Comparative Evaluation of Research vs. Online MT Systems

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Outline

- Introduction
- MT evaluation metrics
- Data sets
- MT systems
- Results
- Conclusion
- Future work

Introduction

- Experiments at the end of Y1 of 3-year EU-funded CoSyne project
- Three language pairs evaluated on data from the news domain
  - DE → EN
  - IT → EN
  - NL → EN
- Compared CoSyne MT system against 4 free web-based systems
- Wide range of state-of-the-art automatic evaluation metrics used

Introduction: CoSyne

- FP7 STREP project (call 4, objective 2.2)
- 3 years: Mar 2010 – Feb 2013
- Objective: to automate the dynamic multilingual content synchronization process of wikis across languages
- Languages
  - 4 core languages: English, German, Italian and Dutch
  - 2 less resourced languages: Turkish and Bulgarian (year 3)
- The CoSyne system will be integrated via web services with the open-source MediaWiki package
- The overall CoSyne system includes
  - Document structure modeling
  - Document structure induction
  - Textual entailment
  - Machine translation

Introduction: CoSyne

- Consortium
  - 7 partners from 4 EU countries: Germany, Ireland, Italy and the Netherlands
- 3 academic partners
  - University of Amsterdam (UvA)
  - Fondazione Bruno Kessler (FBK)
  - Dublin City University (DCU)

- 1 research organization
  - Heidelberg Institute for Theoretical Studies (HITS)

- 3 end users
  - Deutsche Welle (DW) DEUTSCHE WELLE - *Poster in EU projects section!*
  - Netherlands Institute for Sound and Vision (NISV) BEELD EN GELUID
  - Vereniging Wikimedia Nederland (VWN)

MT evaluation metrics

- BLEU (Papineni et al., 2002)
- NIST (Doddington, 2002)

} *n-gram based*

- GTM (Turian et al., 2003) *based on standard measures in NLP*
- METEOR (Banerjee and Lavie, 2005) *additional linguistic information (stemming, synonyms)*
  - METEOR-NEXT
- TER (Snover et al., 2006) error rates
  - TERp
- DCU-LFG (Owczarzak et al., 2007; He et al., 2010) *syntactic dependencies*

Data sets

- From the news domain
  - to match usage scenarios envisaged by end users
- Language pairs
  - DE — EN
  - IT — EN
  - NL — EN
- 2,000 sentence pairs per language combination
  - 1k development + 1k evaluation

Data for DE—EN (DW)

- Documents provided by DW from two online journals
  - Europa Aktuell 2001 to 2010: 2,201 documents
  - Global 3,000: 80 documents
- XML format + alignment scores (sentence, doc, etc.)
  - DE: 25,797 words (average sentence length: 12.9 words)
  - EN: 26,938 words (average sentence length: 13.47 words)
- Tools used to align text
  - TreeTagger
  - Hunalign along with a bilingual dictionary derived from Apertium's DE—EN dictionary

Data for IT—EN (DCU)

- Manual download and alignment of parallel documents
- AsiaNews website (up to July 2010): 87 document pairs
  - IT: 38,607 words (average document length: 444 words)
  - EN: 38,090 words (average document length: 438 words)

Data for NL—EN (NISV)

- Three different data sets:
  - België Diplomatie: 418 HTML doc pairs
  - Video Active: 1,076 doc pairs (XML format)
  - NISV Wiki: 30 doc pairs
    - NL: 45,546 words (average sentence length: 22.8 words)
    - EN: 46,390 words (average sentence length: 23.2 words)

