Introduction to Shallow Parsing

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OUR Aim

Developing a practical shallow parser (for Bio-medical text)

- Need to make a fast and accurate module

Study existing shallow parsing approaches

- Based on Hand-crafted patterns
- Based on Machine Learning techniques

Investigate related tasks, such as

- Text chunking
- Clause identification

Contents

Text Chunking : about

Text Chunking

- Dividing a text in syntactically correlated parts of words

  [NP He] [VP reckons] [NP the current account deficit]

  [VP will narrow] [PP to] [NP only # 1.8 billion]

  [PP in] [NP September] .

- An intermediate step towards full parsing
- Shared task of CoNLL-2000(Computational Natural Language Learning)
  - Training and test data is available
  - Goal : make machine learn chunking test data

Text Chunking : CoNLL Data

```
He          PRP   B-NP
reckons     VBZ   B-VP
the         DT    B-NP
current     JJ    I-NP
account     NN    I-NP
deficit     NN    I-NP
will        MD    B-VP
narrow      VB    I-VP
to          TO    B-PP
only        RB    B-NP
#           #     I-NP
1.8         CD    I-NP
billion     CD    I-NP
in          IN    B-PP
September   NNP   B-NP
.           .     O
```

Text Chunking : CoNLL Result

	precision	recall	F	
[ZDJ01]	94.29%	94.01%	94.13	(*)
[KM01]	93.89%	93.92%	93.91	(*)
[KM00]	93.45%	93.51%	93.48	
[Hal00]	93.13%	93.51%	93.32	
[TKS00]	94.04%	91.00%	92.50	
[ZST00]	91.99%	92.25%	92.12	
[Dej00]	91.87%	92.31%	92.09	
[Koe00]	92.08%	91.86%	91.97	
[Osb00]	91.65%	92.23%	91.94	
[VB00]	91.05%	92.03%	91.54	
[PMP00]	90.63%	89.65%	90.14	
[Joh00]	86.24%	88.25%	87.23	
[VD00]	88.82%	82.91%	85.76	
baseline	72.58%	82.14%	77.07	

Text Chunking : History

1991	[S. Abney] proposed to approach parsing by starting with finding correlated chunks of words
1995	[L. Ramshaw and M. Marcus] have approached chunking by using a machine learning method. Classified every non-NP chunk as VP chunk.
1999	[S. Buchholz et al.] presented results for various phrase chunks (NP, VP, PP, ADJP and ADVP) [J. Veenstra] works with NP, VP and PP chunks
2000	CoNLL-2000 shared task
2002	JMLR Special Issues (on Shallow Parsing)

Clause Identification:about

Clause

- Word sequences which contain a subject and a predicate
- Example

(S The deregulation of railroads and trucking companies
(SBAR that
(S began in 1980)
) enabled
(S shippers to bargain for transportation)
.
)

CoNLL-2001 Shared task

- Training and test data is available
- Consists of 3 parts
  - Identifying clause start positions,
  - Recognizing clause end positions
  - Building complete clauses

Clause Identification:CoNLL Data

```
          The   DT   B-NP  S/X/(S*
deregulation   NN   I-NP  X/X/*
           of   IN   B-PP  X/X/*
    railroads  NNS   B-NP  X/X/*
          and   CC      O  X/X/*
     trucking   NN   B-NP  X/X/*
    companies  NNS   I-NP  X/X/*
         that  WDT   B-NP  S/X/(S*
        began  VBD   B-VP  S/X/(S*
           in   IN   B-PP  X/X/*
         1980   CD   B-NP  X/E/*S)S)
      enabled  VBD   B-VP  X/X/*
     shippers  NNS   B-NP  S/X/(S*
           to   TO   B-VP  X/X/*
      bargain   VB   I-VP  X/X/*
          for   IN   B-PP  X/X/*
transportation   NN   B-NP  X/E/*S)
            .    .      O  X/E/*S)
```

Clause Identification:CoNLL Result

test	precision	recall	F	
[CMPR02]	90.18%	72.59%	80.44	(*)
[CM01]	84.82%	73.28%	78.63	
[MP01]	70.89%	65.57%	68.12	
[TKS01]	76.91%	60.61%	67.79	
[PG01]	73.75%	60.00%	66.17	
[Dej01]	72.56%	54.55%	62.77	
[Ham01]	55.81%	45.99%	50.42	
baseline	98.44%	31.48%	47.71	

Clause Identification:History

1990	[S. Abney] used a clause filter as a part of his CASS parser – one part for recognizing basic clauses – one part for repairing difficult cases (clauses without subjects and clauses with additional VPs).
1996	[Eje96] showed that a parser can benefit from automatically identified clause boundaries in discourse
1998	[Lef98] built a rule-based algorithm for finding clauses in English and Portuguese texts.
2000	[Ora00] used memory-based learning techniques. Included a rule-based post-processing phase for improving clause recognition performance.
2001	CoNLL Shared Task

JMLR Special Issue on Shallow Parsing

Full Parsing?

