

# Converting Multilayer Glosses into Semantic and Pragmatic forms with ***GENLIS***

Rodolfo Delmonte, Serena Trolvi, Francesco Stiffoni  
Ca' Foscari University - Venice (Italy)

# Overview

- Introduction
    - Annotating LIS with Glosses
      - Discourse Units, Sentences, Propositions
  - The Conversion Process
    - Conversion Rules: Default and derivations
      - Adding Semantic and Pragmatic Information
        - Tense/Mood from SpeechActs and Lexical Aspect
        - Choosing Arguments from Subcategorisation Frames
          - Open Complements requires phi-features matching
        - Generating phi-features: Person, Number, Gender and Case
        - The Definiteness and the Reference Resolution algorithms
    - The Peripheral Rules and Discourse Coherence
- Evaluation

# Annotating LIS with glosses

## Discourse Unit 19

Made-up text

Chi arriva ora? Un gufo. "Siete pronte? Cominciamo! 3, 2, 1 ... Via"!

video-clip



The tortoise and the hare

<https://genlis.vercel.app/>

### Glosses

AFF	
ADV	
SYN	wh y/n foc
AGR	
NMS	
MS	VENIRE CHI. GUFO. VOI-DUE PRONTO. COMINCIARE. 3, 2, 1. VIA.
ARS	
QRS	[G ]

9-slot Prolog term

gls('19',[],[],[wh,'y/n',foc],[],[],['venire chi . gufo . voi-due pronto . cominciare . 3,2,1 . via'],[],[g]).

# Converting Glosses into a 9-slot Prolog term

- ***gls(DUInd,Aff,Adv,Syn,Agr,Nms,Ms,Ars,Qrs)***
  - ***DUInd***, is the Discourse Unit index
  - ***Aff, Adv, Syn*** contain annotated information about affective, adverbials (at sentence level) and syntactic Non-Manual Signs
  - ***Agr***, identifies location and agreement of signs
  - ***Nms and Ms*** contain Non-Manual Signs and Manual Signs respectively and are expressed in a tokenised sequence between apostrophes ' ' as atomic objects
  - ***Ars and Qrs*** identify the occurrence of Action Role Shift and Quotation Role Shift

# Conversion Rules

- Conversion Rules are applied in the following order:
  - Identify elements like interjections or others that modify the main predicate, adverbs or discourse markers
  - Extract the first verb you find - if there's none add dummy ESSERE
  - Retrieve lexical verb aspect and create provisional propositional grid
  - Check for presence of a location to be turned into deictic pronouns
  - Insert SpeechAct : Perlocutive, Illocutive-optative, Presentative, DirectSpeech, Question, Statement
  - Insert Arguments into a list allowing for recursive structures like relatives and sentential complements and nested modifiers

# Syntactic-Lexical Forms: Argument Structure

- With the exception of SUBJect and OBJect, arguments are introduced by a functional marker that we derive from LFG theory ([Bresnan, 2002](#)), such as OBL for oblique arguments, SCOMP for sentential complement, VCOMP for verb complement and XCOMP for predicative complement
- Apart from SUBJect, choice of arguments depends strictly on lexical properties of the governing verb taken from the subcategorisation frame
- Nominal heads may contain modifiers, which are introduced by the marker MOD, or specifiers, which are usually included in brackets

# Conversion Rules: inserting arguments

- Subject may be unexpressed - i.e. the gloss may start by indicating a verb. If so, the Subject is marked as little-pro thus requiring that phi-features are retrieved from the subject of previous sentences or DU
- In case of direct speech, arguments may be interjections of acceptance/negation/confirmation
- The object may be a NP but also a complement sentence - SCOMP, an interrogative complement sentence - QCOMP or an infinitival - VCOMP

# Conversion Rules: inserting adjuncts

- Oblique arguments are marked OBL, adjuncts are adverbial structures and are marked ADJS : in their first position they will contain either a preposition, if expressed overtly in manual glosses, or a semantic marker, and the lexical head in second position
- Gerundives are marked ADJ as lexical adverbs and contain the corresponding verb in infinitive form.
- Finally, PROPositions may be coordinated (COORD) or appear in sequence without markers (IPOTAS). These tags are inserted first, before the PROP tag.



