9B. Supertagging

Gerald Penn
Department of Computer Science, University of Toronto

Based upon slides by Michael Auli, Rober Hass and Aravind Joshi
**Why supertag?**

- If lexical items have more description associated with them, parsing is easier
  - Only useful if the supertag space is not huge

- Straightforward to compile parse from accurate supertagging
  - But impossible if there are any supertag errors
    - We can account for *some* supertag errors
    - Don’t always want a full parse anyway
What is supertagging?

- Systematic assignment of supertags
- Supertags are:
  - Statistically selected
    - Robust
    - Tends to work
  - Linguistically motivated
    - This makes sense
What is supertagging?

- Many supertags for each word
  - Extended Domain of Locality
    - Each lexical item has one supertag for every syntactic environment it appears in
    - Inspiration comes from LTAG, lexicalized tree-adjoining grammars, in which all dependencies are localized.
    - Generally, agreement features such as number and tense, are not part of the supertag.
HOW TO SUPERTAG

“Alice opened her eyes and saw.”

Supertags:

- Verb
  - Transitive verb
  - Intransitive verb
  - Infinitive verb
  - ...
- Noun
  - Noun phrase (subject)
  - Nominal predicative
  - Nominal modifier
  - Nominal predicative subject extraction
  - ...
HOW TO SUPERTAG

“How Alice opened her eyes and saw.”

• Supertags:
  • Verb
    ○ Transitive verb
    ○ Intransitive verb
    ○ Infinitive verb
    ○ ...
  • Noun
    ○ Noun phrase (subject)
    ○ Nominal predicative
    ○ Nominal modifier
    ○ Nominal predicative subject extraction
    ○ ...

Diagram:

```
( S / VP )
    /  
   /   
  NP   saw
```

HOW TO SUPERTAG

- A supertag can be ruled out for a given word in a given input string...
  - Left and/or right context is too long/short for the input
  - If the supertag contains other terminals not found in the input
HOW TO SUPERTAG

“Alice opened her eyes and saw.”

- Supertags:
  - Verb
    - Transitive verb
    - Intransitive verb
    - Infinitive verb
    - ...
  - Noun
    - Noun phrase (subject)
    - Nominal predicative
    - Nominal modifier
    - Nominal predicative subject extraction
    - ...

... to saw ...

...
HOW TO SUPERTAG

- This works fairly well
  - 50% average reduction in number of possible supertags
HOW TO SUPERTAG

• ...but there’s more to be done
  • Good: average number of possible supertags per word reduced from 47 to 25
  • Bad: average of 25 possible supertags per word
HOW TO SUPERTAG

- Disambiguation by unigrams?
  - Give each word its most frequent supertag after PoS tagging
    - ~75% accurate
      - Better results than one might expect given large number of possible supertags
      - Common words (determiners, etc.) usually correct
        - This helps accuracy
      - Back off to PoS for unknown words
        - Also usually correct
HOW TO SUPERTAG

- Disambiguation by n-grams?

\[ T = \arg \max_T \Pr(T_1, T_2, \ldots, T_N) \times \Pr(W_1, W_2, \ldots, W_N | T_1, T_2, \ldots, T_N) \]

- We assume that subsequent words are independent

\[ \Pr(W_1, W_2, \ldots, W_N | T_1, T_2, \ldots, T_N) \approx \prod_{i=1}^{N} \Pr(W_i | T_i) \]

- Trigrams plus Good-Turing smoothing
  - Accuracy around 90%
    - Versus 75% from unigrams
  - Contextual information more important than lexical
    - Reversal of trend for PoS tagging
However...

- Correctly supertagged text yields a 30X parsing speedup
  - But even one mistake can cause parsing to fail completely
    - This is rather likely

- Solution: n-best supertags?
  - When n=3, we get up to 96% accuracy...
    - Not bad at all for such a simple method
    - 425 lexical categories (PTB-CFG: ~50)
    - 12 combinatory rules (PTB-CFG: > 500,000)