Dependency tree projection across parallel texts

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Motivation

- For many languages we don't have any manually annotated data for training statistical parsers
- But, for many of these languages, there exists some form of parallel corpus
  - often with English
- Our goal is:
  - make a word-alignment on this parallel corpus
  - run a statistical dependency parser on the English side
  - transfer the dependencies from English to our language using the alignment
  - train the parser on the resulting trees

Outline

- Word alignment
  - uni-directonal alignment
  - symmetrization methods
- Algorithm for projecting dependencies using alignment
  - projecting tags in case we don’t have any tagger
- Training and evaluating MST parser
  - using tagger trained on manually annotated corpus
  - tags projected from English across our parallel corpus
- Ways how to filter out the noise from training data
  - recognition of the bad trees

Word alignment

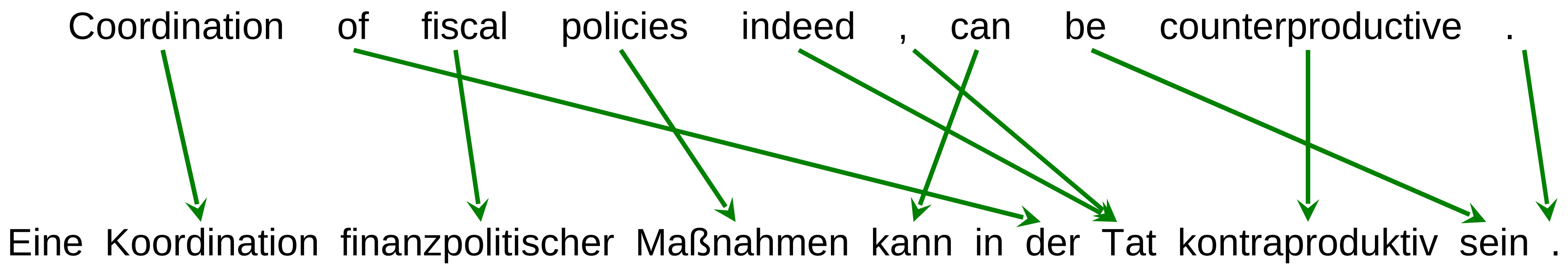
- GIZA++ toolkit [Och and Ney, 2003]

- assymetric output:
  - For each word in one language a counterpart from the other language is found

- GIZA++ is run in both the directions and then it can be symmetrized
  - English-to-X
  - X-to-English
  - Intersection symmetrization
  - Grow-diag-final-and symmetrization

