Chunk Parsing

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- chunk parsing:
  - efficient and robust approach to parsing natural language
  - a popular alternative to the full parsing
- chunks:
  - non-overlapping regions of text
  - contain a head word (e.g. noun)
  - adjacent modifiers and function words
- motivations:
  - extract information
  - ignore information

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<

Extracting Information: Coreference Annotation

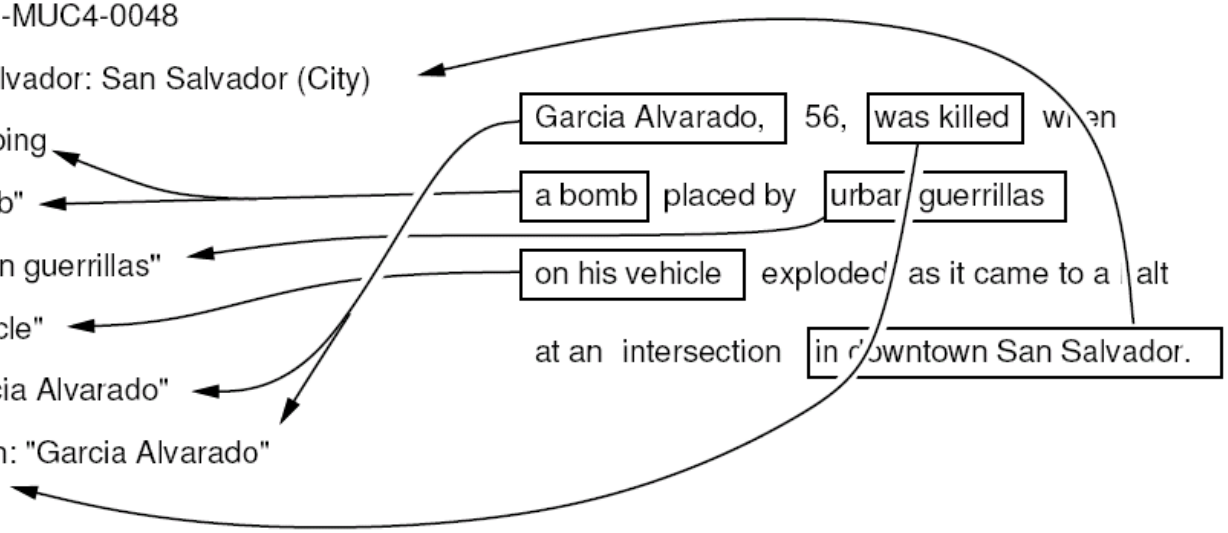
```
<COREF ID="2" MIN="woman">
  This woman
</COREF>
receives three hundred dollars a
month under
<COREF ID="5">
  General Relief
</COREF>
, plus
<COREF ID="16"
       MIN="four hundred dollars">
  four hundred dollars a month in
  <COREF ID="17"
         MIN="benefits" REF="16">
    A.F.D.C. benefits
  </COREF>
</COREF>
for
<COREF ID="9" MIN="son">
  <COREF ID="3" REF="2">
    her
  </COREF>
  son
</COREF>
, who is
```

```
<COREF ID="10" MIN="citizen" REF="9">
  a U.S. citizen
</COREF>.
<COREF ID="4" REF="2">
  She
</COREF>
's among
<COREF ID="18" MIN="aliens">
  an estimated five hundred illegal
  aliens on
  <COREF ID="6" REF="5">
    General Relief
  </COREF>
  out of
  <COREF ID="11" MIN="population">
    <COREF ID="13" MIN="state">
      the state
    </COREF>
    's total illegal immigrant
    population of
    <COREF ID="12" REF="11">
      one hundred thousand
    </COREF>
  </COREF>
</COREF>
```

```
.
<COREF ID="7" REF="5">
  General Relief
</COREF>
is for needy families and unemployable
adults who don't qualify for other public
assistance.  Welfare Department spokeswoman
Michael Reganburg says
<COREF ID="15" MIN="state" REF="13">
  the state
</COREF>
will save about one million dollars a year if
<COREF ID="20" MIN="aliens" REF="18">
  illegal aliens
</COREF>
are denied
<COREF ID="8" REF="5">
  General Relief
</COREF>
.
```

Extracting Information: Message Understanding

0.	Message: ID	TST2-MUC4-0048
3.	Incident: Location	El Salvador: San Salvador (City)
4.	Incident: Type	Bombing
6.	Incident: Instrument ID	"bomb"
9.	Perp: Individual ID	"urban guerrillas"
12.	Phys Tgt: ID	"vehicle"
18.	Hum Tgt: Name	"Garcia Alvarado"
23.	Hum Tgt: Effect of Incident	Death: "Garcia Alvarado"



