ‘want’ and



TT-MCTAG for Hungarian

- tree sets for *fél* ‘is-afraid’ and *want* ‘want’ and