# Ambiguous subcategorisation and Open Complements

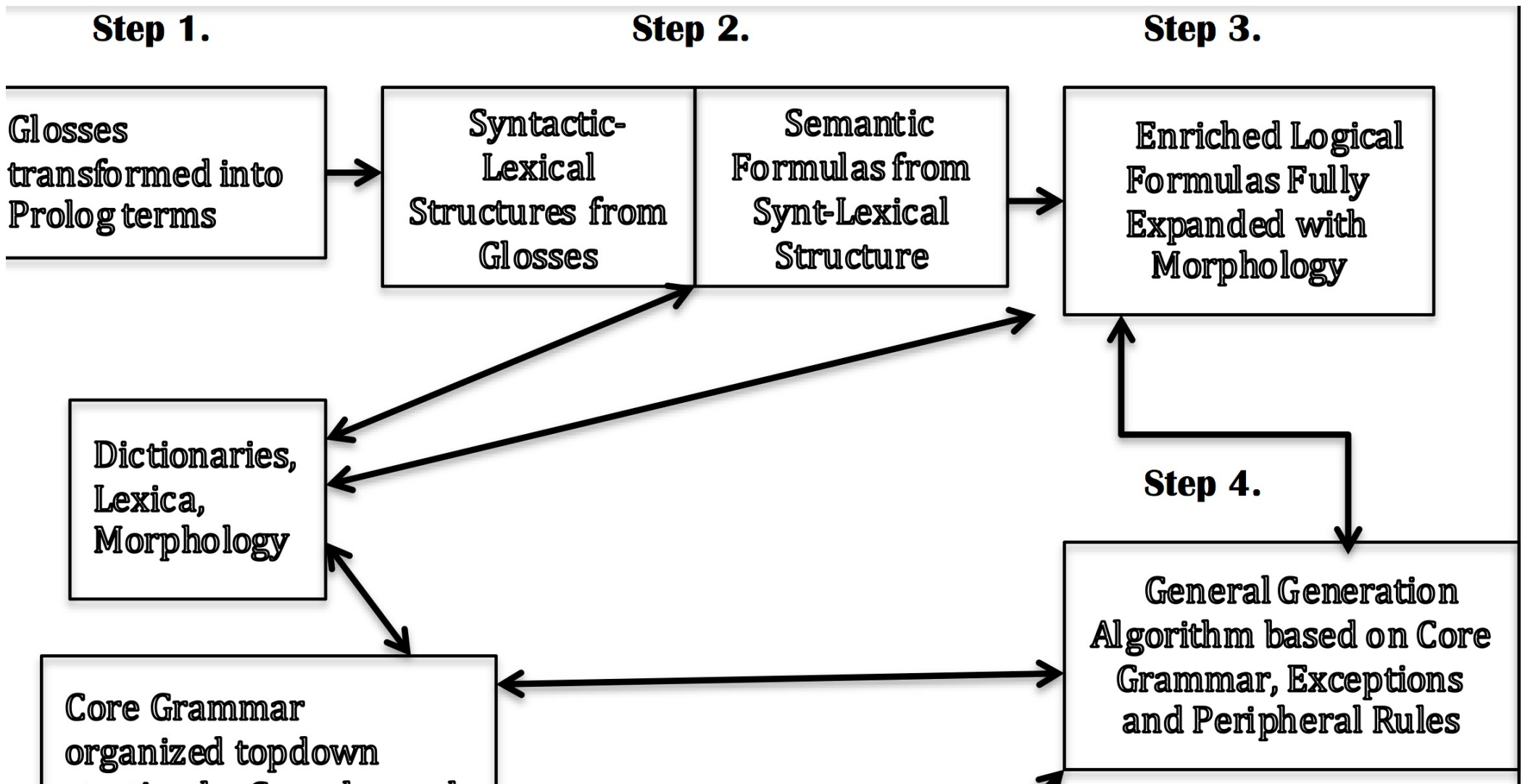
- At lexical level, any governing verb may have an ambiguous complement structure. For instance the one for DIRE/say-tell is characterised by four different complements, the same syntactic category, TRANSitive, the same conceptual and semantic category, *report-dir* - that is a reporting/communication verb that can be used for direct speech introduction.
  - - vcomp = INFINITIVAL
  - ogg = DIRECT-OBJECT
  - ogg2 = Indirect-Object(dative)+fcomp -
  - fcomp = SENTENTIAL-OBJECT
- Verbs like *considerare*/regard and *dipingere*/paint have an open complements like NCOMP (a nominal predicative complement) or XCOMP (a label for generic open complements including infinitivals).

