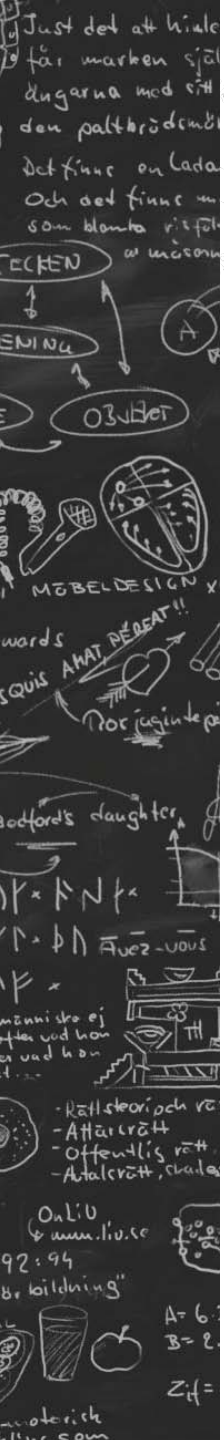

Heuristic word alignment with parallel phrases

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Outline

- Word alignment with parallel phrases
- English-Swedish gold-standard word alignments
- Alignment experiments
- Comparison with Giza++
- Conclusions and future work

Word alignment

- Identify corresponding words in a text and its translation

I do **not think** **it** is **necessary** for **classic cars** **to be** **part of** the directive .

Jag **anser** **det** **inte** **nödvändigt** att **veteranbilar** **skall utgöra** **en del av** direktivet .

I – jag
I do not think – jag anser inte
I do not think it is necessary – jag anser det inte nödvändigt
…

- Applications:
  - Statistical machine translation
    - parallel segments (phrases) extracted from a word aligned parallel corpus
  - Bilingual dictionaries
  - Annotation projection

Word alignment with parallel phrases

- Parallel phrases from manually word aligned texts can be used to align new text.
- Extract all **parallel phrases** from a manually aligned parallel text
  - I do not think – jag anser inte – 0-0 2-2 3-1

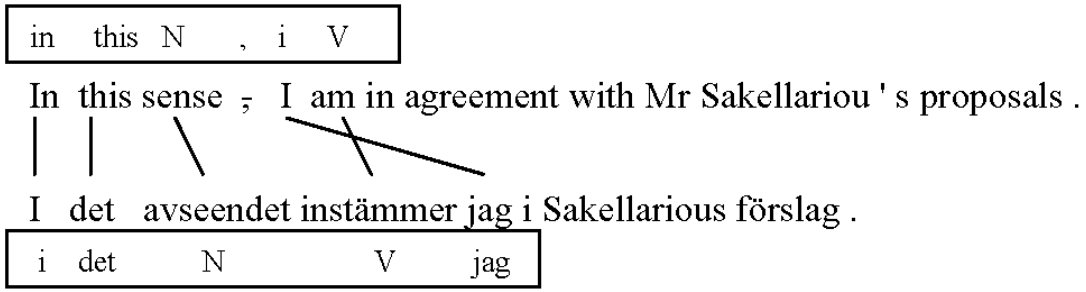
    do not think – anser inte – 1-1 2-0

    …
- Match parallel phrases to new sentence pairs
- If source and target phrase match the new sentence, add links
- Generalize phrases with parts-of-speech to increase recall

the european economy	den europeiska ekonomin	0-0 1-1 2-2
DET european economy	DET europeiska ekonomin	0-0 1-1 2-2
the A economy	den A ekonomin	0-0 1-1 2-2
DET A economy	DET A ekonomin	0-0 1-1 2-2

Word alignment with parallel phrases cont.

- in this N , I V i det N V jag 0-0 1-1 2-2 4-4 5-3



- Heuristics for matching phrases to new sentences
  - Prefer longer phrases over shorter
    - more context -> better alignments
  - Prefer phrases with words over phrases with POS
    - DET european economy DET europeiska ekonomin
      DET A N DET A N
  - Skip phrases that match more than once in the sentence

Manual word alignments

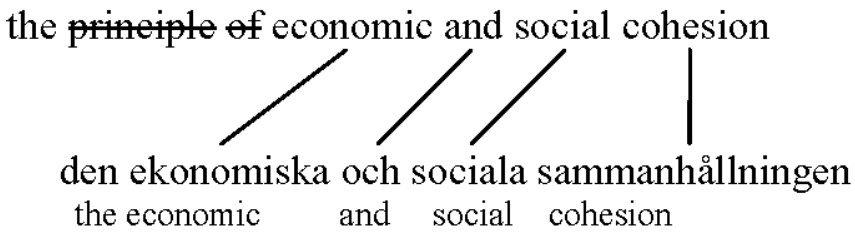
- English-Swedish Europarl corpus (Koehn, 2003)

English	Swedish
But we must support our tourism!	Men vi måste stödja vår turism!
These are events and situations that can not be tolerated.	Detta är händelser och situationer som vi inte kan acceptera.
Well in simple economic terms, Europe's culture adds to genuine prosperity.	Jo, i enkla ekonomiska termer främjar europeisk kultur verkligt välstånd.

