Toward Active Learning in Data Selection:

Automatic Discovery of Language Features During Elicitation

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Feature Detection

- Grammatemes* - Language features that express grammatical meanings (such as number, person, tense)
- Given a set of grammatemes and a structured corpus, can we determine if these grammatemes are expressed in a particular language?
- e.g. Answers "Does this language distinguish singular nouns from plural nouns?" ("And if so, how?")

* Source: Alena Böhmová, Silvie Cinková, Eva Hajičová. Annotation on the tectogrammatical layer in the Prague Dependency Treebank. 2005.

Feature Detection

The dog sleeps
((num sg)…)

The dogs sleep
((num dl)…)

The dogs sleep
((num pl)...)

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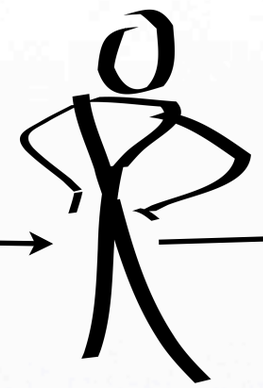
Bilingual Person



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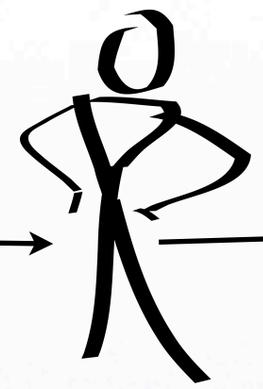

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Feature Detection

Marks Plural? NO
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Marks Dual? NO
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Data Selection

- Given many potential training examples, select the ones that will help the target system most
- Many Uses - Seen in Speech Recognition, Speech Synthesis, and Machine Translation
- Corpus Navigation: Not all data is relevant for all languages
- Helps when money or time is limited
  - e.g. Small Domains, MT Emergencies, and Minority Languages

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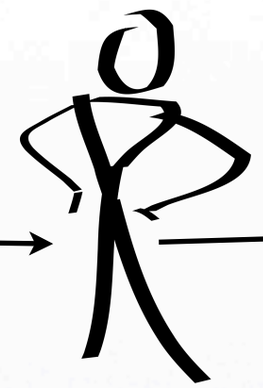

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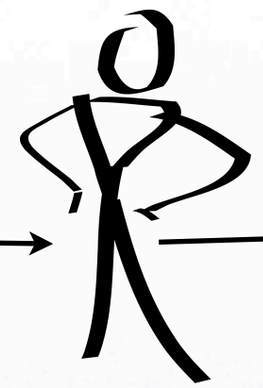

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(Corpus Navigation)

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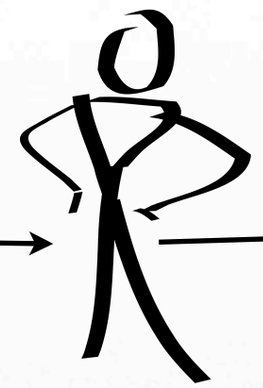