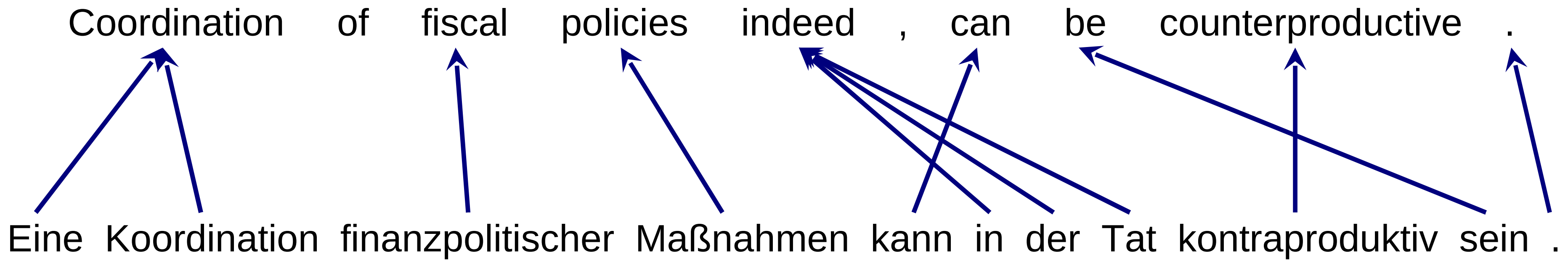
Word alignment - example

- English to German



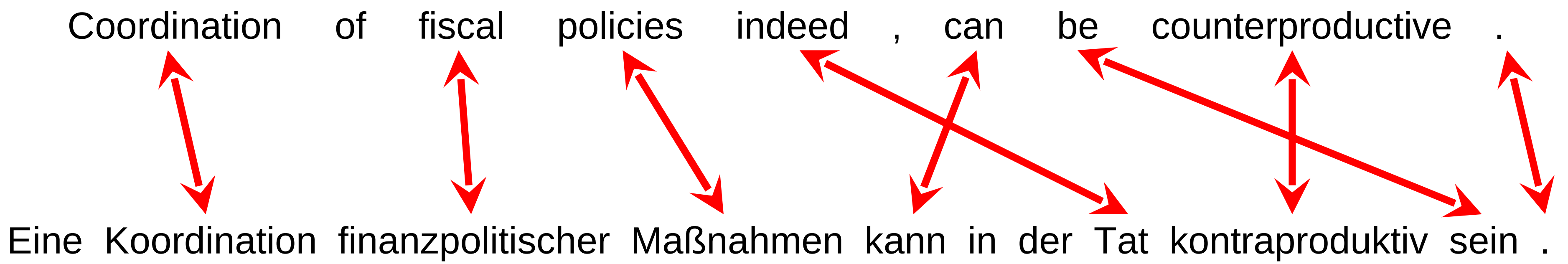
Word alignment - example

- German to English



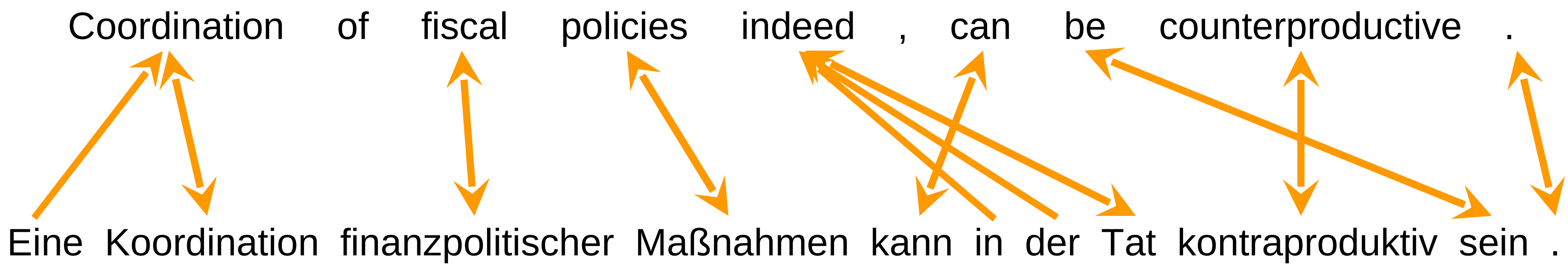
Word alignment - example

- "Intersection" symmetrization
  - intersection of previous two unidirectional alignments



Word alignment - example

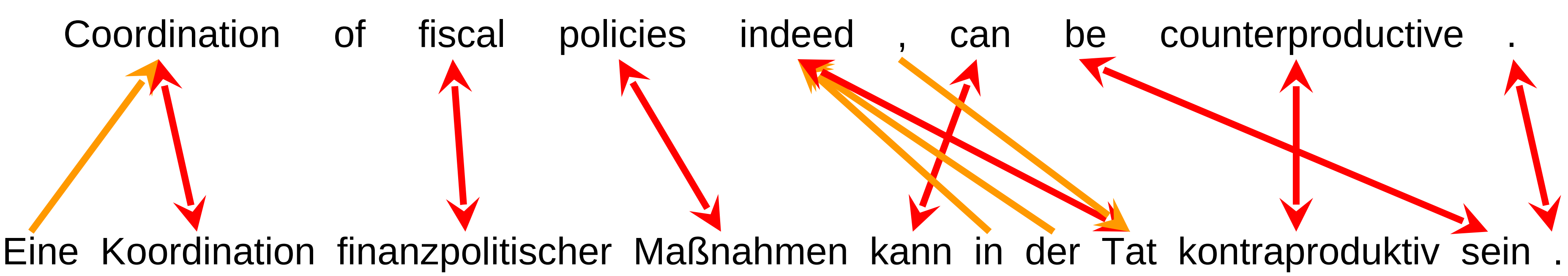
- "Ground-diag-final-and" symmetrization
  - links from intersection
  - links where one or two its ends are neighbouring with some already added link



