Towards a French object-oriented MWE lexicon in XMG

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Properties of MWEs

Types of properties

- Defective property – excludes a literal interpretation of the MWE, e.g.:
  - Defective agreement: ***grands-mères***
- Restrictive property – reduces the number of possible surface realizations of the MWE with respect to the literal reading, e.g.:
  - Restrictive lexical selection: ***retourner sa veste*** vs. *#retourer son blouson*
  - Restrictive agreement: *je **vide mon sac*** vs. *#je vide son sac*
  - Restrictive diathesis: ***les carottes sont cuites*** vs. *#on cuit les carottes*
  - Restrictive modification: *il **mène une vie** de riche* vs. *#il mène une vie*
  - Restrictive dependencies between determiners and modifiers: *j'**ai envie** de le faire*, *j'**ai** une **envie** folle de le faire*

Scale-wise regularity

More regular ($\succ$) = admitted by more objects (in a set)

- sample set: English **Subj-Verb-Obj** expressions (*John pulled the door*)
- "allow any head verb" $\succ$ "allow only the verb *kick*"
- "allow passive" $\succ$ "prohibt passive"
- "allow a possessive determiner"
  John pushed the/my door
  $\succ$ "impose a possessive determiner"
  John ***broke*** *his/our* ***fall*** 'John made his/our fall less forceful'
  $\succ$ "impose a possessive agreeing with Subj"
  John ***crossed his fingers*** 'John hoped for good luck'
  John ***held his tongue*** 'John refrained from expressing his view'

Idiosyncratic = irregular (shared by no two objects)

- Usually only the restrictive lexical selection is truly idiosyncratic (except in polysemous MWEs: ***go on*** 'continue/happen')

Lexical encoding of MWEs

Linguistic tradition of MWE encoding

- Lexicon-grammar [Gross(1986)]
- Explanatory Combinatorial Dictionary [Mel'čuk *et al.*(1988)]
- Some NLP applications:
  - LG: [Hathout and Namer(1997b), Hathout and Namer(1997a), Hathout and Namer(1998), Gardent *et al.*(2005), Gardent *et al.*(2006), Constant and Tolone(2010), Laporte *et al.*(2013), Tolone and Sagot(2011)]
  - DEC: [Apresian *et al.*(2003), Lambrey and Lareau(2015)]

Lexical encoding of MWEs

TAL-oriented encoding

- Dozen formalisms for continuous MWEs (7 languages) [Savary(2008)]
- Verbal MWEs:
  - morphosyntactic databases (NL) [Grégoire(2010)], (HE) [Al-Haj *et al.*(2014)]
  - valence dictionaries (CS) [Hajič *et al.*(2003)] (PL) [Przepiórkowski *et al.*(2014)]
  - ontological approaches with semantic calculus: (EN) [Marjorie McShane and Beale(2005)]

Redundancy and implicitness issues

- Capturing regularity: inflection codes [Savary(2009)], equivalence classes [Grégoire(2010)], macros [Przepiórkowski *et al.*(2014)]
- Implicit interface with a "regular" grammar despite its crucial role in the formalism [Grégoire(2010)],[Przepiórkowski *et al.*(2014)],[Marjorie McShane and Beale(2005)]

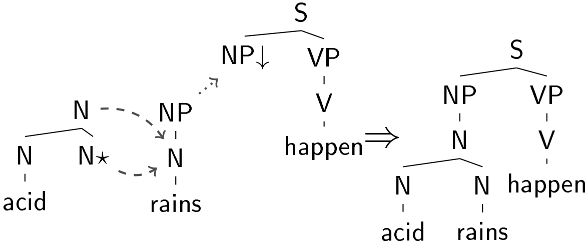
Recommendations

Requirements for a lexical encoding framework for MWEs [Lichte *et al.*(2016)]

- machine- and human-readable,
- representing specific **irregularities** of MWEs,
- friendly to **scale-wise** modeling,
- **factorized** (to avoid redundancies),
- **flexible** (to encode unforeseen properties),
- with a rigorous **denotational semantics** (to avoid vagueness and inconsistencies).
- easy to integrate in a **computational grammar**.

