Statistical Machine Translation and Hybrid Machine Translation

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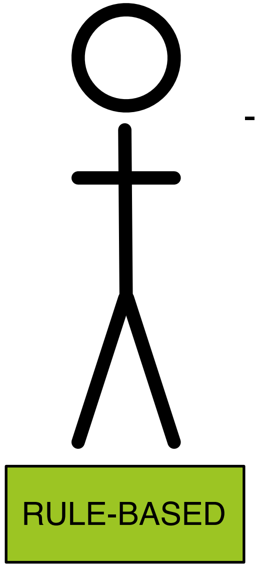
11 August 2006

The Discussion

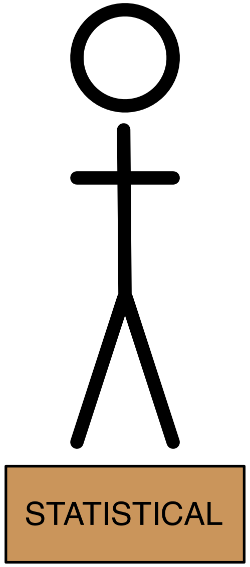


Rationalist Paradigm

- understand basic principles of language and translation
- encode this knowledge in representation and rules

Empiricist Paradigm

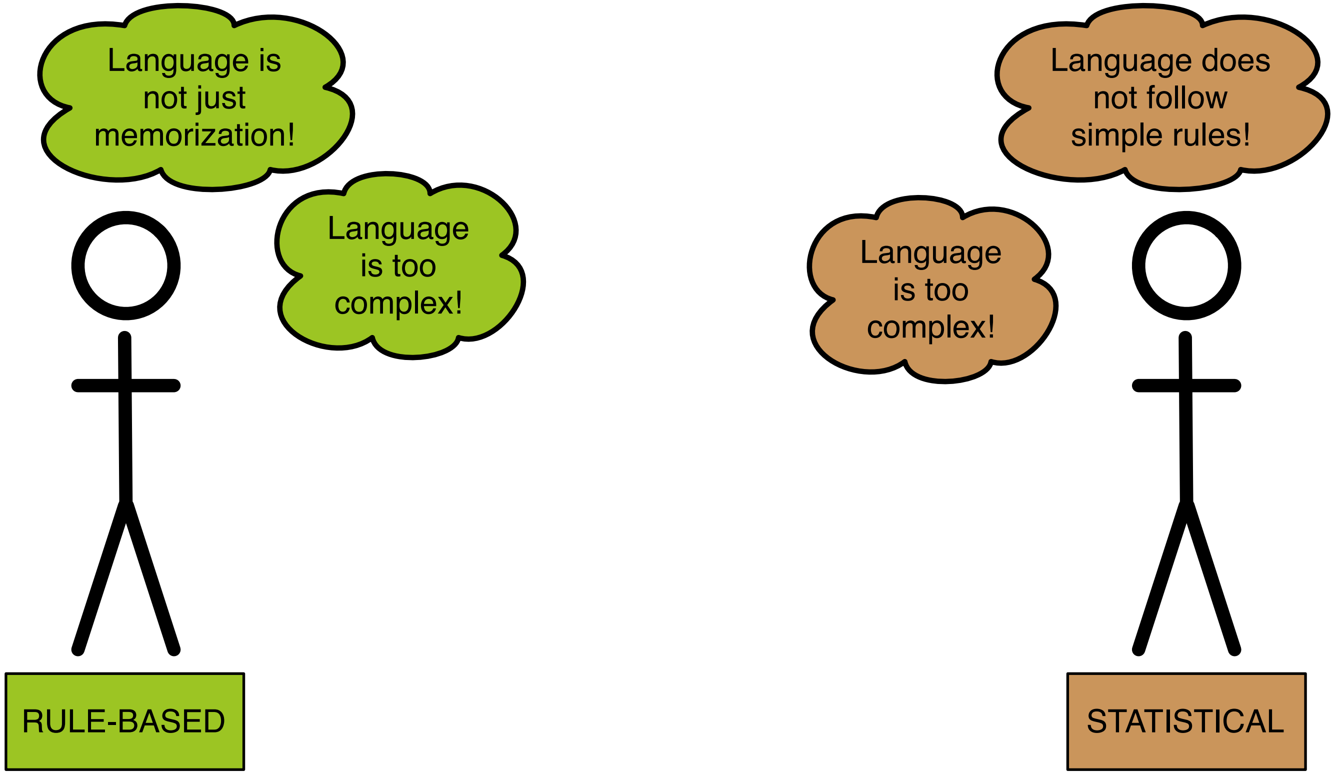
- automatically analyze large amounts of translated text
- build models that learn from this data