Alignment links used for the projection

- We use only such links that appeared in unidirectional X-to-English alignment
  - we need to find some parent for each token in the language X
  - we don’t care about not aligned english words

- We recognize three weights of links
  - 1: links that appeared only in X-to-English alignment (blue)
  - 2: links that appeared also in “grow-diag-final-and” symmetrization (yellow)
  - 3: links that appeared in “intersection” symmetrization (red)

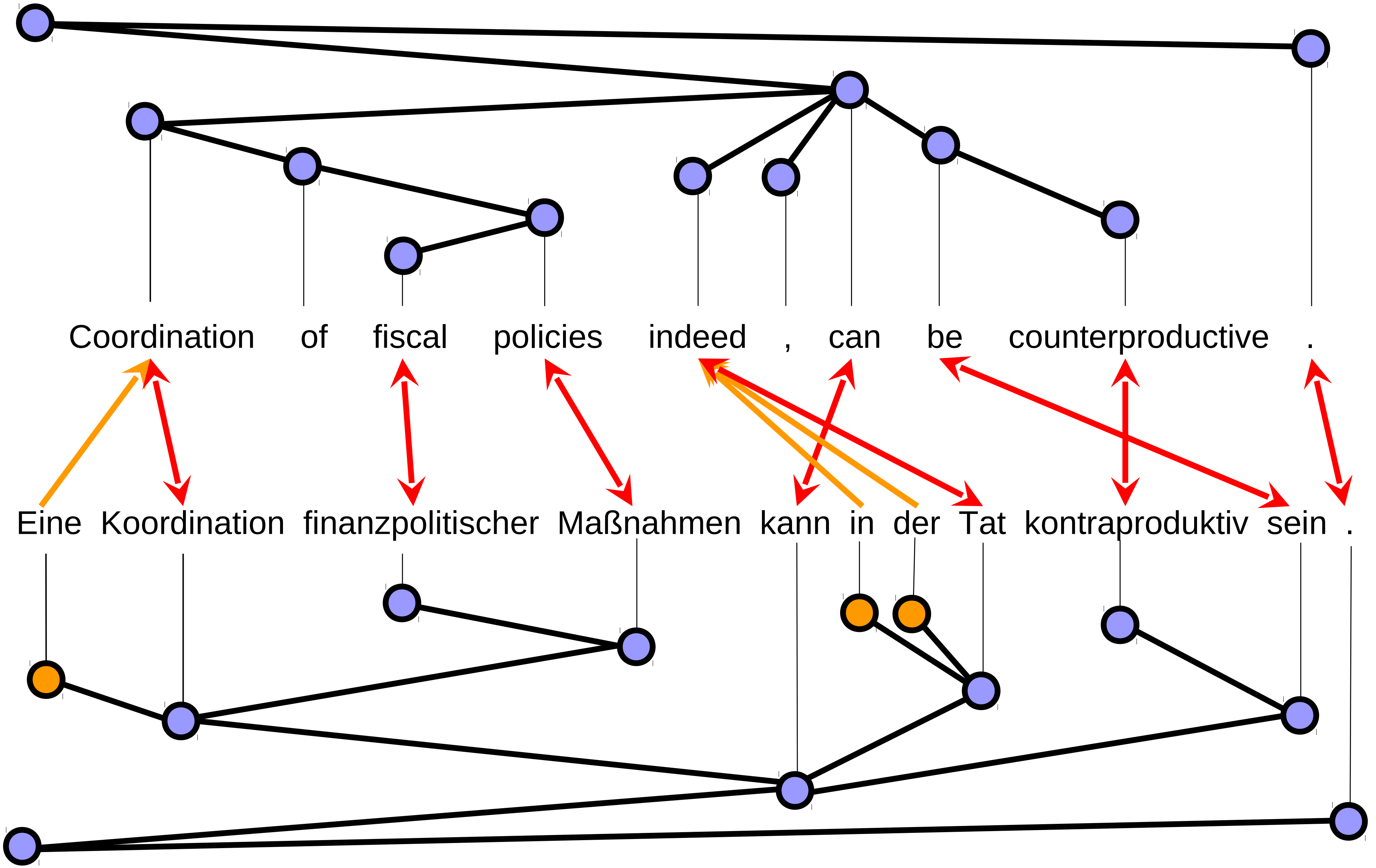


The Algorithm for dependency projection

e_root = *technical root of English parse tree*;
f_root = *technical root of foreign parse tree*;
build_subtree(e_root, f_root);

function build_subtree(e_node, f_node);
begin
    for e_child **in** e_node->get_children **do begin**
        links = *all alignment links leading from* e_child;
        if not links **then**
            build_subtree(e_child, f_node);
        else begin
            main_link = *the link with the highest weight (or the first one of them);*
            main_f_child = *the node which is connected to* e_child *by* main_link;
            other_f_children = *nodes connected to* e_child *by other links;*
            main_f_child->set_parent(f_node);
            main_f_child->set_tag(e_child->get_tag);
            for f_child **in** other_f_children **do** f_child->set_parent(main_f_child);
            build_subtree (e_child, main_f_child);
        end;
    end;
end;