Ignoring Information: Lexical Acquisition

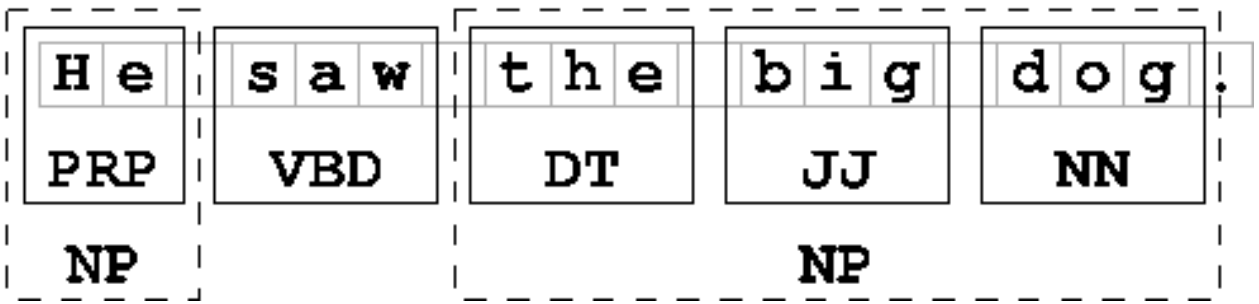
- studying syntactic patterns, e.g. finding verbs in a corpus, displaying possible arguments
- e.g. `gave`, in 100 files of the Penn Treebank corpus
- replaced internal details of each noun phrase with `NP`

```
gave NP
gave up NP in NP
gave NP up
gave NP help
gave NP to NP
```

- use in lexical acquisition, grammar development

Analogy with Tokenization and Tagging

- fundamental in NLP: segmentation and labelling
- tokenization and tagging



- other similarities: skipping material; finite-state; application specific

Chunking vs Parsing

1. Parsing

```
[
  [ G.K. Chesterton ],
  [
    [ author ] of
    [
      [ The Man ] who was
      [ Thursday ]
    ]
  ]
]
```

2. Chunking:

```
[ G.K. Chesterton ],
[ author ] of
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```

Chunking vs Parsing

1. flat vs nested
2. context
3. robustness
4. efficiency
5. methodology

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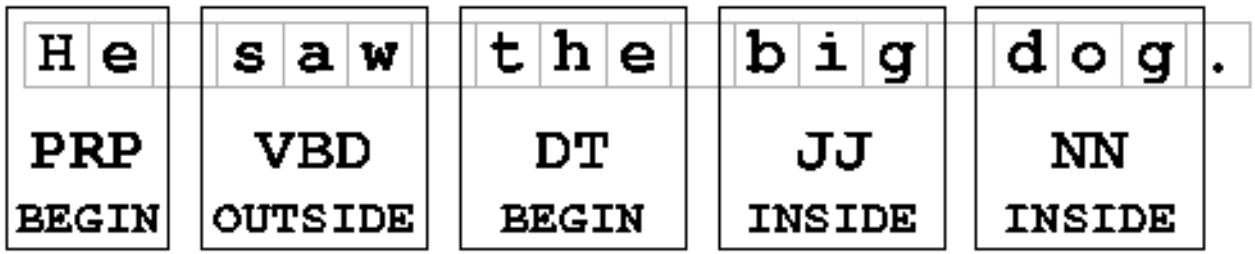
Perfection is unattainable

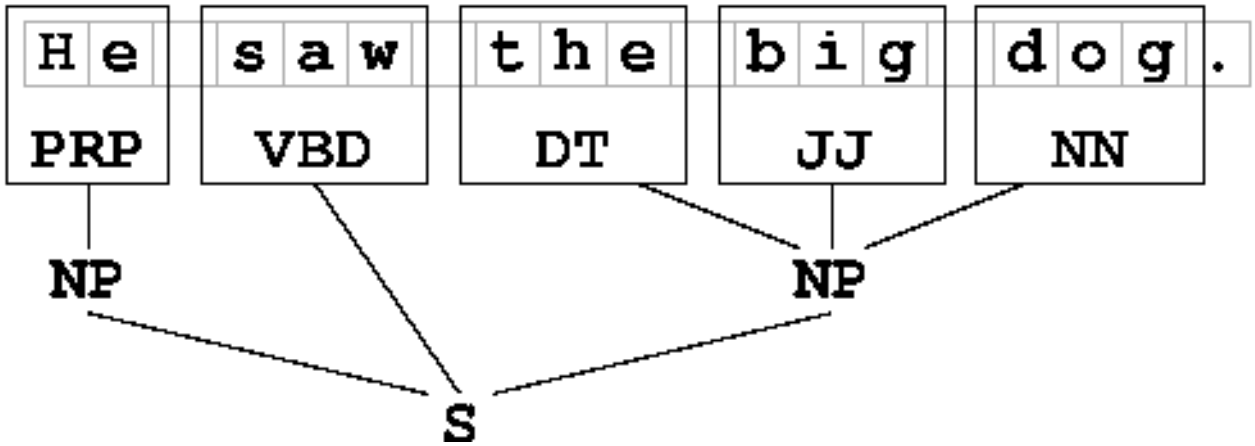
```
1. Prepositional phrase:
[
   [ I ]
   [ turned ]
   [ off the spectroroute ]
]