Not all NLP application requires a complete syntactic analysis

- Full parser often provides more information than needed (or less)

For instances,

- Information Retrieval :
  - finding simple NPs and VPs is enough
- Information Extraction, Summary Generation, Question Answering :
  - specific syntactico-semantic relations(agent, object, location, time, etc) is necessary
  - rather than elaborate configurational syntactic analyses

What is Shallow Parsing?

Shallow (or partial) Parsing…

- is the task of recovering only a limited amount of syntactic information from NL sentences
- has proved to be a useful technology for written and spoken language domains

Application Domain of Shallow Parsing

- Speech-to-Speech translation system
  - Used to add robustness (Verbmobil project: Wahlster,2000)
- Question Answering on the WWW
  - Used to efficiently process large ill-formed doc.s (Buchlhholz and Daelemans 2001, Srihari and Li, 1999)
- Text-mining Application
  - Used to biology text mining (Sekimizu et al., 1998)

Used to reduce the search space for full-blown 'deep' parser (Collins, 96)

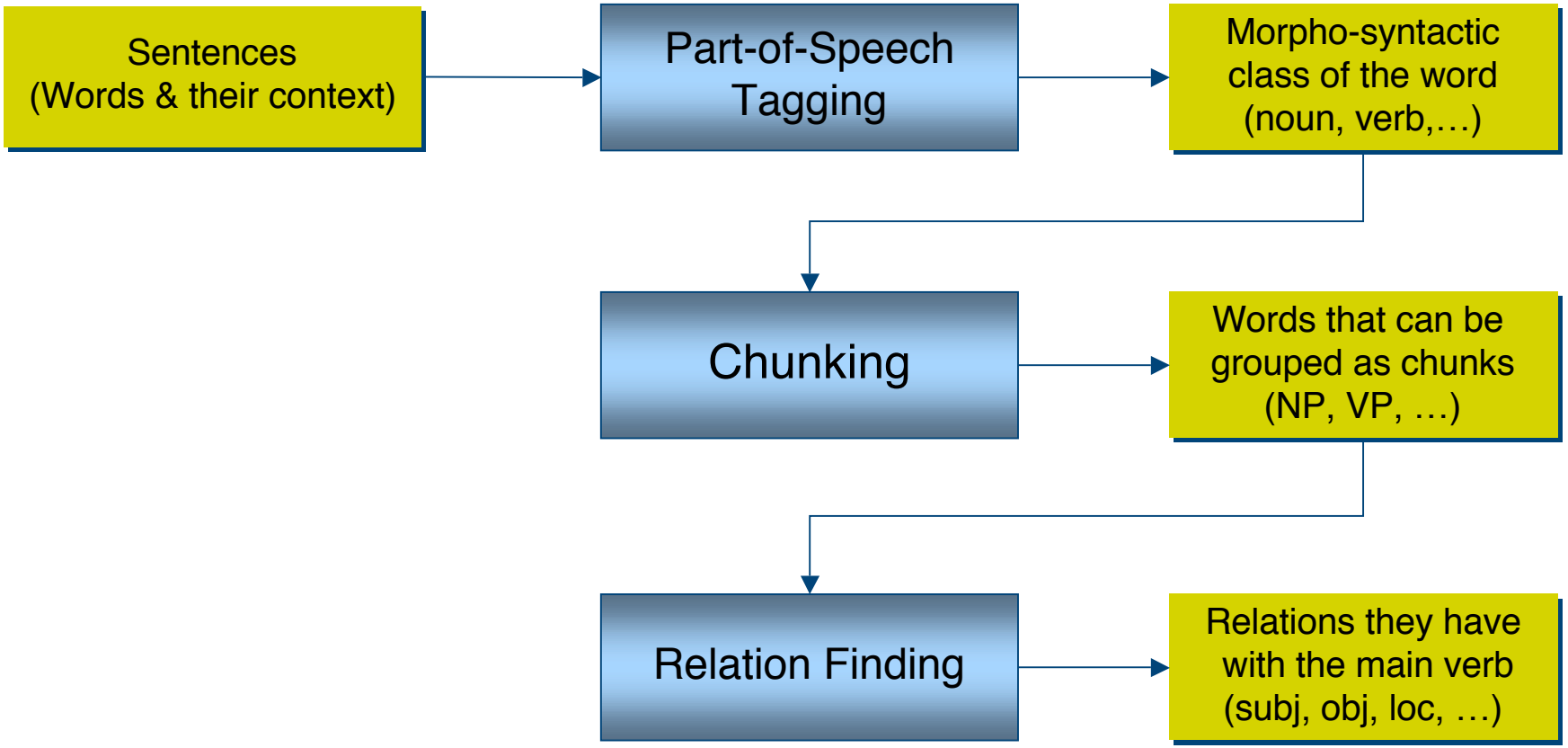
What is Shallow Parsing?