Algorithm - example



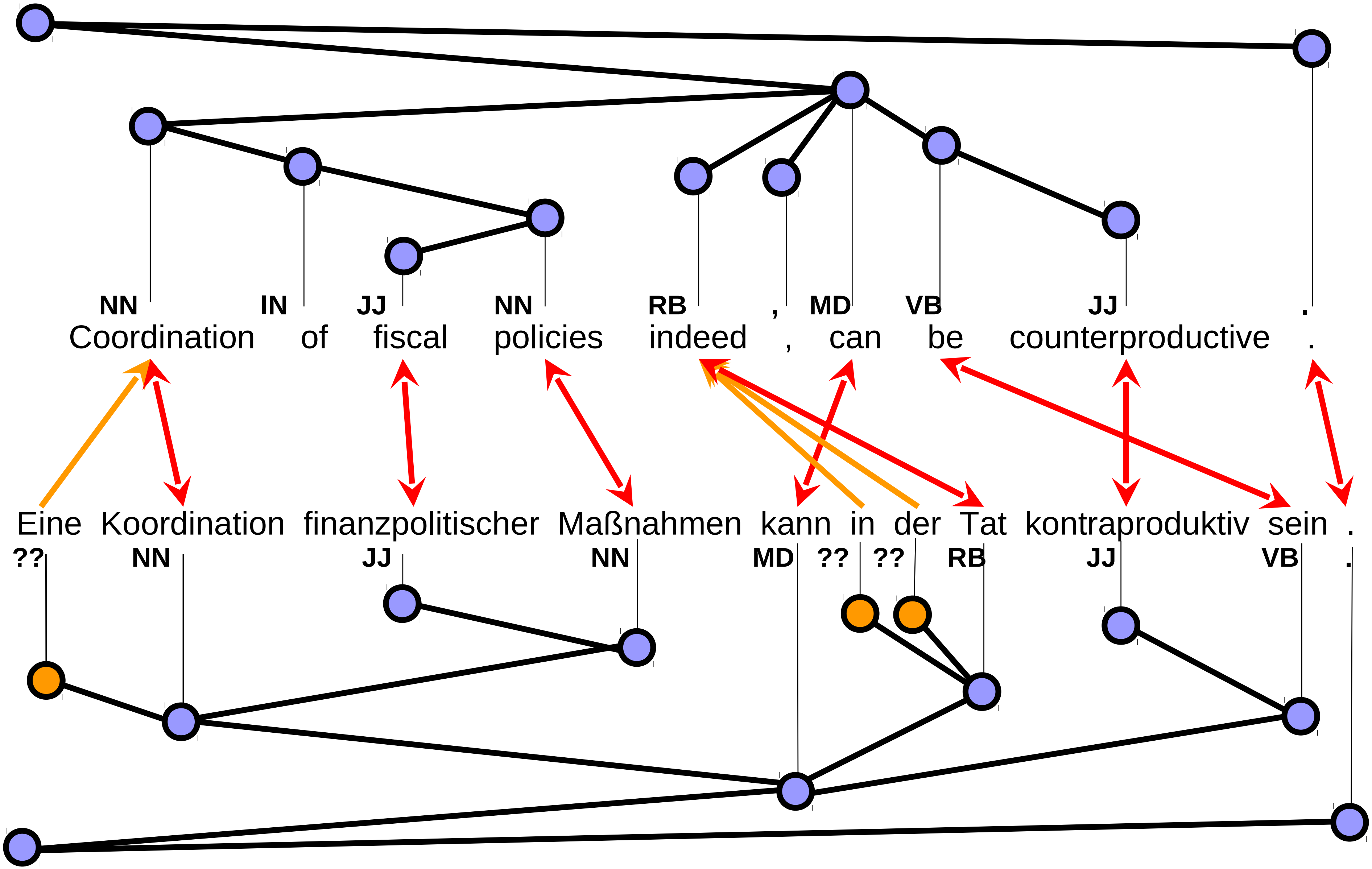
Training a parser – tagging

- We need some tags for training the parser.

- If we have a tagger for our language,
  - we can use it and tag our data.

- In case we don’t have any tagger and any human-anotated corpus,
  - we can make a projection of the English tags into our language
  - we assign a special tag ‘??’ to tokens that haven’t got any tag by the projection

Projecting tags