- Training data set (1000 sentence pairs)
  - Extract parallel phrases
  - One annotator
- Reference set (200 sentence pairs)
  - Evaluation
  - Two annotators
  - Confidence labels for links

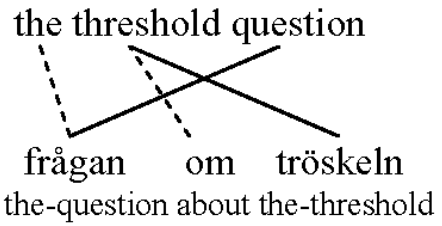
The English-Swedish reference word alignment

- Guidelines for English-Swedish reference aligment similar to Spanish-English guidelines (Lambert et al, 2005)
- Link types
  - Sure links
  - Possible links
  - Null links



- Two annotators
  - Agreement 85,8%
  - Alignments combined into the final reference alignment
  - Different link types -> Possible link

- The final reference alignment
  - 73% sure links
  - 27% possible links



Experiment 1:
Generalized phrases

- Europarl English-Swedish training data
  - 1000 sentence pairs wth manual alignments
  - parallel phrases 2-7 words were extracted from 900 sentence pairs
  - word alignment evaluated on 100 sentence pairs

Method	*Precision*	*Recall*	*F-score*
phrases	92.25	16.85	28.50
generalized phrases	48.81	55.20	51.81

- Some generalized phrases propose incorrect word links
  - Ex. PREP N -> PREP N
    N -> N N
    of DET -> DET

Experiment 2: Constraining generalization

- Which generalized phrases produce correct word links?
- Thresholds for phrase length and generalization
  - P Phrase length
  - L Minimum phrase length for generalization
  - G Max number of words generalized with POS
- P=1, L=3, G=1
  - Phrases of length 1 and up
  - Phrases have to be at least 3 words long to be generalized with POS
  - At most one word is generalized

Thresholds (P-L-G)	*Precision*	*Recall*	*F-score*
1-3-1	86.8	42.8	57.3
1-4-7	72.0	49.8	58.9
2-5-2	95.4	17.5	29.6
2-2-7	48.8	55.2	51.8

Experiment 3:
Evaluating phrases on training data

- Apply phrases to the training data and collect
  - precision for each phrase
  - number of matches
- Perform word alignment with a subset of phrases
  - E.g., phrases with a training data precision above 95%