Tree Adjoining Grammars (TAGs)

- Elementary trees (ETs): initial tress (ITs) ∪ auxiliary trees (ATs)
- Tree rewriting: substitution & adjunction



MWEs in LTAGs

[Abeillé and Schabes(1989)]

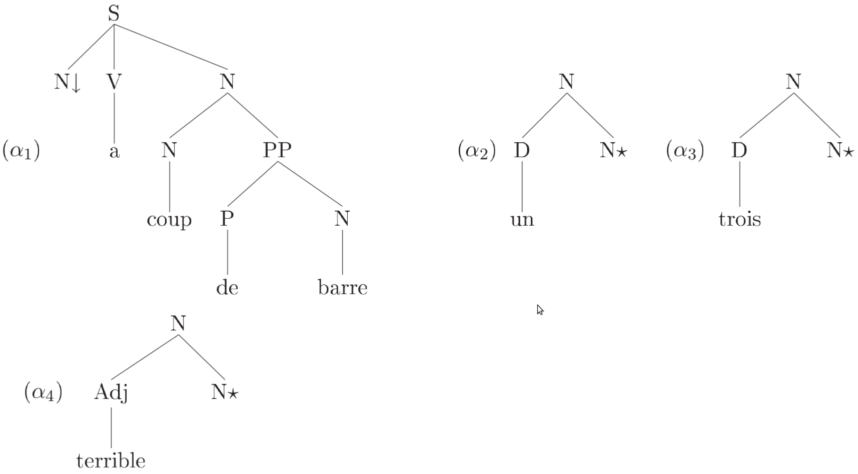
- Representing **discontinuities** (cf. *extended domain of locality*)
  - discontinuities in the internal structure of a MWE ⇒ visible in ETs, handled by **substitution**

    to take something with a pinch of salt
  - insertion of adjuncts ⇒ handled by **adjunction**

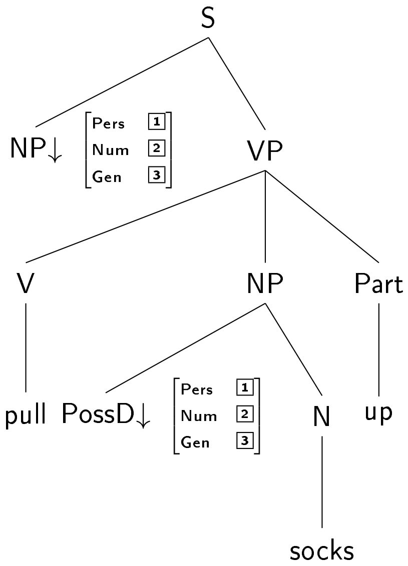
    a whole bunch of NP
- Dependencies between arguments at **different depths** in the ETs are naturally expressed

  She pulled her/#its socks up

Insertion of adjuncts in LTAGs



MWE long-distance dependencies in LTAGs



Redundancy in grammar encoding

Redundancy in MWEs (and "regular" structures)

- properties shared by "regular" structures and by MWEs (e.g. passivisation, extraction etc.),
- properties shared by many MWEs (e.g. poss.-subj. agreement),
- properties of different degrees of regularity co-occur in each MWE.

Redundancy in a TAG grammar

- elementary trees of a lexicalized grammar are very numerous (hundreds or thousands of trees),
- elementary trees share tree fragments and their properties.

Motivation

Objectives

- avoid redudancy in MWE encoding
- abstract away (as much as possible) from the actual grammatical formalism

Object-oriented encoding

- represent the shared tree fragments and properties as **classes**
- combine these classes into complete minimal structures
- class hierarchy:
  - more general properties – encoded in upper upper classes
  - less general ones – encoded in lower classes (which inherit from the uper ones)

XMG [Crabbé *et al.*(2013)]

- a language
  - declarative – grammaticality is defined in terms of constraints rather than procedures
  - notationally expressive - modularity, inheritance, conjunction/disjunction of tree fragments, namespaces
  - extensible to new dimensions (semantics, frames etc.), formalisms (IG, etc.), linguistic principles (e.g. clitic ordering)
- a metagrammar compiler (for each tager language, here FS-LTAG) – constraint solver: produces minimal tree models respecting the constraints

FTAG – French XMG metagrammar [Crabbé *et al.*(2013)]

- XMG implementation of the syntactic TAG grammar of French by [Abeillé(2002)]
  - 285 XMG classes, 96 families (classes assigned to lexemes), compiled into 9045 TAG trees
  - toy lexicon of 555 lexemes, including 248 verbs
- SemTag – extension of FTAG with a (compositional) semantic dimension