Filtering the training data

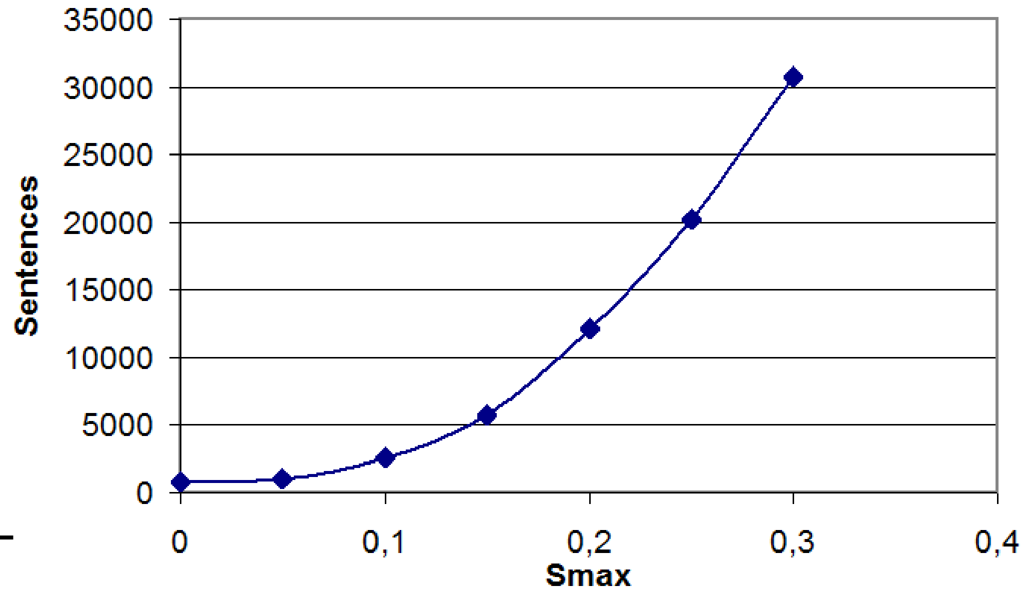
- Why filtering? A lot of noise in the data.
  - non-parallel sentences
  - very free translations
  - very strange trees
- Training a parser on the whole corpus would take a lot of time
  - hours, days, weeks...
- We will filter out such trees that have wrong alignment (alignment sparseness)
- We will filter out such trees that have a lot of non-projective dependencies
  - often caused by wrong alignment

