MOLTO: Goals and First Year Achievements

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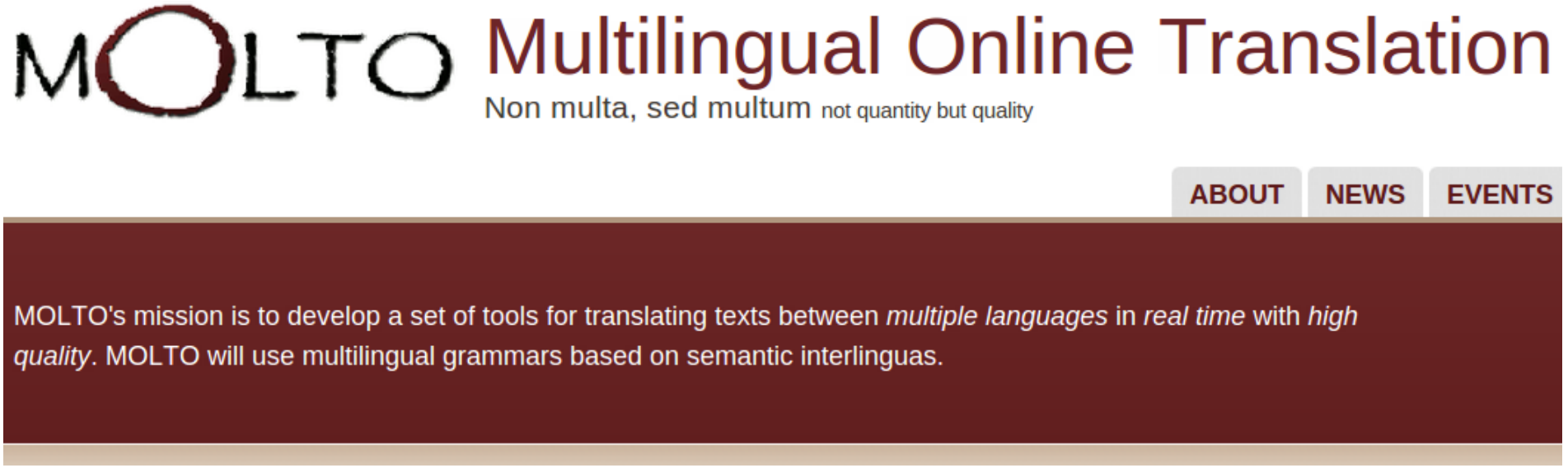
MOLTO Project Review, Luxembourg 15 March 2011



FP7-ICT-247914, Strep, `www.molto-project.eu`

U Gothenburg, U Helsinki, UPC Barcelona, Ontotext (Sofia)

March 2010 - February 2013

What's new?

Tool	**Google, Babelfish**	**MOLTO**
target	consumers	producers
input	unpredictable	predictable
coverage	unlimited	limited
quality	browsing	publishing

Producer's quality

Cannot afford translating French

- *prix 99 euros*

to Swedish

- *pris 99 kronor*

Typical SMT error due to parallel corpus containing localized texts. (N.B. 99 kronor = 11 euros)

Reliability

German to English

- *er bringt mich um -> he is killing me*

correct, but

- *er bringt meinen besten Freund um -> he brings my best friend for*

should be *he kills my best friend*. (Typical error due to **long distance dependencies**, causes **unpredictability**)