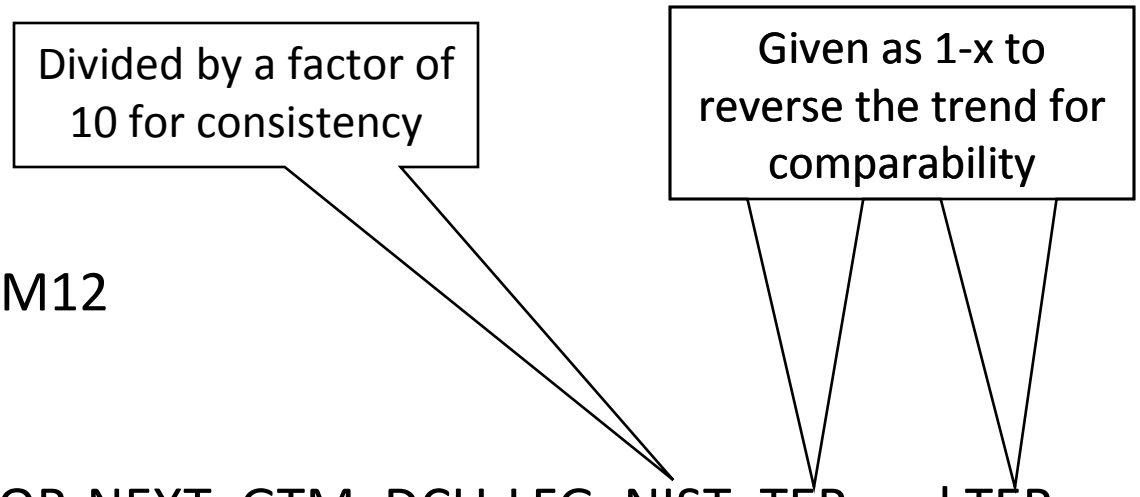
- Same tools used to align text as for DE—EN
  - Bilingual dictionary from Apertium's NL—EN dictionary

MT systems

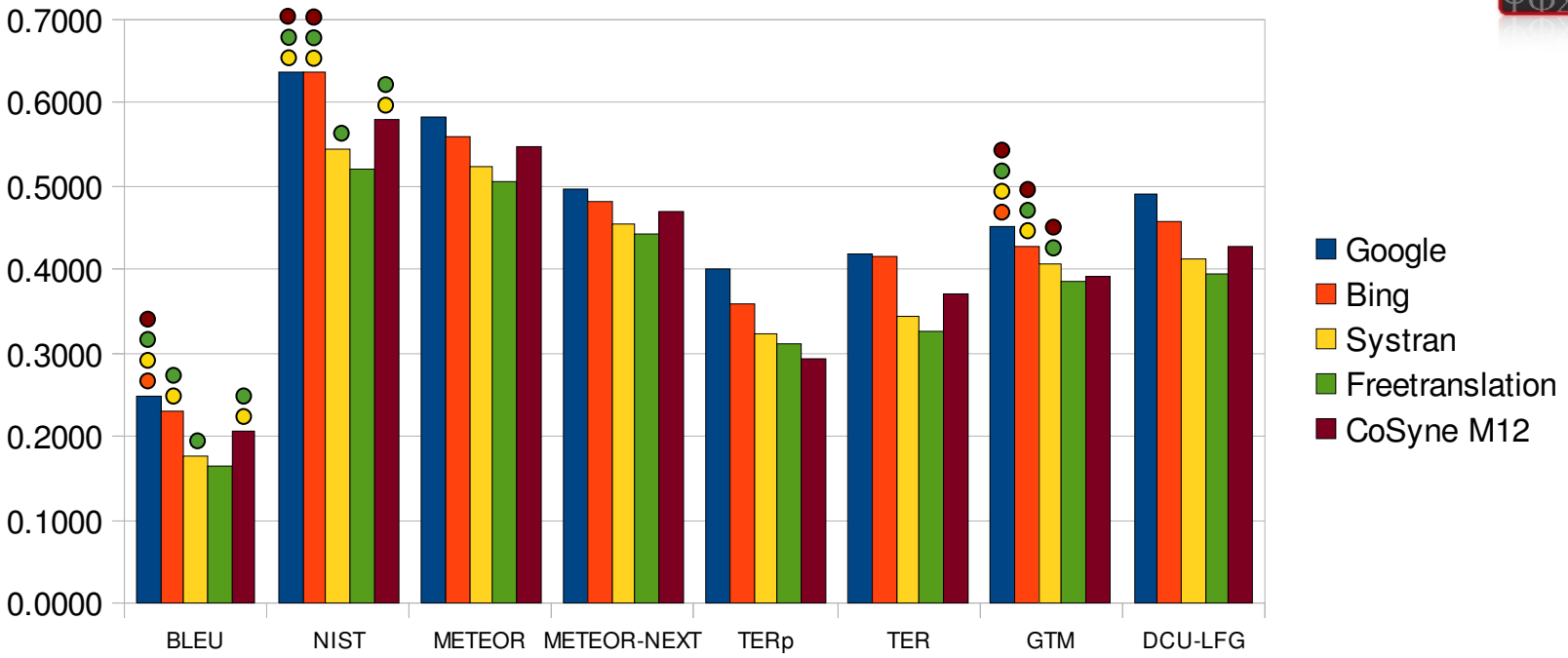
- Free online MT systems
  - Statistical systems
    - Google Translate (Google)
    - Bing Translator (Microsoft)
  - Rule-based systems
    - Systran
    - FreeTranslation (SDL)
- The research MT system
  - CoSyne MT system (Martzoukos & Monz, 2010)
    - Statistical system
    - Developed by UvA (thanks to Christof Monz and his team for making it available for these experiments)