The Discussion

Language is not just memorization!
Language is too complex!
RULE-BASED
STATISTICAL

The Discussion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Language does not follow simple rules!
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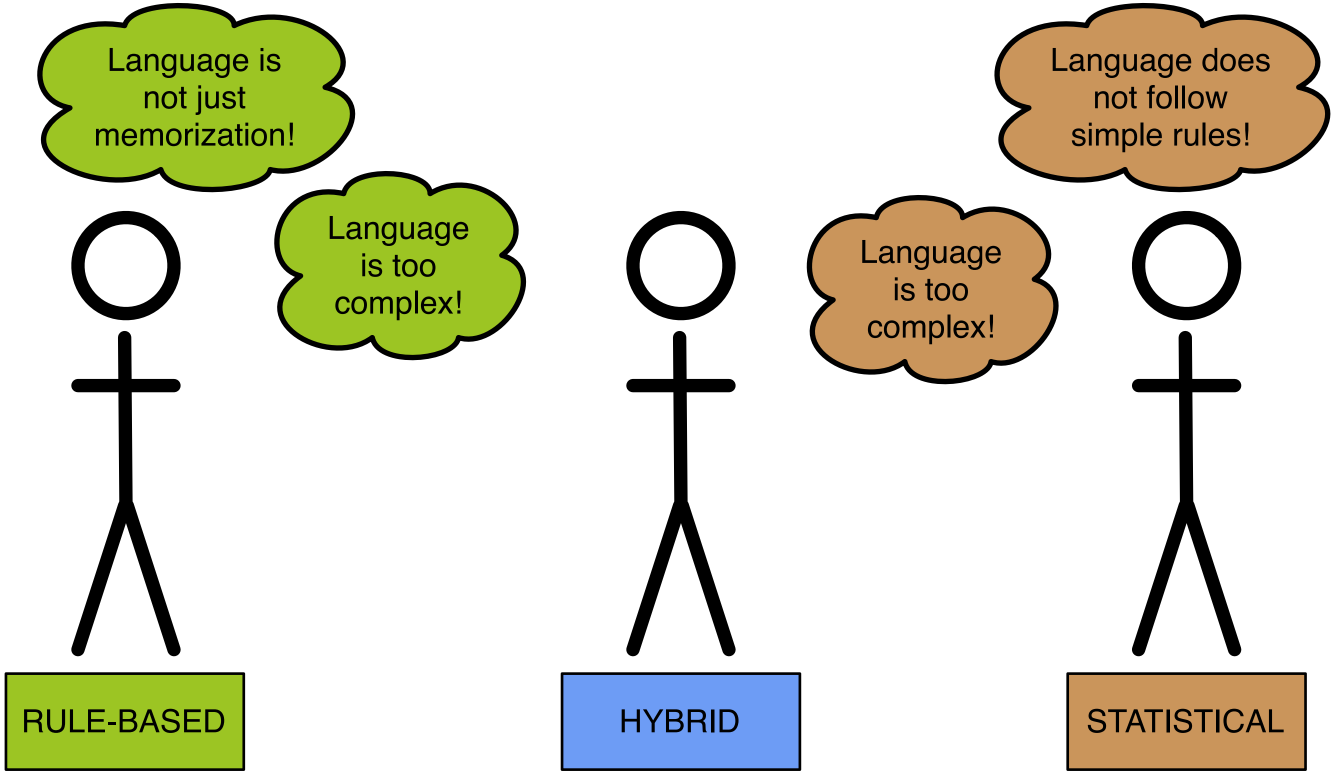

