Welcome to the Statistical Methods of Language Technologyb SoSe21 course

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Topic of this week;

In this first practice class, we are going to focus on two main topics, which will be useful to complete the assignment;

- Earley Parsing
- Rule-based Chunking

Deadline: 02/07 June

In class Exercises

Problem 6.1 Earley Parsing

Assume the following grammar:

$$
\begin{array}{rcl}
S & \rightarrow & NP\,VP \mid NP \\
VP & \rightarrow & V\ NP \mid V\ NP\ PP \\
NP & \rightarrow & NP\ PP \mid D\ N \mid R \\
PP & \rightarrow & P\ NP \\
P & \rightarrow & with \mid in \mid of \\
V & \rightarrow & see \mid take \mid make \\
N & \rightarrow & man \mid telescope \\
D & \rightarrow & the \mid an \mid a \\
R & \rightarrow & I
\end{array}
$$

Parse the sentence **“I see the man with the telescope** top down with the Earley algorithm

Hints:

States (table entries) represent:

- Completed constituents and their locations
- In-progress constituents
- Predicted constituents

The table entries are called states and are represented with dotted rules:

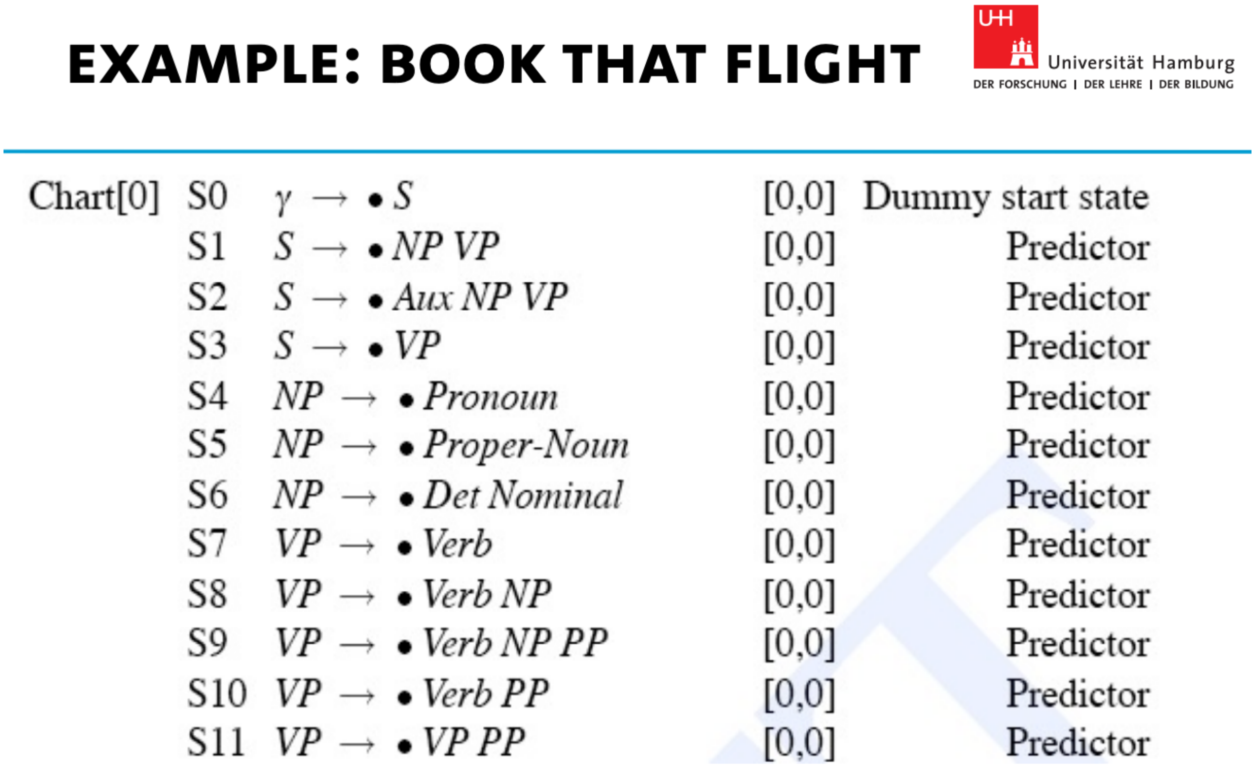
Example taken from Lecture Notes (week5, slide 31)

- S -> • VP (A VP is predicted)
- NP -> Det • Nominal (An NP is in progress)
- VP -> V NP • (A VP has been found)