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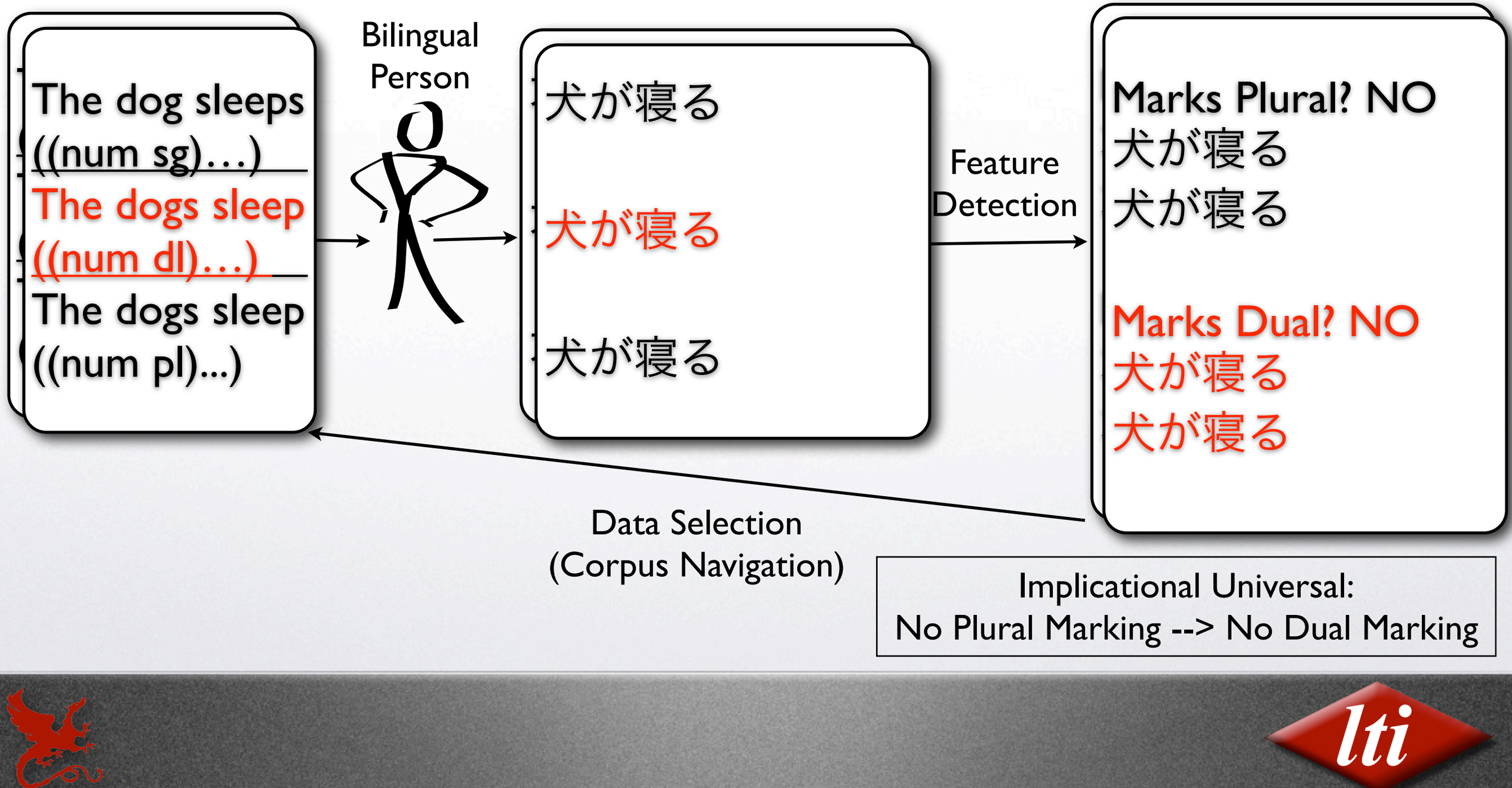
Implicational Universal:
No Plural Marking --> No Dual Marking

Data Selection



Elicitation Corpus Entry

context: Maria bakes cookies regularly or habitually.

srcsent: Maria bakes cookies .