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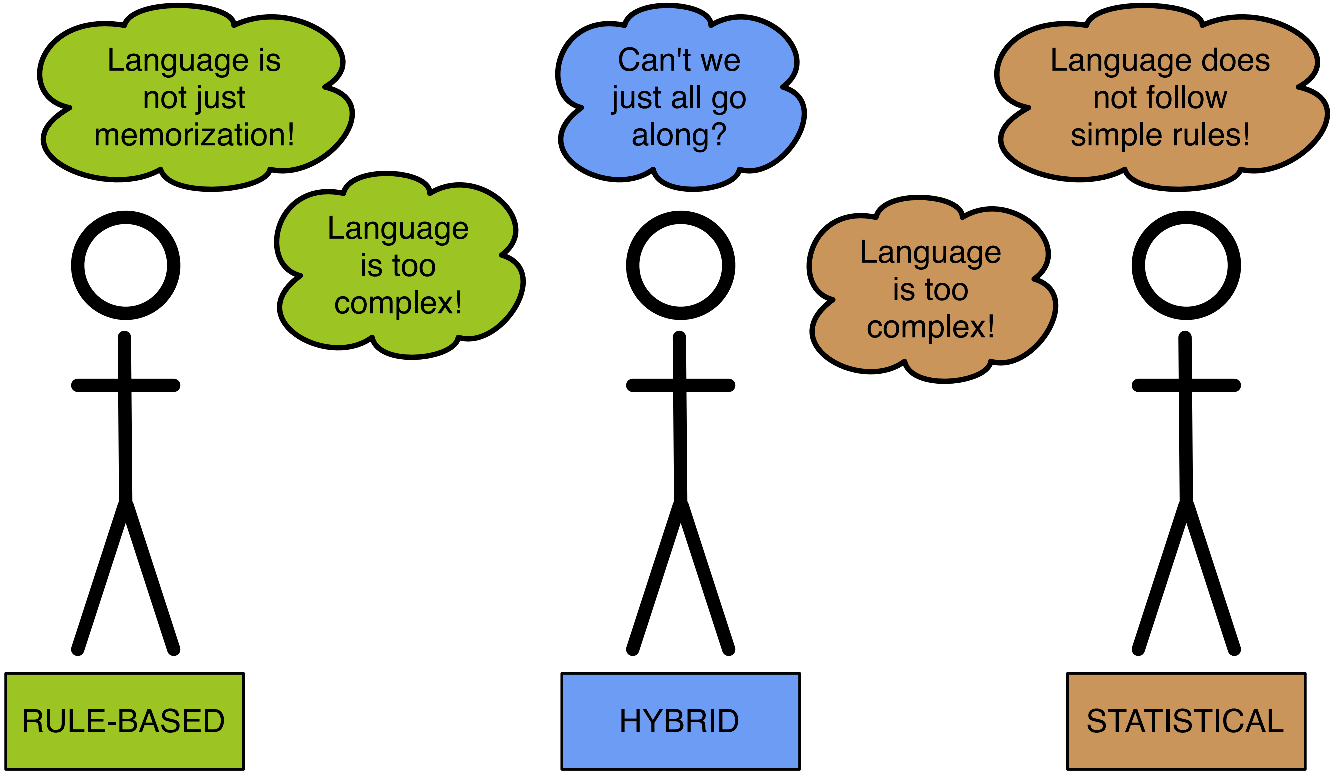

Language is not just memorization!
Language is too complex!
Can't we just all go along?
Language is too complex!
Language does not follow simple rules!
RULE-BASED
HYBRID
STATISTICAL

The case for knowlegde

- Consider this sentence:
  - German: Ich bin gestern von Baltimore nach Boston geflogen.
  - Gloss: I am yesterday from Baltimore to Boston flown.
- Reordering required
  - group verbal components together: bin ... geflogen
  - put the at the right place in the input sentence (after subject)
- Hard to do with a system that has no notion of verb, subject, etc.

The case for statistics

- German Sicherheit translates either as safety or security
- It is very hard to define the difference between safety and security
  - even harder to come up with rules that automatically make this distinction
- Statistical language models do a great job at using context to resolve this

