Joint part-of-speech and dependency projection from multiple sources

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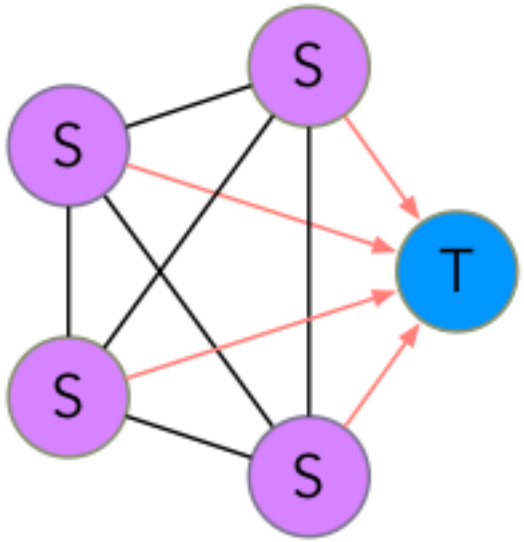
Annotation projection

Parallel corpora



transfer annotation from source to target

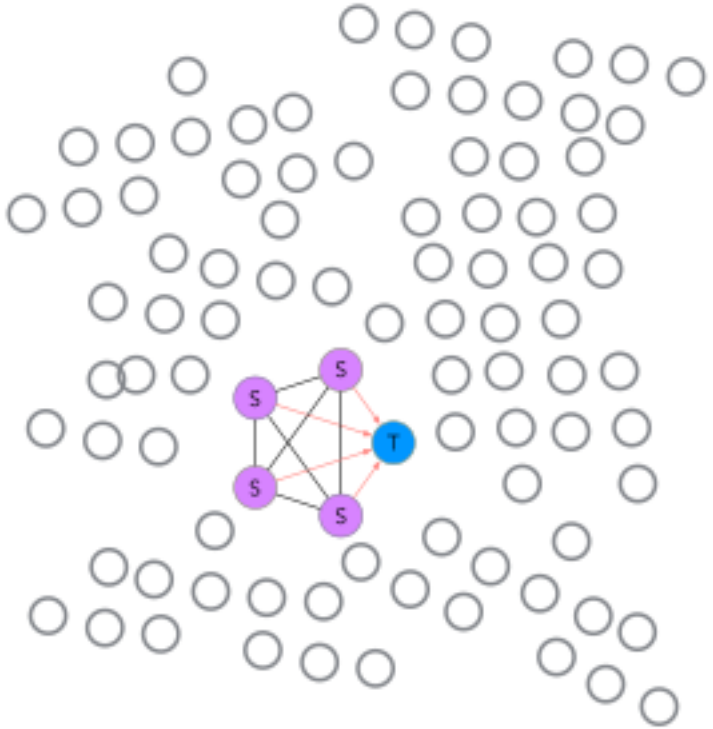
may have multiple sources

train parser

parse test set

evaluate by leave-one-out

The many languages of the world



cross-lingual parsing suffers a little from EUROPARLalism

This work extends Agić et al. (2016):