2. Verb-particle construction:
[
   [ I ]
   [ turned off ]
   [ the spectroroute ]
]
```

Tag Representation



Tree Representation



Chunk Structures

```
(S: (NP: 'I')
    'saw'
    (NP: 'the' 'big' 'dog')
    'on'
    (NP: 'the' 'hill'))
```

- Demonstration: reading chunk structures from Treebank and CoNLL-2000 corpora

Chunk Parsing

- regular expressions over part-of-speech tags: `parse.RegexpChunk`
- *Tag string:* a string consisting of tags delimited with angle-brackets, e.g. `<DT><JJ><NN><VBD><DT><NN>`
- *Tag pattern:* regular expression over tag strings
  - `<DT><JJ>?<NN>`
  - `<NN|JJ>+`
  - `<NN.*>`
- chunk a sequence of words matching a tag pattern: `parse.ChunkRule`

```
>>> rule = parse.ChunkRule('<DT|NN>+',
...             'Chunk sequences of DT and NN')
```

A Simple Chunk Parser

```
>>> from nltk_lite import tag
>>> sent = tag.string2tags("the/DT little/JJ cat/NN sat/VBD on/IN the/
>>> rule = parse.ChunkRule('<NN|DT>+',
...                        'Chunk sequences of NN and DT')
>>> parser = parse.RegexpChunk([rule], chunk_node='NP', top_node='S')
>>> parser.parse(sent)
(S: (NP: ('the', 'DT')) ('little', 'JJ') (NP: ('cat', 'NN'))
    ('sat', 'VBD') ('on', 'IN') (NP: ('the', 'DT') ('mat', 'NN')))
```

Developing Chunk Parsers

```
>>> sent = tag.string2tags("the/DT little/JJ cat/NN sat/VBD on/IN the/DT mat/NN")
>>> rule1 = parse.ChunkRule('<DT><JJ><NN>', 'Chunk det+adj+noun')
>>> rule2 = parse.ChunkRule('<DT|NN>+', 'Chunk sequences of NN and DT')
>>> chunkparser = parse.RegexpChunk([rule1, rule2], chunk_node='NP', top_node='S')
>>> chunk_tree = chunkparser.parse(sent, trace=1)
Input:
                <DT>  <JJ>  <NN>  <VBD>  <IN>  <DT>  <NN>
Chunk det+adj+noun:
               {<DT>  <JJ>  <NN>} <VBD>  <IN>  <DT>  <NN>
Chunk sequences of NN and DT:
               {<DT>  <JJ>  <NN>} <VBD>  <IN> {<DT>  <NN>}
```

- tracing; rule ordering; overlapping contexts

More Chunking Rules: Chinking

- *chink:* sequence of stopwords
- *chinking:* process of removing tokens from a chunk

	Entire chunk	**Middle of a chunk**	**End of a chunk**
Input:	`[a/DT big/JJ cat/NN]`	`[a/DT big/JJ cat/NN]`	`[a/DT big/JJ cat/NN]`
Operation:	Chink `a/DT big/JJ cat/NN`	Chink `big/JJ`	Chink `cat/DT`
Output:	`a/DT big/JJ cat/NN`	`[a/DT] big/JJ [cat/NN]`	`[a/DT big/JJ] cat/NN`

Chinking Example