Recent Developments

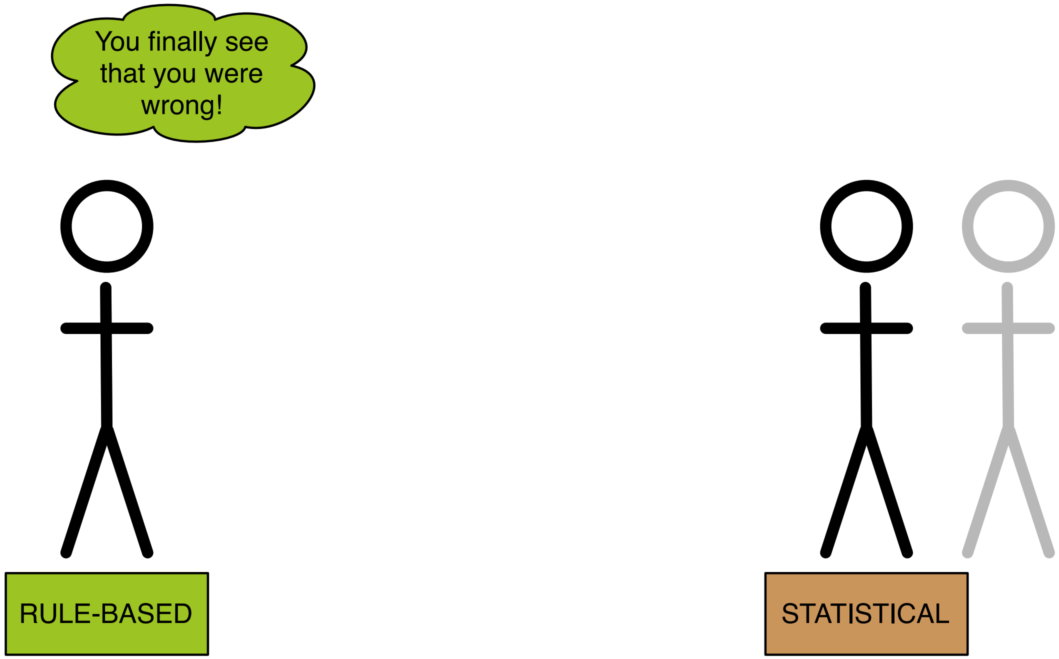
Recent Developments

RULE-BASED

STATISTICAL

morphological analysis as pre-processing
syntactic reordering
tree-based and syntax-based models

Recent Developments



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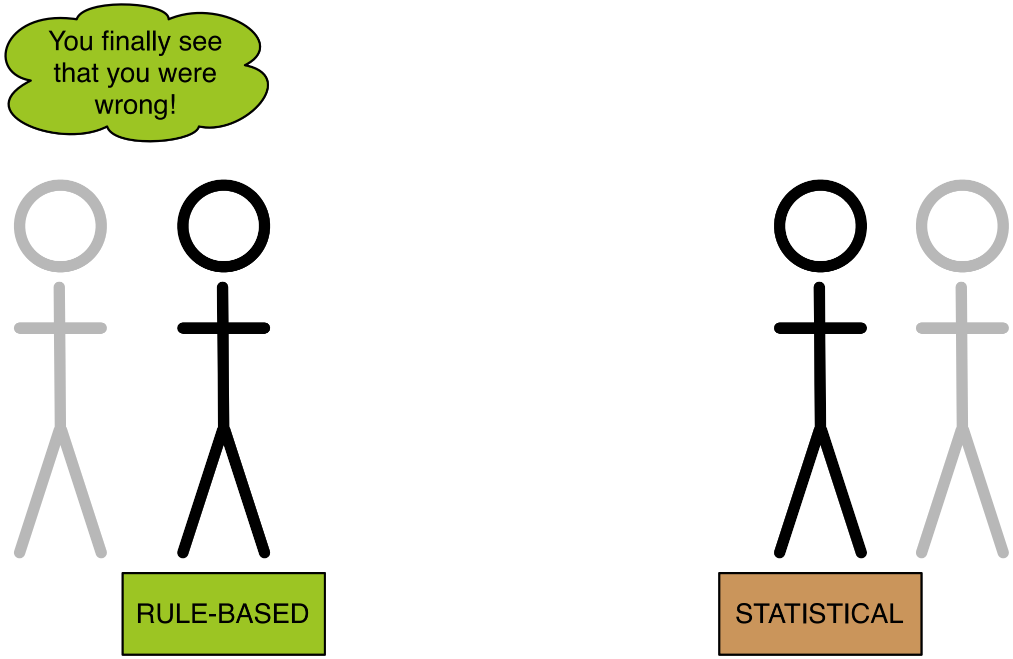

