Improving MT Quality Prediction with Syntactic Tree Kernels

Christian Hardmeier

Uppsala universitet

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Confidence estimation for MT

- MT output is not perfect.
- When it is too bad, post-editors just waste time discarding it and have to translate from scratch anyway.
- Productivity could be increased by discarding sentences automatically if they are unlikely to be good translations.

Confidence estimation for MT

- *Confidence estimation* (or *quality estimation*) aims at predicting the quality of MT output based on input, output, models etc.
- We present results on sentence-level MT confidence estimation with Support Vector Machine classification.
- Using *tree kernels* drastically reduces the effort required to create a confidence estimation system while delivering quite good results.

Subtitle dataset

- English-Swedish datasets
- about 4,000 subtitles from different TV series
- post-edited and annotated by professional translators
- manual quality judgments on a scale from 1 to 4

Quality annotation scheme

1. MT output unusable.
   Subtitle needs to be retranslated from scratch.
2. Post-editing quicker than retranslation.
   "I needed to think about whether or not
   the MT output was usable."
3. Only quick post-editing required.
   "I could see almost immediately what I had to change."
4. MT output fit for purpose, no changes required.

1 and 2: negative class
3 and 4: positive class

Europarl datasets

- Europarl test sets annotated for translation quality
- Published by Lucia Specia et al. (LREC 2010)
- Annotated on a 1–4 scale similar to ours
- 4,000 sentences translated by 4 different MT systems
- Results for confidence estimation with this data set presented by Specia et al. in *Machine Translation* 24 (2010) and two conference papers (EAMT 2009, MT Summit 2009)

Explicit vs. implicit features

Explicit features
: designed in a manual feature engineering process,
extracted with special-purpose tools
labour-intensive but specific

Implicit features
: automatically extracted by a general-purpose method
e. g. *tree kernels*

Explicit features

For all systems:

- number of words, length ratio
- type-token ratio
- number of tokens matching particular patterns such as punctuation, short and long words etc.
- source and target language model scores
- OOV ratio
- word frequencies in training corpus

Only for subtitle system:

- some more specific token counts
- short output indicator
- word alignment types in phrases

Tree kernels

- In SVM learning, features can be represented implicitly by using kernel functions.
- Kernel functions can be defined over structures such as parse trees.
- Tree kernels measure similarities between trees by counting common substructures.

Parse trees

- Constituency parses (Stanford parser):
  - English
- Dependency parses (MaltParser):
  - English
  - Swedish (subtitle test set)
  - Spanish (Europarl test sets)
- Experiments used
  - either *constituency parses* for the MT *input only*
  - or *dependency parses* for both MT *input and output*

Subset Tree Kernel

- The Subset Tree Kernel counts substructure that correspond to *complete productions* in a constituency tree.
- If a fragment contains one child of a node,
  it must contain them all.
- used for *constituency trees*

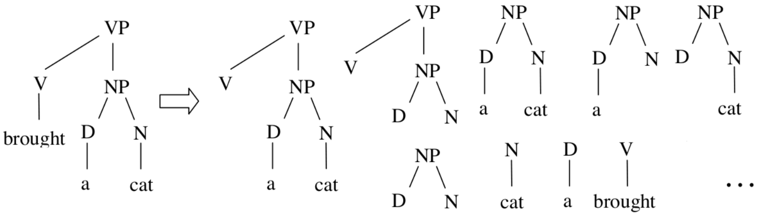
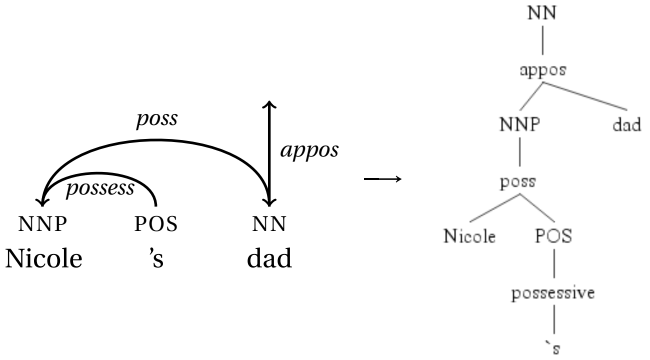


Illustration by A. Moschitti, ECML 2006

Tree kernels for dependency trees

Handle POS tags and edge labels by putting them as nodes into the tree.



Experiments

- binary SVM classifiers
- 3rd degree polynomial kernel for explicit features
- Baseline: majority class classifier, accepts everything

Results: Subtitle system

	P	R	F
majority class	50.2	100.0	66.8
explicit features	69.5	58.3	63.3
constituency (S)	64.8	67.0	65.9
dependency (S+T)	64.9	65.7	65.3
all + constituency (S)	67.5	66.3	66.8
all + dependency (S+T)	68.7	68.8	**68.8**

Results: Europarl system 2

	P	R	F
majority class	54.6	100.0	70.6
explicit features	67.1	82.7	74.0
constituency (S)	69.0	69.9	69.4
dependency (S+T)	69.5	68.2	68.8
all + constituency (S)	74.4	73.3	73.9
all + dependency (S+T)	74.1	76.2	**75.1**

Results: Europarl systems 1–3

	F scores		
	1	2	3
majority class	83.0	70.6	68.3
explicit features	83.5	74.0	70.4
constituency (S)		69.4	66.9
dependency (S+T)		68.8	68.1
all + constituency (S)	**85.1**	73.9	73.4
all + dependency (S+T)	84.8	**75.1**	**73.9**

Results: Accuracy

	Europarl 1	Europarl 2	Europarl 3	sub-titles
majority class	71.0	54.6	51.8	50.2
Specia et al., MT 24 (2010)	76.8	66.0	69.8	
explicit features	72.6	68.7	70.3	66.4
constituency tree kernel (S)		66.4	66.9	64.7
dependency tree kernel (S+T)		66.4	67.8	65.0
explicit + constituency (S)	**77.8**	71.1	72.5	66.7
explicit + dependency (S+T)	76.7	**72.4**	**72.8**	**68.3**

Conclusions

- Tree kernels alone achieve only slightly lower performance for most test sets at reduced development effort.
- Combining tree kernels with explicit features led to a small improvement for all test sets.
- Use tree kernels when you start building a confidence estimation system, then add more features to improve performance…
- …or improve tree kernel approach to use more information.