```
>>> chink_rule = parse.ChinkRule('<VBD|IN>+',
...                              'Chink sequences of VBD and IN')
>>> chunkall_rule = parse.ChunkRule('<.*>+',
...                                 'Chunk everything')
>>> chunkparser = parse.RegexpChunk([chunkall_rule, chink_rule],
...                    chunk_node='NP', top_node='S')
>>> chunk_tree = chunkparser.parse(sent, trace=1)
Input:
                 <DT>  <JJ>  <NN>  <VBD>  <IN>  <DT>  <NN>
Chunk everything:
                {<DT>  <JJ>  <NN>  <VBD>  <IN>  <DT>  <NN>}
Chink sequences of VBD and IN:
                {<DT>  <JJ>  <NN>} <VBD>  <IN> {<DT>  <NN>}
```

More Chunking Rules: other rule types

- `UnChunkRule`: remove any chunk that matches a given tag pattern.
- `SplitRule`: split an existing chunk in two
- `MergeRule`: join two contiguous chunks into one, e.g.:

```
>>> merge_rule = parse.MergeRule('<NN|DT|JJ>', '<NN|DT|JJ>',
...                          'Merge NNs + DTs + JJs')
>>> chunk_rule = parse.ChunkRule('<.*>',
...                        'Chunk all individual tokens')
>>> unchunk_rule = parse.UnChunkRule('<IN|VB.*>',
...                             'Unchunk VBs and INs')
>>> rules = [chunk_rule, unchunk_rule, merge_rule]
>>> chunkparser = parse.RegexpChunk(rules, chunk_node='NP', top_node='S')
>>> chunk_tree = chunkparser.parse(sent, trace=1)
Input:
                 <DT>  <JJ>  <NN>  <VBD>  <IN>  <DT>  <NN>
Chunk all individual tokens:
               {<DT>}{<JJ>}{<NN>}{<VBD>}{<IN>}{<DT>}{<NN>}
Unchunk VBs and INs:
               {<DT>}{<JJ>}{<NN>} <VBD>  <IN> {<DT>}{<NN>}
Merge NNs + DTs + JJs:
               {<DT>  <JJ>  <NN>} <VBD>  <IN> {<DT>  <NN>}
```

Evaluating Chunk Parsers

- Process:
  1. take some already chunked text
  2. strip off the chunks
  3. rechunk it
  4. compare the result with the original chunked text
- `ChunkScore.score()`
  - *precision*: what fraction of the returned chunks were correct?
  - *recall*: what fraction of correct chunks were returned?

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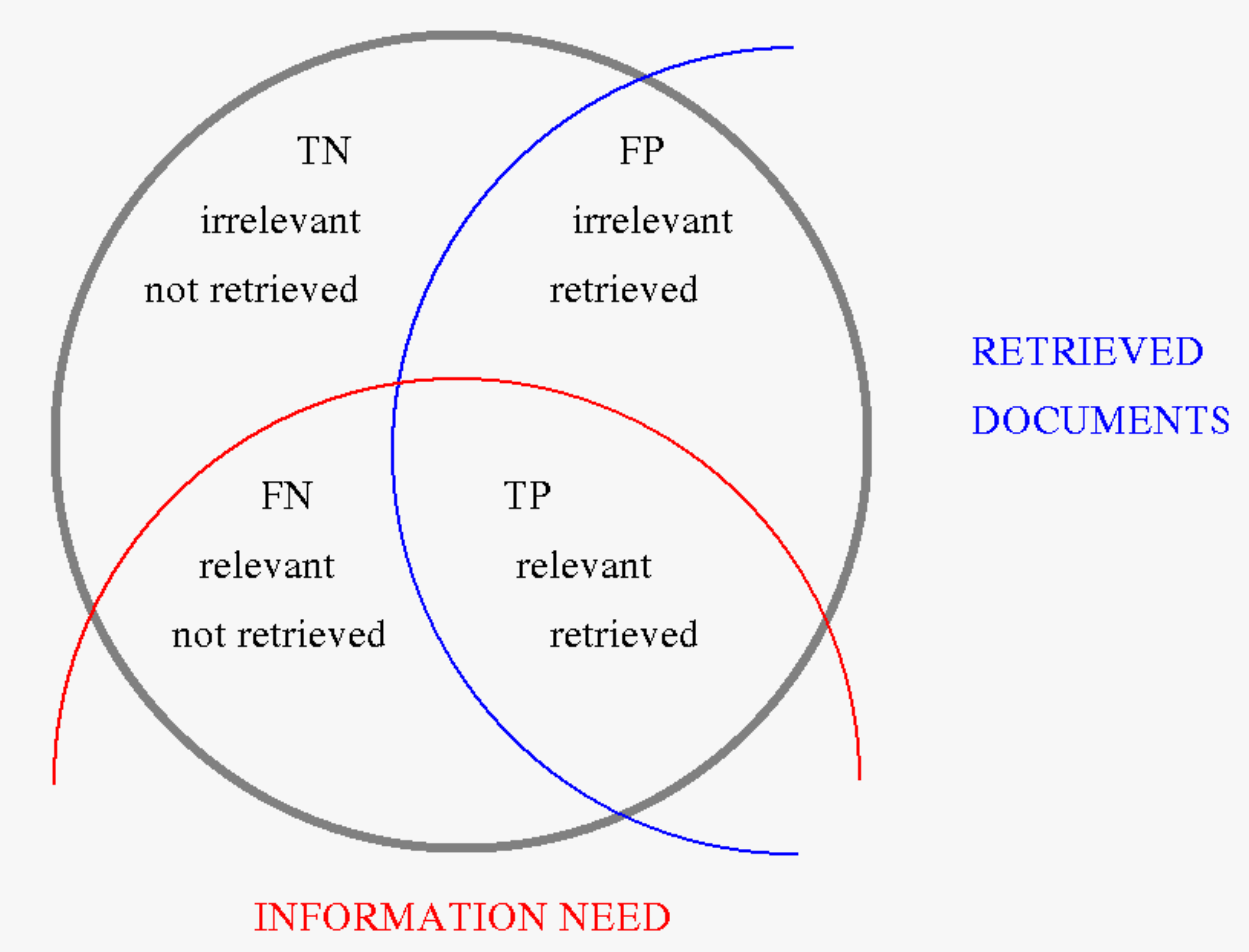
Precision and Recall



Chunker evaluation in NLTK