RULE-BASED

STATISTICAL

corpora for terminology acquisition
language models for disambiguation

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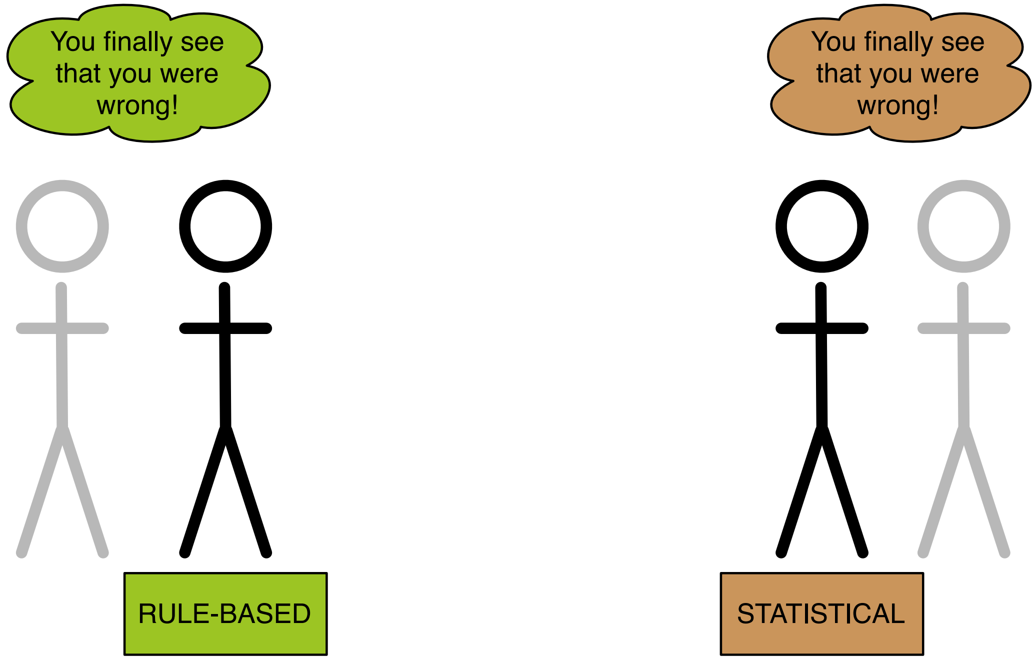
You finally see that you were wrong!
You finally see that you were wrong!
RULE-BASED
STATISTICAL

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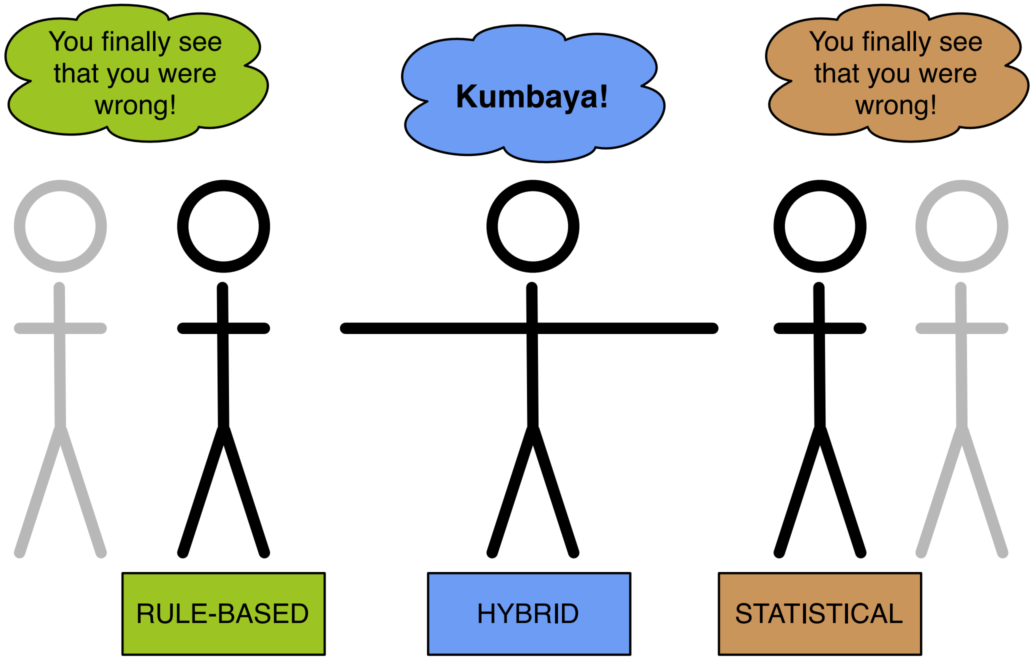
You finally see that you were wrong!
Kumbaya!
You finally see that you were wrong!
RULE-BASED
HYBRID
STATISTICAL