With offsets:

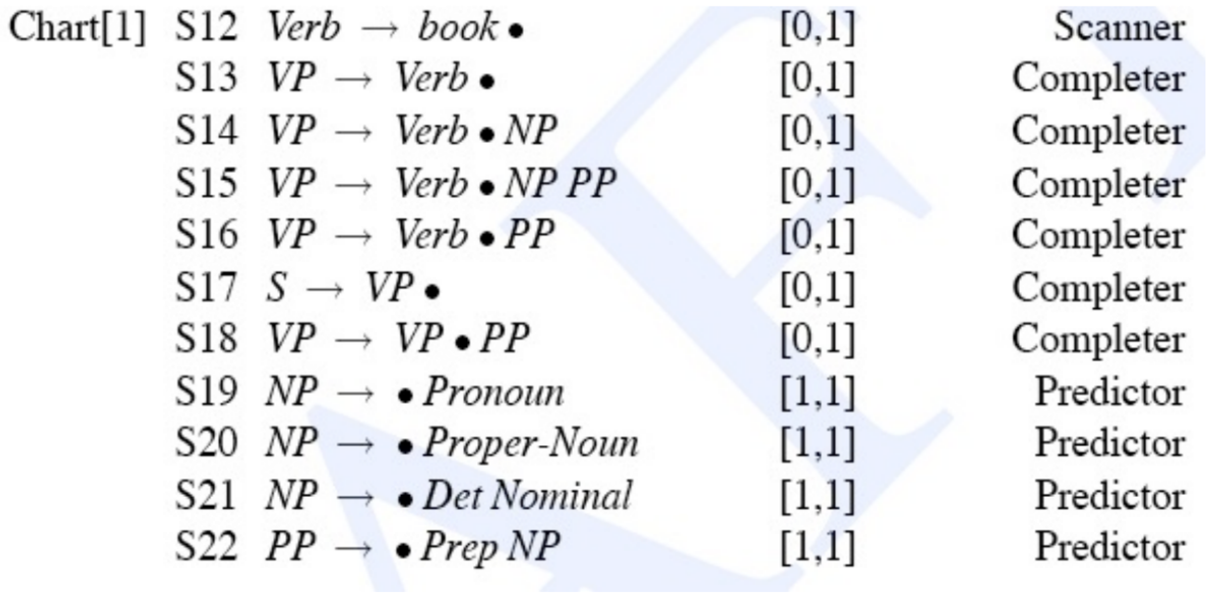
- S -> • VP [0,0] (A VP is predicted at the start of the sentence)
- NP -> Det • Nominal [1,2] (An NP is in progress; the Det goes from 1 to 2)
- VP -> V NP • [0,3] (A VP has been found starting at 0 and ending at 3