Recap – MT evaluation results

- Language pairs
  - DE → EN
  - IT → EN
  - NL → EN
- MT systems
  - Google Translate
  - Bing Translator
  - Systran
  - FreeTranslation
  - CoSyne MT system at M12
- MT evaluation metrics
  - BLEU, METEOR, METEOR-NEXT, GTM, DCU-LFG, NIST, TER and TERp
  - Statistical significance tests provided only for BLEU, NIST and GTM



DE → EN results

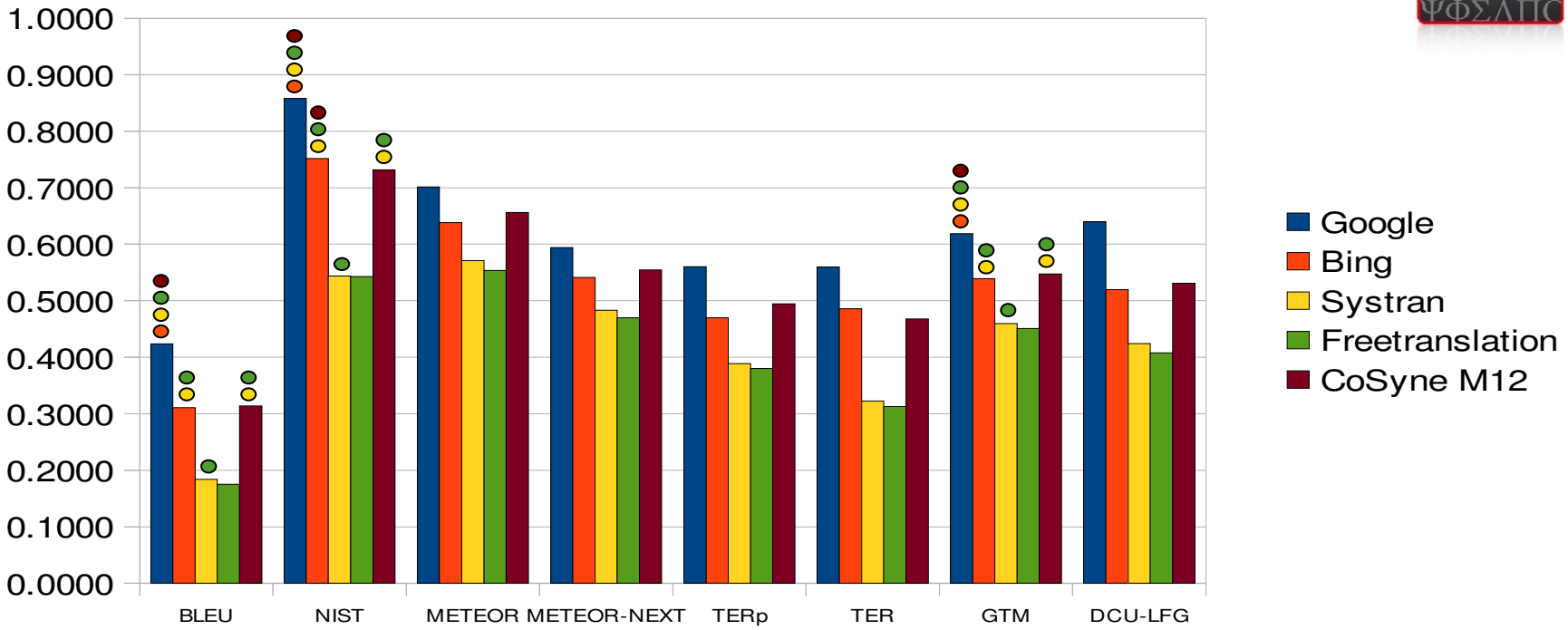


de-en	*Google*	*Bing*	*Systran*	*Freetranslation*	*CoSyne M12*
BLEU	0.2477[b,c,d,e]	0.2294[c,d]	0.1752[d]	0.1657	0.2052[c,d]
NIST	0.6358[c,d,e]	0.6362[c,d,e]	0.5447[d]	0.5212	0.5788[c,d]
METEOR	0.5830	0.5584	0.5239	0.5060	0.5470
METEOR-NEXT	0.4977	0.4807	0.4552	0.4422	0.4692
TERp	0.4000	0.3600	0.3216	0.3100	0.2941
TER	0.4172	0.4161	0.3444	0.3273	0.3700
GTM	0.4517[b,c,d,e]	0.4270[c,d,e]	0.4057[d,e]	0.3849	0.3914
DCU-LFG	0.4899	0.4570	0.4133	0.3957	0.4261

DE → EN discussion

- SMT systems perform better than RBMT systems
- For most metrics (except TERp and GTM) the performance of the CoSyne MT system is between SMT systems and RBMT systems
- Google beats Bing according to almost all metrics (NIST is a tie)
- Systran outperforms FreeTranslation across all the metrics

