Semantic Role Labelling with Tree Conditional Random Fields

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Motivation

- Independent per-node classification makes common errors:
  - child nodes of arguments should not be flagged as arguments
  - arguments should be predicted once or not at all
Approach

- Used CRFs for SRL tagging task
  - label each constituent in parse tree
  - use parse tree as model of adjacency (random field)
  - cleaner solution than per-token tagging or per-node classification
  - labelling constraints enforcable over parent-child nodes

- Efficient CRF inference methods generalise to trees
  - tractable in the absense of loops
  - application of Pearl’s \{sum, max\}-product algorithm
Graphical structure

- Cliques for each single node and each parent and child pair
- Pruning used to limit tree size

Cohn/Blunsom  SRL with tree CRFs  June 2005
Labelling method

- Tried three different labelling strategies

- Outside best performing
CRFs

- Generic CRF definition:

\[
p(y|x) = \frac{1}{Z(x)} \exp \sum_{c \in C} \sum_{k} \lambda_k f_k(c, y_c, x)
\]

- Training involves optimising objective (eg. log-likelihood)

\[
E_{\tilde{p}(x,y)}[f_k] - E_{p(y|x)}[f_k] = 0
\]

  - use sum-product to calculate marginals needed by \( E_{p(y|x)}[f_k] \)
  - use max-product to find best labelling
Results

• Similar features to Xue & Palmer (2004), Pradhan et al. (2005)
  – using Collins parses

• $F_1$ scores of 71.17 (dev), 73.10 (test WSJ) and 63.63 (test Brown)

• Findings:
  – CRF improved over maxent classifier (+1%)
  – pruning was detrimental to generalisation performance (-1%)
  – Charniak parses more useful (+3%) [recent finding]
  – Very few inconsistent ancestor/dependent labellings
  – Quite a number of duplicate argument predictions