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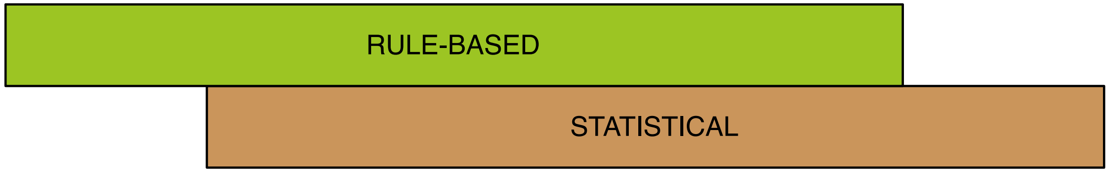
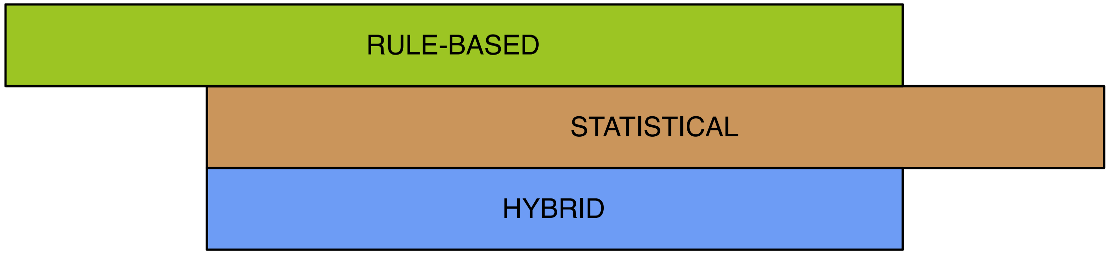
Range of approaches



- What is statistical?
- What is rule-based?

Range of approaches



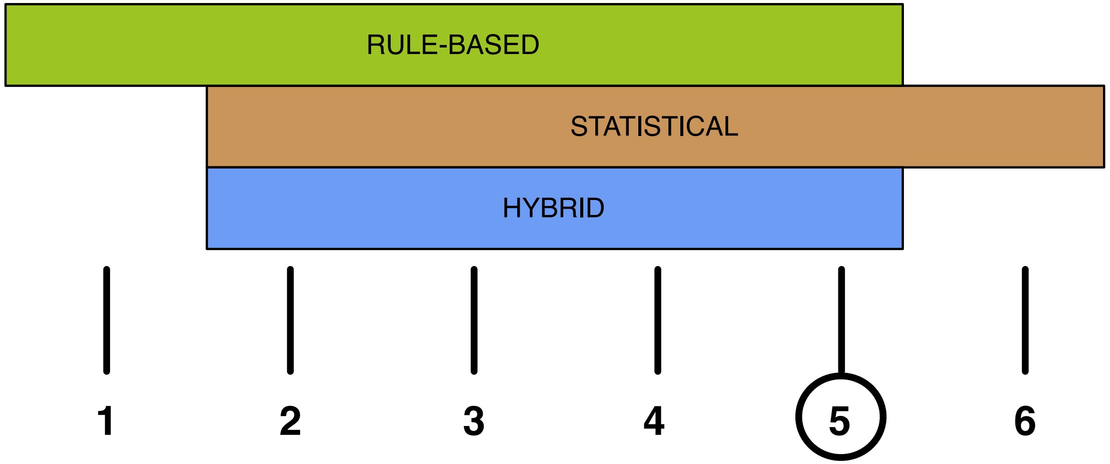
RULE-BASED

STATISTICAL

HYBRID

- What is hybrid?