IT → EN results

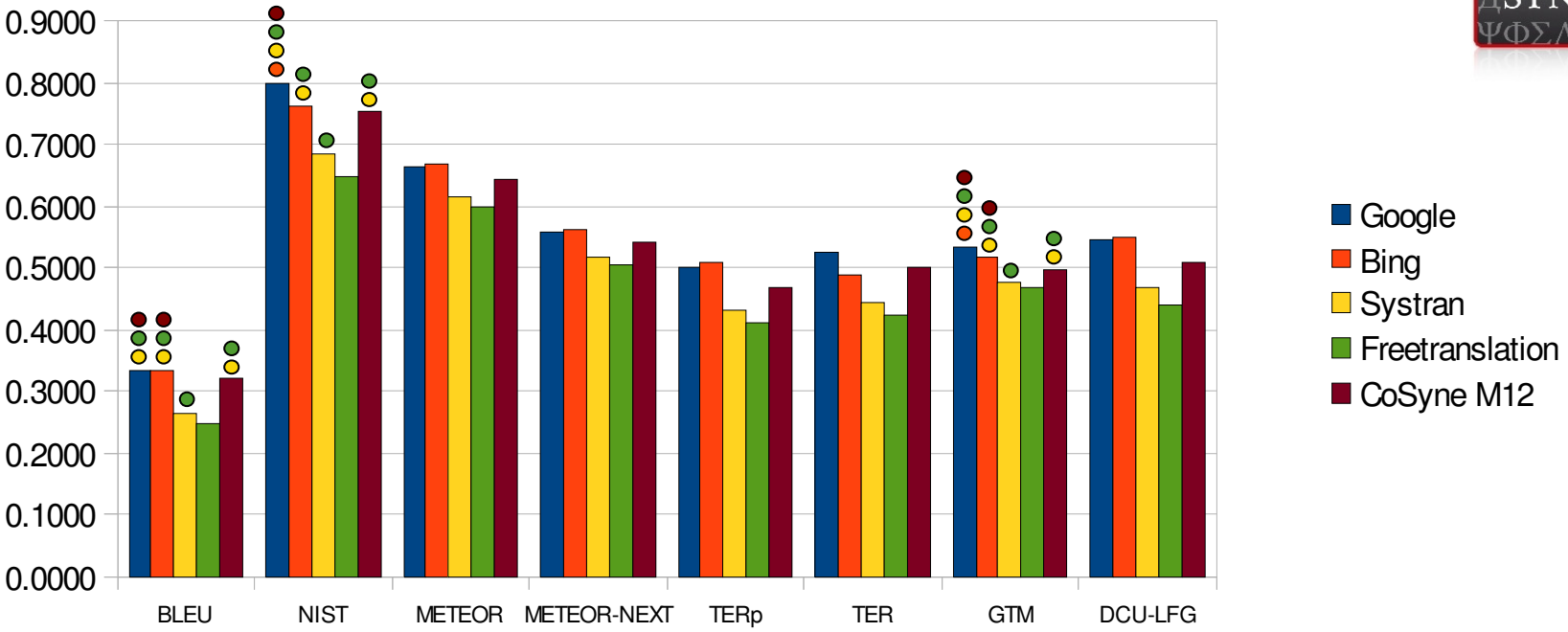


it-en	*Google*	*Bing*	*Systran*	*Freetranslation*	*CoSyne M12*
BLEU	0.4235[b,c,d,e]	0.3106[c,d]	0.1840[d]	0.1754	0.3137[c,d]
NIST	0.8579[b,c,d,e]	0.7517[c,d,e]	0.5439[d]	0.5427	0.7318[c,d]
METEOR	0.7017	0.6384	0.5709	0.5537	0.6565
METEOR-NEXT	0.5942	0.5412	0.4832	0.4700	0.5545
TERp	0.5600	0.4700	0.3890	0.3800	0.4946
TER	0.5599	0.4857	0.3225	0.3128	0.4679
GTM	0.6187[b,c,d,e]	0.5394[c,d]	0.4596[d]	0.4510	0.5475[c,d]
DCU-LFG	0.6400	0.5200	0.4244	0.4080	0.5311

IT → EN discussion

- Google is the clear top performer across all the metrics
- CoSyne MT system performs better than Bing in most metrics (except NIST and TER, but close scores)
- The two RBMT systems attain very similar scores for all evaluation metrics, showing much poorer performances than the SMT systems

NL → EN results



nl-en	*Google*	*Bing*	*Systran*	*Freetranslation*	*CoSyne M12*
BLEU	0.3330[c,d,e]	0.3347[c,d,e]	0.2643[d]	0.2456	0.3223[c,d]
NIST	0.7986[b,c,d,e]	0.7596[c,d]	0.6830[d]	0.6479	0.7532[c,d]
METEOR	0.6633	0.6695	0.6161	0.5964	0.6431
METEOR-NEXT	0.5583	0.5628	0.5180	0.5032	0.5419
TERp	0.4987	0.5066	0.4315	0.4123	0.4690
TER	0.5251	0.4892	0.4424	0.4221	0.5000
GTM	0.5339[b,c,d,e]	0.5156[c,d,e]	0.4761[d]	0.4672	0.4956[c,d]
DCU-LFG	0.5459	0.5507	0.4661	0.4411	0.5080

NL → EN discussion

- SMT systems outperform RBMT systems
- Google outperforms Bing for NIST, TER and GTM, while for the other metrics Bing receives higher scores
- CoSyne MT system performs better than the RBMT systems and is close to Google and Bing