Example from the lecture

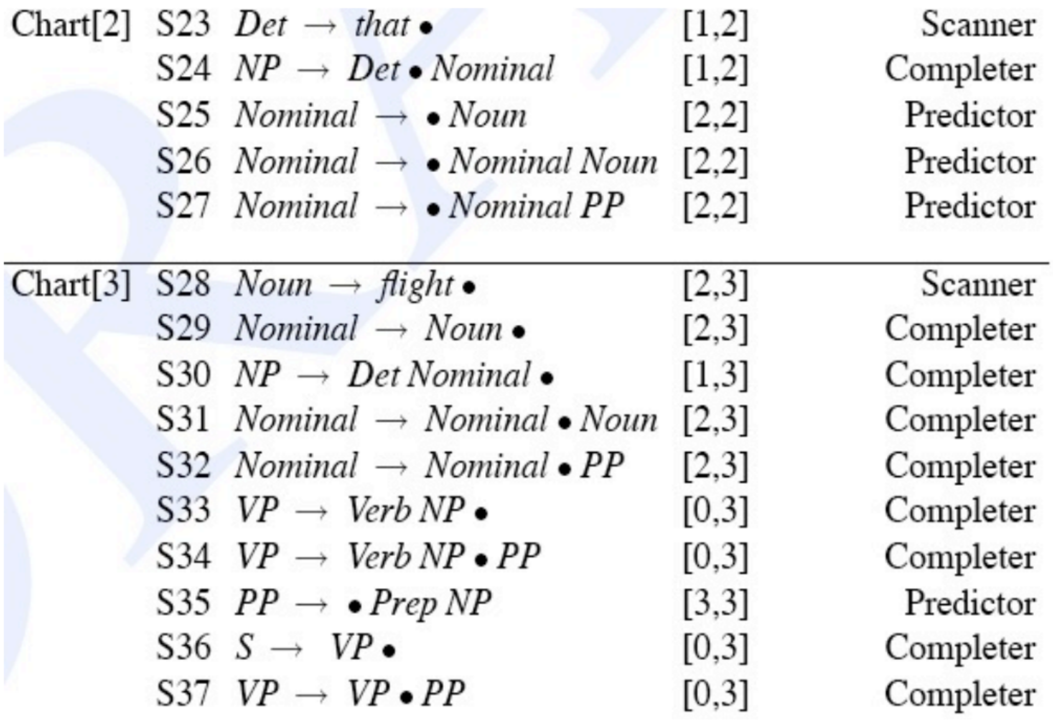


EXAMPLE: BOOK THAT FLIGHT

Chart[0]	S0	$\gamma \rightarrow \bullet S$	[0,0]	Dummy start state
	S1	$S \rightarrow \bullet NP\ VP$	[0,0]	Predictor
	S2	$S \rightarrow \bullet Aux\ NP\ VP$	[0,0]	Predictor
	S3	$S \rightarrow \bullet VP$	[0,0]	Predictor
	S4	$NP \rightarrow \bullet Pronoun$	[0,0]	Predictor
	S5	$NP \rightarrow \bullet Proper\text{-}Noun$	[0,0]	Predictor
	S6	$NP \rightarrow \bullet Det\ Nominal$	[0,0]	Predictor
	S7	$VP \rightarrow \bullet Verb$	[0,0]	Predictor
	S8	$VP \rightarrow \bullet Verb\ NP$	[0,0]	Predictor
	S9	$VP \rightarrow \bullet Verb\ NP\ PP$	[0,0]	Predictor
	S10	$VP \rightarrow \bullet Verb\ PP$	[0,0]	Predictor
	S11	$VP \rightarrow \bullet VP\ PP$	[0,0]	Predictor



Chart[1]	S12	*Verb* → *book* •	[0,1]	Scanner
	S13	*VP* → *Verb* •	[0,1]	Completer
	S14	*VP* → *Verb* • *NP*	[0,1]	Completer
	S15	*VP* → *Verb* • *NP PP*	[0,1]	Completer
	S16	*VP* → *Verb* • *PP*	[0,1]	Completer
	S17	*S* → *VP* •	[0,1]	Completer
	S18	*VP* → *VP* • *PP*	[0,1]	Completer
	S19	*NP* → • *Pronoun*	[1,1]	Predictor
	S20	*NP* → • *Proper-Noun*	[1,1]	Predictor
	S21	*NP* → • *Det Nominal*	[1,1]	Predictor
	S22	*PP* → • *Prep NP*	[1,1]	Predictor



Chart[2]	S23	*Det* → *that* •	[1,2]	Scanner
	S24	*NP* → *Det* • *Nominal*	[1,2]	Completer
	S25	*Nominal* → • *Noun*	[2,2]	Predictor
	S26	*Nominal* → • *Nominal Noun*	[2,2]	Predictor
	S27	*Nominal* → • *Nominal PP*	[2,2]	Predictor
Chart[3]	S28	*Noun* → *flight* •	[2,3]	Scanner
	S29	*Nominal* → *Noun* •	[2,3]	Completer
	S30	*NP* → *Det Nominal* •	[1,3]	Completer
	S31	*Nominal* → *Nominal* • *Noun*	[2,3]	Completer
	S32	*Nominal* → *Nominal* • *PP*	[2,3]	Completer
	S33	*VP* → *Verb NP* •	[0,3]	Completer
	S34	*VP* → *Verb NP* • *PP*	[0,3]	Completer
	S35	*PP* → • *Prep NP*	[3,3]	Predictor
	S36	*S* → *VP* •	[0,3]	Completer
	S37	*VP* → *VP* • *PP*	[0,3]	Completer

Download the **PC5-data.tar.gz** file from Moodle and unpack it. For evaluation, you need to have access to Perl (Windows users can use Babun, http://babun.github.io/ (http://babun.github.io/)).

We want to try a rule-based approach to chunking. As a preprocessing step for Information Extraction, we want to build our own NP Chunker.\

Download the `PC5-data.tar.gz` file from Moodle and unpack it (same data as last week). For evaluation, you need to have access to Perl (Windows users can use Babun, (http://babun.github.io/ (http://babun.github.io/)). Python with NLTK http://www.nltk.org/install.html (http://www.nltk.org/install.html) should also be installed.