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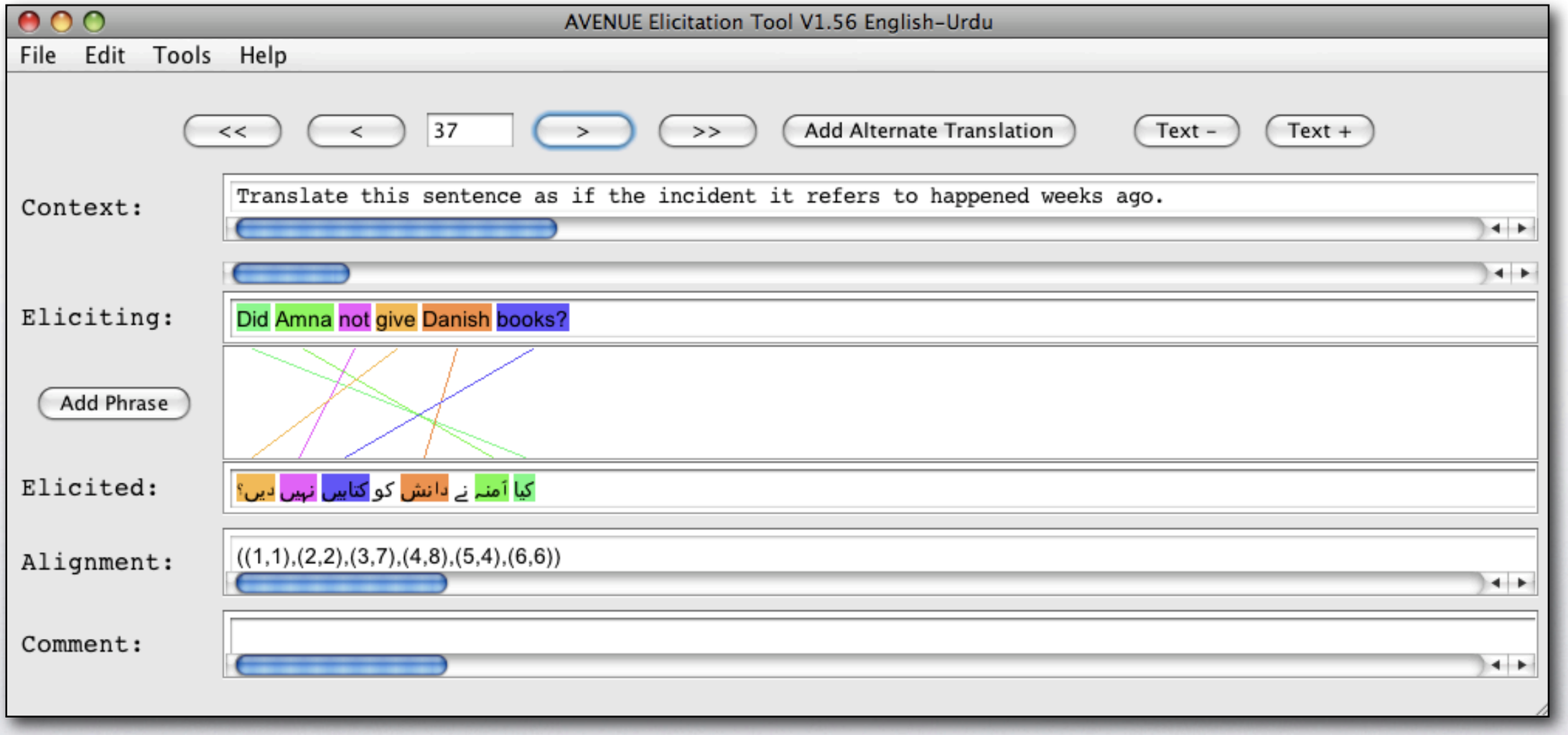

Elicitation Corpus Entry

context: Maria bakes cookies regularly or habitually.
srcsent: Maria bakes cookies .
tgtsent: Maria hornea galletas .
aligned: ((1,1),(2,2),(3,3),(4,4))

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fstruct: [f1]([f2](actor ((gender f)(anim human)(num sg)))
[f3](undergoer ((person 3) (num dl))) (tense pres))

cstruct: [n1](S1 [n2](S [n3](NP [n4](NNP Maria))
[n5](VP [n6](VBZ bakes) [n7](NP [n8](NNS cookies)))))

phimap: phi(n1)=f1; phi(n3)=f2; phi(n7)=f3;

headmap: h(n1)=n2; h(n2)=n5; h(n3)=n4; h(n4)=n4;
h(n5)=n6; h(n6)=n6; h(n7)=n8; h(n8)=n8;