train models for hundreds of languages

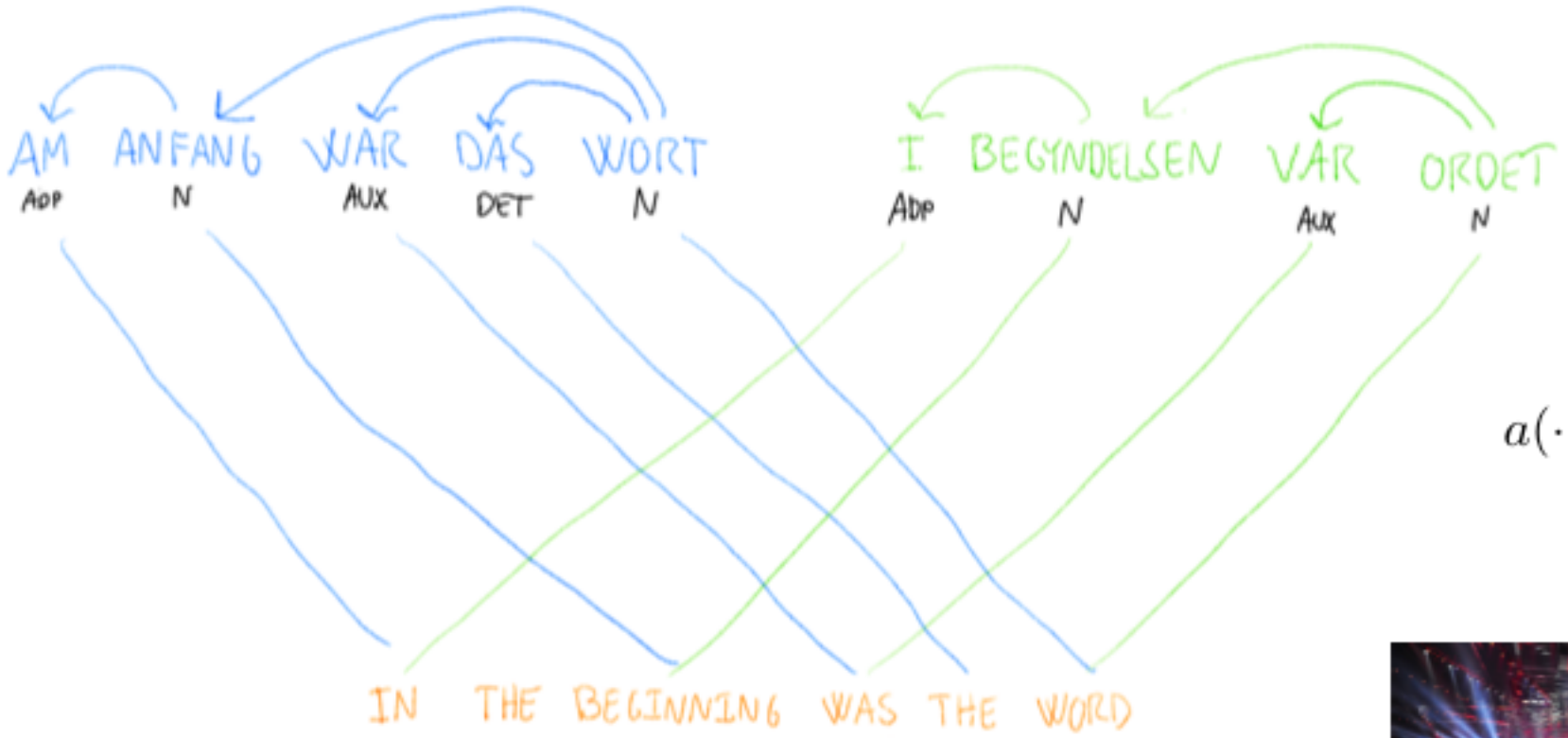
evaluate on 26 languages

Our corpora

Agic et al.

Agic et al.