```
>>> rule = parse.ChunkRule('<DT|JJ|NN>+', "Chunk sequences of DT, JJ,
>>> chunkparser = parse.RegexpChunk([rule], chunk_node='NP', top_node=
>>> chunkscore = parse.ChunkScore()
>>> for chunk_struct in islice(treebank.chunked(), 10):
...     test_sent = chunkparser.parse(chunk_struct.leaves())
...     chunkscore.score(chunk_struct, test_sent)
>>> print chunkscore
ChunkParse score:
    Precision:  48.6%
    Recall:     34.0%
    F-Measure:  40.0%
```

Error Analysis: Missed Chunks

```
>>> from random import randint
>>> missed = chunkscore.missed()
>>> for i in range(15):
...     print missed[randint(0,len(missed)-1)]
(('A', 'DT'), ('Lorillard', 'NNP'), ('spokewoman', 'NN'))
(('it', 'PRP'),)
(('symptoms', 'NNS'),)
(('even', 'RB'), ('brief', 'JJ'), ('exposures', 'NNS'))
(('its', 'PRP$'), ('Micronite', 'NN'), ('cigarette', 'NN'), ('filters'
(('30', 'CD'), ('years', 'NNS'))
(('workers', 'NNS'),)
(('preliminary', 'JJ'), ('findings', 'NNS'))
(('Medicine', 'NNP'),)
(('cancer', 'NN'), ('deaths', 'NNS'))
(('Consolidated', 'NNP'), ('Gold', 'NNP'), ('Fields', 'NNP'), ('PLC',
(('Medicine', 'NNP'),)
(('its', 'PRP$'), ('Micronite', 'NN'), ('cigarette', 'NN'), ('filters'
(('a', 'DT'), ('forum', 'NN'))
(('researchers', 'NNS'),)
```

Error Analysis: Incorrect Chunks

```
>>> incorrect = chunkscore.incorrect()
>>> for i in range(15):
...     print incorrect[randint(0,len(incorrect)-1)]
(('New', 'JJ'), ('York-based', 'JJ'))
(('Micronite', 'NN'), ('cigarette', 'NN'))
(('a', 'DT'), ('forum', 'NN'), ('likely', 'JJ'))
(('later', 'JJ'),)
(('later', 'JJ'),)
(('brief', 'JJ'),)
(('preliminary', 'JJ'),)
(('New', 'JJ'), ('York-based', 'JJ'))
(('resilient', 'JJ'),)
(('group', 'NN'),)
(('cancer', 'NN'),)
(('the', 'DT'),)
(('cancer', 'NN'),)
(('Micronite', 'NN'), ('cigarette', 'NN'))
(('A', 'DT'),)
```

Evaluation Methodology

- Baseline:
  - How hard is chunking?
  - What is a good baseline for evaluation?
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  - hand-crafted vs automatic
- focus on diagnosis:
  - manual
  - utility functions
  - error analysis
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Conclusion

- light-weight methods: as seen in tagging
- applications: extraction, lexical acquisition
  (aside: chunking as a utility method in parsing)
- next: parsing
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