Can Cognate Prediction Be Modelled as a Low-Resource Machine Translation Task?

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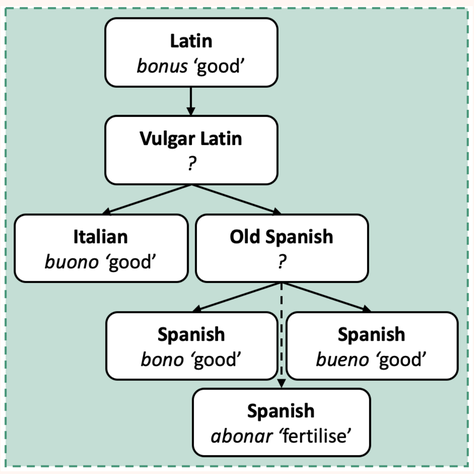
What are cognates?

Cognates are evolutions, in related languages, of the same word from their common ancestor. (+ ancestor)



Latin *bonus* 'good' gave Italian *buono* 'id.', Spanish *bueno* 'id.' and Spanish *bono* 'id.', and they are all cognates.
Spanish *abonar* 'to fertilise', obtained by derivation, is related but not a cognate.

Goals

Cognate prediction produces likely cognates in related languages. Can be modelled as learning seq2seq correspondences from very little data.

→ Can cognate prediction be modelled as a low-resource machine translation task?

We study:

- their theoretical differences
- the efficiency of MT architectures for cognate prediction
- the transferability of data augmentation techniques (from low resource MT)

Theoretical differences

- Representation units
- Reordering, alignment
- Sample length
- Modelled relations
- Ambiguity management
- Impact of extra data for data augmentation

Data

Bilingual	LA–IT	LA–ES	ES–IT
#words	5,109	4,271	1,804
#phones	77,771	63,131	24,576
#Unique phones	34	39	38
Avg. word length	7.62	7.40	6.81
Monolingual	**ES**	**IT**	**LA**
#words	78,412	99,949	18,639
#phones	626,175	815,562	142,955
#Unique phones	38	40	29
Word length	7.98	8.24	7.67

Table 1:Dataset statistics for our lexicons.

Methods

Baseline (S):

- Neural MT:
  - Recurrent neural networks (orange - 1)
  - Transformers (blue - 2)
- Statistical MT (green - 3)

Data augmentation:

- Pre-training (P)
- Backtranslation (B)
- Multilingual neural translation (M)