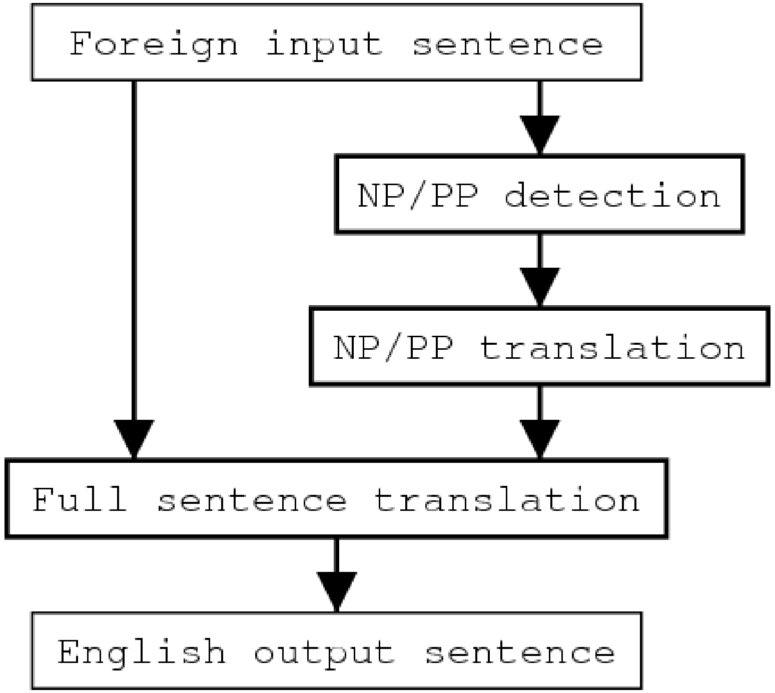
Hybrid scale



- Hybrid scale — I put myself on ”5”
  - starting with a statistical approach
  - linguistic concepts are useful