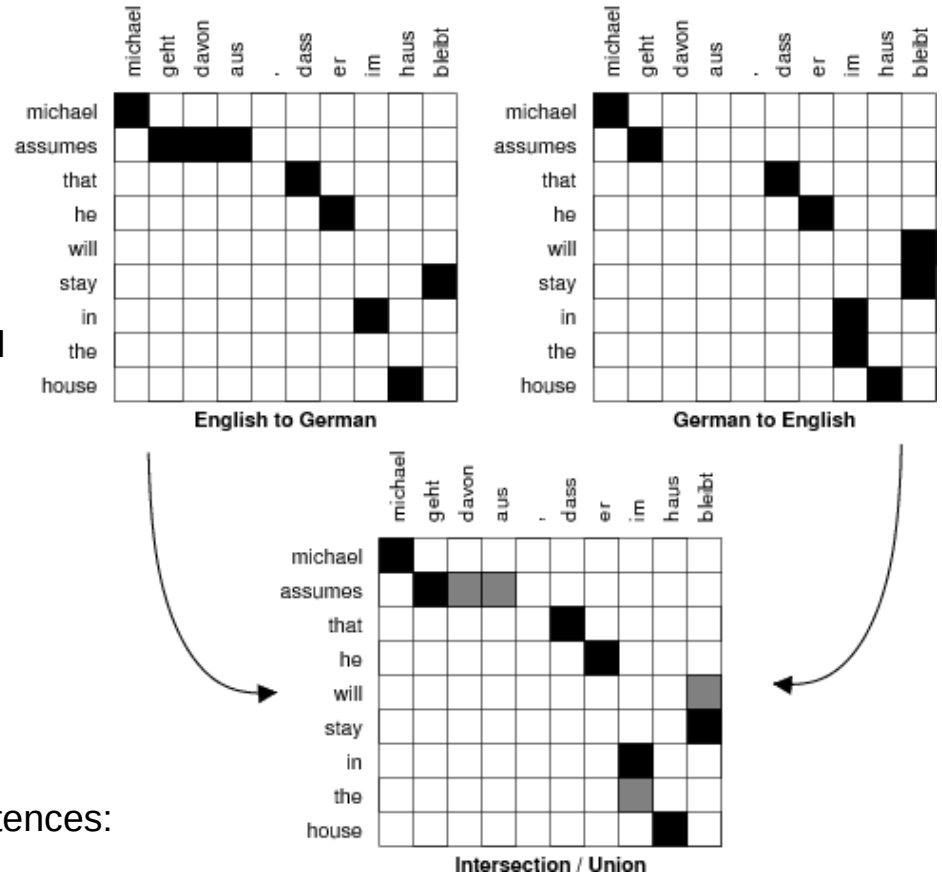
Setting	*Training precision threshold*	*Frequency threshold*	*Precision*	*Recall*
1-3-1	0.95	5	99.6	12.2
1-3-1	0.95	3	99.4	15.1
1-3-1	0.95	2	99.1	18.4
1-3-1	0.90	3	98.5	17.9
1-3-1	0.90	2	98.3	20.8
1-3-1	0.85	2	98.1	23.2
1-3-1	0.80	1	95.8	30.6

Creating final phrase-based alignments

- We have sets of reliable phrases
  - Generalization thresholds
  - Training data precision
  - Precision on the devtest set
- Alignment of test data
  - Combination of reliable phrases
  - Add linksets in sequence according to their precision on the devtest set

Metod	*Precision*	*Recall*	*F-mått*
Combination1	95.85	28.27	43.66
Combination2	90.61	41.73	57.14

Giza++



- Giza++ (Och and Ney, 2003)
  - State-of-the-art system for statistical word alignment
  - Produces one-to-many alignments
- Method for symmetrization
  - **Intersection** – high precision
  - **Union** – high recall
  - **Grow-diag** – best AER
- Results for Giza++ trained on 700K sentences:

Method	*Precision*	*Recall*	*F-score*	*AER*
intersect	94.77	57.05	71.22	16.31
union	70.09	77.17	73.46	21.77
grow-diag	82.35	73.30	77.56	**15.46**

Results for Giza++ and phrase-based word alignment

Method	*Precision*	*Recall*	*AER*
Combination 1	95.8	28.3	45.7
Combination 2	90.6	41.7	31.5
Giza++ grow-diag 700K	82.3	73.3	15.5
Giza++ grow-diag 5K	71.4	62.0	26.6
Giza++ intersect 700K	94.8	57.1	16.3
Giza++ intersect 5K	93.3	42.8	28.7

- Evaluation on test data (200 sentences)
  - Precision is comparable
  - Recall is lower than Giza++

A combination of Giza++ and phrase-based alignments

- Combine phrase based word alignment with statistical alignment
  - Add links from Giza++ for unaligned words
  - Results in improved AER

Method	*Precision*	*Recall*	*AER*
Giza++ 700k intersect	94.77	57.05	16.31
+ Combination1	93.41	**60.10**	**14.81**

Giza++ 700K grow-diag	82.35	73.30	15.46
+ Combination1	**84.60**	71.64	**14.22**

A combination of Giza++ and phrase-based alignments

- Larger improvements in AER for Giza++ trained on a small data set (5K)

Method	*Precision*	*Recall*	*AER*
Giza++ 5K intersect	93.3	42.8	28.7
+ Combination1	92.2	**48.2**	**24.4**

Giza++ 5K grow-diag	71.4	62.0	26.6
+ Combination1	**75.1**	62.2	**23.9**

Conclusions

- Word alignment with parallel phrases creates alignments with high precision (90-95%)
- Generalizing phrases with part-of-speech increased recall
- We have shown two methods to select reliable subsets of phrases that produce high-precision word alignments
- A combination of phrase-based word alignment and Giza++ produced a word alignment with lower AER than the best Giza++ alignment

Future work

- Other factors to find good phrase matches
  - relative position of matches in a sentence pair
- New language pairs
- Different merging strategy with Giza++. Perhaps during symmetrization.
- Better machine translation quality?

Thanks for listening!

Questions?