# Agreement across semantic structures

- Open Complements and Open Adjuncts require special rules to be implemented. Open Complements are often predicative complements of copulative verbs, as in *siete pronti\_masc\_plur/are you ready*
- All open complements require morphological features to match, and this will allow for complement structures to impose agreement for those features.
- Open Adjuncts are state adjectives like *tranquillo/quiet*, which require gender/number agreement with the SUBJect as in *la tartaruga guardava tranquilla\_fem\_sing/the tortoise was watching quiet*. Both cases require SUBJect morphological features to be visible in the Complement/Adjunct section of the generator in order to select or restrict the appropriate word form

# Using Speech Acts to produce Tense/Mood

- We distinguish ***Perlocutive*** from ***Illocutive*** verbs on the basis of the pragmatic nature of the action expressed: **instructions** on how to carry out a task are tagged **Perlocutive** and are enacted with ***Imperative*** mood. **Illocutive** expressions are tagged when the utterance expresses a decision or a wish to come true and are placed in ***Future Tense***.
- Then, as a general rule, **Activities, States,** are realized with ***Indicative Imperfetto***, while **Achievement** uses Past-tense (***passato-remoto***). The remaining cases are all realised with ***Indicative Present***.



# From Syntactic-Lexical to Semantic and Logical Forms

- They contain the so-called phi-features: Person, Number, Gender and Case if needed
- Open Complements are labeled PRED - for predicative
- An internal algorithm decides for Definiteness assignment
- Modifiers are turned into Properties and Adverbials into Adjuncts
- Quantifiers are diversified into Collective vs Distributive
- Every Turn has a Topic taken from propositional Subject and/or inherited by Reference Resolution

# Converting into Semantic Forms - default rules

- We decided conventionally to use **active diathesis**, **in past tense and indicative mood** BUT *direct speech and questions* are always expressed in **present indicative**
- Furthermore morphological features of nouns are always **singular**, unless otherwise indicated in glosses, and gender is derived from **lexical gender**.
- Direct Speech usually lacks an introductory verb which must be provided

# Semantic Forms

- Syntactic-Lexical vectors are now becoming Semantic Forms enriched with semantic information: adding Mood and Tense.
- Verbal forms may undergo transformation during the generation process, into complex structures containing auxiliaries and this triggers decisions for phi-features to be made
- Nominal expressions will contain phi-features, Person, Number, Gender and Case to allow for agreement to be transferred across structures, as happens with Open Complements and Open Adjuncts

# Generating Person

- The verb is checked for agreement with SUBJect morphological features. Person may be available in case the SUBJect is lexically expressed. Empty pronouns on the contrary do not realise Person feature, which is set by default to 3rd.
- Special cases are constituted by Imperative mood and Direct Speech. Imperative mood requires 2nd person-singular to be realised if the command or instruction is addressed directly to the interlocutor.
- But there are commands in the fable addressed by the owl to both competitors, the hare and the tortoise, to start the race. In this second case, also 1st person-plural is acceptable



# Verbal Complex and Auxiliaries

- An important feature of verbal complex is the requirements it poses on auxiliary choice and precise morphological information as to the Tense and Mood to be realised. The specification of the appropriate auxiliary verb depends on the lexical type or on diathesis:
  - *essere* for passive, reflexive, inherent reflexive and unaccusative classes;
  - *avere* for active transitive and intransitive classes
- Morphological information from the SUBJect is required in case of auxiliary *essere* in order to generate the appropriate past participle for the main verb. The same is required from the OBJect in case of pronominalization processes of the nominal head into a clitic pronoun

# Logical Form: Specifier and Definiteness

*[Def,Spec,Num,Head]*

- Definite, Indefinite, Zero for all Nouns - else TOP if pronoun
- Spec for Quantifiers and Num for Cardinality
- Algorithm for Definiteness assignment based on Semantic Lexical category and type of constituent
  - In addition a database is created to record first appearance of nominal expressions: **Indefinite** when new in the discourse vs **Definite** if known

## Syntactical and Lexical Forms

19, 1

```
syntlex(19,1,coord(e,prop(nil,arrivare, stativo, present,[gufo,
avv-[ora]]),prop(nil,dire,achievement,dirspeech,
[little_pro,qcomp-[essere,stativo,question,[voi-[due],xcomp-
[pronto]]]]]))))
```

**essere**

19, 2

```
syntlex(19,2,ipotas(prop(nil,cominciare, process, perloc,
[little_pro-[plur]]), prop(nil,dire,achievement,dirspeech,
[little_pro,interj-['3 2 1 ... via']]))))
```