score_{DE} score_{DA}

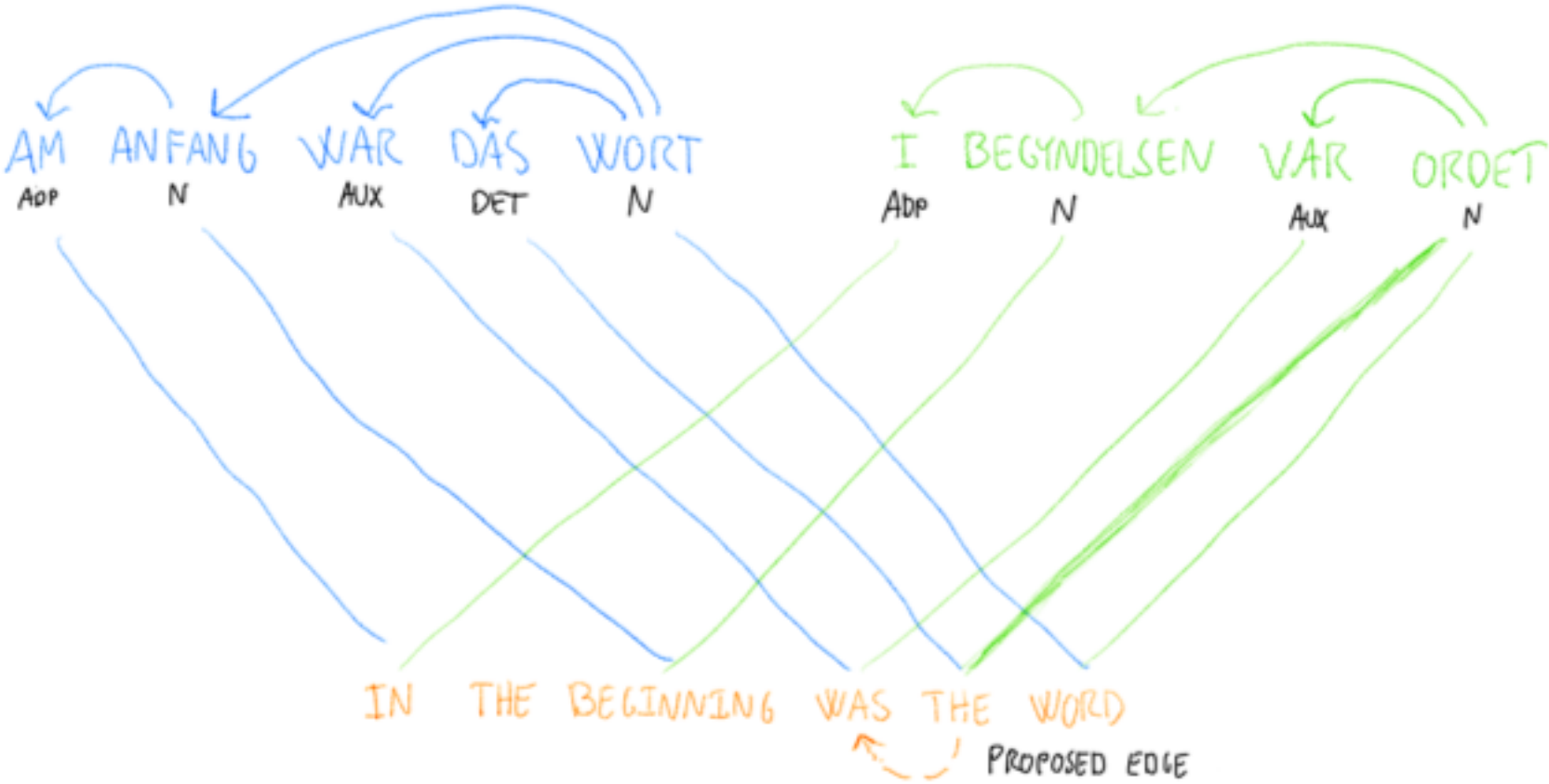


$a(\cdot, \cdot)$

$$\arg\max_{y} \sum_{(i,j)\in y} \text{score}_{\text{T}}(i, j) \quad \text{s.t. } y \text{ is a tree}$$

$$\text{score}_{\text{T}}(\text{word}, \text{was}) = \text{score}_{\text{DA}}(\text{ordet}, \text{var})$$

