TLN Part 1 exercise A

Specifications

The scope of the project is the creation of a translation system from italian english the exercise is divided into three phases:

- Parse the original sentence in italian to get POS tags and costituents and/or dependencies.
- Translate the lemmas from Italian to English
- Generate the sentence plan
- Realize the translated sentence with SimpleNLG

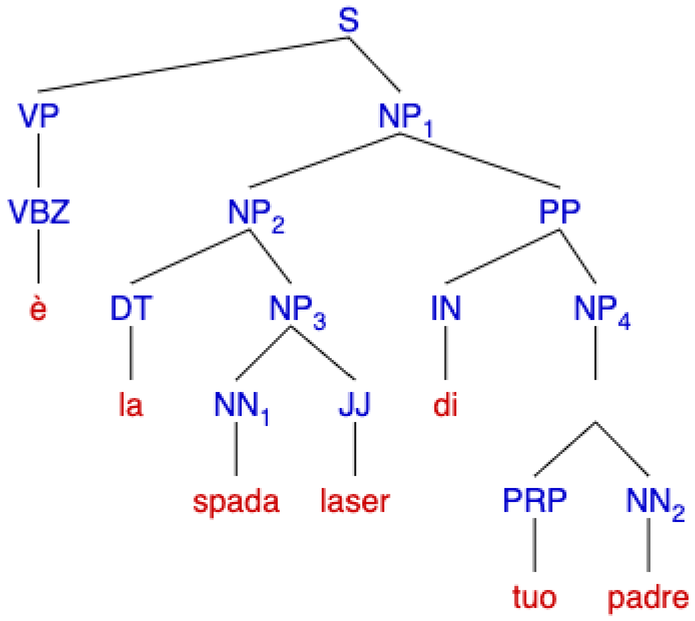
Domain analisys and implementations choises

Both costituent and dependency trees possibility have been explored to choose the best one. The test sentences provided are:

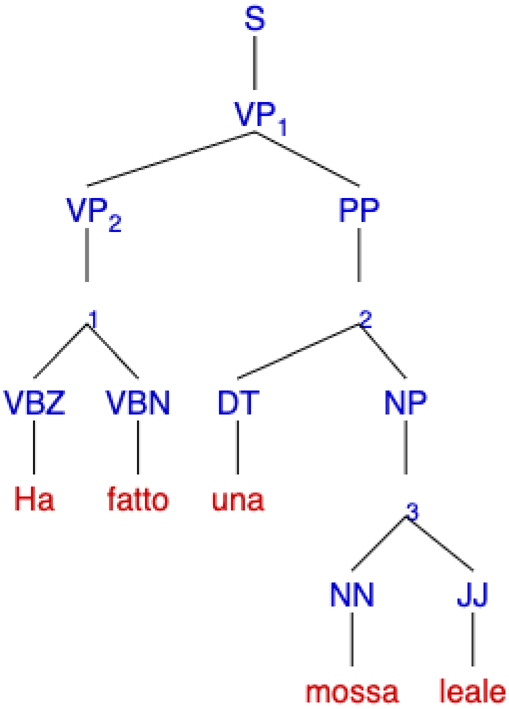
- è la spada laser di tuo padre
- Ha fatto una mossa leale
- Gli ultimi avanzi della vecchia Repubblica sono stati spazzati via