Example Deduction Rule

```
# Perfective/Imperfective Aspect
(rule (sentences (A (aspect perfective))
                 (B (aspect progressive)))
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      (if 0.6 (different
                (target-lex (fnode (A)))
                (target-lex (fnode (B))))
          (then (WALS ”Perfective/Imperfective Aspect”
                      ”Grammatical marking”))))
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      (if 0.6 (different
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                (target-lex (fnode (B))))
          (then (WALS ”Perfective/Imperfective Aspect”
                      ”Grammatical marking”)))
(if 0.4 (same
                (target-lex (fnode (A)))
                (target-lex (fnode (B))))
          (then (WALS ”Perfective/Imperfective Aspect”
                      ”No grammatical marking”))))
```
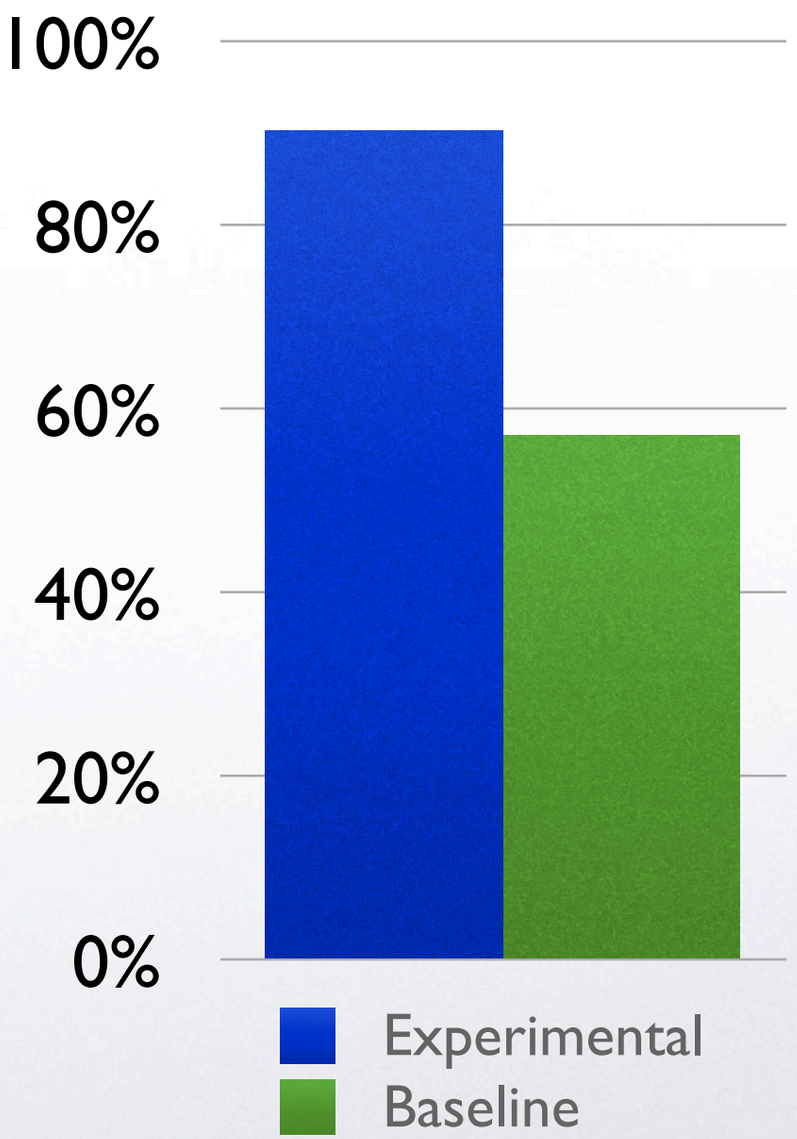

Feature Detection Experiment

- Corpus of 60 Spanish-English sentences
- Tried to identify 21 features from the World Atlas of Language Structures

	Precision	Recall	F1
Baseline	12 / 21	12 / 21	12 / 21
Experimental	19 / 21	19 / 21	19 / 21



Toward Corpus Navigation

- Not all data is relevant for every language
- Performed while a linguistically naive bilingual person translates sentences in GUI
- After eliciting each sentence:
  * Apply feature detection
  * Choose the most valuable sentence to elicit next
- Leverages knowledge from Greenbergian Implicational Universals (from Hal Daume's database learned from WALS)

Other Applications

- Learning feature-annotated closed-class morphemes
- Factored MT
- Selection of data for automatic grammar induction for syntactic and hybrid MT systems
- Aid for linguistics field work

Language Resources

- Result of Corpus Navigation is:

1. A resource dense with the "right" features
2. Highly structured; each language feature is linked with sentences that illustrate it
3. Word-aligned, feature-annotated sentences useful for studying divergences and MT

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Questions?

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WALS Features for Experiment

Gender Distinctions in Independent Personal Pronouns	Position of Interrogative Phrases in Content Questions
Nominal and Locational Predication	Position of Pronominal Possessive Affixes
Occurrence of Nominal Plurality	Position of Tense-Aspect Affixes
Order of Adjective and Noun	Inclusive/Exclusive Distinction in Independent Pronouns
Order of Genitive and Noun	Inclusive/Exclusive Distinction in Verbal Inflection
Order of Numeral and Noun	Semantic Distinctions of Evidentiality
Order of Subject, Object and Verb	The Future Tense
Order of Subject and Verb	Verbal Person Marking
Order of Object and Verb	'Want' Complement Subjects
Perfective/Imperfective Aspect	Zero Copula for Predicate Nominals
Politeness Distinctions in Pronouns	

Production Predicates

fnode
in-order
source-lex
target-lex
*-uhead
*-ihead
same
present
not-present

Elicitation Corpus Availability

- Included in LDC's Less Commonly Taught Languages (LCTL) Language Packs
- 13 languages have already been translated by the LDC
- Urdu language pack used in this year's NIST MT Eval
- Bengali queued for general release this year