Agic et al. gone bad

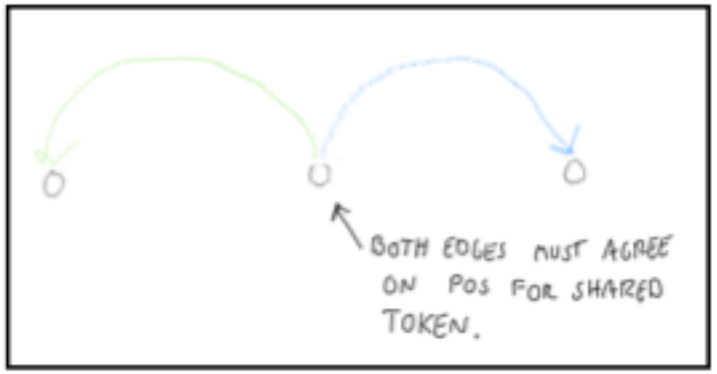


$$\text{score}_{\text{T}}(\text{the}, \text{was}) = \text{score}_{\text{DA}}(\text{ordet}, \text{var})\, a(\text{var}, \text{was})\, a(\text{ordet}, \text{word})$$

Yes, but only if "was" is AUX and "the" is N

Projecting layers of annotation

Projecting layers of annotation



the edge (i, j)

$$\arg\max_{y} \sum_{(i,k,j,l)\in y} \text{score}_{\text{T}}(i,k,j,l)$$ s.t. *y* is a tree

tags for i and j

more difficult

ILP model

Edges	$e_{i,k,j,l}$	$\in \{0,1\}$
Vertices	$v_{i,k}$	$\in \{0,1\}$

Flow $\phi_{i,k,j,l} \in \mathbb{R}^+$

Maximize $\sum_{i,k,j,l} e_{i,k,j,l}\, w_{i,k,j,l}$

One parent per token

$$\sum_{i,k,l} e_{i,k,j,l} = 1 \qquad \forall j \neq 0$$

The root token (index 0) sends n flow

$$\sum_{j,l} \phi_{0,0,j,l} = n$$

Each token consumes one unit of flow

$$\sum_{i,k,l} \phi_{i,k,x,l} - \sum_{k,j,l} \phi_{x,k,j,l} = 1 \qquad \forall x \neq 0$$

One POS per token

$$\sum_{k} v_{i,k} = 1 \qquad \forall i \neq 0$$

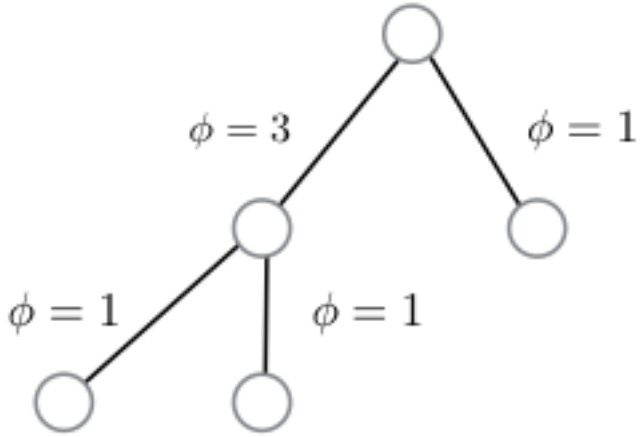
Active edges choose token POS

$$v_{i,k} \geq e_{i,k,j,l} \qquad \forall i \neq 0, j, k, l$$

$$v_{i,l} \geq e_{i,k,j,l} \qquad \forall i, j, k, l$$

Above, i, j, and x are token indices, while k and l refer to POS. Quantification over these symbols in the equations are always with respect to a given target graph.

Root produces *n* flow



Each node consumes one flow

(Martins, 2012)

Results

	Approach		
Predicted POS	ILP	DCA	DELEX
EBC	**51.62** (18)	48.39 (8)	42.44 (1)
WTC	**53.58** (20)	48.40 (0)	47.35 (3)
Gold POS			
EBC	**65.43** (25)	59.94 (2)	64.13 (–)
WTC	**66.51** (23)	55.73 (0)	66.68 (–)

POS tagging	
EBC	WTC
69.40	73.05

Conclusion

We extended Agić et al. (2016) to project multiple layers of annotation jointly.

Approach stays simple and heuristics-free.

These initial experiments show promising results.

Future work

Project higher/lower layers of annotation, or larger tree parts.

Penalise inconsistent structures instead of disallowing.

Questions?