Costituency tree

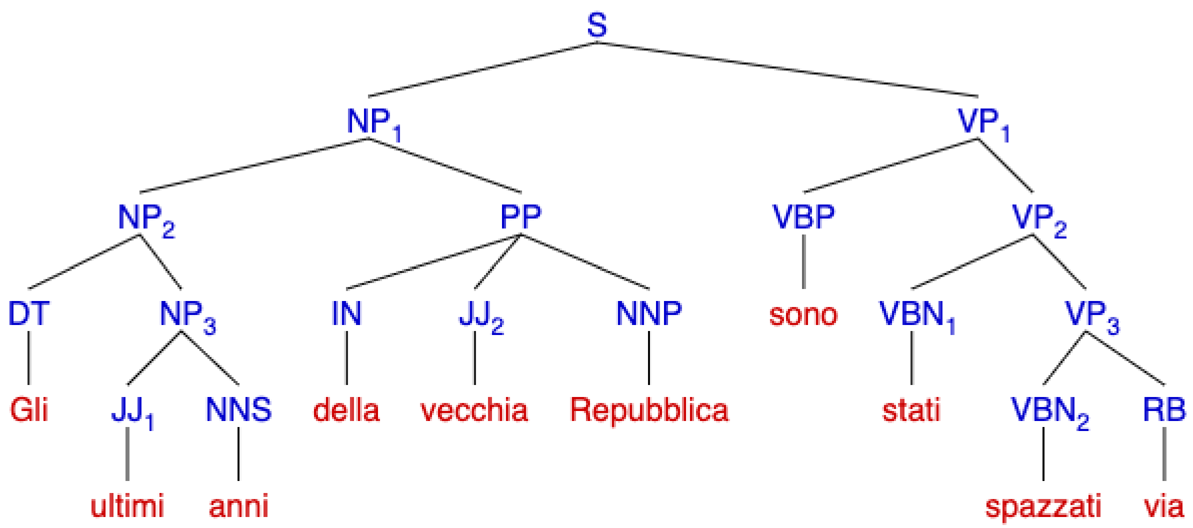
For each of the supplied sentence the sintax tree has been manually drawn (http://ironcreek.net/syntaxtree/):



```
[S
  [VP [VBZ[è]] ]
  [NP
    [NP [DT[la] ]
      [NP
        [NN [spada] ]
        [JJ [laser] ]]]
  [PP
    [IN [di] ]
    [NP
      [ [PRP[tuo]] [NN[padre]] ]]]]]
```



```
  [S
    [VP
      [ VP
        [[VBZ[Ha]]
        [VBN[fatto]]] ]
    [PP
       [DT[una]
       [NP
         [NN[mossa]
          JJ[leale]]]]]]
```



```
[S
  [NP
    [NP[DT[Gli]]
     [NP
       [JJ[ultimi] ]
       [NNS[anni]]]]
     [PP
      [IN[della]]
      [JJ[vecchia]]
      [NNP[Repubblica]]]]
  [VP
    [VBP[sono]]
    [VP
      [VBN[stati]]
        [VP[VBN[spazzati]]
        [RB[via]]]]]]
```