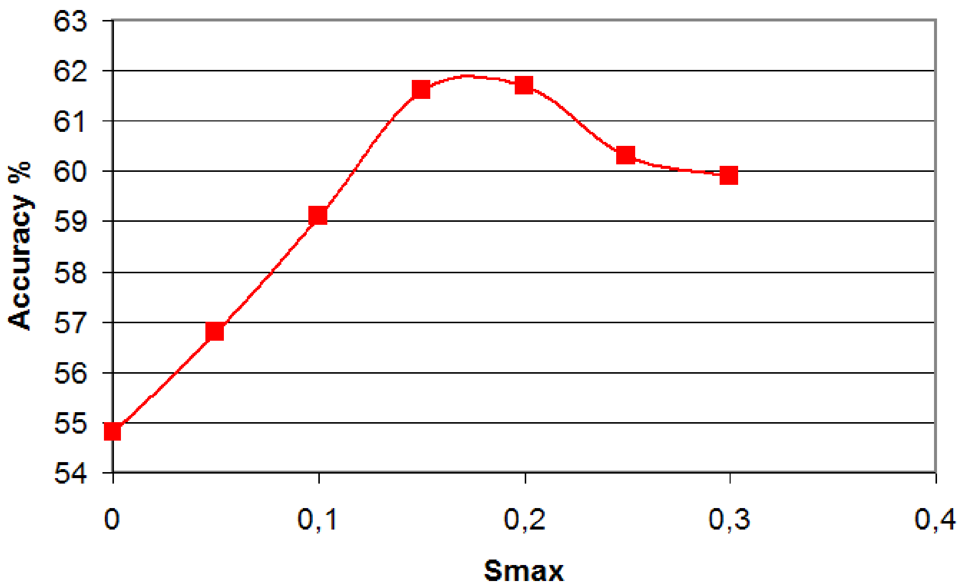
Alignment sparseness limit

- The sentence is not good if there are not many intersection links related to the length of the sentences