Morphology

```
class Jean
{
  <morpho> {
    morph <- "Jean";
    lemma <- "jean";
    cat   <- n
   }
}
```

```
class prend
{
  <morpho> {
    morph <- "prend";
    lemma <- "prendre";
    cat   <- v
   }
}
```

```
class porte
{
  <morpho> {
    morph <- "porte";
    lemma <- "porte";
    cat   <- n
   }
}
```

```
class il
{
  <morpho> {
    morph <- "il";
    lemma <- "il";
    cat   <- cl
   }
}
```

```
class la
{
  <morpho> {
    morph <- "la";
    lemma <- "le";
    cat   <- d;
    gen <- f
   }
}
```

```
class laClitic
{
  <morpho> {
    morph <- "la";
    lemma <- "le";
    cat   <- cl
   }
}
```

Lemmas

```
class LemmeJean
{
  <lemma> {
    entry <- "jean";
    cat   <- n;
    fam   <- propername
  }
}
```

```
class LemmePrendre
{
  <lemma> {
    entry <- "prendre";
    cat   <- v;
    fam   <- n0Vn1
  }
}
```

```
class LemmePorte
{
  <lemma> {
    entry <- "porte";
    cat   <- n;
    fam   <- noun
  }
}
```

```
class LemmeIl
{
  <lemma> {
    entry <- "il";
    cat   <- cl;
    fam   <- CliticT
  }
}
```

```
class LemmeLeClitic
{
  <lemma> {
    entry <- "le";
    cat   <- cl;
    fam   <- CliticT
  }
}
```

```
class LemmeLe
{
  <lemma> {
    entry <- "le";
    cat   <- d;
    fam   <- stddeterminer
  }
}
```

Trivial classes

propename $\rightarrow$ N$\diamond$

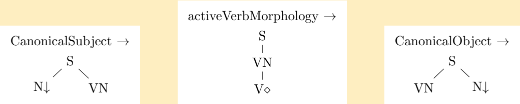
noun $\rightarrow$ N$\diamond$

CliticT $\rightarrow$ CL$\diamond$

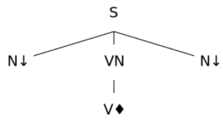
stddeterminer $\rightarrow$ N (D$\diamond$ N$*$)

From metagramar to parsing: **n0Vn1** (*Jean prend la porte*)

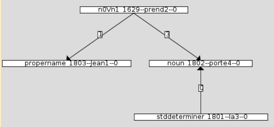
Metagrammar tree fragments inherited by n0Vn1



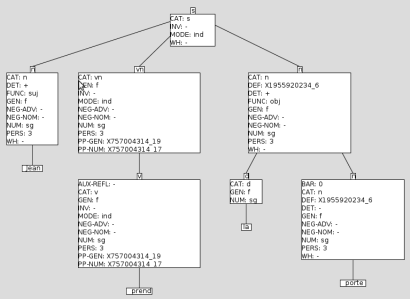
Grammar tree



Derivation tree

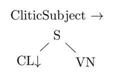


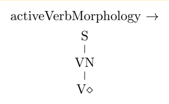
Derived tree

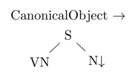


From metagramar to parsing: **n0Vn1** (*Il prend la porte*)

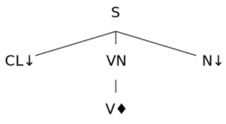
Metagrammar tree fragments inherited by n0Vn1



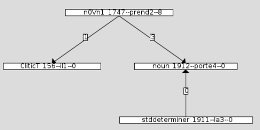




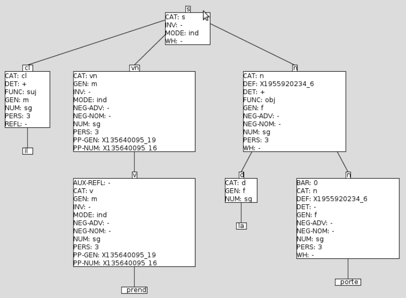
Grammar tree



Derivation tree

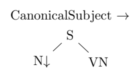


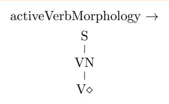
Derived tree

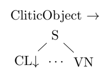


From metagramar to parsing: **n0Vn1** (*Jean la prend*)