Bilingual results

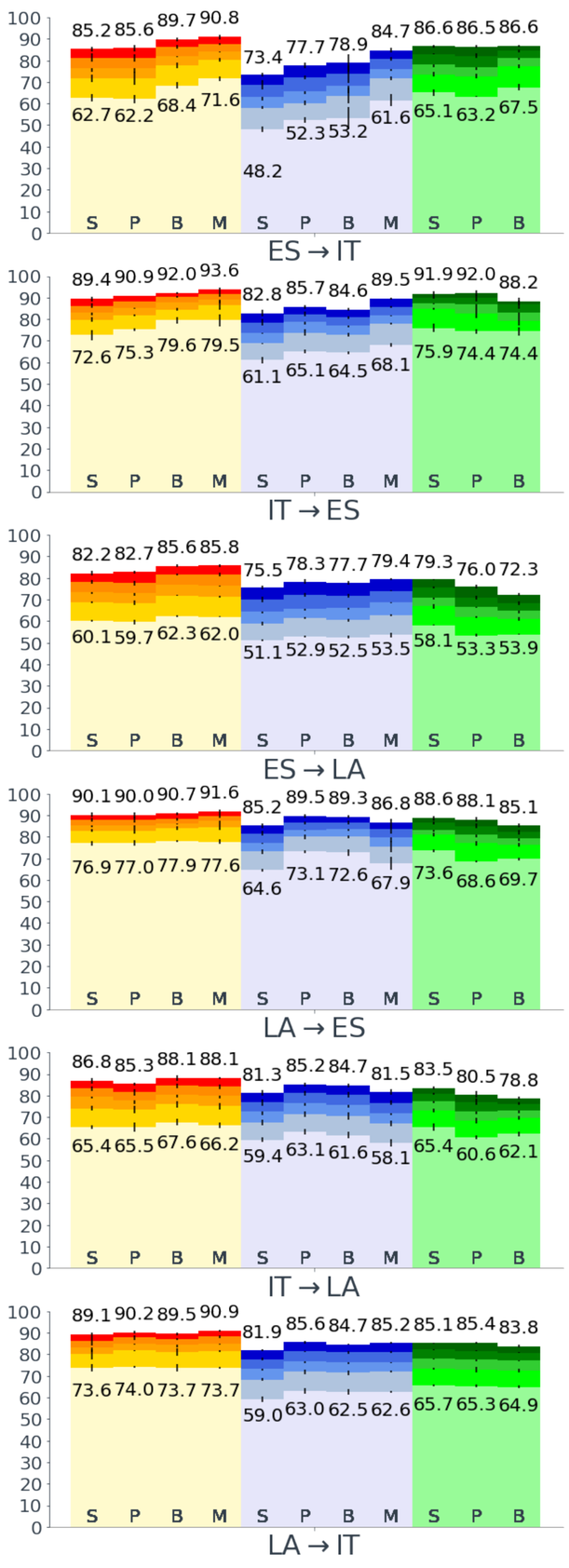


Figure 1:BLEU when comparing all methods

Multilingual results

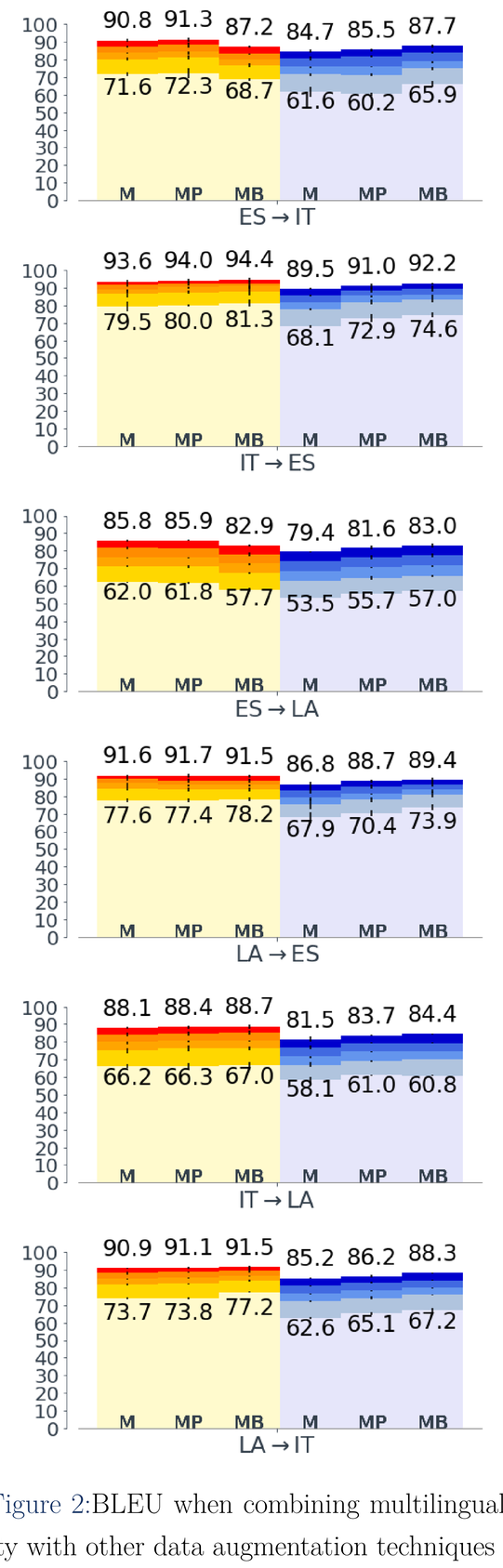


Figure 2:BLEU when combining multilinguality with other data augmentation techniques

Observations

- SMT > NMT for smallest datasets' baseline, RNN > otherwise
- Best data augmentation for RNNs: multilinguality
- Combining data augmentation methods is not very conclusive

Language choice for multilingual setups

Baseline	ES→IT	IT→ES
1000 pairs	53.9 ± 3.4	66.6 ± 4.2
Added data	**ES→IT**	**IT→ES**
Same language pair	62.5 ± 2.5	71.8 ± 1.7
Latin	57.1 ± 1.8	67.4 ± 3.3
French	58.5 ± 2.0	67.0 ± 2.8
Portuguese	58.8 ± 1.1	66.9 ± 2.9

Table 2:BLEU for different multilingual settings.

Best is to add data from current languages. If unavailable, add data from a parent language to source and target. If unavailable, add data from a language closest to the source.

Error analysis

BLEU prediction error repartition (for resp. SMT/RNN/Transformer):

- 84.6/81.4/79.5% : ambiguous sound correspondence
- 10.3/13.4/11.6% : rare sound correspondences
- 0.9/0.9/0.9% : data error
- 4.3/4.3/8.0% : model error

Conclusion

For our studied languages and methods: **Yes, as long as you take into account its specificities regarding ambiguity and n-best prediction.**

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