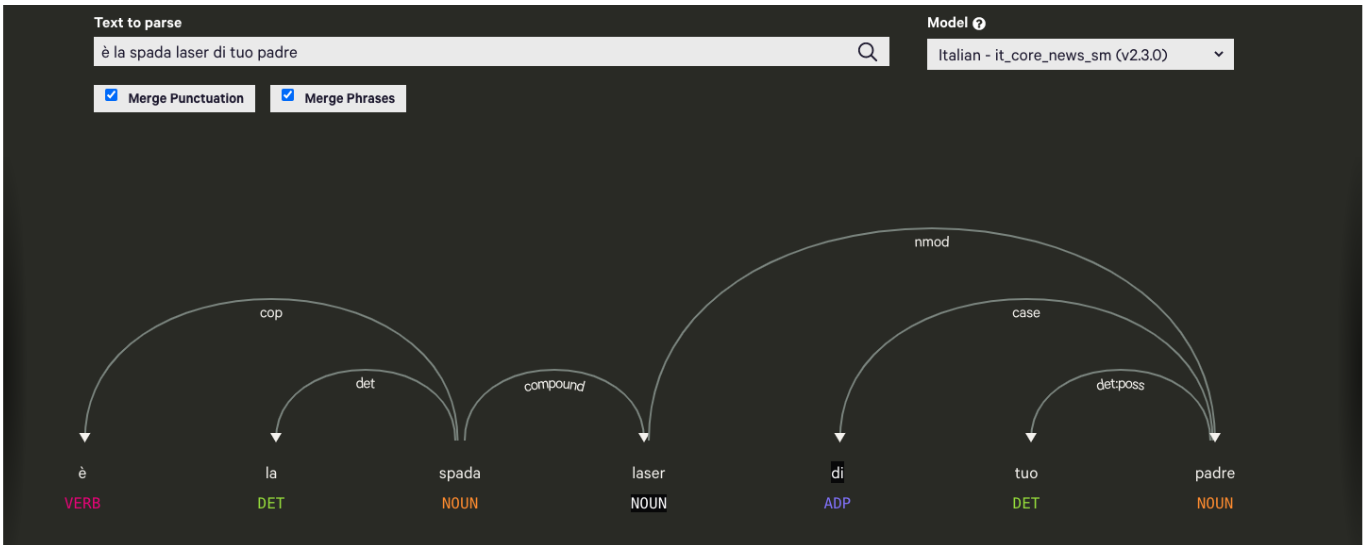
on these tree a toy grammar has been written:

```
S -> VP NP
S -> NP PP
S -> NP VP
S -> VP
NP -> DT NN JJ
NP -> DT JJ NN
NP -> DT JJ NNS
NP -> PRP NN
NP -> NP PP
NP -> DT PRP
VP -> VBZ
VP -> VBZ VBN
VP -> VBP VP
VP -> VBN VP
VP -> VBN RB
```

```
 PP -> IN NP
 PP -> DT NP
 PP -> IN JJ NNP

 DT -> 'il' | 'lo' |'la' | 'i' | 'gli' | 'le' | 'un' | 'uno' | 'una'

IN -> 'a' | 'di' | 'da' | 'in' | 'con' | 'su' | 'per' | 'tra' | 'fa' |
'dei' | 'dello' | 'della' | 'delle'

DD -> 'questo' | 'questa' | 'questi' | 'queste'

PRP -> 'mio' | 'mie'| 'miei'| 'tuo' | 'tue' | 'tua' | 'tuoi' | 'suo' |
'suoi' | 'sua' | 'sue' | 'nostri'| 'nostro' | 'nostre' | 'vostre'|
'vostro' | 'vostri' | 'loro'

VBZ -> 'è' | 'ha'
VBN -> 'fatto' | 'stati' | 'spazzati'
VBP -> 'sono'
RB -> 'via'
NN -> 'spada' | 'padre' | 'mossa'
NNS -> 'anni' | 'avanzi'
NNP -> 'repubblica'
JJ -> 'laser' | 'leale' | 'ultimi' | 'vecchia'
```

Dependency tree

The dependency tree instead have been automatically drawn using the available online tool displaCy Dependency Visualizer (https://explosion.ai/demos/displacy):



