(Have we found the Holy Grail?)

Panel at MT-Summit 2003
The HKUST Leading Question Translation System
v0.1 alpha (experimental)

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The panel chair has put forth 9 questions to be addressed...

- Just fed each question to our experimental system
- Will show n-best translations for each
- Caveat: somewhat flaky
- Suggest we try to answer the questions on the fly here
Question 1

Reference Have we found the ultimate solution to MT’s long quest? If not, is the Holy Grail just around the corner?

Translation Are we just about done?
Question 2(a)

**Reference** Will progress in data-driven MT continue unabated?

**Translation** \[ \lim_{t \to \infty} \max_{m \in M_t} \text{BLEU}^'(m) = \infty \]
Question 2(b)

Reference  Is there an inherent ceiling on MT quality that will resist even the most sophisticated data-driven methods?

Translation 1  Are data-driven methods excluded from making use of linguistic or semantic features?

Translation 2  Is there an inherent ceiling on MT quality that will resist even the most sophisticated methods?
**Question 3**

**Reference** Has the data-driven paradigm been able to model information that was not present in rule-based systems? Or has it `simply’ been able to model the same kind of information more thoroughly and efficiently?

**Translation 1** In data-driven models, do we find `rules’ (categories, collocations, templates, decision algorithms)?

**Translation 2** In rule-based systems, do we find massive amounts of fine-grained information on lexical chain preferences (n-grams), collocational correlations, interacting lexical choice factors that support consistent evidence combination, etc?
Question 4

Reference  Was the metric used to rank participating systems in the NIST competition fair, or was it somehow biased in favor of data-driven systems?

Translation 1  Did MTEval’s scores rate all competing models fairly, or were they preferential in some way to corpus-based models?

Translation 2  Was the metric used to rank participating systems in the NIST competition somehow biased in favor of data-driven systems, or was it fair?
Question 5

Reference Even if the evaluation metric used at NIST was somewhat biased, can we still assume that SMT has indeed surpassed traditional rule-based systems? And if so, at what exactly?

Translation 1 We may assume anything we want (as long as we state our assumptions). But if we don’t like the NIST result, what is it that we wish to prove instead?

Translation 2 Can we conclude that the rate of improvement of SMT has surpassed the rate of improvement of traditional rule-based systems? And if so, whether at the current rate of progress this will soon no longer be an interesting question?
Question 6

**Reference**  Are there niche applications for which the new data-driven techniques are particularly well suited?

**Translation 1**  Are there applications for which the traditional techniques are *not* particularly well suited?

**Translation 2**  Is there anything else we can work on besides translators’ tools and/or intelligence gathering?
**Reference** Is there a danger that SMT’s recent success may lead the public – and worse yet, the funding agencies – to believe that the MT problem has finally been solved, and so to reduce the level of R&D grants to our field? If so, what can we do to combat this misperception?

**Translation 1** Should we launch a campaign blitz to get the public/funders to `Take the MT Challenge’ and test drive our current clunkers for themselves? If so, will they all swear off MT forever in disgust?

**Translation 2** How do we define a metric that correlates with human judgment at least as well as BLEU, but generates much lower numeric values that imply we have a long way to go?
**Question 8**

**Reference** Would the results of the NIST competition have been different if the languages involved had been English and French? If so, why?

**Translation 1** Does French’s more complex morphology hinder some of us? Does the large number of cognates and similar conceptual structure to English help some of us?

**Translation 2** Have the groups working on English/French had a long time to fine-tune their components, features, and resources?
Reference  In previous debates on this question (TMI-92) many people concluded that hybrid systems were the way of the future. What role do rule-based components play in today’s leading data-driven systems, and what are the prospects for their future contribution?

Translation  <#@%$&^#$??!/>

HKUST Human Language Technology Center  Dekai Wu, MT-Summit 2003, 2003.09.26
In the beginning...

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But then...

- SMT plants trees
  - got collocation bilexicons?

- EBMT gets serious about template abstraction
  - got transduction rules?

- Transfer models string out
  - got collocation bilexicons?
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So then...
And then...

- **SMT plants trees**
  - got collocation bilexicons?
  - got ‘real linguistic’ transduction grammar rules?

- **EBMT gets real about scoring**
  - got probabilities?
    - eg: Brown et al. 2003

- **Transfer models soften up**
  - got scores, backoff, stronger decoders?
    - eg: Lavie et al. 2003
### So then...

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Convergence

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The future of MT is...

Trees in statistical transduction models

- Beware...
  - Adding syntax to language models...?
- Still... MT is more inherently tree-ish than speech
  - Constituent order does vary between languages
  - Need freedom to generate legitimate paraphrases
  - Need efficient but (nearly) optimal decoding for both training and runtime
- But a number of fundamental questions need to be answered...
Trees in Statistical Transduction

- More generic or more specific?
- Linguistic interpretation or not?

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<td>$10^9$</td>
<td>Collocational TG (Wu 1996; Och et al. 1999, 2003)</td>
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Trees in Statistical Transduction

- Degree of coupling?
  - Completely independent source, target trees
    - How to link?
  - Transduction grammars
    - (aka bigrammars, synchronous grammars)

- Variants
  - Heads identified or not?
    - (aka dependency models) (Alshawi et al. 2001; Melamed 2003)
    - Just notation, or real mathematical distinctions?
Trees in Statistical Transduction

- Bias toward input or output language?
  - Input: parse input sentence
  - Output: Coerce input language observables into output language hiddens
    - Improves fluency of output
    - Also seems to improve adequacy!
Collocations matter

- Everything is collocations (esp in Chinese)
- Collocation segmentation greatly affects accuracy (aka segment/phrase chunking/tokenization)

How to find `correct’ segmentation?
How to evaluate?
There’s no a priori `correct’ segmentation...
Modifying the performance measure so that it rewards `fixed points’ can impact scores heavily.

nk-blind precision comparisons for n = 8 judges (Wu & Fung 1994)
“Soft Segmentation”

- **Soft segmentation**
  - Accuracy improved by *integrating* segmentation with other translation decisions
  - Avoids premature commitments
    (Wu 1996; Zens & Ney 2003)

- **Nested brackets**
  - Better coverage, generalization, explanatory power, compared to flat 1-level bracketing
  - Fast, when done right
Finding the Holy Grail

Trees in statistical transduction... but smarter.

Some fundamental questions need to be answered.

- Trees with what characteristics?
  - Generic or specific? Linguistic or not?
  - Degree of coupling?
  - Dependency and other variants? Just notation, or real distinctions?
  - Bias toward input or output language?
- Will performance measures pick up on grammaticality improvements? How?
  - No empirical verification yet
  - Interannotator agreement reward?
So have we found the Holy Grail?

- Definitely moving fast, in the right direction.

- Where did the myth that statistical models don’t have structure come from?
  - (In particular: the structure may be tree-like!)

- On evaluation – why would we want to stop making best guesses as to how well our systems are doing?

- Regardless – why would we want to discard any of the power of statistical modeling from our toolbox?