## Semantic Formulas

19, 1, 28

```
seml(19,1,28-42,coord(e,[prst,pres,ind,arrivare,[gufo,avv-
[ora]],[dirs,pres,ind,dire,[little_pro,qcomp-
[essere,stativo,question,[voi-[due],xcomp-[pronto]]]]]))))
```

19, 2, 29

```
seml(19,2,29-44,ipotas([perloc,pres,imperat,cominciare,
[little_pro-[plur]],[dirs,pres,ind,dire,[little_pro,interj-[3 2 1 ...
via]]]))))
```



## Enriched Logical Formulas

19, 1

```
seml(19,1,28-42,coord(e,[prst,pres,ind,arrivare,
[[ndef,_,_,gufo],adj(ora)],[dirs,pres,ind,dire,[[top,_,_,pro],
[quest,pres,ind,essere,[[top,due,plur,voi],[pred,pronto]]]]]))))
```

**ndef**

19, 2

```
seml(19,2,29-44,ipotas([perloc,pres,imperat,cominciare,
[[top,_,_,plur,pro]],[dirs,pres,ind,dire,[[top,_,_,pro],[interj,[3 2
... via]]]]]))))
```

**plur**



## Reference Resolution in Propositional Structure of Dialogue Turns

turn(gufo,prst,arrivare,19,1,28-42)

turn(pro,dirs,dire,19,1,28-42)

turn(pro,perloc,cominciare,19,2,29-44)

turn(pro,dirs,dire,19,2,29-44)

turn(gufo, dirs, dire, 19, 2, 29-44)

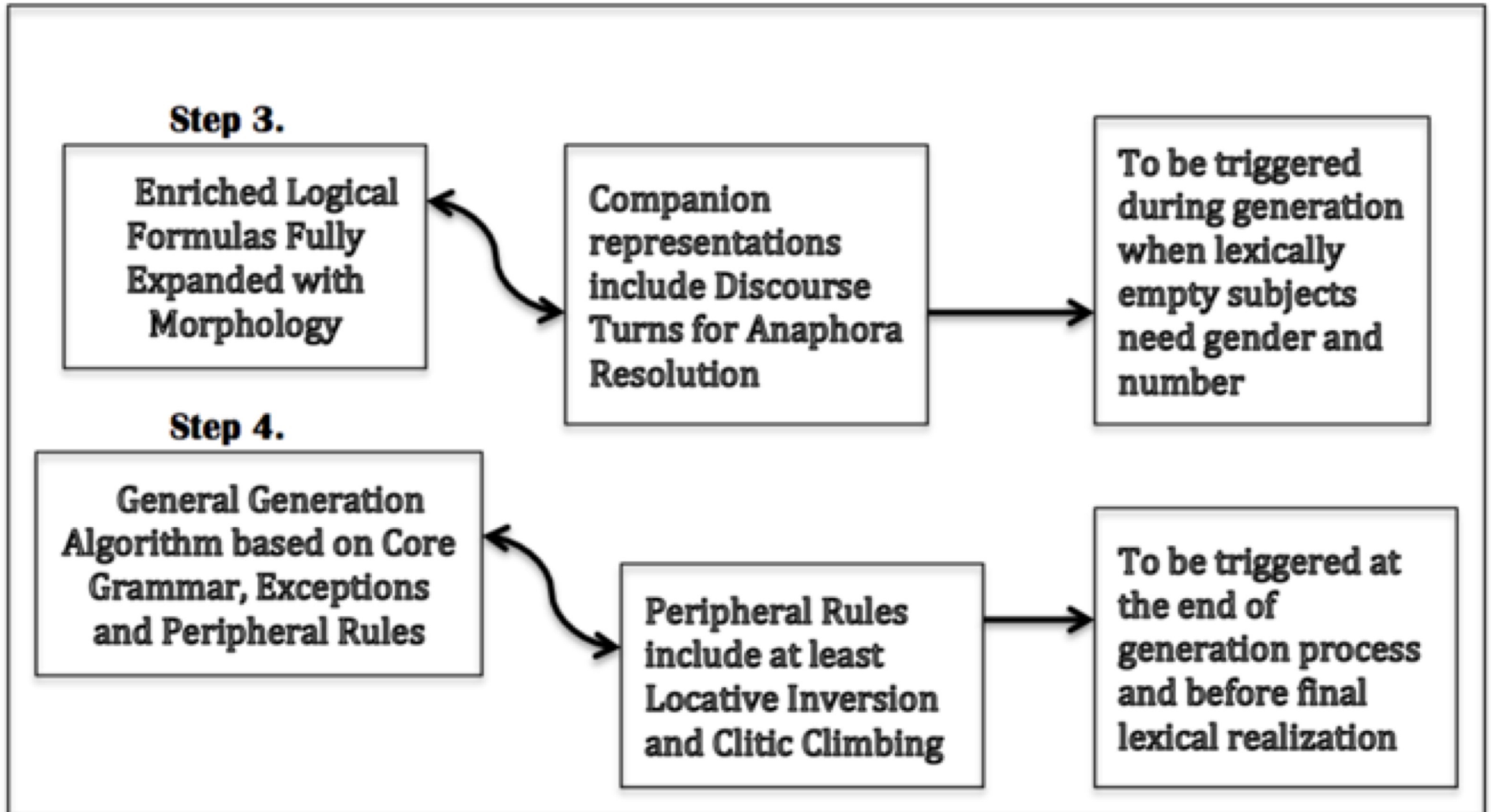
turn(gufo, perloc, cominciare, 19, 2, 29-44)