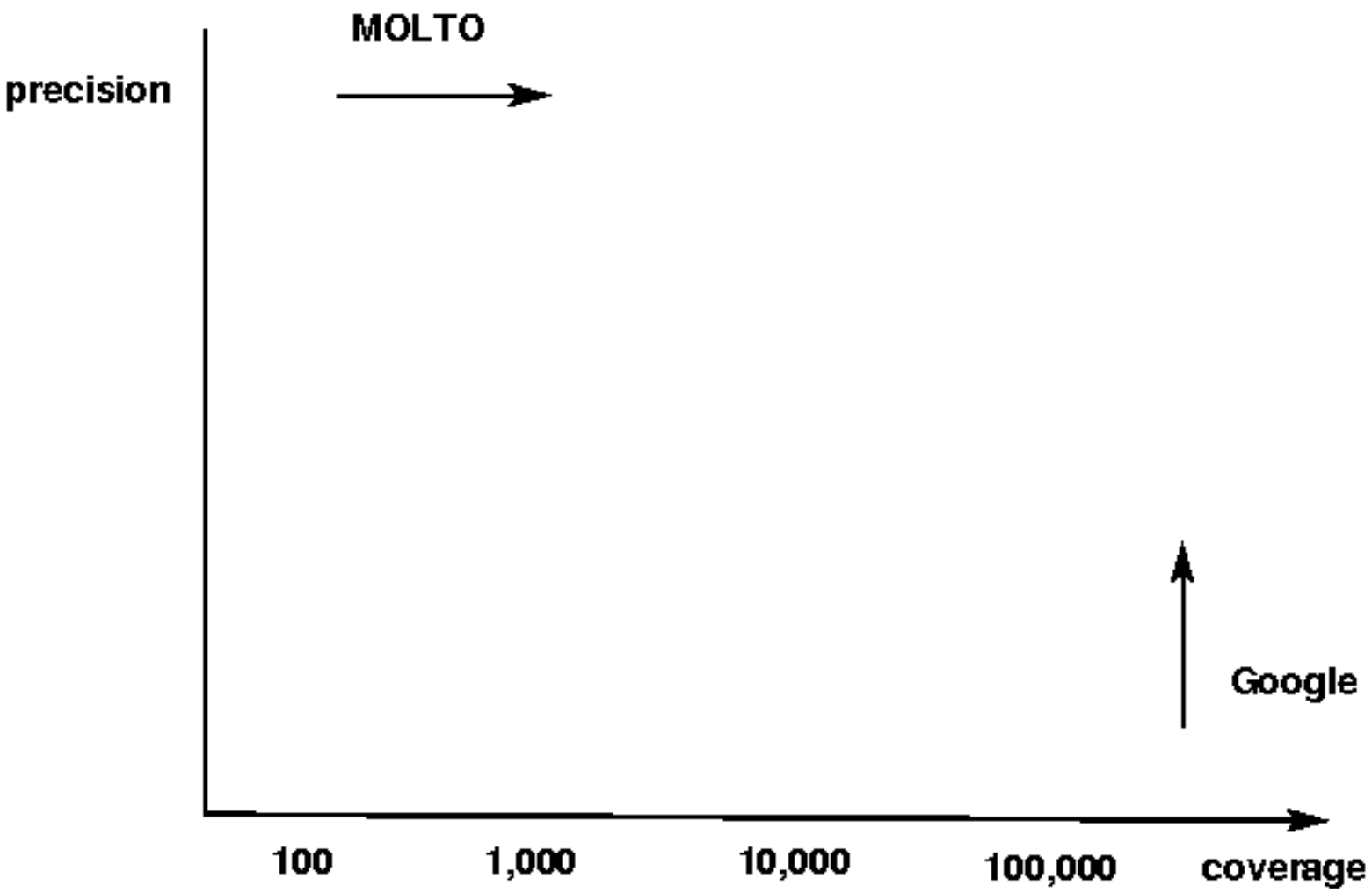
Aspects of reliability

Separation of levels (syntax, semantics, pragmatics, localization)

Predictability (generalization for similar constructs, and over time)

Programmability / debugging and fixing bugs (vs. holism)

But there's a trade-off between coverage and precision: we cannot deal with millions of concepts.


MOLTO
precision
Google
100
1,000
10,000
100,000
coverage

The translation directions

Statistical methods (e.g. Google translate) work decently *to* English

- rigid word order
- simple morphology
- originates in projects funded by U.S. defence

