

Notes on Features

Ling 571
Deep Techniques for NLP
February 10, 2014

Feature Grammar in NLTK

- NLTK supports feature-based grammars
 - Includes ways of associating features with CFG rules
 - Includes readers for feature grammars
 - `.fcfg` files
 - Includes parsers
 - `Nltk.parse.FeatureEarleyChartParser`

Feature Structures

- >>> fs1 = nltk.FeatStruct("[NUM='pl']")
- >>> print fs1
- [NUM='pl']
- >>> print fs1['NUM']
- pl

- More complex structure
- >>> fs2 = nltk.FeatStruct("[POS='N',
• AGR=[NUM='pl',PER=3]]")

Reentrant Feature Structures

- First instance
 - Parenthesized integer: (1)
- Subsequent instances:
 - ‘Pointer’: -> (1)
 - >>> print nltk.FeatStruct("[A='a', B=(1)[C='c'], D->(1)]")
 - [A = 'a']
 - [B = (1) [C = 'c']]
 - [D -> (1)]

Augmenting Grammars

- Attach feature information to non-terminals, on
 - $N[AGR=[NUM='pl']] \rightarrow 'students'$
 - $N[AGR=[NUM='sg']] \rightarrow 'student'$
- So far, all values are literal or reentrant
 - Variables allow generalization: $?a$
 - Allows underspecification, e.g. $Det[GEN=?a]$
 - $NP[AGR=?a] \rightarrow Det[AGR=?a] N[AGR=?a]$

Mechanics

- >>> fs3 = nltk.FeatStruct(NUM='pl',PER=3)
- >>> fs4 = nltk.FeatStruct(NUM='pl')
- >>> print fs4.unify(fs3)
- [NUM = 'pl']
- [PER = 3]

Morphosyntactic Features

- Grammatical feature that influences morphological or syntactic behavior
 - English:
 - Number:
 - Dog, dogs
 - Person:
 - Am; are; is
 - Case:
 - I – me; he – him; etc
 - Countability:

Semantic Features

- Grammatical features that influence semantic(meaning) behavior of associated units
- E.g.:

Semantic Features

- Grammatical features that influence semantic(meaning) behavior of associated units
- E.g.:
 - ?The rocks slept.

Semantic Features

- Grammatical features that influence semantic(meaning) behavior of associated units
- E.g.:
 - ?The rocks slept.
 - ?Colorless green ideas sleep furiously.

Semantic Features

- Many proposed:
 - Animacy: +/-
 - Natural gender: masculine, feminine, neuter
 - Human: +/-
 - Adult: +/-
 - Liquid: +/-
 - Etc.
 - The milk spilled.
 - ?The cat spilled.

Examples

- The climber hiked for six hours.
- The climber hiked on Saturday.
- The climber reached the summit on Saturday.
- *The climber reached the summit for six hours.
- Contrast:

Examples

- The climber hiked for six hours.
- The climber hiked on Saturday.
- The climber reached the summit on Saturday.
- *The climber reached the summit for six hours.
- Contrast:
 - Achievement vs activity

Semantic features & Parsing

- Can filter some classes of ambiguity
 - Old men and women slept.
 - (Old men) and (women) slept.
 - (Old (men and women)) slept.
- Sleeping people and books lie flat.
- (Sleeping people) and (books) lie flat.
- (Sleeping (people and books))lie flat.

Semantic features & Parsing

- Can filter some classes of ambiguity
 - Old men and women slept.
 - (Old men) and (women) slept.
 - (Old (men and women)) slept.
- Sleeping people and books lie flat.
- (Sleeping people) and (books) lie flat.
- *(Sleeping (people and books))lie flat.

Summary

- Features
 - Enable compact representation of grammatical constraints
 - Capture basic linguistic patterns
- Unification
 - Creates and maintains consistency over features
- Integration with parsing allows filtering of ill-formed analyses

More Complex German Example

- Subject – singular, masc
 - *der Hund*
 - The dog
- Subject – plural, masc
 - *die Hunde*
 - The dogs

More Complex German Example

- Objects – determined by verb
- Dative – singular, masc
 - *dem Hund*
 - The dog
- Accusative – plural, masc
 - *die Hunde*
 - The dogs

Contrast

- Subject:
 - *Die Katze*
 - The cat
- Subject: plural
 - *Die Katzen*
 - The cats

Contrast

- Object:
 - *Die Katze*
 - The cat
- Object:
 - *Der Katze*
 - The cat

Analysis

- What are the key contrasts?
 - Number
 - Singular, plural
 - Gender
 - Masc, Fem,
 - Case:
 - Subject (nom), dative, accusative,

+ Interactions

Feature Interaction

- Interactions of German case, number, gender

Case	Masc	Fem	Neut	PL
Nom	Der	Die	Das	Die
Gen	Des	Der	Des	Den
Dat	Dem	Der	Dem	Den
Acc	Den	Die	Das	Die

Examples of Interaction

Die The.Nom.Fem.sg The cat sees the dog	Katze Cat.3.FEM.SG	Sieht See.3.sg	Den The.Acc.Masc.sg	Hund Dog.3.Masc.sg
--	-----------------------	-------------------	------------------------	-----------------------

Examples of Interaction

Die The.Nom.Fem.sg The cat sees the dog	Katze Cat.3.FEM.SG	Sieht See.3.sg	Den The.Acc.Masc.sg	Hund Dog.3.Masc.sg
*Die The.Nom.Fem.sg The cat sees the dog	Katze Cat.3.FEM.SG	Sieht See.3.sg	Dem The.Dat.Masc.sg	Hund Dog.3.Masc.sg

Examples of Interaction

Die The.Nom.Fem.sg The cat sees the dog	Katze Cat.3.FEM.SG	Sieht See.3.sg	Den The.Acc.Masc.sg	Hund Dog.3.Masc.sg
*Die The.Nom.Fem.sg The cat sees the dog	Katze Cat.3.FEM.SG	Sieht See.3.sg	Dem The.Dat.Masc.sg	Hund Dog.3.Masc.sg
Die The.Nom.Fem.sg The cat helps the dog	Katze Cat.3.FEM.SG	hilft help.3.sg	Dem The.Dat.Masc.sg	Hund Dog.3.Masc.sg

Examples of Interaction

Die The.Nom.Fem.sg The cat sees the dog	Katze Cat.3.FEM.SG	Sieht See.3.sg	Den The.Acc.Masc.sg	Hund Dog.3.Masc.sg
*Die The.Nom.Fem.sg The cat sees the dog	Katze Cat.3.FEM.SG	Sieht See.3.sg	Dem The.Dat.Masc.sg	Hund Dog.3.Masc.sg
Die The.Nom.Fem.sg The cat helps the dog	Katze Cat.3.FEM.SG	hilft help.3.sg	Dem The.Dat.Masc.sg	Hund Dog.3.Masc.sg
*Die The.Nom.Fem.sg The cat sees the dog	Katze Cat.3.FEM.SG	hilft help.3.sg	Dem The.Acc.Masc.sg	Hund Dog.3.Masc.sg

German verbs in, at least, 2 classes: assign diff't object case