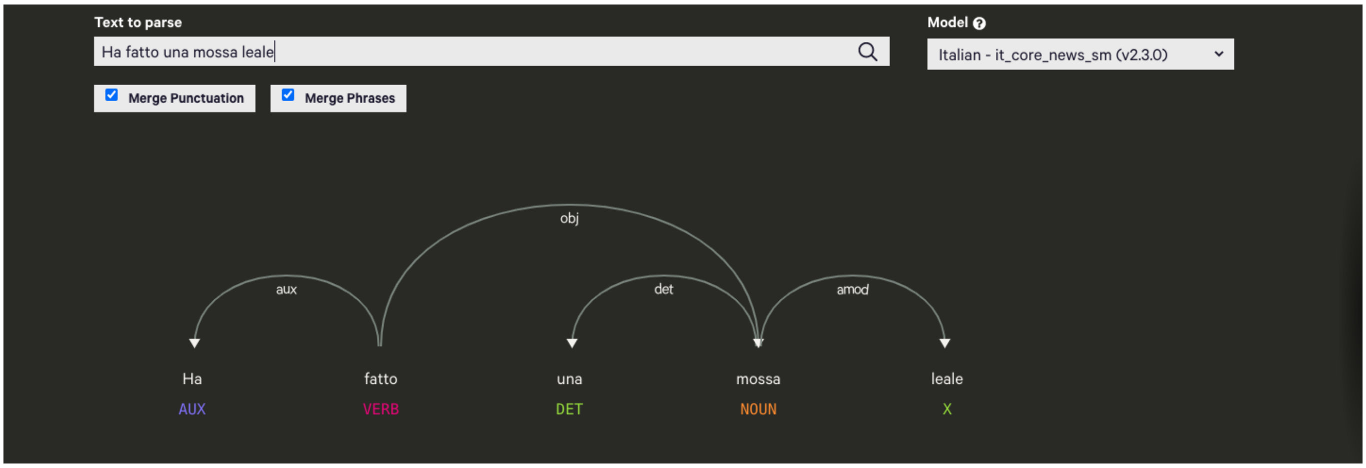
Text to parse

è la spada laser di tuo padre

Model

Italian - it_core_news_sm (v2.3.0)

☑ Merge Punctuation ☑ Merge Phrases



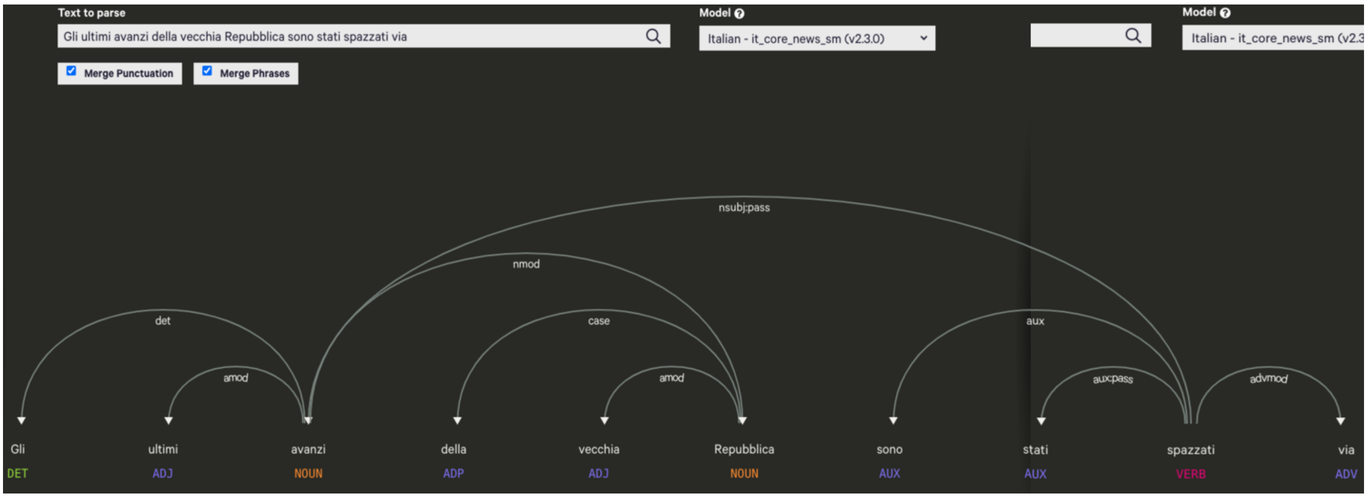
Text to parse

Ha fatto una mossa leale

Model

Italian - it_core_news_sm (v2.3.0)

☑ Merge Punctuation ☑ Merge Phrases



Text to parse

Gli ultimi avanzi della vecchia Repubblica sono stati spazzati via

Model

Italian - it_core_news_sm (v2.3.0)

Model

Italian - it_core_news_sm (v2.3

☑ Merge Punctuation ☑ Merge Phrases

Dependency vs costituency conclusion

According to the requirement to translate not only the shown 3 sentences, but also more general sentences a dependency approach is preferable. The hand made costituency tree needs to be retraited for each new sentence type in input so it is very limited. Moreover more data are needed to find the relations between costituents or to infere them somehow, but good linguistic skills are needed for this task. Some major issues were arising like:

- how to lexilize CFG nodes?
- where to get 'tabelle di percolazione' for the dependencies?
- should be used x-bar theory to project words? Considering the time critical project and the oveload needed to implement the dependency as costituent+conversion, is a better choise an almost ready to

use dependency tree. So to be coherent with the info just analyzed, the library spaCy has been used, because it's the same of the previously drawn graph.