Grammar-based methods work equally well for different languages

- Finnish cases
- German word order

Main technologies

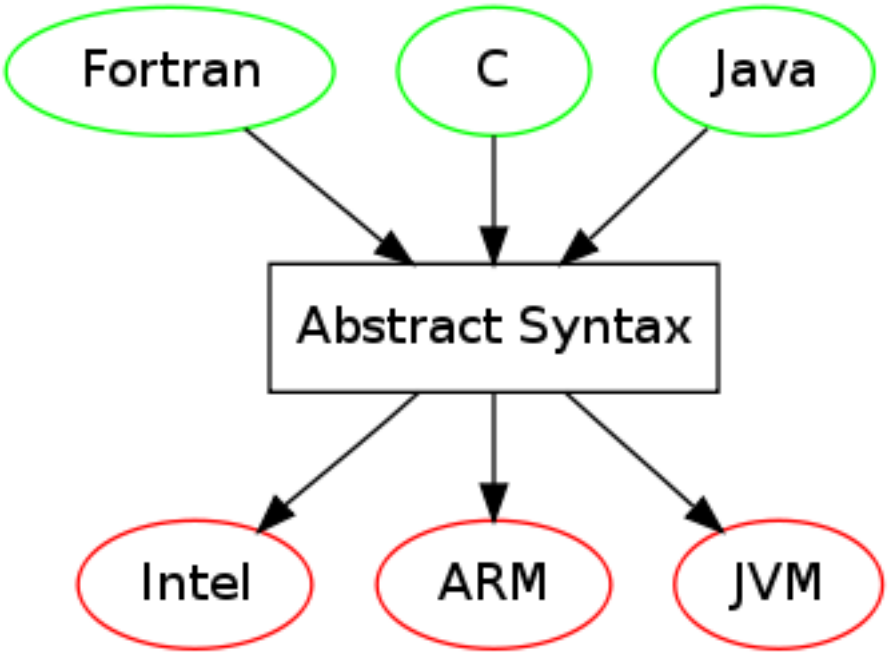
GF, grammaticalframework.org

- "compiling natural languages"
- Domain-specific interlingua + concrete syntaxes
- GF Resource Grammar Library
- Incremental parsing
- Syntax editing