$$S = 1 - \frac{\#links}{(e\_length + f\_length) / 2}$$

- We filter out all the sentences with sparseness greater than some limit Smax





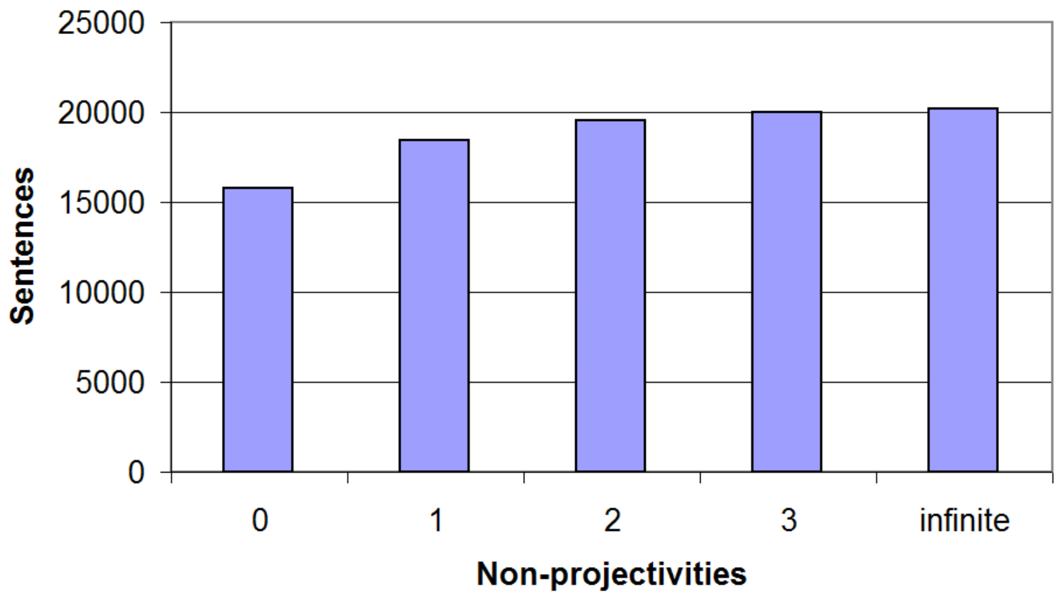
Non-projectivity limit

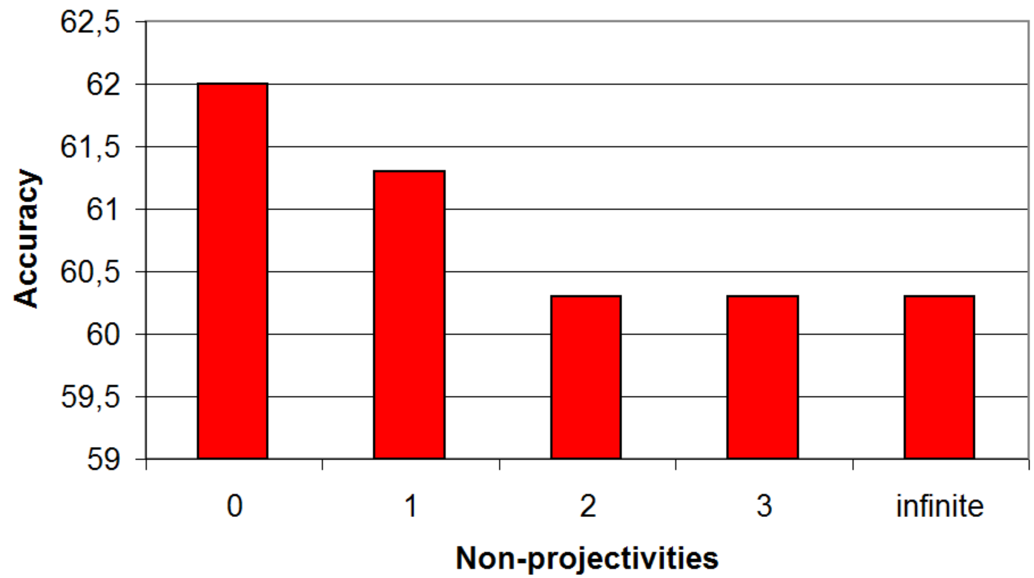
- The sentence is not good if there are many non-projective edges in the projected tree

N = count of non-projectivities

- We filter out all sentences that have more non-projectivities than some limit

- Mesured for S=0.25





Experimental setup

- Languages used:
  - Czech
  - German
- Parallel Corpora
  - Project Syndicate (news-commentaries from WMT10 translation task)
  - about 100,000 parallel sentences
- Treebanks
  - dtest sets from CoNLL shared task 2006/2007
- Parser
  - Maximum spanning tree parser [McDonald, 2005]
- Tagger
  - Morce tagger for English [Spoustova, 2007]
  - Tree-tagger [Schmidt, 1994]

Results

- The best results were achieved with the following filtering:
  - We filter out all the trees with at least one non-projective dependency
  - We filter out all trees where the alignment sparseness S was gretater than 0.25.

Language	Tags	Sentences	Accuracy	Complete
Czech	by tagger	15,762	62.0 %	10.7 %
German	by tagger	17,368	55.7 %	14.9 %
Czech	projected	15,762	53.5 %	7.14 %
German	projected	17,368	54.2 %	11.7 %

Conclusions

- We proved that it’s possible to create a dependency parser without having a manually annotated treebank.
- The unlabeled accuracy is about 60%.
- We tested it on languages for which we have some treebank
- The problem of testing is in a different anotation guidelines for each treebank

Thank you for your attention