Read the train, val and test files (you can either small or medium dataset)

In [ ]:

```
with open('PC5-data/test.small.data','r') as f:
  test_small=f.read()

with open('PC5-data/val.small.data','r') as f:
  val_small=f.read()

with open('PC5-data/train.small.data','r') as f:
  train_small=f.read()

#print(test_small)
```

a) Download the chunking scripts from Moodle (PC6-scripts.zip) and unpack them into the same folder as the chunking data. Run the following script (`6-chunking_1.py`).

What chunks do you see? Ideas for additional rules?

In [1]:

```
import nltk
from nltk.chunk.regexp import RegexpChunkRule

## Grammar section
sentence = [("Barack", "NNP"), ("Obama", "NNP"), ("was", "VBD"), ("born", "

# NP chunking rules
grammar = """NP:
                {<NNP><NNP>}
                {<DT><NN><NNP>}
"""


cp = nltk.RegexpParser(grammar)

result = cp.parse(sentence)
print(result)
result.draw()
```

```
(S
  (NP Barack/NNP Obama/NNP)
  was/VBD
  born/VBN
  in/IN
  (NP the/DT state/NN Hawaii/NNP))
```

b) Run the second script (`6-chunking_2.py`).

Which rules are missing to get the correct NP chunks? Add those rules to the grammar. (Try to solve this task without modifiers like "+", "*", etc.)

In [ ]:

```
import nltk
from nltk.chunk.regexp import RegexpChunkRule

## Grammar section
sentence = [("the", "DT"), ("little", "JJ"), ("yellow", "JJ"), ("dog", "NN"

# NP chunking rules
grammar = """NP:
                {<DT><JJ>*<NN>}
                {<DT><NN>}
"""

cp = nltk.RegexpParser(grammar)

result = cp.parse(sentence)
print(result)
result.draw()
```

c) Think of the following phrases:

- The whole idea
- Oil and auto companies
- George Bush
- the Obama administration
- which
- he
- 100 million dollars

Create rules to cover these phrases.

In [ ]:

```
```

d) Add your rules from the previous task and run your ruleset on the training set (`6-chunking\_3.py`).

What is the performance? Use the `conlleval.pl` script!

In [ ]:

```
import sys
import nltk
from nltk.chunk.regexp import RegexpChunkRule


# helper functions for tuple creation
def group(lst, n):
  for i in range(0, len(lst), n):
    val = lst[i:i+n]
    if len(val) == n:
      yield tuple(val)

def postag(lst):
  for i in range(0, len(lst), 3):
    val = lst[i:i+2]
    if len(val) == 2:
      yield tuple(val)


# open file
raw_annotations = open("train.small.data").read()
split_annotations = raw_annotations.split()


# create tuples of gold annotation and postagged text
reference_annotations = list(group(split_annotations, 3))

postagged_text = list(postag(split_annotations))



## Grammar section

# NP chunking rules
grammar = """NP:
                {<NNP>+}
                {<DT><NN>}
"""
cp = nltk.RegexpParser(grammar)

result = cp.parse(postagged_text)


# Convert prediction to multiline string and then to list (includes pos tag
multiline_string = nltk.chunk.tree2conllstr(result)
listed_pos_and_np = multiline_string.split()


formatted_prediction = list(group(listed_pos_and_np, 3))

# output tab-separated result, add gold annotation
for n,res in enumerate(formatted_prediction):
  print (res[0] + "\t" +res[1] + "\t" + reference_annotations[n][2] + "\t"
```

e) How would you progress to improve the performance?

Resources: For an explanation of the POS tags used, consider Penn Treebank: https://www.ling.upenn.edu/courses/Fall_2003/ling001/penn_treebank_pos.html (https://www.ling.upenn.edu/courses/Fall_2003/ling001/penn_treebank_pos.html) A general tutorial on Information Extraction with NLTK: http://www.nltk.org/book/ch07.html#ref-chunkex-grammar (http://www.nltk.org/book/ch07.html#ref-chunkex-grammar) Documentation of the RegexpChunk parser: http://www.nltk.org/api/nltk.chunk.html#nltk.chunk.regexp.RegexpChunkRule (http://www.nltk.org/api/nltk.chunk.html#nltk.chunk.regexp.RegexpChunkRule)

Good luck with your assignment :-)