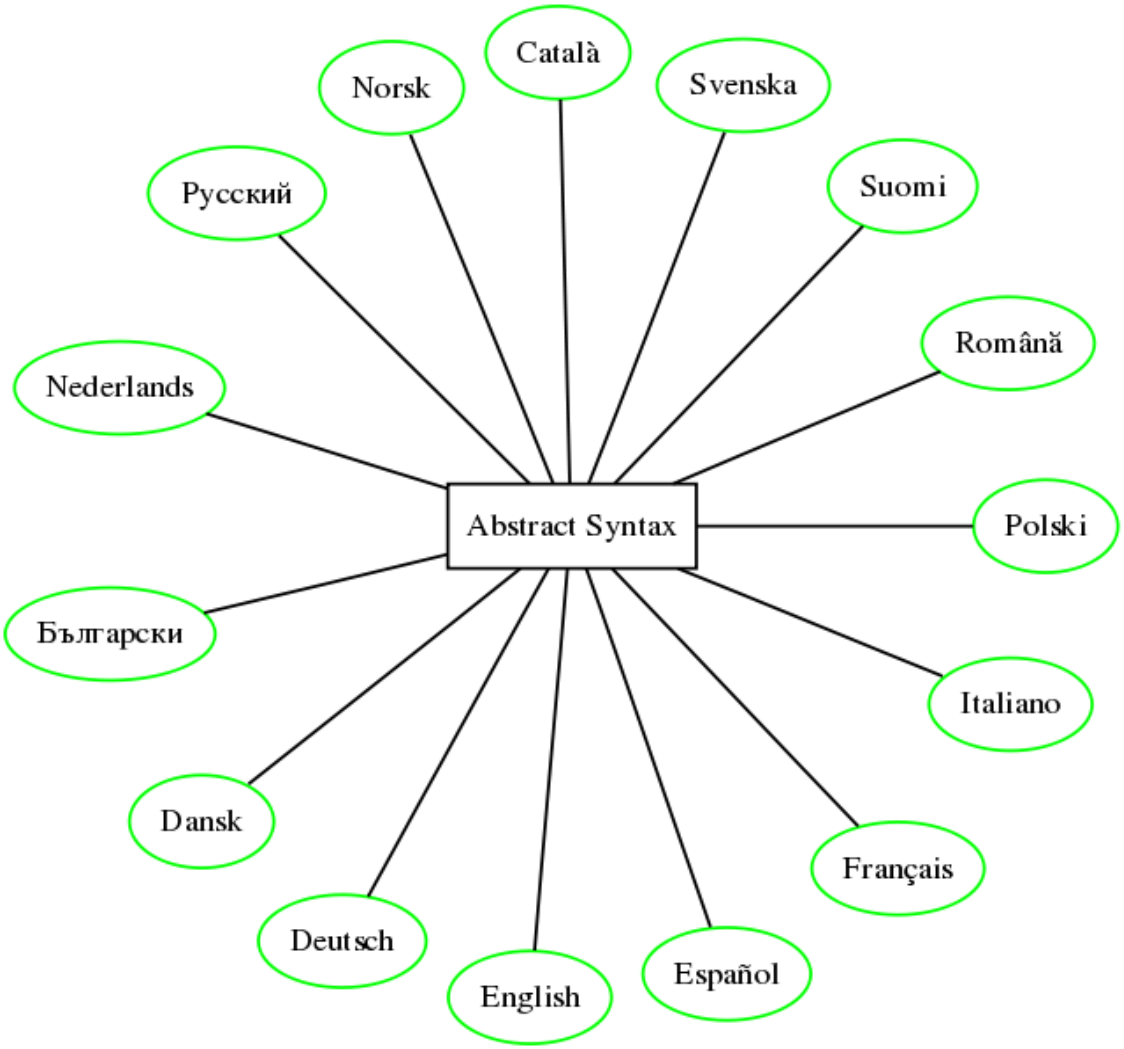
OWL Ontologies

Statistical Machine Translation

The GF model: multi-source multi-target compilers



MOLTO languages



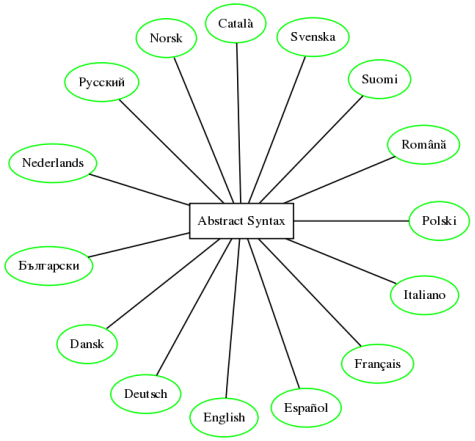
The multilingual document

Master document: semantic representation (abstract syntax)

Updates: from any language that has a concrete syntax

Rendering: to all languages that have a concrete syntax

The technology is there - MOLTO will apply it and scale it up.



Domain-specific interlinguas

The abstract syntax must be formally specified, well-understood

- semantic model for translation
- fixed word senses
- proper idioms

For instance: a mathematical theory, an ontology - anything that is definable in **type theory**

Two things we do better than before

No universal interlingua:

- *The Rosetta stone is not a monolith, but a boulder field.*

Yes universal concrete syntax:

- no hand-crafted *ad hoc* grammars
- but a general-purpose **Resource Grammar Library**

Example: social network

Abstract syntax:

```
fun Like : Person -> Item -> Fact
```

Concrete syntax (first approximation):

```
lin Like x y = x ++ "likes" ++ y      -- Eng
lin Like x y = x ++ "tycker om" ++ y -- Swe
lin Like x y = y ++ "piace a" ++ x   -- Ita
```

Complexity of concrete syntax

Italian: agreement, rection, clitics (*il vino piace a Maria* vs. *il vino mi piace* ; *tu mi piaci*)

```
lin Like x y = y.s ! nominative ++ case x.isPron of {
  True  => x.s ! dative ++ piacere_V ! y.agr ;
  False => piacere_V ! y.agr ++ "a" ++ x.s ! accusative
  }
oper piacere_V = verbForms "piaccio" "piaci" "piace" ...
```

Moreover: contractions (*tu piaci ai bambini*), tenses, mood, ...

The GF Resource Grammar Library

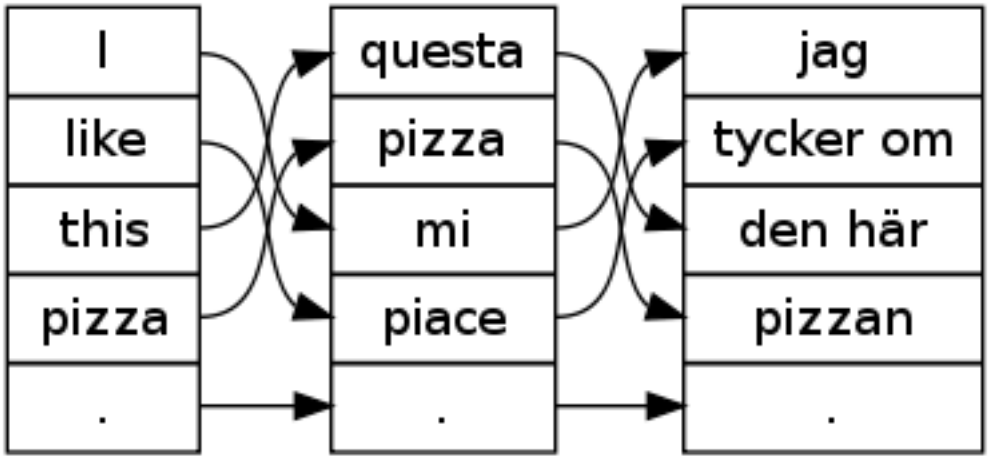
Currently for 16 languages; 3-6 months for a new language.