  - CoSyne MT system performs better than Bing according to TER

Summary of results

- The three SMT systems receive (much) higher scores than the two RBMT systems for all the 8 evaluation metrics in each of the 3 language pairs
- Overall Google Translate receives the best scores consistently across most of the metrics for all 3 language pairs
- Bing Translator and the CoSyne MT system perform similarly
  - Inferior than Google, but better than Systran and FreeTranslation
- CoSyne good for IT / NL → EN, improvement needed for DE → EN
- Among the RBMT systems, Systran always performs better than FreeTranslation according to all the 8 evaluation metrics for the 3 language pairs

Conclusion

- CoSyne MT system evaluation (M12 implementation)
  - against four free online MT systems
  - for 3 language pairs (DE / IT / NL → EN)
  - across 8 automatic MT evaluation metrics
- Assessed the performance of the MT component of the CoSyne system against state-of-the-art MT systems
- Monitor progress over time
- Prioritize and focus efforts on the development and fine-tuning of language pairs requiring improvement (e.g. DE → EN)

Future work

- Diagnostic evaluation
  - Analysis of TER results (INS, DEL, SUB, SHFT) [currently underway]
  - Methodology based on linguistic checkpoints following Zhou et al. (2008) to evaluate system over any linguistic phenomenon [Feb. 2012]
- Correlations of automatic evaluation metrics with human judgments and perception of MT quality (staff at end user partners) [Aug. 2011]

Thank you for your attention!

Questions?

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