turn(gufo, dirs, dire, 19, 1, 28-42)

turn(gufo, prst, arrivare, 19, 1, 28-42)



# Peripheral rules



# Peripheral Rules

- At the end of the generation process
- Regarding stylistically marked structures like Presentative and Locative Inversion sentences
- The main linguistic elements are all generated in their base structure, they are identified and displaced in order to produce a presentation structure where the Locative comes in first position followed by the verb complex and then comes the subject nominal and finally the rest of the sentence, which in this case is an apposition

# Peripheral Rules

- A locative adverbial may be turned into a clitic displaced in front of the verb. At first the clitic is generated after the verb and then it is scrambled before it.
- The most frequent rule of Inversion regards the well known Subject/Object Inversion in Direct Speech utterance where what is being said is positioned before the governing communication verb.
- For example, in the utterance DU.11 *Si', si', qui, rispose la lepre/* Yes, yes, here, replied the hare the generated sentence has the so-called deep order, Subj GovVerb Obj(the spoken utterance). The peripheral rule has the task to invert Obj and Subj and obtain the more naturally pronounced utterance, where the most important part (what is being said) comes at the beginning

# Discourse Coherence and Cohesion

- Discourse level processing is the most complex part of the algorithm, because it is responsible for overall discourse coherence and cohesion. For this purpose we need to erase **REPETITIONS**
- Direct Speech in the glosses is either introduced by DIRE/say-tell or no verb at all. In the former case, previous turns need to be verified in order to ascertain whether the current one is an **answer** or a new utterance
- The easiest solution comes from punctuation. *Exclamations* and *questions* are easily treated by inserting an appropriate verb.

# Discourse Coherence and Cohesion

- This is done at the end of the conversion step as a kind of peripheral rule. To evaluate the current turn, the system has access to the database of Discourse Units (DUs) or turns. The logical structure of the current representation will have to be modified
- The search looks at first to check whether the previous turn contained a question and the turn holder was different from the current one: in that case a verb of the answering type is inserted
- Else as a final default rule, the turn is treated as a new utterance and a communication verb of the saying type is added



# Discourse Coherence and Cohesion

- *Output of the Generator:*
  - 🍏 “Ora arriva un gufo e dice : voi due siete pronti ? 3 2 1 via. /Now comes an owl and says: you two are ready ? 3 2 1 go
- *Manually Built to stylistically suit a typical fable story:*
  - 🍏 “Chi viene ora? Un gufo. “Siete pronte? Cominciamo! 3 2 1 ... via!”/Who is coming now? An owl. Are you ready\_fem\_plur? Let’s start! 3 2 1 ... Go!”

# Evaluation

- To evaluate the output of the conversion process and the generator we built a text of the fable by searching the texts available on the web for the same fable. Then we adapted the contents to the signs produced by the signer
- Then we compared the results of the generator to the fable text. We graded the comparison into three levels:
  - 1. **No difference** = semantically or structurally identical (with possible synonyms);
  - 2. **Slight differences** = semantically or structurally different but not to prevent correct understanding;
  - 3. **Noticeable differences** = semantically or structurally different and preventing correct understanding

# Evaluation

- **Over a total of 54 sentences and 91 propositions:**
- *1. No difference* = **No Discourse Unit or SubUnit is totally identical**
- *2. Slight differences* = **55 DUs**
- *3. Noticeable differences* = **8 DUs — —> less than 10% error rate**

*Questions are welcome*

*Thank you*