Introduced in [Abney 1991]

- Argued the relevance of shallow parsing
  - from the point of view of psycholinguistic evidence and practical applications
- Used hand-crafted cascaded FST(Finite State Transducers) – Abney 1996

We will cover this paper next week

Typical Shallow Parser Architecture



I am a boy ⇨ [NP-SUBJ I/NNP] [VP am/VB] [NP-OBJ a/DT boy/NN]

How to Shallow-parse?

Use Rule Sets

- Because shallow parsers have to deal with entire NL, they need thousands of rules
  - Determiner are good predictors of NP
- Rule sets tend to be largely 'soft'
  - … fatalities on non-interstate roads were about the same

Therefore, building shallow parser is a labor-intensive task

Unsurprisingly, shallow parsers are usually automatically built, using Machine Learning techniques

Machine Learning Approach for SP

Inspired by [Ramshaw and Marcus, 1995]

- Formulates NP-chunking as a tagging task
- Use I (for word inside an NP),
  O (for outside of an NP),
  B (for between the end of one and the start of another NP) tags

[Some/B bankers/I] [are/O reporting/O] [more/I inquiries/I than/I usual/I] [about/B CDs/I] [since/B Friday/I]

The method can be easily extended

- to tag other types of chunks
  - Skut and Brants 1998
- to find relations
  - Buchholz et al., 1999

Machine Learning Approach for SP

Applying ML to shallow parsing is not straight forward, because

- The amount of data to be processed will push batch systems to the limit
  ➔ need to scale
- Labeled training material is frequently noisy and exists in small quantity
  ➔ need to deal with overfitting
- Real world sentences tend to be long
  ➔ Learners which do not operate in (near) linear time are simply unfit for the task

Therefore, shallow parsing is a challenging domain for ML research

Overview of JMLR Special Issue papers

Tjong Kim Sang

- Memory based shallow parsing
  - Base NP identification, arbitrary base phrase recog. clause detection, NP parsing, full parsing
- MBL + weighted majority voting, stacking

Molina and Pla

- HMM based shallow parsing
  - Chunking and Clause identification
- Not use ensemble learning methods, but acquire comparable results

Overview of JMLR Special Issue papers

Zhang et al.

- Text chunking based on generalized version of the Winnow algorithm
- Used very large set of features
- Achieved the best result for a non-ensemble classifier in the CoNLL-2000 shared task

Megyesi

- Retrain 3 POS taggers for shallow parsing Swedish
- Ignoring lexical information improved performance of the system (Because of the char. of Swedish? Unclear)

Overview of JMLR Special Issue papers

Dejean

- Present top-down rule induction system for learning linguistic structures
  - Deal with noisy data
  - Distinguish linguistically motivated exceptions from noise
- Increase efficiency by using prior knowledge
- Apply to CoNLL-2000 task(chunking)

Overview of JMLR Special Issue papers

Osborne

- Consider noisy and non-stationary training material
  - Use various type of artificially noisy material for experiment
- Draw various conclusion
  - Shallow parsers are robust (large quantities of noise will impair performance)
  - For better performance for other domain, annotate more for target distribution and use additional training material from other distribution
  - Best performers in the literature are not always the best at dealing with noise
  - Ensemble learning is not always a sure-fire strategy

Conclusion

Feature Selection is important

- Important consideration for ML of shallow parsers
- Some learner needs to carefully select(and weight) features, while others can cope with many irrelevant features

Ensemble Learning is recent trend

- Train several classifiers and combine their results
- (weighted) voting and stacked classifier
- Not guaranteed to produce the best result [Osborne]

Conclusion

The majority use probabilistic method

- Exception : MBL

All parsers assumed labeled input

- Exception : Zhang use other knowledge sources, in addition to the training set

Shallow parsers are noise-tolerant

- Only massive quantities of noise will significantly undermine performance

Some parsers use generative model, some use discriminative model