(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 $\lim_{t \to \infty} \max_{m \in M_t} \mathrm{BLEU}'(m) \overset{?}{=} \infty$

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?

Question 7

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?

Question 9

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

In the beginning…

	SMT	EBMT	Transfer
Hypothesis probabilities	1		
Collocation bilexicons		1	
Transduction rules			1

But then…

- SMT plants trees
  - got collocation bilexicons?
    - learning: Wu & Xia 1995, Smadja 1996, Och et al. 1999, Koehn et al. 2003
    - decoding: Wu 1996, Och et al. 1999, Koehn et al. 2003
- EBMT gets serious about template abstraction
  - got transduction rules?
- Transfer models string out
  - got collocation bilexicons?

So then…

	SMT	EBMT	Transfer
Hypothesis probabilities	0.6		
Collocation bilexicons	0.4	0.6	0.4
Transduction rules		0.4	0.6

And then…

- SMT plants trees
  - got collocation bilexicons?
    - learning: Wu & Xia 1995, Smadja 1996, Och et al. 1999, Koehn et al. 2003
    - decoding: Wu 1996, Och et al. 1999, Koehn et al. 2003
  - got 'real linguistic' transduction grammar rules?
    - eg: Wu & Wong 1998, Alshawi et al. 1998, Yamada & Knight 2001, Melamed 2003, Schafer & Yarowsky 2003
- 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…

	SMT	EBMT	Transfer
Hypothesis probabilities	0.5	0.2	0.2
Collocation bilexicons	0.3	0.5	0.3
Transduction rules	0.2	0.3	0.5

Convergence

	SMT	EBMT	Transfer
Hypothesis probabilities	0.33	0.33	0.33
Collocation bilexicons	0.33	0.33	0.33
Transduction rules	0.33	0.33	0.33

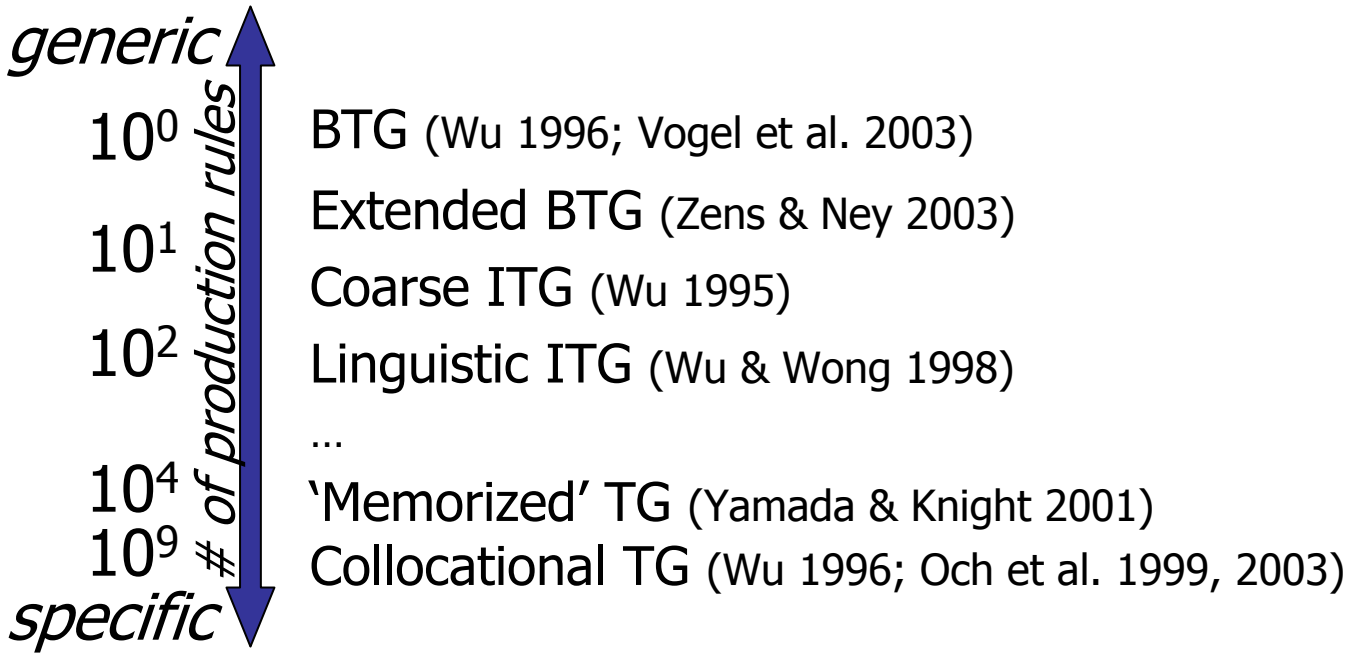
The future of MT is…

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?