Complete morphology, comprehensive syntax, lexicon of irregular words.

Common syntax API:

```
lin Like x y = mkCl x (mkV2 (mkV "like")) y         -- Eng
lin Like x y = mkCl x (mkV2 (mkV "tycker") "om") y -- Swe
lin Like x y = mkCl y (mkV2 piacere_V dative) x    -- Ita
```

Word/phrase alignments via abstract syntax



Domains for case studies

Mathematical exercises (<- WebALT)

Patents in biomedical and pharmaceutical domain

Museum object descriptions

Demo: a tourist phrasebook (web and Android phones)

Android Market

Sök

ANDROID MARKET › RESA OCH LOKALT › PHRASEDROID

PhraseDroid

Molto Project

★★★★★

(4 betyg)

INSTALLERA

Other potential uses

Wikipedia articles

E-commerce sites

Medical treatment recommendations

Social media

SMS

Contracts

Controlled language

Almost what MOLTO is, except that we

- generalize this to **multilingual controlled language systems**
- support ambiguous language

Prime example: Attempto Controlled English

- generalized to 5 languages in GF (CNL 2009)
- starting point for proposed MOLTO extension with U Zurich

Challenge: grammar tools

Scale up production of domain interpreters

- from 100's to 1000's of words
- from GF experts to domain experts and translators
- from months to days
- writing a grammar $\approx$ translating a set of examples

Example-based grammar writing

Abstract syntax	`Like She He`	first grammarian
English example	*she likes him*	first grammarian
German translation	*er gefällt ihr*	human translator
resource tree	`mkCl he_NP gefallen_V2 she_NP`	GF parser
concrete syntax rule	`Like x y = mkCl y gefallen_V2 x`	variables renamed

Challenge: translator's tools

Transparent use:

- text input + prediction
- syntax editor for modification
- disambiguation
- on the fly extension
- normal workflows: plug-ins in standard translator tools, web, mobile phones...

Demo: the MOLTO phrasebook

http://www.grammaticalframework.org/demos/phrasebook/

text input + prediction

(not yet: syntax editor for modification)

disambiguation

(not yet: on the fly extension)

normal workflows: plug-ins in standard translator tools, **web, mobile phones**...

Innovation: OWL interoperability

Transform web ontologies to interlinguas

Pages equipped with ontologies... may soon be equipped by translation systems

Natural language search and inference

Scientific challenge: robustness and statistics

1. Statistical Machine Translation (SMT) as fall-back

2. Hybrid systems

3. Learning of GF grammars by statistics

4. Improving SMT by grammars

Learning GF grammars by statistics

Abstract syntax	`Like She He`	first grammarian
English example	*she likes him*	first grammarian
German translation	*er gefällt ihr*	**SMT system**
resource tree	`mkCl he_NP gefallen_V2 she_NP`	GF parser
concrete syntax rule	`Like x y = mkCl y gefallen_V2 x`	variables renamed