Parse and generate english lemmas tree

The result of getting the dependency tree with spaCY has been saved in a dictionary of node adding per each node the english translation of the lemma. A manual dictionary couldn't fit the need of traducing casual sentences. The translation of lemmas has been done using WordNet with the following procedure:

- map all the POS Penn-Wordnet
- get the sysnsets of the italian word with the specific POS.
- solve disambiguation. At first lersk was used but without good results, so the idea is to choose the most frequent synset for the searched word.
- in case the word is missing in wordnet look up in the python Translate dictionary (https://pypi.org/project/translate/1.0.7/)

Preprocessing

A preprocessing procedure has been develop to handle compound words. In case of compound dependency the child is merged to the parent and all the children point to the new parent.

Build the sentence plan

The sentence plan is built recursively exploring the tree with BFS method. For each node a Phrase or a word is generated and flexed according to the level of the tree (Root or leaf). Then the phrases are built from the leaves up following the dependency rules.

The general idea is to describe rules and discovering the features for each kind of dependency: obj, amod, aux:pass, nsubj:pass, nsubj, cop etc..

Example of generating a Noun phrase on a noun node

```
if case('NOUN'):
 phrase = nlg_factory.createNounPhrase()
 phrase.setNoun(node.get_lemma_eng())
 nounSintax = dict(x.split("=")
                   for x in node.get_sintax()[3:].split("|"))
 if nounSintax.get('Number') == 'Plur':
   phrase.setFeature(Feature.NUMBER, NumberAgreement.PLURAL)
```

Example of rule matching 'aux:pass' dependency:

```
if case('aux:pass'):
  phrase.setFeature(Feature.PASSIVE, True)
```

Some issues arises with particular forms like Genitive Saxon, unknown words (no POS), punctuation or expletive subject that is often needed in english. Most of these issues have a direct impact on the word order but is also due to unresolved sentence ambiguity at early stage of the process.

There are no intermediate structures, the final result is a sentence plan.

Postprocessing

Before realizing the sentence some postprocessing is done mainly to:

- get expletive subject
- check punctuation Ex. Question mark

Results

Italian	English
è la spada laser di tuo padre	It is your father's laser sword.
Ha fatto una mossa leale	It has made a loyal displace.
Gli ultimi avanzi della vecchia Repubblica sono stati spazzati via	Last excesses of the old democracy have been swept off.
Paolo ama Francesca	Paolo loves Francesca.
Paolo ama Francesca?	Does Paolo love Francesca?
Paolo ama Francesca infinitamente	Paolo loves Francesca Infinitely.
Paolo ama Francesca dolcemente	Paolo loves Francesca sweetly.
Lucia corre	Lucia rushes.
Lucia corre?	Does Lucia rush?
La vita è bella.	The life is beautiful.
Il gatto è sul tavolo	The cat is on the table.
Il gatto blu salta sul tavolo agilmente	The blue cat jumps on the table agilely.
Il gatto di mio cugino salta sul tavolo agilmente	Cat my cousin's jumps on the table agilely.
Il ricordo di tuo padre è ancora vivo	Remember your father's is I live Inline.
Marco è stato arrestato	Mark has been stopped.
Un amico di un mio amico è stato arrestato	Friend my friend's has been stopped.
La linguistica computazionale è complicata	Computational linguistic is complicated.
I diamanti sono molto costosi	diamonds are expensive much.
Il lavoro di Vittorio è stato completato	Work of Vittorio has been finalized.

Library

- NLTK
- SimpleNLG
- pySimpleNLG
- spaCy