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?

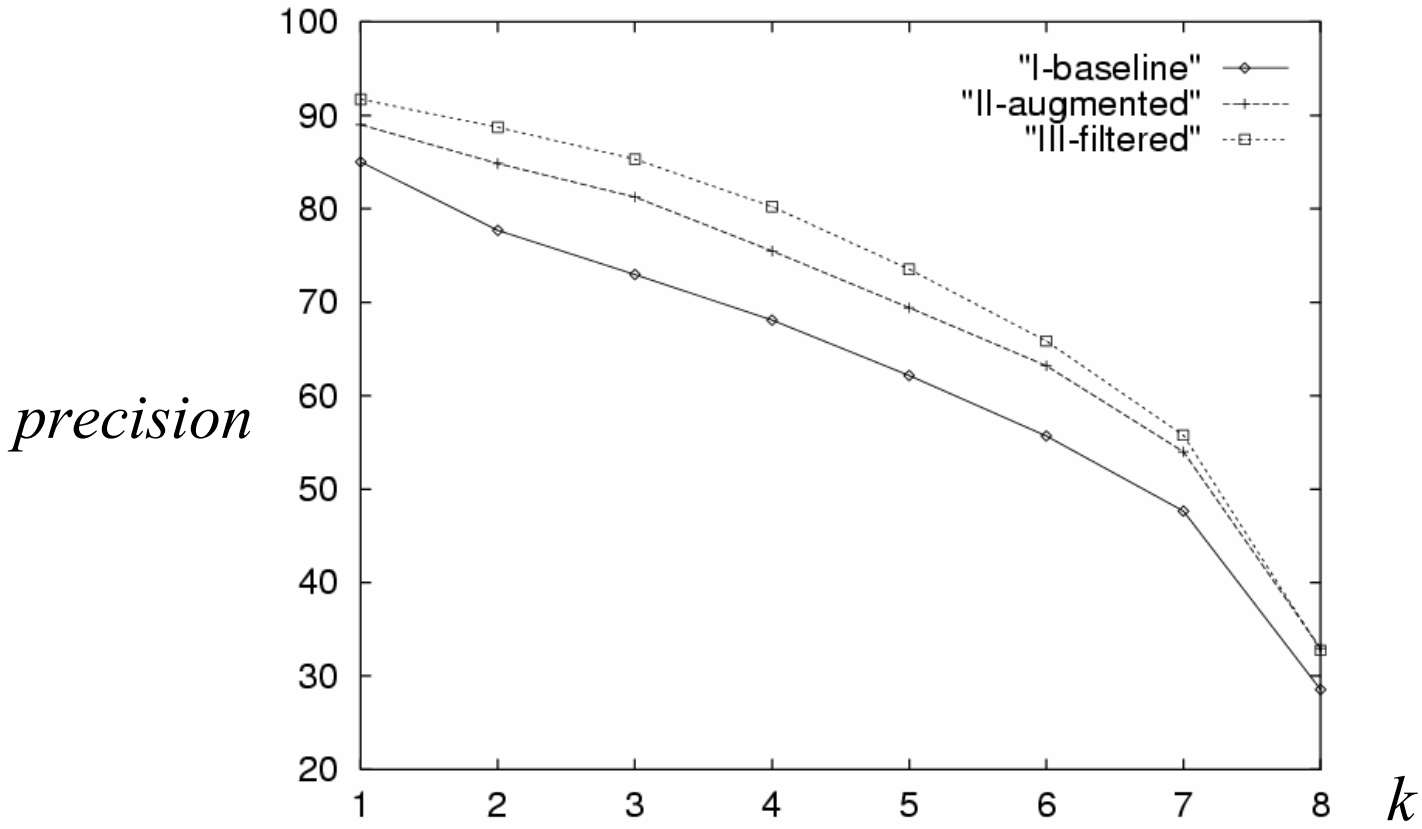
Trees in Statistical Transduction

- 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!

Trees in Statistical Transduction

- 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
    (Wu 1996, 1998; Alshawi et al. 1998; Melamed 2003)

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?