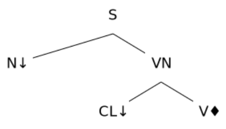
Metagrammar tree fragments inherited by n0Vn1



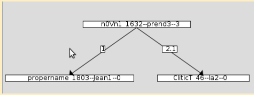




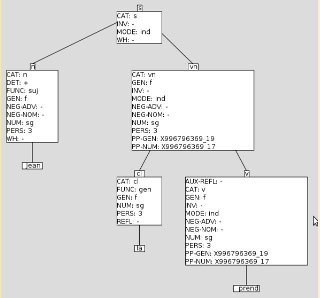
Grammar tree



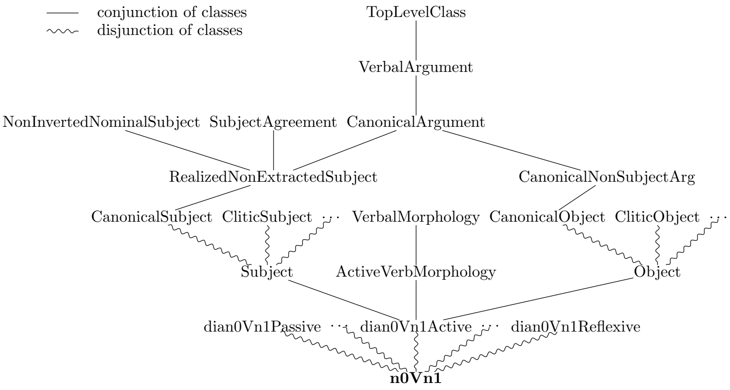
Derivation tree



Derived tree



Class hierarchy



MWEs have more or less regular properties

prendre la porte

- (More) **regular** features:
  - The subject is free and agrees with the verb:
    *Jean/il/elle **prend la porte***
    *Jean, que nous ne voulons pas ici, **prend la porte***
  - The verb inflects freely: ***Prend la porte**!*
- (More) **idiosyncratic** features:
  - The object is lexicalized: *#Jean prend la sortie*
  - The object cannot be:
    cliticised: *#Jean la prend*
    extracted: *#La porte que Jean prend*
    modified: *#Jean prend la grande porte*
  - The verb cannot be passivized: *#La porte est prise par Jean*

Adding MWEs to the metagrammar

Strategy 1 (applied here)

- **reuse** existing tree fragments for the (more) regular properties
- **duplicate** and **modify** existing tree fragments for slightly irregular properties
- **create** new tree fragments for (more) idiosyncratic properties

Strategy 2 (todo)

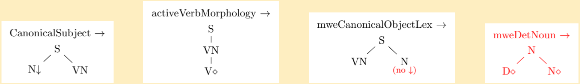
- add **features** to the MWE **lexical entries** marking the non allowed properties
- add **features** with opposite values to existing tree fragments to exclude parses if the features from the lexicon and from the tree do not unify
- Risk: this implies modifying the initial metagrammar

MWE lemmas with co-anchors

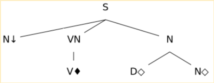
```
class mweLemmePrendreLaPorte
{
  <lemma> {
    entry <- "prendre";
    cat   <- v;
    fam   <-    mwen0VDetNActive;
    coanchor ObjDetNode -> "la"/d;
    coanchor ObjNode -> "porte"/n
  }
}
```

From metagramar to parsing: **mwen0VDetNActive** (*Jean prend la porte*)

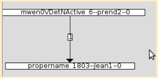
Tree fragments inherited by mwen0VDetNActive



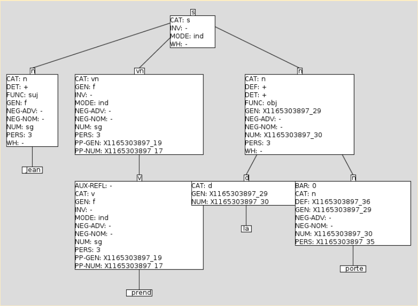
Grammar tree



Derivation tree

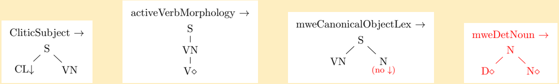


Derived tree

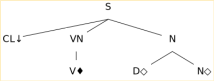


From metagramar to parsing: **mwen0VDetNActive** (*Il prend la porte*)

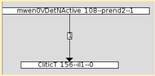
Tree fragments inherited by mwen0VDetNActive