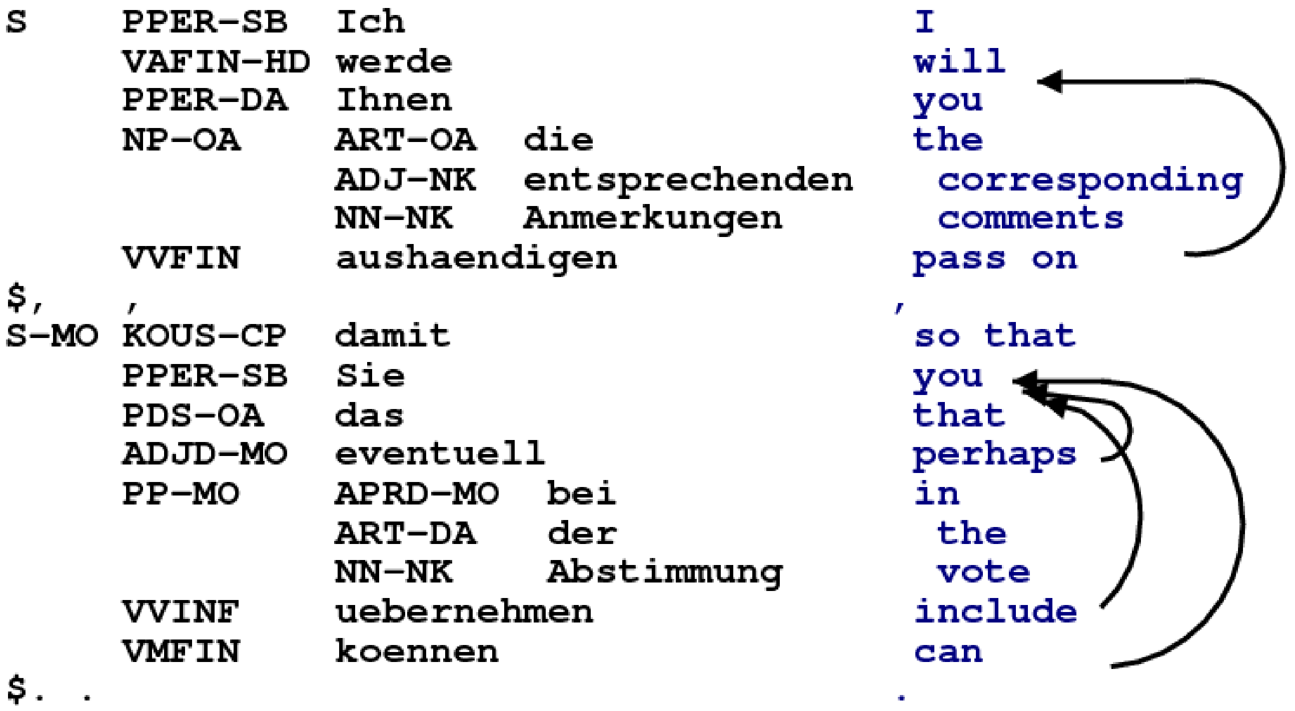
→ learn them from (annotated) data

Noun Phrase Translation



- Translate noun phrases and prepositional phrases in isolation [ACL 2003]
- Integrate **special features** (compound splitting, case agreement, etc.)

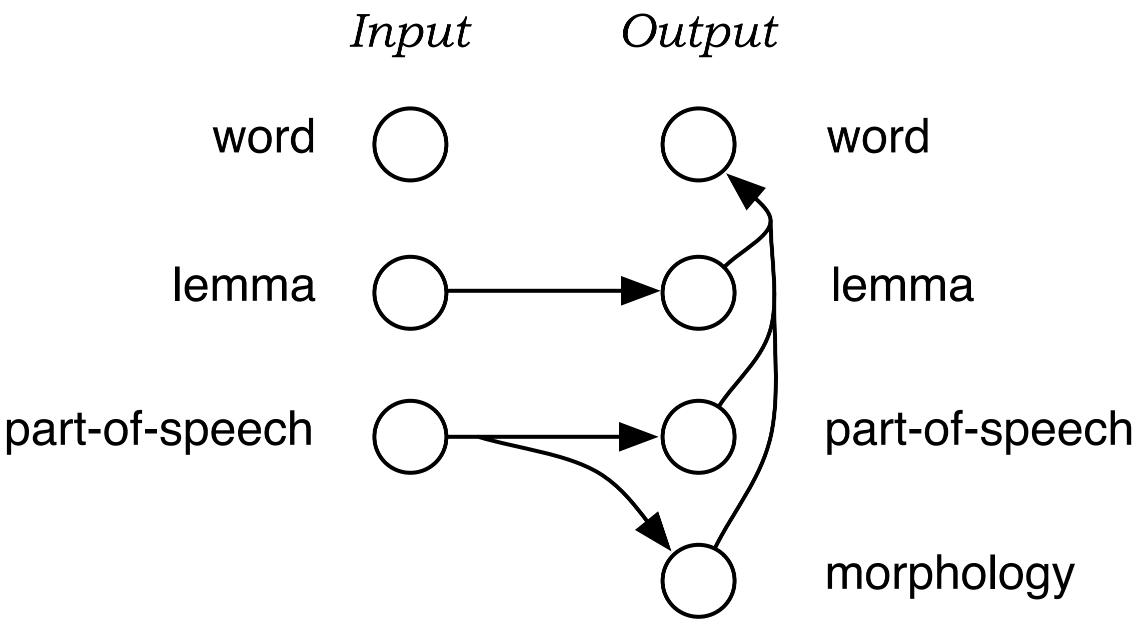
Clause restructuring



```
S     PPER-SB  Ich                                  I
      VAFIN-HD werde                                will
      PPER-DA  Ihnen                                you
      NP-OA    ART-OA  die                          the
               ADJ-NK  entsprechenden                corresponding
               NN-NK   Anmerkungen                   comments
      VVFIN    aushaendigen                         pass on
$,    ,                                            ,
S-MO  KOUS-CP  damit                                so that
      PPER-SB  Sie                                  you
      PDS-OA   das                                  that
      ADJD-MO  eventuell                            perhaps
      PP-MO    APRD-MO  bei                         in
               ART-DA   der                          the
               NN-NK    Abstimmung                   vote
      VVINF    uebernehmen                          include
      VMFIN    koennen                              can
$.  .                                              .
```

- Reorder German clause structure with **manual rules** [ACL 2005]
- Translate with SMT (positive results on German–English and Chinese–English)

Factored translation models



- Factored representation of words, breaking up the translation process into several **mapping** steps that **translate** or **generate** target factors
- JHU Summer Workshop 2006, available in **open source SMT toolkit Moses**