Rationale: SMT is *good* for sentences that are *short* and *frequent*

Improving SMT by grammars

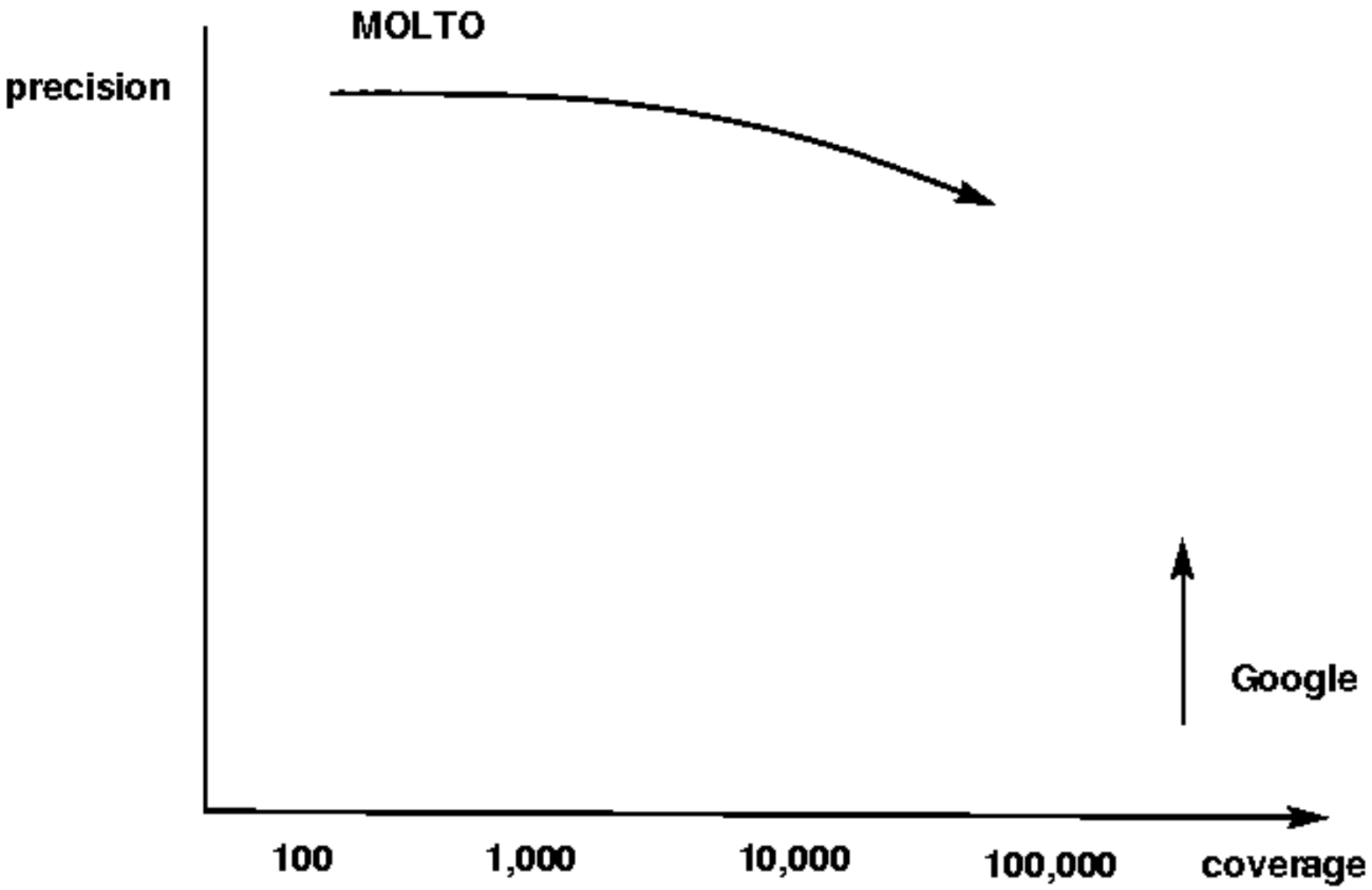
Rationale: SMT is *bad* for sentences that are *long* and involve *word order variations*

if you like me, I like you

`If (Like You I) (Like I You)`

wenn ich dir gefalle, gefällst du mir

A possible scenario: controlled trade-off precision/quality


MOLTO
precision
Google
100
1,000
10,000
100,000
coverage

Availability of MOLTO tools

Open source, LGPL (*except* parts of the patent case study)

Web demos

Mobile applications (Android)

Highlights of the first year

WP2: Grammar Development tools

- web-based grammar development environment
- Term Factory
- multilingual resource grammar API

WP3: Translator's tools

- web-based translation interface
- Android on-board translator
- Java, C, and Python ports of GF

WP4: Knowledge engineering

- GF-OWL interoperability
- the MOLTO KRI

WP5: Statistical and robust parsing

- phrase alignments and probabilities in GF
- hybrid GF/SMT decoding

WP6: Mathematics case study

- OpenMath exercise grammar library in 10 language

WP7: Patents case study

- good domain-specific SMT system for biomedical patents

WP9: Evaluation

- syntax and semantics based evaluation methods

WP10: Dissemination

- MOLTO phrasebook
- GF tutorials: LREC-2010, CNL-2010, CADE-2011
- publications
- GF Summer School 2011

Demos

Phrasebook: http://www.grammaticalframework.org/demos/phrasebook/

Grammar editor: http://www.grammaticalframework.org/demos/gfse/

Ontology queries: "MOLTO KRI" in http://www.molto-project.eu/

Mathematics: http://www.grammaticalframework.org/demos/minibar/mathba

Translator's tool: http://www.grammaticalframework.org:41296/editor/

Phrasedroid: https://market.android.com/details?id=org.grammaticalframewo

Conclusion

You shouldn't expect

- general-purpose translation ("Google competitor")

You should expect

- high quality multilingual translation
- portability to new domains (up to 1000's of words)
- productivity (days, weeks, months)
- ease of use (no training for authoring, a few days for grammarians)