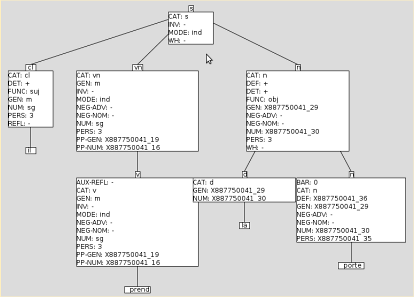
Grammar tree



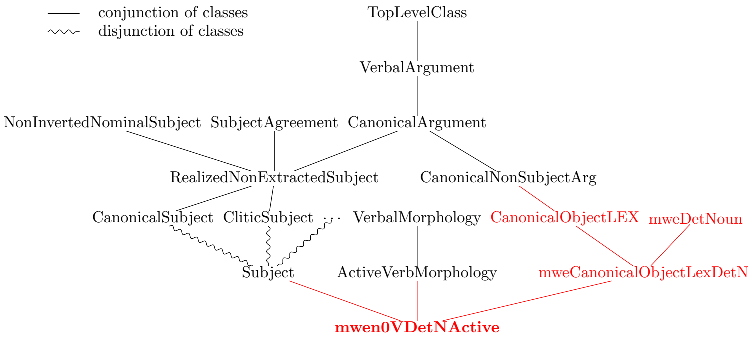
Derivation tree



Derived tree

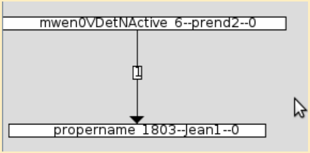


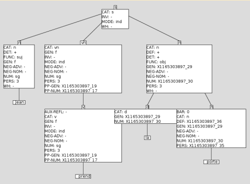
Modified class hierarchy



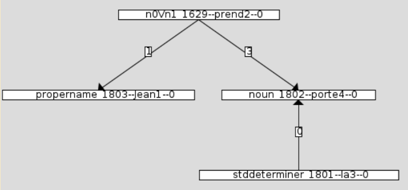
Two readings: *Jean prend la porte*

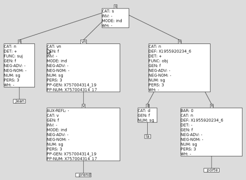
Idiomatic reading





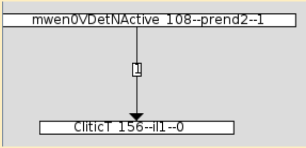
Compositional reading

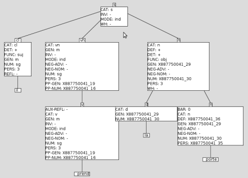




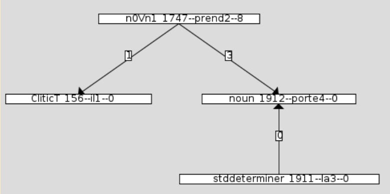
Two readings: *Il prend la porte*

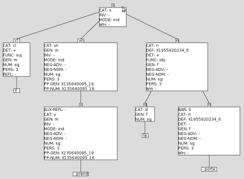
Idiomatic reading





Compositional reading

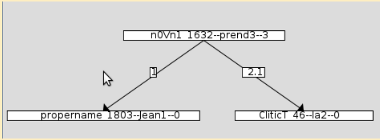


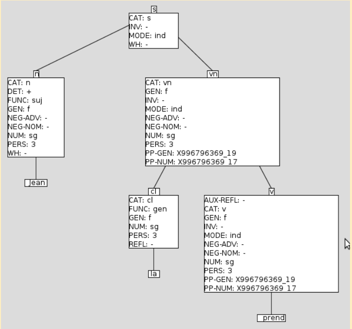


One reading: *Jean la prend*

No idiomatic reading

Compositional reading





Conclusions and future work

Advantages from the XMG encoding of MWEs

- **Explicit** declarative encoding of the properties of MWEs, both (more) regular and (more) idiosyncratic
- **Scale-wise modeling**: regularity/idiosyncrasy are not modelled as binary phenomena
- **Non-redundancy**: properties shared by objects (MWEs or compositional structures) are uniquely described and shared
- Direct integration into a **grammar**

Future work

- **Encode more** MWEs and properties
- Handle **morphological features** in lexicon co-ancors
- Implement the **feature-based strategy**
- Add a **semantic** dimension based on **frames**

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